National Inventory Report

Greenhouse Gas Sources and Sinks in the Republic of Moldova 1990-2020

Submission to the United Nations Framework Convention on Climate Change

Chisinau,

30 June 2022

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FOREWORD

On March 16, 1995, the Republic of Moldova ratified the United Nations Framework Convention on Climate Change (UNFCCC). In conformity with Articles 4(1)(a) and 12(1)(a) of the Convention, the non-Annex I Parties shall provide information to the Conference of the Parties (COP) regarding emissions (by types of sources) and sinks (by types of removals) of all greenhouse gases (GHG) that do not come under the Montreal Protocol.

This Report has been developed within the "Republic of Moldova: Enabling Activities for the Preparation of the Fifth National Communication to the United Nations Framework Convention on Climate Change" Project, implemented by the Public Institution "Environmental Projects Implementation Unit" (PI "EPIU") of the Ministry of Environment (MoE) and the United Nations Environment Programme (UNEP), with financial support of the Global Environment Facility (GEF), from August 2019 through October 2022.

The National Inventory Report reflects the efforts made by the National Inventory Team throughout 2021-2022.

In addition to the GHG emissions inventory results in the Republic of Moldova, the Report also contains relevant information such as the analysis of recent trends in GHG emissions and sinks, the analysis of key categories, additional sectoral data utilized in emission inventory, data regarding the activities related to inventory quality control and uncertainty management.

The UNFCCC stipulates that greenhouse gas emissions shall be monitored through the application of a set of methodologies and guidelines developed by the Intergovernmental Panel on Climate Change (IPCC) and approved by the UNFCCC.

These guidelines describe how to assess GHG emissions, as well as the structure of national communications, biennial update reports and national inventory reports. They serve as an effective tool for generating multiple indicators utilised to compare the performances of the Parties of the UNFCCC.

The Convention also obliges its Parties to continuously improve the quality of national inventories. Through the series of initiatives, which are part of the answer that the Republic of Moldova has to offer to the phenomenon of climate change, the assessment of emissions increases its ability to monitor and report GHG emissions, both nationally and internationally.

Since the first national inventory for the period from 1990 through 1998 was published, an impressive number of people in the Republic of Moldova have expressed interest for the climate change phenomenon, and particularly, for greenhouse gas emissions. Although this interest generated numerous research activities, only a limited number have focused on the process of quantitative evaluation of emissions and development of national emission factors.

Albeit there will always be uncertainties with respect to the assessment of emissions, the monitoring process will continue, both in the Republic of Moldova, and internationally, in order to improve inventory quality and reduce greenhouse gas associated uncertainties.

An independent internal audit of the quality of the national inventory of the Republic of Moldova for the period 1990-2020 was conducted in April-May 2022 by relevant national experts representing universities as well as research and development institutes, previously not involved in the national inventory compilation activities.

The findings of these audits have led to the identification of priority areas, both in view of improving the quality of activity data, as well as methodological approaches and emission factors utilised in the assessment of emissions by source) and sinks by removals within the greenhouse gas national inventory of the Republic of Moldova.

Gavril GILCA
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LIST OF ACRONYMS, ABBREVIATIONS AND UNITS

ABS	Acrylonitrile Butadiene Styrene
AEZ	Agro-Ecological Zones
$Area_{(T)}$	Area sown with crop T
$Area\ burnt_{(T)}$	Annual area of crop T burnt (stubble fields burning)
a.s.	Active substance
ASH	Ash content of the manure in per cent
ASM	Academy of Science of Moldova
ATD	Atmospheric Deposition
ATULBD	Administrative-Territorial Units on the Left Bank of Dniester
AR4	IPCC 4th Assessment Report (IPCC, 2007)
AR5	IPCC 5th Assessment Report (IPCC, 2014)
AR6	IPCC 6th Assessment Report (IPCC, 2021)
B	Billion
B_0	Maximum methane producing capacity
BEF_I	Biomass expansion factor for conversion of annual net increment to aboveground tree biomass increment
BOF	Basic Oxygen Furnaces
BUR	Biennial Update Report
BW	Average live body weight of animal
c	Flight cycle: cruise
°C	Degrees Celsius
C_a	Animal Feeding Situation Coefficient
CA	Hornbeam species (Carpinus ssp.)
C_f	Burning coefficient (used to keep account of incomplete burning related aspects)
CF	Carbon fraction in biomass
CHP	Combined Heat and Power Plant
CIS	Commonwealth of Independent States
CKD	Cement Kiln Dust
COP	Conference of the Parties
CORINAIR	Atmospheric Emission Inventory Guidebook, developed by European Environment Agency with support from United Nations Economic Commission for Europe
cm	Centimetre
cm^2	Square centimetre
CMIP5	Coupled Model Intercomparison Project Phase 5
CR	Crop Residues
$Crop_{(T)}$	Harvested annual dry matter yield for crop T
CS	Country Specific
D	Default
D_{ind}	Degradable organic component in wastewater
dal	Decaliter
DE	Digestible energy
DOC	Degradable Organic Carbon
DOC_F	Dissimilated DOC fraction
dm	Dry matter
DRY	Dry matter fraction of harvested crop
DS	Fraction of organic component removed with sludge
EAF	Electric Arc Furnace
EB	Energy Balance
EE	Eastern Europe
EF	Emission Factor
eq	Equivalent
EU	European Union
EV_{milk}	Energy value for milk
f	Force
F	Methane fraction in biogas
F_{AM}	Quantity of nitrogen incorporated in soil with manure
F_{COMP}	Annual amount of total compost N applied to soils
F_{CR}	Annual amount of N in crop residues returned to soils

F_{ON}	Annual amount of managed animal manure, compost, sewage sludge and other organic N additions applied to soils
F_{OOA}	Annual amount of other organic amendments used as fertilizer
F_{PRP}	Annual amount of other organic amendments used as fertilizer
F_{SEW}	Annual amount of total sewage N that is applied to soils
F_{SOM}	Annual amount of N in mineral soils that is mineralized, in association with loss of soil C from soil organic matter as a result of changes to land use or management
F_{SN}	Annual amount of synthetic fertilizer N applied to soils
FAO	Food and Agriculture Organization of the United Nations
FG	Volume of fuel wood gathering
FOD	First Order Decay Method
FR	Species of ash tree (Fraxinus spp.)
Frac	Fraction
$Frac_{GASF}$	Fraction of synthetic fertilizer N that volatilizes as NH3 and NOx
$Frac_{GASM}$	Per cent of managed manure nitrogen that volatilizes as NH_3 and NO_x
$Frac_{LEACH}$	Per cent of managed manure nitrogen losses due to runoff and leaching
$Frac_{Renew (T)}$	Fraction of total area under crop T that is renewed annually
$Frac_{Remove (T)}$	Fraction of above-ground residues of crop T removed annually for purposes such as feed, fuel for heating and cooking, bedding and construction
FSV	Facilitative Sharing of Views
g	Grams
G_w	Average annual above and belowground biomass increment
Gcal	Gigacalory
g.c.e.	Grams coal equivalent
GCM	Global Climate Models
GDP	Gross Domestic Product
GE	Gross Energy
GEF	Global Environment Facility
Gg	Gigagram
GHG	Greenhouse Gas
GPG	Good Practice Guidance
GWP	Global Warming Potential
H	Annually extracted volume, round wood
ha	Hectare
HDP	High Density Polyethylene
HFC	Hydrofluorocarbons
hl	Hectoliter
HP	Heat Plant
ICA	International Consultation and Analysis
I_v	Average annual net increment in volume suitable for industrial processing
IE	Included Elsewhere
INDC	Intended National Determined Contributions
IPCC	Intergovernmental Panel for Climate Change
JSC	Joint Stock Company
k	Methane generation rate constant
kg	Kilogram
KC	Key Category
km	Kilometre
km^2	Square kilometre
kPa	Kilopascal
kt	kiloton
kW	Kilowatt
kWh	Kilowatt-hour
l	Litre
L	Level
$L_{fellings}$	Annual carbon loss due to commercial felling
L_0	Methane Generation Potential
LDP	Low Density Polyethylene
LDLP	Low Density Linear Polyethylene
LEDS	Low Emission Development Strategy
Ltd.	Limited Liability Company

LTO	Landing Take-Off cycle
LULUCF	Land Use, Land Use Change and Forest
m	Meter
m^2	Square meter
m^3	Cubic meter
MCF	Methane Correction Factor
MD	Moldova
MoE	Ministry of Environment
M.E.	Municipal Enterprise
mg	Milligram
mil.	Million
MJ	Megajoule
mm	millimetres
MMS	Manure Management Systems
MOP	Meeting of the Parties to the Kyoto Protocol
MR	Methane emissions recovered from wastewater treatment and sludge
$MS_{(T,S)}$	Fraction of total annual nitrogen excretion for each livestock species/category T that is managed in manure management System S
MSU	Moldova State University
MSW	Municipal Solid Waste (fraction of waste disposed of in landfills)
MTPP	Moldovan Thermal Power Plant in Dnestrovsk
Mt	Megatons = 10^6 tons
MW_{anim}	Mature body weight of an adult animal
MW	Megawatt
N	Nitrogen
$N_{(T)}$	Number of head of livestock species/category T in the country
$N_{AG\ (T)}$	N content of above-ground residues for crop T
$N_{BG\ (T)}$	N content of below-ground residues for crop T
$N_{bedding\ MS}$	Amount of nitrogen from bedding to be applied for solid storage
$N_{MMS\ Avb}$	Amount of managed manure nitrogen available for application to managed soils
NA	Non Applicable
Nex	Nitrogen excretion rate
NAMA	National Appropriate Mitigation Actions
NBS	National Bureau of Statistics
NC	National Communication
NE	Non Estimated
NE_a	Net Energy for animal activity
NE_g	Net Energy needed for growth
NE_l	Net Energy for lactation
NE_m	Net Energy required by the animal for maintenance
NE_p	Net Energy required for pregnancy
NE_{work}	Net Energy for work
NE_{wool}	Net Energy required to produce a year of wool
NIR	National Inventory Report
ODP	Ozone-Depleting Potential
ODS	Ozone-Depleting Substances
OHF	Open-hearth furnace
p	p value – the value of a statistical test: the lowest value of the significance level for which the extracted information from the sample is significant (true H_0 is rejected); $p < 0.05$ is considered statistically significant
PA	Species of sycamore maple tree (Acer spp.)
P_{EQ}	Population equivalent number
P.	Page
PI	Species of pine (Pinus spp.)
PJ	Petajoule
PL	Species of poplar (Populus spp.)
ppb	Parts per billion of volume
ppm	Parts per million of volume
ppt	Parts per trillion of volume
q	Quintal (100 kg)
QA	Quality Assurance
QC	Quality Control

QU	Species of oak (Quercus spp.)
R	Root-to-shoot ratio
$R_{AG (T)}$	Ratio of above-ground residues dry matter to harvested yield for crop T
$R_{BG (T)}$	Ratio of below-ground residues to harvested yield for crop T
RB	Species of Acacia (Robinia spp.)
RCP	Representative Concentration Pathway
REG	Ratio of net energy available for growth in a diet to digestible energy consumed
RM	Republic of Moldova
SA	Species of willow (Salix spp.)
SAR	Second Assessment Report (IPCC, 1996)
SAUM	State Agrarian University of Moldova
SHS	State Hydrometeorological Service
SM	Emissions from sludge treatment
SN	Synthetic Nitrogen Fertilizers
SOE	State Owned Enterprise
SS_{ix}	Fraction of anaerobically treated sludge
σ	Standard Error
t	Tonne
T	Trend
T1	Tier 1
T2	Tier 2
TAM	Typical animal mass
TAR	Third Assessment Report (IPCC, 2001)
t.c.e.	Tons of coal equivalent
TE	Species of linden tree (Tilia spp.)
TJ	Terajoule
TM	Emissions from wastewater and sludge treatment
TOS	Total organic waste in sludge
TOW	Total organic waste in wastewater
TTE	Team of Technical Experts
TUM	Technical University of Moldova
UCTE	Union for the Coordination of Transmission of Electricity
UL	Species of elm tree (Ulmus spp.)
UN	United Nations
UNDP	United Nations Development Programme
UNEP	United Nations Environment Programme
UNFCCC	United Nations Framework Convention on Climate Change
USA	United States of America
US EPA	United States Environmental Protection Agency
US $	US Dollar
VS	Volatile solid excretion per day
W	Animal Body Weight
W_{ind}	Amount of wastewater generated per unit of industrial output
WBTP	Wastewater Biological Treatment Plant
WE	Western Europe
WG	Daily weight gain
WM	Emissions from wastewater handling
WS_{ix}	Fraction of wastewater treated anaerobically
x	Average value
Y_m	Methane conversion factor
Yield Fresh $_{(T)}$	Harvested fresh yield for crop T
%	Per cent

CHEMICAL FORMULAS

Al_2O_3	Aluminium oxide
$CaCO_3$	Limestone
$CaCO_3 \bullet MgCO_3$	Dolomite
CaO	Lime
CaO • MgO	Dolomitic lime
$CBrClF_2$	Halon 1211
$CBrClF_3$	Halon 1301
CCl_3F	CFC-11
CCl_2F_2	CFC-12
CCl_2CClF_2	CF-113
CCl_4	Carbon Tetrachloride
CF_4	Perfluoromethane
C_2F_6	Perfluoroethane
C_3F_8	Perfluoropropane
C_4F_{10}	Perfluorobutane
$c\text{-}C_4F_8$	Perfluorocyclobutane
C_5F_{12}	Perfluoropentane
C_6F_{14}	Perfluorohexane
CFC	Chlorofluorocarbons
CH_4	Methane
$C_6H_{12}O_6$	Glucose
C_2H_5OH	Ethanol
$CHClF_2$	HCFC-22
CH_2FCF_3	HFC-134a
CHF_3	HFC-23
CH_2F_3	HFC-32
C_2HF_5	HFC-125
CH_3CCl_2F	HCFC-141b
CH_3CClF_2	HCFC-142b
CF_3CH_3	HFC-143a
CH_3CHF_2	HFC-152a
CF_3CHFCF_3	HFC-227ea
$CF_3CH_2CF_3$	HFC-236fa
$CHF_2CH_2CF_3$	HFC-245fa
$CH_3CF_2CH_2CF_3$	HFC-365mfc
$CF_3CHFCHFCF_2CF_3$	HFC-43-10mee
CO	Carbon monoxide
CO_2	Carbon dioxide
$CO(NH_2)_2$	Urea (carbamide)
Fe_2O_3	Iron oxide
HFC	Hydrofluorocarbons
HNO_3	Nitric acid
MgO	Magnesium oxide
NF_3	Nitrogen trifluoride
Na_2CO_3	Sodium carbonate
NaOH	Sodium Hydroxide (caustic soda)
NH_3	Ammonia
NH_4^+	Ammonium
NH_4NO_3	Ammonia Nitrate
$NH_4H_2PO_4$	Monoammonium phosphate
$(NH_4)_2HPO_4$	Diammonium phosphate
NMVOC	Non methane volatile organic compounds
NO_x	Nitrogen Oxides
NO_3^-	Nitrate
N_2O	Nitrous oxide
N_2O_{ATD}	Indirect N_2O emissions produced from deposition of nitrogen as ammonia (NH_3), oxides of N (NO_x), and their products $NH_4 + NH_3$ onto soils and the surface of waters

N_2O_{CR}	N_2O emissions from crop residues returned to soils annually
N_2O_{DIR}	Direct N_2O emissions
N_2O_{IND}	Indirect N_2O emissions
N_2O_{L}	Indirect N_2O emissions due to leaching and runoff from manure management in the country
N_2O_{ON}	N_2O emissions from applied organic N fertilizer
N_2O_{PRP}	N_2O emissions from urine and manure inputs to grazed soils
N_2O_{SN}	N_2O emissions from synthetic fertilizer N
N_2O_{SOM}	N_2O emissions from nitrogen mineralization associated with loss of soil carbon due to land management change
O_3	Ozone
PFC	Perfluorocarbons
SF_6	Sulphur hexafluoride
SiO_2	Silicon oxide
SO_2	Sulphur dioxide

Contents

EXECUTIVE SUMMARY

The Convention, Kyoto Protocol, Paris Agreement and the Party Commitments

The ultimate objective of the United Nations Framework Convention on Climate Change (UNFCCC) is aimed "*to achieve stabilization of greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system*". To date, 196 countries are Parties to the Convention. The Republic of Moldova signed the UNFCCC on June 12, 1992, and it was ratified by the Parliament on March 16, 1995.

Article 4, paragraph 1(a) and Article 12, paragraph 1(a) of the UNFCCC stipulate that each Party has to make available to the Conference of the Parties (COP) "*a national inventory of anthropogenic emissions by sources and removals by sinks, of all greenhouse gases uncontrolled by the Montreal Protocol, to the extent of its capacities, using comparable methodologies to be agreed upon and encouraged by the Conference of the Parties; likewise, a general description of steps taken or envisaged by the Party to implement the Convention, as well as any other information that the Party considers relevant to the achievement of the objective of the Convention and suitable for inclusion in its communication, including, should it be feasible, relevant data for the assessment of global emission trends*".

The main mechanism for making this information available is the National Communications (NCs). COP 2 (Geneva, 1996) adopted the Guidelines on national communications for non-Annex I Parties (Decision 10/CP.2). In conformity with the respective Guidelines, from 1998 to 2000, under the UNDP-GEF Project "*Enabling Activities for the preparation of the First National Communication to the UNFCCC*", the Republic of Moldova developed its First National Communication (NC1) to the UNFCCC, submitted to the COP 6 (The Hague, 2000).

The COP 8 (New Delhi, 2002) adopted new Guidelines for the preparation of NCs for non-Annex I Parties (Decision 17/CP.8). In conformity with these Guidelines, from 2005 to 2009, the Republic of Moldova prepared the Second National Communication (NC2); from 2010 to 2014 – the Third National Communication (NC3); from 2014 to 2018 – the Fourth National Communication (NC4) to the UNFCCC; and from 2019 to 2022, the Republic of Moldova is developing its Fifth National Communication (NC5) to the UNFCCC.

With reference to the UNFCCC implementation instruments, it should be noted that the Kyoto Protocol was adopted at the COP 3 (Kyoto, 1997), an instrument which sets binding targets for the Parties under the Convention, by committing industrialized countries and economies in transition (37 industrialized countries and the European Union) included in Annex I to the Convention, to reduce total emissions of direct GHG by at least 5 per cent compared to 1990 levels over the period January 1, 2008-December 31, 2012 (the first period of the Protocol commitment). The Republic of Moldova ratified the Kyoto Protocol on February 13, 2003. As a non-Annex I Party, the Republic of Moldova had no commitments to reduce GHG emissions under this Protocol.

The COP 13 held in Bali in December 2007 adopted The Bali Action Plan. At this COP, developing countries agreed for the first time to develop and implement National Appropriate Mitigation Actions (NAMA), in the context of sustainable development, supported through technology transfer, appropriate funding and capacity building actions.

The COP 15, held in Copenhagen in December 2009, approved and proposed for implementation a policy statement adopted in support of limiting global warming to no more than 2°C compared to pre-industrial level, in the context of equity and sustainable development. This statement, known as the Copenhagen Accord, reaffirms development issues in the context of climate change, including through the implementation of Low Emission Development Strategies (LEDS).

The Republic of Moldova associated itself to the Copenhagen Accord in January 2010 and submitted an emissions reduction target that is specified in Annex II of this Agreement: "*Nationally Appropriate Mitigation Actions in Developing Countries*". The target of mitigation actions for the Republic of Moldova under this Agreement is "*to reduce the total national level of greenhouse gas emissions to no less than 25 per cent by 2020 compared to the base year (1990), by implementing economic mechanisms* *focused on global climate change mitigation, in accordance with the principles and provisions of the Convention*". This target is presented without indicating specific national appropriate mitigation actions, identified and quantified, and without further clarification of the necessary support to achieve it. Simultaneously, it is recognized that achieving this target will require significant financial, technological and capacity-building support, which can be provided through the UNFCCC mechanisms.

In the same context, from 2010 to 2012, the Low Emissions Development Strategy of the Republic of Moldova until 2020 was prepared, a strategic document that was to allow the country to adjust its development path towards a low carbon economy and to achieve a green sustainable development, based on the socio-economic and development priorities of the country. Also, LEDS was supposed to support overall objectives providing strategic national context for the mitigation efforts, for which countries would receive international support. LEDS was developed in accordance with the provisions in Chapters: "Environment Protection" of the Republic of Moldova's Governance Programme "European Integration: Freedom, Democracy, Welfare" (2011-2014), and "Climate Change" of the European Union Association Agreement.

The draft LEDS contained a set of measures that were set to contribute to the reduction of greenhouse gas emissions, the quantification of the corresponding reduction of GHG emissions for each measure, and the financial requirements for their implementation. The measures proposed in the Action Plan of this Strategy included national appropriate mitigation actions, as provided for non-Annex I Parties to the UNFCCC. LEDS also provided information on implementation procedures and timeframes, as well as provisions on monitoring, measurement, reporting and assessment of the results. The Strategy was prepared by the Ministry of Environment of the Republic of Moldova, the process being led by the Inter-Ministerial Working Group on Climate Change with support from the UNDP country office. This process involved extensive consultations with all parties, represented by ministries, research institutions, donor organizations, NGOs and civil society. It was anticipated that LEDS would be approved by the Government by the end of 2013, which did not happen until the end of 2016[1].

The COP 16 held in Cancun in December 2010, adopted the Cancun Agreements, which encourage developing countries to prepare Low Emission Development Strategies for sustainable development and to undertake National Appropriate Mitigation Actions. The Cancun Agreements highlight the fact that "*stopping climate change requires a paradigm shift towards building a low-carbon emissions society, which offers substantial opportunities and ensures continued economic growth and sustainable development*".

At COP 16, it was also established the periodicity of preparing national communications for non-Annex I countries (Decision 1/CP.16). In line with this, non-Annex I Parties are to prepare and submit *National Communications* to the UNFCCC Secretariat every four years as well as *Biennial Update Reports (BUR)* every two years. The inventory section of the BUR should consist of a *National Inventory Report* as a summary or as a technical annex, expected to present in a detailed and transparent manner the procedures of national inventory for anthropogenic GHG emissions by sources or removals of carbon dioxide through sequestration, including information on emissions trends, key categories, activity data, emission factors, assessment methodologies, quality assurance and quality control, uncertainties, recalculations and planned improvements, for each source or sink category included in the national inventory.

The COP 17 held in Durban in 2011 adopted the *UNFCCC biennial reporting guidelines for countries not included in Annex I to the Convention* (Decision 2/CP.17 and Annex 3 to this Decision). According to this decision, developing countries, non-Annex I Parties, consistent with their capabilities and the level of support provided for reporting, were expected to submit their first BUR to the Secretariat of the UNFCCC by December 2014. The Report is to be submitted to the Secretariat every two years as a stand-alone report or as a summary of the National Communications, should their reporting years coincide.

The Republic of Moldova initiated the process of preparing the First Biennial Update Report in July 2014, and managed to present it to the Secretariat of the UNFCCC on April 5, 2016. The First Biennial

[1] <http://lex.justice.md/index.php?action=view&view=doc&lang=1&id=369528>

Update Report of the RM to the UNFCCC (2016) was presented to the Secretariat of the UNFCCC together with two technical annexes – the National Inventory Report: 1990-2013, Sources of Greenhouse Gas Emissions and Sinks in the Republic of Moldova (2015) and the Report on the National GHG Inventory System in the Republic of Moldova (2015).

Regarding the non-Annex I Parties, the COP 17 in Durban approved (Decision 2/CP.17 and Annex IV) the Modalities and Guidelines for International Consultation and Analysis (ICA) consisting of two steps: (i) the Technical Analysis of BURs and (ii) a Facilitative Sharing of Views (FSV) among Parties on the content of the BURs and the results of Technical Analysis. The process aims to enhance the transparency and accountability of information reported in BURs by non-Annex I Parties. The technical analysis will be conducted by a Team of Technical Experts (TTE) and will be initiated within six months of the BUR's submission to the Secretariat.

As for the First Biennial Update Report of the Republic of Moldova to the UNFCCC, its technical assessment by the TTE took place between the 19th and 23rd of September 2016, the summary report being published on the Secretariat of the UNFCCC web page on February 20, 2017[2]. The FSV among Parties on the BUR1 content and the results of technical analysis was carried out during the 3rd FSV workshop, organized by the UNFCCC Secretariat on May 15, 2017 in Bonn, Germany[3].

The COP 18 (Doha, 2012) adopted the *Doha Amendment to the Kyoto Protocol* which establishes a second commitment period (January 1, 2013-December 31, 2020) for the Parties included in Annex I of the Kyoto Protocol; adds a revised list of greenhouse gases to be reported by Annex I countries in the second commitment period; and a series of amendments to several articles of the Kyoto Protocol regarding the first commitment period and which were to be reviewed to remain valid in the second commitment period. By December 21, 2012, the UN General Secretary, acting as depositary, presented the Doha Amendment to the Kyoto Protocol to all Parties of the UNFCCC, in accordance with provisions of Articles 20 and 21 of the Protocol. Under Doha Amendment, within the second commitment period, developed countries should reduce their greenhouse gas emissions by at least 18% compared to 1990 levels. By October 28, 2020[4], 147 countries had ratified the Doha Amendment to the KP, the majority of which are non-Annex I Parties to the UNFCCC and the Kyoto Protocol. The Doha Amendment came into effect on December 31, 2020.

At COP 19 (Warsaw, 2013), the Parties agreed to communicate their intended nationally determined contributions (INDC) (Decision 1/CP.19), in order to include them in the new Climate Agreement to be considered and adopted by the COP 21 (Paris, 2015). It is expected that the new climate agreement will establish a new commitment period (January 1, 2021-December 31, 2030) for the reduction of GHG emissions. Also, the COP 19 in Warsaw adopted *General guidelines for domestic measurement, reporting and verification of domestically supported nationally appropriate mitigation actions by developing country Parties* (Decision 21/CP.19). This document provides a solid foundation for the new Paris Climate Agreement 2015.

At COP 20 which took place in Lima (2014), the Parties agreed over *the Lima Call for Climate Action* and were repeatedly invited (Decision 1/CP.20) to communicate their intended nationally determined contributions to the UNFCCC Secretariat, in order to facilitate clarity, transparency and understanding. The INDC shall thereby include, as appropriate, inter alia: (i) quantifiable information on the reference point; (ii) time frames and periods for implementation; (iii) scope and coverage; (iv) planning processes; (v) assumptions and methodological approaches including those for estimating and accounting for anthropogenic greenhouse gas emissions and, as appropriate, removals; and (vi) information on the country's considerations on how fair and ambitious its intended nationally determined contribution is, by taking into account specific national circumstances; respectively, how the

[2] <http://unfccc.int/files/national_reports/non-annex_i_parties/biennial_update_reports/submitted_burs/application/pdf/mda.pdf>
[3] The conclusions of the 3rd FSV seminar regarding the BUR1 of the RM under the UNFCCC and the results of the technical assessment are available on the web page: <http://unfccc.int/files/national_reports/non-annex_i_parties/ica/facilitative_sharing_of_views/application/pdf/20170529_mda_v04.pdf>; RM's presentation at the 3rd FSV seminar is available on: <http://unfccc.int/files/national_reports/non-annex_i_parties/ica/facilitative_sharing_of_views/application/pdf/moldova_fsv_workshop_presentation_15.05.2017.pdf>, and the video recording of the presentation and the interventions of the Parties are available on: <https://www.youtube.com/playlist?list=PL-m2oy1bnLzpmdRpG2pTBzUeOH3qrXlZt>
[4] <https://unfccc.int/process/the-kyoto-protocol/the-doha-amendment>

Party considers that its national contributions will facilitate the achievement of the objective of the Convention as set out in Article 2.

According to *the Lima Call for Climate Action*, countries were invited to communicate their intended nationally determined contributions by March 31, 2015, the deadline for the submission being September 30, 2015. The UNFCCC Secretariat was requested to prepare a synthesis report on the aggregate effect of the INDC communicated by Parties by November 1, 2015.

The Republic of Moldova was fully committed to the UNFCCC negotiation process towards adopting a document with legal force under the Convention – at the COP 21 of the Paris Agreement – applicable to all Parties, in line with keeping global warming below 2°C by 2100 compared to the preindustrial era.

The Paris Agreement was signed by the Prime Minister of the Republic of Moldova in New York on September 21, 2016 and was subsequently ratified by the Parliament through Law No. 78 of 04.05.2017 for the ratification of the Paris Agreement (Official Monitor No. 162-170 of 26.05.2017)[5].

On the 25th of September 2015, the Republic of Moldova communicated its Intended Nationally Determined Contribution (INDC)[6] and the accompanying information to facilitate clarity, transparency, and understanding, with reference to decisions 1/CP.19 and 1/CP.20, according to which, the Republic of Moldova intends to achieve the unconditional target of reducing its greenhouse gas emissions by 64-67% below its 1990 level by 2030, and will make great efforts to reduce its emissions by 67%. The reduction commitment expressed above could be increased conditionally up to 78% in accordance with this global agreement which addresses important topics including low-cost financial resources, technology transfer, and technical cooperation, the access depending on the challenges of global climate change. GHG emissions reduction targets have been set in an emission budget covering the period from January 1, 2021, to December 31, 2030. The GHG emission reduction targets, set out in the intended nationally determined contribution of the Republic of Moldova, were subsequently officially approved at national level by Government Decision No. 1470 of 30.12.2016 on the approval of the Low Emissions Development Strategy of the Republic of Moldova by 2030 and the Action Plan for its implementation (Official Monitor No. 85-91 of 24.03.2017)[7].

On March 4, 2020, the Republic of Moldova submitted the updated version of its national determined contribution to the UNFCCC Secretariat[8]. According to it, the Republic of Moldova intends to step up with much more ambitious GHG emission reduction targets by 2030. The unconditional target is thereby to increase from 64-67% to 70% compared to the base year (1990), and the conditional target is to increase from 78% to circa 88% compared to the base year (1990). The new GHG emission reduction targets are to be introduced into the Low Emissions Development Programme until 2030 and the Action Plan for its implementation; in this respect, the updating process of the Strategy was launched in 2020.

The Second Biennial Update Report (BUR2) of the Republic of Moldova to the UNFCCC was submitted to the UNFCCC Secretariat on the December 27, 2018, and later, the two technical annexes: National Inventory Report: 1990-2016, Sources of Greenhouse Gas Emissions and Sinks in the Republic of Moldova on January 24, 2019; and the Report on the National GHG Inventory System in the Republic of Moldova – in 2018, respectively on February 26, 2019. The technical assessment by the TTE took place between May 27-31, 2019, the summary report being published on the Secretariat of the UNFCCC web page on October 28, 2019[9]. FSV among Parties on the BUR2 content and results of technical analysis was carried out during the 9th FSV workshop, held online by the UNFCCC Secretariat between November 24-27, 2020[10].

[5] <http://lex.justice.md/index.php?action=view&view=doc&lang=1&id=370323>
[6] <http://www4.unfccc.int/submissions/INDC/Published%20Documents/Republic%20of%20Moldova/1/INDC_Republic_of_Moldova_25.09.2015.pdf>
[7] <http://lex.justice.md/index.php?action=view&view=doc&lang=1&id=369528>
[8] <https://www4.unfccc.int/sites/NDCStaging/Pages/All.aspx>
[9] <https://unfccc.int/sites/default/files/resource/tasr2_2019_MDA.pdf>, <https://unfccc.int/ICA-cycle2>
[10] The conclusions to the 9th FSV seminar regarding the BUR2 of the RM under the UNFCCC and the results of the technical assessment are available on the web page: <https://unfccc.int/ICA-cycle2>, including RM's presentation at the 9th FSV seminar and the video recording of the presentation and the interventions of the Parties.

The Third Biennial Update Report (BUR3) of the Republic of Moldova to the UNFCCC was submitted to the UNFCCC Secretariat on December 21, 2021, along with two technical annexes: National Inventory Report: 1990-2019, Sources of Greenhouse Gas Emissions and Sinks in the Republic of Moldova and the Report on the National GHG Inventory System in the Republic of Moldova in 2021[11]. The technical assessment by the TTE took place between June 20-24, 2022.

Inventory Process in the Republic of Moldova

The Ministry of Environment (MoE) of the Republic of Moldova is the state authority responsible for development and promotion of policies and strategies addressing environment protection, rational use of natural resources and biodiversity conservation. On behalf of the Government of the Republic of Moldova, MoE oversees the implementation of international environment treaties to which the Republic of Moldova is a Part (including the Rio Conventions). The representative of the Ministry of Environment is also the National Focal Point to the UNFCCC.

According to Government Decision No. 549 of 13.06.2018 on the creation, organizing and functioning of the Environment Agency[12], the latter has been recently assigned the following competencies *in the field of atmospheric air protection and climate change*: the implementation of provisions of policy documents and international environmental treaties to which the RM is a part regarding the quality and protection of atmospheric air and ozone layer, *GHG emissions reduction and adaptation to climate change*, the elaboration and presentation of information on their implementation to the ME; participation to the within the *National Commission for Climate Change*; ensuring the implementation of the *monitoring, reporting and verification system for GHG emissions*; *collecting, centralizing, validating and processing data and required information for the inventories and reports on atmospheric pollutants and GHG emissions*; providing technical support to MoE for the development of *national communications and biennial update reports* according to UNFCCC provisions.

At the same time, in accordance with Government Decision no. 1277 of 26.12.2018 on establishment and operation of the National Monitoring and Reporting System (NMRS) on greenhouse gas emissions and other information relevant to climate change, the Environment Agency has been designated as the *competent authority* responsible for ensuring the operation of the NMRS on greenhouse gas emissions and other information relevant to climate change, providing that the operation of NMRS is carried out at the expense and within the resources approved in the state budget of the institutions that are parties to the system, as well as other sources provided by law, including from external financing *(activities carried out on the basis of technical assistance and capacity building projects)*.

In the above context, it is important to mention that, in accordance with Government Decision no. 1249 of 19.12.2018 on the establishment and operation of the Public Institution "Environmental Projects Implementation Unit" (PI "EPIU")[13], the latter has the mission to support MoE and organizational units in its area of competence, in the purpose of efficient implementation of financial and technical assistance projects, external and internal, in the field of environmental protection and use of natural resources (protection of atmospheric air, ozone layer and *climate change*; management of waste and chemicals; prevention of environmental pollution; management of water resources; biosecurity, biodiversity conservation and management of natural areas protected by the state), in accordance with the provisions of regulatory documents on implementation of the requirements of international conventions to which the Republic of Moldova is party and the alignment with international standards in the field of environmental protection.

As competent authority responsible for the operation of the National Monitoring and Reporting System on greenhouse gas emissions and other information relevant to climate change, the Environment Agency has requested by Letter No. 3471 of 25.09.2019 that PI "EPIU" examine and identifies opportunities for providing the necessary support for the accomplishment of commitments in the field of climate change by organizing the entire process for the preparation of the Third Biennial Update Re-

[11] <https://unfccc.int/BURs>
[12] <https://www.legis.md/cautare/getResults?doc_id=119162&lang=ro>
[13] <https://www.legis.md/cautare/getResults?doc_id=113696&lang=ro>

port of the Republic of Moldova to the UNFCCC (2020-2021), and the Fifth National Communication of the Republic of Moldova to the UNFCCC (2019-2022), respectively, in accordance with the rules, procedures and decisions of the Conference of the Parties to the UNFCCC.

From February 2004 to December 2018, and recently (from January 2019 to July 2020), the Climate Change Office within the PI "EPIU" was responsible for activities associated with the preparation of National Communications, Biennial Update Reports, National Inventory Reports and national inventories of GHG emissions.

The National Inventory Team within the PI "EPIU" is responsible for estimating emissions by source categories and removals by sink categories, key category analysis, quality assurance and quality control activities, uncertainty assessment, documentation and archiving of the information associated with the preparation of the national GHG inventory.

In the process of preparing the national GHG inventory, the National Inventory Team employed a centralized approach consisting of the National Inventory Report (NIR) and the inventory itself reported by using a series of standardised Common Reporting Format (CRF) (Sectoral and Summary) Tables (according to Decision 24/CP.19[14]).

The Report was drafted in compliance with UNFCCC Reporting Guidelines on Annual Inventories and has the following structure: Summary, Chapter 1 'Introduction', Chapter 2 'Greenhouse Gas Emission Trends', Chapter 3 'Energy', Chapter 4 'Industrial Processes and Product Use', Chapter 5 'Agriculture', Chapter 6 'LULUCF', Chapter 7 'Waste', Chapter 8 'Recalculations and Planned Improvements", 'Bibliography' and 'Annexes'.

Emissions of direct (CO_2, CH_4, N_2O, HFC, PFC and SF_6) greenhouse gases were estimated based on methodologies contained in the 2006 IPCC Guidelines, while indirect emissions (NOx, CO, NMVOC and SO_2) were estimated based on methodologies according to the EEA/EMEP Air Pollutant Emission Inventory Guidebook (2019).

Activity data used in this report are based on officially published data, such as national and international statistic publications; scientific literature; national legislation acts; data provided by the ministries and subordinated institutions, central administrative authorities, and economic agents.

The analysis of key categories analysis for the years 1990 and 2020 was carried out following a Tier 1 methodological approach, by use of the Key Categories Analysis Tool v2.5[15], developed by the US Environment Protection Agency (US EPA), revealed: without LULUCF – 18 key categories by level (L) and 20 key categories by trend (T); based on a Tier 2 approach – 17 key categories by level (L), and 16 key categories by trend (T); with LULUCF, based on the Tier 1 methodological approach – 24 key categories by level (L), and 25 key categories by trend (T), respectively, based on a Tier 2 approach – 22 key categories by level (L) and trend (T).

As a part of continuous efforts to develop a transparent and reliable inventory, the Republic of Moldova has developed a "*Quality Assurance and Quality Control Plan*". The key attributes of the Plan include detailed specific procedures and standard verification and quality control forms and checklists, by using Tier 1 (general procedures) and Tier 2 (source-specific procedures) methodological approaches, which serve to standardize the process of implementing quality assurance and quality control activities meant to ensure the quality of the national inventory; peer review carried out by experts not directly involved in the national inventory development process; data quality check, including by comparing the sets of data obtained from different sources; as well as the continuous documentation and archiving of all materials used in the inventory preparation process.

Inventory quality assurance activities were supported by experts representing: the Institute of Power Engineering of the Ministry of Education and Research – for Sector 1 'Energy'; the Technical University of Moldova – for Sector 2 'Industrial Processes and Product Use'; State Agrarian University of Moldova – for Sector 3 'Agriculture'; Forest Research and Management Institute of Moldislva Agency

[14] <https://unfccc.int/resource/docs/2013/cop19/eng/10a03.pdf>, <https://unfccc.int/process/transparency-and-reporting/reporting-and-review-under-convention/greenhouse-gas-6>
[15] <https://19january2017snapshot.epa.gov/climatechange/national-ghg-inventory-capacity-building_.html>

– for Sector 4 'Land Use, Land-Use Change and Forestry'; independent consultant in the field of environmental protection – for Sector 5 'Waste'.

The National Inventory of the Republic of Moldova consists of, mostly, a complete register of greenhouse gas emissions. Although it is intended to be comprehensive, certain sources have been excluded from the estimates presented for various reasons. Sources not accounted for this inventory are excluded due to data limitations. The National Inventory Team is continuously seeking to find the data required to estimate related GHG emissions/removals.

Direct Greenhouse Gas Emission Trends

In comparison with the base year level (1990), by 2020, the Republic of Moldova had reduced its GHG emissions by circa 69.8% (Table ES-1).

Table ES-1: Total GHG emissions and accompanying variables in the RM between 1990-2020

	1990	1995	2000	2005	2010	2015	2016	2017	2018	2019	2020
Population, million inhabitants	**4.362**	**4.348**	**4.304**	**4.087**	**3.687**	**3.345**	**3.299**	**3.251**	**3.199**	**3.151**	**3.110**
Compared to 1990, %		-0.3	-1.3	-6.3	-15.5	-23.3	-24.4	-25.5	-26.6	-27.8	-28.7
Inter-annual fluctuation, %		-0.1	-0.3	-3.4	-2.1	-0.9	-1.4	-1.5	-1.6	-1.5	-1.3
Total GHG emissions, Mt CO_2 eq.	**45.248**	**17.659**	**10.967**	**12.951**	**13.363**	**13.009**	**13.280**	**13.126**	**13.764**	**13.752**	**13.662**
Compared to 1990, %		-61.0	-75.8	-71.4	-70.5	-71.2	-70.7	-71.0	-69.6	-69.6	-69.8
Inter-annual fluctuation, %		-16.1	-7.8	3.1	6.0	-1.7	2.1	-1.2	4.9	-0.1	-0.7
GHG emissions, t CO_2 eq./ per capita	**10.4**	**4.1**	**2.5**	**3.2**	**3.6**	**3.9**	**4.0**	**4.0**	**4.3**	**4.4**	**4.4**
Compared to 1990, %		-60.9	-75.4	-69.5	-65.1	-62.5	-61.2	-61.1	-58.5	-57.9	-57.7
Inter-annual fluctuation, %		-16.1	-7.5	6.7	8.2	-0.8	3.5	0.3	6.5	1.4	0.7
GDP, billion 2015 US $	**11.250**	**4.435**	**3.913**	**5.508**	**6.452**	**7.745**	**8.087**	**8.466**	**8.830**	**9.135**	**8.498**
Compared to 1990, %		-60.6	-65.2	-51.0	-42.6	-31.2	-28.1	-24.7	-21.5	-18.8	-24.5
Inter-annual fluctuation, %		-1.4	2.1	7.5	7.1	-0.3	4.4	4.7	4.3	3.5	-7.0
GHG intensity, kg CO_2 eq./2015 US	**4.0**	**4.0**	**2.8**	**2.4**	**2.1**	**1.7**	**1.6**	**1.6**	**1.6**	**1.5**	**1.6**
Compared to 1990, %		-1.0	-30.3	-41.5	-48.5	-58.2	-59.2	-61.5	-61.2	-62.6	-60.0
Inter-annual fluctuation, %		-15.0	-9.7	-4.1	-1.1	-1.3	-2.2	-5.6	0.5	-3.4	6.8
Imported energy, million t.c.e.	**16.703**	**5.109**	**2.535**	**3.123**	**2.590**	**2.522**	**2.597**	**2.874**	**3.013**	**2.903**	**3.162**
Compared to 1990, %		-69.4	-84.8	-81.3	-84.5	-84.9	-84.5	-82.8	-82.0	-82.6	-81.1
Inter-annual fluctuation, %		11.0	-18.0	4.2	-8.2	-2.1	3.0	10.7	4.8	-3.7	8.9
Consumed energy, million t.c.e.	**15.054**	**5.085**	**2.647**	**3.257**	**3.761**	**3.832**	**3.989**	**4.195**	**4.410**	**4.193**	**4.078**
Compared to 1990, %		-66.2	-82.4	-78.4	-75.0	-74.5	-73.5	-72.1	-70.7	-72.1	-72.9
Inter-annual fluctuation, %		9.7	-20.2	6.3	27.1	0.4	4.1	5.2	5.1	-4.9	-2.7
Produced electricity, billion kWh	**15.690**	**6.168**	**3.624**	**4.225**	**6.115**	**6.050**	**5.852**	**4.963**	**5.389**	**5.697**	**6.179**
Compared to 1990, %		-60.7	-76.9	-73.1	-61.0	-61.4	-62.7	-68.4	-65.7	-63.7	-60.6
Inter-annual fluctuation, %		-25.8	-11.8	1.1	-1.3	12.5	-3.3	-15.2	8.6	5.7	8.5
Consumed electricity, billion kWh	**11.426**	**7.022**	**4.510**	**5.838**	**5.257**	**5.455**	**5.227**	**5.259**	**5.463**	**5.513**	**5.466**
Compared to 1990, %		-38.5	-60.5	-48.9	-54.0	-52.3	-54.3	-54.0	-52.2	-51.7	-52.2
Inter-annual fluctuation, %		-3.9	-4.4	-3.1	-0.9	-8.7	-4.2	0.6	3.9	0.9	-0.8
Produced heat, million Gcal	**22.212**	**9.827**	**4.986**	**5.324**	**4.601**	**3.979**	**4.125**	**4.084**	**4.137**	**3.884**	**3.783**
Compared to 1990, %		-55.8	-77.6	-76.0	-79.3	-82.1	-81.4	-81.6	-81.4	-82.5	-83.0
Inter-annual fluctuation, %		30.9	-26.0	8.2	5.4	-2.1	3.7	-1.0	1.3	-6.1	-2.6
Consumed heat, million Gcal	**20.983**	**8.796**	**4.501**	**4.765**	**3.988**	**3.473**	**3.628**	**3.551**	**3.697**	**3.441**	**3.376**
Compared to 1990, %		-58.1	-78.5	-77.3	-81.0	-83.4	-82.7	-83.1	-82.4	-83.6	-83.9
Inter-annual fluctuation, %		32.1	-23.6	8.4	4.1	-3.1	4.5	-2.1	4.1	-6.9	-1.9

References: [1]Economic Research Service US Department of Agriculture (<http://www.ers.usda.gov/data-products/international-macroeconomic-data-set.aspx>); [2]Statistical Yearbooks of the RM (<http://www.statistica.md/pageview.php?l=ro&idc=263&id=2193>) and ATULBD (<http://www.mepmr.org/pechatnye-izdaniya/statisticheskij-ezhegodnik-pmr>); [3]Energy Balances of the RM for 1990, 1993-2020 and Statistical Yearbooks of the ATULBD.

Table ES-1 reveals that the decrease in GHG emissions over the last 30 years is in full consistency with a decrease in some important economic and social indicators: the real value of the GDP decreased by 24.5% within this time periods, the population – by 28.7%, the GHG intensity (CO_2eq/GDP) – by 60.0%, consumption of primary energy resources – by 72.9%, import of energy – by 81.1%, electricity consumption – by 52.2%, heat consumption – by 83.9%.

The significant reduction of socio-economic indicators between 1990 and 2020 is a consequence of the profound transformation processes common for the transition from a centralized economy to a market economy, after the breakup of the Soviet Union and the Declaration of Independence of the Republic of Moldova on August 27, 1991. In 1990, the country had medium-low incomes while today it is considered one of the countries with the lowest incomes per capita in Europe. Even before 1991, there were some tendencies of economic decline, but the separation from the USSR accelerated the process considerably. The real GDP level decreased continuously from 1990 to 1999, and in 1991 it fell to as little as 34% compared to level in 1990.

The reasons for the economic collapse were numerous. First, the country had been fully integrated in the USSR economic system, and the independence resulted, among other things, in the cessation of any subsidies or cash transfers from the centralized government. Second, the end of the Soviet Era with its well-established commercial links resulted in the emergence of numerous obstacles for free movement of goods, and in access restrictions introduced by the emerging markets. Third, the lack of domestic energy resources and raw materials in the country contributed considerably to the nation's strong dependence on other former Soviet Republics. This dependence has affected consumers' capacity to pay for the energy used due to the increased prices of energy resources (e.g., from 1997 to 2020, the natural gas tariff increased by circa 9 times; the electricity tariff increased by circa 7.4 times; gasoline, diesel and liquefied gas prices increased by circa 2.3-2.4 times), given that most energy resources were imported. On the other hand, without applying cross subsidizations policies, the current energy prices incentivized the population to take strong energy efficiency measures in the RM, which led to a significant decrease in energy intensity, declining since 2006 with an average annual negative growth of circa 2.5%.

Simultaneously, over the period 2000-2020, the real GDP increased from circa 3.9 to 8.5 billion US dollars from 2015 levels, and the real GDP per capita increased from 909.2 to 2732.6 US dollars from 2015 levels.

The considerable increase in real GDP achieved since 2000 seems to show that the economy has developed in the right direction albeit we must remember that in 2020 the real GDP reached only 75.8% of the level recorded in the base year (1990).

We must mention that from 2000 to 2020, the consumption of primary energy resources had increased in the Republic of Moldova by 54.1%; while the intensity of emissions (CO_2eq/GDP) decreased by 42.6%, indicating signs of economic growth decoupling from the increase in GHG emissions by 24.6% over the period 2000-2020 (Figure ES-1).

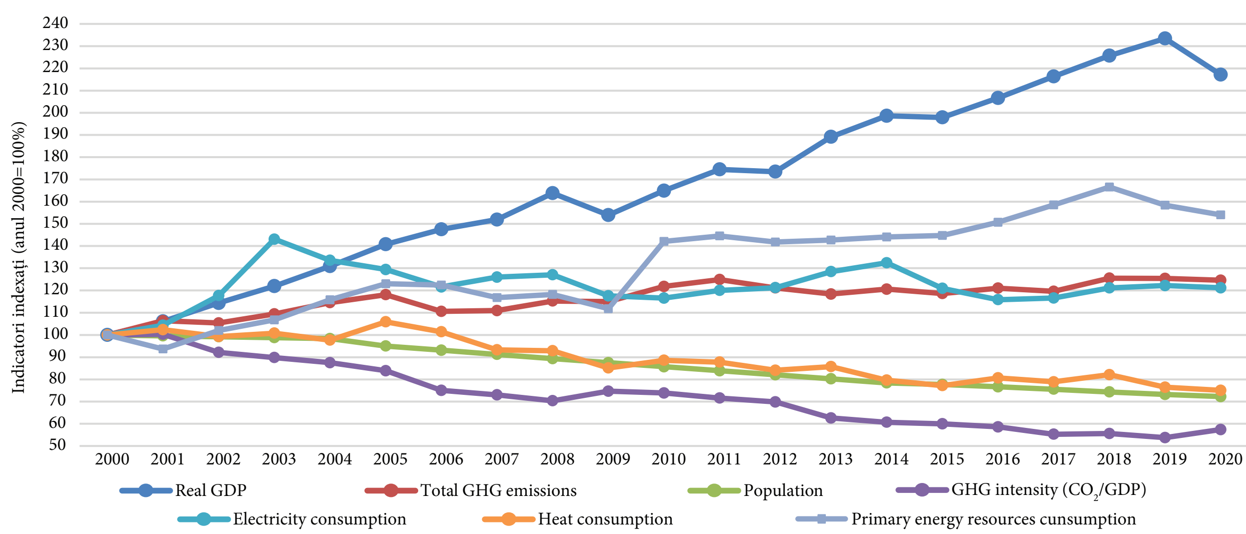


Figure ES-1: Trends in total GHG emissions and associated variables in the Republic of Moldova between 2000-2020.

Table ES-2 provides data on total and net direct GHG emissions in the Republic of Moldova in 2020.

Table ES-2: The Republic of Moldova's Total Direct GHG Emissions in 2020

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2	CH_4	N_2O	HFCs	PFCs	SF_6	Unspecified mix of HFCs and PFCs	NF_3	Total
	CO_2 equivalent (kt)								
1. Energy	**8,972.1085**	**466.8670**	**110.9154**						**9,549.8909**
A. Fuel Combustion (sectoral approach)	8,970.5288	226.6395	110.9127						9,308.0809
1. Energy Industries	3,634.3761	1.6353	1.9598						3,637.9713
2. Manufacturing Industries and Construction	801.4383	0.7451	1.4657						803.6492
3. Transport	2,462.2411	10.8793	38.7861						2,511.9066
4. Other Sectors	2,050.0916	213.3738	68.5953						2,332.0606
5. Other	22.3816	0.0059	0.1058						22.4933
B. Fugitive Emissions from Fuels	1.5797	240.2276	0.0027						241.8100
1. Solid Fuels	NO	NO	NO						NO
2. Oil and Natural Gas	1.5797	240.2276	0.0027						241.8100
C. CO_2 Transport and Storage	NO								NO
2. Industrial Processes and Product Use	**751.8959**	**NO**	**NO**	**245.3168**	**0.0403**	**1.5790**	**NO**	**NO**	**998.8320**
A. Mineral Industry	536.8930								536.8930
B. Chemical Industry	NO	NO	NO						NO
C. Metal Industry	18.6972	NO	NO	NO	NO	NO	NO	NO	18.6972
D. Non-Energy Products from Fuels and Solvent Use	195.3645	NO	NO						195.3645
E. Electronic Industry				NO	NO	NO	NO	NO	NO
F. Product Use as Substitutes for ODS				245.3168	NO	NO	NO	NO	245.3168
G. Other Product Manufacture and Use	0.9412	NO	NO	NO	0.0403	1.5790	NO	NO	2.5605
H. Other									
3. Agriculture	**42.6156**	**433.4064**	**1,070.4136**						**1,546.4355**
A. Enteric Fermentation		389.0391							389.0391
B. Manure Management		44.3673	166.4175						210.7848
C. Rice Cultivation		NO							NO
D. Agricultural Soils			903.9960						903.9960
E. Prescribed Burning of Savannas		NO	NO						NO
F. Field Burning of Agricultural Residues		IE	IE						IE
G. Liming	NO								NO
H. Urea Application	42.6156								42.6156
I. Other Carbon-Containing Fertilizers	NO, NE								NO, NE
J. Other	NO	NO	NO						NO
4. LULUCF	**-172.3409**	**0.8034**	**168.0021**						**-3.5354**
A. Forest Land	-1,887.3228	0.7233	0.4769						-1,886.1227
B. Cropland	1,629.9020	0.0801	0.0248						1,630.0069
C. Grasslands	-223.1528	NE	NE						-223.1528
D. Wetlands	-82.8099	NE	NE						-82.8099
E. Settlements	27.2098	NO, NE	167.5004						194.7102
F. Other Land	329.1445	NE	NE						329.1445
G. Harvested Wood Products	34.6883								34.6883
H. Other	NE	NE	NE						NE
5. Waste	**13.7583**	**1,491.8574**	**60.9751**						**1,566.5908**
A. Solid Waste Disposal	NA, NO	1,246.1821							1,246.1821
B. Biological Treatment of Solid Waste		1.4180	1.0142						2.4322
C. Incineration and Open Burning of Waste	13.7583	7.0563	1.4767						22.2913
D. Wastewater Treatment and Discharge		237.2010	58.4843						295.6853
E. Other	NO	NO	NO						NO
6. Other	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**
Memo Items:									
International Bunkers	**35.2495**	**0.0062**	**0.2938**						**35.5495**
International Aviation	35.2495	0.0062	0.2938						35.5495
International Navigation	NO	NO	NO						NO
Multilateral Operations	**NO**	**NO**	**NO**						**NO**
CO_2 Emissions from Biomass	2,985.9162								2,985.9162
CO_2 Captured and Stored	NO								NO
Long-term Storage of C in waste disposal sites	NE								NE
Indirect N_2O emissions			269.7462						269.7462
Indirect CO_2 emissions	187.7661								187.7661
Total (without the contribution of Sector 4 'LULUCF')									**13,661.7492**
Total (with the contribution of Sector 4 'LULUCF')									**13,658.2138**

Abbreviations: IE – Included Elsewhere; NE – Not Estimated; NO – Not Occurring.

Table ES-3: Republic of Moldova's direct GHG emissions between 1990-2020

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	1990	1995	2000	2005	2010	2015	2016	2017	2018	2019	2020
	CO_2 equivalent (kt)										
1. Energy	**36,992.9272**	**12,391.3486**	**6,940.8801**	**8,836.4882**	**9,496.4226**	**9,119.6469**	**9,256.6167**	**8,924.9057**	**9,406.8597**	**9,401.4161**	**9,549.8909**
A. Fuel Combustion (sectoral approach)	36,081.5198	11,652.5180	6,276.3671	7,987.6700	8,833.9136	8,476.3861	8,568.0854	8,204.5753	8,727.4133	8,929.7241	9,308.0809
1. Energy Industries	21,364.2413	7,192.4074	3,159.3286	3,233.2579	4,052.9708	3,688.0902	3,648.5771	2,999.4997	3,258.6362	3,127.5077	3,637.9713
2. Manufacturing Industries and Construction	1,921.7642	386.9966	521.6280	577.3845	517.2615	518.3827	489.6135	502.7968	595.6181	720.0202	803.6492
3. Transport	4,838.6388	1,660.3423	1,005.6576	1,866.9919	2,188.7989	2,307.8259	2,481.6061	2,463.4491	2,581.8939	2,665.4305	2,511.9066
4. Other Sectors	7,841.3054	2,286.2222	1,552.9485	2,283.7523	2,047.3623	1,939.2152	1,925.2983	2,175.9589	2,267.8044	2,393.7886	2,332.0606
5. Other	115.5701	126.5495	36.8044	26.2833	27.5201	22.8721	22.9905	22.7351	23.4607	22.9770	22.4933
B. Fugitive Emissions from Fuels	911.4074	738.8306	664.5129	848.8182	662.5090	643.2608	688.5313	720.3305	679.4463	471.6920	241.8100
1. Solid Fuels	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
2. Oil and Natural Gas	911.4074	738.8306	664.5129	848.8182	662.5090	643.2608	688.5313	720.3305	679.4463	471.6920	241.8100
C. CO_2 Transport and Storage	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
2. Industrial Processes and Product Use	**1,605.2421**	**456.6563**	**315.7771**	**573.0521**	**561.2070**	**765.1264**	**746.9409**	**779.7366**	**964.6613**	**991.2229**	**998.8320**
A. Mineral Industry	1,338.9600	351.6610	240.7803	439.1892	405.3915	504.2041	488.0182	475.6060	591.9454	593.6612	536.8930
B. Chemical Industry	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
C. Metal Industry	28.5023	26.2369	36.2689	41.9358	9.6985	17.2792	5.2203	18.8842	20.2133	15.7926	18.6972
D. Non-Energy Products from Fuels and Solvent Use	234.3591	76.5607	32.6395	68.1910	66.2398	84.5691	84.8044	97.0212	151.1809	143.6217	195.3645
E. Electronic Industry	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
F. Product Use as Substitutes for ODS	NO	1.0298	5.1199	22.5106	78.1507	157.0394	166.7099	185.8945	198.8877	235.5397	245.3168
G. Other Product Manufacture and Use	3.4207	1.1679	0.9685	1.2255	1.7265	2.0346	2.1882	2.3306	2.4340	2.6076	2.5605
H. Other	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
3. Agriculture	**5,076.7326**	**3,173.3679**	**2,136.1941**	**2,063.2167**	**1,803.7474**	**1,701.2089**	**1,826.6518**	**1,881.7490**	**1,837.3116**	**1,798.7248**	**1,546.4355**
A. Enteric Fermentation	2,189.4276	1,618.0865	1,085.7826	924.0273	708.1752	629.2090	622.0031	578.3838	516.4851	440.9463	389.0391
B. Manure Management	1,394.8097	743.9702	418.9254	420.8418	379.5922	318.7613	321.2590	306.5829	269.6956	246.2774	210.7848
C. Rice Cultivation	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
D. Agricultural Soils	1,491.9134	811.2505	631.0464	718.1737	714.2357	741.9984	871.1149	970.5743	1,007.7685	1,071.8704	903.9960
E. Prescribed Burning of Savannas	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
F. Field Burning of Agricultural Residues	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE
G. Liming	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
H. Urea Application	0.5820	0.0607	0.4397	0.1739	1.7443	11.2402	12.2747	26.2081	43.3624	39.6306	42.6156
I. Other Carbon-Containing Fertilizers	NO, NE	NO, NE	NO, NE	NO, NE	NO, NE	NO, NE	NO, NE	NO, NE	NO, NE	NO, NE	NO, NE
J. Other	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
4. LULUCF	**-1,657.4590**	**-2,031.1108**	**-2,123.3389**	**-1,667.5188**	**-1,228.1669**	**-1,181.9309**	**-937.4818**	**-993.3179**	**-841.0512**	**13.3072**	**-3.5354**
A. Forest Land	-2,563.0889	-2,045.0615	-2,307.4358	-2,409.4945	-2,484.0285	-2,158.4241	-2,115.2503	-2,015.7307	-1,969.1152	-1,950.0547	-1,886.1227
B. Cropland	2,382.2907	1,319.6504	1,223.9203	1,271.9854	1,271.8515	1,112.6784	1,112.0573	1,089.6553	1,206.4257	1,507.4508	1,630.0069
C. Grasslands	-1,205.6938	-1,601.1004	-1,291.9495	-1,058.1239	-691.9874	-418.4569	-402.3693	-384.0392	-440.1513	-293.2923	-223.1528
D. Wetlands	-555.3798	-469.4389	-328.4245	-187.4101	-46.3958	-82.7917	-82.7917	-82.8162	-82.8253	-82.8099	-82.8099
E. Settlements	254.2294	357.7389	396.2187	340.1329	303.7123	229.0089	198.3556	248.8550	186.9048	277.7857	194.7102
F. Other Land	152.3638	401.1281	178.5246	416.5012	441.4824	86.8192	351.6349	218.2055	321.2138	611.7881	329.1445
G. Harvested Wood Products	-122.1804	5.9727	5.8073	-41.1098	-22.8014	49.2353	0.8816	-67.4476	-63.5037	-57.5604	34.6883
H. Other	NE	NO	NE	NE	NE	NE	NE	NE	NE	NE	NE
5. Waste	**1,573.5058**	**1,637.3163**	**1,573.8873**	**1,478.4941**	**1,501.4555**	**1,423.2385**	**1,449.8546**	**1,539.4310**	**1,555.2113**	**1,560.4663**	**1,566.5908**
A. Solid Waste Disposal	1,105.9965	1,256.0725	1,207.0370	1,093.6111	1,160.6703	1,104.4973	1,131.9612	1,220.9072	1,232.4760	1,239.2098	1,246.1821
B. Biological Treatment of Solid Waste	2.3322	1.0843	0.8984	1.0334	1.8439	2.1795	2.1665	2.4799	2.2360	2.2366	2.4322
C. Incineration and Open Burning of Waste	24.2621	24.4574	24.2867	23.4100	20.8019	21.5422	21.0986	23.7193	23.1496	22.5896	22.2913
D. Wastewater Treatment and Discharge	440.9149	355.7021	341.6652	360.4395	318.1393	295.0195	294.6284	292.3246	297.3497	296.4302	295.6853
E. Other	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
6. Other	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**
Memo Items:											
International Bunkers	**195.7347**	**42.5212**	**63.7967**	**38.3980**	**41.5312**	**57.4930**	**102.1063**	**149.8553**	**172.2996**	**153.1717**	**35.5495**
International Aviation	195.7347	42.5212	63.7967	38.3980	41.5312	57.4930	102.1063	149.8553	172.2996	153.1717	35.5495
International Navigation	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Multilateral Operations	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
CO_2 Emissions from Biomass	**232.8093**	**230.0480**	**272.3720**	**307.3920**	**341.0480**	**1,428.4386**	**1,603.1890**	**2,122.7228**	**3,583.0567**	**2,976.2234**	**2,985.9162**
CO_2 Captured and Stored	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Long-term Storage of C in waste disposal sites	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
Indirect N_2O emissions	**763.2533**	**404.8742**	**265.5133**	**288.0244**	**277.4232**	**264.8025**	**294.1106**	**310.2353**	**307.0403**	**314.8264**	**269.7462**
Indirect CO_2 emissions	**207.5471**	**65.4471**	**28.5957**	**61.0627**	**59.3041**	**77.8743**	**77.9170**	**90.1477**	**143.8546**	**136.1237**	**187.7661**
Total (without the contribution of Sector 4 'LULUCF')	**45,248.4076**	**17,658.6891**	**10,966.7387**	**12,951.2511**	**13,362.8324**	**13,009.2207**	**13,280.0640**	**13,125.8224**	**13,764.0439**	**13,751.8300**	**13,661.7492**
Total (with the contribution of Sector 4 'LULUCF')	**43,590.9487**	**15,627.5783**	**8,843.3998**	**11,283.7323**	**12,134.6655**	**11,827.2898**	**12,342.5822**	**12,132.5045**	**12,922.9927**	**13,765.1372**	**13,658.2138**

Abbreviations: IE – Included Elsewhere; NE – Not Estimated; NO – Not Occurring.

The share of CO_2 emissions in the total direct GHG emissions was circa 71.6%, the share of CH_4 was circa 17.5%, N_2O emissions accounted for 9.1% of the total, whereas the share of F-gases (HFC, PFC, SF_6) is completely insignificant, only circa 1.8% of the total (Figure ES-2).

In 2020, in the Republic of Moldova, approximately 69.9% of the total national direct GHG emissions originated from Sector 1 'Energy'. Other relevant direct GHG sources are Sector 5 'Waste' (11.5% of the total), Sector 3 'Agriculture' (11.3% of the total) and Sector 2 'Industrial Processes and Product Use' (7.3% of the total) (Figure ES-3).

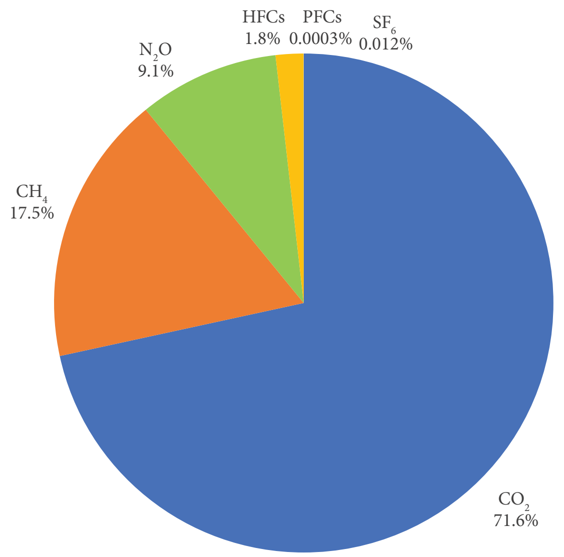


Figure ES-2: Share of direct GHG emissions in the structure of total GHG emissions in the Republic of Moldova in 2020.

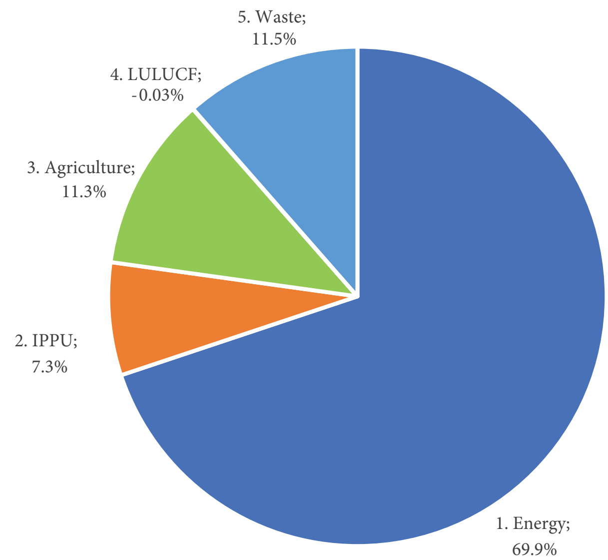


Figure ES-3: Sectoral Breakdown of the total national GHG emissions in the Republic of Moldova in 2020.

Table ES-3 shows the evolution of total direct GHG emissions and removals in the Republic of Moldova for the period 1990-2020. As it can be noted, the total national direct GHG emissions (without the contribution of Sector 4 'LULUCF') had decreased during the period under review by 69.8%, from 45.25 Mt CO_2 equivalent in 1990 to 13.66 Mt CO_2 equivalent in 2020 (GHG emissions had decreased by circa 0.7% compared to 2019 levels). At the same time, net direct GHG emissions (with the contribution of Sector 4 'LULUCF') had decreased by 68.7% in the same time period, from 43.59 Mt CO_2 equivalent in 1990 to 13.66 Mt CO_2 equivalent in 2020 (net emissions had decreased by 0.8 per cent compared to 2019 levels).To be noted that the GHG emissions from Sector 1 'Energy' had decreased in the period 1990-2020 by circa 74.2% (in 2019, they increased by 1.6% as compared to 2019 levels), emissions from Sector 2 'Industrial Processes and Product Use' had decreased by circa 37.8% (however, they increased by 0.8% compared to 2019 levels), emissions from Sector 3 'Agriculture' decreased by 69.5% (they decreased by 14.0% compared to 2019 levels), net removals from Sector 4 'LULUCF' decreased by 99.8% (they increased by 126.6% compared to 2019 levels), respectively, emissions from Sector 5 'Waste' decreased by 0.4% (they increased, however, by 0.4% compared to 2019 levels).

The most significant reductions of direct GHG emissions by source categories had been registered in the period 1990-2020 in the following categories: 4G 'Harvested Wood Products' (-128.4%), 4D 'Wetlands' (-85.1%), 1A1 'Energy Industries' (-83.0%), 3B 'Manure Management' (-84.9%), 3A 'Enteric Fermentation' (-82.2%), 4C 'Grassland' (-81.5%), 1A5 „Other" (-80.5%), 1B2 'Oil and Natural Gas' (-73.5%), 1A4 'Other Sectors' (-70.3%), 2A 'Mineral Industry' (-59.9%), 1A2 'Manufacturing Industries and Construction' (-58.2%), 1A3 'Transport' (-48.1%), 3D 'Agricultural Soils' (-39.4%), 2C 'Metal Industry' (-34.4%), 5D 'Wastewater Treatment and Discharge' (-32.9%), 4B 'Cropland' (-31.6%), 4A 'Forest Land' (-26.4%), 2G 'Other Product Manufacture and Use' (-25.1%), 4E 'Settlements' (-23.4%) and 2D 'Non-Energy Products from Fuels and Solvent Use' (-16.6%).

From 2019 to 2020, an increase in emissions from the following source categories had been recorded: 2D 'Non-Energy Products from Fuels and Solvent Use' (+36.0%), 2C 'Metal Industry' (+18.4%), 1A1 'Energy Industries' (+16.3%), 1A2 'Manufacturing Industries and Construction' (+11.6%), 5B 'Biological Treatment of Solid Waste' (+8.7%), 4B 'Cropland' (+8.1%), 3H 'Urea Application' (+7.5%), 2F 'Product Use as Substitutes for ODS' (+4.2%) and 5A 'Solid Waste Disposal' (+0.6%).

Indirect GHG Emission Trends

Despite not being considered greenhouse gases, photochemically active gases such as carbon monoxide (CO), nitrogen oxides (NO_x) and non-methane volatile organic compounds (NMVOC) contribute to global warming indirectly. These gases are considered as ozone precursors influencing the formation and destruction of ozone in the atmosphere, which are particularly emitted from transportation, fossil fuel combustion, consumption of solvents and other household products, etc.

The national GHG inventory of the RM includes emissions of the following ozone and aerosol precursors: NO_x, CO, NMVOC and SO_2. Between 1990 and 2020, total NO_x emissions had decreased by circa 74.4%: from 95.55 kt in 1990 to 24.47 kt in 2020; total CO emissions had decreased by 49.3%: from 278.79 kt in 1990 to 141.37 kt in 2020; NMVOC emissions had decreased by 21.2%: from 141.57 kt in 1990 to 111.56 kt in 2020; while SO_2 emissions had decreased by 97.1%: from 150.11 kt in 1990 to 4.29 kt in 2020 (Figure ES-4).

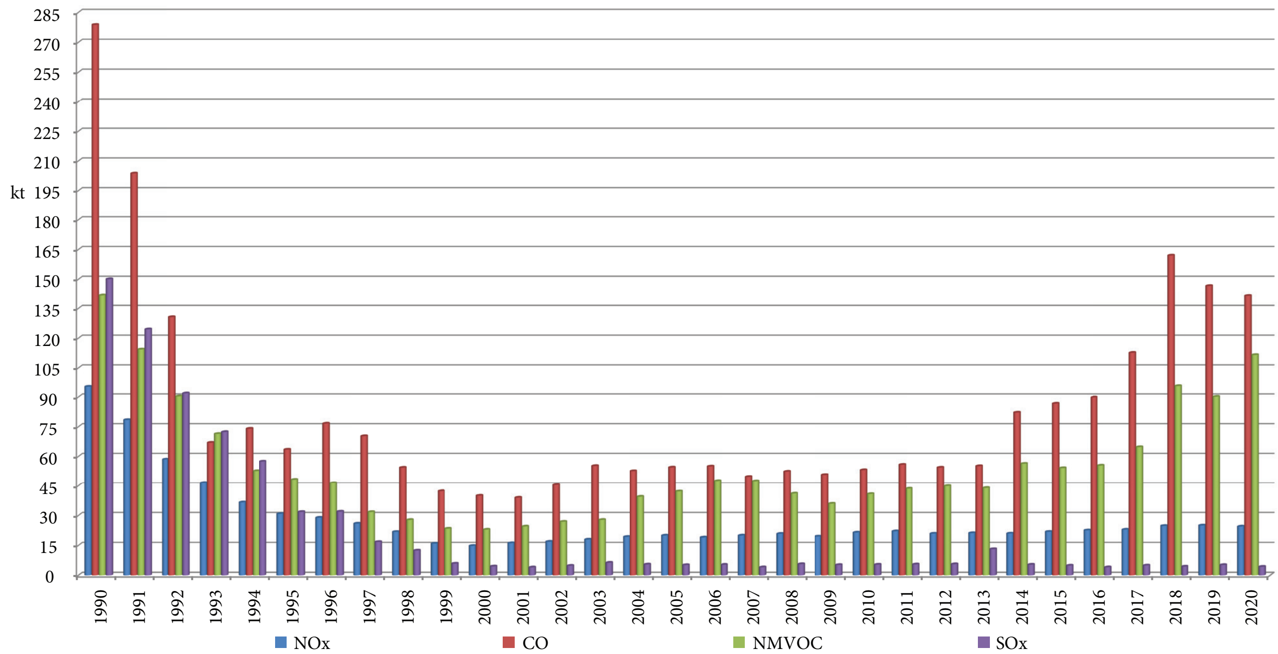


Figure ES-4: National indirect GHG emissions in the RM between 1990-2020.

1. INTRODUCTION

1.1. Climate Change Phenomenon

1.1.1. Climate Change and Greenhouse Effect

Under the UNFCCC, climate change is defined as *'a change of climate which is attributed directly or indirectly to human activity, which alters the composition of the global atmosphere, being an additional effect to natural climate variability observed over comparable time periods*. Human activities change atmospheric concentrations and distribution of greenhouse gases and aerosols. These changes can produce a radiant force by either changing the solar radiation reflection and absorption, or emission and absorption of terrestrial radiation.

Box 1-1: Climate change – definitions and evolution scenarios

To better understand the definition of climate change it is important to perceive the difference between the notions of weather and climate. Weather is a condition of the atmosphere at a certain time and in a certain place, perceived as a change of temperature, air pressure, humidity, wind speed, nebulosity, and precipitations. The notion of weather is used when the abovementioned conditions are related to short periods of time. The notion of climate usually refers to the average state of weather in a certain region of the world which persists over a longer period of time (at least 30 years). So, climate may be defined as a weather pattern characteristic to a certain region of the world. Elements of the climate are precipitations, temperature, humidity, solar radiation, wind speed and such phenomena as fog, frost, hoarfrost, hail and others. Climate change refers to long-term changes in weather patterns caused by both natural phenomena (astronomical: solar activity, the influence of some planets, etc.; geological-geophysical: the change of the Earth's axial tilt, the change of the Earth's orbit and others; geographical: changes of the structure of the active surface – volcanic eruptions, massive landslides), and phenomena of anthropogenic nature (induced by humans), such as pollution of terrestrial atmosphere (change of the global atmosphere composition by generating GHGs).

In accordance with the Sixth Assessment Report (AR6) of the Intergovernmental Panel on Climate Change (IPCC, 2021), each of the past four decades has been successively warmer than any decade since 1850. During the first two decades of the 21st century, the global surface temperature was 0.99°C [between 0.84 and 1.10] higher than between 1850-1900. Simultaneously, the global surface temperature was 1.09°C [between 0.95 and 1.20] higher between 2011 and 2020 than between 1850 and 1900.

Between 1901 and 2018, the sea level had risen by 20 cm [between 15 and 25]. Between 1901 and 1971, the average sea level rise was circa 1.3 mm/year [between 0.6 and 2.1], rising to 1.9 mm/year [between 0.8 and 2.9] between 1971 and 2006, and to 3.7 mm/year [between 3.2 and 4.2] between 2006 and 2018. It highly likely that anthropogenic activities are the mainspring of global glacier retreat from 1990 onwards and the reduction of the Arctic Ocean's ice surface between 1979-1988 and 2010-2019 (by circa 40% in September and by circa 10% in March). Between 2011 and 2020, the average annual arctic sea ice reached its lowest level since 1850. During the summer season, the Arctic sea ice was smaller than at any time in the last 1000 years. The global phenomenon of synchronous glacier retreat observed since 1950 is unprecedented in the last 2000 years.

Heat waves (excessively hot weather) have become more frequent and intense in most terrestrial regions since 1950, while cold waves (excessively cold weather) have become less frequent and less severe. Simultaneously, marine heatwaves have doubled their frequency since 1980. Also, the frequency and intensity of abundant rainfall events have increased since 1950 in most terrestrial areas for which observational data are sufficient to analyse weather trends.

In accordance with the Sixth Assessment Report (AR6) of the Intergovernmental Panel on Climate Change (IPCC, 2021), it is expected that the global surface temperature will continue to rise until at least the mid-21st century in all Shared Socioeconomic Pathway Scenarios considered. The average global temperature will exceed 1.5-2.0°C in the 21st century unless deep reductions in CO_2 and other greenhouse gas emissions take place in the coming decades. Compared to the period 1850-1900, the average global surface temperature between 2081-2100 will most likely be 1.0°C-1.8°C higher in the very low GHG emission scenario (SSP1.0-1.9), 2.1°C-3.5°C higher for the intermediate GHG emission scenario (SSP2.0-4.5) and 3.3°C-5.7°C higher for the high GHG emission scenario (SSP5.0-8.5). The last time when the global surface temperature was maintained at 2.5°C above the level recorded in 1850-1900 was 3 million years ago.

It is highly likely that heavy rainfalls will intensify and become more frequent in most terrestrial regions. On a global scale, extreme daily precipitation events are expected to intensify by circa 7% for every 1°C of global warming. It has also been envisaged that the share of tropical cyclones of maximum intensity will increase (category 4–5) as global warming intensifies.

It is estimated that global warming will further amplify the rate of thawing of permafrost and the loss of seasonal snow, land ice, and Arctic sea ice. By 2050, the Arctic will be virtually ice-free in September. The global water cycle will continue to intensify as global temperatures rise, precipitation and surface runoff are envisaged to become more variable in most land regions over the seasons and year-on-year.

Compared to 1995-2014, in the last two decades of the 21_{st} century (2081-2100), the globally averaged annual precipitation is projected to rise by 0-5% for the very low GHG emission scenario (SSP1.0-1.9), by 1.5-8% for the intermediate GHG emission scenario (SSP2.0-4.5) and by 1-13% for the very high GHG emission scenario (SSP5.0-8.5).

Compared to 1995-2014, the globally averaged sea level rise toward 2100 will be 28-55 cm in the very low GHG emission scenario (SSP1.0-1.9), 44-76 cm for the intermediate GHG emission scenario (SSP2.0-4.5) and 63-101 cm for the very high GHG emission scenario (SSP5.0-8.5).

By the end of the 21st century, the frequency of natural disasters (floods, droughts, heat waves, hurricanes, tornados, etc.) is expected to grow. In some regions, their impact could be devastating, while other regions could benefit from climate change. The impact will depend on the form and magnitude of these changes, and in the case of adverse effects, of the ability of natural and anthropogenic systems to adapt to climate change.

In other words, the greenhouse effect of the atmosphere is similar to the effect that can be observed in greenhouses when the function of the glass or polyethylene is taken over by the greenhouse gases. Short-wave solar radiation freely penetrates the greenhouse gases, reaching the Earth's surface, and warming it. Long-wave radiation (infrared rays) emitted by the Earth's surface is captured by these gases and is partially sent back to the Earth's surface. Consequently, the average atmospheric temperature is by 33°C warmer than it would be in the absence of the greenhouse effect. Basically, this phenomenon makes life on Earth possible.

1.1.2. Greenhouse Gases

The most important greenhouse gas in the atmosphere is water vapours (H_2O), responsible for approximately 2/3 of the total greenhouse effect. The content of water in the atmosphere is not directly influenced by anthropogenic activities, but is determined by the natural water cycle, or, simply, the difference between evaporation and precipitation.

Carbon dioxide (CO_2) has a 30% share in the greenhouse effect, while methane (CH_4), nitrous oxide (N_2O) and ozone (O_3) taken together account for 3%. The group of artificial substances (man-made): chlorofluorocarbons (CFC) and their substitute, hydrofluorocarbons (HCFC, HFC) and other substances, as well as perfluorocarbons (PFCs) and sulphur hexafluoride (SF_6) are also attributed to direct GHG. There are other photochemically active gases, such as carbon monoxide (CO), nitrogen oxides (NO_x) and non-methane volatile organic compounds (NMVOC) (include substances such as: propane, butane, and ethane), which are not attributed to direct GHG, but have an indirect contribution to the greenhouse effect. Such gases influence the formation and destruction of ozone in the atmosphere in the presence of solar rays (ultraviolet radiation) and are considered to be ozone precursors in the troposphere.

Though greenhouse gases are considered to be natural components of the air, their presence in the atmosphere is strongly affected by anthropogenic activities. Increased concentrations of GHG in the atmosphere (caused by emissions of anthropogenic origin) contribute to the enhanced greenhouse effect, thus leading to additional warming of the atmosphere. The GHG concentration in the atmosphere is determined by the difference between GHG emissions and removals. It has been established with certainty that the GHG concentrations in atmosphere have increased significantly in comparison with pre-industrial level. Thereby, from 1750 to the end of 2021, the concentration of CO_2 had increased by circa 148.4%, the concentration of CH_4 – by 264.2%, and the. concentration of N_2O – by circa 123.9 per cent[16] (Table 1-1). To a great extent, these trends can be attributed to human activities – fossil fuel combustion and continuous deforestation of forest lands, in particular.

Table 1-1: Tropospheric concentration (in the Northern Hemisphere), concentration change rate and direct GHG lifetime in the atmosphere

Greenhouse Gases	Preindustrial tropospheric concentration (1850-1900)	Recent tropospheric concentration (end of 2021)	GWP (100-yr time horizon) (IPCC, 2014)	Tropospheric lifetime (years)
Carbon dioxide (CO_2)	280 ppm	415.7 ppm	1	~ 50-200
Methane (CH_4)	722 ppb	1907.2 ppb	28	12.4
Nitrous oxide (N_2O)	270 ppb	334.6 ppb	265	121

Note: ppm – concentration in parts per million of volume; ppb - concentration in parts per billion of volume.

In the year 2020, globally, the amount of annual carbon dioxide emissions from fossil fuel burning was about 31.5 gigatons (Gt)[17], 1.9 Gt less than the level recorded in 2019. The most important sources of car-

16 <https://www.esrl.noaa.gov/gmd/ccgg/trends/>, <https://public.wmo.int/en/media/press-release/carbon-dioxide-levels-continue-record-levels-despite-covid-19-lockdown>
17 <https://library.wmo.int/index.php?lvl=notice_display&id=21975#.Yh0M85b8uUk >

bon dioxide emissions are fossil fuel combustion, deforestation, and industrial processes (for example, cement production). The carbon dioxide lifetime in the atmosphere varies between 50 and 200 years. It can be removed from atmosphere through a complex set of natural sink mechanisms. Also, it is considered that circa 40% of the emitted carbon dioxide can be absorbed by oceans. Photosynthesis, particularly in sea vegetation and plankton is an important, though transitory, mechanism of CO_2 emissions removal, because after the perishing of plants, carbon dioxide is again emitted into the atmosphere.

The concentration of methane in the atmosphere is affected in proportion of circa 60% by anthropogenic activities such as rice cultivation, animal breeding (enteric fermentation and manure management), coal, oil and natural gas extraction, transportation and distribution of natural gases, solid waste disposal on lands, biomass combustion, etc. The breakdown of methane in the atmosphere takes place through chemical reactions (by means of OH radicals). The lifetime of CH_4 in the atmosphere is circa 12.4 years. The annual CH_4 emissions into the atmosphere account for circa 29-30 Mt[18].

It has been established that circa 40% of the atmospheric N_2O is of anthropogenic origin[19], originating from the use of synthetic nitrogen fertiliser, soil cultivation, animal breeding (manure management), wastewater treatment, adipic acid and nitric acid production, fossil fuels combustion, waste incineration and biomass combustion. The other 60%of the atmospheric N_2O originates from the soil and denitrification of water in anaerobic conditions. N_2O breaks down photochemically in the atmosphere. Global annual N_2O emissions from anthropogenic activities are estimated to be circa 7.3 Mt[20].

HFCs (hydrofluorocarbons), PFCs (perfluorocarbons) and SF_6 (sulphur hexafluoride) are greenhouse gases of anthropogenic origin. HFCs are predominantly used to replace ozone-depleting chemicals but are also emitted in the HCFC-22 production process. PFCs and SF_6 are emitted in various industrial processes, including the production of aluminium and magnesium, the production of semiconductors, the transmission and distribution of electricity, etc. All these gases have a long lifetime in the atmosphere and are characterized by a considerable capacity for absorbing infrared radiation, so that in the future they could have a considerable impact on the global warming.

1.1.4. Global Warming Potential

The radiative forcing effect of a gas in the atmosphere is the reflection of its ability to cause atmospheric warming. Direct radiative forcing occurs when the gas itself is a GHG, while indirect radiative forcing occurs when chemical transformation of the original gas produces a gas or gases that are GHGs or when a gas influences the atmospheric lifetimes of other gases.

The concept of 'Global Warming Potential' (GWP) has been developed to allow scientists and policymakers to compare the ability of each GHG to trap heat in the atmosphere. By definition, GWP is the time-integrated change in radiative forcing due to the instantaneous release of 1 kg of a trace gas expressed relative to that from the release of 1 kg of CO_2. In other words, GWP is a relative measure of a warming effect that the emission of a radiant gas (i.e., GHG) might have on the troposphere. The 'Global Warming Potential' considers both the instantaneous radiative forcing due to an incremental concentration of GHG increase in the atmosphere and the lifetime of these gases in the atmosphere.

This report relates to the GWP for a period of 100 years recommended by the IPCC in the IPCC Fourth Assessment Report (IPCC, 2007) for use in GHG emissions inventory under UNFCCC (Table 1-2).

Table 1-2: GWP for a period of 100 years and direct GHG atmospheric lifetimes[21]

GHG	Chemical formula	Lifetime, according to AR5	SAR	TAR	AR4	AR5	AR6
Carbon dioxide	CO_2	50-200	1	1	1	1	1
Methane	CH_4	12.4	21	23	25	28	27.9
Nitrous oxide	N_2O	121	310	296	298	265	273
Nitrogen trifluoride	NF_3	500	NA	10800	17200	16100	17400
Sulphur hexafluoride	SF_6	3200	23900	22200	22800	23500	25200

[18] <https://library.wmo.int/index.php?lvl=notice_display&id=21795#.YIKYFaFDOUk>
[19] <https://www.wmo.int/pages/mediacentre/press_releases/pr_1002_en.html>, <https://library.wmo.int/index.php?lvl=notice_display&id=21795#.YIKYFaFDOUk>
[20] <https://library.wmo.int/index.php?lvl=notice_display&id=21795#.YIKYFaFDOUk>
[21] <http://www.epa.gov/climatechange/Downloads/ghgemissions/US-GHG-Inventory-2014-Annex-6-Additional-Information.pdf>

GHG	Chemical formula	Lifetime, according to AR5	SAR	TAR	AR4	AR5	AR6
Hydrofluorocarbons (HFC)							
HFC-23	CHF_3	222	11700	12000	14800	12140	14600
HFC-32	CH_2F_3	5.2	650	550	675	677	771
HFC-125	C_2HF_5	28.2	2800	3400	3500	3170	3740
HFC-134a	$C_2H_2F_2$ (CH_2FCF_3)	13.4	1300	1300	1430	1300	1530
HFC-143a	$C_2H_3F_3$ (CF_3CH_3)	47.1	3800	4300	4470	4800	5810
HFC-152a	C_2H4F_2 (CH_3CHF_2)	1.5	140	120	124	138	164
HFC-227ea	CF_3CHFCF_3	38.9	2900	3500	3220	3350	3600
HFC-236fa	$CF_3CH_2CF_3$	242	6300	9400	9810	8060	8690
HFC-245fa	$CHF_2CH_2CF_3$	7.7	NA	950	1030	858	962
HFC-365mfc	$CH_3CF_2CH_2CF_3$	8.7	NA	890	794	804	914
HFC-43-10mee	$CF_3CHFCHFCF_2CF_3$	16.1	1300	1500	1640	1650	1600
Perfluorocarbons (PFC)							
Perfluoromethane	CF_4	50000	6500	5700	7390	6630	7380
Perfluoroethane	C_2F_6	10000	9200	11900	12200	11100	12400
Perfluoropropane	C_3F_8	2600	7000	8600	8830	8900	9290
Perfluorobutane	C_4F_{10}	2600	7000	8600	8860	9200	1000
Perfluoropenthane	C_5F_{12}	4100	7500	8900	9160	8550	9220
Perfluorohexane	C_6F_{14}	3100	7400	9000	9300	7910	8620

Source: SAR – Second Assessment Report (IPCC, 1996), TAR – Third Assessment Report (IPCC, 2001), AR4 – Fourth Assessment Report (IPCC, 2007), AR5 – Fifth Assessment Report (IPCC, 2013), and AR6 – Sixth Assessment Report (IPCC, 2021)

1.1.5. Convention, Kyoto Protocol, Paris Agreement and Party's Commitments

The United Nations Framework Convention on Climate Change (UNFCCC) was adopted on May 9, 1992, at the UN Conference on Environment and Sustainable Development in Rio de Janeiro, being regarded as a response of the international community to the global warming phenomenon caused by air pollution and the increased concentrations of greenhouse gases

The ultimate objective of the United Nations Framework Convention on Climate Change (UNFCCC) is aimed '*to achieve stabilization of greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system*'. To-date, 196 countries are Parties to the Convention. The Republic of Moldova signed the UNFCCC on June 12, 1992, and it was ratified by the Parliament on March 16, 1995.

Article 4, paragraph 1(a) and Article 12, paragraph 1(a) of the UNFCCC stipulate that each Party has to make available to the Conference of the Parties (COP) '*a national inventory of anthropogenic emissions by sources and removals by sinks, of all greenhouse gases uncontrolled by the Montreal Protocol, to the extent its capacities permit, using comparable methodologies to be agreed upon by the Conference of the Parties; also, a general description of steps taken or envisaged by the Party to implement the Convention; and any other information that the Party considers relevant to the achievement of the objective of the Convention and suitable for inclusion in its Communication, including, if feasible, relevant data for calculations of global anthropogenic emission trends*'.

The main mechanism for making this information available is national communications. COP 2 (Geneva, 1996) adopted the Guidelines on national communications for non-Annex I Parties (Decision 10/CP 2). In accordance with the respective Guidelines, from 1998 to 2000, under the UNDP-GEF Project '*Enabling Activities for the preparation of the First National Communication to the UNFCCC*', the Republic of Moldova developed its First National Communication (NC1) to the UNFCCC, submitted to the COP 6 (the Hague, 2000).

The COP 8 (New Delhi, 2002) adopted a new Guideline on national communications for non-Annex I Parties (Decision 17/CP 8). In conformity with these Guidelines, between 2005-2009, the Republic of Moldova developed its Second National Communication (NC2); between 2010-2014 – the Third National Communication (NC3); between 2014-2018 – the Fourth National Communication (NC4); and between 2019-2022 – the Republic of Moldova is developing its Fifth National Communication (NC5) to the UNFCCC.

With reference to UNFCCC implementation instruments, it should be noted that the COP 3 (Kyoto, 1997) adopted the Kyoto Protocol[22], which represents an instrument setting binding targets for the

[22] The Kyoto Protocol came into force on February 16, 2005, 90 days after its ratification by the Russian Federation in November 2004, thus covering at least 55 Parties to the Convention, including Annex I countries, which contribute to at least 55% of total carbon dioxide emissions recorded in 1990.

Parties under the Convention, by committing industrialised countries and economies in transition (in total, 37 industrialised countries and the European Union) included in Annex I to Convention, to reduce total emissions of direct GHG by at least 5% compared to 1990 levels over the five-year period: January 1, 2008 - December 31, 2012 (the first period of the Protocol commitment). The Republic of Moldova ratified the Kyoto Protocol on February 13, 2003. As a non-Annex I Party, the Republic of Moldova had no commitments to reduce GHG emissions under this Protocol.

According to the Bali Action Plan, adopted at the 13th Conference of Parties to the UNFCCC (2007), developing countries agreed for the first time to develop and implement National Appropriate Mitigation Actions in the context of sustainable development, supported by technology transfer, adequate financing and capacity-building actions.

The COP 15 held in Copenhagen in December 2009 approved and proposed for implementation a policy statement adopted in support of limiting global warming to no more than 2°C compared to pre-industrial level, in the context of equity and sustainable development. This statement is known as the *Copenhagen Accord* and it reaffirms development issues in the context of climate change, including through the implementation of Low Emission Development Strategies (LEDS).

The Republic of Moldova associated itself to the Copenhagen Accord on January 2010 and submitted an emissions reduction target that is specified in Annex II of this Agreement '*National Appropriate Mitigation Actions in Developing Countries*'. The target of mitigation actions for the Republic of Moldova under this Agreement is '*to reduce, to not less than 25% compared to the base year (1990), the total national level of greenhouse gas emissions by 2020, by implementing economic mechanisms focused on global climate change mitigation, in accordance with the principles and provisions of the Convention*'. This target is presented without indicating specific national appropriate mitigation actions, identified and quantified, and without further clarification of the necessary support to achieve it. Simultaneously, it is recognised that achieving this target will require significant financial, technological and capacity-building support, which can be provided through the UNFCCC mechanisms.

In the same context, between 2010 and 2012, the Low Emissions Development Strategy of the Republic of Moldova until 2020 was prepared – a strategic document that was to allow the country to adjust its development path towards a low-carbon economy and to achieve a green sustainable development, based on the socio-economic and development priorities of the country. Also, LEDS was supposed to support overall objectives, provide strategic national context, for the mitigation efforts, for which countries would receive international support. LEDS was developed in accordance with the Republic of Moldova's Governance Programme – 'European Integration: Freedom, Democracy, Welfare' (2011-2014) – and the provisions of chapter 'Climate Change' of the EU Association Agreement.

The Strategy contained a set of measures that would reduce greenhouse gas emissions, quantifying the corresponding reduction of GHG emissions for each measure, and the financial requirements for their implementation. The measures proposed in the prioritised list of NAMAs, an Annex to LEDS, included national appropriate mitigation actions, as provided for non-Annex I Parties to the UNFCCC. LEDS also provided information on implementation procedures and timeframes, as well as provisions on monitoring, measurement, reporting and assessment of the results. The Strategy was drafted by the Ministry of Environment of the Republic of Moldova, the process being guided by the Inter-Ministerial Working Group on Climate Change with support from the UNDP country office. This process involved extensive consultations with all parties, represented by ministries, research institutions, donor organizations, NGOs and civil society. It was anticipated that LEDS would be approved by the Government by the end of 2013, which did not happen until the end of 2016[23].

The COP 16, held in Cancun in December 2010, adopted the Cancun Agreements, which encourage developing countries to prepare Low Emission Development Strategies for sustainable development and to undertake National Appropriate Mitigation Actions. The Cancun Agreements highlight the fact that '*stopping climate change requires a paradigm shift towards building a low-carbon emissions society, which offers substantial opportunities and ensures continued economic growth and sustainable development*'.

[23] <http://lex.justice.md/index.php?action=view&view=doc&lang=1&id=369528>

The COP 16 (Cancun) established the periodicity of national communications for non-Annex I countries (Decision 1/CP.16). In line with this, the non-Annex I Parties should prepare and submit *National Communications* (NCs) to the UNFCCC Secretariat every four years and *Biennial Update Reports* (BUR) every two years, respectively. The inventory section of the *Biennial Update Reports* should consist of a *National Inventory Report* (NIR) as a summary or a technical annex; this section is expected to present in a detailed and transparent manner the procedures of national inventory for anthropogenic GHG emissions by sources or removals of carbon dioxide through sequestration, including information on emission trends, key categories, activity data, emission factors, estimation methodologies, quality assurance and quality control, uncertainties, recalculations and planned improvements, for each source or sink category included in the national inventory.

The COP 17 (Durban, 2011) adopted the *UNFCCC biennial update reporting guidelines for Parties not included in Annex I to the Convention* (Decision 2/CP.17 and Annex 3 to this Decision). According to this decision, developing countries, non-Annex I Parties, consistent with their capabilities and the level of international support provided for reporting, were expected to submit their first BUR to the Secretariat of the UNFCCC by December 2014. The Report should be submitted to the Secretariat every two years as a stand-alone report or as a summary of the National Communication, should their reporting year coincide.

The Republic of Moldova initiated the process of preparing the First Biennial Update Report in July 2014 and managed to present it to the Secretariat of the UNFCCC on April 5, 2016. The First Biennial Update Report of the RM under the UNFCCC (2016) was presented to the Secretariat of the UNFCCC together with two technical annexes – the National Inventory Report: 1990-2013, Greenhouse Gas Sources and Sinks in the Republic of Moldova (2015) and the Report on the National GHG Inventory System in the Republic of Moldova (2015).

Regarding the non-Annex I Parties, the COP 17 in Durban approved (Decision 2/CP.17 and Annex IV) the Modalities and Guidelines for International Consultation and Analysis (ICA). This process consists of two steps: (i) the technical analysis of BURs and (ii) a facilitative sharing of views among Parties on the content of BURs and the results of technical analysis. The process aims to enhance the transparency and accountability of information reported in BURs by non-Annex I Parties. The technical analysis is conducted by a team of technical experts (TTE) and is initiated within six months of submission of the BUR to the Secretariat).

As for the First Biennial Update Report of the RM to the UNFCCC, its technical analysis by the team of technical experts took place between 19-23 September 2016, with the summary report being published by the Secretariat on the UNFCCC web page on February 20, 2017[24]. The Facilitative Sharing of Views (FSV) among Parties on the BUR1 content and the results of technical analysis was carried out during the 3rd FSV workshop, organised by the UNFCCC Secretariat on May 15, 2017, in Bonn, Germany[25].

The COP 18 (Doha, 2012) adopted the *Doha Amendment to the Kyoto Protocol* which establishes a second commitment period (January 1, 2013 - December 31, 2020) for the Parties included in Annex I to the Kyoto Protocol; adds a revised list of greenhouse gases to be reported by Annex I countries in the second commitment period; and a series of amendments to several articles of the Kyoto Protocol which specifically refer to certain issues related to the first commitment period and which were to be revised in order to remain valid during the second commitment period. By December 21, 2012, the UN General Secretary, acting as depositary, presented the Doha Amendment to the Kyoto Protocol to all Parties of the UNFCCC, in accordance with provisions of Articles 20 and 21 of the Protocol. Under the Doha Amendment, within the second commitment period, the developed countries should reduce their greenhouse gas emissions by at least 18% compared to 1990 levels. By October 28, 2020[26], 147 countries had ratified the Doha Amendment to the KP, most of which are non-Annex I Parties to the UNFCCC and the KP. The Doha Amendment came into effect on December 31, 2020.

At COP 19 (Warsaw, 2013), the Parties agreed to communicate their intended nationally determined contributions (INDC) (Decision 1/CP.19) to include them in the new Climate Agreement to be considered and

[24] <http://unfccc.int/files/national_reports/non-annex_i_parties/biennial_update_reports/submitted_burs/application/pdf/mda.pdf>

[25] The conclusions of the 3rd FSV seminar regarding the BUR1 of the RM under the UNFCCC and the results of the technical analysis are available on the web page: <http://unfccc.int/files/national_reports/non-annex_i_parties/ica/facilitative_sharing_of_views/application/pdf/20170529_mda_v04.pdf>; RM's presentation at the 3rd FSV seminar is available on: <http://unfccc.int/files/national_reports/non-annex_i_parties/ica/facilitative_sharing_of_views/application/pdf/moldova_fsv_workshop_presentation_15.05.2017.pdf>, and the video recording of the presentation and the interventions of the Parties are available on: https://www.youtube.com/playlist?list=PL-m2oy1bnLzpmdRpG2pTBzUeOH3qrXlZt>

[26] <https://unfccc.int/process/the-kyoto-protocol/the-doha-amendment>

adopted by the COP 21 in 2015, in Paris. It is expected that the new climate agreement will establish a new commitment period (January 1st, 2021 - December 31st, 2030) for the reduction of GHG emissions. Also, the COP 19 in Warsaw *adopted General guidelines for domestic measurement, reporting and verification of domestically supported nationally appropriate mitigation actions by developing country Parties* (Decision 21/CP.19). This document provides a solid foundation for the new Paris Climate Agreement 2015.

At COP 20 (Lima, 2014), the Parties agreed over the *Lima Call for Climate Action* and were repeatedly invited to communicate their intended nationally determined contributions to the UNFCCC Secretariat (Decision 1/CP.20) to achieve the objective of the Convention as set out in Article 2.

The Parties agreed that in order to facilitate clarity, transparency and understanding, the INDC may include, as appropriate, inter alia: quantifiable information on the reference point; time frames and/or periods for implementation; scope and coverage; planning processes in the context of approving intended nationally determined contributions; assumptions and methodological approaches including those for estimating and accounting for anthropogenic greenhouse gas emissions and, as appropriate, removals; and information on the country's considerations on how fair and ambitious its intended nationally determined contribution is, considering country specific circumstances; and how the Party considers that its intended nationally determined contribution will facilitate the achievement of the objective of the Convention as set out in Article 2.

In accordance with the *Lima Call for Climate Action*, countries were invited to communicate their intended nationally determined contributions by March 31, 2015, the deadline for the presentation being September 30, 2015. The UNFCCC Secretariat was requested to prepare a synthesis report on the aggregate effect of the INDCs November 1, 2015.

The Republic of Moldova was fully committed to the UNFCCC negotiation process towards adopting the Paris Agreement at COP 21 – a document with legal force under the Convention, applicable to all Parties, in line with keeping global warming below 2°C by 2100 compared to the preindustrial era. The Paris Agreement was signed by the Prime Minister of the Republic of Moldova in New York on September 21, 2016, and was subsequently ratified by the Parliament through Law No. 78 of 04.05.2017 for the ratification of the Paris Agreement (Official Monitor No. 162-170 of 26.05.2017)[27].

On September 25, 2015, the Republic of Moldova communicated its Intended Nationally Determined Contribution (INDC)[28] and the accompanying information to facilitate clarity, transparency, and understanding, with reference to decisions 1/CP.19 and 1/CP.20. According to its NDC, the Republic of Moldova intends to achieve, by 2030, an economy-wide unconditional target of reducing its greenhouse gas emissions by 64-67% below its 1990 level and to make best efforts to reduce its emissions by 67%. The reduction commitment expressed above could be increased conditionally up to 78% below 1990 level in accordance with this global agreement which addresses important topics including low-cost financial resources, technology transfer, and technical cooperation, accessible to all at a scale that is appropriate to the challenge of global climate change. GHG emission reduction targets have been set in an emission budget covering the period from January 1, 2021, to December 31, 2030. The GHG emission reduction targets established in the intended nationally determined contribution of the Republic of Moldova were subsequently officially approved at national level by Government Decision No. 1470 of 30.12.2016 regarding the approval of the Low Emissions Development Strategy of the Republic of Moldova by 2030 and the Action Plan for its implementation (Official Monitor No. 85-91 of 24.03.2017)[29].

On March 4, 2020, the Republic of Moldova presented the updated version of its NDC to the UNFCCC Secretariat[30]. According to it, the Republic of Moldova intends to step up with much more ambitious GHG emission reduction targets by 2030. The unconditional target is thereby to increase from 64-67% to 70% compared to the base year (1990), and the conditional target is to increase from 78% to circa 88% compared to the base year (1990). The new GHG emission reduction targets are to be introduced into the Low Emissions Development Programme until 2030 and the Action Plan for its implementation; in this regard, the updating process was launched in 2020.

[27] <http://lex.justice.md/index.php?action=view&view=doc&lang=1&id=370323>
[28] <http://www4.unfccc.int/submissions/INDC/Published%20Documents/Republic%20of%20Moldova/1/INDC_Republic_of_Moldova_25.09.2015.pdf>
[29] <https://www.legis.md/cautare/getResults?doc_id=114408&lang=ro>
[30] <https://www4.unfccc.int/sites/NDCStaging/Pages/All.aspx>

The Second Biennial Update Report (BUR2) of the Republic of Moldova to the UNFCCC was presented to the UNFCCC Secretariat on December 27, 2018, and later, the two technical annexes: the National Inventory Report: 1990-2016, Sources of Greenhouse Gas Emissions and Sinks in the Republic of Moldova on January 24, 2019; and the Report on the National GHG Inventory System in the Republic of Moldova – 2018, respectively, on February 26, 2019.

The technical assessment by the TTE took place between May 27-31, 2019, the summary report being published on the web page of the Secretariat of the UNFCCC on October 28, 2019[31]. FSV among Parties on the content of the BUR2 and results of technical analysis was carried out during the 9th FSV workshop, held online by the UNFCCC Secretariat between November 24-27, 2020[32].

The Third Biennial Update Report (BUR3) of the Republic of Moldova to the UNFCCC was presented to the UNFCCC Secretariat on December 21, 2021, together with two technical annexes: the National Inventory Report: 1990-2019, Sources of Greenhouse Gas Emissions and Sinks in the Republic of Moldova and the Report on the National GHG Inventory System in the Republic of Moldova in 2021[33]. The technical assessment by the TTE took place between June 20-24, 2022.

1.1.6. The Republic of Moldova's Relative Contribution to Global Warming

The Republic of Moldova's historic contribution to global warming is low. In 2020, the country contributed with circa 13.66 Mt CO_2 equivalent, which represents less than 0.03% of the total global GHG emissions.

Total and net emissions per capita, respectively, twice as low as the global average (4.4 t CO_2 equivalent per capita compared to 6.4 t CO_2 equivalent per capita). Also, the RM's share in global GHG emissions recorded since 1990 is low – under 0.05% (without LULUCF).

For example, between 1990 and 2019, the total national GHG emissions (without LULUCF) decreased by circa 69.6%, which is significantly more than in most industrialised countries and economies in transition included in Annex I to Convention (Figure 1-1).

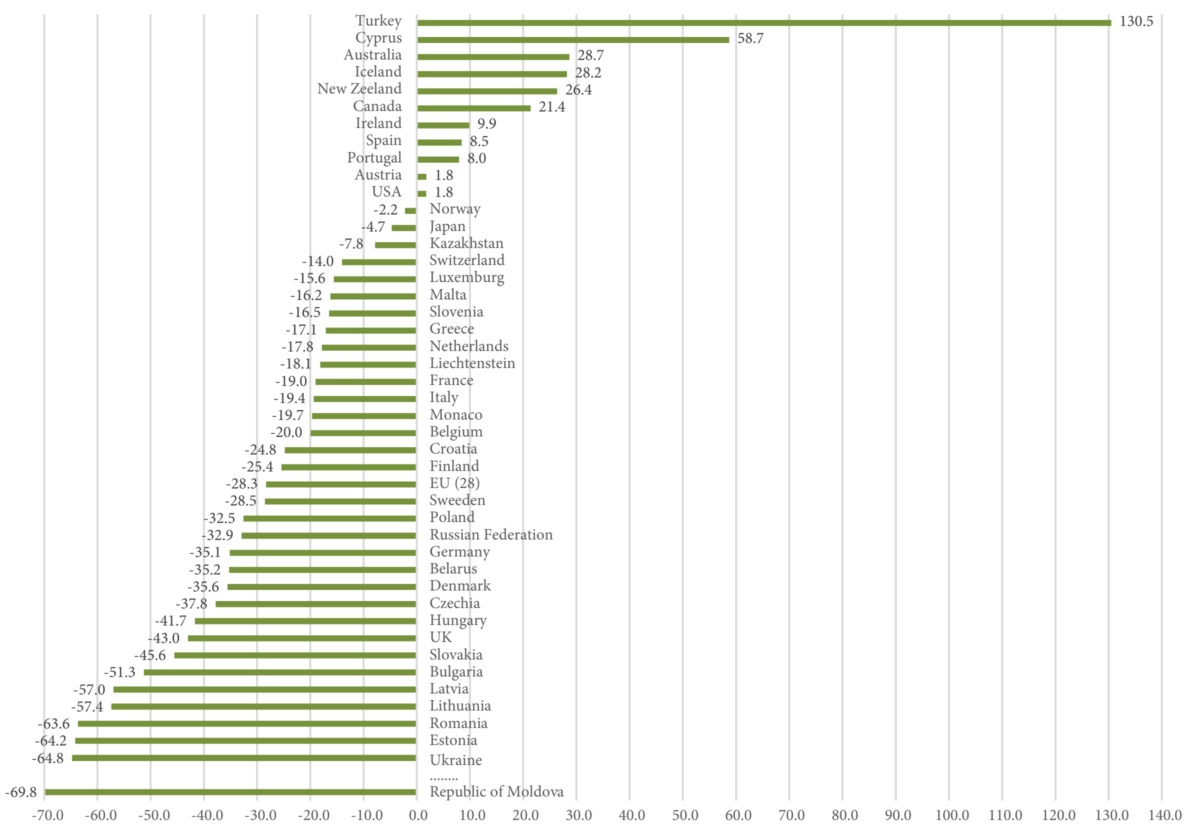


Figure 1-1: Total GHG emissions in the Republic of Moldova (without LULUCF) and Annex I Parties to the Convention in 2019 (% compared to 1990).

[31] <https://unfccc.int/sites/default/files/resource/tasr2_2019_MDA.pdf>, <https://unfccc.int/ICA-cycle2>
[32] Conclusions of the 9th FSV seminar regarding the BUR2 of the RM under the UNFCCC and the results of the technical analysis are available on the web page: <https://unfccc.int/ICA-cycle2>, including the RM's presentation at the 9th FSV seminar and the video recording of the presentation and the interventions of the Parties.
[33] <https://unfccc.int/BURs>

1.2. Institutional and Legal Arrangements for Inventory Preparation

1.2.1. National Inventory System

The Ministry of Environment (MoE) of the Republic of Moldova is the state authority responsible for development and promotion of policies and strategies addressing environment protection, natural resources and climate change.

On behalf of the Government of the Republic of Moldova, the Ministry of Environment oversees the implementation of international environment treaties to which the Republic of Moldova is a Part (including Rio Conventions). The representative of the ME is also the UNFCCC National Focal Point.

In accordance with Government Decision no. 549 of 13.06.2018 on the establishment, organization and functioning of the Environment Agency[34], the latter has been assigned the following competencies *in the field of atmospheric air protection and climate change*: implementation of the provisions of policy documents and international environmental treaties to which the RM is party in the field of atmospheric air quality and ozone layer protection, *in the field of reducing greenhouse gas emissions and adaptation to climate change*, development and submission to the MoE of information on their achievement; participation in the *National Commission on Climate Change*; ensuring the implementation of the *system for monitoring, reporting and verifying greenhouse gas emissions; carrying out the process of collecting, aggregating, validating and processing the data and information necessary for the development of inventories and reports on emissions of air pollutants and greenhouse gases*; providing the MoE with technical support for the development of *national communications and biennial update reports*, according to the provisions of the UNFCCC.

At the same time, in accordance with Government Decision no. 1277 of 26.12.2018 on the establishment and operation of the National Monitoring and Reporting System (NMRS) on greenhouse gas emissions and other information relevant to climate change, the Environment Agency has been designated as the *competent authority* responsible for ensuring the operation of the NMRS on greenhouse gas emissions and other information relevant to climate change, provided that the operation of the NMRS is carried out at the expense and within the resources approved in the state budget of the institutions party to the system, as well as other sources provided by law, including from external financing *(activities carried out on the basis of technical assistance and capacity building projects).*

In the above context, it is important to mention that, in accordance with Government Decision no. 1249 of 19.12.2018 on the organization and operation of the Public Institution 'Environmental Projects Implementation Unit' (PI 'EPIU')[35], the latter has the mission to support the MoE and organizational units in its competency area, in the purpose of efficient implementation of financial and technical assistance projects, foreign and domestic, in the field of environmental protection and use of natural resources (protection of atmospheric air, ozone layer and *climate change*; waste and chemical management; prevention of environmental pollution; water resource management; biosecurity, biodiversity conservation and management of natural areas protected by the state), in accordance with the provisions of regulatory documents, on the implementation of the requirements of international conventions to which the Republic of Moldova is party and the alignment with international standards in the field of environmental protection, whereas the main tasks of the PI 'EPIU' are: efficient implementation of projects in its competency area in accordance with established objectives; supervision and quality control of provided services, submission of work and provision of goods within established deadlines; management of financial resources allocated to projects in its competency areas, in accordance with the assistance agreements and the approved budget; provision of support to the founder in the development of project proposals in its competency area; development and submission of progress reports on project implementation and project financing.

The management body of the PI 'EPIU' includes the Director of the institution (executive body) and, respectively, a Supervisory Committee – a high level collegial body which leads and supervises the activity of the institution. The committee consists of 5 members, appointed for a 4-year term. The nomi-

[34] <https://www.legis.md/cautare/getResults?doc_id=119162&lang=ro>
[35] <https://www.legis.md/cautare/getResults?doc_id=113696&lang=ro>.

nal composition of the Committee members is established by Order of the MoE, with mandatory inclusion of at least one representative each from the State Chancellery, Ministry of Finance, Ministry of Environment, and civil society in the competency areas of the PI 'EPIU'. The position of Chairperson of the Committee is exercised by the Ministry of Environment, who chairs the meetings of the Committee and exercises other established duties. In the absence of the Chairperson of the Committee, the meeting shall be chaired by one of the members, elected by the members attending the meeting.

The National Monitoring and Reporting System (NMRS) for reporting greenhouse gas emissions and other information relevant to climate change to the UNFCCC, approved by GD no. 1277 of 26.12.2018, includes, as integral parts, two subsystems:

1. The national inventory system, which provides the institutional, legal and procedural framework established for estimating anthropogenic emissions by sources and removal by sinks by all greenhouse gases compiled in the national GHG emission inventory, and for reporting and archiving information regarding the inventory, in accordance with decisions taken under the UNFCCC and the Paris Agreement.
2. The national system for policies, measures, and projections, which provides the institutional, legal, and procedural framework for assessing progress in implementing climate change mitigation policies, for making projections of anthropogenic emissions by sources or removal of greenhouse gas emissions by sinks.

The implementation of the NMRS ensures the appropriate collection, processing of data and information which are necessary for: (1) the development and reporting of the national inventory and projections of anthropogenic emissions by sources or removal by sinks of greenhouse gases, and (2) the assessment and reporting of: progress in implementing mitigation policies; vulnerability to climate change, impact of climate change, and progress in implementing adaptation actions; and aggregate financial and technological support provided by industrially developed countries, listed in Annex I to the UNFCCC, for the implementation of climate change mitigation and adaptation actions, technical assistance projects, and capacity building in the field of climate change.

In the context of GD No. 1277 of 26.12.2018, the NMRS aims to ensure transparent, accurate, consistent and comprehensive monitoring and reporting of greenhouse gases to the UNFCCC Secretariat, through planned reporting tools, including actions taken to adapt to the consequences of climate change, respectively, to ensure evaluation, reporting and verification of information on national progress in meeting the commitments under the UNFCCC, the Paris Agreement and the decisions taken in accordance with them.

Regarding the National Inventory System (NIS), it is designed and managed to ensure adherence to transparency, consistency, comparability, completeness principles in the preparation of the national inventory of greenhouse gas emissions, in accordance with the provisions of the 2006 IPCC Guidelines on development of national greenhouse gas inventories.

The Environment Agency, as competent authority, in direct collaboration with responsible authorities and institutions that are part of the NMRS and with the support of the Central Authority for Natural Resources and Environment (MoE), manages the organization and operation of the NIS, by periodically improving the institutional, legal, and procedural framework, in accordance with the national and international legal framework.

Within the NIS, the competent authority shall develop the national greenhouse gas emissions inventory every two years. The data of the national inventory are presented according to the format set out in Table 1 of Annex 1 to GD no. 1277 of 26.12.2018. In the case of direct greenhouse gas emissions, the national inventory is compiled in accordance with the 2006 IPCC Guidelines, through the reporting software recommended by the UNFCCC, while in the case of indirect greenhouse gas emissions, the national inventory is compiled in accordance with the updated editions of the EEA/EMEP Air Pollutant Emission Inventory Guidebook, the technical guideline for inventory of national emissions, published and regularly updated by the European Environment Agency under the European Monitoring and Assessment Program.

Based on the National Inventory of Greenhouse Gas Emissions, the competent authority shall be responsible for compiling the National Inventory Report (NIR) every two years, in Romanian and in English, using the structure set out in the relevant decisions of the Conferences of Parties signatories to the UNFCCC, namely: (1) 'Introduction'; (2) 'Greenhouse Gas Emission Trends'; (3) description of GHG emissions in the 'Energy Sector'; (4) description of GHG emissions in the 'Industrial Processes and Product Use Sector'; (5) description of GHG emissions in the 'Agriculture Sector'; (6) description of GHG emissions in the 'LULUCF Sector'; (7) description of GHG emissions in the 'Waste Sector'; (8) 'Recalculations and Planned Improvements'; (9) 'References'; and (10) 'Annexes'.

The competent authority publishes the National Inventory Report (NIR) on its official website (<http://am.gov.md/>) every two years, as well as the national inventory of greenhouse gas emissions in table format. The summation tables show the trends of greenhouse gas emissions by gas and by sector.

The competent authority ensures the quality of national inventories by covering the planning, preparation, and management stages, which include collection of activity data, appropriate selection of estimation methods and emission factors, estimation of anthropogenic greenhouse gas emissions, implementation of uncertainty analysis, activities for quality assurance and quality control, as well as data verification procedures included in the national inventory.

At the planning stage for the national inventory, the following activities are to be performed:

1) allocation of financial resources necessary for the development of the national inventory, establishing the responsibilities of the personnel involved in the preparation of the national inventory, including for the collection of activity data, selection of emission factors and estimation methods, implementation of quality assurance and quality control measures, key category analysis, uncertainty analysis, envisioning recalculations and planned improvements, for each source category or sink included in the national inventory;
2) development, update and periodical approval of the QA/QC plan which describes specific QC procedures to be implemented during the inventory development process, and the description of the overall QA procedures to be conducted on the entire inventory and establish quality objectives;
3) publication on the official website of the competent authority the postal and electronic addresses of the national competent authority responsible for the inventory;
4) establishment of processes for the official consideration and approval of the inventory, prior to its submission to the UNFCCC Secretariat.

At the preparation stage of the national inventory, the following activities are to be performed:

1) identification of key categories by following the methods described in the 2006 IPCC Guidelines;
2) collection of activity data and emission factors and processing information so as to ensure the application of selected methods for estimating the level of greenhouse gas emissions;
3) estimation of anthropogenic emissions from sources and removals by sinks of all greenhouse gases in accordance with the default calculation methods (Tier 1) set out in the 2006 IPCC Guidelines, applying higher ranking calculation methods (Tier 2 or 3) to key categories;
4) quantitative estimation of the uncertainty of the inventory as a whole and for each category separately according to the 2006 IPCC Guidelines;
5) recalculation, if necessary, of estimates of the level of anthropogenic emissions from sources and removals by sinks of greenhouse gases in accordance with the 2006 IPCC Guidelines;
6) compilation of the national inventory in accordance with the decisions adopted under the UNFCCC and the Paris Agreement;
7) implementation of general QC procedures (tier 1) in accordance with the approved QA/QC plan following the 2006 IPCC Guidelines;
8) application of specific QC procedures (tier 2) in accordance with the approved QA/QC plan, both for key categories and categories in which methodological revisions occurred, as well as for activity data and emission factors in accordance with the 2006 IPCC Guidelines;

9) evaluation of the inventory by third parties, natural and/or legal persons who were not involved in the preparation of the inventory;

10) an extensive review of the inventory for key categories, as well as for categories in which the methodological approaches and/or activity data and/or emission factors were revised;

11) re-evaluation of the inventory planning process in order to meet the established quality objectives established in the QA/QC plan, taking into account recommendations from the actions laid down above in pt. 9) and 10), and of the results of periodic internal evaluations of the inventory preparation process.

At the management stage of the national inventory, the following activities are to be performed:

1) periodically archive and store the inventory information for each inventory year, including:
   a) all disaggregated emission factors, activity data, and documentation about how these factors and data have been generated and aggregated for the preparation of the inventory;
   b) internal documentation on QA/QC procedures;
   c) documentation on external and internal reviews, identification of annual key categories and planned inventory improvements;
2) provide the teams of technical of experts (TTE) responsible for the assessment process and international analysis with access to the information utilised to develop the national inventory, as well as to information on the NSMR;
3) respond to clarification requests as soon as possible during the evaluation process and international analysis, from the team of technical experts regarding the information in the national inventory, in accordance with the UNFCCC provisions and decisions.

The competent authority shall communicate to the central authority for natural resources and environment the following data by 15 December of the year in which the report is made (year X):

1) the level of anthropogenic emissions of direct greenhouse gases – carbon dioxide [CO_2], methane [CH_4], nitrous oxide [N_2O], hydrofluorocarbons [HFCs], perfluorocarbons [PFCs], sulphur hexafluoride [SF_6], nitrogen trifluoride [NF_3] – recorded 2 years prior to the year in which the reporting is done (year X-2);
2) the level of anthropogenic emissions of indirect greenhouse gases – carbon monoxide [CO], nitrogen oxides [NO_x], non-methane volatile organic compounds [NMVOC] and sulphur dioxide [SO_2] – recorded 2 years prior to the year in which the reporting is done (year X-2);
3) accounting of emissions and removals from land use, land-use change and forestry sector, recorded two years prior to the year in which the reporting is done (year X-2);
4) any recalculations and/or modifications of information provided for in pt. 1)-3), covering the period between the base year (1990) and 3 years prior to the year in which the reporting is done (X-3);
5) the elements comprised in the NIR, information on QA/QC plan, a general assessment of uncertainty and completeness of the inventory, as well as information on any other recalculations;
6) measures taken to improve GHG emissions estimates, mainly recalculated estimates.

The central authority for natural resources and environment shall submit to the UNFCCC Secretariat, based on data provided by the competent authority, prior to 31 December of the year in which the reporting is done (year X), the complete greenhouse gases national inventory for the period starting with base year (1990) and ending with the year X-2.

The competent authority shall make available to the public the information on greenhouse gas emissions, in accordance with the provisions of GD No. 1277 of 26.12.2018 on the establishment and operation of the National Monitoring and Reporting System for greenhouse gas emissions and other information relevant to climate change.

1.2.2. Institutional Arrangements

The list of competent authorities and institutions which are part of the NMRS for greenhouse gas emissions, as well as other information relevant to climate changes in accordance with Annex No. 2 to GD No. 1277 of 26.12.2018, comprises:

1. Specialized central public authorities:
   1) Ministry of Environment;
   2) Ministry of Agriculture and Food industry;
   3) Ministry of Economy;
   4) Ministry of Infrastructure and Regional Development;
   5) Ministry of Finance;
   6) Ministry of Health,
   7) Ministry of Defence;
   8) Ministry of Foreign Affairs and European Integration;
   9) Ministry of Education and Research.
2. Public authorities subordinated to ministries:
   1) Environment Agency;
   2) National Agency for Regulation of Nuclear and Radiological Activities;
   Environmental Protection Inspectorate;
   3) Public Institution 'Environmental Projects Implementation Unit'.
   4) Civil Aviation Authority;
   5) Naval Agency of the Republic of Moldova;
   6) Customs Service;
   7) Agency for Energy Efficiency;
   8) National Agency for Public Health;
   9) Agency 'Moldsilva';
   10) State Hydrometeorological Service;
   11) Agency 'Waters of Moldova'.
3. Central public authorities:
   1) National Bureau of Statistics;
   2) Agency for Land Relations and Cadastre;
   3) Agency for Medicines and Medical Devices;
   4) Public Services Agency;
   5) National Agency for Food Safety;
4. State-owned enterprises and joint stock companies subordinated to specialized public authorities and companies with shares of state-owned capital:
   1) SOE 'State Road Administration';
   2) SOE 'Ungheni River Harbour';
   3) SOE 'Molovata Ferry';
   4) Forestry-Didactic Enterprise 'Forestry Research and Management Institute' (subordinated to Agency 'Moldsilva');
   5) SOE 'Moldova Railways';
   6) SOE 'Chisinau Glass Factory';
   7) SOE 'Moldelectrica', Chisinau;
   8) JSC 'RED-NORD', Balti;
   9) JSC 'TERMOELECTRICA', Chisinau;

10) JSC 'CHP-North', Balti;

11) JSC 'Moldovagaz'.

As competent authority responsible for the operation of the National Monitoring and Reporting System for greenhouse gas emissions and other information relevant to climate change, the Environment Agency, by Letter No. 3471 of 25.09.2019 to the Climate Change Office of the PI 'EPIU', requested the examination and identification of the possibility to provide the necessary support for carrying out responsibilities in the field of climate change by organizing the entire process of developing the Third Biennial Update Report of the Republic of Moldova to the UNFCCC, respectively, the Fifth National Communication of the Republic of Moldova to the UNFCCC, in accordance with the rules, procedures and decisions of the Conference of the Parties to the UNFCCC.

Towards this end, the Climate Change Office of the PI 'EPIU' has been given the authority:

- to request and receive, directly or through the Environment Agency, information from central public authorities, local public authorities, organizations and institutions, economic operators working in fields holding primary information needed to complete these two national reports;
- to collect, process and validate the data and information necessary for the preparation of national inventories and reports on greenhouse gas emissions;
- to train specialists from the Environment Agency in processes for working with collected data and information in order to develop their capacities in targeted fields.

It should be noted that the Climate Change Office, being within the MoE (February 2004-December 2018), and more recently also under the PI 'EPIU' (January 2019-July 2020), held the responsibility for activities associated with the preparation of NCs, BURs, NIRs and national GHG emission inventories.

Figure 1-2 schematically defines the institutional arrangements for the NMRS of the Republic of Moldova. Thus, within the PI 'EPIU', the inventory team is responsible for assessing emissions by source category and removals by sink category, analysis of key emission sources, activities for verification and control of the inventory quality, uncertainty assessment, documentation and archiving of information associated with the process of preparing the national inventory of GHG emissions, the development of NCs, BURs and NIRs.

The functional responsibilities of the participants in the process are briefly described as follows:

- The Coordinator of the National GHG Inventory is responsible for the coordination of the inventory preparation process, supervising the estimation of emissions by individual source categories and removals by individual sink categories, key category analysis, uncertainty analysis interpretation, coordinating QA/QC activities coordination, archiving the data used in the inventory preparation process, synthesis of sectoral reports – which serve as basis for the NIR compilation, respectively Chapter 2 'GHG National Inventory' in the BURs and NCs;
- The national experts are responsible for the process of estimating emissions by individual source categories and removals by individual sink categories at sectoral level (Sector 1 'Energy', Sector 2 'Industrial Processes and Product Use', Sector 3 'Agriculture', Sector 4 'LULUCF' and Sector 5 'Waste'); national experts are responsible for the preparation of sectoral chapters in the National Inventory Report; likewise, they are responsible for the activity data (AD) collection, application of decision trees in terms of selecting suitable estimation methods and EFs, estimating emission uncertainties by individual source categories, as well as for taking correction measures as a response to QA/QC activities.

The activity data necessary for the compilation of the national inventory are available in the Statistical Yearbooks, Energy Balances, sectoral statistical publications, as well as in the online database managed by the National Bureau of Statistics (NBS) of the Republic of Moldova.

For the period until 1992, the information is available for the whole territory of the Republic of Moldova, and only for the right bank of the Dniester River, without Transnistria, since 1993 (further referred to as Administrative Territorial Units on the Left Bank of the Dniester). The statistical data for the left bank of the Dniester are available in the Statistical Yearbooks of the ATULBD and in other relevant sectoral statistical publications available on the web page of the Ministry of Economy of the ATULBD[36].

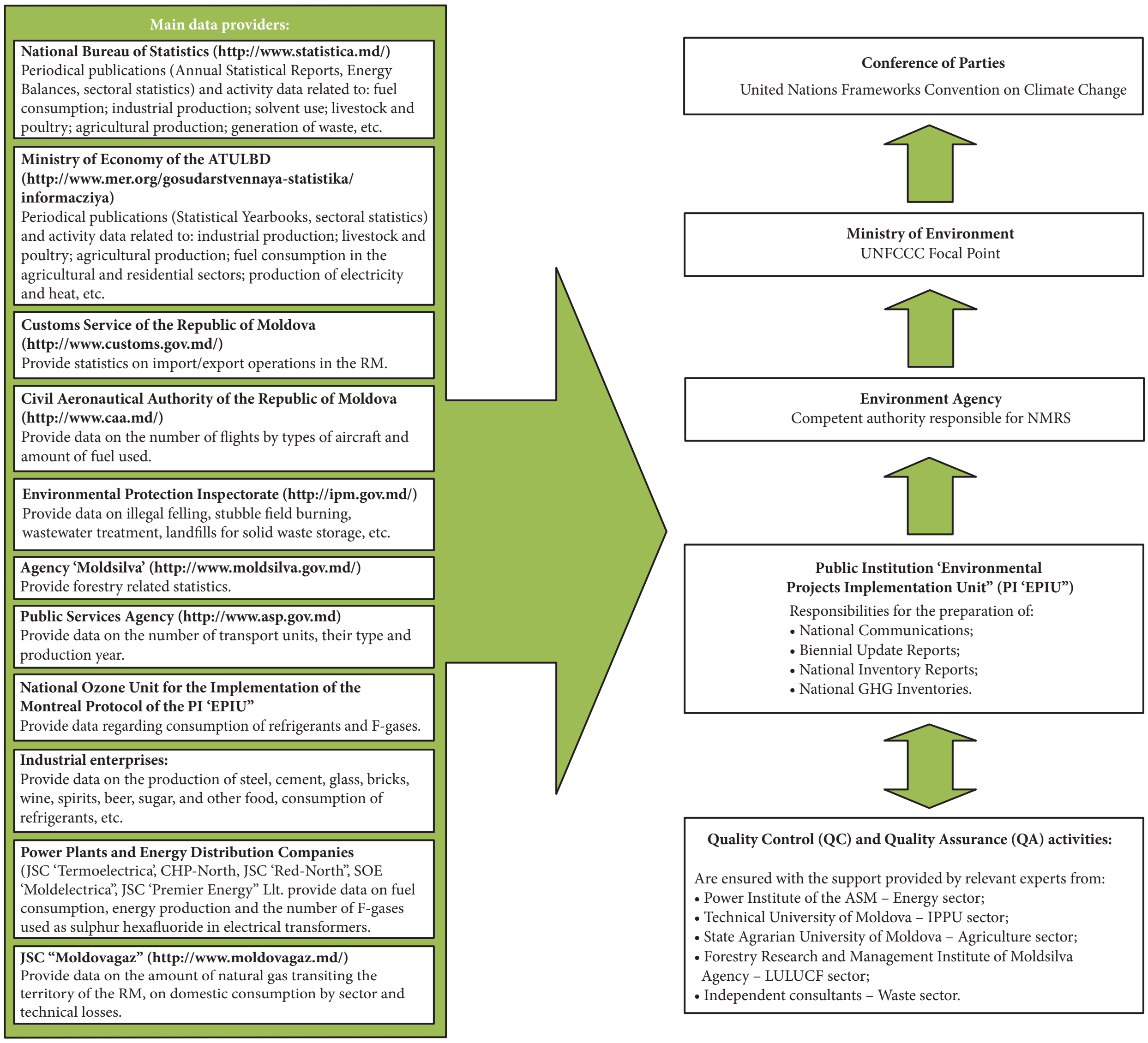


Figure 1-2: Institutional arrangements for the NMRS of the Republic of Moldova.

Additional statistical information (unpublished) can be obtained upon request from several partner institutions, with the status of data providers, in accordance with provisions of GD No. 1277 of 26.12.2018 on the establishment and operation of the National Monitoring and Reporting System of Greenhouse Gas Emissions and other information relevant to climate change, including:

- From the Ministry of Health and the Agency for Medicines and Medical Devices: data on the use of pressurized aerosols with HFCs as a propellant;
- from the Ministry of Defence: information on the amount of fuel used for military transportation;
- from the Customs Service: statistics on the import/export operations in the Republic of Moldova;
- from the Public Services Agency: information on the number of transport units registered, their type and production year;
- from the Naval Agency of the Republic of Moldova and SOE 'Ungheni Harbor' and SOE 'Molovata Ferry': information on the amount of fuel used to ensure the operation of naval transportation;
- from the Civil Aviation Authority of the Republic of Moldova: information on the amount of fuel used in air transportation (civil and international aviation) and the number of flights by type of aircraft;
- from the Agency for Land Relations and Cadastre: information on land-use by category of use;
- from Agency 'Moldsilva': information on forestry related statistics;

[36] Ministry of Economy of the ATULBD: <http://mer.gospmr.org/gosudarstvennaya-sluzhba-statistiki/informacziya.html>

- from the Environmental Protection Inspectorate: information on illegal felling and stubble field burning;
- from the National Ozone Unit of the PI 'EPIU': data on import and use of refrigerants in refrigeration and air conditioning equipment;
- from the SOE 'Moldova Railways': data on the amount of fuel consumed for the provision of railway transportation services, as well as on the rolling stock used at the enterprise;
- from the SOE 'State Road Administration': data on the amount of asphalt produced and used in the Republic of Moldova;
- from JSC 'Moldovagaz': information on the amount of natural gas transited on the territory of the Republic of Moldova, on the consumption of natural gas in the national economy at sectoral level, as well as on technical losses;
- from Power Plants (JSC 'TERMOELECTRICA' and CHP-North): information on the production of electricity and heat as well as on the amount of fuel consumption;
- from the enterprises specialized in the transportation and distribution of electricity (SOE 'Moldelectrica', JSC 'Premier Energy', JSC 'Red-North'): data on the amount of PFCs and SF_6 used in electrical transformers;
- from industrial enterprises (JSC 'Lafarge Cement Moldova', JSC 'Macon', ME 'Glass Factory No. 1', JSC 'Glass-Container Company', etc.): information on the amount of fuel used, industrial output and on the number of mineral resources used.

1.3. Process of Inventory Preparation

PI 'EPIU' applies a top-down approach in the process of preparing the national inventory, which consists of the National Inventory Report (NIR) and the standard evaluation and reporting tables as approved by Decision 24/CP.19 (see Annex 6). The process of preparing the national inventory is presented schematically in Figure 1-3.

The Coordinator of the National GHG Inventory is responsible for compiling the assessments and ensuring consistency and quality of the inventory by producing the NIR and Chapters 2

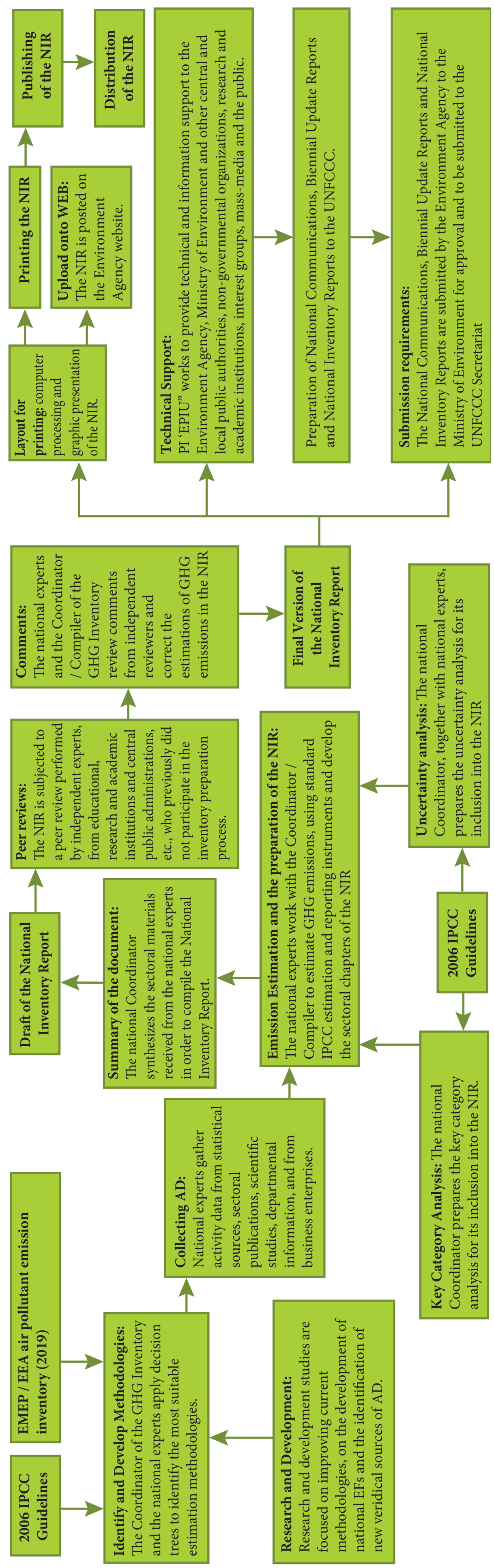


Figure 1-3: Inventory process in the Republic of Moldova.

‘National GHG Inventory’ from the Biennial Update Reports and the National Communications. Estimation of emissions by individual source categories and removals by individual sink categories is the responsibility of national experts who have more familiar with individual features of source/sink categories.

The national experts, under direct guidance of the Coordinator of the National GHG Inventory, decide, by applying decision trees, on employing the best estimation methodology, and collect AD necessary for the assessment. For most source and sink categories, methodologies used in the previous inventory cycle are applied. It is needed to collect new AD for a more recent period under review or for the entire period under review if historical AD were amended or recalculated. Should an estimation for a new source/sink category be made, or a higher Tier methodology be used, the Coordinator of the National GHG Inventory, together with the national experts, decide on which estimation methodology to use, collect most reasonable AD and EFs, calculate GHG emissions, assess uncertainties, ensure verification procedures, QA/QC procedures, including by technical review of the results obtained by relevant independent experts, who work for research and academic institutions, ministries and subordinated institutions, central administrative authorities and/or the private sector.

National experts produce explanatory texts for the research on estimation of emissions by individual source categories and removals by individual sink categories, as well as annexes to these, likewise, indicating the bibliography used.

The Coordinator/Compiler of the National GHG Inventory is responsible for collecting and reviewing these materials, to draft the NIR sectoral chapters (Chapter 3 ‘Energy’, Chapter 4 ‘Industrial Processes and Product Use’, Chapter 5 ‘Agriculture’, Chapter 6 ‘LULUCF’, Chapter 7 ‘Waste’). The Coordinator/Compiler is also responsible for drafting other chapters (Executive Summary, Chapter 1 ‘Introduction’, Chapter 2 ‘Trends in National GHG Emissions’, Chapter 8 ‘Recalculations’, ‘Bibliography’ and ‘Annexes’), as well as for checking the correctness of the key category analysis, compatible with the 2006 IPCC Guidelines.

The NIR is produced in compliance with the general structure of the National Inventory Reports, as established in Decision 24/CP.19. In addition to the NIR, the Common Reporting Format (CRF) Tables are filled-in (see Annex 6).

The Coordinator/Compiler of the National GHG Inventory has to monitor the process of producing the Sectoral and Summary CRF Tables, to ensure the consistency of results. The national experts perform uncertainty assessment, as well as verification and QA/QC activities, in close cooperation with the Coordinator/Compiler of the National GHG Inventory.

The first *QA/QC Plan* was produced in 2006 within the UNDP-GEF Regional Project ‘*Capacity Building for Improving the Quality of the National GHG Inventories (Central Europe and CIS countries)*’ and complied with the 2006 IPCC Guidelines requirements. Subsequently, it was periodically updated during the national GHG inventory processes.

During the peer reviews, the draft version of the NIR is sent to a group of independent experts (who did not previously participate in the national inventory preparation). The purpose of the inventory peer reviews is to receive comments on quality of the draft version from relevant experts in the areas of major interest, particularly on the relevance of methodological approaches, EFs and AD used. The received comments are reviewed and, should it be necessary, estimations are corrected based on the explanatory notes.

Following the final review, after the incorporation of comments received in the process of peer reviews, the PI ‘EPIU’ prepares the MS Word final version of the National Inventory Report, which is then sent for approval to the Environment Agency.

The National Inventory Report, the Biennial Update Reports and/or the National Communications are submitted by the Environment Agency to the Ministry of Environment for approval, after which they are officially submitted by the ME to the UNFCCC Secretariat, in accordance with the RM’s international commitments to the UNFCCC.

1.4. Methodologies and Data Sources

The national inventory is structured to match the reporting requirement of the UNFCCC and is divided into five main sectors: (1) Energy, (2) Industrial Processes and Product Use, (3) Agriculture, (4) Land Use, Land-Use Change and Forestry, and (5) Waste. Each of these sectors is further subdivided, within the inventory, by source categories (Table 1-3).

Table 1-3: Summary of methods and EFs used for the preparation of the national inventory of the Republic of Moldova

Greenhouse Gas Source and Sink Categories	CO_2		CH_4		N_2O		HFC		PFC		SF_6	
	Method	EF	Method	EF	Method	EF	Method	EF	Method	EF	Method	EF
1. Energy												
A. Fuel Combustion	T1	D, CS	T1	D	T1	D						
1. Energy Industries	T1	D, CS	T1	D	T1	D						
2. Manufacturing Industries and Construction	T1	D, CS	T1	D	T1	D						
3. Transport	T1	D, CS	T1	D	T1	D						
4. Other Sectors	T1	D, CS	T1	D	T1	D						
5. Other	T1	D, CS	T1	D	T1	D						
B. Fugitive Emissions from Fuels	T1	D, CS	T1	D	T1	D						
1. Solid Fuels	NO	NO	NO	NO	NO	NO						
2. Oil and Natural Gas	T1	D, CS	T1	D	T1	D						
C. CO_2 Transport and Storage	NO	NO										
2. Industrial Processes and Product Use												
A. Mineral Industry	T2, T1	D, CS	NA	NA	NA	NA						
B. Chemical Industry	NO	NO	NO	NO	NO	NO						
C. Metal Industry	T2	CS, D	NO	NO	NO	NO						
D. Non-Energy Products from Fuels and Solvent Use	T2, T1	D	NA	NA	NO	NO						
E. Electronic Industry	NA	NA	NA	NA	NA	NA	NA	NA	NO	NO	NO	NO
F. Product Use as Substitutes for ODS	NA	NA	NA	NA	NA	NA	T2, T1	CS, D	NA	NA	NA	NA
G. Other Product Manufacture and Use	T2, T1	D	NA	NA	T1	D	NA	NA	T1	D	T1	D
H. Other	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
3. Agriculture												
A. Enteric Fermentation			T2, T1	D, CS	NA	NA						
B. Manure Management			T2, T1	D, CS	T2, T1	D, CS						
C. Rice Cultivation			NO	NO	NA	NA						
D. Agricultural Soils			NA	NA	T1, T3	D, CS						
E. Prescribed Burning of Savannas			NO	NO	NA	NA						
F. Field Burning of Agricultural Residues			IE	IE	IE	IE						
G. Liming	NO	NO	NA	NA	NA	NA						
H. Urea Application	T1	D	NA	NA	NA	NA						
I. Other Carbon-Containing Fertilisers	NO	NO	NA	NA	NA	NA						
J. Other	NO	NO	NO	NO	NO	NO						
4. LULUCF												
A. Forest Land	T3, T2, T1	D, CS	T1	D	T1	D						
B. Cropland	T2, T1	D, CS	T1	D	T1	D						
C. Grassland	T2	CS	NE	NE	NE	NE						
D. Wetlands	T2, T1	D, CS	NE	NE	NE	NE						
E. Settlements	T2, T1	D, CS	NE	NE	T1	D						
F. Other Land	T2, T1	D, CS	NE	NE	NE	NE						
G. Harvested Wood Products	T1	D	NA	NA	NA	NA						
H. Other	NO	NO	NO	NO	NO	NO						
5. Waste												
A. Solid Waste Disposal	NA	NA	T3	D, CS	NA	NA						
B. Biological Treatment of Solid Waste	NA	NA	T1	D	T1	D						
C. Incineration and Open Burning of Waste	T1	D	T1	D	T1	D						
D. Wastewater Treatment and Discharge	NA	NA	T1	D, CS	T1	D						
E. Other	NO	NO	NO	NO	NO	NO						
6. Other	NO	NO	NO	NO	NO	NO						
Memo Items												
International Bunkers	T2, T1	D, CS	T1	D	T1	D						
Multilateral Operations	NO	NO	NO	NO	NO	NO						
CO_2 Emissions from Biomass	T1	D, CS	IE	IE	IE	IE						
CO_2 Captured and Stored	NO	NO	NA	NA	NA	NA						

Abbreviations: T1 – Tier 1 Method; T2 – Tier 2 Method; C – EMEP/EEA; CS – Country Specific; D – Default; IE – Included Elsewhere; NA – Not Applicable; NE – Not Estimates; NO – Not Occurring.

Emissions of direct (CO_2, CH_4, N_2O, HFCs, PFCs, and SF_6) (no NF_3 emissions have been recorded in the Republic of Moldova) greenhouse gases were estimated based on methodologies in the 2006 IPCC Guidelines, while indirect emissions (NO_x, CO, NMVOC, and SO_2) were estimated based on methodologies according to the EEA/EMEP Air Pollutant Emission Inventory Guidebook (2019).

Generally, a GHG inventory can be defined as a '*comprehensive account of anthropogenic sources of emissions and removals by sinks and associated data from source and sink categories within the inventory area over a specified time frame*'.

It can be prepared 'top-down', 'bottom-up', or using a combination approach. The Republic of Moldova's national inventory is prepared using a 'top-down' approach, providing estimates of GHG emissions at a national level. Ideally, a GHG inventory should be developed by using direct measurements of emissions and removals from individual source categories or sinks in the country, considering the methodological approach 'bottom-up'.

The inventory team is continuously working to improve accuracy, completeness and transparency of its inventory. Currently, it has not been possible to apply a bottom-up approach, even if for some sectors the emissions assessment is based on known individual sources from a geographical point of view.

To the extent possible, AD used in this report are based on officially published data: national (Statistical Yearbooks of the RM, respectively of the Administrative-Territorial Units from the Left Bank of the Dniester River (Transnistria), Energy Balances, etc.) and international statistical publications (UN FAO on-line database), publications of academic, research and development institutions ('Nicolae Dimo' Institute of Pedology, Agrochemistry and Soil Protection of the ASM, Institute of Ecology and Geography of the ASM, Institute of Power Engineering of the ASM, Forest Research and Management Institute, etc.), AD provided by ministries and subordinated institutions (Ministry of Defence; Ministry of Health), AD provided by administrative authorities subordinated to ministries (Environment Agency, Environmental Protection Inspectorate, Customs Service; Agency 'Moldsilva', State Hydrometeorological Service), data from central administrative authorities (National Bureau of Statistics, Agency for Land Relations and Cadastre, Public Services Agency, Naval Agency, Civil Aeronautical Authority, Medicines and Medical Devices Agency, National Food Safety Agency), data obtained from enterprises and businesses associations (SOE 'Moldova Railways', JSC 'Moldovagaz', JSC 'Lafarge Cement (Moldova)', JSC 'Macon', SOE 'Glass Factory in Chisinau', JSC 'Glass Container Company', etc.).

1.5. Key Categories

According to the 2006 IPCC Guidelines, it is good practice to identify key categories, to help prioritise efforts and improve the overall quality of the national inventory. A key category is defined as a 'source or sink category, which is prioritised within the national inventory system because its estimate has a significant influence on a country's total direct greenhouse gases in terms of the absolute level of emissions, the trend in emissions, or both'.

Table 1-4, respectively Annex 1, presents the key categories for the RM's National GHG Inventory for the years 1990 and 2020, without the contribution of LULUCF – based on the Tier 1 methodological approach – 18 key categories by level (L) and 20 key categories by trend (T); based on a Tier 2 approach – 17 key categories by level (L) and 16 key categories by trend (T); with the contribution of LULUCF, based on the Tier 1 methodological approach – 24 key categories by level (L) and 25 key categories by trend (T), respectively, based on a Tier 2 methodological approach – 22 key categories by level (L) and 22 key categories by trend (T).

Following the recommendations set in the 2006 IPCC Guidelines, the inventory was first disaggregated by source categories which were further used to identify key categories.

Source and sink categories were defined in conformity with the following guidelines:

(1) emissions/removals from individual source/sink categories identified according to standard classification, were expressed in CO_2 equivalent units, estimated by using the GWP for a period of 100 years;

Table 1-4: Summary overview of the Republic of Moldova's key categories for the years 1990 and 2020, based on Tier 1 and Tier 2 approaches

IPCC classification	Key categories	Gas	Without LULUCF				With LULUCF			
			T1		T2		T1		T2	
			L	T	L	T	L	T	L	T
1A1	Energy industries – liquid fuels	CO_2	X	X	X	X	X	X	X	X
1A1	Energy industries – gaseous fuels	CO_2	X	X	X	X	X	X	X	X
1A1	Energy industries – solid fuels	CO_2	X	X	X	X	X	X	X	X
1A2	Manufacturing industries and construction	CO_2	X	X	X	X	X	X	X	X
1A3b	Road transportation	CO_2	X	X	X	X	X	X	X	X
1A3c	Railways	CO_2	X	X			X	X		
1A4a	Commercial/institutional	CO_2	X	X	X		X	X	X	
1A4b	Residential	CO_2	X	X	X		X	X	X	
1A4b	Residential	CH_4	X	X	X	X	X	X	X	X
1A4c	Agriculture/forestry/fishing	CO_2	X	X			X	X	X	
1B2	Fugitive emissions from oil and natural gas	CH_4	X	X	X		X		X	
2A1	Cement production	CO_2	X	X			X	X		
2D	Non-energy products from fuels and solvent use	CO_2	X	X	X	X	X	X	X	X
2F1	Product uses as substitutes for ODS – refrigeration and air conditioning	HFC	X	X	X	X	X	X	X	X
2F2	Product uses as substitutes for ODS – foam blowing	HFC		X		X				X
3A	Enteric fermentation	CH_4	X	X	X	X	X	X	X	X
3B	Manure management	CH_4	X	X	X	X	X	X	X	
3B1	Direct N_2O emissions from manure management	N_2O	X		X	X	X		X	X
3B5	Indirect N_2O emissions from manure management	N_2O	X		X	X	X		X	X
3Da	Direct N_2O emissions from managed soils	N_2O	X	X	X	X	X	X	X	X
3Db	Indirect N_2O emissions from managed soils	N_2O	X	X	X	X	X		X	X
4A1	Forest lands remaining forest lands	CO_2					X	X	X	X
4A2	Land converted to forest land	CO_2					X	X	X	X
4B1	Cropland remaining cropland	CO_2					X	X	X	X
4C2	Land converted to grassland	CO_2					X	X	X	X
4D2	Land converted to wetlands	CO_2					X	X		X
4E2	Land converted to settlements	N_2O					X	X	X	
4F2	Land converted to other land	CO_2					X	X	X	X
4G	Harvested wood products	CO_2						X		X
5A	Solid waste disposal	CH_4	X	X	X	X	X	X	X	X
5D	Wastewater treatment and disposal	CH_4	X	X	X	X	X	X	X	X

Abbreviations L – Level Assessment; T – Trend Assessment; T1 – Tier 1; T2 – Tier 2

(2) source/storage categories have been identified for each gas, as for different greenhouse gases directly the methodological approaches used, emission factors and uncertainties differ significantly;

(3) source and sink categories that use the same emission factors based on common methodological approaches were aggregated before analysis.

Key categories were identified from two perspectives:

(1) based on the level contribution of each category in the structure of total national emissions; and

(2) based on the trend of the contribution of each category in the structure of total national emissions during the period under review (in order to identify the absolute changes recorded: reductions or increases).

The per cent contributions to both levels (L), and trends (T), in emissions was calculated and sorted from greatest to least (see Annex 1). When a Tier 1 approach was used, a 95% cumulative contribution threshold has been used in this analysis to define an upper boundary for the key category identification; respectively, when a Tier 2 approach was used (considering AD and EF uncertainties used to estimate GHG emissions for individual source/sink categories), a 90% cumulative contribution threshold has been used in this analysis to define an upper boundary for the key category identification.

The Key Category Analysis was carried out using the Key Category Calculation Tool developed by the United States Environment Protection Agency (US EPA v2.5)[37].

[37] US EPA's Key Category Calculation Tool v2.5, <https://19january2017snapshot.epa.gov/climatechange/national-ghg-inventory-capacity-building_.html>

1.6. Quality Assurance and Quality Control

Following the recommendations in the 2006 IPCC Guidelines, national inventories have to be transparent, well documented, consistent, complete, comparable, assessed for uncertainties, subject to verification and QA/QC. The 2006 IPCC Guidelines defines the QA/QC terms as follows:

- *Quality Control* (QC) is a system of routine technical activities to measure and control the quality of the inventory as it is being developed. A basic QC system should provide routine and consistent checks to ensure data integrity, correctness, and completeness; identify and address errors and omissions; and document and archive inventory material and record all QC activities.
- *Quality Assurance* (QA) comprises a planned system of review procedures conducted by personnel not directly involved in the inventory compilation and development process.

As a part of continuous efforts to develop a transparent and reliable inventory, the Republic of Moldova developed a '*Quality Assurance and Quality Control Plan*'. The key attributes of the '*QA/QC Plan*' include detailed specific procedures (Figure 1-4) and standard verification and quality control forms and checklists (see Annex 4), by using Tier 1 (general procedures) and Tier 2 (source-specific procedures), that serve to standardize the process of implementing quality assurance and quality control activities meant to ensure the quality of the national inventory; peer review carried out by experts not directly involved in the national inventory development process; data quality check including by comparing the sets of data obtained from different sources; inventory planning and coordination at an inter-institutional level; as well as the continuous documentation and archiving of all materials used in the inventory preparation process.

It is well known that the development of the inventory implies a huge amount of information that has to be gathered, handled and stored. The process sustainability is ensured through a good management and archiving of materials used along the inventory process.

In the Republic of Moldova, the National Inventory Working Group has a sufficiently transparent documentation allowing to fully reproduce the GHG emissions estimates. A standard system for documenting and archiving numeric and qualitative information, in compliance with the 2006 IPCC Guidelines recommendations was used.

The activity data sources were documented by inserting references to these into the inventory document text. Estimation methods and EF sources and their selection justification are documented in the corresponding chapters of the NIR.

Recalculations made are documented and argued both in sectoral Chapters (3-7), as well as in the Chapter 8 'Recalculations and Improvements' of the NIR.

Individual source and sink categories related documentation include: (1) list of personnel responsible for estimates and individual responsibilities as per Terms of Reference; (2) reference sources for the activity data used; (3); justification of EF estimation methods selection; (4) samples of GHG emissions estimation process (in Excel format); (5) uncertainty assessment results by individual source and sink categories; (6) annexes; (7) references.

Materials used in the inventory development process were archived both electronically and on hard copies. As the entity responsible for the national inventory development, the PI 'EPIU' holds all documentation used for its compilation.

Summing up, one can assert that transparency and credibility of the national inventory are ensured through: (1) the ability to demonstrate, through appropriate documentation, transparency of inventory development process; (2) further improvements of the inventory process and its basic products; and (3) ensuring that the inventory process employed consistent approaches allowing to obtain comparable results for all source and sink categories.

It is obvious that in comparison with the previous inventory cycles, through continuous integration of QA/QC activities, the Republic of Moldova ensures a better-quality inventory.

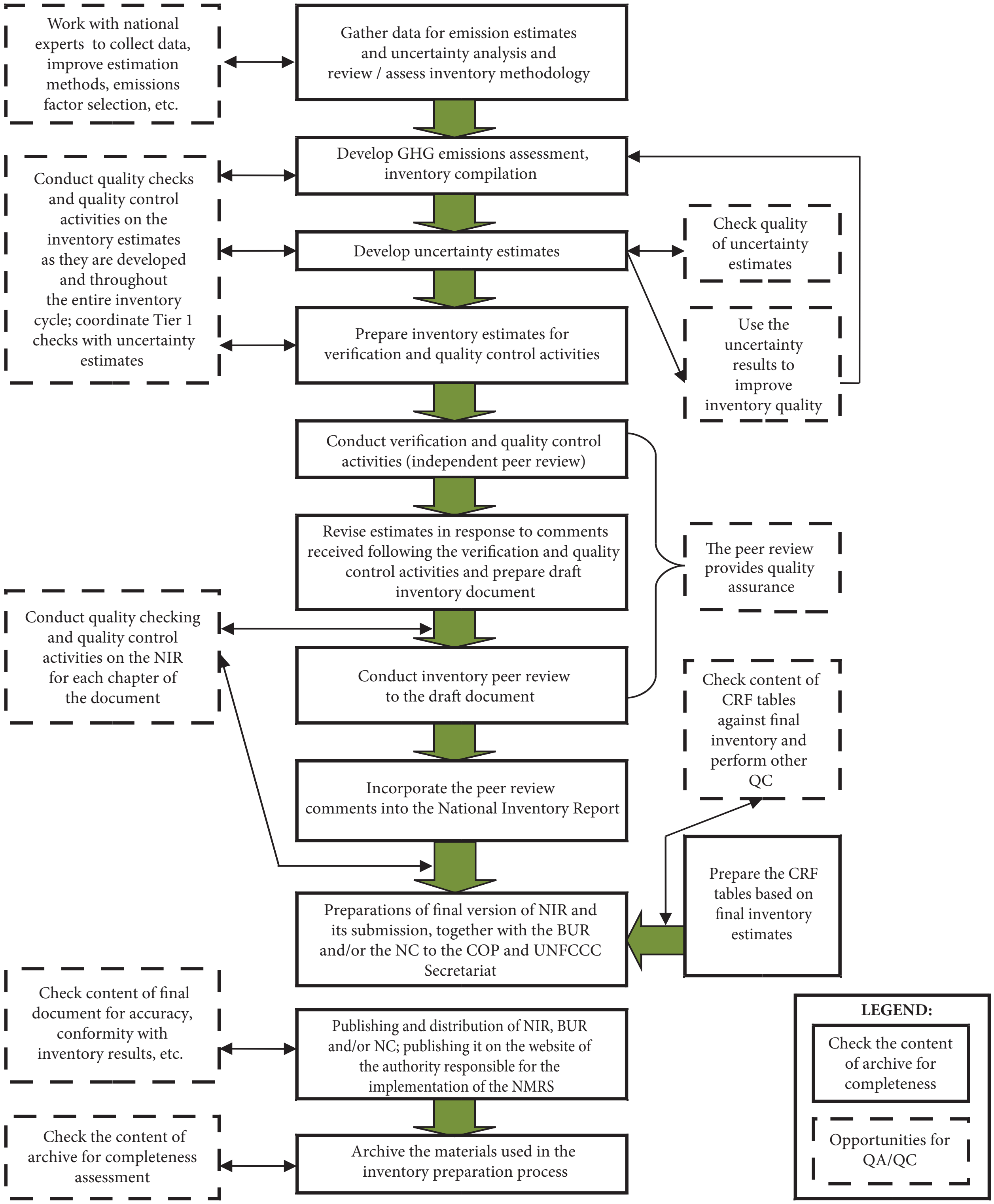


Figure 1-4: The role of QA/QC activities in the inventory preparing process

1.7. Uncertainty Assessment

Uncertainty assessment is an essential element of a complete and transparent emissions inventory. Uncertainty information is not intended to challenge the validity of inventory estimates, but to help prioritize efforts to improve the accuracy of future inventories and guide future decisions on methodological choice.

While the Republic of Moldova's National Inventory Team assessed GHG emissions with the highest possible accuracy, uncertainties are associated to a varying degree with the development of emission estimates for any inventory.

Some current estimates, such as those for CO_2 emissions from fossil fuel combustion or from cement production are considered to have minimal uncertainty associated with them. For some other categories of emissions, however, a lack of data, the use of emission factors used by default or an incomplete understanding of how emissions are generated increases the uncertainty surrounding the estimates presented.

Additional research in the following areas could help reduce uncertainty in the RM's Inventory:

- *Incorporating excluded emission sources.* Quantitative estimates for some of the source and sink categories are not available at this time.
- *Improving the accuracy of emission factors.* Further research is needed in some cases to improve the accuracy of emission factors used to calculate emissions from a variety of sources (for example, the accuracy of current emission factors applied to CH_4 fugitive emissions from oil and natural gas, emissions of CO_2 from solvent use and other products, indirect N_2O emissions from manure management, and indirect N_2O emissions from agricultural soils etc., is highly uncertain).
- *Collecting more detailed activity data.* Although methodologies for estimating emissions for some sources exist, problems arise in obtaining activity data, particularly the ability to estimate emissions of F-gases within Sector 2 'Industrial Processes and Product Use'.

The overall inventory uncertainty was estimated using a Tier 1 methodological approach. An estimate of the overall quantitative uncertainty (±6.44% level uncertainty and, respectively ±2.08% trend uncertainty) are shown in Table 1-5, as well as in the Annex 5 of the NIR.

Table 1-5: Estimated overall national inventory quantitative uncertainty in the RM

	CO_2	CH_4	N_2O	Total
Level uncertainty	±4.96	±27.49	±23.11	±6.44
Trend uncertainty	±1.53	±12.00	±10.21	±2.08

Emissions estimated in the RM's National GHG Inventory currently reflect the best practices available; in some cases, however, estimates are based on approximate methodologies, and incomplete activity data. As soon as new information becomes available in the future, the RM's inventory team will continue to improve, revise and recalculate its GHG emission estimates.

1.8. Completeness Assessment

The Republic of Moldova's National GHG Inventory is, mostly, a complete inventory of the following direct GHGs – CO_2, CH_4, N_2O, HFC, PFC and SF_6.

The national inventory also includes ozone precursors and aerosols such as: CO, NO_x, NMVOC and SO_2.

Despite the effort to cover all existent sources and sinks, the inventory still has some gaps, most of which being determined by the lack of activity data required to estimate certain emissions (at the moment, the HFC emissions from source categories 2F5 'Solvents' and 2F6 'Other uses' are reported as 'Not occurring' due to lack of confirmation from economical enterprises on using HFCs in such applications).

As part of the inventory improvement plan, in the future inventory cycles, the national inventory team will continue their efforts to identify new and relevant data for the GHG emissions/removals assessment from the respective categories.

2. GREENHOUSE GAS EMISSION TRENDS

2.1. Summary of Direct GHG Emission Trends

Between 1990 and 2020, the evolution of total direct greenhouse gas emissions, expressed in CO_2 equivalent, shows a decreasing trend in the Republic of Moldova, emissions having decreased by about 69.8%: from 45.248 Mt CO_2 equivalent in 1990 to 13.662 Mt CO_2 equivalent in 2020, net greenhouse gas emissions having decreased for the same period by about 68.7%: from 43.591 Mt CO_2 equivalent in 1990 to 13.658 Mt CO_2 equivalent in 2020 (Figure 2-1).

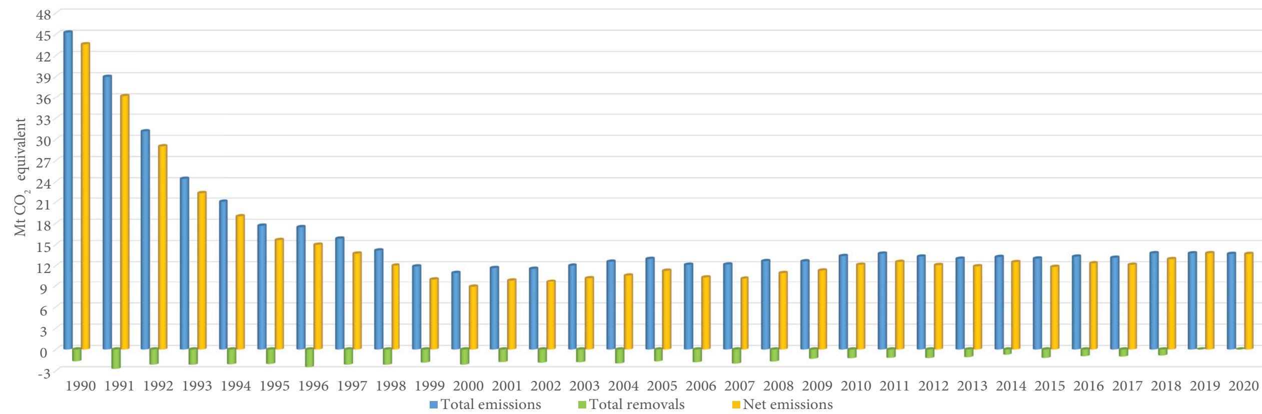


Figure 2-1: Greenhouse Gas Emission and Removal Trends between 1990-2020.

The most significant reductions in direct GHG emissions by source category were recorded during the 1990-2020 period in the following categories: 4G 'Harvested Wood Products' (-128.4%), 4D 'Wetlands' (-85.1%), 3B 'Manure Management' (-84.9%), 1A1 'Energy Industries' (-83.0%), 3A 'Enteric Fermentation' (-82.2%), 4C 'Grassland' (-81.5%), 1A5 'Other' (-80.5%), 1B2 'Fugitive Emissions from Oil and Natural Gas' (-73.5%), 1A4 'Other Sectors' (-70.3%), 2A 'Mineral Industry' (-59.9%), 1A2 'Manufacturing Industries and Construction' (-58.2%), 1A3 'Transport' (-48.1%), 3D 'Agricultural Soils' (-39.4%), 2C 'Metal Industry' (-34.4%), 5D 'Wastewater Treatment and Discharge' (-32.9%), 4B 'Cropland' (-31.6%), 4A 'Forest Land' (-26.4%), 2G 'Other Product Manufacture and Use' (-25.1%), 4E 'Settlements' (-23.4%) and 2D 'Non-energy Products from Fuels and Solvent Use' (-16.6%).

Over the period 2019-2020, there has been an increase in emissions from the following source categories: 2D 'Non-energy Products from Fuels and Solvent Use' (+36.0%), 2C 'Metal Industry' (+18.4%), 1A1 'Energy Industries' (+16.3%), 1A2 'Manufacturing Industries and Construction' (+11.6%), 5B 'Biological Treatment of Solid Waste' (+8.7%), 4B 'Cropland' (+8.1%), 3H 'Urea Application' (+7.5%), 2F 'Product Use as Substitutes for ODS' (+4.2%) and 5A 'Solid Waste Disposal' (+0.6%).

2.2. Emission Trends by Gas

Over the 1990-2020 period, total CO_2 emissions (without LULUCF) have decreased by about 73.6% (from circa 37.02 Mt in 1990 to 9.78 Mt in 2020). CH_4 and N_2O emissions had decreased by about 55.7% (from circa 5.40 Mt CO_2 equivalent in 1990 to 2.39 Mt CO_2 equivalent in 2020), respectively by 56.1% (from circa 2.83 Mt CO_2 equivalent in 1990 to 1.24 Mt CO_2 equivalent in 2020) (Table 2-1).

Table 2-1: Direct GHG Emissions between 1990-2020, Mt CO_2 equivalent

	1990	1991	1992	1993	1994	1995	1996	1997
CO_2 (without LULUCF)	37.0219	31.3250	24.1486	18.0938	15.0634	11.9471	11.8103	10.7438
CO_2 (with LULUCF)	35.1914	28.4172	21.8257	15.7291	12.7521	9.6622	9.0698	8.3532
CH_4 (without LULUCF)	5.3988	5.0527	4.8116	4.4870	4.3961	4.1627	4.1152	3.7226
CH_4 (with LULUCF)	5.4014	5.0551	4.8138	4.4900	4.3978	4.1649	4.1168	3.7253
N_2O (without LULUCF)	2.8278	2.5921	2.1787	1.8275	1.6003	1.5479	1.5155	1.3617
N_2O (with LULUCF)	2.9982	2.7759	2.3834	2.0501	1.8368	1.7994	1.7778	1.6339
HFCs	NO	NO	NO	NO	NO	0.0010	0.0017	0.0023
PFCs	NO	NO	NO	NO	NO	NO	NO	NO
SF_6	NO	NO	NO	NO	NO	NO	NO	NO
Total (without LULUCF)	**45.2484**	**38.9698**	**31.1390**	**24.4083**	**21.0598**	**17.6587**	**17.4427**	**15.8305**
Total (with LULUCF)	**43.5909**	**36.2482**	**29.0229**	**22.2692**	**18.9867**	**15.6276**	**14.9660**	**13.7147**

	1998	1999	2000	2001	2002	2003	2004	2005
CO_2 (without LULUCF)	9.2819	7.2670	6.5160	7.1474	6.9144	7.5811	8.1018	8.4391
CO_2 (with LULUCF)	6.8593	5.1266	4.0954	5.0826	4.7629	5.5019	5.8536	6.4848
CH_4 (without LULUCF)	3.5847	3.4598	3.3714	3.3590	3.4239	3.3341	3.2988	3.3169
CH_4 (with LULUCF)	3.5872	3.4622	3.3723	3.3603	3.4242	3.3342	3.2990	3.3171
N_2O (without LULUCF)	1.2850	1.1574	1.0743	1.1507	1.2098	1.0765	1.1464	1.1727
N_2O (with LULUCF)	1.5693	1.4513	1.3706	1.4473	1.5068	1.3708	1.4365	1.4593
HFCs	0.0031	0.0040	0.0051	0.0069	0.0091	0.0122	0.0160	0.0225
PFCs	NO	NO	NO	NO	NO	NO	NO	NO
SF_6	NO	NO	NO	NO	NO	0.0000	0.0000	0.0000
Total (without LULUCF)	**14.1548**	**11.8882**	**10.9667**	**11.6640**	**11.5573**	**12.0039**	**12.5630**	**12.9513**
Total (with LULUCF)	**12.0190**	**10.0440**	**8.8434**	**9.8970**	**9.7030**	**10.2191**	**10.6051**	**11.2837**
	2006	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**
CO_2 (without LULUCF)	7.7740	8.1574	8.5307	8.5699	9.2160	9.5168	9.2144	8.8668
CO_2 (with LULUCF)	5.6977	5.8887	6.5743	7.0093	7.7295	8.0948	7.7807	7.5777
CH_4 (without LULUCF)	3.1779	3.0078	2.9903	2.9192	2.9355	2.9806	2.9158	2.8132
CH_4 (with LULUCF)	3.1782	3.0094	2.9910	2.9195	2.9357	2.9808	2.9170	2.8140
N_2O (without LULUCF)	1.1460	0.9582	1.0612	1.0526	1.1324	1.1145	1.0562	1.1891
N_2O (with LULUCF)	1.4286	1.2362	1.3332	1.3179	1.3906	1.3664	1.2896	1.4064
HFCs	0.0332	0.0448	0.0574	0.0675	0.0782	0.0905	0.1005	0.1091
PFCs	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
SF_6	0.0003	0.0004	0.0005	0.0005	0.0007	0.0007	0.0008	0.0010
Total (without LULUCF)	**12.1315**	**12.1686**	**12.6400**	**12.6097**	**13.3628**	**13.7031**	**13.2877**	**12.9792**
Total (with LULUCF)	**10.3381**	**10.1794**	**10.9564**	**11.3147**	**12.1347**	**12.5332**	**12.0886**	**11.9082**
	2014	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**%**
CO_2 (without LULUCF)	8.8728	8.9092	8.9583	8.5679	9.1726	9.3915	9.7804	-73.6
CO_2 (with LULUCF)	7.9454	7.5363	7.8412	7.4022	8.1660	9.2428	9.6080	-72.7
CH_4 (without LULUCF)	2.8619	2.8142	2.8834	2.9988	2.9944	2.6818	2.3921	-55.7
CH_4 (with LULUCF)	2.8620	2.8149	2.8838	2.9993	2.9946	2.6822	2.3929	-55.7
N_2O (without LULUCF)	1.3689	1.1277	1.2705	1.3721	1.3968	1.4416	1.2423	-56.1
N_2O (with LULUCF)	1.5714	1.3179	1.4498	1.5439	1.5621	1.6031	1.4103	-53.0
HFCs	0.1230	0.1570	0.1667	0.1859	0.1989	0.2355	0.2453	N/A
PFCs	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	N/A
SF_6	0.0011	0.0011	0.0011	0.0011	0.0013	0.0014	0.0016	N/A
Total (without LULUCF)	**13.2277**	**13.0092**	**13.2801**	**13.1258**	**13.7640**	**13.7518**	**13.6617**	**-69.8**
Total (with LULUCF)	**12.5029**	**11.8273**	**12.3426**	**12.1325**	**12.9230**	**13.7651**	**13.6582**	**-68.7**

Abbreviations: NA – Not Applicable; NO – Not Occurring.

Halocarbons emissions (HFCs, PFCs) and sulphur hexafluoride (SF_6) emissions have been recorded beginning with 1995, considered as a starting year for monitoring F-gases (HFCs, PFCs and SF_6) (no NF_3 emissions have been recorded so far in the Republic of Moldova). The evolution of these emissions denotes a steady increase trend in the last years, though their share in the total national emissions structure is insignificant for now.

CO_2 continues to be the most important source of total national direct greenhouse gas emissions in the Republic of Moldova. Figure 2-2 shows the fluctuation of direct GHG emissions in the structure of total national GHG emissions in 1990 and 2020.

Figure 2-2: Direct GHGs share in the structure of total national GHG emissions in 1990 and 2020.

In 2020, the source categories with the highest share in the structure of total carbon dioxide emissions were: 1A1 'Energy Industries' (37.8% of the total), 1A3 'Transport' (25.6% of the total), 1A4 'Other Sectors' (21.3% of the total), 4A 'Forest Land' (-19.6% of the total), 4B 'Cropland' (17.0% of the total), 1A2 'Manufacturing Industries and Construction' (8.3% of the total), 2A 'Mineral Industry' (5.6% of the total), 4F 'Other Land' (3.4% of the total), 4C 'Grassland' (-2.3% of the total), 2D 'Non-energy Products from Fuels and Solvent Use' (2.0% of the total) and 4D 'Wetlands' (-0.9% of the total) (Figure 2-3).

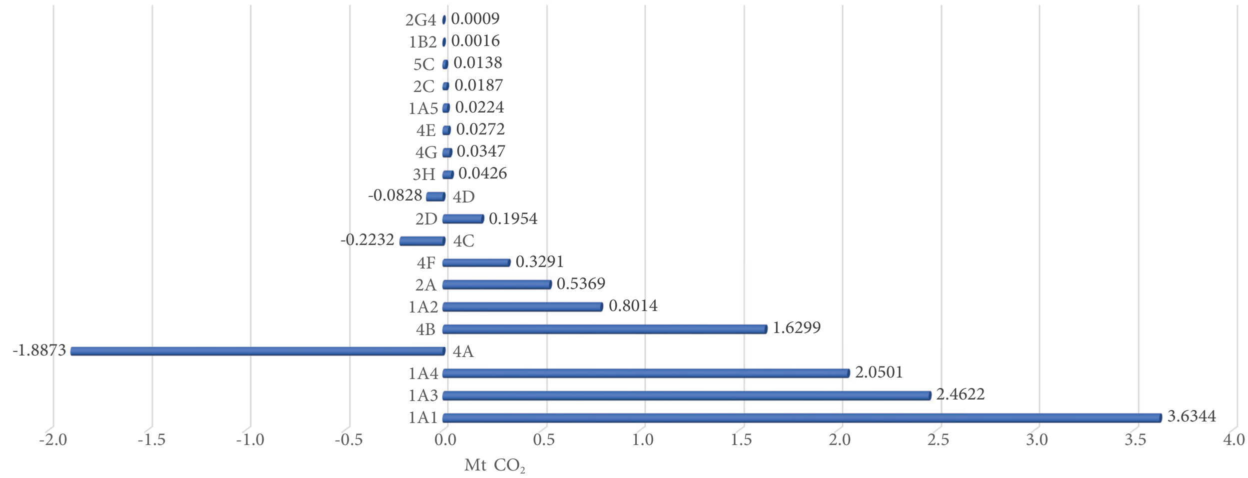


Figure 2-3: Share of source categories in the structure of total CO_2 emissions in 2020.

The source categories with the highest share in the structure of total methane emissions in 2020 were: 5A 'Solid Waste Disposal' (52.1% of the total), 3A 'Enteric Fermentation' (16.3% of the total), 1B2 'Fugitive Emissions from Oil and Natural Gas' (10.0% of the total), 5D 'Wastewater Treatment and Discharge' (9.9% of the total), 1A4 'Other Sectors' (8.9% of the total), 3B 'Manure Management' (1.9% of the total) and 1A3 'Transport' (0.5% of the total) (Figure 2-4).

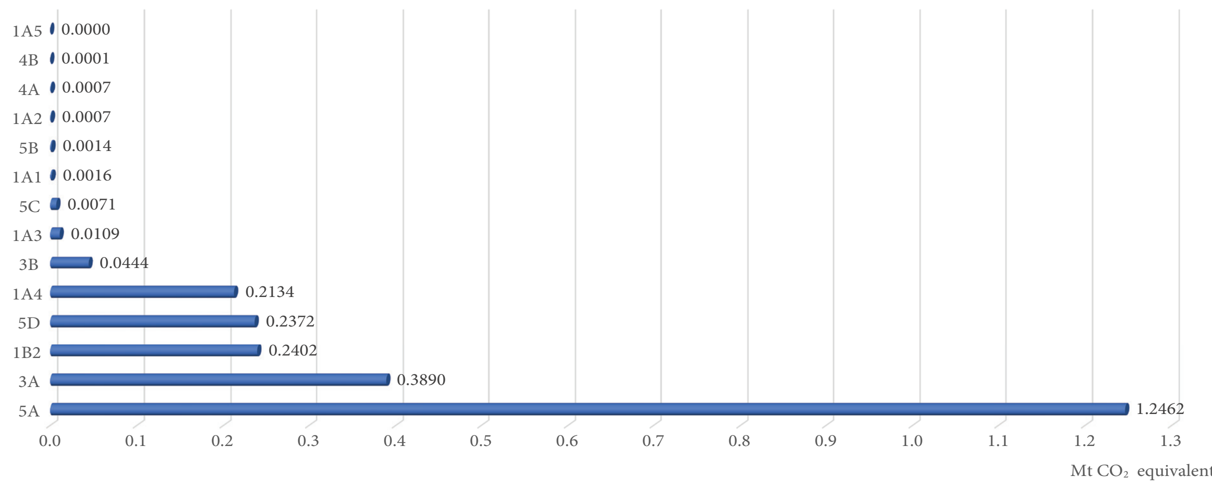


Figure 2-4: Share of source categories in the structure of total CH_4 emissions in 2020.

In 2020, the source categories with the highest share in the structure of total N_2O emissions were: 3D 'Agricultural Soils' (64.1% of the total), 4E 'Settlements' (11.9% of the total), 3B 'Manure Management' (11.8% of the total), 1A4 'Other Sectors' (4.9% of the total), 5D 'Wastewater Treatment and Discharge' (4.1% of the total) and 1A3 'Transport' (2.8% of the total) (Figure 2-5).

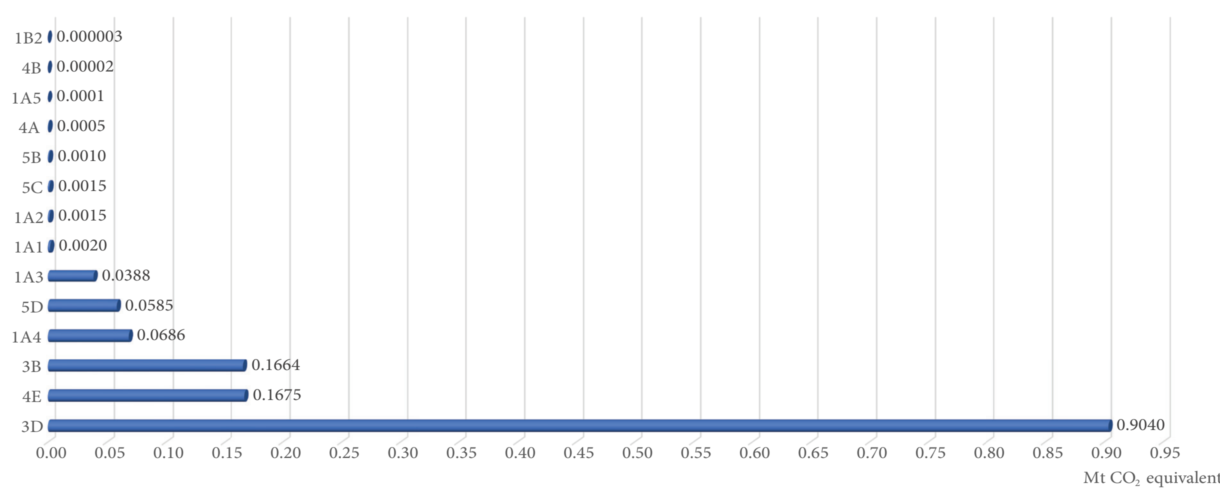


Figure 2-5: Share of source categories in the structure of total N_2O emissions in 2020.

2.3. Emission Trends by Sources

Emissions estimates were grouped into five sectors: (1) ‘Energy’, (2) ‘Industrial Processes and Product Use’, (3) ‘Agriculture’, (4) ‘Land Use, Land-Use Change and Forestry’ (LULUCF) and (5) ‘Waste’. Interpretation of GHG emissions inventory results under the LULUCF Sector is different from other sectors: positive figures indicate that this sector is a net source of emissions, while negative figures indicate that the sector is a net sink of CO_2 removals.

Over the 1990-2020 period, total GHG emissions tended to decrease, thus, emissions from the energy sector decreased by circa 74.2%, those from the IPPU sector – by circa 37.8%, from the agriculture sector – by 69.5%, from the LULUCF sector – by 99.8%, and those from the waste sector – by 0.4% (Table 2-2).

Table 2-2: Evolution of direct GHG emissions by sector between 1990-2020, Mt CO_2 equivalent

	1990	1991	1992	1993	1994	1995	1996	1997
1. Energy	36.9929	31.2587	24.4198	18.2540	15.3780	12.3913	12.3740	11.1206
2. Industrial Processes and Product Use	1.6052	1.4113	0.8225	0.7379	0.5566	0.4567	0.4169	0.4548
3. Agriculture	5.0767	4.6954	4.2923	3.7546	3.4834	3.1734	3.0137	2.6246
4. LULUCF	-1.6575	-2.7216	-2.1161	-2.1392	-2.0731	-2.0311	-2.4767	-2.1157
5. Waste	1.5735	1.6044	1.6044	1.6619	1.6418	1.6373	1.6382	1.6305
	1998	1999	2000	2001	2002	2003	2004	2005
1. Energy	9.6520	7.6403	6.9409	7.5701	7.3557	8.0419	8.5459	8.8365
2. Industrial Processes and Product Use	0.3787	0.3422	0.3158	0.3198	0.3703	0.3986	0.4722	0.5731
3. Agriculture	2.5194	2.3069	2.1362	2.2282	2.2975	2.0642	2.0641	2.0632
4. LULUCF	-2.1358	-1.8442	-2.1233	-1.7670	-1.8543	-1.7848	-1.9579	-1.6675
5. Waste	1.6047	1.5988	1.5739	1.5459	1.5339	1.4992	1.4808	1.4785
	2006	2007	2008	2009	2010	2011	2012	2013
1. Energy	7.9821	8.1547	8.4509	8.8753	9.4964	9.7876	9.4652	9.0359
2. Industrial Processes and Product Use	0.6791	0.9373	1.0256	0.5303	0.5612	0.6649	0.6829	0.7332
3. Agriculture	2.0054	1.6241	1.6966	1.7252	1.8037	1.7402	1.6453	1.7747
4. LULUCF	-1.7934	-1.9892	-1.6836	-1.2950	-1.2282	-1.1699	-1.1991	-1.0710
5. Waste	1.4649	1.4525	1.4670	1.4788	1.5015	1.5104	1.4942	1.4355
	2014	2015	2016	2017	2018	2019	2020	%
1. Energy	9.0697	9.1196	9.2566	8.9249	9.4069	9.4014	9.5499	-74.2
2. Industrial Processes and Product Use	0.7602	0.7651	0.7469	0.7797	0.9647	0.9912	0.9988	-37.8
3. Agriculture	1.9740	1.7012	1.8267	1.8817	1.8373	1.7987	1.5464	-69.5
4. LULUCF	-0.7247	-1.1819	-0.9375	-0.9933	-0.8411	0.0133	-0.0035	-99.8
5. Waste	1.4237	1.4232	1.4499	1.5394	1.5552	1.5605	1.5666	-0.4

The Energy sector is the most important source of total national direct greenhouse gas emissions, its share varying during the 1990-2020 period between 81.8% and 69.9%. Other relevant sources of direct greenhouse gas emissions are the agriculture, waste and IPPU sectors (Figure 2-6).

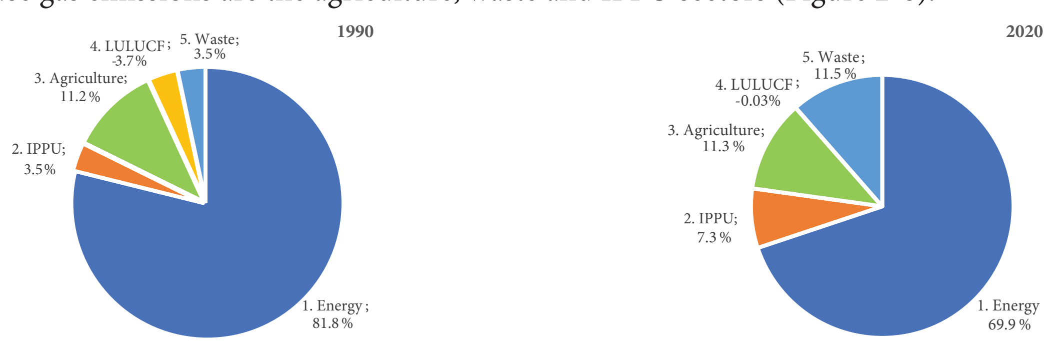


Figure 2-6: Sectoral breakdown in the structure of total national GHG emissions in the Republic of Moldova in 1990 and 2020.

Throughout the study period, except for 2019, the LULUCF sector was a net source of carbon removal. With the reduction of direct greenhouse gas emissions at national level, the relevance of this sector in the structure of net greenhouse gas emissions at national level showed a similar trend: in 1990, about 3.7% of the total GHG emissions were removed at national level, whereas in 2020 only 0.03% of total GHG emissions at national level.

2.3.1. Sector 1 'Energy'

In the Republic of Moldova, the energy sector is the most important source of greenhouse gas emissions. The sector includes emissions from stationary and mobile combustion of fuels for energy (97.5 of total emissions from this sector in 2020), as well as fugitive emissions from oil and natural gas production, processing, transportation, storage, delivery and distribution (2.5% of total emissions from this sector in 2020) (Figure 2-7, Table 2-3).

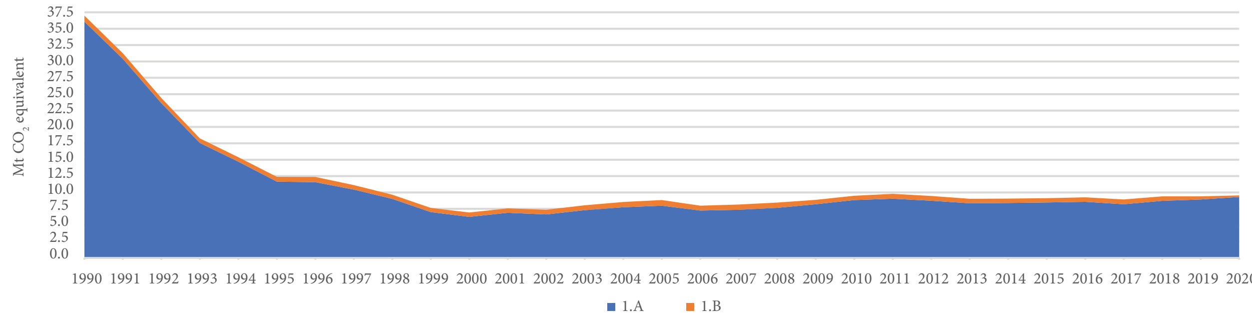


Figure 2-7: total GHG emissions in Sector 1 'Energy' in the Republic of Moldova, 1990-2020.

Overall, these emissions have accounted for about 69.9% of the total national direct GHG emissions in 2020. During the 1990-2020 period, total direct GHG emissions from the Energy sector had decreased by about 74.2%: from 36.99 Mt CO_2 equivalent in 1990 to 9.55 Mt CO_2 equivalent in 2020.

Table 2-3: GHG Emissions from Sector 1 'Energy' over the period 1990-2020, Mt CO_2 equivalent

	1990	1995	2000	2005	2010	2015	2016	2017	2018	2019	2020
1. Energy	**36.9929**	**12.3913**	**6.9409**	**8.8365**	**9.4964**	**9.1196**	**9.2566**	**8.9249**	**9.4069**	**9.4014**	**9.5499**
1A. Fuel Combustion	**36.0815**	**11.6525**	**6.2764**	**7.9877**	**8.8339**	**8.4764**	**8.5681**	**8.2046**	**8.7274**	**8.9297**	**9.3081**
1A.1. Energy Industries	21.3642	7.1924	3.1593	3.2333	4.0530	3.6881	3.6486	2.9995	3.2586	3.1275	3.6380
1A.2. Manufacturing Industries and Construction	1.9218	0.3870	0.5216	0.5774	0.5173	0.5184	0.4896	0.5028	0.5956	0.7200	0.8036
1A.3. Transport	4.8386	1.6603	1.0057	1.8670	2.1888	2.3078	2.4816	2.4634	2.5819	2.6654	2.5119
1A.4. Other Sectors	7.8413	2.2862	1.5529	2.2838	2.0474	1.9392	1.9253	2.1760	2.2678	2.3938	2.3321
1A.5. Other	0.1156	0.1265	0.0368	0.0263	0.0275	0.0229	0.0230	0.0227	0.0235	0.0230	0.0225
1B. Fugitive Emissions from Fuels	**0.9114**	**0.7388**	**0.6645**	**0.8488**	**0.6625**	**0.6433**	**0.6885**	**0.7203**	**0.6794**	**0.4717**	**0.2418**
1B.1. Solid Fuels	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
1B.2. Oil and Natural Gas	0.9114	0.7388	0.6645	0.8488	0.6625	0.6433	0.6885	0.7203	0.6794	0.4717	0.2418
1C. CO_2 Transport and Storage	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**

Abbreviations: NO – Not Occurring.

The most important source category within the Energy sector is 1A1 'Energy Industries', with a share of circa 38.1% of the total from this sector, in 2020 (57.8% in 1990). Other relevant sources are source categories: 1A3 'Transport' – with a share of 26.3% of the total (13.1% in 1990), 1A4 'Other Sectors' – with a share of circa 24.4% of the total (21.2% in 1990), and 1A2 'Manufacturing Industries and Construction' – with a share of circa 8.4% of the total (5.2% in 1990) (Figure 2-8).

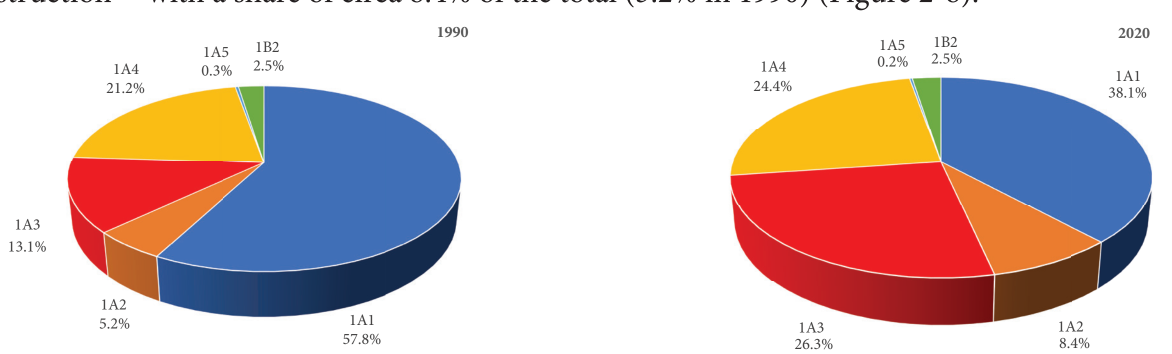


Figure 2-8: Contribution to total direct GHG emissions by source category in the Energy Sector in 1990 and 2020.

2.3.2. Sector 2 'Industrial Processes and Product Use'

Sector 2 'IPPU' is a relevant source of GHG emissions, and it includes emissions from non-energy industrial activities. In 2020, this sector had a share of about 7.3% of total national GHG emissions (3.5%

in 1990). Between 1990 and 2020, total GHG emissions from the sector decreased by about 37.8%: from 1.6 Mt CO_2 equivalent in 1990 to 1.0 Mt CO_2 equivalent in 2020 (Figure 2-9).

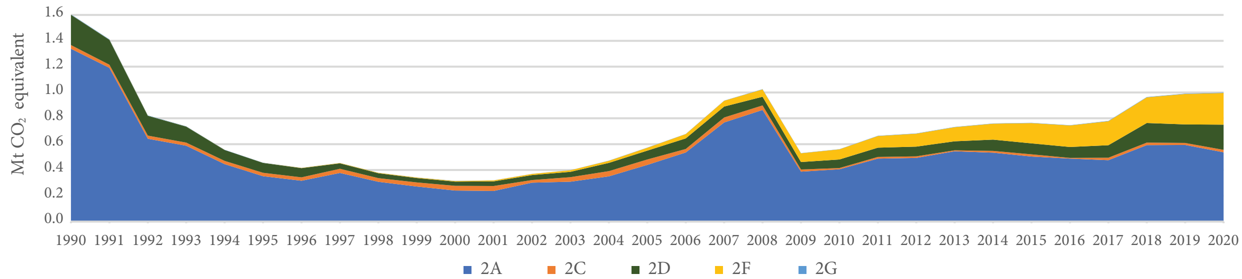


Figure 2-9: Total GHG emissions from Sector 2 'IPPU' in the RM between 1990-2020.

Between 2008 and 2009, these emissions decreased by 48% because of the economic crisis that significantly affected the industrial sector of the Republic of Moldova. Subsequently, between 2010 and 2020, direct GHG emissions from the sector showed a slight increasing trend, mainly due to increase in production of cement, lime, glass, steel, as well as due to increase in halocarbon consumption. Between 2019 and 2020, total GHG emissions from the sector increased by 0.8% (Table 2-4).

Table 2-4: Direct GHG emissions from Sector 2 'IPPU' between 1990-2020, Mt CO_2 equivalent

	1990	1995	2000	2005	2010	2015	2016	2017	2018	2019	2020
2. Industrial Processes and Product Use	**1.6052**	**0.4567**	**0.3158**	**0.5731**	**0.5612**	**0.7651**	**0.7469**	**0.7797**	**0.9647**	**0.9912**	**0.9988**
A. Mineral Industry	1.3390	0.3517	0.2408	0.4392	0.4054	0.5042	0.4880	0.4756	0.5919	0.5937	0.5369
B. Chemical Industry	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
C. Metal Industry	0.0285	0.0262	0.0363	0.0419	0.0097	0.0173	0.0052	0.0189	0.0202	0.0158	0.0187
D. Non-Energy Products from Fuels and Solvent Use	0.2344	0.0766	0.0326	0.0682	0.0662	0.0846	0.0848	0.0970	0.1512	0.1436	0.1954
E. Electronic Industry	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
F. Product Use as Substitutes for ODS	NO	0.0010	0.0051	0.0225	0.0782	0.1570	0.1667	0.1859	0.1989	0.2355	0.2453
G. Other Product Manufacture and Use	0.0034	0.0012	0.0010	0.0012	0.0017	0.0020	0.0022	0.0023	0.0024	0.0026	0.0026
H. Other	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

Abbreviations: NA – Not Applicable; NO – Not Occurring.

Within Sector 2 'IPPU', the most important source category is 2A1 'Cement Production', with a share of about 46.8% of the total from this sector in 2020 (60.5% in 1990). Other relevant source categories in 2020 were 2D3 'Solvent Use' – with a share of 18.7% of the total (12.7% in 1990), 2F1 'Refrigeration and Air Conditioning' – with a share of about 15.3% of the total, 2F2 'Foam Blowing Agents' – with a share of 8.9% of the total, 2A3 'Glass production' – with a share of 3.3% of the total (1.7% in 1990), 2A2 'Lime production' – with a share of 2.1% of the total (16.5% in 1990), 2C1 'Iron and steel production' – with a share of 1.9% of the total (1.8% in 1990), and 2A4 'Other process uses of carbonates' – with a share of 1.5% of the total (4.7% in 1990) (Figure 2-10).

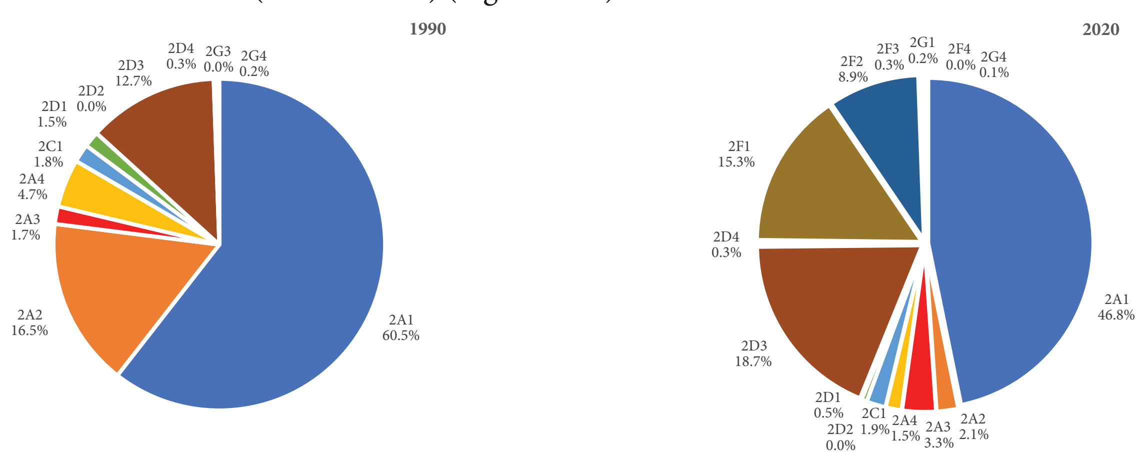


Figure 2-10: Total GHG emissions by source category in Sector 2 'IPPU' in 1990 and 2020.

2.3.3. Sector 3 'Agriculture'

Sector 3 'Agriculture' is an important contributor of direct GHG emissions: CH_4 emissions from 'Enteric fermentation' (category 3A) and 'Manure management' (category 3B); N_2O emissions from 'Manure management' (category 3B) and 'Agricultural soils' (category 3D), respectively CO_2 emissions from 'Urea application' (category 3H). In the Republic of Moldova There are no emissions recorded from 3C 'Rice cultivation', 3E 'Prescribed burning of savannas', 3G 'Liming', 3I 'Other carbon-containing fertilizers' and 3J 'Other'. As for the emissions from 3F 'Field burning of agricultural residues', these are monitored in the LULUCF sector, under category 4B 'Cropland'.

In 2020, the agriculture sector had a share of about 11.3% of total national direct GHG emissions (11.2% in 1990). Over the period 1990-2020, total direct GHG emissions from the respective sector decreased by circa 69.5%: from 5.08 Mt CO_2 equivalent in 1990 to 1.55 Mt CO_2 equivalent in 2020 (Table 2-5), mainly due to the decrease in such indicators as: livestock and poultry population, the amount of synthetic nitrogen and organic fertilizers applied to soils, the amount of agricultural crop residues returned to soils and the increase in carbon losses from mineral soils and changes of tillage practices.

Table 2-5: Direct GHG emissions from Sector 3 'Agriculture' between 1990-2020, Mt CO_2 equivalent

	1990	1995	2000	2005	2010	2015	2016	2017	2018	2019	2020
3. Agriculture	**5.0767**	**3.1734**	**2.1362**	**2.0632**	**1.8037**	**1.7012**	**1.8267**	**1.8817**	**1.8373**	**1.7987**	**1.5464**
A. Enteric Fermentation	2.1894	1.6181	1.0858	0.9240	0.7082	0.6292	0.6220	0.5784	0.5165	0.4409	0.3890
B. Manure Management	1.3948	0.7440	0.4189	0.4208	0.3796	0.3188	0.3213	0.3066	0.2697	0.2463	0.2108
C. Rice Cultivation	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
D. Agricultural Soils	1.4919	0.8113	0.6310	0.7182	0.7142	0.7420	0.8711	0.9706	1.0078	1.0719	0.9040
E. Prescribed Burning of Savannas	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
F. Field Burning of Agricultural Residues	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE
G. Liming	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
H. Urea Application	0.0006	0.0001	0.0004	0.0002	0.0017	0.0112	0.0123	0.0262	0.0434	0.0396	0.0426
I. Other Carbon-Containing Fertilisers	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
J. Other	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO

Abbreviations: IE – Included Elsewhere; NO – Not Occurring.

Between 2019 and 2020, direct greenhouse gas emissions from the agriculture sector decreased by about 14.0% (Figure 2-11), mainly due to unfavourable agrometeorological conditions caused by the drastic drought that affected the Republic of Moldova and the reduction of livestock and poultry population.

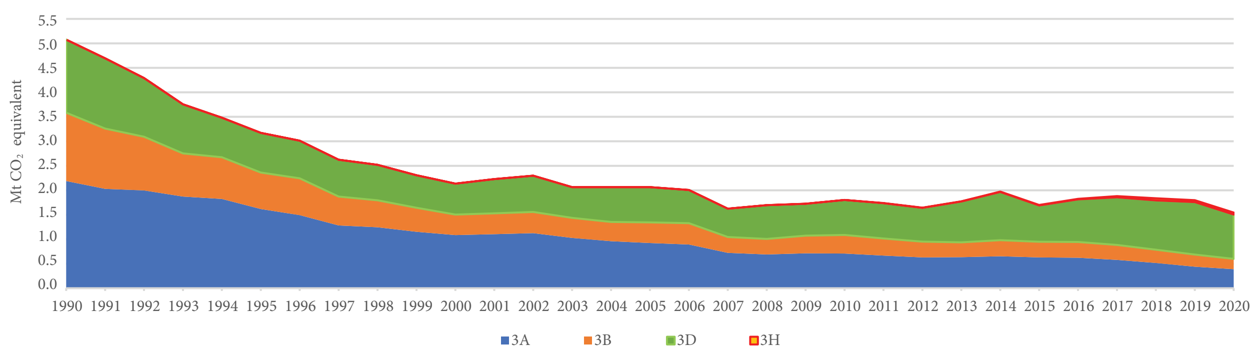


Figure 2-11: Total direct GHG emissions from Sector 3 'Agriculture', 1990-2020.

In 2020, the most important source category was 3D 'Agricultural soils', with a share of about 58.5% of the total from this sector (29.4% in 1990). Other relevant source categories are 3A 'Enteric fermentation' – with a share of 25.2% of the total (43.1% in 1990), and 3B 'Manure management' – with a share of about 13.6% of the total (29.4% in 1990). The share of category 3H 'Urea application' is currently insignificant from this sector (Figure 2-12), however, it shows a continuous upward trend.

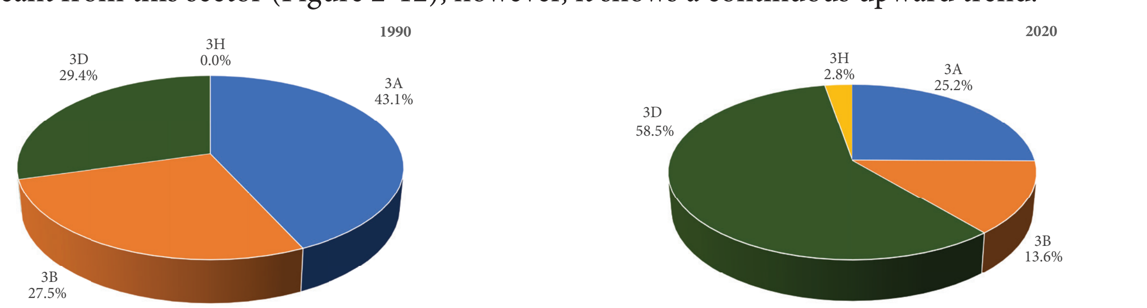


Figure 2-12: Total GHG emissions from Sector 3 'Agriculture' by source category in 1990 and 2020.

2.3.4. Sector 4 'Land Use, Land-Use Change and Forestry'

Except for 2019, in the period 1990-2020, the LULUCF sector was a source of net carbon removal in the Republic of Moldova. In 2019, this sector has become a net source of emissions nationwide for the first time. Between 1990 and 2020, the evolution of net CO_2 removals/emissions recorded a downward trend, decreasing by about 99.8%, from -1.6575 Mt CO_2 equivalent in 1990 to -0.0035 Mt CO_2 equivalent in 2020 (Table 2-6, Figure 2-13). This is mainly due to changes in the use and management practices of cropland (category 4B), which led to a significant reduction in organic carbon reserves in agricultural soils[38], thus changing the humus balance from positive to negative and/or to deeply negative. The process was also influenced by some changes in category 4A – forest land, such as the increase in the volume of authorized wood harvested, the substantial increase in the volume of illegal logging, the increase in the conversion of cropland to forest land, etc.

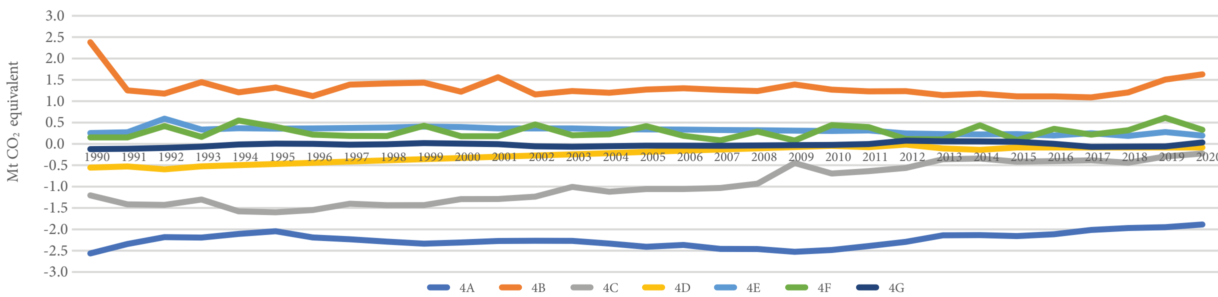


Figure 2-13: Direct GHG emissions/removals in Sector 4 'LULUCF' by source/sink category 1990-2020

Table 2-6: Emissions and removals in Sector 4 'LULUCF' between 1990-2020, Mt CO_2 equivalent

	1990	1995	2000	2005	2010	2015	2016	2017	2018	2019	2020
4. LULUCF	**-1.6575**	**-2.0311**	**-2.1233**	**-1.6675**	**-1.2282**	**-1.1819**	**-0.9375**	**-0.9933**	**-0.8411**	**0.0133**	**-0.0035**
A. Forest Land	-2.5631	-2.0451	-2.3074	-2.4095	-2.4840	-2.1584	-2.1153	-2.0157	-1.9691	-1.9501	-1.8861
B. Cropland	2.3823	1.3197	1.2239	1.2720	1.2719	1.1127	1.1121	1.0897	1.2064	1.5075	1.6300
C. Grassland	-1.2057	-1.6011	-1.2919	-1.0581	-0.6920	-0.4185	-0.4024	-0.3840	-0.4402	-0.2933	-0.2232
D. Wetlands	-0.5554	-0.4694	-0.3284	-0.1874	-0.0464	-0.0828	-0.0828	-0.0828	-0.0828	-0.0828	-0.0828
E. Settlements	0.2542	0.3577	0.3962	0.3401	0.3037	0.2290	0.1984	0.2489	0.1869	0.2778	0.1947
F. Other Land	0.1524	0.4011	0.1785	0.4165	0.4415	0.0868	0.3516	0.2182	0.3212	0.6118	0.3291
G. Harvested Wood Products	-0.1222	0.0060	0.0058	-0.0411	-0.0228	0.0492	0.0009	-0.0674	-0.0635	-0.0576	0.0347
H. Other	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO

Abbreviations: IE – Included Elsewhere; NO – Not Occurring.

In 2020, the main source of CO_2 emission removal in the LULUCF sector was 4A 'Forest land' (forests, forest belts, etc.) with a share of 43.1% of the total (35.4% in 1990), followed by 4C 'Grassland' – with a share of about 5.1 percent (16.7 percent in 1990), and 4D 'Wetlands' – with a share of about 1.9 percent (7.7 per cent in 1990). Category 4B 'Cropland' is a net source of emissions, with a share of 37.2% (32.9% in 1990), followed by category 4F 'Other land' – with a share of about 7.5% (2.1% in 1990), and category 4E 'Settlements' – with a share of about 4.4 percent (3.5 percent in1990) (Figure 2-14).

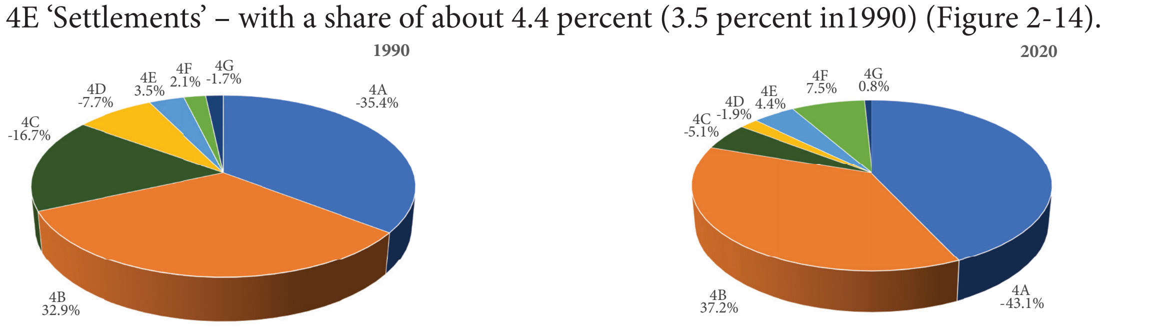


Figure 2-14: CO_2 emissions and removals by source and sink category in the LULUCF Sector in 1990 and 2020.

2.3.5. Sector 5 'Waste'

Sector 5 'Waste' is an important source of GHG emissions in the Republic of Moldova: CO_2 emissions from 5C 'Incineration and open burning of waste', methane emissions from 5A 'Solid waste disposal', 5B 'Biological treatment of solid waste', 5C 'Incineration and open burning of waste' and 5D 'Wastewa-

[38] Organic carbon and nitrogen in soil are highly dependent within the humus content in soil; carbon losses through the oxidation process due to changes in the use and management of agricultural soils are accompanied by simultaneous mineralization (biochemical decomposition) of nitrogen.

ter treatment and discharge', respectively N_2O emissions from 5B 'Biological treatment of solid waste', 5C 'Incineration and open burning of waste' and 5D 'Wastewater treatment and discharge' (human manure). There are no emissions recorded from category 5E 'Other' in the RM.

In 2020, the waste sector had a share of about 11.5% of the total national GHG emissions (3.5% in 1990). In the period 1990-2020, total direct GHG emissions from this sector decreased by about 0.4%: from 1.5735 Mt CO_2 equivalent in 1990 to 1.5666 Mt CO_2 equivalent in 2020 (Table 2-7). Between 2019 and 2020, direct GHG emissions generated by the waste sector increased by about 0.4%.

Table 2-7: Direct GHG emissions from Sector 5 'Waste' between 1990-2020, Mt CO_2 equivalent

	1990	1995	2000	2005	2010	2015	2016	2017	2018	2019	2020
5. Waste	**1.5735**	**1.6373**	**1.5739**	**1.4785**	**1.5015**	**1.4232**	**1.4499**	**1.5394**	**1.5552**	**1.5605**	**1.5666**
A. Solid Waste Disposal	1.1060	1.2561	1.2070	1.0936	1.1607	1.1045	1.1320	1.2209	1.2325	1.2392	1.2462
B. Biological Treatment of Solid Waste	0.0023	0.0011	0.0009	0.0010	0.0018	0.0022	0.0022	0.0025	0.0022	0.0022	0.0024
C. Incineration and Open Burning of Waste	0.0243	0.0245	0.0243	0.0234	0.0208	0.0215	0.0211	0.0237	0.0231	0.0226	0.0223
D. Wastewater Treatment and Discharge	0.4409	0.3557	0.3417	0.3604	0.3181	0.2950	0.2946	0.2923	0.2973	0.2964	0.2957
E. Other	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO

Abbreviations: NE – Not Estimated; NO – Not Occurring.

The decreasing trend of total GHG emissions from the waste sector, particularly until 2000, could be explained by the economic decline recorded in the Republic of Moldova during transition to the market economy, by a significant drop in the well-being of the population, and respectively, by the capacity to generate household waste. At the same time, from 2006, there has been a slight upward trend of direct GHG emissions from the waste sector (Figure 2-15).

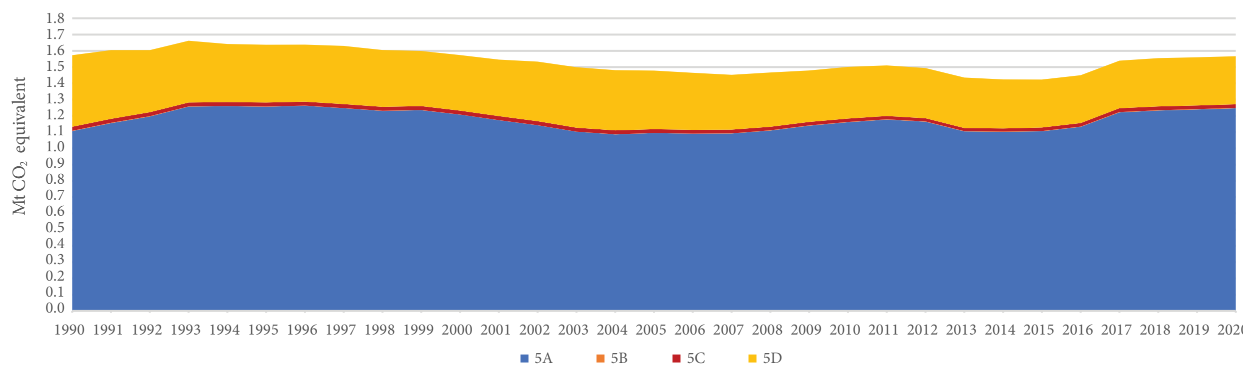


Figure 2-15: Total direct GHG emissions from Sector 5 'Waste' in the Republic of Moldova between 1990-2020.

In 2020, the most important source category in this sector was category 5A 'Solid waste disposal', with a share of circa 79.5% of the total sectoral emissions (70.3% in 1990), followed by category 5D 'Wastewater treatment and discharge' – with a share of circa 18.9% of the total (28.0% in 1990), respectively, by category 5C 'Incineration and open burning of waste' – with a share of circa 1.4% of the total (1.5% in 1990) (Figure 2-16).

Figure 2-16: Share of total direct GHG emissions by source category from Sector 5 'Waste' in the Republic of Moldova in 1990 and 2020.

2.4. Emission Trends for Ozone and Aerosol Precursors

Though not considered greenhouse gases, photochemically active gases such as carbon monoxide (CO), nitrogen oxides (NO_x) and non-methane volatile organic compounds (NMVOC) contribute indirectly to the greenhouse effect in the atmosphere. These gases are considered as ozone precursors, influencing the formation and destruction of the ozone in the atmosphere. They are mainly emitted from exhaust fumes in transportation, fossil fuel combustion in stationary sources, consumption of solvents and other household products, etc. Thus, the national GHG inventory of the Republic of Moldova includes emissions of the following ozone and aerosol precursors: NO_x, CO, NMVOC and SO_2.

Over the period 1990-2020, total nitrogen oxides emissions had decreased by circa 74.4%: from 95.55 kt in 1990 to 24.47 kt in 2020, total carbon monoxide emissions – by circa 49.3%: from 278.79 kt in 1990, to 141.37 kt in 2020, total carbon monoxide emissions – by circa 21.2%: from 141.57 kt in 1990 to 111.56 kt in 2020, and sulphur dioxide emissions – by circa 97.1%: from 150.11 kt in 1990 to 4.29 kt in 2020 (Table 2-8).

Table 2-8: Ozone and aerosol precursors (NO_x, CO and NMVOC) and SO_2 emission trends in the RM between 1990-2020, kt

	1990	1991	1992	1993	1994	1995	1996	1997
NO_x	95.5512	78.4217	58.5033	46.5799	36.6026	30.8466	28.8884	25.9441
CO	278.7930	203.7123	130.6554	66.9326	74.0283	63.4598	76.6445	70.2812
NMVOC	141.5732	114.3401	90.3583	71.4281	52.6015	48.1949	46.5154	31.7581
SO_2	150.1134	124.4509	91.8546	72.3744	57.4117	31.8008	31.9788	16.7550
	1998	1999	2000	2001	2002	2003	2004	2005
NO_x	21.7918	15.9443	14.8007	16.1643	16.8895	17.9390	19.2975	19.9620
CO	54.3680	42.2865	39.9908	38.9542	45.4014	55.2136	52.5471	54.4534
NMVOC	27.7926	23.4240	22.9213	24.4817	26.8842	27.8119	39.4607	42.1519
SO_2	12.4820	5.9010	4.5137	3.9943	4.8222	6.3270	5.4764	5.1861
	2006	2007	2008	2009	2010	2011	2012	2013
NO_x	19.0276	19.9797	20.8382	19.4561	21.4697	22.0956	20.9137	21.2070
CO	54.9733	49.6659	52.3467	50.6392	53.0984	55.8416	54.3956	55.1415
NMVOC	47.5410	47.4475	41.0502	35.9526	40.8386	43.5601	44.8404	43.8719
SO_2	5.3328	4.0330	5.6386	5.2233	5.3806	5.5088	5.5982	13.1659
	2014	2015	2016	2017	2018	2019	2020	%
NO_x	20.9688	21.8663	22.5799	22.9189	24.8043	25.0238	24.4709	-74.4
CO	82.1869	86.7007	89.7942	112.6536	161.9930	146.6523	141.3672	-49.3
NMVOC	56.3396	54.1274	55.4061	64.7482	95.9239	90.1994	111.5648	-21.2
SO_2	5.3742	4.8979	4.0432	4.9513	4.4461	5.2165	4.2932	-97.1

In 2020, the source categories with the highest share in the structure of total nitrogen oxides emissions were: 1A3 'Transport' (39.6% of the total), 1A4 'Other sectors' (26.6% of the total), 1A1 'Energy industries' (23.6% of the total), 2A 'Mineral industry' (7.2% of the total), and 1A2 'Manufacturing industries and construction' (1.8% of the total) (Figure 2-17).

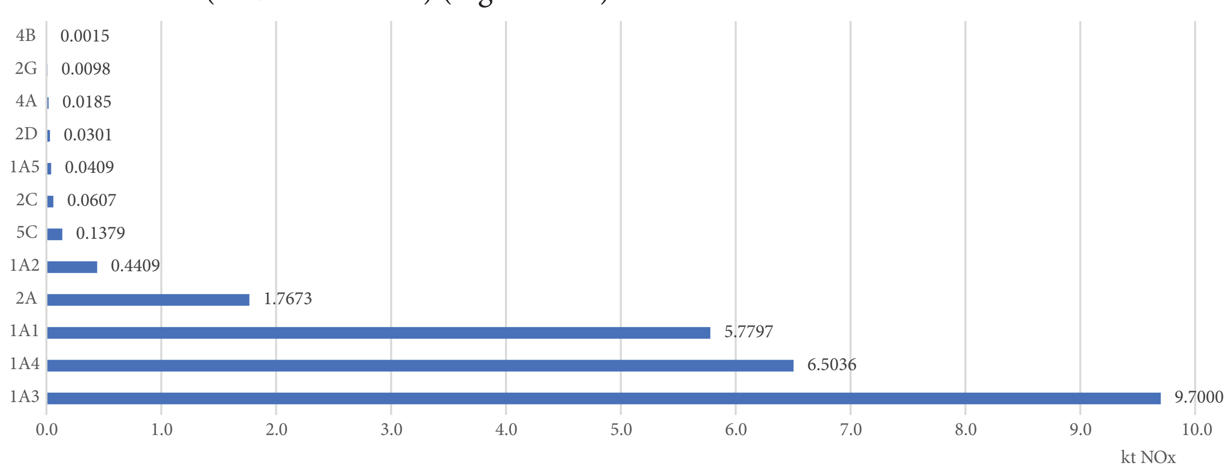


Figure 2-17: Total NO_x emissions by source category in 2020

The source categories with the highest share in the total carbon monoxide emissions in 2020 were: 1A4 'Other sectors' (80.1% of the total), 1A3 'Transport' (12.9% of the total), 1A1 'Energy industries' (1.8% of the total), 5C 'Incineration and open burning of waste' (1.7% of the total), 1A2 'Manufacturing industries and construction' (1.0% of the total), and 2A 'Mineral industry' (1.0% of the total) (Figure 2-18).

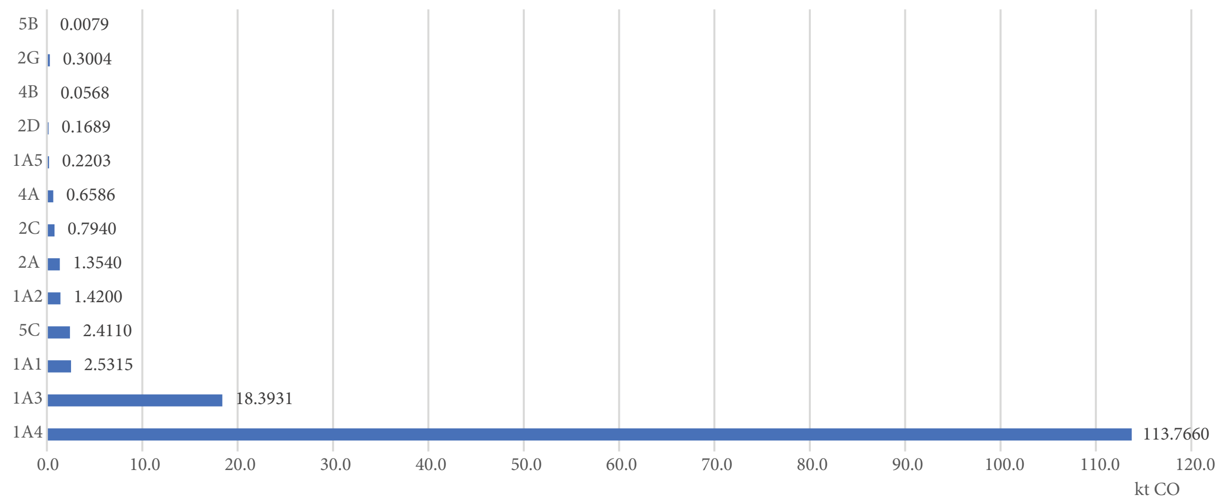


Figure 2-18: Total CO emissions by source category in 2020.

In 2020, the source categories with the highest share in the total non-methane volatile organic compounds emissions were: 2D 'Non-energy products from fuels and solvent use' (76.1% of the total), 1A4 'Other sectors; (15.2% of the total), 2H 'Other' (food and alcoholic beverages) (3.1% of the total), 1A3 'Transport' (2.2% of the total), and 5A 'Solid waste disposal' (1.9% of the total) (Figure 2-19).

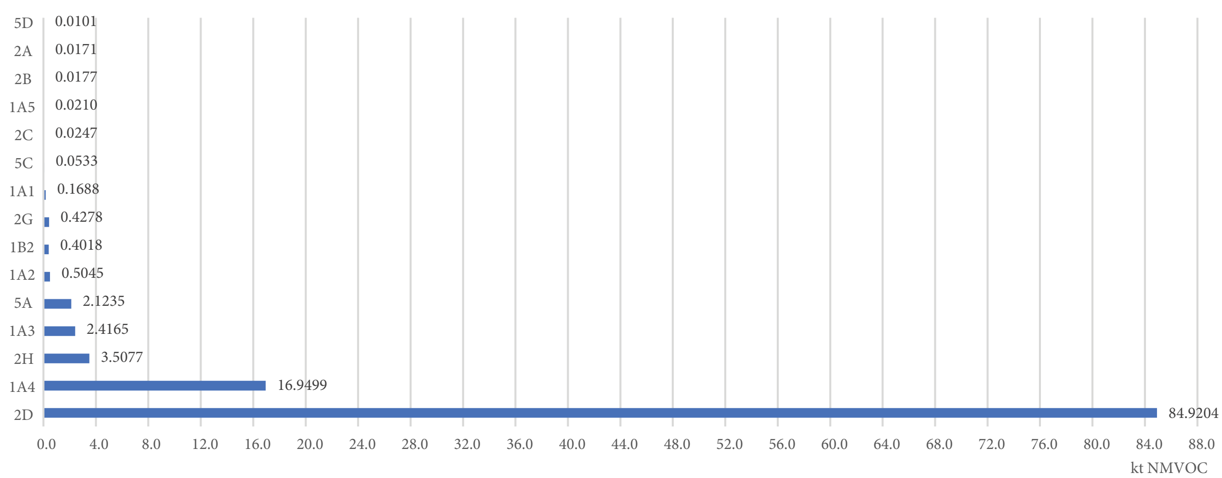


Figure 2-19: Total NMVOC emissions by source category in 2020.

The source categories with the highest share in the total sulphur dioxide emissions in 2020 were: 1A4 'Other sectors' (57.6% of the total), 1A2 'Manufacturing industries and construction' (18.1% of the total), 2A 'Mineral industry' (17.6% din total) and 1A5 'Other' (4.6% of the total) (Figure 2-20).

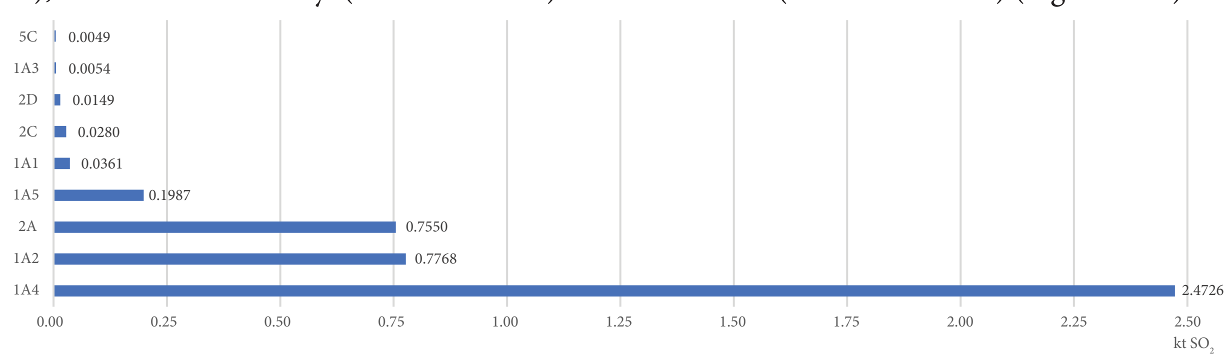


Figure 2-20: Total SO_2 emissions by source category in 2020.

3. ENERGY SECTOR

3.1. Overview

Sector 1 'Energy' includes GHG emissions resulting from electricity and heat production activities, and fuel combustion for energy generation purposes. Methodological guidance used fot the inventory of GHG emissions includes the 2006 IPCC Guidelines for National Greenhouse Gas Inventories (IPCC, 2006) (particularly for the estimation of direct GHG emissions) and the EMEP/EEA Air Pollutant Emission Inventory Guidebook (2019) (particularly for the estimation of indirect GHG emissions).

Under the Republic of Moldova's GHG Inventory, Sector 1 'Energy' covers GHG emissions generated by the following source categories:

Sector 1 'Energy'
Sub-sector 1A 'Fuel Combustion'

- Source category 1A1 'Energy Industries' (1A1a 'Main Activity Electricity and Heat Production', 1A1b 'Petroleum Refining');
- Source category 1A2 'Manufacturing Industries and Construction' (12 industries);
- Source category 1A3 'Transport' (1A3a 'Civil Aviation', 1A3b 'Road Transportation', 1A3c 'Rai-lways', 1A3d 'Navigation', 1A3e 'Other Transportation');
- Source category 1A4 'Other Sectors' (1A4a 'Commercial/Institutional', 1A4b 'Residential', 1A4c 'Agriculture/Forestry/Fishing');
- Source category 1A5 'Other'.

Sub-sector 1B 'Fugitive Emissions from Fuels'

- Source category 1B2 'Oil and Natural Gas'.

'Memo items'

- Source category 'International Aviation';
- Source category 'CO_2 Emissions from Biomass'.

A brief overview, methodological issues, uncertainty assessment and times-series consistency, QA/QC and verification, and information regarding recalculations made and planned improvements are described for each source category in this sector.

GHG emissions in Sector 1 'Energy' result from fuel combustion for power generation (electricity and heat); industrial production (for energy purposes); transport; residential sector; agriculture, forestry, fishing; and other sources.

3.1.1. Summary of Emission Trends

Between 1990 and 2020, the total GHG emissions from Sector 1 'Energy' recorded a downward trend, decreasing by 74.2% (Table 3-1, Figure 3-1).

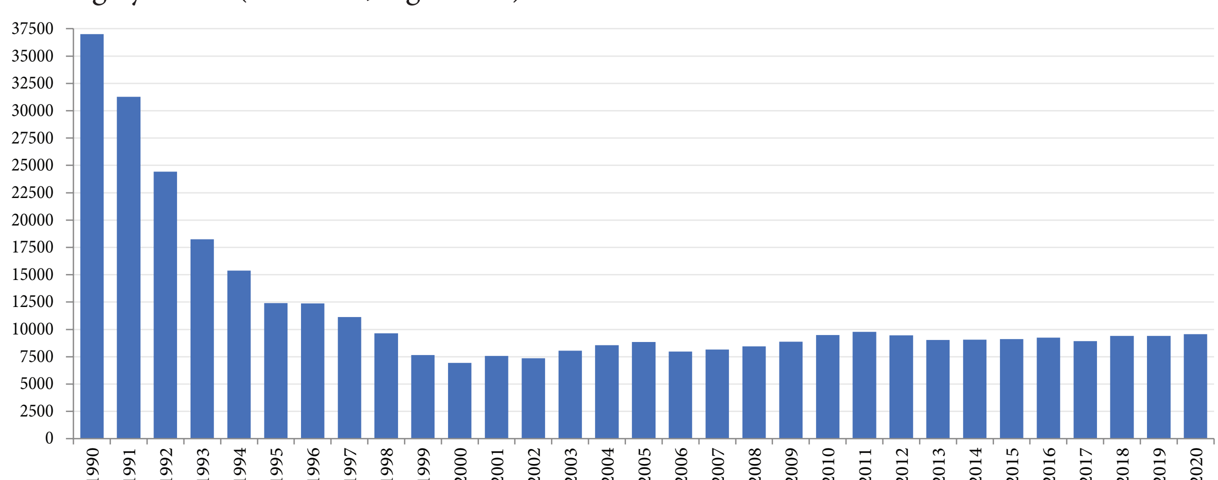


Figure 3-1: Total direct GHG emissions from Sector 1 'Energy' between 1990 and 2020, kt CO_2 equivalent.

Table 3-1: Total direct GHG emissions from Sector 1 'Energy' in the Republic of Moldova between 1990-2020

	1990	1991	1992	1993	1994	1995	1996	1997
Sector 1 'Energy', kt CO_2 equivalent	36,992.93	31,258.69	24,419.84	18,253.96	15,377.49	12,391.35	12,373.96	11,120.62
%, compared to 1990	100.0	84.5	66.0	49.3	41.6	33.5	33.4	30.1
	1998	1999	2000	2001	2002	2003	2004	2005
Sector 1 'Energy', kt CO_2 equivalent	9,652.00	7,640.28	6,940.88	7,570.06	7,355.70	8,041.88	8,545.94	8,836.49
%, compared to 1990	26.1	20.7	18.8	20.5	19.9	21.7	23.1	23.9
	2006	2007	2008	2009	2010	2011	2012	2013
Sector 1 'Energy', kt CO_2 equivalent	7,982.09	8,154.68	8,450.92	8,875.33	9,496.42	9,787.59	9,465.24	9,035.88
%, compared to 1990	21.6	22.0	22.8	24.0	25.7	26.5	25.6	24.4
	2014	2015	2016	2017	2018	2019	2020	%
Sector 1 'Energy', kt CO_2 equivalent	9,069.71	9,119.65	9,256.62	8,924.91	9,406.86	9,401.42	9,549.89	-74.2
%, compared to 1990	24.5	24.7	25.0	24.1	25.4	25.4	25.8	

Compared to the base year (1990), direct GHG emissions had decreased significantly by 2020: CO_2 emissions constituted circa 25.3% of the base year level, CH_4 emissions – 37.5%, N_2O emissions – 32.1%, and direct GHG emissions (CO_2 equivalent) – 25.8% (Table 3-2, Figure 3-2).

Table 3-2: Total direct GHG emissions from Sector 1 'Energy' between 1990 and 2020

	Sector 1 'Energy', kt CO_2 equivalent				% of the total			%, compared to 1990			
	CO_2	CH_4	N_2O	Total	CO_2	CH_4	N_2O	CO_2	CH_4	N_2O	Total
1990	35,401.10	1,246.22	345.60	36,992.93	95.7	3.4	0.9	100.0	100.0	100.0	100.0
1991	29,898.25	1,103.05	257.39	31,258.69	95.6	3.5	0.8	84.5	88.5	74.5	84.5
1992	23,310.73	929.40	179.71	24,419.84	95.5	3.8	0.7	65.8	74.6	52.0	66.0
1993	17,340.75	764.20	149.01	18,253.96	95.0	4.2	0.8	49.0	61.3	43.1	49.3
1994	14,491.66	751.17	135.17	15,378.00	94.2	4.9	0.9	40.9	60.3	39.1	41.6
1995	11,476.32	786.75	128.28	12,391.35	92.6	6.3	1.0	32.4	63.1	37.1	33.5
1996	11,379.84	882.53	111.59	12,373.96	92.0	7.1	0.9	32.1	70.8	32.3	33.4
1997	10,275.21	743.21	102.20	11,120.62	92.4	6.7	0.9	29.0	59.6	29.6	30.1
1998	8,891.03	681.34	79.62	9,652.00	92.1	7.1	0.8	25.1	54.7	23.0	26.1
1999	6,913.78	672.13	54.37	7,640.28	90.5	8.8	0.7	19.5	53.9	15.7	20.7
2000	6,189.88	702.51	48.48	6,940.88	89.2	10.1	0.7	17.5	56.4	14.0	18.8
2001	6,819.36	700.83	49.87	7,570.06	90.1	9.3	0.7	19.3	56.2	14.4	20.5
2002	6,538.31	753.43	63.96	7,355.70	88.9	10.2	0.9	18.5	60.5	18.5	19.9
2003	7,179.54	800.15	62.20	8,041.88	89.3	9.9	0.8	20.3	64.2	18.0	21.7
2004	7,630.44	852.53	62.97	8,545.94	89.3	10.0	0.7	21.6	68.4	18.2	23.1
2005	7,873.98	899.54	62.96	8,836.49	89.1	10.2	0.7	22.2	72.2	18.2	23.9
2006	7,114.22	803.38	64.49	7,982.09	89.1	10.1	0.8	20.1	64.5	18.7	21.6
2007	7,251.25	841.08	62.35	8,154.68	88.9	10.3	0.8	20.5	67.5	18.0	22.0
2008	7,548.68	838.84	63.40	8,450.92	89.3	9.9	0.8	21.3	67.3	18.3	22.8
2009	8,093.86	723.85	57.61	8,875.33	91.2	8.2	0.6	22.9	58.1	16.7	24.0
2010	8,719.05	714.64	62.73	9,496.42	91.8	7.5	0.7	24.6	57.3	18.2	25.7
2011	8,926.90	796.20	64.49	9,787.59	91.2	8.1	0.7	25.2	63.9	18.7	26.5
2012	8,614.85	790.23	60.16	9,465.24	91.0	8.3	0.6	24.3	63.4	17.4	25.6
2013	8,227.64	742.86	65.37	9,035.88	91.1	8.2	0.7	23.2	59.6	18.9	24.4
2014	8,214.86	782.12	72.74	9,069.71	90.6	8.6	0.8	23.2	62.8	21.0	24.5
2015	8,277.62	762.77	79.26	9,119.65	90.8	8.4	0.9	23.4	61.2	22.9	24.7
2016	8,353.89	817.70	85.03	9,256.62	90.2	8.8	0.9	23.6	65.6	24.6	25.0
2017	7,934.35	891.86	98.69	8,924.91	88.9	10.0	1.1	22.4	71.6	28.6	24.1
2018	8,350.55	942.92	113.40	9,406.86	88.8	10.0	1.2	23.6	75.7	32.8	25.4
2019	8,583.68	703.73	114.01	9,401.42	91.3	7.5	1.2	24.2	56.5	33.0	25.4
2020	8,972.11	466.87	110.92	9,549.89	93.9	4.9	1.2	25.3	37.5	32.1	25.8

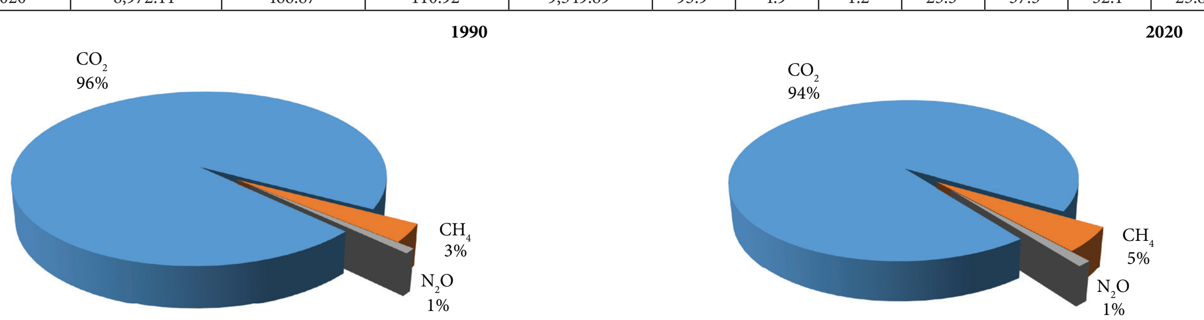


Figure 3-2: Share of direct GHG emissions from Sector 1 'Energy' in total direct GHG emissions in 1990 and 2020, % of total.

Compared to the base year (1990), GHG emissions in the Republic of Moldova had decreased significantly by 2020: CO_2 emissions constituted 25.3% of the 1990 level, CH_4 emissions – 37.5%, N_2O emissions – 32.1%, NO_x emissions – 24.5%, CO emissions – 50.4%, NMVOC emissions – 64.1%, and SO_2 emissions – 2.3% (Table 3-3).

Table 3-3: GHG emissions from Sector 1 'Energy' between 1990-2020

	Sector 1 'Energy', kt							%, compared to 1990						
	CO_2	CH_4	N_2O	NO_x	CO	NMVOC	SO_2	CO_2	CH_4	N_2O	NO_x	CO	NMVOC	SO_2
1990	35,401.10	49.85	1.16	91.64	270.66	31.90	148.72	100.0	100.0	100.0	100.0	100.0	100.0	100.0
1991	29,898.25	44.12	0.86	74.83	196.16	23.20	123.15	84.5	88.5	74.5	81.7	72.5	72.7	82.8
1992	23,310.73	37.18	0.60	56.50	124.60	15.09	91.17	65.8	74.6	52.0	61.7	46.0	47.3	61.3
1993	17,340.75	30.57	0.50	44.67	61.05	8.24	71.70	49.0	61.3	43.1	48.7	22.6	25.8	48.2
1994	14,491.66	30.05	0.45	35.06	68.54	8.88	56.87	40.9	60.3	39.1	38.3	25.3	27.8	38.2
1995	11,476.32	31.47	0.43	29.49	58.25	7.31	31.31	32.4	63.1	37.1	32.2	21.5	22.9	21.0
1996	11,379.84	35.30	0.37	27.68	71.35	8.77	31.56	32.1	70.8	32.3	30.2	26.4	27.5	21.2
1997	10,275.21	29.73	0.34	24.53	64.65	7.96	16.25	29.0	59.6	29.6	26.8	23.9	24.9	10.9
1998	8,891.03	27.25	0.27	20.53	49.21	6.41	12.01	25.1	54.7	23.0	22.4	18.2	20.1	8.1
1999	6,913.78	26.89	0.18	14.81	37.01	5.04	5.50	19.5	53.9	15.7	16.2	13.7	15.8	3.7
2000	6,189.88	28.10	0.16	13.51	34.62	4.92	3.97	17.5	56.4	14.0	14.7	12.8	15.4	2.7
2001	6,819.36	28.03	0.17	14.92	33.48	4.83	3.48	19.3	56.2	14.4	16.3	12.4	15.1	2.3
2002	6,538.31	30.14	0.21	15.54	40.73	5.92	4.27	18.5	60.5	18.5	17.0	15.0	18.5	2.9
2003	7,179.54	32.01	0.21	16.51	49.79	7.07	5.74	20.3	64.2	18.0	18.0	18.4	22.2	3.9
2004	7,630.44	34.10	0.21	17.71	46.76	7.13	4.83	21.6	68.4	18.2	19.3	17.3	22.4	3.2
2005	7,873.98	35.98	0.21	18.10	48.44	7.24	4.43	22.2	72.2	18.2	19.8	17.9	22.7	3.0
2006	7,114.22	32.14	0.22	17.04	49.39	7.35	4.55	20.1	64.5	18.7	18.6	18.2	23.0	3.1
2007	7,251.25	33.64	0.21	17.45	42.96	6.75	3.10	20.5	67.5	18.0	19.0	15.9	21.2	2.1
2008	7,548.68	33.55	0.21	18.14	45.66	7.35	4.67	21.3	67.3	18.3	19.8	16.9	23.0	3.1
2009	8,093.86	28.95	0.19	18.03	45.99	7.22	4.69	22.9	58.1	16.7	19.7	17.0	22.6	3.2
2010	8,719.05	28.59	0.21	19.97	48.68	7.26	4.81	24.6	57.3	18.2	21.8	18.0	22.8	3.2
2011	8,926.90	31.85	0.22	20.31	51.12	7.87	4.81	25.2	63.9	18.7	22.2	18.9	24.7	3.2
2012	8,614.85	31.61	0.20	19.22	49.89	7.66	4.97	24.3	63.4	17.4	21.0	18.4	24.0	3.3
2013	8,227.64	29.71	0.22	19.35	50.93	7.60	12.45	23.2	59.6	18.9	21.1	18.8	23.8	8.4
2014	8,214.86	31.28	0.24	19.16	77.82	11.73	4.68	23.2	62.8	21.0	20.9	28.8	36.8	3.1
2015	8,277.62	30.51	0.27	20.10	81.97	12.28	4.22	23.4	61.2	22.9	21.9	30.3	38.5	2.8
2016	8,353.89	32.71	0.29	20.95	85.70	13.00	3.44	23.6	65.6	24.6	22.9	31.7	40.7	2.3
2017	7,934.35	35.67	0.33	21.24	107.79	16.21	4.32	22.4	71.6	28.6	23.2	39.8	50.8	2.9
2018	8,350.55	37.72	0.38	22.63	156.72	23.69	3.58	23.6	75.7	32.8	24.7	57.9	74.3	2.4
2019	8,583.68	28.15	0.38	23.01	141.65	21.18	4.46	24.2	56.5	33.0	25.1	52.3	66.4	3.0
2020	8,972.11	18.67	0.37	22.47	136.33	20.46	3.49	25.3	37.5	32.1	24.5	50.4	64.1	2.3

Table 3-4, Figures 3-3 and 3.4 show the evolution of GHG emissions by source category in Sector 1 'Energy' of the Republic of Moldova between 1990 and 2020, and the share of each source category from the total per sector for the same period, respectively.

Table 3-4: Direct GHG emissions by source category from Sector 1 'Energy' between 1990-2020

	Sector 1 'Energy', kt CO_2 equivalent							share of each category, % of total					
	1A1	1A2	1A3	1A4	1A5	1B2	Total	1A1	1A2	1A3	1A4	1A5	1B2
1990	21,364.24	1,921.76	4,838.64	7,841.31	115.57	911.41	36,992.93	57.75	5.19	13.08	21.20	0.31	2.46
1991	18,984.17	1,287.13	3,769.31	6,248.30	107.57	862.20	31,258.69	60.73	4.12	12.06	19.99	0.34	2.76
1992	15,706.26	935.00	2,699.86	4,221.52	78.53	778.67	24,419.84	64.32	3.83	11.06	17.29	0.32	3.19
1993	12,679.18	619.48	1,920.97	2,240.23	94.33	699.78	18,253.96	69.46	3.39	10.52	12.27	0.52	3.83
1994	9,992.56	737.87	1,656.54	2,227.11	89.02	674.40	15,377.49	64.98	4.80	10.77	14.48	0.58	4.39
1995	7,192.41	387.00	1,660.34	2,286.22	126.55	738.83	12,391.35	58.04	3.12	13.40	18.45	1.02	5.96
1996	7,124.41	327.03	1,619.22	2,411.71	82.80	808.79	12,373.96	57.58	2.64	13.09	19.49	0.67	6.54
1997	5,625.67	564.95	1,555.14	2,611.65	77.46	685.76	11,120.62	50.59	5.08	13.98	23.48	0.70	6.17
1998	4,844.68	540.32	1,397.91	2,156.43	73.68	638.98	9,652.00	50.19	5.60	14.48	22.34	0.76	6.62
1999	3,664.69	484.70	932.11	1,875.25	49.80	633.73	7,640.28	47.97	6.34	12.20	24.54	0.65	8.29
2000	3,159.33	521.63	1,005.66	1,552.95	36.80	664.51	6,940.88	45.52	7.52	14.49	22.37	0.53	9.57
2001	3,681.93	602.80	1,087.35	1,488.15	43.88	665.96	7,570.06	48.64	7.96	14.36	19.66	0.58	8.80
2002	2,936.80	412.30	1,442.41	1,814.59	40.13	709.48	7,355.70	39.93	5.61	19.61	24.67	0.55	9.65
2003	3,040.38	440.49	1,625.88	2,161.78	28.81	744.54	8,041.88	37.81	5.48	20.22	26.88	0.36	9.26
2004	3,110.79	449.04	1,828.60	2,325.26	28.02	804.23	8,545.94	36.40	5.25	21.40	27.21	0.33	9.41
2005	3,233.26	577.38	1,866.99	2,283.75	26.28	848.82	8,836.49	36.59	6.53	21.13	25.84	0.30	9.61
2006	2,495.92	635.99	1,787.95	2,274.88	39.49	747.86	7,982.09	31.27	7.97	22.40	28.50	0.49	9.37
2007	2,893.82	802.37	1,894.81	1,721.37	45.12	797.19	8,154.68	35.49	9.84	23.24	21.11	0.55	9.78
2008	2,994.61	887.28	1,999.17	1,732.08	44.17	793.60	8,450.92	35.44	10.50	23.66	20.50	0.52	9.39
2009	3,840.34	503.07	1,964.24	1,881.51	10.60	675.57	8,875.33	43.27	5.67	22.13	21.20	0.12	7.61
2010	4,052.97	517.26	2,188.80	2,047.36	27.52	662.51	9,496.42	42.68	5.45	23.05	21.56	0.29	6.98
2011	3,750.73	577.52	2,322.56	2,375.67	19.95	741.17	9,787.59	38.32	5.90	23.73	24.27	0.20	7.57
2012	3,807.85	540.29	2,037.01	2,341.96	7.01	731.12	9,465.24	40.23	5.71	21.52	24.74	0.07	7.72

	Sector 1 'Energy', kt CO_2 equivalent							share of each category, % of total						
	1A1	1A2	1A3	1A4	1A5	1B2	Total	1A1	1A2	1A3	1A4	1A5	1B2
2013	3,604.02	579.17	2,145.88	2,021.66	2.39	682.76	9,035.88	39.89	6.41	23.75	22.37	0.03	7.56
2014	3,560.30	565.23	2,182.58	2,067.07	25.16	669.37	9,069.71	39.25	6.23	24.06	22.79	0.28	7.38
2015	3,688.09	518.38	2,307.83	1,939.22	22.87	643.26	9,119.65	40.44	5.68	25.31	21.26	0.25	7.05
2016	3,648.58	489.61	2,481.61	1,925.30	22.99	688.53	9,256.62	39.42	5.29	26.81	20.80	0.25	7.44
2017	2,999.50	502.80	2,503.58	2,175.96	22.74	720.33	8,924.91	33.61	5.63	28.05	24.38	0.25	8.07
2018	3,258.64	595.62	2,581.89	2,267.80	23.46	679.45	9,406.86	34.64	6.33	27.45	24.11	0.25	7.22
2019	3,127.51	720.02	2,665.43	2,393.79	22.98	471.69	9,401.42	33.27	7.66	28.35	25.46	0.24	5.02
2020	3,637.97	803.65	2,511.91	2,332.06	22.49	241.81	9,549.89	38.09	8.42	26.30	24.42	0.24	2.53

The source category with the largest share in the national direct GHG emissions from Sector 1 'Energy' is 1A1 'Energy Industries', with a decreasing share from 57.8% (1990) to 38.1% (2020).

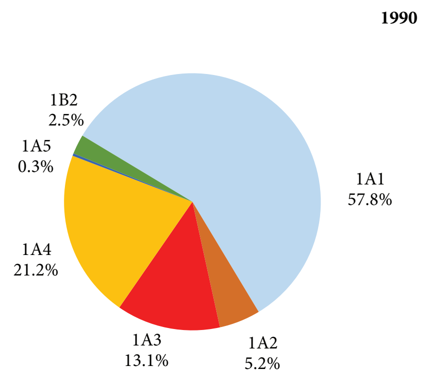


Figure 3-3: The share of different source categories in the structure of total direct GHG emissions from Sector 1 'Energy' in 1990, % of total.

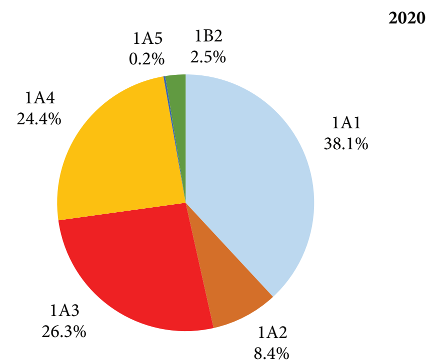


Figure 3-4: The share of different source categories in the structure of total direct GHG emissions from Sector 1 'Energy' in 2020, % of total.

Compared to the level recorded in 1990, by 2020, the share of certain categories had increased in the structure of total sectoral direct GHG emissions: 1A2 'Manufacturing Industries and Construction' (from 5.2% to 8.4%), 1A3 'Transport' (from 13.1% to 26.3%), 1A4 'Other Sectors' (from 21.2% to 24.4%), 1B2 'Fugitive Emissions from Oil and Natural Gas' -2.5% (1990, 2020) (Table 3-4, Figure 3-5, 3-6).

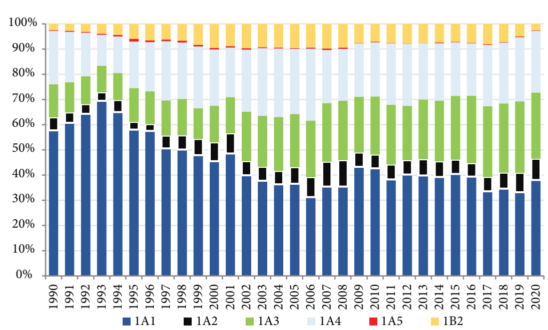


Figure 3-5: The share of different source categories in the structure of total direct GHG emissions from Sector 1 'Energy' for the period 1990-2020, % of total.

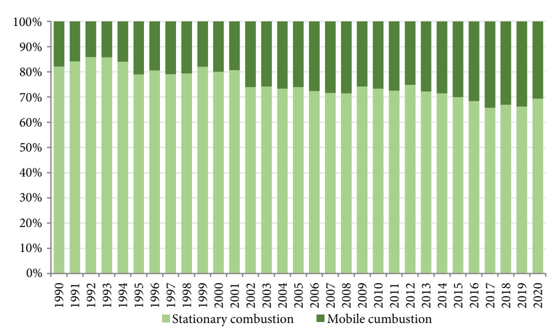


Figure 3-6: The share of direct GHG emissions from 'Stationary combustion' and 'Mobile combustion' in Sector 1 'Energy', % of total from sub-sector 1A.

The share of GHG emissions originating from sub-sector 'Stationary combustion', source categories 1A1, 1A2, 1A4 and 1A5, decreased from 82.1% (1990) to 69.3% (2020). Respectively, the share of GHG emissions originating from sub-sector 'Mobile mombustion', source categories 1A3, 1A4 and 1A5, increased from 17.9% to 30.7% (Table 3-5).

Table 3-5: GHG emissions from 'Stationary combustion' and 'Mobile combustion' within Sector 1 'Energy'

	Sector 1 'Energy', kt CO_2 equivalent			% of total		%, compared to 1990	
	Stationary	Mobile	Total	Stationary	Mobile	Stationary	Mobile
1990	29,622.16	6,459.36	36,081.52	82.1	17.9	100	100
1991	25,575.69	4,820.81	30,396.49	84.1	15.9	86.3	74.6
1992	20,294.97	3,346.21	23,641.17	85.8	14.2	68.5	51.8
1993	15,056.92	2,497.26	17,554.18	85.8	14.2	50.8	38.7

	Sector 1 'Energy', kt CO_2 equivalent			% of total		%, compared to 1990	
	Stationary	Mobile	Total	Stationary	Mobile	Stationary	Mobile
1994	12,350.14	2,352.96	14,703.10	84.0	16.0	41.7	36.4
1995	9,203.82	2,448.70	11,652.52	79.0	21.0	31.1	37.9
1996	9,314.94	2,250.23	11,565.17	80.5	19.5	31.4	34.8
1997	8,252.21	2,182.65	10,434.86	79.1	20.9	27.9	33.8
1998	7,153.60	1,859.41	9,013.01	79.4	20.6	24.1	28.8
1999	5,745.20	1,261.34	7,006.55	82.0	18.0	19.4	19.5
2000	5,020.57	1,255.79	6,276.37	80.0	20.0	16.9	19.4
2001	5,569.18	1,334.92	6,904.11	80.7	19.3	18.8	20.7
2002	4,916.92	1,729.31	6,646.23	74.0	26.0	16.6	26.8
2003	5,411.70	1,885.64	7,297.34	74.2	25.8	18.3	29.2
2004	5,673.53	2,068.18	7,741.71	73.3	26.7	19.2	32.0
2005	5,908.54	2,079.13	7,987.67	74.0	26.0	19.9	32.2
2006	5,233.71	2,000.52	7,234.24	72.3	27.7	17.7	31.0
2007	5,267.51	2,089.98	7,357.49	71.6	28.4	17.8	32.4
2008	5,474.25	2,183.07	7,657.31	71.5	28.5	18.5	33.8
2009	6,082.38	2,117.37	8,199.75	74.2	25.8	20.5	32.8
2010	6,474.37	2,359.54	8,833.91	73.3	26.7	21.9	36.5
2011	6,556.73	2,489.69	9,046.42	72.5	27.5	22.1	38.5
2012	6,537.12	2,196.99	8,734.12	74.8	25.2	22.1	34.0
2013	6,032.38	2,320.73	8,353.12	72.2	27.8	20.4	35.9
2014	6,000.92	2,399.43	8,400.35	71.4	28.6	20.3	37.1
2015	5,927.74	2,544.69	8,472.42	70.0	30.0	20.0	39.4
2016	5,854.88	2,709.17	8,564.05	68.4	31.6	19.8	41.9
2017	5,387.88	2,812.84	8,200.73	65.7	34.3	18.2	43.5
2018	5,835.23	2,889.12	8,724.35	66.9	33.1	19.7	44.7
2019	5,913.00	3,015.39	8,928.39	66.2	33.8	20.0	46.7
2020	6,447.80	2,858.72	9,306.52	69.3	30.7	21.8	44.3

In the structure of the total GHG emissions originating from Sector 1 'Energy', the share of fugitive emissions from sub-sector 1B 'Fugitive emissions from fuels' recorded an upward trend – from 2.46% in 1990 and 2.53% in 2020. Respectively, the share of GHG emissions originating from sub-sector 1A 'Fuel Combustion' recorded a downward trend – from 97.54% in 1990 and 97.47% in 2020 (Figure 3-7, Table 3-6).

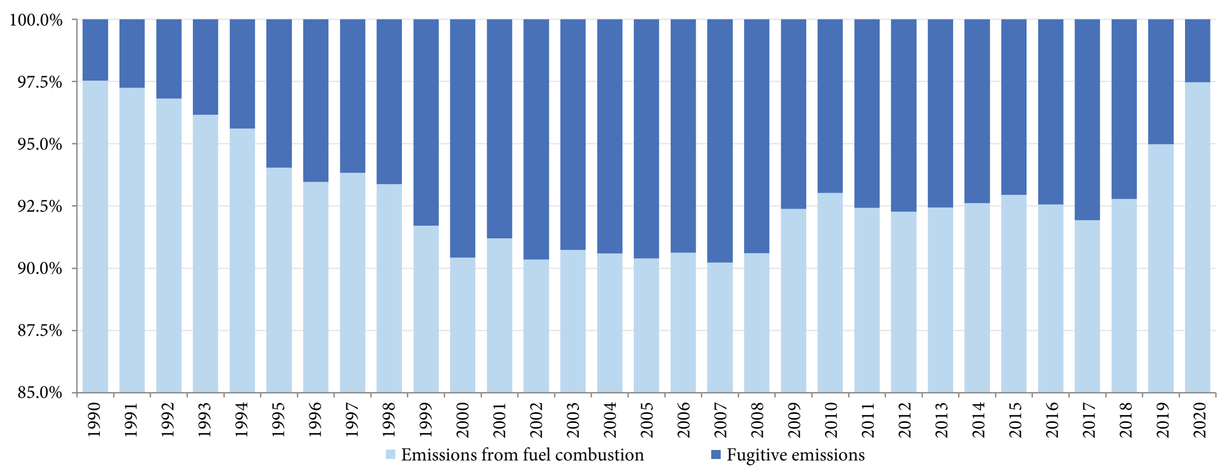


Figure 3-7: Share of GHG emissions from sub-sectors 1A 'Fuel Combustion' and 1B 'Fugitive Emissions from Fuels' within Sector 1 'Energy' for the period 1990-2020, % of total.

Table 3-6: Direct GHG emissions from sub-sectors 1A 'Fuel Combustion' and 1B 'Fugitive Emissions from Fuels' within Sector 1 'Energy' between 1990-2020

	Sector 1 'Energy', kt CO_2 equivalent			% of total		%, compared to 1990		
	1A Fuel Combustion	1B Fugitive Emissions	Total	1A Fuel Combustion	1B Fugitive Emissions	1A Fuel Combustion	1B Fugitive Emissions	Total
1990	36,081.52	911.41	36,992.93	97.54	2.46	100.0	100.0	100.0
1991	30,396.49	862.20	31,258.69	97.24	2.76	84.2	94.6	84.5
1992	23,641.17	778.67	24,419.84	96.81	3.19	65.5	85.4	66.0
1993	17,554.18	699.78	18,253.96	96.17	3.83	48.7	76.8	49.3
1994	14,703.10	674.40	15,377.49	95.61	4.39	40.7	74.0	41.6
1995	11,652.52	738.83	12,391.35	94.04	5.96	32.3	81.1	33.5
1996	11,565.17	808.79	12,373.96	93.46	6.54	32.1	88.7	33.4
1997	10,434.86	685.76	11,120.62	93.83	6.17	28.9	75.2	30.1
1998	9,013.01	638.98	9,652.00	93.38	6.62	25.0	70.1	26.1

	Sector 1 'Energy', kt CO_2 equivalent			% of total		%, compared to 1990		
	1A Fuel Combustion	1B Fugitive Emissions	Total	1A Fuel Combustion	1B Fugitive Emissions	1A Fuel Combustion	1B Fugitive Emissions	Total
1999	7,006.55	633.73	7,640.28	91.71	8.29	19.4	69.5	20.7
2000	6,276.37	664.51	6,940.88	90.43	9.57	17.4	72.9	18.8
2001	6,904.11	665.96	7,570.06	91.20	8.80	19.1	73.1	20.5
2002	6,646.23	709.48	7,355.70	90.35	9.65	18.4	77.8	19.9
2003	7,297.34	744.54	8,041.88	90.74	9.26	20.2	81.7	21.7
2004	7,741.71	804.23	8,545.94	90.59	9.41	21.5	88.2	23.1
2005	7,987.67	848.82	8,836.49	90.39	9.61	22.1	93.1	23.9
2006	7,234.24	747.86	7,982.09	90.63	9.37	20.0	82.1	21.6
2007	7,357.49	797.19	8,154.68	90.22	9.78	20.4	87.5	22.0
2008	7,657.31	793.60	8,450.92	90.61	9.39	21.2	87.1	22.8
2009	8,199.75	675.57	8,875.33	92.39	7.61	22.7	74.1	24.0
2010	8,833.91	662.51	9,496.42	93.02	6.98	24.5	72.7	25.7
2011	9,046.42	741.17	9,787.59	92.43	7.57	25.1	81.3	26.5
2012	8,734.12	731.12	9,465.24	92.28	7.72	24.2	80.2	25.6
2013	8,353.12	682.76	9,035.88	92.44	7.56	23.2	74.9	24.4
2014	8,400.35	669.37	9,069.71	92.62	7.38	23.3	73.4	24.5
2015	8,476.39	643.26	9,119.65	92.95	7.05	23.5	70.6	24.7
2016	8,568.09	688.53	9,256.62	92.56	7.44	23.7	75.5	25.0
2017	8,204.58	720.33	8,924.91	91.93	8.07	22.7	79.0	24.1
2018	8,727.41	679.45	9,406.86	92.78	7.22	24.2	74.5	25.4
2019	8,929.72	471.69	9,401.42	94.98	5.02	24.7	51.8	25.4
2020	9,308.08	241.81	9,549.89	97.47	2.53	25.8	26.5	25.8

3.1.2. Key Categories

The results of key category analysis (with LULUCF), which were carried out following a Tier 1 approach are provided in Chapter 1.5 of this Report.

Table 3-7 provides information on identified key categories (assessment by level – L, and trend – T) in Sector 1 'Energy'.

Table 3-7: Key categories in Sector 1 'Energy'

IPCC Categories	GHG	Source Categories	Without LULUCF				With LULUCF			
			T1		T2		T1		T2	
			L	T	L	T	L	T	L	T
1.A.1	CO_2	CO_2 Emissions from Energy Industries – Gaseous Fuels	X	X	X	X	X	X	X	X
1.A.1	CH_4	CO_2 Emissions from Energy Industries – Gaseous Fuels								
1.A.1	N_2O	CO_2 Emissions from Energy Industries – Gaseous Fuels								
1.A.1	CO_2	CO_2 Emissions from Energy Industries – Liquid Fuels	X	X	X	X	X	X	X	X
1.A.1	CH_4	CO_2 Emissions from Energy Industries – Liquid Fuels								
1.A.1	N_2O	CO_2 Emissions from Energy Industries – Liquid Fuels								
1.A.1	CO_2	CO_2 Emissions from Energy Industries – Solid Fuels	X	X	X	X	X	X	X	X
1.A.1	CH_4	CO_2 Emissions from Energy Industries – Solid Fuels								
1.A.1	N_2O	CO_2 Emissions from Energy Industries – Solid Fuels								
1.A.2	CO_2	CO_2 Emissions from Manufacturing Industries and Construction	X	X	X	X	X	X	X	X
1.A.2	CH_4	CH_4 Emissions from Manufacturing Industries and Construction								
1.A.2	N_2O	N_2O Emissions from Manufacturing Industries and Construction								
1.A.3a	CO_2	CO_2 Emissions from Civil Aviation								
1.A.3a	CH_4	CH_4 Emissions from Civil Aviation								
1.A.3a	N_2O	N_2O Emissions from Civil Aviation								
1.A.3b	CO_2	CO_2 Emissions from Road Transportation	X	X	X	X	X	X	X	X
1.A.3b	CH_4	CH_4 Emissions from Road Transportation								
1.A.3b	N_2O	N_2O Emissions from Road Transportation								
1.A.3c	CO_2	CO_2 Emissions from Railways	X	X			X	X		
1.A.3c	CH_4	CH_4 Emissions from Railways								
1.A.3c	N_2O	N_2O Emissions from Railways								
1.A.3d	CO_2	CO_2 Emissions from Water-borne Navigation								
1.A.3d	CH_4	CH_4 Emissions from Water-borne Navigation								
1.A.3d	N_2O	N_2O Emissions from Water-borne Navigation								
1.A.3e	CO_2	CO_2 Emissions from Other Transportation								
1.A.3e	CH_4	CH_4 Emissions from Other Transportation								
1.A.3e	N_2O	N_2O Emissions from Other Transportation								
1.A.4a	CO_2	CO_2 Emissions from the Commercial/Institutional Sector	X	X	X		X	X	X	
1.A.4a	CH_4	CH_4 Emissions from the Commercial/Institutional Sector								
1.A.4a	N_2O	N_2O Emissions from the Commercial/Institutional Sector								
1.A.4b	CO_2	CO_2 Emissions from the Residential Sector	X	X	X		X	X	X	
1.A.4b	CH_4	CH_4 Emissions from the Residential Sector	X	X	X	X	X	X	X	X
1.A.4b	N_2O	N_2O Emissions from the Residential Sector								
1.A.4c	CO_2	CO_2 Emissions from Agriculture/Forestry/Fishing	X	X			X	X	X	

IPCC Categories	GHG	Source Categories	Without LULUCF				With LULUCF			
			T1		T2		T1		T2	
			L	T	L	T	L	T	L	T
1.A.4c	CH_4	CH_4 Emissions from Agriculture/Forestry/Fishing								
1.A.4c	N_2O	N_2O Emissions from Agriculture/Forestry/Fishing								
1.A.5	CO_2	CO_2 Emissions from Other Transportation								
1.A.5	CH_4	CH_4 Emissions from Other Transportation								
1.A.5	N_2O	N_2O Emissions from Other Transportation								
1.B.2	CO_2	CO_2 Fugitive Emissions from Oil and Natural Gas								
1.B.2	CH_4	CH_4 Fugitive Emissions from Oil and Natural Gas	X	X	X		X		X	
1.B.2	N_2O	N_2O Fugitive Emissions from Oil and Natural Gas								

Abbreviations: L –Level Assessment; T –Trend Assessment; T1 –Tier 1; T2 –Tier 2.

3.1.3. Methodological Issues

Under Sector 1 'Energy', there were estimated GHG emissions originating from 5 source categories within sub-sector 1A 'Fuel Combustion' (1A1, 1A2, 1A3, 1A4 and 1A5), one source category within sub-sector 1B 'Fugitive Emissions from Fuels' (1B2) and 2 source categories under Memo Items ('International Aviation', and 'CO_2 Emissions from Biomass'). GHG emissions originating from Sector 1 'Energy' were estimated following a Tier 1 approach, except 'International Aviation', for which a Tier 2 methodology was applied (Table 3-8).

Table 3-8: Methods used to estimate GHG emissions from Sector 1 'Energy'

IPCC Categories	Source Category	Method	EF
1.A.1	Energy Industries	T1	D, CS
1.A.2	Manufacturing Industries and Construction	T1	D, CS
1.A.3	Transport (Civil Aviation, Road Transportation, Railways, Navigation, Pipeline Transport)	T1, T3	D, CS
1.A.4	Other Sectors (Commercial/Institutional, Residential, Agriculture/Forestry/Fishing)	T1	D, CS
1.A.5	Other (Stationary/Mobile)	T1	D, CS
1.B.2	Fugitive Emissions from Oil and Natural Gas	T1	D
Memo items	International Aviation	T2	D, CS
Memo items	CO_2 Emissions from Biomass	T1	D, CS

Abbreviations: T1 – Tier 1; T2 – Tier 2; EF – Emission Factors; D – Default Values; CS – Country Specific.

For natural gas, country specific net annual average caloric values were used, thus emissions from combustion of this particular type of fuel were estimated using a Tier 2 approach. For Road Transportation, GHG emissions were estimated using a Tier 3 approach (the COPERT 4.9 model program was tested); this change, however, was possible only for the years 1990, 1995, 2004-2020, but the results obtained are still preliminary. The basic equation used to estimate GHG emissions under Sector 1 'Energy' is described below (the estimation of SO_2 emissions is described in Annex 3-1.1 of this Report):

$$GHG\ Emissions = \Sigma\ (Fuel\ Consumption_j \bullet Emission\ Factor_j),$$

where: j – type of fuel.

The main source of reference for activity data used for estimating GHG emissions under the Sector 1 'Energy' is the National Bureau of Statistics (NBS), through its annual publication – Energy Balances of the Republic of Moldova for the years 1990, 1993-2020 (the Energy Balances for 2020 is presented in Annex 2) and Statistical Yearbooks, including those of the ATULBD (activity data regarding fuel consumption on the territory on the Left Bank of the Dniester River are available in Annex 3-1.2).

In order to estimate emissions from all source categories within this sector, a large amount of detailed information on fuel consumption is needed. The main source of information is the Energy Balances of the Republic of Moldova, provided annually by the National Bureau of Statistics (NBS). At the same time, the information provided directly by enterprises in the field of energy, transport, as well as ministries and agencies is also useful. The legal base for data requests is assured by Law No. 93 of 26.05.2017 on Official Statistics, as well as Law No. 982 as of 11.05.2000 on Access to Information. The list of organisations that provide primary data for Sector 1 'Energy' is presented below:

1. National Bureau of Statistics, Direction for Industry, Energy and Construction Statistics;
2. JSC 'Termoelectrica' (subdivisions 'CHP-1', 'CHP-2' and 'Termoservice');
3. JSC 'CHP-North';
4. Ministry of Infrastructure and Regional Development of the Republic of Moldova;

5. Ministry of Defence, Service for Ecology and Environmental Protection;
6. Customs Service of the Republic of Moldova;
7. Public Services Agency;
8. Civil Aeronautical Authority of the Republic of Moldova;
9. SOE 'Moldova Railways';
10. 'Ungheni River Port', 'Giurgiulesti International Free Port', SOE 'Bacul Molovata';
11. JSC 'Moldovagaz';
12. Environmental Protection Inspectorate;
13. Institute of Power Engineering of the Ministry of Education and Research.

To be noted that the Energy Balance for the year 1990 ensures geographical coverage of the whole country, while the Energy Balances for the period 1993-2020 covered only the territory on the right bank of the Dniester River (in 1991-1992, the Energy Balances were not published; it should also be noted that for 1990 and 1993-2014, the Energy Balances were generated by the NBS in an MS DOS format, and only since 2015 were they generated and provided to users in an MS Excel form, which facilitates the data analysis and information use). The estimation of GHG emissions was based on country specific values (Table 3-9)

Table 3-9: Emission factors and other relevant parameters used to estimate GHG emissions from Sector 1 'Energy'

Fuel Type	Net Caloric Value (CS Values), TJ/kt		Net Caloric Value, TJ/kt		Emission Factors, t C/TJ		Carbon oxidation fraction	
	Ranges according to the BNS	Value used	IPCC, 1997	IPCC, 1997	IPCC, 1997	IPCC, 2006	IPCC, 1997	IPCC, 2006
Coal	15.40 - 29.13		18.58				0.98	1
Anthracite	22.83 - 29.13		18.58	26.7	26.8	26.8	0.98	1
Brown Coal, including:	6.31 - 15.37		14.65	11.9	27.6	27.6	0.98	1
from Donetsk Coal Basin	25.70	25.70			26.8		0.98	1
from Kuznetsk Coal Basin	25.44	25.44			26.8		0.98	1
from the Ukrainian Coal Basin	6.31 - 11.68	11.68			27.6		0.98	1
from Kansk-Acinsk Coal Basin	15.14	15.14			25.8		0.98	1
Coal Briquettes	17.75	17.75		20.7	25.8	26.6	0.98	1
Coke	26.41 - 29.05	26.41	18.58	28.2	25.8	25.8	0.98	1
Diesel Oil	42.54	42.54	43.33	43.0	20.2	20.2	0.99	1
Fuel for Oven	42.54	42.54			21.1		0.99	1
Residual Fuel Oil	39.02 - 40.20	40.20	40.19	40.4	21.1	21.1	0.99	1
Fuel for Engines	41.96	41.96			20.0		0.99	1
Including Jet engines	43.13				19.5		0.99	1
Aviation Gasoline	43.72	43.72	44.80	44.3	18.9	19.1	0.99	1
Gasoline	43.72	43.72	44.80	44.3	18.9	18.9	0.99	1
Kerosene	43.13	43.13	44.75	43.8	19.6	19.6	0.99	1
Lubricants	42.19	42.19	40.19	40.2	20.0	20.0	0.99	1
Bitumen	39.61	39.61	40.19	40.2	22.0	22.0	0.99	1
Other Oil Products	40.19	40.19	40.19	40.2	20.0	20.0	0.99	1
Natural Gas	33.15 - 34.03	33.86	33.70	48.0	15.3	15.3	0.995	1
Liquefied Petroleum Gases	46.06	46.06	47.31	47.3	17.2	17.2	0.99	1
Fuelwood	12.32	12.32	15	15.6	29.9	30.5	0.98	1
Agricultural Residues	14.67	14.67	15.2		29.9		0.98	1

Source: Instructions for Compiling the Statistical Report nr.1-EBs 'Energy Balance', approved through Order No. 88 of 24.09.2018 of the National Bureau of Statistics of the RM <https://statistica.gov.md/pageview.php?l=ro&id=6867&idc=627>.

In the Statistical Report No. 1-EB 'Energy Balance' and the 'Instructions for compiling the Statistical Report No. 1-EB', respectively, average caloric values are available for converting quantitative indicators for fuel from natural units to coal equivalent units (Table 3-10).

Table 3-10: The calculation method for the average caloric values based on the instructions for compiling the Statistical Report No. 1-EB 'Energy Balance'

Fuel Type	Unit	Average caloric values for converting natural fuels to coal equivalent units	Average caloric values, TJ/kt (estimated using the conversion coefficient 29.31 TJ/ktce)
Coal – total (from 0.778 to 0.993 kcal/t)			
Donetsk Coal	t	0.876	25.70
Coal rich in volatile matter	t	0.816	23.94
Long Flame Coal	t	0.782	22.94

Fuel Type	Unit	Average caloric values for converting natural fuels to coal equivalent units	Average caloric values, TJ/kt (estimated using the conversion coefficient 29.31 TJ/ktce)
Anthracite AS	t	0.888	26.05
Anthracite AK	t	0.993	29.13
Kuznetsk Coal	t	0.867	25.44
Lignite (from 0.215 to 0.524 kcal/t)			
Kansk-Acinsk Coal	t	0.516	15.14
Podmoskovnii Lignite	t	0.335	9.83
Ukrainian Brown Lignite	t	0.307	9.01
Brown Coal Briquettes	t	0.605	17.75
Coking Coal	t	0.990	29.05
Petroleum	t	1.430	41.96
Diesel Oil	t	1.450	42.54
Fuel for Oven	t	1.450	42.54
Residual Fuel Oil	t	1.370	40.20
Fuel for Jet Engines	t	1.470	43.13
Fuel for Diesel Engines	t	1.430	41.96
Aviation Gasoline	t	1.490	43.72
Gasoline	t	1.490	43.72
Kerosene for Tractors	t	1.470	43.13
Kerosene for lighting	t	1.470	43.13
Kerosene for Aviation	t	1.470	43.13
Lubricants	t	1.438	42.19
Bitumen	t	1.350	39.61
White-Spirit	t	1.474	43.25
Paraffin	t	1.479	43.39
Processed Oils	t c.e.	1.000	29.34
Other Oil Products	t	1.000	29.34
Natural Gas	1000 m^3 stand.	1.154	33.86
Liquefied Petroleum Gases	t	1.570	46.06
Fuelwood	1000 m^3 comp.	0.266	7.80
Wood Waste	t c.e.	1.000	29.31
Agricultural Fuel Residues	t c.e.	1.000	29.31
Other types of fuel	t c.e.	1.000	29.31
Electricity	million kWh	0.123	3.61
Heat	thousand Gcal	0.143	4.20

Source: <https://www.statistica.gov.md/>

The table below shows source categories in Sector 1 'Energy' for which statistical data regarding the territory on the left bank of the Dniester River are available (Table 3-11).

Table 3-11: Source categories in Sector 1 'Energy' for which statistical data regarding the territory on the LBDR are available

Source Categories	RBDR	LBDR	Statistical data for the LBDR, by fuels and the period for which data are available
1A1. Energy Industries	*	*	
1A1a. Main Activity Electricity and Heat Production	*	*	
1A1ai Electricity Generation	*	*	Coal, Residual Fuel Oil:1990-1998, 2008-2019; Natural Gas: 1990-2020
1A1aii Heat and Power Generation	*	NO	Not Occurring
1A1aiii Heat Plants	*	*	Coal, Residual Fuel Oil: 1990-1998, 2008-2019; Natural Gas: 1994-2020
1A1b Petroleum Refining	*	NO	Not Occurring
1A1c Manufacture of Solid Fuels and Other Energy Industries	NO	NO	Not Occurring
1A2. Manufacturing Industries and Construction	*	*	Natural Gas: 1994-2020; Coal, Residual Fuel Oil: 2008-2020; LPG: 2011-2020
a. Iron and Steel	*	*	
b. Non-Ferrous Metals	*	*	
c. Chemicals	*	*	
d. Pulp, Paper and Print	*	*	
e. Food Processing, Beverages and Tobacco	*	*	
f. Non-Metallic Minerals	*	*	
g. Transport Equipment	*	*	
h. Machinery	*	*	
i. Mining and Quarrying	*	*	
j. Wood and Wood Products	*	*	
k. Construction	*	*	
l. Textile and Leather	*	*	
m. Non-specified Industries	*	*	
1A3. Transport	*	*	
a. Civil Aviation	*	NO	Not Occurring
b. Road Transportation	*	*	Natural Gas, LPG: 2009-2020
c. Railways	*	*	
d. Water-borne Navigation	*	*	

Source Categories	RBDR	LBDR	Statistical data for the LBDR, by fuels and the period for which data are available
e i. Pipeline Transport	*	*	
e ii Off-road Transport	NA	NA	
e iii Other Transport	NO	NO	
1A4. Other Sectors	*	*	
a. Commercial/Institutional	*	*	Natural Gas: 1999-2019, LPG: 2011-2020; Coal, Residual Fuel Oil: 2008-2020
b. Residential	*	*	Natural Gas, LPG: 1995-2020; Fuelwood: 2008-2020
c i. Agriculture/Forestry/Fishing (stationary)	*	*	Coal, Resident Fuel Oil: 2008-2020
c ii. Agriculture/Forestry/Fishing (mobile)	*	*	Gasoline, Diesel Oil: 1995-2015, for 2016-2020 – Not Occuring
1A5. Other	*	*	
a. Mobile	*	*	Coal, Residual Fuel Oil: 2008-2020
b. Stationary	*	NO	Not Occuring
1B. Fugitive Emissions from Fuels	*	*	
1B1. Solid Fuels	NO	NO	
a. Coal mining	NO	NO	
b. Solid Fuel Transformation	NO	NO	
c. Other	NO	NO	
1B2. Oil, Natural Gas and Fugitive Emissions from Energy Production	*	*	
a. Oil	*	NO	Not Occuring
b. Natural Gas	*	*	
c. Venting and Flaring	*	*	
d. Other	NO	NO	
1C. CO_2 Transport and Storage	**NO**	**NO**	
1. CO_2 Transport	NO	NO	
2. CO_2 Transport Injection and Storage	NO	NO	
3. Other	NO	NO	
Memo Items: (1)	*	**NO**	
International Bunkers	*	NO	
International Aviation	*	NO	Not Occuring
International Marine Navigation	NO	NO	
Multilateral Operations	NO	NO	
CO2 Emissions from Biomass	*	*	Fuelwood: 2008-2020
CO2 Captured and Stored	NO	NO	
For storage at national level	NO	NO	
For storage in other countries	NO	NO	

Abbreviations: RBDR – Right Bank of Dniester River; LBDR – Left Bank of Dniester River; NA – Not Available, NO – Not Occurring

3.1.4. Uncertainties and Time Series Consistency

The uncertainty analysis of GHG emissions from Sector 1 'Energy' (by source category) is described in detail in the sub-chapters 3.2-3.9 of the NIR, as well as in the Annex 5-3.1 according to the 2006 IPCC Guidelines. Combined uncertainties as a percentage of total direct GHG emissions from Sector 1 'Energy' were estimated to be circa 3.93%. The uncertainties introduced in trend in sectoral emissions were estimated to be circa 1.03%. In view of ensuring time-series consistency of the obtained results, the same approach was used for the entire period under review, in conformity with the recommendations included in the 2006 IPCC Guidelines.

3.1.5. Quality Assurance and Quality Control

Tier 1 and Tier 2 procedures associated with the quality assurance and quality control process in the Sector 1 'Energy' include the following:

- according to the description of each source category, representative information was collected, AD used in the previous inventory cycle were updated and specified;
- the sources of reference for collected data were updated and specified;
- with the full transition to the methodologies available in the 2006 IPCC Guidelines, the default EFs used to estimate GHG emissions from each source category were updated and specified; these are available in spreadsheets as tables and can be imported automatically into calculation sheets;
- for SO_x, a special calculation formula according to the EMEP/EEA 2019 was applied for mobile source categories;
- standard internal documentation procedures are provided for each source category; separate calculation files were developed, identical to the CRF tables used by Annex I countries (Decision 24/CP.19[39]);

[39] <https://unfccc.int/resource/docs/2013/cop19/eng/10a03.pdf>, <https://unfccc.int/process/transparency-and-reporting/reporting-and-review-under-convention/greenhouse-gas-6>.

- the same estimation method was used for the entire period under review at individual source category level; for a better view of the results, charts showing the GHG trends at category level are created automatically;
- the procedures for data archiving used to estimate sectoral GHG emissions have been updated and improved, and a special file naming system has been introduced;
- in order to ensure the completeness of the inventory, including from the territorial point of view, various reference sources for AD regarding fossil fuel consumption on the LBDR were used; data on natural gas were provided by periodic statistical publications produced by the State Service for Statistical Analysis attached to the Ministry of Economic Development of the ATULBD, as well as 'Press Releases regarding housing and utilities' and 'Press Releases from MTPP in Dnestrovsk';
- as far as possible, the recommendations of the international expert who carried out the inventory quality expertise in the previous inventory cycle, associated with the preparation of the BUR2 of the Republic of Moldova to the UNFCCC were applied;
- mechanical errors related to entering activity data were eliminated; in most cases, the respective errors were associated with line routing and incomplete summary;
- for each source category where problems were identified regarding the collection of AD, an additional verification of the AD sources was carried out, and the AD rows were updated, respectively.

3.1.6. Recalculations

Since a series of improvements were adopted within the current inventory cycle, it was necessary to recalculate GHG emissions from all categories included in Sector 1 'Energy'. The main causes of these recalculations are:

- a series of errors from the data entry of AD were eliminated;
- for each source category, AD associated with fuel consumption were updated and specifiend;
- methodological approaches for the estimation of emissions from source categories 1A1b and 1B2 have been implemented; EFs for liquefied petroleum gases and coal in the case of source category 1A2 have been specified; EFs for source categories Road transportation, Water-borne navigation and Domestic aviation have also been specified (in connection with the publication of the updated version of the 2019 EMEP/EEA Guidebook); for the calculation of indirect GHG emissions for source categories 1A3b and 1A3d, methodological approaches and default EFs available in the 2019 EMEP/EEA Guidebook were applied.

In comparison to the results recorded in the BUR3 of the Republic of Moldova to the UNFCCC (2021), the changes made in the current inventory cycle, except for the years 2015-2016 and 2018, have resulted in an insignificant increase in direct GHG emissions in the years. Between 1990 and 2020, total direct GHG emissions from Sector 1 'Energy' decreased by circa 74.6% (Table 3-12).

Table 3-12: Recalculated GHG emissions for the period 1990-2020, included in the BUR3 of the RM to the UNFCCC (Sector 1 'Energy'), Mt CO_2 equivalent

	1990	1991	1992	1993	1994	1995	1996	1997
BUR3	36.8953	31.2043	24.3515	18.1696	15.2946	12.3097	12.2798	11.0094
NC5	36.9929	31.2587	24.4198	18.2540	15.3775	12.3913	12.3740	11.1206
Difference, %	0.3	0.2	0.3	0.5	0.5	0.7	0.8	1.0
	1998	1999	2000	2001	2002	2003	2004	2005
BUR3	9.5700	7.5571	6.8761	7.4994	7.2925	7.9740	8.4757	8.7644
NC5	9.6520	7.6403	6.9409	7.5701	7.3557	8.0419	8.5459	8.8365
Difference, %	0.9	1.1	0.9	0.9	0.9	0.9	0.8	0.8
	2006	2007	2008	2009	2010	2011	2012	2013
BUR3	7.9199	8.0885	8.3876	8.8010	9.3278	9.7144	9.2874	8.9802
NC5	7.9821	8.1547	8.4509	8.8753	9.4964	9.7876	9.4652	9.0359
Difference, %	0.8	0.8	0.8	0.8	1.8	0.8	1.9	0.6
	2014	2015	2016	2017	2018	2019	2020	%
BUR3	8.8830	9.1825	9.3349	8.8995	9.4093	9.3217		
NC5	9.0697	9.1196	9.2566	8.9249	9.4069	9.4014	9.5499	-74.6
Difference, %	2.1	-0.7	-0.8	0.3	0.0	0.9		

Abbreviations: BUR3 – Third Biennial Update Report of the RM to the UNFCCC, NC5 – Fifth National Communication of the RM to the UNFCCC.

3.1.7. Assessment of Completeness

Under the current inventory cycle within Sector 1 'Energy', direct GHG emissions originating from 8 source categories were estimated (Table 3-13). As no coal mining exists in the country, no GHG emissions from category 1B1 'Fugitive Emissions from Coal Mining and Handling' were recorded.

Table 3-13: Assessment of completeness under Sector 1 'Energy'

IPCC Category	Source Category	CO_2	CH_4	N_2O
1.A.1	Energy Industries	X	X	X
1.A.2	Manufacturing Industries and Construction	X	X	X
1.A.3	Transport (Civil Aviation, Road Transportation, Railways, Domestic Navigation, Pipeline Transport)	X	X	X
1.A.4	Other Sectors (Commercial/Institutional, Residential, Agriculture/Forestry/Fishing)	X	X	X
1.A.5	Other (other works and needs)	X	X	X
1.B.1	Fugitive Emissions from Coal Mining and Handling	NO	NO	NO
1.B.2	Fugitive Emissions from Oil and Natural Gas	X	X	X
Memo Items	International Aviation	X	X	X
Memo Items	CO_2 Emissions from Biomass	X	X	X

Abbreviations: X – Source Categories Included in GHG Inventory; NO – Not Occurring.

3.1.8. Planned Improvements

Planned improvements at source category level within Sector 1 'Energy' are described in more detail in sub-chapters 3.2-3.9 of this report.

3.2. Energy Industries (Category 1A1)

3.2.1. Source Category Description

The emission sources monitored in the Republic of Moldova under source category 1A1 'Energy Industries' are as following:

- 1A1a Main Activity Electricity and Heat Production
  - *1A1ai Electricity Generation*
  - *1A1aii Combined Heat and Power Generation*
  - *1A1aiii Heat Plants*
- 1A1b Petroleum Refining

Between 1990 and 2020, GHG emissions from source category 1A1 'Energy Industries' tended to decrease to 17.0% compared to the base year 1990 (Table 3-14).

Table 3-14: GHG emissions from source category 1A1 'Energy Industries' between 1990-2020

	1990	1991	1992	1993	1994	1995	1996	1997
1A1, kt CO_2 equivalent	21,364.2413	18,984.1702	15,706.2560	12,679.1754	9,992.5601	7,192.4074	7,124.4109	5,625.6671
%, compared to 1990	100.00	88.86	73.52	59.35	46.77	33.67	33.35	26.33
	1998	1999	2000	2001	2002	2003	2004	2005
1A1, kt CO_2 equivalent	4,844.6778	3,664.6852	3,159.3286	3,681.9284	2,936.7953	3,040.3758	3,110.7870	3,233.2579
%, compared to 1990	22.68	17.15	14.79	17.23	13.75	14.23	14.56	15.13
	2006	2007	2008	2009	2010	2011	2012	2013
1A1, kt CO_2 equivalent	2,495.9204	2,893.8184	2,994.6093	3,840.3395	4,052.9708	3,750.7325	3,807.8454	3,604.0198
%, compared to 1990	11.68	13.55	14.02	17.98	18.97	17.56	17.82	16.87
	2014	2015	2016	2017	2018	2019	2020	%
1A1, kt CO_2 equivalent	3,560.3022	3,688.0902	3,648.5771	2,999.4997	3,258.6362	3,127.5077	3,637.9713	-83.0
%, compared to 1990	16.66	17.26	17.08	14.04	15.25	14.64	17.03	

Total direct GHG emissions from source category 1A1 'Energy Industries' decreased from circa 21,364.2 kt CO_2 equivalent in 1990 to circa 3,638.0 kt CO_2 equivalent in 2020 (Table 3-15). CO_2 has the largest share in the total structure of direct GHG emissions.

Table 3-15: Direct GHG emissions from source category 1A1 'Energy Industries' between 1990-2020

	1A1, kt CO_2 equivalent				share of total, %			%, compared to 1990			
	CO_2	CH_4	N_2O	Total	CO_2	CH_4	N_2O	CO_2	CH_4	N_2O	Total
1990	21,300.2929	12.2813	51.6671	21,364.2413	99.70	0.06	0.24	100.0	100.0	100.0	100.0
1991	18,927.0336	10.5744	46.5622	18,984.1702	99.70	0.06	0.25	88.9	86.1	90.1	88.9
1992	15,660.9863	8.9470	36.3227	15,706.2560	99.71	0.06	0.23	73.5	72.9	70.3	73.5
1993	12,640.6006	7.0580	31.5167	12,679.1754	99.70	0.06	0.25	59.3	57.5	61.0	59.3

	1A1, kt CO_2 equivalent				share of total, %			%, compared to 1990			
	CO_2	CH_4	N_2O	Total	CO_2	CH_4	N_2O	CO_2	CH_4	N_2O	Total
1994	9,961.8515	4.7207	25.9879	9,992.5601	99.69	0.05	0.26	46.8	38.4	50.3	46.8
1995	7,174.0286	3.4249	14.9539	7,192.4074	99.74	0.05	0.21	33.7	27.9	28.9	33.7
1996	7,107.0544	3.3821	13.9743	7,124.4109	99.76	0.05	0.20	33.4	27.5	27.0	33.3
1997	5,615.6123	2.7692	7.2856	5,625.6671	99.82	0.05	0.13	26.4	22.5	14.1	26.3
1998	4,836.6106	2.4047	5.6624	4,844.6778	99.83	0.05	0.12	22.7	19.6	11.0	22.7
1999	3,660.2540	1.8165	2.6146	3,664.6852	99.88	0.05	0.07	17.2	14.8	5.1	17.2
2000	3,155.7517	1.5249	2.0520	3,159.3286	99.89	0.05	0.06	14.8	12.4	4.0	14.8
2001	3,677.7189	1.8154	2.3940	3,681.9284	99.89	0.05	0.07	17.3	14.8	4.6	17.2
2002	2,933.2101	1.5342	2.0510	2,936.7953	99.88	0.05	0.07	13.8	12.5	4.0	13.7
2003	3,036.7432	1.5649	2.0677	3,040.3758	99.88	0.05	0.07	14.3	12.7	4.0	14.2
2004	3,107.0816	1.5984	2.1069	3,110.7870	99.88	0.05	0.07	14.6	13.0	4.1	14.6
2005	3,229.4503	1.6505	2.1572	3,233.2579	99.88	0.05	0.07	15.2	13.4	4.2	15.1
2006	2,492.9310	1.2935	1.6959	2,495.9204	99.88	0.05	0.07	11.7	10.5	3.3	11.7
2007	2,890.4481	1.4797	1.8906	2,893.8184	99.88	0.05	0.07	13.6	12.0	3.7	13.5
2008	2,990.8419	1.6305	2.1369	2,994.6093	99.87	0.05	0.07	14.0	13.3	4.1	14.0
2009	3,835.5110	2.0776	2.7509	3,840.3395	99.87	0.05	0.07	18.0	16.9	5.3	18.0
2010	4,047.8107	2.2279	2.9322	4,052.9708	99.87	0.05	0.07	19.0	18.1	5.7	19.0
2011	3,746.1444	1.9971	2.5910	3,750.7325	99.88	0.05	0.07	17.6	16.3	5.0	17.6
2012	3,803.4077	1.8878	2.5499	3,807.8454	99.88	0.05	0.07	17.9	15.4	4.9	17.8
2013	3,596.7176	1.6916	5.6106	3,604.0198	99.80	0.05	0.16	16.9	13.8	10.9	16.9
2014	3,555.9756	1.8743	2.4523	3,560.3022	99.88	0.05	0.07	16.7	15.3	4.7	16.7
2015	3,684.4508	1.6461	1.9933	3,688.0902	99.90	0.04	0.05	17.3	13.4	3.9	17.3
2016	3,644.8751	1.6434	2.0586	3,648.5771	99.90	0.05	0.06	17.1	13.4	4.0	17.1
2017	2,996.5052	1.3584	1.6362	2,999.4997	99.90	0.05	0.05	14.1	11.1	3.2	14.0
2018	3,255.3655	1.4816	1.7891	3,258.6362	99.90	0.05	0.05	15.3	12.1	3.5	15.3
2019	3,124.4150	1.4044	1.6884	3,127.5077	99.90	0.04	0.05	14.7	11.4	3.3	14.6
2020	3,634.3761	1.6353	1.9598	3,637.9713	99.90	0.04	0.05	17.1	13.3	3.8	17.0

Table 3-16 shows the evolution of direct GHG emissions from category 1A1 'Energy Industries' by source (1A1a and 1A1b). The contribution of GHG emissions from 1A1b in the structure of total GHG emissions from category 1A1 is insignificant.

Table 3-16: Evolution of direct GHG emissions from category 1A1 'Energy Industries' by source between 1990-2020, kt CO_2 equivalent

	1A1ai	1A1aii	1A1aiii	1A1b	1A1	1A1a	1A1b	1A1
1990	11,779.8626	1,966.2536	7,618.1252	NO	21,364.2413	21,364.2413	NO	21,364.2413
1991	10,512.4534	2,184.3363	6,287.3805	NO	18,984.1702	18,984.1702	NO	18,984.1702
1992	8,864.8180	1,854.7694	4,986.6686	NO	15,706.2560	15,706.2560	NO	15,706.2560
1993	7,472.5226	1,590.8395	3,615.8134	NO	12,679.1754	12,679.1754	NO	12,679.1754
1994	6,749.4514	342.9810	2,900.1276	NO	9,992.5601	9,992.5601	NO	9,992.5601
1995	4,305.3853	313.4214	2,573.6008	NO	7,192.4074	7,192.4074	NO	7,192.4074
1996	4,366.0527	444.7600	2,313.5981	NO	7,124.4109	7,124.4109	NO	7,124.4109
1997	2,817.4791	516.0840	2,292.1039	NO	5,625.6671	5,625.6671	NO	5,625.6671
1998	2,153.9727	358.2230	2,332.4821	NO	4,844.6778	4,844.6778	NO	4,844.6778
1999	1,599.4590	361.2374	1,703.9888	NO	3,664.6852	3,664.6852	NO	3,664.6852
2000	1,461.0369	385.9338	1,312.3578	NO	3,159.3286	3,159.3286	NO	3,159.3286
2001	1,782.3738	583.8622	1,315.6924	NO	3,681.9284	3,681.9284	NO	3,681.9284
2002	1,367.6781	492.8533	1,076.2639	NO	2,936.7953	2,936.7953	NO	2,936.7953
2003	1,437.8398	451.2426	1,151.2933	NO	3,040.3758	3,040.3758	NO	3,040.3758
2004	1,594.7055	474.5035	1,041.5780	NO	3,110.7870	3,110.7870	NO	3,110.7870
2005	1,531.3888	544.2083	1,157.6608	NO	3,233.2579	3,233.2579	NO	3,233.2579
2006	816.4618	525.0423	1,154.4163	NO	2,495.9204	2,495.9204	NO	2,495.9204
2007	1,367.1077	512.8196	1,013.8911	NO	2,893.8184	2,893.8184	NO	2,893.8184
2008	1,456.8539	461.3959	1,076.3596	NO	2,994.6093	2,994.6093	NO	2,994.6093
2009	2,409.4560	447.9544	982.9291	NO	3,840.3395	3,840.3395	NO	3,840.3395
2010	2,549.4779	422.8277	1,080.6652	NO	4,052.9708	4,052.9708	NO	4,052.9708
2011	2,321.6841	399.0442	1,030.0042	NO	3,750.7325	3,750.7325	NO	3,750.7325
2012	2,428.7802	381.4285	997.6368	NO	3,807.8454	3,807.8454	NO	3,807.8454
2013	2,197.4510	360.4051	1,046.1637	NO	3,604.0198	3,604.0198	NO	3,604.0198
2014	2,224.4686	356.5504	979.2832	NO	3,560.3022	3,560.3022	NO	3,560.3022
2015	2,572.6397	633.7631	477.7235	3.9639	3,688.0902	3,684.1263	3.9639	3,688.0902
2016	2,519.3265	633.5269	491.6847	4.0389	3,648.5771	3,644.5382	4.0389	3,648.5771
2017	1,902.9491	611.1327	481.5696	3.8483	2,999.4997	2,995.6514	3.8483	2,999.4997
2018	2,117.7533	670.9937	466.8275	3.0617	3,258.6362	3,255.5745	3.0617	3,258.6362
2019	2,086.5242	587.4915	452.1584	1.3335	3,127.5077	3,126.1742	1.3335	3,127.5077
2020	2,593.7472	601.7548	440.9089	1.5604	3,637.9713	3,636.4109	1.5604	3,637.9713

Table 3-17 shows the evolution of direct and indirect GHG emissions from category 1A1 'Energy Industries'.

Table 3-17: Direct and indirect GHG emissions from category 1A1 'Energy Industries' between 1990-2020

	1A1, kt							%, compared to 1990						
	CO_2	CH_4	N_2O	NO_x	CO	NMVOC	SO_2	CO_2	CH_4	N_2O	NO_x	CO	NMVOC	SO_2
1990	21,300.2929	0.4913	0.1734	39.4664	7.2099	0.6297	102.3606	100.0	100.0	100.0	100.0	100.0	100.0	100.0
1991	18,927.0336	0.4230	0.1562	35.0660	6.4107	0.5515	90.5225	88.9	86.1	90.1	88.9	88.9	87.6	88.4
1992	15,660.9863	0.3579	0.1219	28.7536	5.5760	0.4762	71.2477	73.5	72.9	70.3	72.9	77.3	75.6	69.6
1993	12,640.6006	0.2823	0.1058	23.6435	4.2355	0.3687	62.2743	59.3	57.5	61.0	59.9	58.7	58.6	60.8
1994	9,961.8515	0.1888	0.0872	18.8108	3.5570	0.2847	47.1207	46.8	38.4	50.3	47.7	49.3	45.2	46.0
1995	7,174.0286	0.1370	0.0502	12.9854	3.1484	0.2369	25.5949	33.7	27.9	28.9	32.9	43.7	37.6	25.0
1996	7,107.0544	0.1353	0.0469	12.7474	3.2595	0.2422	23.4411	33.4	27.5	27.0	32.3	45.2	38.5	22.9
1997	5,615.6123	0.1108	0.0244	9.5174	3.1362	0.2233	10.5370	26.4	22.5	14.1	24.1	43.5	35.5	10.3
1998	4,836.6106	0.0962	0.0190	8.1103	2.7791	0.1972	7.9288	22.7	19.6	11.0	20.5	38.5	31.3	7.7
1999	3,660.2540	0.0727	0.0088	5.8881	2.3787	0.1638	2.1288	17.2	14.8	5.1	14.9	33.0	26.0	2.1
2000	3,155.7517	0.0610	0.0069	5.0439	2.1204	0.1437	0.9753	14.8	12.4	4.0	12.8	29.4	22.8	1.0
2001	3,677.7189	0.0726	0.0080	5.8773	2.5004	0.1689	0.8801	17.3	14.8	4.6	14.9	34.7	26.8	0.9
2002	2,933.2101	0.0614	0.0069	4.6959	2.0055	0.1356	0.6884	13.8	12.5	4.0	11.9	27.8	21.5	0.7
2003	3,036.7432	0.0626	0.0069	4.8529	2.0895	0.1407	0.5251	14.3	12.7	4.0	12.3	29.0	22.3	0.5
2004	3,107.0816	0.0639	0.0071	4.9649	2.1435	0.1442	0.4804	14.6	13.0	4.1	12.6	29.7	22.9	0.5
2005	3,229.4503	0.0660	0.0072	5.1572	2.2318	0.1500	0.4400	15.2	13.4	4.2	13.1	31.0	23.8	0.4
2006	2,492.9310	0.0517	0.0057	3.9840	1.7263	0.1160	0.3339	11.7	10.5	3.3	10.1	23.9	18.4	0.3
2007	2,890.4481	0.0592	0.0063	4.6122	2.0151	0.1350	0.2113	13.6	12.0	3.7	11.7	27.9	21.4	0.2
2008	2,990.8419	0.0652	0.0072	4.7865	2.0898	0.1404	0.3057	14.0	13.3	4.1	12.1	29.0	22.3	0.3
2009	3,835.5110	0.0831	0.0092	6.1430	2.6585	0.1791	0.6150	18.0	16.9	5.3	15.6	36.9	28.4	0.6
2010	4,047.8107	0.0891	0.0098	6.4814	2.8196	0.1898	0.5281	19.0	18.1	5.7	16.4	39.1	30.1	0.5
2011	3,746.1444	0.0799	0.0087	5.9885	2.6096	0.1753	0.3978	17.6	16.3	5.0	15.2	36.2	27.8	0.4
2012	3,803.4077	0.0755	0.0086	6.0853	2.6153	0.1756	0.6665	17.9	15.4	4.9	15.4	36.3	27.9	0.7
2013	3,596.7176	0.0677	0.0188	6.2249	2.0253	0.1397	7.1268	16.9	13.8	10.9	15.8	28.1	22.2	7.0
2014	3,555.9756	0.0750	0.0082	5.6971	2.4781	0.1664	0.4068	16.7	15.3	4.7	14.4	34.4	26.4	0.4
2015	3,684.4508	0.0658	0.0067	5.8503	2.5548	0.1705	0.1072	17.3	13.4	3.9	14.8	35.4	27.1	0.1
2016	3,644.8751	0.0657	0.0069	5.7964	2.5196	0.1682	0.2330	17.1	13.4	4.0	14.7	34.9	26.7	0.2
2017	2,996.5052	0.0543	0.0055	4.7627	2.0849	0.1391	0.0472	14.1	11.1	3.2	12.1	28.9	22.1	0.0
2018	3,255.3655	0.0593	0.0060	5.1810	2.2679	0.1513	0.0570	15.3	12.1	3.5	13.1	31.5	24.0	0.1
2019	3,124.4150	0.0562	0.0057	4.9700	2.1753	0.1451	0.0468	14.7	11.4	3.3	12.6	30.2	23.0	0.05
2020	3,634.3761	0.0654	0.0066	5.7797	2.5315	0.1688	0.0361	17.1	13.3	3.8	14.6	35.1	26.8	0.04

By 2020, the level of direct and indirect GHG emissions in the RM from source category 1A1 'Energy Industries' reached, for CO_2 – circa 17.1% of the base year level, for CH_4 – 13.3%, N_2O – 3.8%, NO_x – 14.6%, CO – 35.1%, NMVOC – 26.8% and SO_2 – 0.04%.

1A1a Main Activity Electricity and Heat Production

1A1a 'Main Activity Electricity and Heat Production' is disaggregated into three other emission sources: 1A1ai 'Electricity Generation', 1A1aii 'Combined Heat and Power Generation' and 1A1aiii 'Heat Plants'. Between 1990 and 2020, total direct GHG emissions from 1A1a 'Main Activity Electricity and Heat Production' decreased from circa 21,364.24 kt CO_2 equivalent to circa 3,636.41 kt CO_2 equivalent (Table 3-18).

Table 3-18: Evolution of direct GHG emissions from 1A1a 'Main Activity Electricity and Heat Production' in the Republic of Moldova between 1990-2020

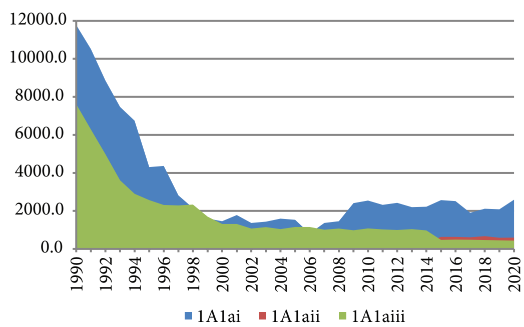
	1990	1991	1992	1993	1994	1995	1996	1997
1A1a, kt CO_2 equivalent	21,364.24	18,984.17	15,706.26	12,679.18	9,992.56	7,192.41	7,124.41	5,625.67
%, compared to 1990	100.00	88.86	73.52	59.35	46.77	33.67	33.35	26.33
	1998	1999	2000	2001	2002	2003	2004	2005
1A1a, kt CO_2 equivalent	4,844.68	3,664.69	3,159.33	3,681.93	2,936.80	3,040.38	3,110.79	3,233.26
%, compared to 1990	22.68	17.15	14.79	17.23	13.75	14.23	14.56	15.13
	2006	2007	2008	2009	2010	2011	2012	2013
1A1a, kt CO_2 equivalent	2,495.92	2,893.82	2,994.61	3,840.34	4,052.97	3,750.73	3,807.85	3,604.02
%, compared to 1990	11.68	13.55	14.02	17.98	18.97	17.56	17.82	16.87
	2014	2015	2016	2017	2018	2019	2020	%
1A1a, kt CO_2 equivalent	3,560.30	3,684.13	3,644.54	2,995.65	3,255.57	3,126.17	3,636.41	-82.98
%, compared to 1990	16.66	17.24	17.06	14.02	15.24	14.63	17.02	

CO_2 emissions had the largest share in the total structure of direct GHG emissions from 1A1a 'Main Activity Electricity and Heat Production' between 1990 and 2020 (Table 3-19).

Table 3-19: Evolution of direct GHG emissions from 1A1a 'Main Activity Electricity and Heat Production' between 1990-2020 and the share of each gas in the total structure of GHG emissions

	1A1a, kt CO_2 equivalent				% of total			%, compared to 1990			
	CO_2	CH_4	N_2O	Total	CO_2	CH_4	N_2O	CO_2	CH_4	N_2O	Total
1990	21,300.2929	12.2813	51.6671	21,364.2413	99.70	0.06	0.24	100.0	100.0	100.0	100.0
1991	18,927.0336	10.5744	46.5622	18,984.1702	99.70	0.06	0.25	88.9	86.1	90.1	88.9
1992	15,660.9863	8.9470	36.3227	15,706.2560	99.71	0.06	0.23	73.5	72.9	70.3	73.5
1993	12,640.6006	7.0580	31.5167	12,679.1754	99.70	0.06	0.25	59.3	57.5	61.0	59.3
1994	9,961.8515	4.7207	25.9879	9,992.5601	99.69	0.05	0.26	46.8	38.4	50.3	46.8
1995	7,174.0286	3.4249	14.9539	7,192.4074	99.74	0.05	0.21	33.7	27.9	28.9	33.7
1996	7,107.0544	3.3821	13.9743	7,124.4109	99.76	0.05	0.20	33.4	27.5	27.0	33.3
1997	5,615.6123	2.7692	7.2856	5,625.6671	99.82	0.05	0.13	26.4	22.5	14.1	26.3
1998	4,836.6106	2.4047	5.6624	4,844.6778	99.83	0.05	0.12	22.7	19.6	11.0	22.7
1999	3,660.2540	1.8165	2.6146	3,664.6852	99.88	0.05	0.07	17.2	14.8	5.1	17.2
2000	3,155.7517	1.5249	2.0520	3,159.3286	99.89	0.05	0.06	14.8	12.4	4.0	14.8
2001	3,677.7189	1.8154	2.3940	3,681.9284	99.89	0.05	0.07	17.3	14.8	4.6	17.2
2002	2,933.2101	1.5342	2.0510	2,936.7953	99.88	0.05	0.07	13.8	12.5	4.0	13.7
2003	3,036.7432	1.5649	2.0677	3,040.3758	99.88	0.05	0.07	14.3	12.7	4.0	14.2
2004	3,107.0816	1.5984	2.1069	3,110.7870	99.88	0.05	0.07	14.6	13.0	4.1	14.6
2005	3,229.4503	1.6505	2.1572	3,233.2579	99.88	0.05	0.07	15.2	13.4	4.2	15.1
2006	2,492.9310	1.2935	1.6959	2,495.9204	99.88	0.05	0.07	11.7	10.5	3.3	11.7
2007	2,890.4481	1.4797	1.8906	2,893.8184	99.88	0.05	0.07	13.6	12.0	3.7	13.5
2008	2,990.8419	1.6305	2.1369	2,994.6093	99.87	0.05	0.07	14.0	13.3	4.1	14.0
2009	3,835.5110	2.0776	2.7509	3,840.3395	99.87	0.05	0.07	18.0	16.9	5.3	18.0
2010	4,047.8107	2.2279	2.9322	4,052.9708	99.87	0.05	0.07	19.0	18.1	5.7	19.0
2011	3,746.1444	1.9971	2.5910	3,750.7325	99.88	0.05	0.07	17.6	16.3	5.0	17.6
2012	3,803.4077	1.8878	2.5499	3,807.8454	99.88	0.05	0.07	17.9	15.4	4.9	17.8
2013	3,596.7176	1.6916	5.6106	3,604.0198	99.80	0.05	0.16	16.9	13.8	10.9	16.9
2014	3,555.9756	1.8743	2.4523	3,560.3022	99.88	0.05	0.07	16.7	15.3	4.7	16.7
2015	3,680.5003	1.6421	1.9838	3,684.1263	99.90	0.04	0.05	17.3	13.4	3.8	17.2
2016	3,640.8500	1.6393	2.0489	3,644.5382	99.90	0.04	0.06	17.1	13.3	4.0	17.1
2017	2,992.6702	1.3544	1.6268	2,995.6514	99.90	0.05	0.05	14.0	11.0	3.1	14.0
2018	3,252.3143	1.4785	1.7817	3,255.5745	99.90	0.05	0.05	15.3	12.0	3.4	15.2
2019	3,123.0860	1.4030	1.6852	3,126.1742	99.90	0.04	0.05	14.7	11.4	3.3	14.6
2020	3,632.8213	1.6337	1.9559	3,636.4109	99.90	0.04	0.05	17.1	13.3	3.8	17.0

Table 3-20 and Figure 3-8 shows the evolution of direct GHG emissions from 1A1a 'Main Activity Electricity and Heat Production' by source between 1990 and 2020.



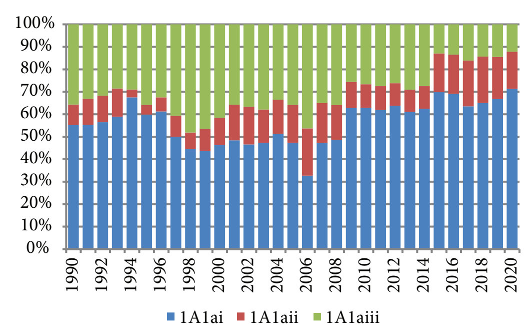


Figure 3-8: Evolution of GHG emissions by source from category 1A1a 'Main Activity Electricity and Heat Production' between 1990-2020, kt CO_2 equivalent.

Table 3-20: Evolution of direct GHG emissions from category 1A1a 'Main Activity Electricity and Heat Production' by source between 1990-2020, kt CO_2 equivalent

	1A1a, kt CO_2 equivalent				% of total		
	1A1ai	1A1aii	1A1aiii	1A1a	1A1ai	1A1aii	1A1aiii
1990	11,779.8626	1,966.2536	7,618.1252	21,364.2413	55.14	9.20	35.66
1991	10,512.4534	2,184.3363	6,287.3805	18,984.1702	55.37	11.51	33.12
1992	8,864.8180	1,854.7694	4,986.6686	15,706.2560	56.44	11.81	31.75
1993	7,472.5226	1,590.8395	3,615.8134	12,679.1754	58.94	12.55	28.52
1994	6,749.4514	342.9810	2,900.1276	9,992.5601	67.54	3.43	29.02
1995	4,305.3853	313.4214	2,573.6008	7,192.4074	59.86	4.36	35.78
1996	4,366.0527	444.7600	2,313.5981	7,124.4109	61.28	6.24	32.47
1997	2,817.4791	516.0840	2,292.1039	5,625.6671	50.08	9.17	40.74
1998	2,153.9727	358.2230	2,332.4821	4,844.6778	44.46	7.39	48.15

	1A1a, kt CO_2 equivalent				% of total		
	1A1ai	1A1aii	1A1aiii	1A1a	1A1ai	1A1aii	1A1aiii
1999	1,599.4590	361.2374	1,703.9888	3,664.6852	43.65	9.86	46.50
2000	1,461.0369	385.9338	1,312.3578	3,159.3286	46.25	12.22	41.54
2001	1,782.3738	583.8622	1,315.6924	3,681.9284	48.41	15.86	35.73
2002	1,367.6781	492.8533	1,076.2639	2,936.7953	46.57	16.78	36.65
2003	1,437.8398	451.2426	1,151.2933	3,040.3758	47.29	14.84	37.87
2004	1,594.7055	474.5035	1,041.5780	3,110.7870	51.26	15.25	33.48
2005	1,531.3888	544.2083	1,157.6608	3,233.2579	47.36	16.83	35.80
2006	816.4618	525.0423	1,154.4163	2,495.9204	32.71	21.04	46.25
2007	1,367.1077	512.8196	1,013.8911	2,893.8184	47.24	17.72	35.04
2008	1,456.8539	461.3959	1,076.3596	2,994.6093	48.65	15.41	35.94
2009	2,409.4560	447.9544	982.9291	3,840.3395	62.74	11.66	25.59
2010	2,549.4779	422.8277	1,080.6652	4,052.9708	62.90	10.43	26.66
2011	2,321.6841	399.0442	1,030.0042	3,750.7325	61.90	10.64	27.46
2012	2,428.7802	381.4285	997.6368	3,807.8454	63.78	10.02	26.20
2013	2,197.4510	360.4051	1,046.1637	3,604.0198	60.97	10.00	29.03
2014	2,224.4686	356.5504	979.2832	3,560.3022	62.48	10.01	27.51
2015	2,572.6397	633.7631	477.7235	3,684.1263	69.83	17.20	12.97
2016	2,519.3265	633.5269	491.6847	3,644.5382	69.13	17.38	13.49
2017	1,902.9491	611.1327	481.5696	2,995.6514	63.52	20.40	16.08
2018	2,117.7533	670.9937	466.8275	3,255.5745	65.05	20.61	14.34
2019	2,086.5242	587.4915	452.1584	3,126.1742	66.74	18.79	14.46
2020	2,593.7472	601.7548	440.9089	3,636.4109	71.33	16.55	12.12

1A1ai Electricity Generation

In the Republic of Moldova, electricity generation capacity includes: Moldavian Thermal Power Plant (MTPP) in Dnestrovsk (on the left bank of the Dniester River) with an installed capacity of 2,520 MW, built between 1964-1982, and other Power Plants, including renewable sources. In recent years, renewable energy sources of small power capacity are under development. Their total capacity in 2020 represented circa 54.7 MW[40]. Out of the total energy produced from renewable sources, the largest share (61.6%) is electric power generated from wind power (circa 50 mil. kWh).

The MTPP in Dnestrovsk has an installed capacity of 2,520 MW, equipped with eight energy groups on coal, with an electric power of 200 MW, in service from 1964-1971, 2 energy groups on residual fuel oil and natural gas with an electric power of 210 MW, and two energy groups on natural gas, operating on gas-steam combined cycle, with an installed capacity of 250 MW each (in service since 1980). The MTPP can operate on coal, residual fuel oil and natural gas. Currently, the main fuel type is represented by natural gas with a volume that varied from circa 1206.6 mil. m^3 (1990) to 1362.6 mil. m^3 (2020).

To be noted that official statistical data on residual fuel oil and coal consumption within the MTTP are available only for 1990-1998 and 2012-2020. AD are published in natural values; in order to convert it into energy values, the following conversion factors were used: for coal – 25.44 TJ/kt, for residual fuel oil – 40.2 TJ/kt, for natural gas – 33.86 TJ/mln.m^3.

Data regarding fuel consumption for electricity generation in the Republic of Moldova between 2010-2020 is presented in Table 3-21.

Table 3-21: Fuel consumption for electricity generation between 1990-2020

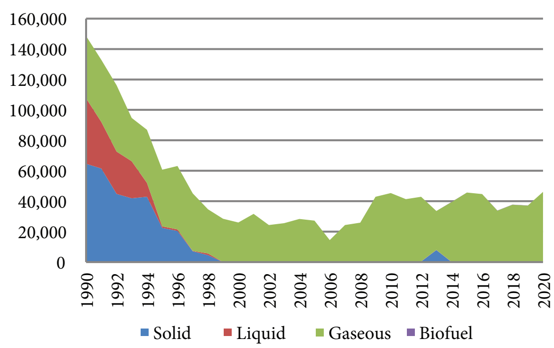
	Bituminous Coal, TJ	Diesel Oil, TJ	Residual Fuel Oil, TJ	Natural Gas, TJ	Biogas, TJ
1990	64,643	NO	43,010	40,855	NO
1991	61,539	NO	30,484	40,862	NO
1992	44,774	NO	27,855	43,541	NO
1993	41,900	NO	24,422	28,361	NO
1994	42,907	NO	9,166	34,876	NO
1995	22,461	NO	1,049	37,192	NO
1996	20,513	NO	949.	41,709	NO
1997	7,171	NO	243	37,696	NO
1998	4,641	NO	1,082	29,004	NO
1999	NO	NO	NO	28,483	NO
2000	NO	NO	NO	26,018	NO

[40] Annual Activity Report, National Agency for Energy Regulation 2020, P. 24.

	Bituminous Coal, TJ	Diesel Oil, TJ	Residual Fuel Oil, TJ	Natural Gas, TJ	Biogas, TJ
2001	NO	NO	NO	31,740	NO
2002	NO	NO	NO	24,355	NO
2003	NO	NO	NO	25,605	NO
2004	NO	NO	NO	28,398	NO
2005	NO	NO	NO	27,271	NO
2006	NO	NO	NO	14,539	NO
2007	NO	NO	NO	24,345	NO
2008	NO	NO	NO	25,944	NO
2009	NO	NO	NO	42,907	NO
2010	NO	21	NO	45,373	NO
2011	NO	19	NO	41,319	NO
2012	335	10	103	42,528	NO
2013	7,942	10	74	25,571	10
2014	6	9	59	39,406	18
2015	50	6	55	45,644	14
2016	188	8	80	44,424	2
2017	NO	11	27	33,835	84
2018	11	8	34	37,636	150
2019	19	8	15	37,094	126
2020	5	8	23	46,139	153

Source: Energy Balances of the RM 1990-2020; for MTPP: natural gas – JSC 'Moldovagaz'; residual fuel oil – for the period 1990-1998: NC1 of the RM to the UNFCCC (2000), for the period 2012-2020: Press Releases of the MTTP in Dnestrovsk (<www.moldgres.com>).

Figure 3-9 and Table 3-22 show data on fuel consumption (in TJ) by type for electricity generation within 1A1ai 'Electricity Generation', and their share (%) in the structure of total fuel consumption, respectively.



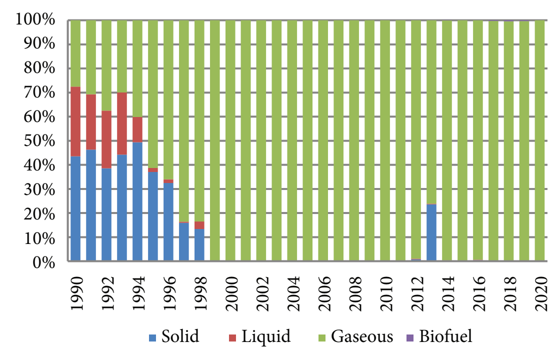


Figure 3-9: Fuel consumption by type for electricity generation within 1A1ai 'Electricity Generation', TJ.

For the year 2013, coal consumption at the MTPP constituted 23% of the total amount of fuels utilised, which has contributed to the increase in their share that year. In 2020, the volume of natural gas consumed at the MTPP was calculated by indirect method, due to the lack of official statistical sources.

Table 3-22: Fuel consumption by category for electricity generation within 1A1ai 'Electricity Generation' and their share in the total consumption structure

	1A1ai, TJ					1A1ai, % of total			
	Solid	Liquid	Gaseous	Biofuels	Total	Solid	Liquid	Gaseous	Biofuels
1990	64,643	43,010	40,855	NO	148,508	43.5	29.0	27.5	NO
1991	61,539	30,484	40,862	NO	132,885	46.3	22.9	30.8	NO
1992	44,774	27,855	43,541	NO	116,170	38.5	24.0	37.5	NO
1993	41,900	24,422	28,361	NO	94,682	44.3	25.8	30.0	NO
1994	42,907	9,166	34,876	NO	86,949	49.3	10.5	40.1	NO
1995	22,461	1,049	37,192	NO	60,702	37.0	1.7	61.3	NO
1996	20,513	949	41,709	NO	63,171	32.5	1.5	66.0	NO
1997	7,171	243	37,696	NO	45,111	15.9	0.5	83.6	NO
1998	4,641	1,082	29,004	NO	34,727	13.4	3.1	83.5	NO
1999	NO	NO	28,483	NO	28,483	NO	NO	100.0	NO
2000	NO	NO	26,018	NO	26,018	NO	NO	100.0	NO
2001	NO	NO	31,740	NO	31,740	NO	NO	100.0	NO
2002	NO	NO	24,355	NO	24,355	NO	NO	100.0	NO
2003	NO	NO	25,605	NO	25,605	NO	NO	100.0	NO
2004	NO	NO	28,398	NO	28,398	NO	NO	100.0	NO
2005	NO	NO	27,271	NO	27,271	NO	NO	100.0	NO
2006	NO	NO	14,539	NO	14,539	NO	NO	100.0	NO
2007	NO	NO	24,345	NO	24,345	NO	NO	100.0	NO

	1A1ai, TJ					1A1ai, % of total			
	Solid	Liquid	Gaseous	Biofuels	Total	Solid	Liquid	Gaseous	Biofuels
2008	NO	NO	25,944	NO	25,944	NO	NO	100.0	NO
2009	NO	NO	42,907	NO	42,907	NO	NO	100.0	NO
2010	NO	21	45,373	NO	45,394	NO	0.0	100.0	NO
2011	NO	19	41,319	NO	41,338	NO	0.0	100.0	NO
2012	335	113	42,528	NO	42,977	0.8	0.3	99.0	NO
2013	7,942	84	25,571	10	33,606	23.6	0.2	76.1	0.0
2014	67	68	39,406	18	39,559	0.2	0.2	99.6	0.0
2015	50	61	45,644	14	45,770	0.1	0.1	99.7	0.0
2016	188	88	44,424	2	44,702	0.4	0.2	99.4	0.0
2017	*NO*	38	33,835	84	33,958	NO	0.1	99.6	0.2
2018	11	42	37,636	150	37,839	0.0	0.1	99.5	0.4
2019	19	23	37,094	126	37,261	0.0	0.1	99.6	0.3
2020	5	31	46,139	153	46,327	0.0	0.1	99.6	0.3

1A1aii 'Combined Heat and Power Generation'

On the RBDR there are 3 Combined Heat and Power (CHP) Plants: the CHP-1 and the CHP-2 in Chisinau municipality, and the CHP-North in Balti municipality.

Total electricity generation on the RBDR in 2020 constituted circa 1.184 billion kWh (Table 3-23).

Table 3-23: Electricity generation, import and consumption between 2005-2020, million kWh

	2005	2006	2007	2008	2009	2010	2011	2012
Electricity generation	1,127	1,080	1,051	985	970	972	933	890
Electricity import	1,600	2,881	2,931	2,961	2,941	2,662	3,142	3,279
Electricity consumption	3,686	3,871	4,030	4,065	3,979	4,106	4,161	4,211
	2013	2014	2015	2016	2017	2018	2019	2020
Electricity generation	849	889	934	897	885	931	893	1,184
Electricity import	3,244	3,341	3,322	3,322	3,458	3,920	3,464	3,418
Electricity consumption	4,236	4,305	4,256	4,219	4,343	4,852	4,356	4,602

Source: for the period 2005-2014: SOE 'Moldelectrica'; for the period 2015-2020: <https://statbank.statistica.md/>

In the context of the recent upward trend in electricity consumption, this is a negative factor, including from the energy security point of view. More detailed information on fuel consumption, electricity and heat generation from the three CHPs in the Republic of Moldova (CHP-1 and CHP-2, and CHP-North) is presented in Table 3-24.

Table 3-24: Fuel consumption, electricity and heat generation at the CHPs in the Republic of Moldova between 1990-2020

		1990	1991	1992	1993	1994	1995	1996	1997
CHP-1	Residual Fuel Oil, kt	13.4	26.1	14.2	14.0	6.2	4.7	8.5	3.7
	Natural Gas, million m^3	271.2	290.0	245.8	184.2	161.0	137.6	118.6	113.4
	Electricity, million kWh	207.5	207.0	196.3	150.2	136.5	106.4	114.6	93.2
	Heat, thousands Gcal	2,249.2	2,618.7	2,178.1	1,023.7	1,308.5	1,035.1	1,006.3	882.1
CHP-2	Residual Fuel Oil, kt	76.4	135.9	164.9	120.4	53.1	57.3	67.5	49.9
	Natural Gas, million m^3	486.1	419.0	337.1	318.4	315.2	270.7	323.2	386.5
	Electricity, million kWh	1,150.0	951.4	923.4	883.4	751.2	670.9	838.8	896.2
	Heat, thousands Gcal	2,544.7	2,775.8	2,577.6	2,021.6	1,631.6	1,518.2	1,515.0	1,524.6
CHP-North	Residual Fuel Oil, kt	40.0	35.0	31.9	19.6	3.8	8.1	1.4	1.1
	Natural Gas, million m^3	15.7	87.6	136.3	102.0	98.5	86.9	107.2	93.6
	Electricity, million kWh	121.0	100.0	102.0	75.0	87.0	81.0	100.0	96.0
	Heat, thousands Gcal	1,360.0	1,450.0	1,144.0	834.0	625.0	596.0	642.0	500.0
		1998	1999	2000	2001	2002	2003	2004	2005
CHP-1	Residual Fuel Oil, kt	4.6	4.1	1.2	0.4	0.0	0.1	0.1	0.9
	Natural Gas, million m^3	135.2	73.0	65.2	82.3	85.7	81.3	76.3	84.8
	Electricity, million kWh	138.6	115.0	100.8	138.5	142.1	138.8	136.5	154.9
	Heat, thousands Gcal	1,045.9	448.3	387.4	408.8	386.3	405.9	335.6	375.6
CHP-2	Residual Fuel Oil, kt	34.3	22.3	3.7	3.1	1.2	1.9	0.0	2.9
	Natural Gas, million m^3	313.5	312.2	267.4	365.1	313.0	286.0	278.9	326.8
	Electricity, million kWh	723.3	801.0	658.1	942.2	804.7	741.9	714.3	854.4
	Heat, thousands Gcal	1,296.0	1,286.5	947.0	1,068.4	1,069.2	1,018.6	885.7	1,198.1
CHP-North	Residual Fuel Oil, kt	6.8	10.1	0.9	0.0	0.0	0.0	0.0	0.0
	Natural Gas, million m^3	70.1	39.3	25.0	40.5	38.0	44.6	41.6	44.3
	Electricity, million kWh	75.0	50.7	27.3	44.4	40.6	52.5	57.7	67.8
	Heat, thousands Gcal	416.0	247.0	125.7	206.1	198.5	246.0	229.6	232.6

		2006	2007	2008	2009	2010	2011	2012	2013
CHP-1	Residual Fuel Oil, kt	0.0	0.0	0.0	1.2	0.0	0.0	0.0	0.0
	Natural Gas, million m^3	83.5	81.1	78.3	70.0	51.2	40.3	33.8	33.1
	Electricity, million kWh	148.0	151.9	140.3	135.6	94.9	70.2	56.7	59.5
	Heat, thousands Gcal	378.8	329.1	319.6	271.9	245.4	203.5	184.6	170.9
CHP-2	Residual Fuel Oil, kt	0.0	0.0	0.0	9.6	0.0	0.0	0.0	0.0
	Natural Gas, million m^3	316.3	308.5	294.8	284.6	304.2	295.3	288.9	267.2
	Electricity, million kWh	818.4	805.4	755.3	754.6	782.4	765.2	742.9	649.8
	Heat, thousands Gcal	1,204.2	1,159.3	1,153.8	1,126.8	1,193.4	1,166.0	1,135.7	1,047.5
CHP-North	Residual Fuel Oil, kt	0.0	0.0	0.0	0.8	0.0	0.0	0.0	0.0
	Natural Gas, million m^3	44.4	38.0	37.8	38.0	41.5	39.1	38.9	33.5
	Electricity, million kWh	74.7	67.7	67.4	66.5	70.0	69.9	66.3	60.2
	Heat, thousands Gcal	222.7	193.5	199.1	205.8	227.5	225.9	227.7	253.9
		2014	2015	2016	2017	2018	2019	2020	2021
CHP-1	Residual Fuel Oil, kt	0.0	0.0	0.0	0.0	0.0	0.0	0.0	N/A
	Natural Gas, million m^3	35.9	25.6	24.5	23.9	26.2	19.1	20.3	N/A
	Electricity, million kWh	67.4	47.2	43.9	32.4	35.7	25.6	27.8	N/A
	Heat, thousands Gcal	167.8	195.3	186.0	181.2	199.7	144.6	155.2	N/A
CHP-2	Residual Fuel Oil, kt	0.0	0.0	0.0	0.0	0.0	0.0	14.6	N/A
	Natural Gas, million m^3	268.7	274.7	275.6	266.7	280.3	260.5	261.7	N/A
	Electricity, million kWh	702.3	731.6	708.3	692.8	725.2	681.8	693.6	N/A
	Heat, thousands Gcal	1,049.7	1,095.8	2,101.3	1,110.2	1,156.7	1,081.6	1,058.3	N/A
	Residual Fuel Oil, kt	0.0	0.0	0.0	0.0	0.0	0.0	0.0	N/A
	Natural Gas, million m^3	0.0	0.0	0.0	182.6	129.1	27.3	0.0	N/A
CHP-North	Electricity, million kWh	0.0	0.0	0.0	0.0	91.2	160.2	191.5	N/A
CHP-1	Heat, thousands Gcal	34.4	36.0	37.1	34.52	38.03	33.9	41.1	N/A
	Residual Fuel Oil, kt	61.5	66.6	67.5	-	-	-	113.5	N/A
	Natural Gas, million m^3	259.9	275.5	285.2	264.5	594.4	236.5	191.8	N/A

Source: SOE 'Termoelectrica' by Letter No. 79/3114 of 26.05.2016 answer to Letter No. 512/2016-05-01 of 10.05.2016, contains information for the year 2015; Subdivision 'Termoservice' of JSC CHP-2 by Letter No. 79/823 of 19.02.2015, answer to Letter No. 497/2015-01-11 of 31.01.2015, contains information for the period 2010-2014; CHP-1 by Letter No. 01-11/6-56 of 22.02.2011 answer to Letter No.03-07/175 of 02.02.2011, contains information for the period 2000-2010; Letter No. 01-11/6-10 of 13.01.2014 answer to Letter No. 320/2014-01-01 of 03.01.2014, contains information for the period 2011-2012; Letter No. 18/215 of 16.02.2015 answer to Letter No. 408/2015-01-10 of 31.01.2015, contains information for the period 2010-2014; Letter from 02.03.2020 answer to Letter No. 08-310/1 of 11.02.2020, contains information for the period 2017-2019; CHP-2 by letter No. 43/195 of 14.02.2011 answer to Letter No. 03-07/175 of 02.02.2011, contains information for the period 2000-2010; Letter No. 18/37 of 13.01.2014 answer to Letter No. 320/2014-01-01 of 03.01.2014, contains information for the period 2011-2012; Letter No. 18/188 of 10.02.2015 answer to Letter No. 408/2015-01-10 of 31.01.2015, contains information for the period 2010-2014; Letter from 02.03.2020 answer to Letter No. 08-310/1 of 11.02.2020, contains information for the period 2017-2019; The CHP-1 and CHP-2 by letter of 25.06.2021 answer to letter No 08/136/2021, of 09.06.2021, and contains information for 2020; CHP-North by letter No. 04/14-119 of 28.02.2011 answer to Letter No. 03-07/175 of 02.02.2011, contains information for the period 2000-2010; Letter No. 04-14/34 of 22.01.2014 answer to Letter No. 320/2014-01-01 of 03.01.2014, contains information for the period 2011-2012; Letter No. 04-14/71 of 06.02.2015 answer to Letter No. 497/2015-01-11 of 31.01.2015, contains information for the period 2010-2014; Letter No. 04-14/316 of 17.05.2016 answer to Letter No. 512/2016-05-01 of 10.05.2016, contains information for the year 2015; Letter No. 79/68 of 18.01.18 answer to Letter from 22.12.2017; Letter No. 221/333 of 24.02.2020 answer to Letter No. 08-310/1 of 11.02.2020, contains information for 2017-2019 years.

More detailed information on fuel consumption from the CHPs in the RM is presented in Table 3-25.

Table 3-25: Fuel consumption by type of fuels for the combined heat and power generation between 1990-2020, TJ

	1990	1991	1992	1993	1994	1995	1996	1997
Anthracite	NO	NO	NO	129	NO	NO	NO	NO
Diesel Oil	43	2,127	1,276	12	NO	29	29	29
Residual Fuel Oil	5,215	7,918	8482	6,189	1,086	1,144	1,350	1,144
Natural Gas	27,774	25,133	19,610	19,528	4,606	3,961	6,015	7,570
	1998	1999	2000	2001	2002	2003	2004	2005
Anthracite	NO	NO	NO	NO	NO	NO	NO	NO
Diesel Oil	29	59	29	29	NO	NO	11	21
Residual Fuel Oil	851	352	147	235	88	88	61	116
Natural Gas	5,164	5,868	6,631	10,034	8,655	7,914	8,351	9,503
	2006	2007	2008	2009	2010	2011	2012	2013
Anthracite	NO	NO	NO	NO	NO	NO	NO	NO
Diesel Oil	17	12	16	18	20	19	10	10
Residual Fuel Oil	35	14	40	309	105	94	58	57
Natural Gas	9,279	9,097	8,140	7,526	7,358	6,951	6,699	6,326
	2014	2015	2016	2017	2018	2019	2020	%
Anthracite	NO	NO	5	NO	NO	NO	NO	-
Diesel Oil	9	NO	NO	NO	NO	NO	NO	-
Residual Fuel Oil	64	NO	NO	NO	NO	NO	NO	-
Natural Gas	6,249	11,686	11,723	10,883	11,949	10,462	10,716	-61.4

Note: for the period 1990-1993, AD represent aggregated data on fuel consumption within subcategories 1A1ai and 1A1aiii; for 1990-1992, AD available only in natural units were converted to energy units by applying heat values accepted in the current inventory cycle; for 1993-2020, AD in energy units were taken directly from the Energy Balances of the RM.

Information on fuel consumption by type of fuel (solid, liquid, gaseous and biofuels) at CHPs is presented in Table 3-26 and Figure 3-10.

Table 3-26: Fuel consumption by type of fuel at the CHPs between 1990-2020, TJ

	1990	1991	1992	1993	1994	1995	1996	1997
Solid Fuels	NO	NO	NO	129	NO	NO	NO	NO
Liquid Fuels	5,257	10,045	9,759	6,201	1,086	1,173	1,379	1,173
Gaseous Fuels	27,747	25,133	19,610	19,528	4,606	3,961	6,015	7,570

	1998	1999	2000	2001	2002	2003	2004	2005
Liquid Fuels	880	411	176	264	88	88	72	137
Gaseous Fuels	5,164	5,868	6,631	10,034	8,655	7,914	8,351	9,503
	2006	2007	2008	2009	2010	2011	2012	2013
Liquid Fuels	52	26	56	327	125	113	68	67
Gaseous Fuels	9,279	9,097	8,140	7,526	7,358	6,951	6,699	6,326
	2014	2015	2016	2017	2018	2019	2020	%
Solid Fuels	NO	NO	5	NO	NO	NO	NO	-
Liquid Fuels	73	NO	NO	NO	NO	NO	NO	-
Gaseous Fuels	6,249	11,286	11,273	10,883	11,949	10,462	10,716	-61.4

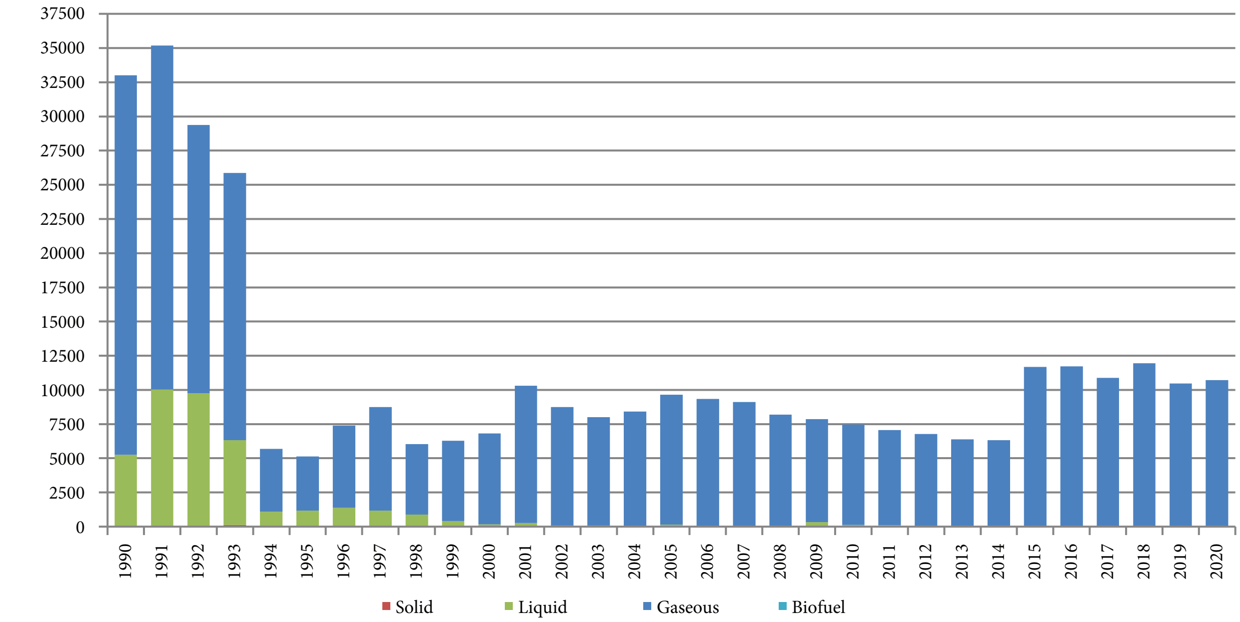


Figure 3-10: Fuel consumption by type of fuel at CHPs between 1990-2020, TJ.

1A1aiii 'Heat Plants'

There are many heat plants (HPs) in the Republic of Moldova, mainly operating on natural gases and residual fuel oil, and fewer which operate on coal and biomass. Information regarding the amount of fuel consumption is accounted in the Energy Balances of the Republic of Moldova.

Between 1990 and 2016, AD on natural gas consumption for heat generation on the Left Bank of the Dniester River are provided by JSC 'Moldovagaz'. These were considered as the difference between total fuel consumption in the energy sector of the ATULBD and fuel consumption at the MTTP in Dnestrovsk. AD is available in natural units (million m^3), being converted in energy units (TJ) by applying the conversion factor (33.86 TJ/mil.m^3). For 2017-2020, consumption of natural gas is calculated using indirect methods, taking into account the volume of heat produced.

AD on fuel consumption (including in energy units) regarding fuel consumption for heat generation on the RBDR is available in the Energy Balances of the Republic of Moldova (see rubric 'Heat Production'.

The table below shows aggregated AD on fuel consumption for heat production in the Republic of Moldova (Table 3-27).

Table 3-27: Fuel consumption for heat production between 1990-2020, TJ

	1990	1991	1992	1993	1994	1995	1996	1997
Anthracite	NO	NO	NO	373	176	117	29	29
Brown Coal (lignite)	35	NO	NO	202	59	29	29	29
Other types of Bituminous Coal	3,384	2,732	2,081	1,418	675	441	499	411
Diesel Oil	2,595	1,811	1,028	244	293	323	205	147
Kerosene for Oven	43	NO	NO	100	59	NO	29	29
Residual Fuel Oil	45,426	37,564	29,703	21,841	12,176	11,208	10,034	7,130
Natural Gas	63,508	52,995	42,844	30,273	32,780	28,896	26,065	29,925
Liquefied Petroleum Gases	46	NO	NO	35	NO	NO	NO	NO
Fuelwood	9	NO	NO	6	NO	NO	NO	NO
Wood Waste	59	NO	NO	50	147	88	NO	59
Agricultural Residues	NO	NO	NO	NO	NO	NO	88	NO

	1998	1999	2000	2001	2002	2003	2004	2005
Anthracite	29	NO	NO	NO	59	59	59	81
Brown Coal (lignite)	29	NO	NO	NO	NO	NO	NO	NO
Other types of Bituminous Coal	323	176	117	88	29	58	78	42
Diesel Oil	59	29	59	29	59	88	75	73
Kerosene for Oven	59	59	59	29	29	29	15	NO
Residual Fuel Oil	5,663	3,609	1,584	1,350	1,115	733	637	523
Natural Gas	32,900	24,941	20,826	21,301	17,348	19,125	17,299	19,563
Liquefied Petroleum Gases	NO	NO	NO	29	NO	NO	5	9
Fuelwood	NO	NO	NO	NO	NO	NO	3	3
Wood Waste	29	29	59	147	NO	29	16	16
Agricultural Residues	NO	NO	NO	NO	235	205	226	226
	2006	2007	2008	2009	2010	2011	2012	2013
Anthracite	44	39	71	113	91	61	67	264
Brown Coal (lignite)	56	26	28	9	5	8	7	64
Other types of Bituminous Coal	42	21	22	31	28	19	18	33
Diesel Oil	NO	NO	NO	3	NO	NO	NO	NO
Kerosene for Oven	439	268	372	679	745	544	460	528
Residual Fuel Oil	NO	NO	NO	NO	NO	NO	17	1
Natural Gas	19,706	17,531	18,436	16,283	17,990	17,429	16,946	17,273
Liquefied Petroleum Gases	8	4	3	7	1	1	NO	NO
Fuelwood	2	NO	1	1	2	1	1	37
Wood Waste	1	1	1	2	2	1	3	3
Agricultural Residues	214	239	373	435	514	399	226	229
Pellets and briquettes from vegetable waste	NO	NO	NO	NO	NO	NO	NO	NO
Biogas	NO	NO	NO	NO	NO	NO	NO	7
	2014	2015	2016	2017	2018	2019	2020	2021
Anthracite	52	NO	NO	5	3	NO	NO	N/A
Brown Coal (lignite)	28	NO	NO	NO	NO	NO	NO	N/A
Other types of Bituminous Coal	20	NO	NO	NO	NO	NO	NO	N/A
Diesel Oil	NO	NO	NO	NO	NO	NO	NO	N/A
Kerosene for Oven	408	NO	NO	NO	NO	NO	NO	N/A
Residual Fuel Oil	NO	NO	NO	NO	NO	NO	NO	N/A
Natural Gas	16,697	8,507	8,755	8,566	8,307	8,052	7,851	N/A
Liquefied Petroleum Gases	NO	NO	NO	NO	NO	NO	NO	N/A
Fuelwood	29	NO	NO	NO	NO	NO	NO	N/A
Wood Waste	5	NO	NO	NO	NO	NO	NO	N/A
Agricultural Residues	321	NO	NO	NO	NO	NO	3	N/A
Pellets and briquettes from vegetable waste	NO	NO	22	23	32	10	10	N/A
Biogas	99	NO	NO	NO	NO	NO	NO	N/A

Fuel consumption by type for heat production between 1990 and 2020 is presented in Table 3-28.

Table 3-28: Fuel consumption by type of fuel for heat production between 1990-2020

	Fuel consumption by category, TJ					%, compared to 1990				
	Coal	Oil Products	Natural gas	Biofuel	Total	Coal	Oil Products	Natural gas	Biofuel	Total
1990	3,419	48,064	63,554	68	115,105	100	100	100	100	100
1991	2,732	39,376	52,995	NA	95,103	80	82	83	NA	83
1992	2,081	30,730	42,844	NA	75,655	61	64	67	NA	66
1993	1,993	22,185	30,308	56	54,542	58	46	48	82	47
1994	910	12,528	32,780	147	46,365	27	26	52	216	40
1995	587	11,531	28,896	88	41,102	17	24	45	129	36
1996	557	10,268	26,065	88	36,978	16	21	41	129	32
1997	469	7,306	29,925	59	37,759	14	15	47	87	33
1998	381	5,781	32,900	29	39,091	11	12	52	43	34
1999	176	3,697	24,941	29	28,843	5	8	39	43	25
2000	117	1,702	20,826	59	22,704	3	4	33	87	20
2001	88	1,408	21,330	147	22,973	3	3	34	216	20
2002	88	1,203	17,348	235	18,874	3	3	27	346	16
2003	117	850	19,125	234	20,326	3	2	30	344	18
2004	137	727	17,304	245	18,413	4	2	27	360	16
2005	123	596	19,572	245	20,536	4	1	31	360	18
2006	100	481	19,714	217	20,512	3	1	31	319	18
2007	65	289	17,535	240	18,129	2	1	28	353	16
2008	99	394	18,439	375	19,307	3	1	29	551	17
2009	122	713	16,290	438	17,563	4	1	26	644	15
2010	96	773	17,991	518	19,378	3	2	28	762	17
2011	69	563	17,430	401	18,463	2	1	27	590	16
2012	74	495	16,946	230	17,745	2	1	27	338	15

	Fuel consumption by category, TJ					%, compared to 1990				
	Coal	Oil Products	Natural gas	Biofuel	Total	Coal	Oil Products	Natural gas	Biofuel	Total
2013	328	562	17,273	276	18,439	10	1	27	406	16
2014	80	428	16,697	454	17,659	2	1	26	668	15
2015	NA	NA	8,507	NA	8,507	NA	NA	13	NA	7
2016	NA	NA	8,755	22	8,777	NA	NA	14	32	8
2017	5	NA	8,566	23	8,594	0	NA	13	34	7
2018	3	NA	8,307	32	8,342	0	NA	13	47	7
2019	NA	NA	8,052	10	8,062	NA	NA	13	15	7
2020	NA	NA	7,851	13	7,864	NA	NA	12	19	7

In recent years, the largest share in the structure of total fuel consumption for heat generation was represented by natural gas (Figure 3-11).

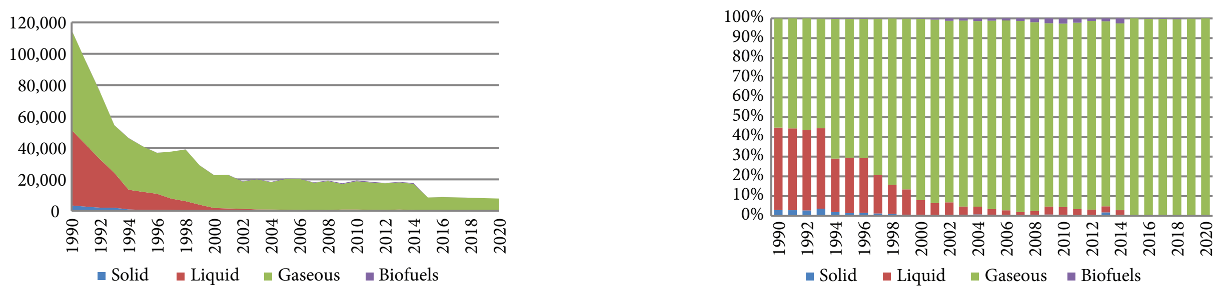


Figure 3-11: Fuel consumption by category in the production of heat between 1990-2020.

Fuel consumption by sources within 1A1a 'Main Activity Electricity and Heat Production'

Fuel consumption by sources within 1A1a 'Main Activity Electricity and Heat Production', as well as the share of each source are presented in Table 3-29.

Table 3-29: Fuel consumption (TJ) by source within 1A1a 'Main Activity Electricity and Heat Production' and the share of each source (%) in the structure of total emissions between 1990-2020

	Fuel consumption by source, TJ				Share, % of total		
	1A1ai	1A1aii	1A1aiii	1A1a	1A1ai	1A1aii	1A1aiii
1990	148,508.5	33,004.6	115,104.7	296,617.8	50.1	11.1	38.8
1991	132,885.3	35,177.7	95,102.9	263,165.9	50.5	13.4	36.1
1992	116,169.6	29,368.5	75,655.4	221,193.4	52.5	13.3	34.2
1993	94,682.3	25,858.2	54,541.5	175,082.0	54.1	14.8	31.2
1994	86,948.5	5,692.0	46,364.8	139,005.3	62.6	4.1	33.4
1995	60,702.0	5,134.0	41,101.9	106,937.9	56.8	4.8	38.4
1996	63,170.7	7,394.0	36,977.8	107,542.5	58.7	6.9	34.4
1997	45,110.6	8,743.0	37,758.7	91,612.3	49.2	9.5	41.2
1998	34,727.3	6,044.0	39,091.4	79,862.7	43.5	7.6	48.9
1999	28,483.0	6,279.0	28,842.6	63,604.6	44.8	9.9	45.3
2000	26,018.0	6,807.0	22,703.9	55,528.9	46.9	12.3	40.9
2001	31,740.4	10,298.0	22,972.5	65,010.9	48.8	15.8	35.3
2002	24,355.5	8,743.0	18,873.8	51,972.3	46.9	16.8	36.3
2003	25,604.9	8,002.0	20,325.7	53,932.6	47.5	14.8	37.7
2004	28,398.4	8,423.0	18,412.9	55,234.3	51.4	15.2	33.3
2005	27,270.8	9,640.0	20,536.5	57,447.3	47.5	16.8	35.7
2006	14,539.5	9,331.0	20,512.4	44,382.8	32.8	21.0	46.2
2007	24,345.3	9,123.0	18,129.5	51,597.8	47.2	17.7	35.1
2008	25,943.5	8,196.0	19,306.5	53,446.1	48.5	15.3	36.1
2009	42,907.4	7,853.0	17,563.0	68,323.4	62.8	11.5	25.7
2010	45,394.1	7,483.0	19,377.5	72,254.6	62.8	10.4	26.8
2011	41,338.2	7,064.0	18,463.0	66,865.2	61.8	10.6	27.6
2012	42,976.6	6,767.0	17,745.0	67,488.5	63.7	10.0	26.3
2013	33,606.4	6,393.0	18,438.8	58,438.3	57.5	10.9	31.6
2014	39,559.0	6,322.0	17,659.1	63,540.1	62.3	9.9	27.8
2015	45,769.5	11,286.0	8,507.3	65,562.8	69.8	17.2	13.0
2016	44,702.5	11,278.0	8,777.1	64,757.6	69.0	17.4	13.6
2017	33,957.5	10,883.0	8,594.2	53,434.7	63.5	20.4	16.1
2018	37,839.2	11,949.0	8,341.8	58,130.1	65.1	20.6	14.4
2019	37,261.4	10,462.0	8,061.7	55,785.0	66.8	18.8	14.5
2020	46,327.5	10,716.0	7,864.2	64,907.7	71.4	16.5	12.1

Fuel consumption within 1A1a 'Main Activity Electricity and Heat Production'

The evolution of fuel consumption by sources under 1A1a 'Main Activity Electricity and Heat Production' between 1990 and 2020 is presented in Table 3-30 and Figure 3-12.

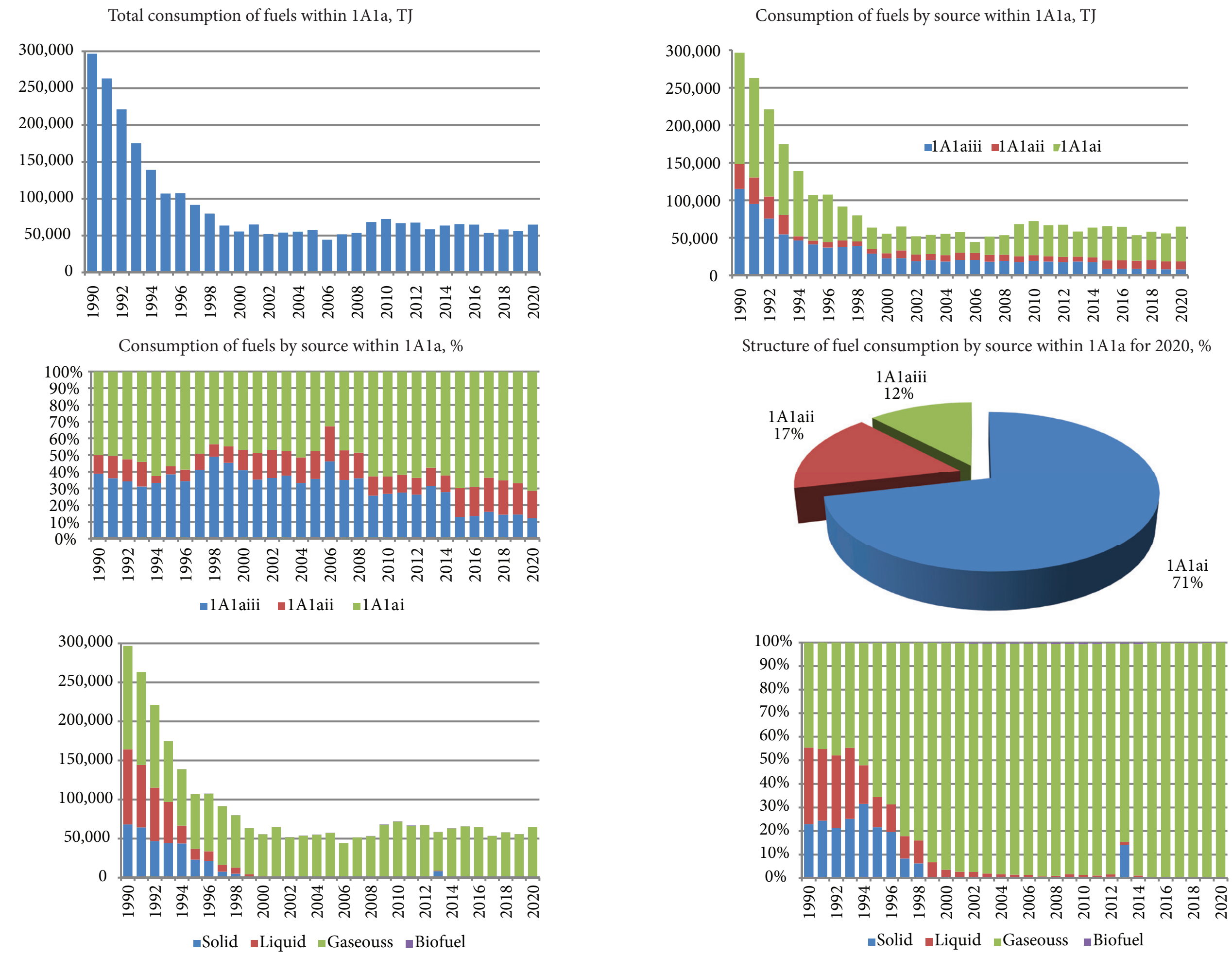


Figure 3-12: Fuel consumption by emission sources and fuel types within 1A1a 'Main Activity Electricity and Heat Production' between 1990-2020.

During the respective period, the share of solid fuels (coal) decreased from 22.9% to 0.01%; the share of liquid fuels (petroleum products) decreased from 32.5% to 0.05%; the share of gaseous fuels (natural gases and LPG) increased from 44.6% to 99.7%; and the share of biofuels increased from 0.02% to 0.26% of the total (biofuel consumption recorded a significant growth, particularly between 2000-2014, from circa 59 TJ to 472 TJ). In total, fuel consumption within 1A1a 'Main Activity Electricity and Heat Production' constituted only circa 21.9% in 2020, compared to the base year level (1990).

Table 3-30: Fuel consumption by category within 1A1a 'Main Activity Electricity and Heat Production' between 1990-2020

	Fuel Consumption, TJ					Share, % of total				%, compared to 1990				
	Coal	Oil Products	Natural Gases	Biofuels	Total	Coal	Oi Products	Natural Gases	Biofuels	Coal	Oil Products	Natural Gases	Biofuels	Total
1990	68,062	96,331	132,156	68	296,618	22.9	32.5	44.6	0.0	100.0	100.0	100.0	100.0	100.0
1991	64,272	79,904	118,990	0	263,166	24.4	30.4	45.2	0.0	94.4	82.9	90.0	0.0	88.7
1992	46,855	68,344	105,995	0	221,193	21.2	30.9	47.9	0.0	68.8	70.9	80.2	0.0	74.6
1993	44,022	52,808	78,197	56	175,082	25.1	30.2	44.7	0.0	64.7	54.8	59.2	82.4	59.0
1994	43,817	22,780	72,262	147	139,005	31.5	16.4	52.0	0.1	64.4	23.6	54.7	216.2	46.9
1995	23,048	13,753	70,049	88	106,938	21.6	12.9	65.5	0.1	33.9	14.3	53.0	129.4	36.1
1996	21,070	12,596	73,789	88	107,543	19.6	11.7	68.6	0.1	31.0	13.1	55.8	129.4	36.3
1997	7,640	8,722	75,191	59	91,612	8.3	9.5	82.1	0.1	11.2	9.1	56.9	86.8	30.9
1998	5,022	7,743	67,069	29	79,863	6.3	9.7	84.0	0.0	7.4	8.0	50.7	42.6	26.9
1999	176	4,108	59,292	29	63,605	0.3	6.5	93.2	0.0	0.3	4.3	44.9	42.6	21.4
2000	117	1,878	53,475	59	55,529	0.2	3.4	96.3	0.1	0.2	1.9	40.5	86.8	18.7
2001	88	1,672	63,104	147	65,011	0.1	2.6	97.1	0.2	0.1	1.7	47.7	216.2	21.9

	Fuel Consumption, TJ					Share, % of total				%, compared to 1990				
	Coal	Oil Products	Natural Gases	Biofuels	Total	Coal	Oi Products	Natural Gases	Biofuels	Coal	Oil Products	Natural Gases	Biofuels	Total
2002	88	1,291	50,358	235	51,972	0.2	2.5	96.9	0.5	0.1	1.3	38.1	345.6	17.5
2003	117	938	52,644	234	53,933	0.2	1.7	97.6	0.4	0.2	1.0	39.8	344.1	18.2
2004	137	799	54,053	245	55,234	0.2	1.4	97.9	0.4	0.2	0.8	40.9	360.3	18.6
2005	123	733	56,346	245	57,447	0.2	1.3	98.1	0.4	0.2	0.8	42.6	360.3	19.4
2006	100	533	43,533	217	44,383	0.2	1.2	98.1	0.5	0.1	0.6	32.9	319.1	15.0
2007	65	315	50,978	240	51,598	0.1	0.6	98.8	0.5	0.1	0.3	38.6	352.9	17.4
2008	99	450	52,522	375	53,446	0.2	0.8	98.3	0.7	0.1	0.5	39.7	551.5	18.0
2009	122	1,040	66,723	438	68,323	0.2	1.5	97.7	0.6	0.2	1.1	50.5	644.1	23.0
2010	96	919	70,722	518	72,255	0.1	1.3	97.9	0.7	0.1	1.0	53.5	761.8	24.4
2011	69	695	65,700	401	66,865	0.1	1.0	98.3	0.6	0.1	0.7	49.7	589.7	22.5
2012	409	676	66,173	230	67,489	0.6	1.0	98.1	0.3	0.6	0.7	50.1	338.2	22.8
2013	8,270	713	49,169	286	58,438	14.2	1.2	84.1	0.5	12.2	0.7	37.2	420.6	19.7
2014	147	569	62,352	472	63,540	0.2	0.9	98.1	0.7	0.2	0.6	47.2	694.1	21.4
2015	50	61	65,438	14	65,563	0.1	0.1	99.8	0.0	0.1	0.1	49.5	20.6	22.1
2016	193	88	64,452	24	64,758	0.3	0.1	99.5	0.0	0.3	0.1	48.8	35.3	21.8
2017	5	38	53,285	107	53,435	0.0	0.1	99.7	0.2	0.0	0.0	40.3	157.4	18.0
2018	14	42	57,892	182	58,130	0.0	0.1	99.6	0.3	0.0	0.0	43.8	267.6	19.6
2019	19	23	55,608	136	55,785	0.0	0.0	99.7	0.2	0.0	0.0	42.1	200.0	18.8
2020	5	31	64,706	166	64,908	0.0	0.0	99.7	0.3	0.0	0.0	49.0	244.1	21.9

Trends in GHG emissions within 1A1a 'Main Activity Electricity and Heat Production'

1A1ai 'Electricity Generation'

Direct GHG emissions from 1A1ai 'Electricity Generation' in the Republic of Moldova between 1990 and 2020 are presented in Figure 3-13.

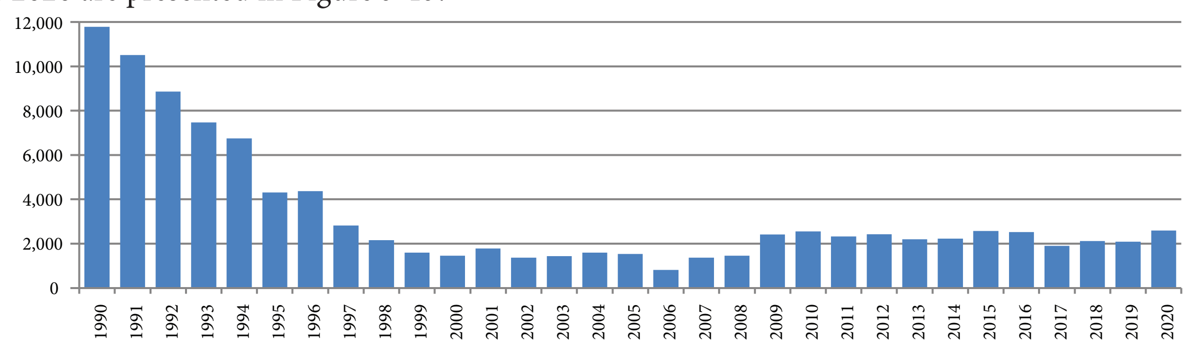


Figure 3-13: Direct GHG emissions from 1A1ai 'Electricity Generation' in the Republic of Moldova between 1990-2020, kt CO_2 equivalent.

During the respective period, GHG emissions from this source category recorded a significant decrease, constituting in 2020 only circa 22.0% of the base year level (Table 3-31).

Table 3-31: Evolution of direct GHG emissions from 1A1ai 'Electricity Generation' between 1990-2020

	1990	1991	1992	1993	1994	1995	1996	1997
1A1ai, RM, kt CO_2 equivalent	11,779.86	10,512.45	8,864.82	7,472.52	6,749.45	4,305.39	4,366.05	2,817.48
%, compared to 1990	100.0	89.2	75.3	63.4	57.3	36.5	37.1	23.9
	1998	1999	2000	2001	2002	2003	2004	2005
1A1ai, RM, kt CO_2 equivalent	2,153.97	1,599.46	1,461.04	1,782.37	1,367.68	1,437.84	1,594.71	1,531.39
%, compared to 1990	18.3	13.6	12.4	15.1	11.6	12.2	13.5	13.0
	2006	2007	2008	2009	2010	2011	2012	2013
1A1ai, RM, kt CO_2 equivalent	816.46	1,367.11	1,456.85	2,409.46	2,549.48	2,321.68	2,428.78	2,197.45
%, compared to 1990	6.9	11.6	12.4	20.5	21.6	19.7	20.6	18.7
	2014	2015	2016	2017	2018	2019	2020	%
1A1ai, RM, kt CO_2 equivalent	2,224.47	2,572.64	2,519.33	1,902.95	2,117.75	2,086.52	2,593.75	78.0
%, compared to 1990	18.9	21.8	21.4	16.2	18.0	17.7	22.0	

CO_2 emissions constituted the largest share in the structure of total direct GHG emissions from 1A1ai 'Electricity Generation' between 1990 and 2020 (Table 3-32).

Table 3-32: Evolution of direct GHG emissions from 1A1ai 'Electricity Generation' between 1990-2020 and the share of each gas in the total structure at source level

	1A1ai, kt CO_2 equivalent				% of total		
	CO_2	CH_4	N_2O	Total	CO_2	CH_4	N_2O
1990	11,736.1962	5.8632	37.8031	11,779.8626	99.63	0.05	0.32
1991	10,473.4309	4.8463	34.1763	10,512.4534	99.63	0.05	0.33
1992	8,834.2289	4.2970	26.2921	8,864.8180	99.65	0.05	0.30
1993	7,444.9936	3.5881	23.9409	7,472.5226	99.63	0.05	0.32
1994	6,724.9619	2.6320	21.8576	6,749.4514	99.64	0.04	0.32
1995	4,292.4793	1.5700	11.3360	4,305.3853	99.70	0.04	0.26
1996	4,353.8441	1.6267	10.5820	4,366.0527	99.72	0.04	0.24
1997	2,811.9669	1.1399	4.3722	2,817.4791	99.80	0.04	0.16
1998	2,149.9182	0.9223	3.1322	2,153.9727	99.81	0.04	0.15
1999	1,597.8981	0.7121	0.8488	1,599.4590	99.90	0.04	0.05
2000	1,459.6111	0.6505	0.7753	1,461.0369	99.90	0.04	0.05
2001	1,780.6344	0.7935	0.9459	1,782.3738	99.90	0.04	0.05
2002	1,366.3434	0.6089	0.7258	1,367.6781	99.90	0.04	0.05
2003	1,436.4367	0.6401	0.7630	1,437.8398	99.90	0.04	0.05
2004	1,593.1492	0.7100	0.8463	1,594.7055	99.90	0.04	0.05
2005	1,529.8943	0.6818	0.8127	1,531.3888	99.90	0.04	0.05
2006	815.6651	0.3635	0.4333	816.4618	99.90	0.04	0.05
2007	1,365.7736	0.6086	0.7255	1,367.1077	99.90	0.04	0.05
2008	1,455.4321	0.6486	0.7731	1,456.8539	99.90	0.04	0.05
2009	2,407.1047	1.0727	1.2786	2,409.4560	99.90	0.04	0.05
2010	2,546.9861	1.1359	1.3559	2,549.4779	99.90	0.04	0.05
2011	2,319.4150	1.0344	1.2347	2,321.6841	99.90	0.04	0.05
2012	2,426.2627	1.0801	1.4374	2,428.7802	99.90	0.04	0.06
2013	2,192.2793	0.8444	4.3274	2,197.4510	99.76	0.04	0.20
2014	2,222.2592	0.9924	1.2170	2,224.4686	99.90	0.04	0.05
2015	2,570.0984	1.1473	1.3940	2,572.6397	99.90	0.04	0.05
2016	2,516.7809	1.1220	1.4236	2,519.3265	99.90	0.04	0.06
2017	1,901.0807	0.8508	1.0176	1,902.9491	99.90	0.04	0.05
2018	2,115.6666	0.9481	1.1386	2,117.7533	99.90	0.04	0.05
2019	2,084.4700	0.9327	1.1215	2,086.5242	99.90	0.04	0.05
2020	2,591.2003	1.1597	1.3871	2,593.7472	99.90	0.04	0.05

Table 3-33 shows the evolution of direct and indirect GHG emissions from 1A1ai 'Electricity Generation' between 1990 and 2020.

Table 3-33: Evolution of direct and indirect GHG emissions from 1A1ai 'Electricity Generation' between 1990-2020

	1A1ai, kt							%, compared to 1990						
	CO_2	CH_4	N_2O	NO_x	CO	NMVOC	SO_2	CO_2	CH_4	N_2O	NO_x	CO	NMVOC	SO_2
1990	11,736.1962	0.2345	0.1269	23.2539	2.8052	0.2698	74.3087	100.0	100.0	100.0	100.0	100.0	100.0	100.0
1991	10,473.4309	0.1939	0.1147	20.8271	2.5893	0.2379	65.5632	89.2	82.7	90.4	89.6	92.3	88.2	88.2
1992	8,834.2289	0.1719	0.0882	17.1883	2.5082	0.2220	50.5153	75.3	73.3	69.5	73.9	89.4	82.3	68.0
1993	7,444.9936	0.1435	0.0803	14.7490	1.8394	0.1718	46.4543	63.4	61.2	63.3	63.4	65.6	63.7	62.5
1994	6,724.9619	0.1053	0.0733	13.3730	1.8718	0.1547	39.7306	57.3	44.9	57.8	57.5	66.7	57.3	53.5
1995	4,292.4793	0.0628	0.0380	8.1534	1.6617	0.1216	18.9478	36.6	26.8	30.0	35.1	59.2	45.1	25.5
1996	4,353.8441	0.0651	0.0355	8.1341	1.8194	0.1311	17.3022	37.1	27.7	28.0	35.0	64.9	48.6	23.3
1997	2,811.9669	0.0456	0.0147	4.8882	1.5362	0.1057	6.0112	24.0	19.4	11.6	21.0	54.8	39.2	8.1
1998	2,149.9182	0.0369	0.0105	3.7050	1.1879	0.0825	4.3492	18.3	15.7	8.3	15.9	42.3	30.6	5.9
1999	1,597.8981	0.0285	0.0028	2.5350	1.1108	0.0741	0.0080	13.6	12.1	2.2	10.9	39.6	27.4	0.0
2000	1,459.6111	0.0260	0.0026	2.3156	1.0147	0.0676	0.0073	12.4	11.1	2.1	10.0	36.2	25.1	0.0
2001	1,780.6344	0.0317	0.0032	2.8249	1.2379	0.0825	0.0089	15.2	13.5	2.5	12.1	44.1	30.6	0.0
2002	1,366.3434	0.0244	0.0024	2.1676	0.9499	0.0633	0.0068	11.6	10.4	1.9	9.3	33.9	23.5	0.0
2003	1,436.4367	0.0256	0.0026	2.2788	0.9986	0.0666	0.0072	12.2	10.9	2.0	9.8	35.6	24.7	0.0
2004	1,593.1492	0.0284	0.0028	2.5275	1.1075	0.0738	0.0080	13.6	12.1	2.2	10.9	39.5	27.4	0.0
2005	1,529.8943	0.0273	0.0027	2.4271	1.0636	0.0709	0.0077	13.0	11.6	2.1	10.4	37.9	26.3	0.0
2006	815.6651	0.0145	0.0015	1.2940	0.5670	0.0378	0.0041	6.9	6.2	1.1	5.6	20.2	14.0	0.0
2007	1,365.7736	0.0243	0.0024	2.1667	0.9495	0.0633	0.0068	11.6	10.4	1.9	9.3	33.8	23.5	0.0
2008	1,455.4321	0.0259	0.0026	2.3090	1.0118	0.0675	0.0073	12.4	11.1	2.0	9.9	36.1	25.0	0.0
2009	2,407.1047	0.0429	0.0043	3.8188	1.6734	0.1116	0.0121	20.5	18.3	3.4	16.4	59.7	41.4	0.0
2010	2,546.9861	0.0454	0.0045	4.0396	1.7699	0.1180	0.0137	21.7	19.4	3.6	17.4	63.1	43.7	0.0
2011	2,319.4150	0.0414	0.0041	3.6786	1.6118	0.1074	0.0125	19.8	17.6	3.3	15.8	57.5	39.8	0.0
2012	2,426.2627	0.0432	0.0048	3.8703	1.6632	0.1112	0.3382	20.7	18.4	3.8	16.6	59.3	41.2	0.5
2013	2,192.2793	0.0338	0.0145	3.9477	1.0680	0.0746	6.5566	18.7	14.4	11.4	17.0	38.1	27.7	8.8
2014	2,222.2592	0.0397	0.0041	3.5317	1.5391	0.1027	0.0959	18.9	16.9	3.2	15.2	54.9	38.1	0.1
2015	2,570.0984	0.0459	0.0047	4.0823	1.7820	0.1189	0.0815	21.9	19.6	3.7	17.6	63.5	44.1	0.1
2016	2,516.7809	0.0449	0.0048	4.0051	1.7356	0.1159	0.2066	21.4	19.1	3.8	17.2	61.9	43.0	0.3

	1A1ai, kt							%, compared to 1990						
	CO_2	CH_4	N_2O	NO_x	CO	NMVOC	SO_2	CO_2	CH_4	N_2O	NO_x	CO	NMVOC	SO_2
2017	1,901.0807	0.0340	0.0034	3.0234	1.3234	0.0883	0.0235	16.2	14.5	2.7	13.0	47.2	32.7	0.0
2018	2,115.6666	0.0379	0.0038	3.3707	1.4744	0.0983	0.0370	18.0	16.2	3.0	14.5	52.6	36.5	0.0
2019	2,084.4700	0.0373	0.0038	3.3191	1.4521	0.0968	0.0334	17.8	15.9	3.0	14.3	51.8	35.9	0.0
2020	2,591.2003	0.0464	0.0047	4.1247	1.8059	0.1204	0.0286	22.1	19.8	3.7	17.7	64.4	44.6	0.0

1A1aii 'Combined Heat and Power Generation'

The evolution of direct GHG emissions from 1A1aii 'Combined Heat and Power Generation' in the RM between 1990 and 2020 is presented in Figure 3-14.

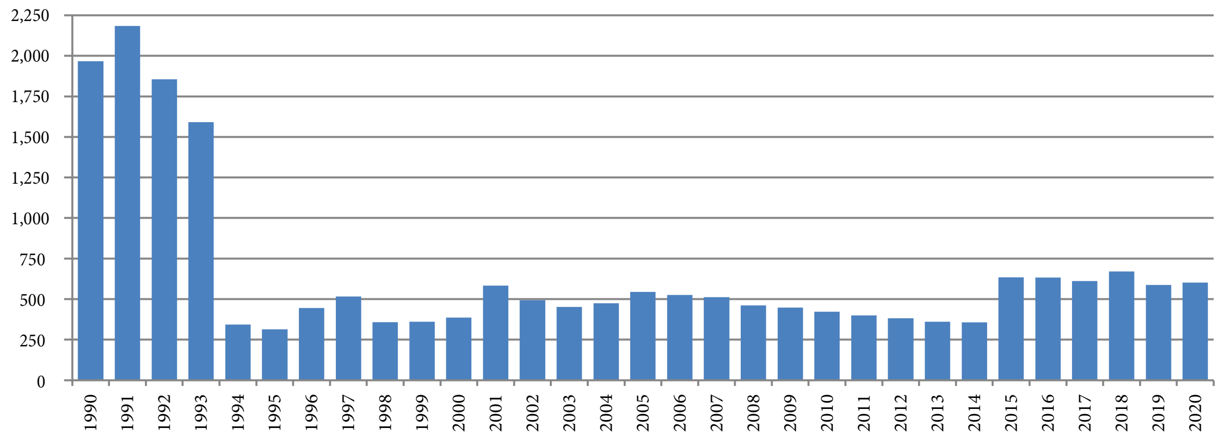


Figure 3-14: Direct GHG emissions from 1A1aii 'Combined Heat and Power Generation' between 1990-2020, kt CO_2 equivalent.

During the respective period, GHG emissions from this source recorded a significant decrease, constituting in 2020 only circa 30.6% of the base year level (Table 3-34).

Table 3-34: Direct GHG emissions from 1A1aii 'Combined Heat and Power Generation' in the RM between 1990-2020

	1990	1991	1992	1993	1994	1995	1996	1997
1A1aii, kt CO_2 equivalent	1,966.2536	2,184.3363	1,854.7694	1,590.8395	342.9810	313.4214	444.7600	516.0840
%, compared to 1990	100.0	111.1	94.3	80.9	17.4	15.9	22.6	26.2
	1998	1999	2000	2001	2002	2003	2004	2005
1A1aii, kt CO_2 equivalent	358.2230	361.2374	385.9338	583.8622	492.8533	451.2426	474.5035	544.2083
%, compared to 1990	18.2	18.4	19.6	29.7	25.1	22.9	24.1	27.7
	2006	2007	2008	2009	2010	2011	2012	2013
1A1aii, kt CO_2 equivalent	525.0423	512.8196	461.3959	447.9544	422.8277	399.0442	381.4285	360.4051
%, compared to 1990	26.7	26.1	23.5	22.8	21.5	20.3	19.4	18.3
	2014	2015	2016	2017	2018	2019	2020	%
1A1aii, kt CO_2 equivalent	356.5504	633.7631	633.5269	611.1327	670.9937	587.4915	601.7548	-69.4
%, compared to 1990	18.1	32.2	32.2	31.1	34.1	29.9	30.6	

Table 3-35 shows the evolution of direct GHG emissions from 1A1aii 'Combined Heat and Power Generation' in the Republic of Moldova for the period 1990-2020, the share of each gas in the total structure at source level, as well as the evolution of direct GHG emissions expressed in % compared to the base year level.

Table 3-35: Direct GHG emissions from 1A1aii 'Combined Heat and Power Generation' between 1990-2020

	1A1aii, kt CO_2 equivalent				Share of total, %			%, compared to 1990		
	CO_2	CH_4	N_2O	Total	CO_2	CH_4	N_2O	CO_2	CH_4	N_2O
1990	1,963.3987	1.0880	1.7669	1,966.2536	99.85	0.06	0.09	100.0	100.0	100.0
1991	2,180.4097	1.3817	2.5450	2,184.3363	99.82	0.06	0.12	111.1	127.0	144.0
1992	1,851.2180	1.2221	2.3292	1,854.7694	99.81	0.07	0.13	94.3	112.3	131.8
1993	1,588.1346	0.9565	1.7484	1,590.8395	99.83	0.06	0.11	80.9	87.9	99.0
1994	342.4530	0.1966	0.3314	342.9810	99.85	0.06	0.10	17.4	18.1	18.8
1995	312.9066	0.1870	0.3278	313.4214	99.84	0.06	0.10	15.9	17.2	18.6
1996	444.0804	0.2538	0.4258	444.7600	99.85	0.06	0.10	22.6	23.3	24.1
1997	515.3715	0.2772	0.4353	516.0840	99.86	0.05	0.08	26.2	25.5	24.6
1998	357.7167	0.1951	0.3112	358.2230	99.86	0.05	0.09	18.2	17.9	17.6
1999	360.8115	0.1775	0.2484	361.2374	99.88	0.05	0.07	18.4	16.3	14.1
2000	385.5258	0.1790	0.2291	385.9338	99.89	0.05	0.06	19.6	16.5	13.0
2001	583.2453	0.2707	0.3462	583.8622	99.89	0.05	0.06	29.7	24.9	19.6

	1A1aii, kt CO_2 equivalent				Share of total, %			%, compared to 1990		
	CO_2	CH_4	N_2O	Total	CO_2	CH_4	N_2O	CO_2	CH_4	N_2O
2002	492.3567	0.2230	0.2737	492.8533	99.90	0.05	0.06	25.1	20.5	15.5
2003	450.7866	0.2045	0.2516	451.2426	99.90	0.05	0.06	23.0	18.8	14.2
2004	474.0276	0.2142	0.2617	474.5035	99.90	0.05	0.06	24.1	19.7	14.8
2005	543.6528	0.2479	0.3077	544.2083	99.90	0.05	0.06	27.7	22.8	17.4
2006	524.5206	0.2359	0.2858	525.0423	99.90	0.04	0.05	26.7	21.7	16.2
2007	512.3145	0.2294	0.2757	512.8196	99.90	0.04	0.05	26.1	21.1	15.6
2008	460.9356	0.2077	0.2526	461.3959	99.90	0.05	0.05	23.5	19.1	14.3
2009	447.4590	0.2127	0.2827	447.9544	99.89	0.05	0.06	22.8	19.5	16.0
2010	422.3928	0.1933	0.2416	422.8277	99.90	0.05	0.06	21.5	17.8	13.7
2011	398.6346	0.1823	0.2273	399.0442	99.90	0.05	0.06	20.3	16.8	12.9
2012	381.0441	0.1726	0.2118	381.4285	99.90	0.05	0.06	19.4	15.9	12.0
2013	360.0414	0.1632	0.2005	360.4051	99.90	0.05	0.06	18.3	15.0	11.3
2014	356.1894	0.1617	0.1993	356.5504	99.90	0.05	0.06	18.1	14.9	11.3
2015	633.1446	0.2822	0.3363	633.7631	99.90	0.04	0.05	32.2	25.9	19.0
2016	632.9068	0.2820	0.3382	633.5269	99.90	0.04	0.05	32.2	25.9	19.1
2017	610.5363	0.2721	0.3243	611.1327	99.90	0.04	0.05	31.1	25.0	18.4
2018	670.3389	0.2987	0.3561	670.9937	99.90	0.04	0.05	34.1	27.5	20.2
2019	586.9182	0.2616	0.3118	587.4915	99.90	0.04	0.05	29.9	24.0	17.6
2020	601.1676	0.2679	0.3193	601.7548	99.90	0.04	0.05	30.6	24.6	18.1

The evolution of direct and indirect GHG emissions from 1A1aii 'Combined Heat and Power Generation' between 1990 and 2020 is presented in Table 3-36. In this period, GHG emissions from this source recorded a significant decrease. In 2020, CO_2 emissions constituted circa 30.62% compared to the level in 1990, whereas CH_4 – 24.62%, N_2O – 18.07%, NO_x – 29.69%, CO – 35.98%, NMVOC – 33.10%, and SO_2 – 0.12%.

Table 3-36: Direct and indirect GHG emissions from 1A1aii 'Combined Heat and Power Generation' in the Republic of Moldova between 1990-2020

	1A1aii, kt							%, compared to 1990						
	CO_2	CH_4	N_2O	NO_x	CO	NMVOC	SO_2	CO_2	CH_4	N_2O	NO_x	CO	NMVOC	SO_2
1990	1,963.3987	0.0435	0.0059	3.2128	1.1616	0.0842	2.5911	100.00	100.00	100.00	100.00	100.00	100.00	100.00
1991	2,180.4097	0.0553	0.0085	3.4994	1.1342	0.0853	4.0254	111.05	127.00	144.04	108.92	97.64	101.29	155.35
1992	1,851.2180	0.0489	0.0078	3.0327	0.9135	0.0715	4.2637	94.29	112.33	131.83	94.40	78.65	84.97	164.55
1993	1,588.1346	0.0383	0.0059	2.6446	0.8564	0.0651	3.1755	80.89	87.92	98.95	82.32	73.72	77.40	122.55
1994	342.4530	0.0079	0.0011	0.5641	0.1960	0.0145	0.5389	17.44	18.07	18.76	17.56	16.88	17.20	20.80
1995	312.9066	0.0075	0.0011	0.5169	0.1722	0.0130	0.5687	15.94	17.19	18.55	16.09	14.83	15.39	21.95
1996	444.0804	0.0102	0.0014	0.7289	0.2554	0.0188	0.6713	22.62	23.33	24.10	22.69	21.99	22.30	25.91
1997	515.3715	0.0111	0.0015	0.8381	0.3130	0.0223	0.5698	26.25	25.48	24.64	26.09	26.94	26.54	21.99
1998	357.7167	0.0078	0.0010	0.5823	0.2147	0.0154	0.4240	18.22	17.93	17.61	18.13	18.48	18.30	16.37
1999	360.8115	0.0071	0.0008	0.5761	0.2351	0.0161	0.1786	18.38	16.32	14.06	17.93	20.24	19.14	6.89
2000	385.5258	0.0072	0.0008	0.6129	0.2613	0.0176	0.0760	19.64	16.45	12.96	19.08	22.50	20.91	2.93
2001	583.2453	0.0108	0.0012	0.9283	0.3953	0.0267	0.1205	29.71	24.88	19.59	28.89	34.04	31.66	4.65
2002	492.3567	0.0089	0.0009	0.7828	0.3389	0.0227	0.0460	25.08	20.49	15.49	24.36	29.17	26.98	1.77
2003	450.7866	0.0082	0.0008	0.7168	0.3100	0.0208	0.0458	22.96	18.79	14.24	22.31	26.69	24.69	1.77
2004	474.0276	0.0086	0.0009	0.7526	0.3268	0.0219	0.0331	24.14	19.69	14.81	23.43	28.13	25.97	1.28
2005	543.6528	0.0099	0.0010	0.8636	0.3727	0.0250	0.0611	27.69	22.78	17.41	26.88	32.09	29.69	2.36
2006	524.5206	0.0094	0.0010	0.8319	0.3627	0.0242	0.0207	26.71	21.68	16.18	25.89	31.22	28.77	0.80
2007	512.3145	0.0092	0.0009	0.8124	0.3552	0.0237	0.0100	26.09	21.08	15.61	25.29	30.58	28.15	0.39
2008	460.9356	0.0083	0.0008	0.7312	0.3183	0.0213	0.0228	23.48	19.09	14.30	22.76	27.40	25.27	0.88
2009	447.4590	0.0085	0.0009	0.7149	0.2985	0.0203	0.1559	22.79	19.55	16.00	22.25	25.70	24.11	6.02
2010	422.3928	0.0077	0.0008	0.6711	0.2889	0.0194	0.0550	21.51	17.77	13.67	20.89	24.87	23.03	2.12
2011	398.6346	0.0073	0.0008	0.6332	0.2728	0.0183	0.0494	20.30	16.75	12.87	19.71	23.49	21.75	1.91
2012	381.0441	0.0069	0.0007	0.6051	0.2623	0.0176	0.0311	19.41	15.86	11.99	18.83	22.58	20.86	1.20
2013	360.0414	0.0065	0.0007	0.5718	0.2477	0.0166	0.0305	18.34	15.00	11.35	17.80	21.33	19.71	1.18
2014	356.1894	0.0065	0.0007	0.5658	0.2448	0.0164	0.0339	18.14	14.86	11.28	17.61	21.08	19.49	1.31
2015	633.1446	0.0113	0.0011	1.0045	0.4402	0.0293	0.0032	32.25	25.93	19.03	31.26	37.89	34.86	0.12
2016	632.9068	0.0113	0.0011	1.0043	0.4397	0.0293	0.0073	32.24	25.91	19.14	31.26	37.85	34.83	0.28
2017	610.5363	0.0109	0.0011	0.9686	0.4244	0.0283	0.0031	31.10	25.01	18.36	30.15	36.54	33.62	0.12
2018	670.3389	0.0119	0.0012	1.0635	0.4660	0.0311	0.0034	34.14	27.46	20.15	33.10	40.12	36.91	0.13
2019	586.9182	0.0105	0.0010	0.9311	0.4080	0.0272	0.0029	29.89	24.04	17.65	28.98	35.13	32.32	0.11
2020	601.1676	0.0107	0.0011	0.9537	0.4179	0.0279	0.0030	30.62	24.62	18.07	29.69	35.98	33.10	0.12

1A1aiii 'Heat Plants'

The evolution of direct GHG emissions from 1A1aiii 'Heat Plants' in the RM between 1990 and 2020 is presented in Figure 3-15

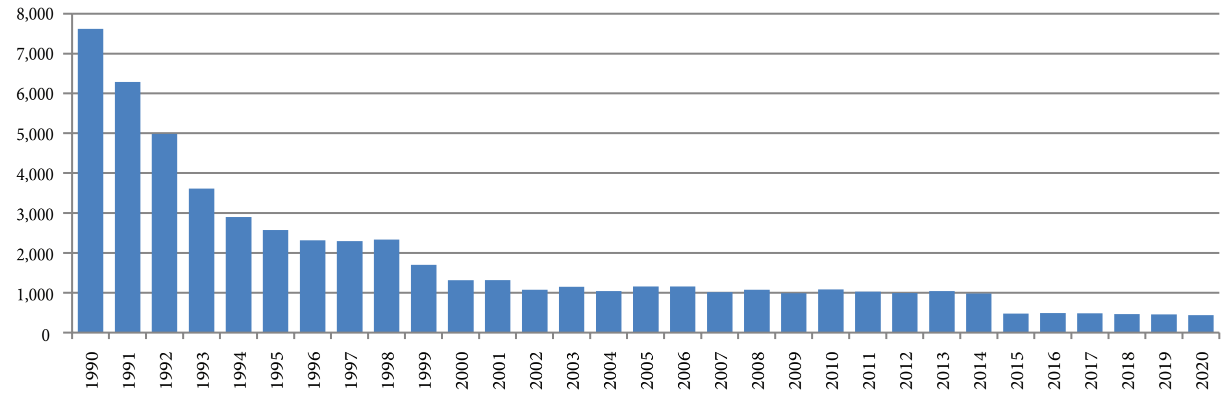


Figure 3-15: Direct GHG emissions from 1A1aiii 'Heat Plants' between 1990-2020.

During the respective period, GHG emissions had significantly decreased, constituting in 2020 only circa 5.8% compared to the base year (Table 3-37).

Table 3-37: Direct GHG emissions from 1A1aiii 'Heat Plants' between 1990-2020

	1990	1991	1992	1993	1994	1995	1996	1997
1A1aiii, kt CO_2 equivalent	7,618.1252	6,287.3805	4,986.6686	3,615.8134	2,900.1276	2,573.6008	2,313.5981	2,292.1039
%, compared to 1990	100.0	82.5	65.5	47.5	38.1	33.8	30.4	30.1
	1998	1999	2000	2001	2002	2003	2004	2005
1A1aiii, kt CO_2 equivalent	2,332.4821	1,703.9888	1,312.3578	1,315.6924	1,076.2639	1,151.2933	1,041.5780	1,157.6608
%, compared to 1990	30.6	22.4	17.2	17.3	14.1	15.1	13.7	15.2
	2006	2007	2008	2009	2010	2011	2012	2013
1A1aiii, kt CO_2 equivalent	1,154.4163	1,013.8911	1,076.3596	982.9291	1,080.6652	1,030.0042	997.6368	1,046.1637
%, compared to 1990	15.2	13.3	14.1	12.9	14.2	13.5	13.1	13.7
	2014	2015	2016	2017	2018	2019	2020	%
1A1aiii, kt CO_2 equivalent	979.2832	477.7235	491.6847	481.5696	466.8275	452.1584	440.9089	-94.2
%, compared to 1990	12.9	6.3	6.5	6.3	6.1	5.9	5.8	

The evolution of direct and indirect GHG emissions from 1A1aiii 'Heat Plants' between 1990 and 2020 is presented in Table 3-38. In this period, GHG emissions from this source recorded a significant decrease: in 2020, CO_2 emissions constituted circa 5.8% compared to the level in 1990, whereas CH_4 – 3.9%, N_2O – 2.1%, NO_x – 5.4%, CO – 9.5%, NMVOC – 7.4% and SO_2 – 0.01%%.

Table 3-38: Direct and indirect GHG emissions from 1A1aiii 'Heat Plants' between 1990-2020

	1A1aiii, kt							%, compared to 1990						
	CO_2	CH_4	N_2O	NO_x	CO	NMVOC	SO_2	CO_2	CH_4	N_2O	NO_x	CO	NMVOC	SO_2
1990	7,600.6980	0.2132	0.0406	12.9996	3.2431	0.2758	25.4608	100.00	100.00	100.00	100.00	100.00	100.00	100.00
1991	6,273.1931	0.1739	0.0330	10.7395	2.6871	0.2284	20.9340	82.53	81.54	81.35	82.61	82.86	82.81	82.22
1992	4,975.5393	0.1371	0.0258	8.5326	2.1542	0.1826	16.4688	65.46	64.31	63.66	65.64	66.42	66.22	64.68
1993	3,607.4725	0.1005	0.0196	6.2499	1.5397	0.1318	12.6444	47.46	47.15	48.17	48.08	47.48	47.79	49.66
1994	2,894.4367	0.0757	0.0127	4.8736	1.4891	0.1155	6.8512	38.08	35.50	31.40	37.49	45.92	41.89	26.91
1995	2,568.6427	0.0667	0.0110	4.3152	1.3144	0.1024	6.0783	33.79	31.29	27.20	33.19	40.53	37.14	23.87
1996	2,309.1299	0.0601	0.0100	3.8845	1.1846	0.0922	5.4677	30.38	28.17	24.52	29.88	36.53	33.45	21.47
1997	2,288.2739	0.0541	0.0083	3.7911	1.2870	0.0953	3.9561	30.11	25.37	20.48	29.16	39.68	34.54	15.54
1998	2,328.9758	0.0515	0.0074	3.8230	1.3765	0.0993	3.1556	30.64	24.15	18.34	29.41	42.44	36.00	12.39
1999	1,701.5444	0.0371	0.0051	2.7770	1.0327	0.0736	1.9422	22.39	17.39	12.54	21.36	31.84	26.69	7.63
2000	1,310.6148	0.0278	0.0035	2.1153	0.8444	0.0584	0.8920	17.24	13.05	8.66	16.27	26.04	21.19	3.50
2001	1,313.8392	0.0301	0.0037	2.1241	0.8672	0.0598	0.7507	17.29	14.10	9.11	16.34	26.74	21.67	2.95
2002	1,074.5100	0.0281	0.0035	1.7454	0.7167	0.0495	0.6356	14.14	13.18	8.69	13.43	22.10	17.97	2.50
2003	1,149.5199	0.0288	0.0035	1.8572	0.7809	0.0533	0.4721	15.12	13.51	8.71	14.29	24.08	19.34	1.85
2004	1,039.9048	0.0270	0.0034	1.6848	0.7092	0.0485	0.4393	13.68	12.65	8.26	12.96	21.87	17.57	1.73
2005	1,155.9031	0.0288	0.0035	1.8665	0.7955	0.0541	0.3713	15.21	13.52	8.57	14.36	24.53	19.61	1.46
2006	1,152.7453	0.0278	0.0033	1.8581	0.7966	0.0540	0.3091	15.17	13.02	8.08	14.29	24.56	19.58	1.21
2007	1,012.3600	0.0257	0.0030	1.6331	0.7104	0.0480	0.1945	13.32	12.04	7.35	12.56	21.91	17.42	0.76
2008	1,074.4742	0.0310	0.0037	1.7464	0.7597	0.0517	0.2756	14.14	14.53	9.19	13.43	23.42	18.73	1.08
2009	980.9473	0.0317	0.0040	1.6094	0.6866	0.0473	0.4470	12.91	14.86	9.83	12.38	21.17	17.14	1.76
2010	1,078.4318	0.0359	0.0045	1.7708	0.7608	0.0524	0.4594	14.19	16.86	11.03	13.62	23.46	19.00	1.80
2011	1,028.0948	0.0312	0.0038	1.6767	0.7250	0.0496	0.3360	13.53	14.64	9.33	12.90	22.35	17.98	1.32
2012	996.1009	0.0254	0.0030	1.6099	0.6897	0.0469	0.2973	13.11	11.92	7.45	12.38	21.27	17.01	1.17
2013	1,044.3969	0.0274	0.0036	1.7054	0.7095	0.0485	0.5397	13.74	12.83	8.95	13.12	21.88	17.57	2.12
2014	977.5270	0.0288	0.0035	1.5996	0.6942	0.0473	0.2770	12.86	13.51	8.56	12.30	21.40	17.15	1.09
2015	477.2573	0.0085	0.0009	0.7571	0.3318	0.0221	0.0024	6.28	3.99	2.10	5.82	10.23	8.02	0.01
2016	491.1622	0.0094	0.0010	0.7810	0.3434	0.0229	0.0027	6.46	4.42	2.37	6.01	10.59	8.31	0.01
2017	481.0532	0.0093	0.0010	0.7653	0.3362	0.0224	0.0068	6.33	4.34	2.36	5.89	10.37	8.14	0.03

	1A1aiii, kt							%, compared to 1990						
	CO_2	CH_4	N_2O	NO_x	CO	NMVOC	SO_2	CO_2	CH_4	N_2O	NO_x	CO	NMVOC	SO_2
2018	466.3088	0.0093	0.0010	0.7425	0.3269	0.0218	0.0051	6.14	4.35	2.37	5.71	10.08	7.92	0.02
2019	451.6978	0.0084	0.0008	0.7174	0.3149	0.0210	0.0024	5.94	3.92	2.08	5.52	9.71	7.62	0.01
2020	440.4534	0.0082	0.0008	0.6998	0.3074	0.0205	0.0023	5.79	3.87	2.06	5.38	9.48	7.44	0.01

Table 3-39 presents direct GHG emissions from the respective source between 1990 and 2020, the share of each gas in the total structure at category level, as well as the evolution of these emissions expressed in % compared to the base year level.

Table 3-39: Evolution of direct GHG emissions from 1A1aiii 'Heat Plants' between 1990-2020

	1A1aiii, kt CO_2 equivalent				Share of total, %			%, compared to 1990		
	CO_2	CH_4	N_2O	Total	CO_2	CH_4	N_2O	CO_2	CH_4	N_2O
1990	7,600.6980	5.3301	12.0971	7,618.1252	99.77	0.07	0.16	100.0	100.0	100.0
1991	6,273.1931	4.3464	9.8410	6,287.3805	99.77	0.07	0.16	82.5	81.5	81.3
1992	4,975.5393	3.4279	7.7014	4,986.6686	99.78	0.07	0.15	65.5	64.3	63.7
1993	3,607.4725	2.5134	5.8275	3,615.8134	99.77	0.07	0.16	47.5	47.2	48.2
1994	2,894.4367	1.8921	3.7988	2,900.1276	99.80	0.07	0.13	38.1	35.5	31.4
1995	2,568.6427	1.6679	3.2901	2,573.6008	99.81	0.06	0.13	33.8	31.3	27.2
1996	2,309.1299	1.5016	2.9665	2,313.5981	99.81	0.06	0.13	30.4	28.2	24.5
1997	2,288.2739	1.3520	2.4780	2,292.1039	99.83	0.06	0.11	30.1	25.4	20.5
1998	2,328.9758	1.2874	2.2189	2,332.4821	99.85	0.06	0.10	30.6	24.2	18.3
1999	1,701.5444	0.9269	1.5175	1,703.9888	99.86	0.05	0.09	22.4	17.4	12.5
2000	1,310.6148	0.6955	1.0476	1,312.3578	99.87	0.05	0.08	17.2	13.0	8.7
2001	1,313.8392	0.7513	1.1019	1,315.6924	99.86	0.06	0.08	17.3	14.1	9.1
2002	1,074.5100	0.7024	1.0515	1,076.2639	99.84	0.07	0.10	14.1	13.2	8.7
2003	1,149.5199	0.7203	1.0531	1,151.2933	99.85	0.06	0.09	15.1	13.5	8.7
2004	1,039.9048	0.6743	0.9989	1,041.5780	99.84	0.06	0.10	13.7	12.7	8.3
2005	1,155.9031	0.7208	1.0368	1,157.6608	99.85	0.06	0.09	15.2	13.5	8.6
2006	1,152.7453	0.6942	0.9769	1,154.4163	99.86	0.06	0.08	15.2	13.0	8.1
2007	1,012.3600	0.6417	0.8894	1,013.8911	99.85	0.06	0.09	13.3	12.0	7.4
2008	1,074.4742	0.7742	1.1112	1,076.3596	99.82	0.07	0.10	14.1	14.5	9.2
2009	980.9473	0.7923	1.1896	982.9291	99.80	0.08	0.12	12.9	14.9	9.8
2010	1,078.4318	0.8986	1.3347	1,080.6652	99.79	0.08	0.12	14.2	16.9	11.0
2011	1,028.0948	0.7804	1.1289	1,030.0042	99.81	0.08	0.11	13.5	14.6	9.3
2012	996.1009	0.6351	0.9007	997.6368	99.85	0.06	0.09	13.1	11.9	7.4
2013	1,044.3969	0.6841	1.0827	1,046.1637	99.83	0.07	0.10	13.7	12.8	8.9
2014	977.5270	0.7203	1.0360	979.2832	99.82	0.07	0.11	12.9	13.5	8.6
2015	477.2573	0.2127	0.2535	477.7235	99.90	0.04	0.05	6.3	4.0	2.1
2016	491.1622	0.2354	0.2871	491.6847	99.89	0.05	0.06	6.5	4.4	2.4
2017	481.0532	0.2315	0.2849	481.5696	99.89	0.05	0.06	6.3	4.3	2.4
2018	466.3088	0.2317	0.2870	466.8275	99.89	0.05	0.06	6.1	4.3	2.4
2019	451.6978	0.2088	0.2519	452.1584	99.90	0.05	0.06	5.9	3.9	2.1
2020	440.4534	0.2060	0.2495	440.9089	99.90	0.05	0.06	5.8	3.9	2.1

1A1b 'Petroleum Refining'

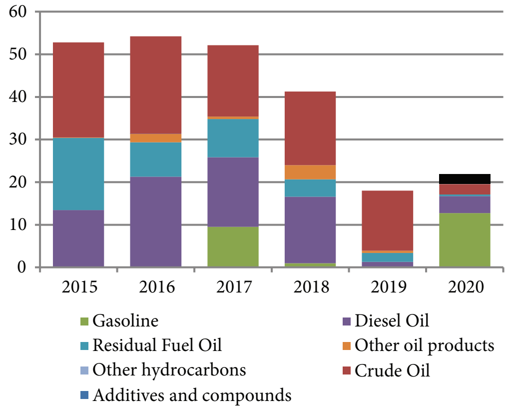
GHG emissions from source category 1A1b 'Petroleum Refining' were estimated within Sector 1 'Energy' in the current inventory cycle, taking into consideration the information from the National Bureau of Statistics regarding the amount of products consumed for energy purposes in oil refineries.

AD for the period 2003-2014, available in the RM's EBs in MS DOS format, were excluded in the current GHG emission inventory cycle due to the lack of information which reflects the amount of fuel consumed in oil refineries directly for energy purposes, Table 3-40.

Table 3-40: Activity data for source category 1A1b 'Petroleum Refining', TJ

Production Type		2015	2016	2017	2018	2019	2020
Source category 1A1b 'Petroleum Refining'	Additives and compounds	NO	NO	NO	NO	NO	2,32
	Oil	22.32	22.88	16.8	17.28	14.08	2.4
	Gasoline	NO	0.16	9.52	0.96	NO	12.72
	Diesel Oil	13.44	21.12	16.32	15.6	1.28	4
	Residual Fuel Oil	16.96	8.08	8.96	4.08	2.08	0.4
	Other Petroleum Products	0.08	1.92	0.56	3.36	0.56	NO
	Other Hydrocarbons	NO	0.08	NO	NO	NO	NO
	Fuel for Oven	NO	NO	NO	NO	NO	NO
	Fuel fo Engines	NO	NO	NO	NO	NO	NO

For the period 2015-2020, the activity data corresponding to category 1A1b 'Petroleum Refining' includes the following types of fuels: crude oil, gasoline, diesel fuel, residual fuel oil, other petroleum products, other hydrocarbons. A new type of fuel appeared for the first time, in 2020: additives and compounds (MTBE, ETBE) (Figure 3-16, Table 27).



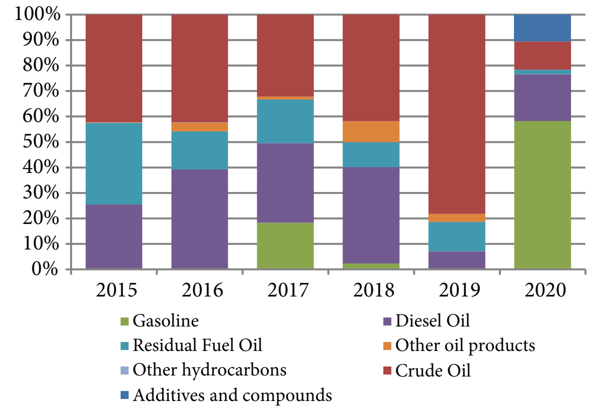


Figure 3-16: Consumption of petroleum products under source category 1A1b 'Petroleum Refining' between 2015-2020.

The Energy Balances of the RM for 2015-2020 are published in MS Excel format. The required information is available within Chapter 'Transformation', categories 'Petroleum installations' and 'Petrol Refineries'. In the Republic of Moldova there are two companies involved in this sector: 'Valiexchimp' Ltd. is involved in oil extraction on oil fields near Valeni village, Cahul district, and Arnaut Petrol JSC owns a small capacity oil refinery located in Comrat (ATU Gagauzia)

The values of direct GHG emissions were taken from the 2006 IPCC Guidelines, while for indirect GHG emissions – from the 2019 EMEP/EEA Guidebook (Table 3-41).

Table 3-41: Emission factors for source category 1A1b 'Petroleum Refining', kg/TJ

Fuel type	Emission Factors						
	CO_2	CH_4	N_2O	NO_x	CO	NMVOC	SO_2
Petroleum	73,300	3	0.6	142	15.1	2.3	495
Gasoline	69,300	3	0.6	65	16.2	0.8	46.5
Diesel Oil	74,100	3	0.6	65	16.2	0.8	46.5
Residual Fuel Oil	77,400	3	0.6	142	15.1	2.3	495
Other Petroleum Products	73,300	3	0.6	65	16.2	0.8	46.5
Other hydrocarbons	73,300	3	0.6	65	16.2	0.8	46.5
Fuel for Oven	74,100	3	0.6	65	16.2	0.8	46.5
Fuel for Engines	74,100	3	0.6	65	16.2	0.8	46.5
Source of reference:	2006 IPCC Guidelines			2019 EMEP/EEA Guidebook			

The evolution of direct GHG emissions from this category between 2003 and 2020 is presented in Table 3-42.

Table 3-42: Direct GHG emissions from source category 1A1b 'Petroleum Refining' between 2003-2020

	2015	2016	2017	2018	2019	2020
1A1b, kt CO_2 equivalent	3.9639	4.0389	3.8483	3.0617	1.3335	1.5604

Table 3-43 shows direct and indirect GHG emissions under 1A1b 'Petroleum Refining' source category for the period 2003-2020.

Table 3-43: GHG emissions from source category 1A1b 'Petroleum Refining' between 2003-2020, kt

	CO_2	CH_4	N_2O	NO_x	CO	NMVOC	SO_2
2015	3.9505	0.0002	0.0000	0.0065	0.0008	0.0001	0.0201
2016	4.0252	0.0002	0.0000	0.0059	0.0008	0.0001	0.0164
2017	3.8350	0.0002	0.0000	0.0054	0.0008	0.0001	0.0140
2018	3.0512	0.0001	0.0000	0.0043	0.0006	0.0001	0.0115
2019	1.3290	0.0001	0.0000	0.0024	0.0003	0.0000	0.0081
2020	1.5548	0.0001	0.0000	0.0015	0.0003	0.0000	0.0022

The evolution of direct GHG emissions from the respective source category between 2003 and 2020 as well as the share of each gas in the total structure at category level are presented in Table 3-44.

Table 3-44: Direct GHG emissions from source category 1A1b 'Petroleum Refining' between 2003-2020

	GHG emissions, kt CO_2 equivalent				Share of GHG in the total structure of emissions, %		
	CO_2	CH_4	N_2O	Total	CO_2	CH_4	N_2O
2015	3.9505	0.0040	0.0094	3.9639	99.6619	0.0999	0.2382
2016	4.0252	0.0041	0.0097	4.0389	99.6592	0.1007	0.2401
2017	3.8350	0.0039	0.0093	3.8483	99.6560	0.1017	0.2423
2018	3.0512	0.0031	0.0074	3.0617	99.6578	0.1011	0.2411
2019	1.3290	0.0014	0.0032	1.3335	99.6574	0.1012	0.2413
2020	1.5548	0.0016	0.0039	1.5604	99.6448	0.1050	0.2503

1A1c 'Manufacture of Solid Fuels and Other Energy Industries'

The EBs of RM do not reflect the information on the volume of fuel used directly for energy purposes for the production of wood coal, therefore this category was not considered in the current cycle of GHG emission inventory.

3.2.2. Methodological Issues and Emission Factors

GHG emissions originating from category 1A1 'Energy Industries' were estimated following a Tier 1 methodology (Table 3-45), using default emission factors. To ensure the conversion from natural units to energy units, CS NCVs were used. The carbon oxidation fraction value used is recommended by the 2006 IPCC Guidelines.

Table 3-45: Methods, EFs and parameters used to estimate direct GHG emissions originating from source category 1A1 'Energy Industries'

Category	CO_2				CH_4		N_2O	
	Method	Net Calorific Value, TJ/kt	Carbon Oxidation Fraction	EF, t C/TJ	Method	EF, kg/TJ	Method	EF, kg/TJ
1A1 Energy Industries	T1,T3	CS	1	D	T1	D	T1	D

Abbreviations: T1 – Tier 1; EF – Emission Factor; D – Default; CS – Country Specific.

Default EFs available in the 2019 EMEP/EEA Guidebook were used for the estimation of non-CO_2 emissions (Table 3-46).

Table 3-46: Emission factors used for estimating GHG emissions originating from source category 1A1 'Energy Industries', kg/TJ

	CO_2	CH_4	N_2O	NO_x	CO	NMVOC	SO_2	Source – 2019 EMEP/EEA Guidebook
Anthracite	98,300	1	1.5	209	8.7	1	820	Table 3.2 (coal)
Brown Coal (lignite)	101,000	1	1.5	247	8.7	1.4	1,680	Table 3.3 (brown coal)
Other types of bituminous coal	94,600	1	1.5	209	8.7	1	820	Table 3.2 (coal)
Diesel Oil	74,100	3	0.6	65	16.2	0.8	46.5	Table 3-6 (diesel oil)
Gasoline	69,300	3	0.6	65	16.2	0.8	46.5	Table 3-6 (diesel oil)
Fuel for oven	71,900	3	0.6	65	16.2	0.8	46.5	Table 3-6 (diesel oil)
Residual Fuel Oil	77,400	3	0.6	142	15.1	2.3	495	Table 3-5 (Residual fuel oil)
Other Petroleum Products	73 300	3	0.6	65	16.2	0.8	46.5	Table 3-6 (diesel oil)
Natural Gas	56,100	1	0.1	89	39	2.6	0.281	Table 3-4 (gaseous fuel)
Liquefied Petroleum Gases	63,100	1	0.1	89	39	2.6	0.281	Table 3-4 (gaseous fuel)
Fuelwood	112,000	30	4	81	90	7.31	10.8	Table 3-7 (biomass)
Wood Waste	112,000	30	4	81	90	7.31	10.8	Table 3-7 (biomass)
Agricultural Residue	100,000	30	4	81	90	7.31	10.8	Table 3-7 (biomass)
Charcoal	112,000	200	4	81	90	7.31	10.8	Table 3-7 (biomass)
Pellets and Briquettes*	100,000	30	4	81	90	7.31	10.8	Table 3-7 (biomass)
Biogas	54,600	1	0.1	89	39	2.6	0.281	Table 3-4 (gaseous fuel)
Source:	2006 IPCC Guidelines, Volume 2, Chapter 2, Table 2.2, P. 2.16-2.17.			2019 EMEP/EEA Guidelines, Category 1A1 Energy Industries				

3.2.3. Uncertainties and Time Series Consistency

The primary factors that affect inventory uncertainties are largely dependent on the methodology, and emission factors used to calculate the GHG emissions from category 1A1 'Energy Industries' and they also depend on the quality of available AD. Uncertainties associated with EFs used to estimate CO_2 emissions were estimated to be circa 5%; those associated to EFs used to estimate CH_4 and N_2O emissions reach up to ±50%, respectively. Uncertainties associated with AD regarding fuel consumption within Sector 1 'Energy' were estimated to be circa 5% for CO_2 and CH_4 emissions, and ±3% for N_2O emissions, respectively. (Annex 5-3.1).

In view of ensuring time-series consistency of the obtained results, the same approach was used for the entire period under review, in conformity with the recommendations included in the 2006 IPCC Guidelines.

3.2.4. Quality Assurance and Quality Control

Standard verification and quality control forms and check-lists were filled in for 1A1 'Energy Industries', following a Tier 1 approach. To be noted that AD and methods used for estimating GHG emissions under the category 1A1 'Energy Industries' were documented and archived both in hard copies and electronically.

In order to identify errors related to data entry and those related to the GHG assessment process, procedures have been carried out to check and control the quality of the data used and the emission factors applied.

The quality control and verification procedures applied in the calculation process for category 1A1 'Energy Industries' included:

- Verification of AD collecting and manipulation procedures, including: verifying whether disaggregation of AD collected for each source category included in 1A1 'Energy Industries' complies with the requirements set out in the description of each source category in the 2006 IPCC Guidelines; verifying the correctness of EFs used for each source category; verifying if the primary reference sources are correctly indicated; the accuracy of calculations for subcategories included in category 1A1 are verified randomly;
- Implementation of error minimization procedures for manual entry of AD, with all the spreadsheets provided with the initial sources of activity data in tabular format;
- In the calculation files, the import of the respective values into calculation formulas is ensured by automatic connections;
- The consistency of calculations is also ensured by verifying the correctness of applying conversion factors of natural units into energy units for all source categories and the entire range of years covered by the inventory;
- Verification whether the same method is used for the entire range of years covered by the inventory;
- Verifying whether GHG emissions calculations have been made for all years and for all types of fuels mentioned in the Energy Balances of the RM and other relevant reference sources;
- Verifying to what extent the full geographical coverage of the national GHG inventory of the RM is ensured;
- Verifying the inter-annual evolution trends of emissions by creating representative charts, and unusual fluctuations are explained;
- Regarding recalculations, their need is explained, including by drawing attention to the implemented recommendations resulting from the audit carried out by national and international experts in the previous inventory cycles;
- Verifying maintenance and completion of the national inventory of GHG emissions archive.

Following the recommendations included in the 2006 IPCC Guidelines, GHG emissions were estimated using AD and national EFs from official sources of information.

3.2.5. Recalculations

The GHG emissions from 1A1 'Energy Industries' category were recalculated within the current inventory cycle due to the following causes:

- The AD on the consumption of natural gas for 2015, 2016 from 1A1aii 'Combined Production of Electricity and Heat' and 1A1aiii 'Heat Plants', were updated based on the information in the EBs in PDF format (2021 edition);
- Between 2017 and 2019, when considering the fuel consumption from 1A1ai 'Power plants' and 1A1aiii 'Heat Plants', for the left bank of the Dniester River, indirect calculation methods were used (in the absence of real data, previously presented by JSC 'Moldovagaz').

- With the publication of the EBs of the RM in an MS Excel form for 2015-2019, it became easier to monitor and allocate fuel consumption within source category 1A1b, thus avoiding the misallocation in other categories of the sector;
- Fuel consumption data for the period 2003-2014 under source cateogry 1A1b 'Petroleum Refining' was excluded from the data string. During that period, the total volume of petroleum products in RM was accounted for, and it does not represent the amount of fuel consumed in refineries for energy purposes.
- At the same time, for the period 2015-2019, within source category 1A1b 'Petroleum Refining', the amount of oil and lubricants used at oil refineries were excluded from the rubric 'Other Petroleum Products'.

In comparison with the results included in the BUR3 of the RM to the UNFCCC (2021), the recalculation performed in the current inventory cycle resulted in an insignificant decrease in direct GHG emissions between 2003 and 2016, respectively a slight increase in direct GHG emissions between 2017 and 2019, varying from a minimum increase by 0.1% in 2019, to a maximum increase by circa 3.8% in 2017 (Table 3-47).

Table 3-47: Recalculation results of GHG emissions from source category 1A1 'Energy Industries' included in the BUR3 of the RM to the UNFCCC for the period 1990-2019, kt CO_2 equivalent

	1990	1991	1992	1993	1994	1995	1996	1997
BUR3	21,364.2413	18,984.1702	15,706.2560	12,679.1754	9,992.5601	7,192.4074	7,124.4109	5,625.6671
NC5	21,364.2413	18,984.1702	15,706.2560	12,679.1754	9,992.5601	7,192.4074	7,124.4109	5,625.6671
Difference, %	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	1998	1999	2000	2001	2002	2003	2004	2005
BUR3	4,844.6778	3,664.6852	3,159.3286	3,681.9284	2,936.7953	3,040.3820	3,112.7641	3,235.4860
NC5	4,844.6778	3,664.6852	3,159.3286	3,681.9284	2,936.7953	3,040.3758	3,110.7870	3,233.2579
Difference, %	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	-0.1
	2006	2007	2008	2009	2010	2011	2012	2013
BUR3	2,497.5390	2,897.8280	3,001.1558	3,849.7472	4,059.6277	3,757.1773	3,814.5475	3,610.9821
NC5	2,495.9204	2,893.8184	2,994.6093	3,840.3395	4,052.9708	3,750.7325	3,807.8454	3,604.0198
Difference, %	-0.1	-0.1	-0.2	-0.2	-0.2	-0.2	-0.2	-0.2
	2014	2015	2016	2017	2018	2019	2020	%
BUR3	3,566.5248	3,689.9589	3,648.6333	2,886.8208	3,180.5484	3,123.5171		
NC5	3,560.3022	3,688.0902	3,648.5771	2,999.4997	3,258.6362	3,127.5077	3,637.9713	-83.0
Difference, %	-0.2	-0.1	0.0	3.8	2.4	0.1		

Abbreviations: BUR3 – Third Biennial Update Report of the RM to the UNFCCC; NC5 – Fifth National Communication of the RM to the UNFCCC.

For 2020, direct GHG emissions from source category 1A1 were estimated for the first time. Direct GHG emissions from category 1A1 'Energy Industries' had decreased by circa 83.0% between 1990 and 2020.

3.2.6. Planned Improvements

Potential improvements within source category 1A1 'Energy Industries' could be possible once new AD regarding the fuel consumption for electricity and heat generation on the territory of the LBDR are available (filling the gaps for certain years). Likewise, another potential improvement could be identifying additional AD sources or updating AD in official statistical publications.

3.3. Manufacturing Industries and Construction (Category 1A2)

3.3.1. Source Category Description

GHG emissions from 1A2 'Manufacturing Industries and Construction' are a result of fuel combustion within the manufacturing industries of the Republic of Moldova (except for emissions from technological processes taken into account under Sector 2 'IPPU').

Direct GHG emissions from 1A2 'Manufacturing Industries and Construction' are monitored within the following source categories (which correspond to the ISIC Rev. 3.1[41]):

1A2a 'Iron and Steel' (ISIC Group 271, Class 2731);

1A2b 'Non-Ferrous Metals' (ISIC Group 272, Class 2732);

[41] ISIC Rev.3.1 (International Standard Industrial Classification of All Economic Activities, Rev.3.1) (<https://unstats.un.org/unsd/cr/registry/regcst.asp?Cl=17>)

1A2c 'Chemicals' (ISIC Division 24);

1A2d 'Pulp, Paper and Print' (ISIC Divisions 21 and 22);

1A2e 'Food Processing, Beverages and Tobacco' (ISIC Divisions 15 and 16);

1A2f 'Non-Metallic Minerals' (glass, ceramic, cement) (ISIC Division 26);

1A2g 'Transport Equipment' (ISIC Divisions 34 and 35);

1A2h 'Machinery' (ISIC Divisions 28, 29, 30, 31 and 32);

1A2i 'Mining (excluding fuels) and Quarrying' (ISIC Divisions 13 and 14);

1A2j 'Wood and Wood Products' (ISIC Division 20);

1A2k 'Construction' (ISIC Division 45);

1A2l 'Textile and Leather' (ISIC Divisions 17, 18 and 19);

1A2m 'Non-specified Industry' (not included above) (ISIC Divisions 25, 33, 36 and 37), as well as the activity on the LBDR.

Between 1990 and 2020, the evolution of GHG emissions from category 1A2 'Manufacturing Industries and Construction' tended to decrease by circa 58.2%: from 1923.38 kt CO_2 equivalent recorded in 1990, to circa 803.55 kt CO_2 equivalent in 2020 (Table 3-48, Figure 3-17).

Table 3-48: GHG emissions from source category 1A2 'Manufacturing Industries and Construction' between 1990-2020, kt CO_2 equivalent

	1990	1991	1992	1993	1994	1995	1996	1997
1A2 RBDR	1,923.38	1,282.16	929.85	614.15	216.08	245.87	222.96	259.98
1A2 LBDR	0.00	0.00	0.00	0.00	523.08	136.37	99.08	288.06
1A2 RM	**1,923.38**	**1,282.16**	**929.85**	**614.15**	**739.16**	**382.23**	**322.04**	**548.04**
1A2 RBDR, %	100.0	100.0	100.0	100.0	29.2	64.3	69.2	47.4
1A2 LBDR, %	0.0	0.0	0.0	0.0	70.8	35.7	30.8	52.6
	1998	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**
1A2 RBDR	265.28	215.83	246.69	270.29	271.79	289.25	307.90	380.32
1A2 LBDR	278.56	258.78	273.61	331.79	139.18	150.21	136.71	194.89
1A2 RM	**543.84**	**474.61**	**520.30**	**602.09**	**410.97**	**439.46**	**444.61**	**575.22**
1A2 RBDR, %	48.8	45.5	47.4	44.9	66.1	65.8	69.3	66.1
1A2 LBDR, %	51.2	54.5	52.6	55.1	33.9	34.2	30.7	33.9
	2006	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**
1A2 RBDR	380.89	359.46	408.56	261.73	206.23	341.98	176.99	365.63
1A2 LBDR	254.60	442.27	478.63	233.92	217.08	235.27	257.61	212.00
1A2 RM	**635.49**	**801.73**	**887.19**	**495.65**	**423.31**	**577.25**	**434.60**	**577.63**
1A2 RBDR, %	59.9	44.8	46.1	52.8	48.7	59.2	40.7	63.3
1A2 LBDR, %	40.1	55.2	53.9	47.2	51.3	40.8	59.3	36.7
	2014	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**%**
1A2 RBDR	196.66	307.56	257.19	307.52	384.60	505.05	470.69	-75.5
1A2 LBDR	248.03	206.73	229.54	192.10	206.15	213.42	332.86	-36.3
1A2 RM	**444.69**	**514.28**	**486.73**	**499.62**	**590.75**	**718.47**	**803.55**	-58.2
1A2 RBDR, %	44.2	59.8	52.8	61.6	65.1	70.3	58.6	
1A2 LBDR, %	55.8	40.2	47.2	38.4	34.9	29.7	41.4	

Abbreviations: RBDR – Right Bank of the Dniester River; LB – Left Bank of the Dniester River; RM – aggregated for the Republic of Moldova; IE – included elsewhere

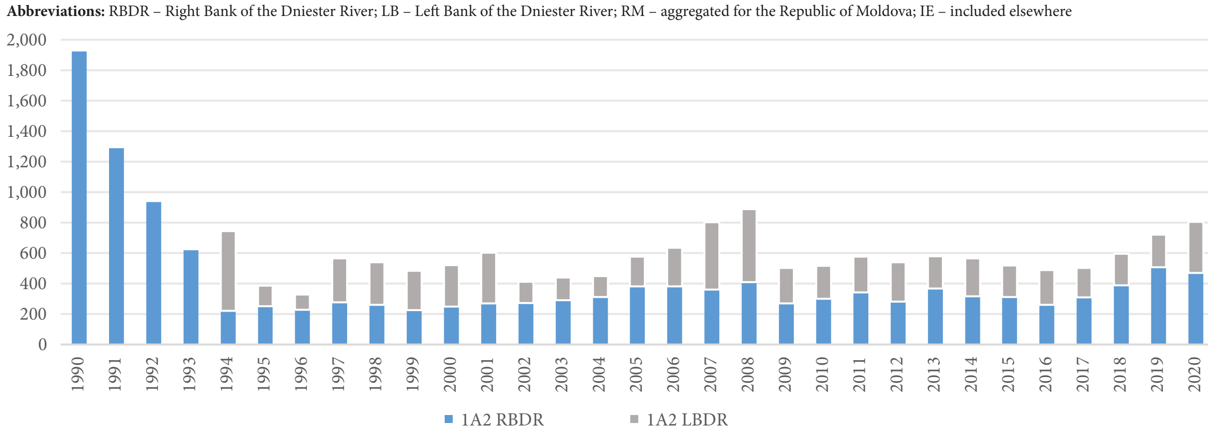


Figure 3-17: GHG emissions from source category 1A2 'Manufacturing Industries and Construction' between 1990-2020, kt CO_2 equivalent.

GHG emission trends from source category 1A2 'Manufacturing Industries and Construction' between 1990 and 2020 for each industry are presented in Table 3-49.

Table 3-49: GHG emissions from source category 1A2 'Manufacturing Industries and Construction' by industry between 1990-2020, kt CO_2 equivalent

	1A2a	1A2b	1A2c	1A2d	1A2e	1A2f	1A2g	1A2h	1A2i	1A2j	1A2k	1A2L	1A2m	1A2
1990	140.6211		19.5532		214.5734	1,419.9593		80.4099	8.6644	9.1108	10.0462	20.4039		1,923.3422
1991					174.2189	1,024.8992		65.8768		7.6492	9.5189			1,282.1630
1992					133.8644	729.4423		51.3612		6.1877	8.9916			929.8471
1993	0.9672				9.2018	433.9853		37.2554		4.7261	10.1017	0.5940	32.3149	614.1464
1994					61.1426	138.5284		10.1467		0.0563	6.2101			739.1596
1995	37.3650		0.1364	3.6819	94.0572	160.0848		31.1970		1.9092	13.9831	20.1825	19.6371	382.2342
1996	27.9411		0.0991	1.9816	97.6775	127.1931		17.5682		0.8917	13.4161	19.8164	15.4568	322.0417
1997	101.6860		0.2881	5.1851	118.2599	173.3511		41.4257		1.4403	22.5771	45.8019	38.0242	548.0393
1998	91.6447		5.5711	4.1783	130.1451	161.5925		28.0617		1.3928	19.3022	63.2321	38.7192	543.8396
1999	94.7138		4.9168	3.1054	86.2915	153.3218		21.7624		1.0351	16.3019	57.7081	35.4530	474.6097
2000	97.6794		5.1986	4.9250	80.6927	185.0696		25.7493		1.6417	9.6263	80.7154	29.0028	520.3009
2001	117.7871		4.3133	7.9631	8 .9993	201.9861		29.8567		3.6497	11.1799	98.5430	40.8107	602.0890
2002	27.2798		1.6702	0.5567	60.5383	219.2179		11.2266		1.8094	8.5026	41.4764	38.6928	410.9707
2003	47.0160		1.8025	2.2855	87.4103	216.8802		13.6453		1.8025	5.8344	26.4371	36.3510	439.4649
2004	45.9838		2.4726	2.5367	68.4748	241.7923		13.6461		1.5575	9.3788	25.7320	33.0389	444.6136
2005	67.1910		3.3682	3.1645	76.3172	311.4929		18.8296	0.2246	2.1143	7.9688	38.6981	45.8448	575.2139
2006	76.2603		4.7540	3.9984	90.6463	309.2993	0.5054	25.9219		1.9461	16.7199	59.8435	45.5894	635.4844
2007	206.1910		4.8802	3.7345	86.2114	304.3629		32.8354	0.1123	1.2742	46.3646	60.2408	55.5183	801.7257
2008	215.2902		5.5404	4.2436	98.1883	338.7939		31.7962	0.0562	0.7846	58.0943	59.2849	75.1140	887.1866
2009	74.8543		3.7728	2.8371	54.5963	220.3261		13.5974		0.2339	9.3773	38.8607	77.1935	495.6494
2010	40.9161		3.9150	3.0107	69.1544	147.6620		17.7775		0.6509	17.0491	48.8393	74.3343	423.3092
2011	53.5364		5.8572	5.6232	73.4899	277.4338		19.5247		0.6402	16.2314	48.4433	76.4685	577.2486
2012	65.1751		5.8822	3.5244	80.9126	112.5034		18.8642		1.2633	18.9314	46.9119	80.6301	434.5986
2013	31.8026		7.4596	3.6684	82.4974	303.8729		17.7529		4.6356	14.9036	51.6726	59.3593	577.6249
2014	67.4642		6.5891	3.8092	92.4693	122.3674		10.9133		2.4037	23.9393	34.8645	79.8657	444.6858
2015	49.8207		4.5225	4.1221	81.6243	240.5578	0.0019	9.3983		0.2320	13.6165	27.0193	83.3663	514.2818
2016	41.7758		6.1805	3.4402	94.0419	180.7082	0.6362	11.3361		0.2392	15.7187	33.6583	99.2291	486.9642
2017	60.5105		4.8980	1.0019	91.8457	231.4392	0.1143	10.1178		0.2624	14.3458	25.0485	60.0329	499.6168
2018	65.7608		6.2899	3.0778	103.7048	293.0296	0.3950	11.3938	0.0645	0.2803	16.0842	27.3411	63.3238	590.7457
2019	56.6840		7.2551	3.1471	90.8812	282.4785	0.7901	13.7620	0.2808	0.1923	16.9791	35.1023	211.0910	718.6434
2020	92.9951		12.9924	3.4599	98.9476	261.3406	0.7881	16.8712	0.2246	0.1787	18.4493	45.8092	251.5921	803.6492

Note: For the year 1994, the value for the LBDR is presented in aggregate, as disaggregation by industry has been available only since 1995.

Shares in the structure of total direct GHG emissions are the following: CO_2 – 41.9%, CH_4 – 38.9%, and N_2O – 33.5%, total – 41.9% compared to 1990 level (Table 3-50).

Table 3-50: Direct GHG emissions from 1A2 'Manufacturing Industries and Construction' between 1990-2020

	1A2, kt CO_2 equivalent				1A2 Total CO_2 equivalent, % compared to 1990			
	CO_2	CH_4	N_2O	Total	CO_2	CH_4	N_2O	Total
1990	1,923.34	2.13	4.39	1,929.86	100	100	100	100
1991	1,282.16	1.36	2.85	1,286.38	66.7	64.1	65.0	66.7
1992	929.85	1.00	2.06	932.90	48.3	46.9	46.9	48.3
1993	614.15	0.67	1.35	616.17	31.9	31.4	30.9	31.9
1994	216.08	0.22	0.38	216.67	11.2	10.1	8.6	11.2
1995	382.23	0.29	0.44	382.96	19.9	13.4	10.1	19.8
1996	322.04	0.29	0.47	322.80	16.7	13.5	10.7	16.7
1997	548.04	0.45	0.68	549.17	28.5	21.3	15.5	28.5
1998	543.84	0 47	0.71	545.02	28.3	21.9	16.3	28.2
1999	474.61	0.32	0.46	475.39	24.7	15.1	10.5	24.6
2000	520.30	0.30	0.41	521.01	27.1	14.0	9.5	27.0
2001	602.09	0.37	0.55	603.01	31.3	17.3	12.6	31.2
2002	410.97	0.24	0.33	411.54	21.4	11.3	7.6	21.3
2003	439.46	0.24	0.33	440.04	22.8	11.3	7.5	22.8
2004	444.61	0.29	0.41	445.31	23.1	13.4	9.4	23.1
2005	575.21	0.33	0.46	576.00	29.9	15.6	10.4	29.8
2006	635.48	0.33	0.45	636.27	33.0	15.6	10.2	33.0
2007	801.73	0.39	0.50	802.61	41.7	18.3	11.3	41.6
2008	887.19	0.84	1.33	889.36	46.1	39.5	30.4	46.1
2009	495.65	0.54	0.87	497.06	25.8	25.2	19.9	25.8
2010	423.31	0.30	0.44	424.05	22.0	14.0	10.1	22.0
2011	577.25	0.66	1.07	578.98	30.0	30.8	24.4	30.0
2012	434.60	0.28	0.39	435.26	22.6	13.1	8.8	22.6
2013	577.62	0.75	1.24	579.62	30.0	35.2	28.3	30.0
2014	444.69	0.35	0.53	445.56	23.1	16.3	12.0	23.1

	1A2, kt CO_2 equivalent				1A2 Total CO_2 equivalent, % compared to 1990			
	CO_2	CH_4	N_2O	Total	CO_2	CH_4	N_2O	Total
2015	514.28	0.63	1.03	515.95	26.7	29.7	23.6	26.7
2016	486.73	0.24	0.77	487.74	25.4	12.8	17.5	25.4
2017	499.62	0.53	0.87	501.02	26.0	24.9	19.9	26.0
2018	590.75	0.56	0.93	592.24	30.7	26.3	21.3	30.7
2019	718.64	0.95	1.55	721.14	37.4	44.5	35.3	37.4
2020	803.65	0.75	1.47	805.86	41.9	38 .9	33.5	41.9

Compared to the year 1990, the level of GHG emissions from source category 1A2 'Manufacturing Industries and Construction' constituted, towards 2020, regarding direct GHG emissions: CO_2 – 41.9%; CH_4 – 38.9%; NO_x – only 16.9% compared to the base year; whereas indirect GHG emissions: N_2O – 33.5%, CO – 40.9%; NMVOC – 57.5%; SO_x – 29.0%. (Table 3-51).

Table 3-51: Direct and indirect GHG emissions from source category 1A2 'Manufacturing Industries and Construction' between 1990-2020

	1A2, kt							%, compared to 1990						
	CO_2	CH_4	N_2O	NO_x	CO	NMVOC	SOx	CO_2	CH_4	N_2O	NO_x	CO	NMVOC	SO_x
1990	1,916.8273	0.0851	0.0147	9.0489	3.4763	0.8788	2.6881	100.0	100.0	100.0	100.0	100.0	100.0	100.0
1991	1,277.9476	0.0546	0.0096	6.5424	1.7479	0.5482	1.2265	66.7	64.1	65.0	72.3	50.3	62.4	45.6
1992	926.7893	0.0399	0.0069	4.5977	1.3236	0.4070	0.9321	48.4	46.9	46.9	50.8	38.1	46.3	34.7
1993	612.1245	0.0267	0.0045	2.8759	0.9478	0.2790	0.6765	31.9	31.4	30.9	31.8	27.3	31.7	25.2
1994	738.0581	0.0179	0.0022	1.2535	0.7234	0.3230	0.3553	38.5	21.1	14.9	13.9	20.8	36.8	13.2
1995	381.5061	0.0114	0.0015	0.6870	0.5581	0.1795	0.3662	19.9	13.4	10.1	7.6	16.1	20.4	13.6
1996	321.2863	0.0115	0.0016	0.6490	0.6323	0.1600	0.4747	16.8	13.5	10.7	7.2	18.2	18.2	17.7
1997	546.9038	0.0181	0.0023	0.9180	0.7370	0.2841	0.3965	28.5	21.3	15.5	10.1	21.2	32.3	14.7
1998	542.6603	0.0186	0.0024	1.0266	0.7118	0.3020	0.3295	28.3	21.9	16.3	11.3	20.5	34.4	12.3
1999	473.8274	0.0129	0.0015	0.7360	0.4969	0.2249	0.2275	24.7	15.1	10.5	8.1	14.3	25.6	8.5
2000	519.5881	0.0119	0.0014	0.7914	0.4871	0.2261	0.2274	27.1	14.0	9.5	8.7	14.0	25.7	8.5
2001	601.1675	0.0147	0.0019	1.1500	0.5744	0.2598	0.2825	31.4	17.3	12.6	12.7	16.5	29.6	10.5
2002	410.3969	0.0096	0.0011	0.6019	0.4089	0.1809	0.2019	21.4	11.3	7.6	6.7	11.8	20.6	7.5
2003	438.8946	0.0096	0.0011	0.6697	0.3867	0.1868	0.1729	22.9	11.3	7.5	7.4	11.1	21.3	6.4
2004	443.9172	0.0114	0.0014	0.7048	0.4457	0.2047	0.2038	23.2	13.4	9.4	7.8	12.8	23.3	7.6
2005	574.4257	0.0133	0.0015	0.8636	0.4932	0.2545	0.1904	30.0	15.6	10.4	9.5	14.2	29.0	7.1
2006	634.7036	0.0133	0.0015	0.9501	0.4873	0.2692	0.1704	33.1	15.6	10.2	10.5	14.0	30.6	6.3
2007	800.8383	0.0156	0.0017	1.1306	0.5048	0.3350	0.0992	41.8	18.3	11.3	12.5	14.5	38.1	3.7
2008	885.0121	0.0336	0.0045	1.3642	2.2677	0.4690	1.8481	46.2	39.5	30.4	15.1	65.2	53.4	68.7
2009	494.2397	0.0215	0.0029	0.7591	1.5897	0.2773	1.3676	25.8	25.2	19.9	8.4	45.7	31.6	50.9
2010	422.5661	0.0119	0.0015	0.6693	0.5900	0.1993	0.3732	22.0	14.0	10.1	7.4	17.0	22.7	13.9
2011	575.5198	0.0263	0.0036	0.9067	1.8629	0.3338	1.5812	30.0	30.8	24.4	10.0	53.6	38.0	58.8
2012	433.9343	0.0111	0.0013	0.6347	0.4237	0.2029	0.1794	22.6	13.1	8.8	7.0	12.2	23.1	6.7
2013	575.6340	0.0299	0.0042	0.8821	2.2984	0.3553	2.0310	30.0	35.2	28.3	9.7	66.1	40.4	75.6
2014	443.8136	0.0139	0.0018	0.6822	0.7672	0.2183	0.5408	23.2	16.3	12.0	7.5	22.1	24.8	20.1
2015	512.6146	0.0253	0.0035	0.7978	1.8079	0.3136	1.5446	26.7	29.7	23.6	8.8	52.0	35.7	57.5
2016	485.7159	0.0198	0.0026	0.7463	1.2679	0.2653	1.0235	25.4	12.8	17.5	8.3	36.5	30.3	38.2
2017	498.2139	0.0212	0.0029	0.9414	1.3692	0.2706	1.1302	26.0	24.9	19.9	10.4	39.4	30.8	42.0
2018	589.2526	0.0224	0.0031	1.2750	1.2408	0.2948	0.9569	30.7	26.3	21.3	14.1	35.7	33.5	35.6
2019	715.9741	0.0379	0.0052	1.5592	1.5227	0.4795	0.9228	37.4	44.5	35.3	17.2	43.8	54.6	34.3
2020	801.3386	0.0298	0.00491	1.5233	1.4199	0.5044	0.7767	41.9	38.9	33.5	16.9	40.9	57.5	29.0

3.3.2. Methodological Issues, Emission Factor and Activity Data

GHG emissions originating from source category 1A2 'Manufacturing Industries and Construction' were estimated following a Tier 1 methodology (Table 3-52).

Table 3-52: Methods and coefficients used for assessing direct GHG emissions originating from source category 1A2 'Manufacturing Industries and Construction'

Category	CO_2				CH_4		N_2O	
	Method	Net Calorie Value, TJ/kt	Carbon Oxidation Fraction	EF tC/TJ	Method	EF, kg/TJ	Metoda	EF, kg/TJ
1A2 Manufacturing Industries and Construction	T1	CS	1	D	T1	D	T1	D

Abbreviations: T1 – Tier 1; EF – Emission Factor; D - Default; CS – Country Specific.

Default EFs were used from the 2006 IPCC Guidelines for the National Inventory of Greenhouse Gas Emissions (for the estimation of direct greenhouse gas emissions) and the 2019 EMEP/EEA Air Pollutant Emission Inventory (for the estimation of indirect greenhouse gas emissions). To ensure the natural conversion from natural measurement units to energy units, country specific net calorific values were used. The value used for the carbon oxidation fraction is recommended by the 2006 IPCC Guidelines. Default EFs available in the 2019 EMEP/EEA Guidebook were used for estimating non-CO_2 emissions (Table 3-53).

Table 3-53: Default EFs used for the estimation of GHG emissions from source category 1A2 'Manufacturing Industries and Construction', kg/TJ

Fuel Categories	Fuels	CO_2	CH_4	N_2O	NO_x	CO	NMVOC	SO_2
Biofuels	Fuelwood and Wood Waste	112,000	30	4	91	570	300	11
	Other types of Solid Biomass	100,000	30	4	91	570	300	11
	Charcoal	112,000	200	4	91	570	300	11
Liquid Fuels	Residual Fuel Oil	77,400	3	0.6	513	66	25	47
	Other Kerosene	71,900	3	0.6	513	66	25	47
	Liquefied Petroleum Gases	63,100	3	0.6	513	66	25	0.67
	Other Petroleum Products	73,300	3	0.6	513	66	25	47
	Petroleum Coke	97,500	3	0,6	513	66	25	47
Gaseous Fuels	Natural Gas	56,100	1	0.1	74	29	23	0.67
Solid Fuels	Anthracite	98,300	1	1.5	173	931	88.8	900
	Other Bituminous Coal	94,600	1	1.5	173	931	88.8	900
	Lignite	101,000	1	1.5	173	931	88.8	900
	Brown Coal Briquettes	97,500	1	1.5	173	931	88.8	900
	Oven Coke and Lignite Coke	107,000	1	1.5	173	931	88.8	900

Source: CO_2, CH_4, N_2O – 2006 IPCC Guidelines, Chapter 'Stationary Combustion', Table 2.3; NO_x, CO, NMVOC, SO_x - EMEP/EEA Air Pollutant Emission Inventory (2019), Category 1.A.2, Tables 3-2, 3-3, 3-4 and 3-5.

Activity Data

The AD associated with fuel consumption for energy purposes within source category 1A2 'Manufacturing Industries and Construction' were collected from the Energy Balances of the Republic of Moldova for the years 1990, 1993-2020, as well as from the statistical publications of the ATULBD (Table 3-54) for the entire sector.

Table 3-54: Fuel consumption for energy purposes within source category 1A2 'Manufacturing Industries and Construction' on the LBDR between 1994-2020

	1994	1995	1996	1997	1998	1999	2000	2001	2002
Natural Gas, million m^3	275.10	71.72	52.11	151.50	146.50	136.10	143.90	174.50	73.20
	2003	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**
Natural Gas, million m^3	79.00	71.90	102.50	133.90	232.60	250.50	121.90	113.50	123
Residual Fuel Oil, kt	NO	NO	NO	NO	NO	0.8715	0.5705	0.3208	0.3098
Bituminous Coal, kt	NO	NO	NO	NO	NO	0.0737	0.1473	0.1108	0.1102
Liquefied Petroleum Gases (LPG), kt	NO	NO	NO	NO	NO	NO	NO	NO	0.057
	2012	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**
Natural Gas, million m^3	134.90	110.8	129.7	108.0	120.0	100.0	108.0	112.0	174.84
Residual Fuel Oil, kt	0.2581	0.3713	0.3713	0.3713	0.3713	0.3606	0.289	0.1269	0.1269
Bituminous Coal, kt	0.0840	0.0324	0.0722	0.0641	0.0622	0.335	0.0206	0.0151	0.0106
Liquefied Petroleum Gases (LPG), kt	0.0346	0.0291	0.0249	0.0204	0.0204	0.0133	0.011	0.0121	0.0000

Source: JSC 'Moldovagaz' Letter to No. 06-1253 of 27.09.2006 and No. 02/1476 of 23.02.2011; 2011-2012 – JSC 'Moldovagaz' Letter to No. 02/1-288 of 22.02.2014; 2013-2014 – JSC 'Moldovagaz' Letter to No. 02/1-507 of 10.02.2015; 2015 – JSC 'Moldovagaz' Letter to No. 02/1-2183 of 03.06.2016, answer to Letter No. 512/2016-05-01 of 10.05.2016; 2016 – 'Moldovagaz' Letter to No. 03/2-74 of 12.01.2018, answer to Letter No. 601/2017-12-03 of 14.12.2017; 2017, 2018 – JSC 'Moldovagaz' Letter to No. 03/4-676 of 03.03.2020, Letter to No. 08-310/1 of 11.02.2020; UATSN statistical report 'Press Releases on Housing and Communal Services 2020'.

Information regarding fuel consumption for each industry within the sector for the RBDR is shown in Table 3-55 and Table 3-59.

Table 3-55: Fuel consumption for energy purposes within source category 1A2a 'Iron and Steel' between 1990-2020, TJ

	1990	1991	1992	1993	1994	1995	1996	1997
Coke	158	NO	NO	9	NO	NO	NO	NO
Natural Gas	2,171	NO	NO	NO	NO	NO	NO	NO
LPG	NO	NO	NO	NO	NO	NO	NO	NO
	1998	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**
Coke	NO	NO	NO	NO	NO	NO	3	5
Natural Gas	NO	NO	NO	NO	NO	NO	NO	NO
LPG	NO	NO	NO	NO	NO	NO	NO	NO
	2006	**2007**	**2010**	**2011**	**2012**	**2013**	**2008**	**2009**
Coke	6	5	3	5	NO	2	3	NO
Natural Gas	NO	NO	NO	NO	NO	NO	NO	NO
LPG	NO	NO	NO	1	NO	NO	1	NO

	2014	2015	2016	2017	2018	2019	2020	%
Coke	NO	NO	NO	NO	NO	NO	NO	
Natural Gas	NO	NO	NO	NO	NO	2	2	-99.9
LPG	NO	NO	NO	NO	NO	NO	NO	

Table 3-56: Fuel consumption for energy purposes within source category 1A2c 'Chemicals', including the pharmaceutical industry between 1990-2020, TJ

	1990	1991	1992	1993	1994	1995	1996	1997
Residual Fuel Oil	80	NO	NO	NO	NO	NO	NO	NO
Other Petroleum Products	NO	NO	NO	NO	NO	NO	NO	NO
Natural Gas	234	NO	NO	NO	NO	NO	NO	NO
Liquefied Petroleum Gases	NO	NO	NO	NO	NO	NO	NO	NO
Fuelwood	NO	NO	NO	NO	NO	NO	NO	NO
Agricultural Residues	NO	NO	NO	NO	NO	NO	NO	NO
	1998	1999	2000	2001	2002	2003	2004	2005
Residual Fuel Oil	NO	NO	NO	NO	NO	NO	1	1
Other Petroleum Products	NO	NO	NO	NO	NO	NO	NO	8
Natural Gas	NO	NO	NO	NO	NO	NO	11	3
Liquefied Petroleum Gases	NO	NO	NO	NO	NO	NO	NO	NO
Fuelwood	NO	NO	NO	NO	NO	NO	NO	NO
Agricultural Residues	NO	NO	NO	NO	NO	NO	NO	NO
	2006	2007	2008	2009	2010	2011	2012	2013
Residual Fuel Oil	NO	NO	NO	NO	NO	18	NO	18
Other Petroleum Products	12	NO	NO	NO	NO	NO	NO	NO
Natural Gas	10	7	39	34	4	4	13	2
Liquefied Petroleum Gases	NO	1	NO	NO	NO	NO	NO	NO
Fuelwood	NO	NO	NO	NO	NO	NO	NO	7
Agricultural Residues	NO	NO	NO	NO	NO	NO	NO	NO
	2014	2015	2016	2017	2018	2019	2020	%
Residual Fuel Oil	NO	NO	NO	NO	NO	NO	NO	
Other Petroleum Products	NO	6	1	NO	NO	NO	NO	
Natural Gas	29	21	27	29	30	42	95	-59.4
Liquefied Petroleum Gases	NO	NO	NO	NO	1	NO	NO	
Fuelwood	NO	NO	NO	NO	NO	NO	NO	
Agricultural Residues	NO	4	NO	2	3	2	1	

Table 3-57: Fuel consumption for energy purposes within source category 1A2d 'Pulp, Paper and Print' between 2000-2020, TJ

	1998	1999	2000	2001	2002	2003	2004	2005
Jet Kerosene	NO	NO	NO	NO	NO	NO	NO	NO
Natural Gas	NO	NO	NO	NO	NO	30	33	39
	2006	2007	2008	2009	2010	2011	2012	2013
Jet Kerosene	NO	NO	NO	NO	1	NO	NO	NO
Natural Gas	44	35	50	34	33	75	49	54
	2014	2015	2016	2017	2018	2019	2020	%
Anthracite	NO	NO	NO	NO	NO	1	1	
Jet Kerosene	NO	NO	NO	NO	NO	NO	NO	
Natural Gas	59	55	49	11	51	47	48	60.0
Wood Waste	NO	NO	NO	NO	4	NO	NO	

Table 3-58: Fuel consumption for energy purposes within source category 1A2e 'Food Processing, Beverages and Tobacco' between 1990-2020, TJ

	1990	1991	1992	1993	1994	1995	1996	1997
Anthracite	80	56	33	9	NO	NO	NO	NO
Other types of Bituminous Coal	NO	NO	NO	NO	NO	NO	NO	NO
Coke	634	549	463	378	323	352	381	323
Fuel for oven	468	329	189	50	59	29	88	117
Residual Fuel Oil	563	499	434	370	235	264	264	147
Jet Kerosene	647	494	341	188	29	NO	NO	NO
Other Petroleum Products	NO	NO	NO	NO	NO	NO	NO	NO
Natural Gas	68	70	73	76	29	117	235	323
Liquefied Petroleum Gases	NO	NO	NO	6	NO	NO	NO	NO
Fuelwood	126	105	83	62	NO	29	29	29
Wood Waste	NO	NO	NO	NO	NO	NO	NO	NO
Agricultural Residues	NO	NO	NO	NO	NO	NO	NO	NO
Other types of fuel	NO	NO	NO	NO	NO	NO	NO	117
Pellets and Briquettes from Vegetable Waste	NO	NO	NO	NO	NO	NO	NO	NO
Biogas	NO	NO	NO	NO	NO	NO	NO	NO

	1998	1999	2000	2001	2002	2003	2004	2005
Anthracite	29	NO	29	29	28	29	133	167
Other types of Bituminous Coal	NO	NO	NO	NO	NO	NO	NO	1
Coke	264	205	176	235	184.87	147	51	1
Fuel for oven	59	117	117	117	86	29	25	16
Residual Fuel Oil	205	88	88	117	NO	117	140	121
Jet Kerosene	29	NO	NO	NO	NO	NO	5	10
Other Petroleum Products	NO	NO	NO	NO	NO	NO	4	NO
Liquefied Petroleum Gases	352	293	NO	NO	NO	29	5	7
Fuelwood	NO	NO	12.32	12.32	12.32	NO	7	10
Wood Waste	24.64	12.32	NO	NO	NO	NO	33	20
Agricultural Residues	NO	NO	NO	NO	NO	NO	NO	NO
Other types of fuel	NO	NO	NO	NO	NO	NO	NO	NO
Pellets and Briquettes from Vegetable Waste	59	59	NO	NO	NO	NO	NO	NO
	2006	2007	2008	2009	2010	2011	2012	2013
Anthracite	156	77	78	53.4	70	78	94	78
Other types of Bituminous Coal	NO	NO	NO	NO	NO	NO	NO	NO
Coke	NO	NO	2	NO	NO	NO	NO	NO
Fuel for oven	8	4	15	NO	6	4	2	NO
Residual Fuel Oil	122	54	90	NO	6	9	6	NO
Jet Kerosene	NO	NO	NO	NO	NO	NO	NO	NO
Other Petroleum Products	NO	NO	NO	NO	NO	NO	NO	NO
Natural Gas	527	526	562	474	565	644	710	676
Liquefied Petroleum Gases	18	5	5	NO	48	2	11	5
Fuelwood	5	3	2	NO	2	3	6	7
Wood Waste	NO	3	3	NO	2	2	1	NO
Agricultural Residues	NO	NO	NO	NO	NO	1	1	8
Other types of fuel	NO	NO	NO	NO	NO	NO	NO	NO
Pellets and Briquettes from Vegetable Waste	NO	NO	NO	NO	NO	NO	NO	NO
	2014	2015	2016	2017	2018	2019	2020	%
Anthracite	117	56	63	49	60	38	28	-65.0
Other types of Bituminous Coal	NO	NO	NO	NO	NO	NO	NO	
Coke	NO	NO	NO	NO	NO	NO	NO	
Fuel for oven	NO	NO	NO	NO	NO	NO	NO	
Residual Fuel Oil	35	17	67	29	17	5	NO	
Jet Kerosene	NO	NO	NO	NO	NO	NO	NO	
Other Petroleum Products	NO	NO	NO	NO	NO	NO	NO	
Natural Gas	705	869	909	1,021	1,186	974	894	1,214.7
Liquefied Petroleum Gases	71	7	8	7	17	17	15	150.0
Fuelwood	12	15	10	8	16	9	6	-95.2
Wood Waste	NO	1	NO	NO	NO	NO	NO	
Agricultural Residues	NO	NO	NO	5	4	3	2	
Other types of fuel	NO	NO	NO	NO	NO	NO	NO	
Pellets and Briquettes from Vegetable Waste	NO	27	18	20	29	3	2	

Table 3-59: Fuel consumption for energy purposes within source category 1A2f 'Non-Metallic Minerals' between 1990-2020, TJ

	1990	1991	1992	1993	1994	1995	1996	1997
Anthracite	828	NO	NO	NO	NO	NO	29	29
Lignite	12	16	20	25	29	NO	NO	NO
Other Bituminous Coal	NO	NO	NO	NO	NO	NO	59	30
Coke	79	NO	NO	NO	NO	29	29	29
Fuel for oven	NO	NO	NO	NO	NO	NO	NO	NO
Residual Fuel Oil	13,266	9,994	6,721	3,449	176	59	59	59
Natural Gas	5,077	4,351	3,624	2,898	2,171	2,699	1,966	2,817
Liquefied Petroleum Gases	46	NO	NO	NO	NO	NO	NO	NO
Fuelwood	NO	NO	NO	NO	NO	NO	NO	NO
Wood Waste	29	NO	NO	NO	NO	NO	NO	NO
Pellets and Briquettes from Vegetable Waste	NO	NO	NO	NO	NO	NO	NO	NO
Biogas	NO	NO	NO	NO	NO	NO	NO	NO
	1998	1999	2000	2001	2002	2003	2004	2005
Anthracite	29	29	NO	NO	NO	NO	NO	NO
Lignite	NO	NO	NO	NO	NO	NO	NO	NO
Other Bituminous Coal	NO	NO	29	NO	NO	NO	14	14
Coke	NO	NO	NO	NO	NO	NO	NO	NO
Fuel for oven	NO	NO	NO	NO	NO	NO	1	5
Residual Fuel Oil	59	NO	NO	NO	NO	30	22	25
Natural Gas	2,729	2,670	3,227	2,934	3,894	3,810	4,242	5,474
Liquefied Petroleum Gases	NO	NO	NO	557	NO	NO	3	1
Fuelwood	NO	NO	NO	NO	NO	NO	NO	NO
Wood Waste	NO	NO	NO	NO	NO	NO	NO	NO
Pellets and Briquettes from Vegetable Waste	29	NO	NO	NO	NO	NO	NO	NO

	2006	2007	2008	2009	2010	2011	2012	2013
Anthracite	NO	NO	148	27	199	1,655	60	2,166
Lignite	NO	NO	NO	NO	NO	NO	NO	NO
Other Bituminous Coal	NO	NO	1,795	1,374	985	NO	1103	5
Coke	1	2	NO	53	121	NO	28	2
Fuel for oven	3	3	1	NO	NO	NO	NO	NO
Residual Fuel Oil	27	30	19	40	3	NO	NO	NO
Natural Gas	5,450	5,346	2,695	1,388	38	28	7	NO
Liquefied Petroleum Gases	1	1	3	NO	1,989	1,983	1,832	1,589
Fuelwood	NO	NO	2	NO	1	1	2	NO
Wood Waste	NO	NO	NO	NO	NO	NO	NO	NO
Pellets and Briquettes from Vegetable Waste	NO	NO	NO	NO	NO	NO	NO	NO
Charcoal	NO	NO	NO	NO	NO	NO	NO	NO
Petroleum coke	NO	NO	NO	NO	NO	NO	NO	NO
	2014	2015	2016	2017	2018	2019	2020	%
Anthracite	416	2	1	NO	3	NO	NO	
Lignite	NO	NO	NO	NO	NO	NO	NO	
Other Bituminous Coal	1,256	1,646	915	1,161	926	866	760	1,188.1
Coke	52	NO	141	NO	NO	NO	NO	
Other Coal Products	NO	NO	NO	NO	NO	27	NO	
Fuel for oven	NO	NO	NO	NO	NO	NO	NO	
Residual Fuel Oil	NO	13	8	7	NO	8	NO	
Natural Gas	1,346	1,469	1,382	1,318	1,777	1,528	1,790	-64.7
Liquefied Petroleum Gases	NO	NO	NO	NO	NO	NO	NO	
Fuelwood	NO	NO	NO	NO	NO	1	1	
Wood Waste	NO	NO	NO	NO	NO	NO	NO	
Pellets and Briquettes from Vegetable Waste	NO	NO	NO	NO	NO	NO	NO	
Charcoal	NO	NO	NO	1	1	NO	NO	
Petroleum coke	NO	NO	NO	473	1,071	1,135	906	

Aggregated fuel consumption data for industries within source categories 1A2g 'Transport Equipment', 1A2h 'Machinery', 1A2i 'Mining and Quarrying', 1A2j 'Wood and Wood Products', 1A2k 'Construction', 1A2l 'Textile and Leather', and 1A2m 'Non-specified Industry', which are not included in the above categories or for which no individual data is available, is shown in Table 3-60. Also, fuel consumption is transferred from source category 1A1aii 'Combined Heat and Power Generation' and 1A1aiii 'Heat Plants' – energy producers for own consumption for the RBDR between 2015 and 2020, as well as fuel consumption on the LBDR, to source category 1A2m 'Non-specified Industry'. The analysis of the total quantities indicates an increase in fuel consumption in this aggregated category, particularly with reference to the consumption of natural gas and agricultural fuel residues, and that residual fuel oil consumption is decreasing.

Table 3-60: Aggregated fuel consumption for energy purposes from other sources within 1A2 'Manufacturing Industries' for the period 1990-2005, TJ

	1990	1991	1992	1993	1994	1995	1996	1997
Anthracite	267.30	89.93	99.47	115.00	59.00	59.00	88.00	88.00
Other Bituminous Coal	NO	NO	NO	NO	NO	NO	NO	NO
Lignite	NO	NO	NO	NO	NO	NO	NO	NO
Other Coal Products	NO	NO	NO	NO	NO	NO	NO	NO
Coke	NO	NO	NO	NO	NO	NO	NO	NO
Charcoal	NO	NO	NO	NO	NO	NO	NO	NO
Fuel for Oven	NO	NO	NO	NO	NO	NO	NO	NO
Residual Fuel Oil	80.40	169.93	259.47	742.00	88.00	NO	NO	NO
Jet Kerosene	NO	NO	NO	NO	NO	NO	NO	NO
Other Petroleum Products	NO	NO	NO	NO	NO	NO	NO	NO
Petroleum Coke	NO	NO	NO	NO	NO	NO	NO	NO
Natural Gas	1,218.96	838.07	491.03	176.00	9,402.89	2,692.44	1,910.44	5,275.79
Liquefied Petroleum Gases	46.06	NO	NO	3.00	NO	NO	NO	NO
Fuelwood	8.99	NO	NO	NO	NO	NO	NO	NO
Wood Waste	146.70	120.13	93.57	67.00	29.00	NO	NO	NO
Agricultural Residues	NO	NO	NO	NO	NO	NO	NO	NO
Pellets and Briquettes from Vegetable Waste	NO	NO	NO	NO	NO	NO	NO	NO
Biogas	NO	NO	NO	NO	NO	NO	NO	NO
	1998	1999	2000	2001	2002	2003	2004	2005
Anthracite	59.00	29.00	29.00	29.00	40.20	NO	40.00	14.00
Other Bituminous Coal	NO	NO	NO	NO	NO	NO	NO	NO
Lignite	NO	NO	NO	NO	NO	NO	NO	NO
Other Coal Products	NO	NO	NO	NO	NO	NO	NO	NO
Coke	NO	NO	NO	NO	NO	NO	1.00	NO
Charcoal	NO	NO	NO	NO	NO	NO	NO	NO

	1998	1999	2000	2001	2002	2003	2004	2005
Fuel for Oven	NO	NO	NO	NO	NO	NO	NO	NO
Residual Fuel Oil	NO	NO	NO	NO	NO	NO	NO	3.00
Jet Kerosene	NO	NO	NO	NO	NO	NO	NO	NO
Other Petroleum Products	NO	NO	NO	NO	NO	NO	NO	1.00
Petroleum Coke	NO	NO	NO	NO	NO	NO	NO	NO
Natural Gas	5,077.49	4,725.35	4,960.45	5,996.57	2,546.27	2,732.94	2,520.53	3,572.65
Liquefied Petroleum Gases	NO	NO	NO	NO	NO	NO	4.00	8.00
Fuelwood	NO	NO	NO	NO	NO	NO	2.00	1.00
Wood Waste	NO	NO	NO	NO	NO	NO	6.00	6.00
Agricultural Residues	NO	NO	NO	NO	NO	NO	NO	NO
Pellets and Briquettes from Vegetable Waste	NO	NO	NO	NO	NO	NO	NO	NO
Biogas	NO	NO	NO	NO	NO	NO	NO	NO

Table 3-61: Aggregated fuel consumption for energy purposes from other sources within 1A2 'Manufacturing Industries' for the period 2006-2020, TJ

	2006	2007	2008	2009	2010	2011	2012	2013
Anthracite	46.00	53.00	33.00	14.00	23.00	23.00	29.00	2.00
Other Bituminous Coal	NO	NO	1.87	3.77	2.82	2.80	2.14	0.82
Lignite	NO	NO	NO	NO	NO	NO	NO	NO
Other Coal Products	NO	NO	NO	NO	NO	NO	NO	NO
Coke	NO	NO	NO	NO	NO	NO	NO	NO
Charcoal	NO	NO	NO	NO	NO	NO	NO	NO
Fuel for Oven	NO	NO	NO	NO	NO	NO	NO	NO
Residual Fuel Oil	2.00	4.00	39.04	22.93	13.90	12.42	12.38	14.93
Jet Kerosene	NO	NO	NO	NO	NO	NO	NO	NO
Other Petroleum Products	NO	NO	NO	NO	NO	NO	NO	NO
Petroleum Coke	NO	NO	NO	NO	NO	NO	NO	NO
Natural Gas	4,644.85	7,973.84	8,669.77	4,199.25	3,945.11	4,290.78	4,650.71	3,929.69
Liquefied Petroleum Gases	5.00	7.00	19.00	NO	11.00	7.63	3.59	1.34
Fuelwood	2.00	3.00	3.00	NO	9.00	14.00	11.00	6.00
Wood Waste	1.00	2.00	11.00	NO	14.00	23.00	35.00	5.00
Agricultural Residues	NO	NO	NO	NO	NO	4.00	1.00	2.00
Pellets and Briquettes from Vegetable Waste	NO	NO	NO	NO	NO	NO	NO	NO
Biogas	NO	NO	NO	NO	NO	NO	NO	NO

	2014	2015	2016	2017	2018	2019	2020	%
Anthracite	30.00	74.00	70.00	84.00	83.00	41.00	31.00	-88.4
Other Bituminous Coal	1.96	12.63	13.58	15.17	20.35	0.38	0.27	
Lignite	NO	NO	NO	NO	NO	NO	NO	
Other Coal Products	NO	NO	NO	NO	NO	NO	NO	
Coke	NO	NO	NO	NO	NO	NO	NO	
Charcoal	NO	NO	NO	NO	NO	NO	NO	
Fuel for Oven	NO	NO	NO	NO	1.00	NO	4.00	
Residual Fuel Oil	14.93	284.93	523.93	447.47	299.83	123.10	22.10	-72.5
Jet Kerosene	NO	NO	NO	NO	NO	NO	NO	
Other Petroleum Products	NO	NO	NO	3.00	1.00	1.00	8.00	
Petroleum Coke	NO	NO	NO	NO	NO	NO	NO	
Natural Gas	4,527.64	5,714.88	6,147.20	5,632.00	6,118.88	6,339.32	8,413.08	590.2
Liquefied Petroleum Gases	1.15	1.94	10.94	3.61	7.51	6.56	1.00	-97.8
Fuelwood	1.00	18.00	23.00	6.00	5.00	6.00	11.00	22.3
Wood Waste	16.00	10.00	2.00	7.00	26.00	2.00	9.00	-93.8
Agricultural Residues	NO	341.00	290.00	234.00	385.00	362.00	404.00	
Pellets and Briquettes from Vegetable Waste	NO	35.00	65.00	125.00	115.00	135.00	64.00	
Biogas	NO	387.00	359.00	198.00	163.00	166.00	140.00	

Table 3-62 shows the contribution of industrial branches in the structure of industrial production on the LBDR, in % of the total.

Table 3-62: Contribution of industrial branches in the structure of industrial production on the LBDR, % of the total

	1990	1991	1992	1993	1994	1995	1996	1997
1A2a Iron and Steel	N/A	N/A	N/A	N/A	N/A	27.4	28.2	35.3
1A2c Chemicals	N/A	N/A	N/A	N/A	N/A	0.1	0.1	0.1
1A2d Pulp, Paper and Print	N/A	N/A	N/A	N/A	N/A	2.7	2	1.8
1A2e Food Processing, beverages and Tobacco	N/A	N/A	N/A	N/A	N/A	19.7	16.5	15.6
1A2f Non-Metallic Minerals	N/A	N/A	N/A	N/A	N/A	0.6	0.6	0.6
1A2h Machinery	N/A	N/A	N/A	N/A	N/A	13.2	11.1	12.1
1A2j Wood and Wood Products	N/A	N/A	N/A	N/A	N/A	1.4	0.9	0.5
1A2k Construction	N/A	N/A	N/A	N/A	N/A	5.7	5	4.9
1A2l Textile and leather	N/A	N/A	N/A	N/A	N/A	14.8	20	15.9
1A2m Energy Industries	N/A	N/A	N/A	N/A	N/A	14.4	15.6	13.2

	1998	1999	2000	2001	2002	2003	2004	2005
1A2a Iron and Steel	32.9	36.6	35.7	35.5	19.6	31.3	33.4	34.2
1A2c Chemicals	2	1.9	1.9	1.3	1.2	1.2	1.3	1.3
1A2d Pulp, Paper and Print	1.5	1.2	1.8	2.4	0.4	0.4	0.5	0.5
1A2e Food Processing, beverages and Tobacco	13.2	12.4	9.2	7.1	10.3	12.9	10.5	9.9
1A2f Non-Metallic Minerals	0.3	0.2	0.4	0.4	0.4	0.4	0.2	0.2
1A2h Machinery	8.3	6.5	8.2	8	6.7	8	8.1	8.4
1A2j Wood and Wood Products	0.5	0.4	0.6	1.1	1.3	1.2	1	0.8
1A2k Construction	4.7	4.8	2.1	2.2	2.5	2.8	2.8	2.1
1A2l Textile and leather	22.7	22.3	29.5	29.7	29.8	17.6	18.2	19.4
1A2m Energy Industries	13.9	13.7	10.6	12.3	27.8	24.2	24	23.2
	2006	2007	2008	2009	2010	2011	2012	2013
1A2a Iron and Steel	29.7	46.5	44.9	32	18.7	22.5	25.3	14.9
1A2c Chemicals	1.3	1	0.7	0.8	1.7	1.8	2	2.8
1A2d Pulp, Paper and Print	0.6	0.4	0.3	0.4	0.5	0	0.3	0.3
1A2e Food Processing, beverages and Tobacco	13.5	10	10.5	9.7	12.2	12.1	11.8	17.2
1A2f Non-Metallic Minerals	0.3	0.3	0	0	0	0	0	0
1A2h Machinery	9.3	6.8	6.1	5	7.3	7	6.8	7.5
1A2j Wood and Wood Products	0.6	0.2	0.1	0.1	0.1	0.1	0.2	0.4
1A2k Construction	3.5	8.9	11.1	3.2	3.6	4.2	4.7	5.4
1A2l Textile and leather	23.4	13.5	12.2	15.8	21.8	19.3	17.8	23.5
1A2m Energy Industries	17.8	12.4	14.1	33	34.1	32.4	31.1	28
	2014	2015	2016	2017	2018	2019	2020	2021
1A2a Iron and Steel	27.2	24.1	18.2	31.5	31.9	26.5	27.9	N/A
1A2c Chemicals	2	1.4	2	1.7	2.2	2.4	2.3	N/A
1A2d Pulp, Paper and Print	0.2	0.5	0.3	0.2	0.1	0.2	0.2	N/A
1A2e Food Processing, beverages and Tobacco	13.7	12.3	13.5	14.0	13.9	14.5	13.2	N/A
1A2f Non-Metallic Minerals	0	0	0	0	0	0	0	N/A
1A2h Machinery	4.4	4.3	4.4	4.8	4.7	5.9	4.8	N/A
1A2j Wood and Wood Products	0.3	0.1	0.1	0.1	0.1	0.1	0.03	N/A
1A2k Construction	6.6	4.8	6	5.4	5.5	5.4	4.4	N/A
1A2l Textile and leather	13.4	12.2	14.1	12.6	11.9	15.0	12.8	N/A
1A2m Energy Industries	32.2	40.3	41.4	29.7	29.7	33.3	34.4	N/A

AD on total fuel consumption within source category 1A2 'Manufacturing Industries and Construction' for the Right Bank of the Dniester River and reallocated data from categories 1A1aii 'Combined Heat and Power Generation' and 1A1aiii 'Heat Plants' is available in Table 3-63.

Table 3-62: Total consumption by fuel type for energy purposes within category 1A2 'Manufacturing Industries and Construction' on the RBDR between 1990-2020, TJ

	1990	1991	1992	1993	1994	1995	1996	1997
Solid Fuels	2,058.31	710.90	615.78	538.67	470	456.20	604.76	519.80
Gaseous Fuels	8,963.44	5,311.33	4,223.13	3,178.93	2,288	3,080	2,347	3,286
Liquid Fuels	15,104.49	11,484.56	7,945.03	4,801.50	587.00	352.00	411.00	323.00
Biofuels	310.94	224.74	176.87	129.00	29.00	29.00	29.00	146
	1998	1999	2000	2001	2002	2003	2004	2005
Solid Fuels	381.00	292.00	263.00	293.00	252.77	176.00	242.00	202.00
Gaseous Fuels	3,198.00	3,080.00	3,638.00	3,872.00	4,266.36	4,572.00	4,775.00	6,145.00
Liquid Fuels	352.00	205.00	205.00	234.00	86.26	176.00	201.00	194.00
Biofuels	171.64	71.32	12.32	12.32	12.32	9.66	48.00	27.00
	2006	2007	2008	2009	2010	2011	2012	2013
Solid Fuels	209.00	137.00	2,059.00	1,598.4	1,401.00	1,761.00	1,314.00	2,255.00
Gaseous Fuels	6,172.00	6,034.00	3,584.00	2,010.74	2,808.00	2,897.00	2,748.00	2,516.00
Liquid Fuels	176.00	95.00	129.00	40.20	55.00	59.00	17.00	18.00
Biofuels	8.00	11.00	21.00	0	27.00	47.00	55.00	35.00
	2014	2015	2016	2017	2018	2019	2020	%
Solid Fuels	1,871.00	1,789.00	1,202.00	1,301.00	1,086.00	973.00	820.00	-60.2
Gaseous Fuels	2,357.00	4,487.00	4,469.00	4,647.00	5,539.00	5,170.00	5,347.00	-40.3
Liquid Fuels	35.00	306.00	585.00	946.00	1,388.00	1267.00	931.00	-93.8
Biofuels	29.00	838.00	767.00	605.00	750.00	689.00	640.00	105.8

3.3.3. Uncertainties and Time Series Consistency

The primary uncertainty-related factors pertain to methodology, emission factors used to estimate GHG emissions covered by source category 1A2 'Manufacturing Industries and Construction', and quality of available activity data. Uncertainties associated with EFs are estimated to be circa 5% for CO_2 emissions, and up to ±50% for CH_4 and N_2O emissions, respectively. Uncertainties associated with activity data regarding fuel consumption within 'Manufacturing Industries and Construction' are circa 5% for CO_2 and CH_4 emissions, and circa 3% for N_2O emissions (Annex 5-3.1).

In view of ensuring time-series consistency of the obtained results, the same approach was used for the entire period under review, in conformity with the recommendations included in the 2006 IPCC Guidelines.

3.3.4. Quality Assurance and Quality Control

A standard verification and quality control form and check-list were filled in for the 1A2 'Manufacturing Industries and Construction' following the Tier 1 approach.

The AD and methods used to estimate GHG emissions under category 1A2 'Manufacturing Industries and Construction' are documented and archived both in hard copies and electronically. To identify the data entry and emission estimation process related errors regarding the assessment of GHG emissions, there were applied verifications and quality control procedures and EFs.

The Quality Control and verification procedures applied in the calculation process for category 1A2 'Manufacturing and construction industry' included:

- Verification of AD collecting and manipulation procedures, including: verifying whether disaggregation of AD collected for each sub-category included in category 1A2 'Manufacturing Industries and Construction' complies with the requirements set out in the description of each industrial sub-category in the 2006 IPCC Guidelines (GHG emissions were calculated for 12 industrial sub-categories, when 7 sub-categories were aggregated into a single sub-category due to the reduced fuel consumption from year to year);
- For each sub-category, the AD is available in separate files in energy units; GHG emissions were initially calculated for each sub-category separately, but statistical evidence of fuel consumption within each sub-category revealed uneven and fragmented trends associated with the consumption of certain limited types of fuels during the period under review; it has thereby been decided to present aggregated GHG emissions at source category level;
- Verifying the correctness of EFs used for each sub-category;
- Verifying whether the primary reference sources are correctly indicated;
- The accuracy of calculations for sources included in category 1A2 is verified randomly;
- Implementation of error minimization procedures for manual entry of AD, with all the spreadsheets provided with the initial sources of activity data in tabular format;
- In the calculation files, the EFs are specified in tabular formats for each sub-category, the import of the respective values into calculation formulas is ensured by automatic connections;
- The consistency of the calculations is also ensured by verifying the correctness of applying conversion factors of natural units to energy units for all sub-categories and the entire range of years covered by the inventory;
- Verification whether the same method is used for the entire range of years covered by the inventory;
- Verifying whether GHG emission calculations have been made for all years and for all types of fuels mentioned in the Energy Balances of the RM and relevant reference sources;
- Verifying to what extent the full geographical coverage of the national GHG inventory of the RM is ensured;
- Verifying the inter-annual evolution trends of emissions by creating representative charts, while unusual fluctuations are explained;
- Regarding recalculations, their need is explained, including by drawing attention to the implemented recommendations resulting from the audit carried out by national and international experts in the previous inventory cycle;
- Verifying maintenance and completion of the national inventory of GHG emission archive, etc.

Following the recommendations included in the 2006 IPCC Guidelines, GHG emissions were estimated using AD and CS EFs from official sources of information. In the current cycle, when preparing the activity data series, the following alterations have been made:

- the information regarding primary activity data for the years 2017-2020 was collected and specified;
- the consumption of liquefied petroleum gases was presented on aggregate with the consumption of natural gas, being attributed to gaseous fuels;
- for the LBDR, with reference to source category 1A2 'Manufacturing Industries and Construction', natural gas consumption for 2020 was calculated indirect data;
- the primary activity data from the EBs of the RM associated with the consumption of fuels previously allocated to source category 1A1aii 'Combined Heat and Power Generation' and 1A1aiii 'Heat Plants' – producers of energy for own consumption, were reallocated to category 1A2m 'Non-specified Industry'; the reallocation has been carried out since 2015, as for the previous years, the disaggregated information by source category is missing. This reallocation has not been changed;
- for the confirmation of the final results obtained, control checks of the calculation formulas are performed in the work files;
- when calculating emissions for each category of the entire time series, the same calculation method has been used, and graphs in Excel files are presented for analysis and visualisation;
- to ensure the coverage of the inventory from a territorial point of view for all source categories, activity data collected for the territory on the LBDR are included; various statistical publications of the ATULBD were used, including the Statistical Report 'The State of Housing and Communal Services of the ATULBD';
- In the current cycle of the CN5 1990-2020, all approaches used in the previous cycle have been applied.

3.3.5. Recalculations

In the current inventory cycle, a number of measures have been taken to improve the quality of the national GHG inventory and this implied the recalculation of GHG emissions from source category 1A2 'Manufacturing Industries and Construction'. The main causes for these recalculations are:

- the emission factors for category 1A2 'Manufacturing industries and construction' have been corrected: liquefied petroleum gases, for CO_2 emissions – 63,100 (instead of 64,200); solid fuels, for CH_4 emissions – 1 (instead of 10);
- missing data on the consumption of 'other bituminous coals' has been added for the years 2010, 2012 and 2014;
- since 2015, changes have been made associated with the reallocation of activity data from source categories 1A1aii 'Combined Heat and Power Generation' and 1A1aiii 'Heat Plants' – producers of energy for own consumption to source category 1A2m 'Non-specified Industry';
- With reference to category 1A2 'Manufacturing and Construction Industry', aviation gasoline consumption was detected in the Ebs of the RM and was reallocated to source category 1A3a;
- At the same time, the consumption of gasoline and diesel oil allocated in some years in the Energy Balances to source category 1A2 'Manufacturing Industries and Construction' was reallocated to source category 1A3b 'Road Transportation', as they are consumed on national roads.

Table 3-64: Recalculation results of GHG emissions from source category 1A2 'Manufacturing Industries and Construction' included in the BUR3 of the RM to the UNFCCC for the period 1990-2019, kt CO_2 equivalent

	1990	1991	1992	1993	1994	1995	1996	1997
BUR3	1,923.3779	1,282.1630	929.8471	614.1484	739.1596	382.2342	322.0417	548.0393
NC5	1,921.7642	1,287.1322	935.0040	619.4837	744.9079	386.9966	327.0306	564.9501
Difference, %	-0.08	2.13	0.26	0.12	0.32	0.23	1.00	0.38
	1998	1999	2000	2001	2002	2003	2004	2005
BUR3	543.8396	474.6097	520.3009	602.0890	410.9707	439.4649	444.6143	575.2151
NC5	540.3244	484.7013	521.6280	602.7967	412.3027	440.4941	449.0403	577.3845
Difference, %	-0.65	2.13	0.26	0.12	0.32	0.23	1.00	0.38
	2006	2007	2008	2009	2010	2011	2012	2013
BUR3	635.4857	801.7268	887.1888	495.6502	423.3105	577.2543	434.6008	577.6270
NC5	635.9882	802.3722	887.2826	503.0709	517.2615	577.5153	540.2918	579.1734
Difference, %	0.08	0.08	0.01	1.50	22.19	0.05	24.32	0.27

	2014	2015	2016	2017	2018	2019	2020	%
BUR3	444.6875	654.1931	643.629	661.1426	751.3852	718.476		
NC5	565.2305	518.3827	489.6135	502.7968	595.6181	720.0203	803.6492	58.2
Difference, %	27.11	-20.76	-23.93	-23.95	-20.73	0.21		

Between 1990 and 2020, direct GHG emissions from source category 1A2 'Manufacturing Industries and Construction' had decreased by circa 58.2%.

3.3.6. Planned Improvements

Potential improvements within source category 1A2 'Manufacturing Industries and Construction' regarding fuel consumption for energy purposes could be possible once the updated AD on fuel consumption for the territory on the LBDR is available, thus filling the gaps for certain years. Also, another approach to restore activity data for the territory on the LBDR is possible.

3.4. Transport (Category 1A3)

3.4.1. Source Category Description

Source category 1A3 'Transport' includes the following sources: 1A3a 'Civil Aviation' (1A3ai 'International Aviation' and 1A3aii 'Domestic Aviation'), 1A3b 'Road Transportation', 1A3c 'Railways', 1A3d 'Water-borne Navigation' and 1A3e 'Other Transportation'.

Total GHG emissions from source category 1A3 'Transport'

Total GHG emissions from source category 1A3 'Transport' recorded a downward trend between 1990 and 2020 from 4,838.64 kt CO_2 equivalent in 1990 to 2,511.91 kt CO_2 equivalent in 2020, or by 48.1% (Table 3-65).

Table 3-65: GHG emissions from source category 1A3 'Transport' between 1990-2020, kt CO_2 equivalent

	1990	1991	1992	1993	1994	1995	1996	1997
1A3, kt CO_2 equivalent	4,838.64	3,769.31	2,699.86	1,920.97	1,656.54	1,660.34	1,619.22	1,555.14
%, compared to 1990	100.0	77.9	55.8	39.7	34.2	34.3	33.5	32.1
	1998	1999	2000	2001	2002	2003	2004	2005
1A3, kt CO_2 equivalent	1,397.91	932.11	1,005.66	1,087.35	1,442.41	1,625.88	1,828.60	1,866.99
%, compared to 1990	28.9	19.3	20.8	22.5	29.8	33.6	37.8	38.6
	2006	2007	2008	2009	2010	2011	2012	2013
1A3, kt CO_2 equivalent	1,787.95	1,894.81	1,999.17	1,964.24	2,188.80	2,322.56	2,037.01	2,145.88
%, compared to 1990	37.0	39.2	41.3	40.6	45.2	48.0	42.1	44.3
	2014	2015	2016	2017	2018	2019	2020	%
1A3, kt CO_2 equivalent	2,182.58	2,307.83	2,481.61	2,503.58	2,581.89	2,665.43	2,511.91	-48.1
%, compared to 1990	45.1	47.7	51.3	51.7	53.4	55.1	51.9	

In the current inventory cycle, GHG emissions from source category 1A3 'Transport' were estimated separately for the territory on the RBDR (according to AD available in the EBs of the RM), respectively for the LBDR (based on specific fuel consumption per capita) (for the period 1990-1992, the information is presented for the entire territory of the country, while since 1993, separately for the RBDR and LBDR).

In 2020, the level of direct and indirect GHG emissions from source category 1A3 'Transport' constituted: emissions of CO_2 – circa 52.4% of the level of emissions recorded in the base year (1990), CH_4 – 32.3%, N_2O – 36.3%, NO_x – 46.5%, CO – 26.0%, NMVOC – 26.6%, and SO_2 – 0.7% (Table 3-66).

Table 3-66: Evolution of direct and indirect GHG emissions from source category 1A3 'Transport' between 1990-2020

	1A3, kt							%, compared to 1990						
	CO_2	CH_4	N_2O	NO_x	CO	NMVOC	SO_x	CO_2	CH_4	N_2O	NO_x	CO	NMVOC	SO_x
1990	4,698.2416	1.3467	0.3582	20.8774	70.8644	9.0718	0.7843	100.0	100.0	100.0	100.0	100.0	100.0	100.0
1991	3,656.1040	1.0343	0.2931	16.6517	53.9238	6.9484	0.6152	77.8	76.8	81.8	79.8	76.1	76.6	78.4
1992	2,615.2237	0.7228	0.2234	12.5061	37.2521	4.8651	0.4462	55.7	53.7	62.4	59.9	52.6	53.6	56.9
1993	1,854.7578	0.4928	0.1808	9.9160	24.6271	3.3175	0.3241	39.5	36.6	50.5	47.5	34.8	36.6	41.3
1994	1,612.9419	0.4373	0.1096	6.0604	22.3481	2.8670	0.2180	34.3	32.5	30.6	29.0	31.5	31.6	27.8
1995	1,617.6947	0.4447	0.1058	6.1549	23.3801	2.9715	0.2340	34.4	33.0	29.5	29.5	33.0	32.8	29.8
1996	1,578.3769	0.4312	0.1009	5.9472	22.3021	2.8506	0.2207	33.6	32.0	28.2	28.5	31.5	31.4	28.1
1997	1,516.0213	0.4009	0.0976	5.9219	24.4735	3.0625	0.2299	32.3	29.8	27.3	28.4	34.5	33.8	29.3

	1A3, kt							%, compared to 1990						
	CO_2	CH_4	N_2O	NO_x	CO	NMVOC	SO_x	CO_2	CH_4	N_2O	NO_x	CO	NMVOC	SO_x
1998	1,363.1855	0.4034	0.0827	4.9702	21.3567	2.6620	0.1945	29.0	30.0	23.1	23.8	30.1	29.3	24.8
1999	910.5958	0.2475	0.0514	3.3339	12.5288	1.5798	0.1366	19.4	18.4	14.4	16.0	17.7	17.4	17.4
2000	982.2638	0.2519	0.0574	3.7206	12.4426	1.5683	0.1582	20.9	18.7	16.0	17.8	17.6	17.3	20.2
2001	1,061.7864	0.2667	0.0634	3.9981	13.3140	1.6688	0.1332	22.6	19.8	17.7	19.2	18.8	18.4	17.0
2002	1,405.6363	0.3418	0.0947	5.6192	17.2878	2.2088	0.1735	29.9	25.4	26.4	26.9	24.4	24.3	22.1
2003	1,588.6955	0.4003	0.0912	6.1096	20.6504	2.5992	0.2110	33.8	29.7	25.5	29.3	29.1	28.7	26.9
2004	1,786.1813	0.4311	0.1062	7.1263	22.4044	2.8401	0.2464	38.0	32.0	29.6	34.1	31.6	31.3	31.4
2005	1,821.7199	0.4397	0.1150	7.5129	22.8675	2.9169	0.0452	38.8	32.6	32.1	36.0	32.3	32.2	5.8
2006	1,742.1028	0.4060	0.1198	7.4749	21.0274	2.7125	0.0436	37.1	30.1	33.4	35.8	29.7	29.9	5.6
2007	1,846.7731	0.4274	0.1253	7.9312	21.7418	2.8091	0.0462	39.3	31.7	35.0	38.0	30.7	31.0	5.9
2008	1,949.9802	0.4511	0.1272	8.2916	22.7260	2.9400	0.0485	41.5	33.5	35.5	39.7	32.1	32.4	6.2
2009	1,919.6624	0.4575	0.1112	7.5165	22.6058	2.8767	0.0046	40.9	34.0	31.0	36.0	31.9	31.7	0.6
2010	2,140.5138	0.4708	0.1225	8.7584	22.2774	2.8861	0.0052	45.6	35.0	34.2	42.0	31.4	31.8	0.7
2011	2,272.6744	0.4687	0.1281	9.1192	22.9464	2.9620	0.0056	48.4	34.8	35.8	43.7	32.4	32.7	0.7
2012	1,992.5651	0.4049	0.1152	8.2265	19.3038	2.5284	0.0048	42.4	30.1	32.2	39.4	27.2	27.9	0.6
2013	2,101.2934	0.4086	0.1153	8.4230	18.8125	2.4595	0.0049	44.7	30.3	32.2	40.3	26.5	27.1	0.6
2014	2,140.5508	0.4056	0.1070	8.0152	18.5701	2.4006	0.0049	45.6	30.1	29.9	38.4	26.2	26.5	0.6
2015	2,261.4456	0.4285	0.1197	8.8431	19.1901	2.5021	0.0051	48.1	31.8	33.4	42.4	27.1	27.6	0.7
2016	2,428.3642	0.4966	0.1370	9.8287	19.6405	2.5823	0.0054	51.7	36.9	38.3	47.1	27.7	28.5	0.7
2017	2,451.2471	0.4838	0.1350	9.7865	19.0444	2.5083	0.0054	52.2	35.9	37.7	46.9	26.9	27.6	0.7
2018	2,529.5773	0.5024	0.1334	9.7836	19.8909	2.5892	0.0055	53.8	37.3	37.3	46.9	28.1	28.5	0.7
2019	2,611.5525	0.4983	0.1390	10.1388	20.5687	2.6841	0.0058	55.6	37.0	38.8	48.6	29.0	29.6	0.7
2020	2,462.2411	0.4352	0.1302	9.7000	18.3931	2.4165	0.0054	52.4	32.3	36.3	46.5	26.0	26.6	0.7

The evolution of GHG emissions from source category 1A3 'Transport' between 1990-2020 is further present by emission source.

Source 1A3b 'Road Transportation' has the largest share in the structure of total direct GHG emissions from category 1A3 'Transport' between 1990-2020, followed by 1A3c 'Railways' and 1A3e 'Other Transportation' (pipeline transport), while the share of sources 1A3a 'Civil Aviation' and 1A3d 'Water-borne Navigation' is insignificant (Figure 3-18, Table 3-67).

Table 3-67: Evolution of direct GHG emissions from source category 1A3 'Transport' by source between 1990-2020

	1A3, kt						%, of total				
	1A3a	1A3b	1A3c	1A3d	1A3e i	1A3	1A3a	1A3b	1A3c	1A3d	1A3e i
1990	72.9612	4,204.8572	450.4461	19.1071	91.2673	4,838.6388	1.51	86.90	9.31	0.39	1.89
1991	55.2246	3,239.5975	398.1451	0.2907	76.0561	3,769.3140	1.47	85.95	10.56	0.01	2.02
1992	37.4879	2,274.3236	330.7604	0.2487	57.0420	2,699.8627	1.39	84.24	12.25	0.01	2.11
1993	19.7513	1,572.6876	305.9782	0.2870	22.2631	1,920.9673	1.03	81.87	15.93	0.01	1.16
1994	19.9387	1,410.7364	121.5340	0.2241	104.1069	1,656.5401	1.20	85.16	7.34	0.01	6.28
1995	20.0886	1,432.9646	107.1307	0.2165	99.9419	1,660.3423	1.21	86.31	6.45	0.01	6.02
1996	20.2086	1,354.1225	103.9447	0.2350	140.7085	1,619.2192	1.25	83.63	6.42	0.01	8.69
1997	20.3045	1,386.7388	89.3226	0.2532	58.5207	1,555.1398	1.31	89.17	5.74	0.02	3.76
1998	20.6883	1,254.4799	66.0888	0.1583	56.4915	1,397.9068	1.48	89.74	4.73	0.01	4.04
1999	2.0476	833.1039	34.4317	0.2636	62.2658	932.1127	0.22	89.38	3.69	0.03	6.68
2000	2.0476	931.3112	37.2283	0.1166	34.9539	1,005.6576	0.20	92.61	3.70	0.01	3.48
2001	0.0990	1,029.5930	40.0201	0.2103	17.4258	1,087.3482	0.01	94.69	3.68	0.02	1.60
2002	0.0857	1,312.7013	91.1362	0.4874	37.9952	1,442.4058	0.01	91.01	6.32	0.03	2.63
2003	0.6615	1,549.3745	48.4132	0.4417	26.9934	1,625.8842	0.04	95.29	2.98	0.03	1.66
2004	0.3530	1,717.8919	66.9536	0.4483	42.9533	1,828.6001	0.02	93.95	3.66	0.02	2.35
2005	1.6946	1,733.9282	90.4439	0.2599	40.6653	1,866.9919	0.09	92.87	4.84	0.01	2.18
2006	0.1989	1,666.5695	113.0672	0.5203	7.5969	1,787.9528	0.01	93.21	6.32	0.03	0.42
2007	1.0591	1,776.1132	113.7805	0.3473	3.5102	1,894.8103	0.06	93.74	6.00	0.02	0.19
2008	0.1528	1,889.3814	104.6019	0.3477	4.6871	1,999.1709	0.01	94.51	5.23	0.02	0.23
2009	0.0766	1,894.8443	57.2949	0.3483	11.6737	1,964.2378	0.00	96.47	2.92	0.02	0.59
2010	0.3530	2,112.1609	58.3140	0.2617	17.7092	2,188.7989	0.02	96.50	2.66	0.01	0.81
2011	0.0706	2,241.8367	53.8020	0.2623	26.5862	2,322.5577	0.00	96.52	2.32	0.01	1.14
2012	0.1412	1,954.7978	57.9864	0.2628	23.8262	2,037.0144	0.01	95.96	2.85	0.01	1.17
2013	0.1982	2,093.4434	37.1689	0.2635	14.8038	2,145.8778	0.01	97.56	1.73	0.01	0.69
2014	0.1412	2,157.6253	3.1133	2.3774	19.3246	2,182.5818	0.01	98.86	0.14	0.11	0.89
2015	0.3140	2,260.4866	25.1001	2.4654	19.4599	2,307.8259	0.01	97.95	1.09	0.11	0.84
2016	0.2321	2,410.3305	52.3706	1.8364	16.8364	2,481.6061	0.01	97.13	2.11	0.07	0.68
2017	0.5919	2,438.3632	42.2714	1.7509	20.6074	2,503.5847	0.02	97.39	1.69	0.07	0.82
2018	0.1548	2,539.1440	22.8770	1.5792	18.1388	2,581.8939	0.01	98.34	0.89	0.06	0.70
2019	0.2859	2,618.7224	27.3825	1.8450	17.1947	2,665.4305	0.01	98.25	1.03	0.07	0.65
2020	0.0706	2,478.4017	21.2607	0.6151	11.5584	2,511.9066	0.00	98.67	0.85	0.02	0.46

In 2020, GHG emissions from 1A3a 'Civil Aviation' had a share of only 0.01% of the total per category, whereas 1A3b 'Road Transportation' – 98.67% 1A3c 'Railways' – 0.85%, 1A3d 'Water-borne Navigation' – 0.02%, and 1A3e 'Other Transportation' – 0.46% of the total.

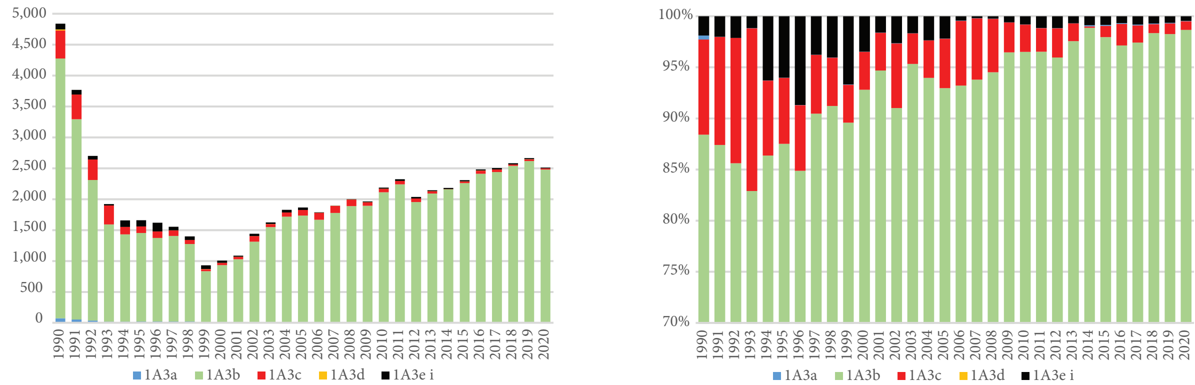


Figure 3-18: Evolution of direct GHG emissions from source category 1A3 'Transport', by source, between 1990-2020, in kt CO_2 equivalent; and their share in the structure of total direct GHG emissions within the respective category, % of the total.

3.4.2. Methodological Issues, Emission Factors and Activity Data

GHG emissions from source category 1A3 'Transport' were estimated following a Tier 1 methodological approach available in the 2006 IPCC Guidelines, based on activity data on fuel consumption and default emission factors. In order to estimate non-CO_2 emissions, default EFs were used, which are available in the EMEP/EEA Air Pollutant Emission Inventory (2019) (Table 3-68).

Table 3-68: EFs used for the estimation of GHG emissions from source category 1A3 'Transport', kg/TJ

Category	Fuel	CO_2	CH_4	N_2O	NO_x	CO	NMVOC	SO_x	Sources of reference for: CO_2, CH_4, N_2O	Sources of reference for: NO_x, CO and NMVOC
1A3a	Aviation gasoline	69,300	0.5	2	4	1200	19	1	2006 IPCC Guidelines, Volume 2, Chapter 3, Tables 3.6.4 and 3.6.5	EMEP/EEA Guidebook 2019, Categories 1.A.3.a, 1.A.5.b, Table 3-3
1A3b	Gasoline	69,300	33.0	3.2	8.7	84.7	10.1		2006 IPCC Guidelines, Volume 2, Chapter 3, Tables 3.2.1 and 3.2.2	EMEP/EEA Guidebook 2019, October Update 2021, Categories 1.A.3.b.i, 1.A.3.b.ii, 1.A.3.b.iii, 1.A.3.b.iv, Tables 3-5 and 3-6
	Diesel oil	74,100	3.9	3.9	13.0	3.3	0.7			
	Natural gas	56,100	92.0	3.0	13.0	5.7	0.3	0.0		
	LPG	63,100	62.0	0.2	15.2	84.7	13.6	0.0		
1A3c	Diesel oil	74,100	4.15	28.6	52.4	10.7	4.65		2006 IPCC Guidelines, Volume 2, Chapter 3, Table 3.4.1	EMEP/EEA Guidebook 2019, Category 1.A.3.c, Table 3-1
1A3d	Diesel oil	74,100	7	2	79.3	7.4	2.7	20	2006 IPCC Guidelines, Volume 2, Chapter 3, Tables 3.5.2 and 3.5.3	EMEP/EEA Guidebook 2019, October Update 2021, Categories 1.A.3.d.i, 1.A.3.d.ii, 1.A.4.c.iii, Table 3-1
1A3e	Natural gas	56,100	1	0.1	74	29	23	0.67	2006 IPCC Guidelines, Volume 2, Chapter 3, Table 2.2	EMEP/EEA Guidebook 2019, Categories 1.A.4.a.i, 1.A.4.b.i, 1.A.4.c.i, 1.A.5.a, Table 3-8

For the years 1990, 1995 and 2004-2020, an assessment method for estimating GHG emissions from category 1A3 'Transport' was applied by using the COPERT model, ver. 4.9, the equivalent of a Tier 3 methodological approach. The calculations performed are still preliminary and have not been included into this Report.

The calculation of SO_2 emissions from 1A3b 'Road Transportation' and 1A3c 'Railways' were applied in accordance with the estimation methods available in the 2019 EMEP/EEA Air Pollutant Emission Inventory.

For the LBDR, there are incomplete AD on diesel oil and gasoline consumption by transport units in the agriculture sector, and incomplete data on natural gas consumption by transport units in the region, respectively. The information received from JSC 'Moldovagaz', as well as from the statistical publications from 'The State of Housing and Communal Services of the ATULBD' (generated and published between 2011 and 2020) serve as reference sources. All missing data have been restored and the methods applied are described below.

For the RBDR, the main reference sources regarding fuel consumption for the transport sector between 1993 and 2020 is the information provided by the Energy Balances of the Republic of Moldova, both in natural units (kt and/or million m^3), and in energy units (TJ). In the Energy Balances for the year 1990, AD are available in natural units, as well as in kilotonnes of conventional fuel (in the years 1991 and 1992, the Energy Balances were not published). For the year 1990, available data in natural units was converted into energy units (TJ) by using country specific NCVs. For the period 1991-1992, the data was reconstructed by the interpolation method based on the values available for the years 1990 and 1993. Additionally, for water-borne navigation and civil aviation, AD was used provided through official letters by the Ministry of Economy and Infrastructure, SOE 'Moldova Railways', SOE 'Molovata' Port, and the Civil Aeronautical Authority of the Republic of Moldova, respectively.

The main types of fuels within source category 1A3 'Transport' are aviation gasoline, gasoline, natural gases, liquefied petroleum gases, kerosene and other petroleum products. It was accepted that part of the diesel oil consumption in the agriculture sector is made on roads of national importance, and the largest share in agricultural fields (the ratio for 1990-1993 was 30% and 70%; and for the period 1994-2020, 10% and 90%). Fuel consumption on roads of national importance was considered in the estimation of GHG emissions from source category 1A3 'Transport', and fuel consumed by transport units in agricultural fields was considered in the estimation of GHG emissions from source category 1A4c 'Agriculture/forestry/fishing'.

Consumption of engine lubricants and greases, in accordance with the estimation methodologies available in the 2006 IPCC Guidelines, is included in Sector 2 'IPPU'.

1A3 'Transport'

1A3a Civil Aviation (1A3aii 'Domestic Aviation')

The civil aviation sector is represented by light aircraft and helicopters.

GHG emission trends in source category 1A3a 'Civil Aviation' (1A3aii 'Domestic Aviation')

Compared to the base year, emissions from this category decreased by circa 99.9% by 2020 (Table 3-69).

Table 3-69: Direct GHG emissions from source category 1A3a 'Civil Aviation' (1A3aii 'Domestic Aviation') and their share compared to the base year (1990)

	1990	1991	1992	1993	1994	1995	1996	1997
1A3a, kt CO_2 equivalent	72.96	55.22	37.49	19.75	19.94	20.09	20.21	20.30
%, compared to 1990	100	75.7	51.4	27.1	27.3	27.5	27.7	27.8
	1998	1999	2000	2001	2002	2003	2004	2005
1A3a, kt CO_2 equivalent	20.69	2.05	2.05	0.10	0.09	0.66	0.35	1.69
%, compared to 1990	28.4	2.8	2.8	0.1	0.1	0.9	0.5	2.3
	2006	2007	2008	2009	2010	2011	2012	2013
1A3a, kt CO_2 equivalent	0.20	1.06	0.15	0.08	0.35	0.07	0.14	0.20
%, compared to 1990	0.3	1.5	0.2	0.1	0.5	0.1	0.2	0.3
	2014	2015	2016	2017	2018	2019	2020	%
1A3a, kt CO_2 equivalent	0.14	0.31	0.23	0.59	0.15	0.29	0.07	-99.9
%, compared to 1990	0.7	1.5	1.1	2.9	0.7	1.4	0.3	

Direct and indirect GHG emissions between 1990-2020 from source category 1A3a 'Civil Aviation' (1A3aii 'Domestic Aviation') are shown in Table 3-70.

Table 3-70: Direct and indirect GHG emissions from source category 1A3a 'Civil Aviation' (1A3aii 'Domestic Aviation') and their share compared to the level in the base year (1990)

	1A3a, kt							%, compared to 1990						
	CO_2	CH_4	N_2O	NO_x	CO	NMVOC	SO_x	CO_2	CH_4	N_2O	NO_x	CO	NMVOC	SO_x
1990	72.3324	0.0005	0.0021	0.0001	0.0284	0.0004	0.0000	100.0	100.0	100.0	100.0	100.0	100.0	100.0
1991	54.7486	0.0004	0.0016	0.0001	0.0215	0.0003	0.0000	75.7	75.7	75.7	75.7	75.7	75.7	75.7
1992	37.1649	0.0003	0.0011	0.0000	0.0146	0.0002	0.0000	51.4	51.4	51.4	51.4	51.4	51.4	51.4
1993	19.5811	0.0001	0.0006	0.0000	0.0077	0.0001	0.0000	27.1	27.1	27.1	27.1	27.1	27.1	27.1
1994	19.7669	0.0001	0.0006	0.0000	0.0078	0.0001	0.0000	27.3	27.3	27.3	27.3	27.3	27.3	27.3
1995	19.9155	0.0001	0.0006	0.0000	0.0078	0.0001	0.0000	27.5	27.5	27.5	27.5	27.5	27.5	27.5
1996	20.0344	0.0001	0.0006	0.0000	0.0079	0.0001	0.0000	27.7	27.7	27.7	27.7	27.7	27.7	27.7
1997	20.1295	0.0001	0.0006	0.0000	0.0079	0.0001	0.0000	27.8	27.8	27.8	27.8	27.8	27.8	27.8
1998	20.5100	0.0001	0.0006	0.0000	0.0081	0.0001	0.0000	28.4	28.4	28.4	28.4	28.4	28.4	28.4
1999	2.0300	0.0000	0.0001	0.0000	0.0008	0.0000	0.0000	2.8	2.8	2.8	2.8	2.8	2.8	2.8
2000	2.0300	0.0000	0.0001	0.0000	0.0008	0.0000	0.0000	2.8	2.8	2.8	2.8	2.8	2.8	2.8
2001	0.0982	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.1	0.1	0.1	0.1	0.1	0.1	0.1

	1A3a, kt							%, compared to 1990						
	CO_2	CH_4	N_2O	NO_x	CO	NMVOC	SO_x	CO_2	CH_4	N_2O	NO_x	CO	NMVOC	SO_x
2002	0.0849	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.1	0.1	0.1	0.1	0.1	0.1	0.1
2003	0.6558	0.0000	0.0000	0.0000	0.0003	0.0000	0.0000	0.9	0.9	0.9	0.9	0.9	0.9	0.9
2004	0.3500	0.0000	0.0000	0.0000	0.0001	0.0000	0.0000	0.5	0.5	0.5	0.5	0.5	0.5	0.5
2005	1.6800	0.0000	0.0000	0.0000	0.0007	0.0000	0.0000	2.3	2.3	2.3	2.3	2.3	2.3	2.3
2006	0.1972	0.0000	0.0000	0.0000	0.0001	0.0000	0.0000	0.3	0.3	0.3	0.3	0.3	0.3	0.3
2007	1.0500	0.0000	0.0000	0.0000	0.0004	0.0000	0.0000	1.5	1.5	1.5	1.5	1.5	1.5	1.5
2008	0.1515	0.0000	0.0000	0.0000	0.0001	0.0000	0.0000	0.2	0.2	0.2	0.2	0.2	0.2	0.2
2009	0.0760	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.1	0.1	0.1	0.1	0.1	0.1	0.1
2010	0.3500	0.0000	0.0000	0.0000	0.0001	0.0000	0.0000	0.5	0.5	0.5	0.5	0.5	0.5	0.5
2011	0.0700	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.1	0.1	0.1	0.1	0.1	0.1	0.1
2012	0.1400	0.0000	0.0000	0.0000	0.0001	0.0000	0.0000	0.2	0.2	0.2	0.2	0.2	0.2	0.2
2013	0.1965	0.0000	0.0000	0.0000	0.0001	0.0000	0.0000	0.3	0.3	0.3	0.3	0.3	0.3	0.3
2014	0.1400	0.0000	0.0000	0.0000	0.0001	0.0000	0.0000	0.2	0.2	0.2	0.2	0.2	0.2	0.2
2015	0.3113	0.0000	0.0000	0.0000	0.0001	0.0000	0.0000	0.4	0.4	0.4	0.4	0.4	0.4	0.4
2016	0.2301	0.0000	0.0000	0.0000	0.0001	0.0000	0.0000	0.3	0.3	0.3	0.3	0.3	0.3	0.3
2017	0.5868	0.0000	0.0000	0.0000	0.0002	0.0000	0.0000	0.8	0.8	0.8	0.8	0.8	0.8	0.8
2018	0.1535	0.0000	0.0000	0.0000	0.0001	0.0000	0.0000	0.2	0.2	0.2	0.2	0.2	0.2	0.2
2019	0.2835	0.0000	0.0000	0.0000	0.0001	0.0000	0.0000	0.4	0.4	0.4	0.4	0.4	0.4	0.4
2020	0.0700	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.1	0.1	0.1	0.1	0.1	0.1	0.1

Direct GHG emissions and the contribution of each gas in the share of total emissions from the respective source between 1990-2020 are shown in Table 3-71.

Table 3-71: Direct GHG emissions from source category 1A3a 'Civil Aviation' (1A3aii 'Domestic Aviation') and the share of each GHG of the total

	1A3a, kt CO_2 equivalent				Share of total, %		
	CO_2	CH_4	N_2O	Total	CO_2	CH_4	N_2O
1990	72.33	0.01	0.62	72.96	99.1	0.0	0.8
1991	54.75	0.01	0.47	55.22	99.1	0.0	0.8
1992	37.16	0.01	0.32	37.49	99.1	0.0	0.8
1993	19.58	0.00	0.17	19.75	99.1	0.0	0.8
1994	19.77	0.00	0.17	19.94	99.1	0.0	0.8
1995	19.92	0.00	0.17	20.09	99.1	0.0	0.8
1996	20.03	0.00	0.17	20.21	99.1	0.0	0.8
1997	20.13	0.00	0.17	20.30	99.1	0.0	0.8
1998	20.51	0.00	0.17	20.69	99.1	0.0	0.8
1999	2.03	0.00	0.02	2.05	99.1	0.0	0.8
2000	2.03	0.00	0.02	2.05	99.1	0.0	0.8
2001	0.10	0.00	0.00	0.10	99.1	0.0	0.8
2002	0.08	0.00	0.00	0.09	99.1	0.0	0.8
2003	0.66	0.00	0.01	0.66	99.1	0.0	0.8
2004	0.35	0.00	0.00	0.35	99.1	0.0	0.8
2005	1.68	0.00	0.01	1.69	99.1	0.0	0.8
2006	0.20	0.00	0.00	0.20	99.1	0.0	0.8
2007	1.05	0.00	0.01	1.06	99.1	0.0	0.8
2008	0.15	0.00	0.00	0.15	99.1	0.0	0.8
2009	0.08	0.00	0.00	0.08	99.1	0.0	0.8
2010	0.35	0.00	0.00	0.35	99.1	0.0	0.8
2011	0.07	0.00	0.00	0.07	99.1	0.0	0.8
2012	0.14	0.00	0.00	0.14	99.1	0.0	0.8
2013	0.20	0.00	0.00	0.20	99.1	0.0	0.8
2014	0.14	0.00	0.00	0.14	99.1	0.0	0.8
2015	0.31	0.00	0.00	0.31	99.1	0.0	0.8
2016	0.23	0.00	0.00	0.23	99.1	0.0	0.8
2017	0.59	0.00	0.00	0.59	99.1	0.0	0.8
2018	0.15	0.00	0.00	0.15	99.1	0.0	0.8
2019	0.28	0.00	0.00	0.29	99.1	0.0	0.8
2020	0.07	0.00	0.00	0.07	99.1	0.0	0.8

Methodological Issues, Emission Factor and Activity Data

Direct GHG emissions were estimated following a Tier 1 methodology. EFs are available in the 2006 IPCC Guidelines, whereas in order to estimate non-CO_2 emissions, default EFs were used, available in the EMEP/EEA Air Pollutant Emission Inventory (2019) (Table 3-72).

Table 3-72: Emission factors utilised for the estimation of GHG emissions from source category 1A3a 'Civil Aviation' (1A3aii 'Domestic Aviation')

Fuel type	Emission Factor						
	kg/TJ			kg/t fuel			
	CO_2	CH_4	N_2O	NO_x	CO	NMVOC	SO_x
Aviation gasoline	70,000	0.5	2	4	1,200	19	1
References:	2006 IPCC Guidelines, Chapter 'Mobile Combustion'			EMEP/EEA Guidebook 2019, Category 1.A.3.a.			

Activity Data

Compared to the previous inventory cycle, the data series in the current one was completed with the 2020 values according to the data in the EBs of the RM and the emission factor was rectified from 69,300 to 70,000 kg/TJ for CO_2. All approaches used in the previous cycle have been applied, namely: aviation fuels found in the EBs of the RM in source categories 1A2 and 1A3b have been reallocated to source category 1A3a; activity data for three time series 1991-1992, 1994-1997 and 1999-2000 were restored by the interpolation method.

In the EBs of the RM, aviation gasoline values in chapter 'Aviation' are available only for the years 1990, 1993, 1998 and 2020. Therefore, AD was collected by official letters requested from the Civil Aeronautical Authority in the previous inventory cycles, but such information could only be collected only for the period 2001-2020.

The following approaches have been applied in order to restore the time series for this category:

- Recommendations were received from the international expert on the reallocation of fuels that could be used in domestic aviation (kerosene, jet fuel, fuel for engines, aviation gasoline) from source category 1A2 to source category 1A3a – the recommendation has been implemented;
- In accordance with the EBs of the RM published between 1990 and 1999, aviation gasoline consumption existed only in 1990, 1993 and 1998; based on these values, the activity data for the years 1991-1992 and 1994-1997 was restored by interpolation;
- For the years 2001-2019, the activity data is available from the official letters provided by the Civil Aeronautical Authority of the RM;
- For the period 2001-2019, in EBs of the RM, in category 1A2, aviation fuel consumption was detected for the years 2004-2005, 2010, and 2014, which was reallocated to source category 1A3a;
- Similarly, fuels such as kerosene (1999, 2000, 2005, 2007, 2010, 2011) and 'Other Petroleum Products' (2010 and 2012), previously allocated to category 1A3b 'Road Transportation', were reallocated to source category 1A3a 'Civil Aviation' (Table 3-73).

Table 3-73: Activity data associated with the consumption of aviation fuel, available in the EBs reallocated to source category 1A3a 'Civil Aviation' from source categories 1A2 and 1A3b, TJ

	Activity data associated with fuel consumption reallocated to source category 1A3a 'Civil Aviation'								
	From source category 1A2 'Manufacturing Industries and Construction'					From source category 1A3b 'Road Transportation' and 1A3e 'Other Transportation'			
	Aviation Gasoline	Jet Fuel	Kerosene	Fuel for engines	Total, TJ	1A3b Kerosene	1A3b Other Petroleum Products	1A3eii Kerosene	Total, TJ
1990		299	647		946				
1991		121	494		615				
1992		73	341		414				
1993	12	27	191		230	15		26	41
1994			29		29				
1998			29	264	293				
1999								29	29
2000								29	29
2004			5		5				
2005			10		10	14			14
2007						3		12	15
2010			1		1	3	1		4
2011						1			1
2012							2		2
2014				2	2				

Based on the above-mentioned, fuel consumption has been restored for source category 1A3a 'Civil Aviation' (1A3aii 'Domestic Aviation') (Table 3-74).

Table 3-74: Fuel consumption for source category 1A3a 'Civil Aviation' (1A3aii 'Domestic Aviation') between 1990-2020, TJ

	1990	1991	1992	1993	1994	1995	1996	1997
Aviation Gasoline	87	61	35	9				
Reallocated data from category 1A2	946	615	414	230	29			
Reallocated data from category 1A3b				41				
Total	**1,033**	**782**	**531**	**280**	**282**	**285**	**286**	**288**
	1998	1999	2000	2001	2002	2003	2004	2005
Aviation Gasoline				1	1	9	6	2
Reallocated data from category 1A2	293						5	10
Reallocated data from category 1A3b		29	29					14
Total	**293**	**29**	**29**	**1**	**1**	**9**	**11**	**26**
	2006	2007	2008	2009	2010	2011	2012	2013
Aviation Gasoline	3	2	2	1	2	2	3	3
Reallocated data from category 1A2					1			
Reallocated data from category 1A3b		15			4	1	2	
Total	**3**	**17**	**2**	**1**	**7**	**3**	**5**	**3**
	2014	2015	2016	2017	2018	2019	2020	%
Aviation Gasoline	2	4	3	8	2	4	**1**	-99.9
Reallocated data from category 1A2	2							
Reallocated data from category 1A3b								
Total	**4**	**4**	**3**	**8**	**2**	**4**	**1**	**-99.9**

The data collected through official letters from the Civil Aeronautical Authority for 1A3a 'Civil Aviation' (1A3aii 'Domestic Aviation') for the period 2001-2020 is presented in Table 3-75.

Table 3-75: Data associated with aviation gasoline, collected through official letters from the Civil Aeronautical Authority for the period 2001-2020

	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
1A3a, kt	0.0321	0.0278	0.2146	0.1352	0.0369	0.0645	0.0411	0.0496	0.0249	0.0383
1A3a, TJ	1.4022	1.2133	9.3684	5.9030	1.6105	2.8173	1.7957	2.1643	1.0854	1.6704
	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
1A3a, kt	0.0395	0.0676	0.0643	0.0390	0.1019	0.0753	0.1900	0.0502	0.0927	0.0230
1A3a, TJ	1.7246	2.9514	2.8073	1.7027	4.4468	3.2876	8.1947	2.1930	4.0490	1.0000

Recalculations

In the current inventory cycle, a number of measures have been taken in order to improve the quality of the national GHG inventory, as a result of which it was necessary to recalculate GHG emissions from source category 1A3a 'Civil Aviation' (1A3aii 'Domestic Aviation').

The main causes for these recalculations are the rectification of the emission factor from 69,300 to 70,000 kg/TJ for CO_2. Compared to the base year, emissions from this source category decreased by circa 99.9% by 2020.

Table 3-76: Recalculation results of GHG emissions from source category 1A3a 'Civil Aviation' included in the BUR3 of the RM to the UNFCCC (2020) for the period 1990-2020, kt CO_2 equivalent

	1990	1991	1992	1993	1994	1995	1996	1997
BUR3	72.2379	54.6771	37.1163	19.5555	19.7410	19.8895	20.0082	20.1032
NC5	72.9612	55.2246	37.4879	19.7513	19.9387	20.0886	20.2086	20.3045
Difference, %	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
	1998	1999	2000	2001	2002	2003	2004	2005
BUR3	20.4832	2.0273	2.0273	0.0980	0.0848	0.6549	0.3495	1.6778
NC5	20.6883	2.0476	2.0476	0.0990	0.0857	0.6615	0.3530	1.6946
Difference, %	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
	2006	2007	2008	2009	2010	2011	2012	2013
BUR3	0.1970	1.0486	0.1513	0.0759	0.3495	0.0699	0.1398	0.1963
NC5	0.1989	1.0591	0.1528	0.0766	0.3530	0.0706	0.1412	0.1982
Difference, %	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
	2014	2015	2016	2017	2018	2019	2020	%
BUR3	0.1398	0.3109	0.2298	0.5860	0.1533	0.2831		
NC5	0.1412	0.3140	0.2321	0.5919	0.1548	0.2859	0.0706	-99.9
Difference, %	1.0	1.0	1.0	1.0	1.0	1.0		

Planned Improvements

Primary data from two sources are used for the calculations, which creates an inconsistency. This disagreement is currently difficult to eliminate. It may be corrected when the complete data series for domestic aviation appears in the EBs, as well as when making an effort to recalculate the numerical values related to fuel consumption for domestic aviation from the EBs of the RM by the NBS.

'Road Transportation'

The categories of vehicles considered under source 1A3b 'Road Transportation' include the following means of transportation:

1A3bi Cars (M1):

1A3b i 1 – Passenger cars with 3-way catalysts

1A3b i 2 – Passenger cars without 3-way catalysts

1A3bii Light duty trucks (N1):

1A3b ii 1 – Light duty trucks with 3-way catalysts

1A3b ii 2 – Light duty trucks without 3-way catalysts

1A3b iii Heavy duty trucks (N2-N3) and buses (M2-M3)

1A3b iv Motorcycles (L1-L7) weighing less than 680

GHG emission trends in source category 1A3b 'Road Transportation'

Aggregated direct GHG emissions from source category 1A3b 'Road Transportation' had decreased between 1990 and 2020 by circa 41.1% (Table 3-77).

Table 3-77: Direct GHG emissions from source category 1A3b 'Road Transportation' between 1990-2020 and their share compared to the base year (1990)

	1990	1991	1992	1993	1994	1995	1996	1997
1A3b, kt CO_2 equivalent	4,204.86	3,239.60	2,274.32	1,572.69	1,410.74	1,432.96	1,354.12	1,386.74
%, compared to 1990	100	77.0	54.1	37.4	33.6	34.1	32.2	33.0
	1998	1999	2000	2001	2002	2003	2004	2005
1A3b, kt CO_2 equivalent	1,254.48	833.10	931.31	1,029.59	1,312.70	1,549.37	1,717.89	1,733.93
%, compared to 1990	29.8	19.8	22.1	24.5	31.2	36.8	40.9	41.2
	2006	2007	2008	2009	2010	2011	2012	2013
1A3b, kt CO_2 equivalent	1,666.57	1,776.11	1,889.38	1,894.84	2,112.16	2,241.84	1,954.80	2,093.44
%, compared to 1990	39.6	42.2	44.9	45.1	50.2	53.3	46.5	49.8
	2014	2015	2016	2017	2018	2019	2020	%
1A3b, kt CO_2 equivalent	2,157.63	2,260.49	2,410.33	2,438.36	2539.14	2,618.72	2,478.40	-41.1
%, compared to 1990	51.3	53.8	57.3	58.0	60.4	62.3	58.9	

Direct and indirect GHG emissions from source category 1A3b 'Road Transportation' had decreased significantly between 1990 and 2020. In 2020, emissions of CO_2 constituted 59.1% compared to the level in 1990, whereas emissions of CH_4 – 32.6%; N_2O – 61.5%; NO_x – 66.8%; CO – 26.4%; NMVOC – 28.3%; and SO_x – 0.8% of the base year level (Table 3-78).

Table 3-78: Direct and indirect GHG emissions from source category 1A3b 'Road Transportation' compared to the level in the base year (1990)

	1A3b, kt							%, compared to 1990						
	CO_2	CH_4	N_2O	NO_x	CO	NMVOC	SO_x	CO_2	CH_4	N_2O	NO_x	CO	NMVOC	SO_x
1990	4,112.3462	1.3202	0.1997	14.0495	69.4192	8.4388	0.6806	100.0	100.0	100.0	100.0	100.0	100.0	100.0
1991	3,168.4585	1.0125	0.1538	10.8163	52.6919	6.4080	0.5267	77.0	76.7	77.0	77.0	75.9	75.9	77.4
1992	2,224.5569	0.7049	0.1079	7.6675	36.2354	4.4188	0.3728	54.1	53.4	54.0	54.6	52.2	52.4	54.8
1993	1,538.5798	0.4769	0.0744	5.3306	23.6776	2.9040	0.2543	37.4	36.1	37.3	37.9	34.1	34.4	37.4
1994	1,380.0873	0.4292	0.0668	4.1136	21.9171	2.6637	0.1891	33.6	32.5	33.5	29.3	31.6	31.6	27.8
1995	1,401.7612	0.4374	0.0680	4.4280	22.9950	2.7889	0.2084	34.1	33.1	34.1	31.5	33.1	33.0	30.6
1996	1,324.4333	0.4233	0.0641	4.2140	21.9055	2.6555	0.1954	32.2	32.1	32.1	30.0	31.6	31.5	28.7
1997	1,357.1694	0.3952	0.0661	4.5148	24.1637	2.9204	0.2089	33.0	29.9	33.1	32.1	34.8	34.6	30.7
1998	1,226.8853	0.3989	0.0591	3.9117	21.1185	2.5514	0.1788	29.8	30.2	29.6	27.8	30.4	30.2	26.3
1999	815.2586	0.2446	0.0394	2.7392	12.3912	1.5088	0.1281	19.8	18.5	19.7	19.5	17.8	17.9	18.8
2000	911.8524	0.2494	0.0444	3.1202	12.3106	1.5048	0.1514	22.2	18.9	22.2	22.2	17.7	17.8	22.2
2001	1,008.2244	0.2644	0.0495	3.3792	13.1832	1.6088	0.1262	24.5	20.0	24.8	24.1	19.0	19.1	18.5

	1A3b, kt							%, compared to 1990						
	CO_2	CH_4	N_2O	NO_x	CO	NMVOC	SO_x	CO_2	CH_4	N_2O	NO_x	CO	NMVOC	SO_x
2002	1,285.4781	0.3365	0.0631	4.2122	16.9911	2.0728	0.1575	31.3	25.5	31.6	30.0	24.5	24.6	23.1
2003	1,517.2708	0.3973	0.0744	5.3531	20.4890	2.5242	0.2024	36.9	30.1	37.3	38.1	29.5	29.9	29.7
2004	1,682.5044	0.4270	0.0829	6.0728	22.1785	2.7341	0.2344	40.9	32.3	41.5	43.2	31.9	32.4	34.4
2005	1,698.1445	0.4344	0.0836	6.1126	22.5709	2.7807	0.0427	41.3	32.9	41.9	43.5	32.5	33.0	6.3
2006	1,632.5243	0.4001	0.0807	5.7813	20.6797	2.5600	0.0409	39.7	30.3	40.4	41.1	29.8	30.3	6.0
2007	1,739.9570	0.4216	0.0860	6.2324	21.3936	2.6573	0.0436	42.3	31.9	43.0	44.4	30.8	31.5	6.4
2008	1,851.1078	0.4458	0.0910	6.7279	22.4055	2.7999	0.0461	45.0	33.8	45.6	47.9	32.3	33.2	6.8
2009	1,856.2592	0.4544	0.0914	6.6480	22.4255	2.7962	0.0043	45.1	34.4	45.8	47.3	32.3	33.1	0.6
2010	2,069.9797	0.4675	0.1023	7.8668	22.0908	2.8018	0.0048	50.3	35.4	51.2	56.0	31.8	33.2	0.7
2011	2,197.5929	0.4655	0.1094	8.2831	22.7690	2.8800	0.0052	53.4	35.3	54.8	59.0	32.8	34.1	0.8
2012	1,916.4223	0.4016	0.0951	7.3317	19.1151	2.4420	0.0044	46.6	30.4	47.6	52.2	27.5	28.9	0.7
2013	2,052.7538	0.4065	0.1024	7.8501	18.6917	2.4043	0.0046	49.9	30.8	51.3	55.9	26.9	28.5	0.7
2014	2,115.9635	0.4049	0.1058	7.9433	18.5506	2.3885	0.0047	51.5	30.7	53.0	56.5	26.7	28.3	0.7
2015	2,216.7708	0.4267	0.1109	8.4436	19.1036	2.4609	0.0048	53.9	32.3	55.5	60.1	27.5	29.2	0.7
2016	2,362.5871	0.4935	0.1188	9.0276	19.4727	2.5063	0.0051	57.5	37.4	59.5	64.3	28.1	29.7	0.7
2017	2,390.4768	0.4811	0.1203	9.1302	18.9050	2.4440	0.0051	58.1	36.4	60.3	65.0	27.2	29.0	0.7
2018	2,489.2483	0.5008	0.1254	9.4194	19.8120	2.5516	0.0053	60.5	37.9	62.8	67.0	28.5	30.2	0.8
2019	2,567.7380	0.4964	0.1294	9.6891	20.4725	2.6392	0.0055	62.4	37.6	64.8	69.0	29.5	31.3	0.8
2020	2,430.9715	0.4338	0.1228	9.3853	18.3260	2.3852	0.0053	59.1	32.9	61.5	66.8	26.4	28.3	0.8

Between 1990 and 2020, the share of CO_2 emissions in the structure of direct GHG emissions in 1A3b at source category level varied between 97.80% and 98.09% of the total, whereas emissions of CH_4 – between 0.49% and 0.78% of the total, N_2O – between 1.42% and 1.48% of the total (Table 3-79).

Table 3-79: Direct GHG emissions from source category 1A3b 'Road Transportation' and their share in the total structure at source category level

	1A3b, kt CO_2 equivalent				Share, % of total		
	CO_2	CH_4	N_2O	Total	CO_2	CH_4	N_2O
1990	4,112.35	33.00	59.51	4,204.86	97.80	0.78	1.42
1991	3,168.46	25.31	45.83	3,239.60	97.80	0.78	1.41
1992	2,224.56	17.62	32.14	2,274.32	97.81	0.77	1.41
1993	1,538.58	11.92	22.18	1572.69	97.83	0.76	1.41
1994	1,380.09	10.73	19.92	1,410.74	97.83	0.76	1.41
1995	1,401.76	10.94	20.27	1,432.96	97.82	0.76	1.41
1996	1,324.43	10.58	19.11	1,354.12	97.81	0.78	1.41
1997	1,357.17	9.88	19.69	1,386.74	97.87	0.71	1.42
1998	1,226.89	9.97	17.62	1,254.48	97.80	0.80	1.40
1999	815.26	6.12	11.73	833.10	97.86	0.73	1.41
2000	911.85	6.23	13.22	931.31	97.91	0.67	1.42
2001	1,008.22	6.61	14.76	1,029.59	97.92	0.64	1.43
2002	1,285.48	8.41	18.81	1,312.70	97.93	0.64	1.43
2003	1,517.27	9.93	22.17	1,549.37	97.93	0.64	1.43
2004	1,682.50	10.67	24.71	1,717.89	97.94	0.62	1.44
2005	1,698.14	10.86	24.92	1,733.93	97.94	0.63	1.44
2006	1,632.52	10.00	24.04	1,666.57	97.96	0.60	1.44
2007	1,739.96	10.54	25.62	1,776.11	97.96	0.59	1.44
2008	1,851.11	11.14	27.13	1,889.38	97.97	0.59	1.44
2009	1,856.26	11.36	27.23	1,894.84	97.96	0.60	1.44
2010	2,069.98	11.69	30.49	2,112.16	98.00	0.55	1.44
2011	2,197.59	11.64	32.61	2,241.84	98.03	0.52	1.45
2012	1,916.42	10.04	28.34	1,954.80	98.04	0.51	1.45
2013	2,052.75	10.16	30.53	2,093.44	98.06	0.49	1.46
2014	2,115.96	10.12	31.54	2,157.63	98.07	0.47	1.46
2015	2,216.77	10.67	33.05	2,260.49	98.07	0.47	1.46
2016	2,362.59	12.34	35.41	2,410.33	98.02	0.51	1.47
2017	2,390.48	12.03	35.86	2,438.36	98.04	0.49	1.47
2018	2,489.25	12.52	37.38	2,539.14	98.03	0.49	1.47
2019	2,567.74	12.41	38.57	2,618.72	98.05	0.47	1.47
2020	2,430.97	10.85	36.58	2,478.40	98.09	0.44	1.48

Methodological Issues, Emission Factors and Activity Data

GHG emissions from fuel consumption (gasoline, diesel oil, natural gas and liquefied petroleum gases) under category 1A3b 'Road Transportation' were estimated following a Tier 1 methodological approach (Equation 3.2.1, p. 3.12, 2006 IPCC Guidelines, Volume 1 'Mobile Combustion'):

$$Emissions = \Sigma\ [Fuel_a \bullet EF_a]$$

where:

Emissions – GHG emissions (kt);

Fuel $_a$ – fuel sold (TJ);

EF_a – emission factor (kg/TJ);

a – type of fuel (gasoline, diesel oil, natural gas, LPG, etc.).

Emission factors for direct greenhouse gases were taken from the 2006 IPCC Guidelines, and for indirect greenhouse gases from the EMEP/EEA Air Pollutant Emission Inventory (2019) (Table 3-80).

Table 3-80: EFs for direct and indirect GHG from source category 1A3b 'Road Transportation'

	CO_2	CH_4	N_2O	NO_x	CO	NMVOC	SO_x
	kg/TJ			kg/tone			kg/TJ
Gasoline	69,300	33.0	3.2	8.7	84.7	10.1	equation
Diesel Oil	74,100	3.9	3.9	13.0	3.3	0.7	equation
Natural Gas	56,100	92.0	3.0	13.0	5.7	0.3	
LPG	63,100	62.0	0.2	15.2	84.7	13.6	
References:	2006 IPCC Guidelines, Chapter 'Mobile Combustion'			EMEP/EEA Guidebook 2019, Chapter 1. A.3.b.i, 1.A.3.b.ii, 1.A.3.b.iii, 1.A.3.b.iv			

Activity Data

The main sources of data for source category 1A3b 'Road Transportation' for the territory on the RBDR are the EBs of the RM for the years 1990 and 1993-2020. Additionally, information received from JSC 'Moldovagaz' based on official letters from the Ministry of Environment and/or to the Environment Agency is used. For the territory on the LBDR, statistical data associated with fuel consumption are somewhat fragmentary. There is information associated with natural gas and liquefied gas consumption, according to the publications in the ATULBD's Communal Services Press Releases (available only for 2011-2020). Unfortunately, the information associated with the consumption of gasoline and diesel oil for source category 1A3b 'Road Transportation' for the LBDR is missing.

In the previous inventory cycle, fuel consumption for the territory on the Left Bank of the Dniester River was restored by taking into account the specific fuel consumption per capita on the Right Bank of the Dniester River. The same approach was applied in the current inventory cycle, but the availability of updated information regarding the population of the RM because of the recent recalculation of population census results conducted in 2014 was taken into account, as well as information updates in statistical editions for the year 2021, for the LBDR (Table 3-81).

Table 3-81: Population, presented separately for the RBDR and LBDR for the period 1990-2020

	1990	1991	1992	1993	1994	1995	1996	1997
LBDR, thousand people	730.7	730.3	729.6	702.5	701.7	691.6	679.1	670.8
RBDR, thousand people	3,630.6	3,635.6	3,628.8	3,618.2	3,650.2	3,646.2	3,642.8	3,640.9
RM, thousand people	4,361.3	4,365.9	4,358.4	4,320.7	4,351.9	4,337.8	4,321.9	4,311.7
	1998	1999	2000	2001	2002	2003	2004	2005
LBDR, thousand people	665.7	660.0	651.8	642.5	633.6	623.8	554.4	547.5
RBDR, thousand people	3,655.0	3,649.3	3,643.5	3,634.5	3,627.2	3,617.7	3,606.8	3,533.0
RM, thousand people	4,320.7	4,309.3	4,295.3	4,277.0	4,260.8	4,241.5	4,161.2	4,080.5
	2006	2007	2008	2009	2010	2011	2012	2013
LBDR, thousand people	540.6	533.5	527.5	522.5	518.0	513.4	509.4	505.2
RBDR, thousand people	3,459.3	3,385.5	3,311.8	3,238.0	3,164.3	3,090.5	3,016.7	2,943.0
RM, thousand people	3,999.9	3,919.0	3,839.3	3,760.5	3,682.3	3,603.9	3,526.1	3,448.2
	2014	2015	2016	2017	2018	2019	2020	%
LBDR, thousand people	500.7	474.5	470.6	469.0	465.1	465.2	465.8	-36.3
RBDR, thousand people	2,869.2	2,844.7	2,824.4	2,780.0	2,730.4	2,686.1	2,643.9	-27.2
RM, thousand people	3,369.9	3,319.2	3,295.0	3,249.0	3,195.5	3,151.3	3,109.7	-28.7

Table 3-82: *Diesel oil* consumption in the RM within source category 1A3b 'Road Transportation', presented separately for the RBDR and LBDR

	1990	1991	1992	1993	1994	1995	1996	1997
RM: diesel oil, TJ*	22,419	17,555	12,691					
Specific consumption, MJ/per capita	5.1	4.0	2.9	2.2	1.9	1.8	1.7	2.0
RBDR: diesel oil, TJ	18,663	14,618	10,567	7,828	6,787	6,632	6,187	7,223
LBDR: diesel oil, TJ	3,756	2,936	2,125	1,520	1,305	1,258	1,153	1,331
RM: diesel oil, TJ	**22,419**	**17,555**	**12,691**	**9,348**	**8,092**	**7,890**	**7,340**	**8,554**

	1998	1999	2000	2001	2002	2003	2004	2005
Specific consumption, MJ/per capita	1.5	1.2	1.5	1.7	2.2	2.6	2.9	3.0
RBDR: diesel oil, TJ	5,440	4,291	5,437	6,190	7,907	9,297	10,579	10,766
LBDR: diesel oil, TJ	991	776	973	1,094	1,381	1,603	1,626	1,668
RM: diesel oil, TJ	**6,431**	**5,067**	**6,409**	**7,284**	**9,288**	**10,900**	**12,205**	**12,434**
	2006	2007	2008	2009	2010	2011	2012	2013
Specific consumption, MJ/per capita	3.1	3.5	3.8	3.9	4.8	5.4	4.9	5.6
RBDR: diesel oil, TJ	10,751	11,705	12,632	12,607	15,282	16,535	14,735	16,478
LBDR: diesel oil, TJ	1,680	1,845	2,012	2,034	2,502	2,747	2,488	2,829
RM: diesel oil, TJ	**12,431**	**13,550**	**14,643**	**14,641**	**17,783**	**19,282**	**17,223**	**19,306**
	2014	2015	2016	2017	2018	2019	2020	%
Specific consumption, MJ/per capita	6.0	6.4	6.9	7.2	7.6	8.0	7.9	53.6
RBDR: diesel oil, TJ	17,252	18,125	19,474	20,047	20,760	21,510	20,877	11.9
LBDR: diesel oil, TJ	3,011	3,023	3,245	3,382	3,536	3,725	3,678	-2.1
RM: diesel oil, TJ	**20,262**	**21,148**	**22,719**	**23,430**	**24,296**	**25,235**	**24,556**	**9.5**

Note: for the period 1990-1992, the informaion is aggregated for the entire country.

Table 3-83: *Gasoline* consumption in the RM within source category 1A3b 'Road Transportation', presented separately for the RBDR and LBDR

	1990	1991	1992	1993	1994	1995	1996	1997
RM: gasoline, TJ*	34,320	26,047	17,774					
Specific consumption, MJ/per capita	7.9	6.0	4.1	2.6	2.5	2.6	2.5	2.3
RBDR: gasoline, TJ	28,570	21,90	14,799	9,501	9,037	9,593	9,095	8,474
LBDR: gasoline, TJ	5,750	4, 57	2, 975	1, 845	1 ,737	1, 820	1, 696	1, 561
RM: gasoline, TJ	**34,320**	**26,047**	**17 ,774**	**11 ,346**	**10 ,774**	**11 ,413**	**10 ,791**	**10 ,035**
	1998	1999	2000	2001	2002	2003	2004	2005
Specific consumption, MJ/per capita	2.4	1.4	1.4	1.5	1.9	2.3	2.5	2.7
RBDR: gasoline, TJ	8,861	5,076	5,016	5,487	7,012	8,353	9,106	9,363
LBDR: gasoline, TJ	1,614	918	897	970	1,225	1,440	1,400	1,451
RM: gasoline, TJ	**10,475**	**5,994**	**5,913**	**6,457**	**8,237**	**9,793**	**10,506**	**10,814**
	2006	2007	2008	2009	2010	2011	2012	2013
Specific consumption, MJ/per capita	2.5	2.6	2.7	2.8	2.7	2.9	2.4	2.4
RBDR: gasoline, TJ	8,584	8,778	8,992	8,990	8,557	8,993	7,280	6,982
LBDR: gasoline, TJ	1,341	1,383	1,432	1,451	1,401	1,494	1,229	1,199
RM: gasoline, TJ	**9,925**	**10,161**	**10,424**	**10,441**	**9,958**	**10,487**	**8,509**	**8,181**
	2014	2015	2016	2017	2018	2019	2020	%
Specific consumption, MJ/per capita	2.4	2.5	2.6	2.5	2.7	2.8	2.6	-67.4
RBDR: gasoline, TJ	6,889	7,112	7,238	6,966	7,373	7,637	6,777	-76.3
LBDR: gasoline, TJ	1,202	1,186	1,206	1,175	1,256	1,323	1,194	-79.2
RM: diesel oil, **TJ**	**8,091**	**8,298**	**8,444**	**8,141**	**8,629**	**8,960**	**7,971**	-76.8

Note: for the period 1990-1992, the informaion is aggregated for the entire country.

Table 3-84: *Natural gas* consumption in the RM within source category 1A3b 'Road Transportation', presen-ted separately for the RBDR and LBDR

	1990	1991	1992	1993	1994	1995	1996	1997
RM, mln.m³	**13.0**	**9.5**	**9.1**	**13.7**	**8.5**	**7.6**	**10.6**	**11.1**
LBDR	3.9	3.1	2.6	1.9	1.2	0.8	1.1	0.6
RBDR	9.1	6.4	6.5	11.8	7.3	6.8	9.4	10.5
RM, TJ	**779**	**625**	**522**	**381**	**244**	**175**	**244**	**139**
LBDR	131	105	87	64	39	28	39	22
RBDR	648	520	435	317	205	147	205	117
	1998	1999	2000	2001	2002	2003	2004	2005
RM, mln.m³	**11.5**	**11.3**	**12.8**	**13.2**	**14.2**	**13.5**	**12.4**	**12.5**
LBDR	0.6	0.5	0.5	0.5	0.5	0.5	0.4	0.5
RBDR	10.9	10.8	12.3	12.7	13.7	13.0	12.0	12.0
RM, TJ	**138**	**104**	**104**	**104**	**120**	**103**	**102**	**115**
LBDR	21	16	16	16	18	15	15	16
RBDR	117	88	88	88	102	88	87	99
	2006	2007	2008	2009	2010	2011	2012	2013
RM, mln.m³	**2.3**	**3.5**	**7.5**	**13**	**8.9**	**3.8**	**4.2**	**5.2**
LBDR	0.3	0.5	0.4	4.1	6.9	1.8	2.2	3.2
RBDR	2.0	3.0	7.1	8.9	2.0	2.0	2.0	2.0
RM, TJ	**82**	**125**	**107**	**207**	**282**	**139**	**152**	**173**
LBDR	11	17	15	139	234	61	74	108
RBDR	71	108	92	68	48	78	78	65
	2014	2015	2016	2017	2018	2019	2020	%
RM, mln.m³	**6.8**	**17.0**	**29.0**	**26.0**	**28.0**	**22.0**	**23.0**	**76.9**
LBDR	4.8	5.0	5.0	5.0	5.0	5.0	6.0	53.8
RBDR	2.0	12.0	24.0	21.0	23.0	17.0	18.0	97.8
RM, TJ	**222**	**293**	**979**	**907**	**931**	**738**	**739**	**-5.1**
LBDR	163	169	169	169	169	169	169	29.0
RBDR	59	124	810	738	762	569	570	-12.0

Table 3-85: *Liquefied petroleum gas* consumption in the RM within source category 1A3b 'Road Transportation', presented separately for the RBDR and LBDR

	1990	1991	1992	1993	1994	1995	1996	1997
RM, kt	**13.00**	**9.00**	**9.00**	**10.09**	**7.10**	**4.74**	**4.84**	**3.59**
LBDR	1.68	1.58	1.53	1.69	1.10	0.74	0.84	0.95
RBDR	11.32	7.88	7.59	8.40	6.00	4.00	4.00	2.64
RM, TJ	**461**	**436**	**420**	**465**	**315**	**210**	**244**	**279**
LBDR	77	73	70	78	51	34	39	44
RBDR	383	363	349	387	264	176	205	235
	1998	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**
RM, kt	**3.48**	**3.31**	**2.49**	**1.51**	**2.17**	**7.11**	**5.89**	**5.85**
LBDR	0.82	0.93	1.04	0.69	0.88	1.11	0.89	0.85
RBDR	2.66	2.38	1.45	0.82	1.29	6.00	5.00	5.00
RM, TJ	**243**	**278**	**312**	**208**	**271**	**344**	**277**	**288**
LBDR	38	43	48	32	41	51	41	39
RBDR	205	235	264	176	230	293	236	249
	2006	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**
RM, kt	**5.76**	**7.03**	**11.66**	**11.63**	**15.14**	**10.96**	**13.79**	**13.71**
LBDR	0.76	1.03	1.66	1.63	2.14	0.96	0.79	0.71
RBDR	5.00	6.00	10.00	10.00	13.00	10.00	13.00	13.00
RM, TJ	**257**	**343**	**553**	**536**	**697**	**499**	**632**	**623**
LBDR	35	47	77	75	99	44	37	33
RBDR	222	296	476	461	598	455	595	590
	2014	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**%**
RM, kt	**13.56**	**14.54**	**13.66**	**13.37**	**12.40**	**12.42**	**13.53**	**4.0**
LBDR	0.56	0.54	0.66	0.37	0.40	0.42	0.53	-68.7
RBDR	13.00	14.00	13.00	13.00	12.00	12.00	13.00	14.8
RM, TJ	**613**	**654**	**575**	**604**	**566**	**555**	**560**	**21.5**
LBDR	26	25	30	17	18	20	24	-68.5
RBDR	587	629	545	587	548	535	536	39.9

Aggregated fuel consumption within source category 1A3b 'Road Transportation' between 1990 and 2020 is shown in energy units in Table 3-86.

Table 3-86: Aggregated fuel consumption within source category 1A3b 'Road Transportation' for the period 1990-2020, TJ

	RBDR				LBDR				Republic of Moldova				
	Gasoline	Diesel Oil	Natural Gas	LPG	Gasoline	Diesel Oil	Natural Gas	LPG	Gasoline	Diesel Oil	Natural Gas	LPG	Total
1990	28,568	18,661	648	383	5,752	3,757	130	77	34,320	22,419	779	461	57,978
1991	21,688	14,617	520	363	4,359	2,938	105	73	26,047	17,555	625	436	44,663
1992	14,796	10,565	392	343	2,978	2,126	79	69	17,774	12,691	471	412	31,348
1993	9,501	7,828	317	387	1,916	1,578	62	75	11,417	9,406	379	462	21,664
1994	9,037	6,787	205	264	1,739	1,306	39	51	10,776	8,093	244	315	19,429
1995	9,593	6,632	147	176	1,846	1,276	28	33	11,439	7,908	175	209	19,732
1996	9,095	6,187	205	205	1,727	1,175	38	38	10,822	7,362	243	243	18,670
1997	8,474	7,223	117	235	1,581	1347	22	43	10,055	8,570	139	278	19,042
1998	8,861	5,440	117	205	1,626	998	21	37	10,487	6,438	138	242	17,306
1999	5,076	4,291	88	235	926	783	16	43	6,002	5,074	104	278	11,457
2000	5,016	5,437	88	264	909	985	16	47	5,925	6,421	104	311	12,761
2001	5,487	6,190	88	176	984	1,110	16	31	6,471	7,300	103	207	14,081
2002	7,012	7,907	102	230	1,242	1,401	18	40	8,254	9,308	120	270	17,952
2003	8,353	9,297	88	293	1,463	1,628	15	51	9,816	10,925	103	344	21,188
2004	9,106	10,579	87	236	1,575	1,830	13	36	10,681	12,409	100	272	23,463
2005	9,363	10,766	99	249	1,469	1,689	15	39	10,832	12,455	114	288	23,689
2006	8,584	10,751	71	222	1,359	1,701	11	35	9,943	12,452	82	257	22,733
2007	8,778	11,705	108	296	1,402	1,869	17	47	10,180	13,575	125	343	24,222
2008	8,992	12,632	92	476	1,449	2,035	15	76	10,441	14,666	107	552	25,765
2009	8,990	12,607	68	461	1,465	2,054	139	74	10,455	14,661	207	535	25,858
2010	8,557	15,282	48	598	1,413	2,523	234	98	9,970	17,805	282	696	28,752
2011	8,993	16,535	78	455	1,507	2,771	61	44	10,500	19,307	139	499	30,445
2012	7,280	14,735	78	595	1,239	2,508	74	37	8,519	17,242	152	632	26,545
2013	6,982	16,478	65	590	1,209	2,852	176	33	8,191	19,330	241	623	28,384
2014	6,889	17,252	59	587	1,213	3,037	163	26	8,102	20,289	222	613	29,225
2015	7,112	18,125	124	629	1,252	3,190	169	25	8364	21,315	293	654	30,626
2016	7,238	19,474	810	545	1,216	3,272	169	30	8,454	22,746	979	575	32,755
2017	6,966	20,047	738	587	1,179	3,394	169	17	8,145	23,441	907	604	33,098
2018	7,373	20,760	762	548	1,266	3,566	169	18	8,639	24,326	931	566	34,463
2019	7,637	21,510	569	535	1,325	3,731	169	19	8,962	25,241	738	554	35,494
2020	6,777	20,877	293	500	1,194	3,678	169	24	7,971	24,556	462	524	33,513

Aggregated fuel consumption within source category 1A3b 'Road Transportation' between 1990 and 2020 is shown in natural units in Table 3-87.

Table 3-87: Aggregated fuel consumption within source category 1A3b 'Road Transportation' for the period 1990-2020, kt / mil. m³ (for natural gas)

	RBDR				LBDR				Republic of Moldova			
	Gasoline	Diesel Oil	Natural Gas	LPG	Gasoline	Diesel Oil	Natural Gas	LPG	Gasoline	Diesel Oil	Natural Gas	LPG
1990	653	439	9.1	11.3	132	88	3.9	1.7	785	527	13.0	13.0
1991	496	344	6.4	7.9	100	69	3.1	1.6	596	413	9.5	9.5
1992	338	248	6.6	7.4	68	50	2.3	1.5	407	298	8.9	8.9
1993	217	173	11.8	8.4	44	37	1.8	1.6	260	211	13.6	10.0
1994	206	104	7.3	6.0	40	31	1.2	1.1	246	135	8.5	7.1
1995	218	123	6.8	4.0	42	30	0.8	0.7	260	153	7.6	4.7
1996	208	115	9.4	4.0	39	28	1.1	0.8	247	142	10.5	4.8
1997	239	116	10.5	2.6	36	32	0.6	0.9	275	148	11.1	3.6
1998	203	101	10.9	2.7	37	23	0.6	0.8	240	124	11.5	3.5
1999	117	85	10.8	2.4	21	18	0.5	0.9	138	103	11.3	3.3
2000	116	110	12.3	1.5	21	23	0.5	1.0	137	133	12.8	2.5
2001	125	120	12.7	0.8	23	26	0.5	0.7	148	146	13.2	1.5
2002	162	147	13.7	1.3	28	33	0.5	0.9	190	180	14.2	2.2
2003	191	202	13.0	6.0	33	38	0.4	1.1	224	240	13.4	7.1
2004	208	242	12.0	5.0	36	43	0.4	0.8	244	285	12.4	5.8
2005	215	245	12.0	5.0	34	40	0.5	0.8	249	285	12.5	5.8
2006	196	244	2.0	5.0	31	40	0.3	0.8	227	284	2.3	5.8
2007	201	268	3.0	6.0	32	44	0.5	1.0	233	312	3.5	7.0
2008	206	289	7.1	10.0	33	48	0.4	1.6	239	337	7.5	11.6
2009	206	277	8.9	10.0	33	48	4.1	1.6	239	325	13.0	11.6
2010	196	367	2.0	13.0	32	59	6.9	2.1	228	427	8.9	15.1
2011	205	396	2.0	10.0	34	65	1.8	1.0	239	461	3.8	11.0
2012	167	355	2.0	13.0	28	59	2.2	0.8	195	414	4.2	13.8
2013	161	390	2.0	13.0	28	67	3.2	0.7	189	457	5.2	13.7
2014	159	393	2.0	13.0	28	71	4.8	0.6	187	464	6.8	13.6
2015	162	414	12.0	14.0	29	75	5.0	0.5	191	489	17.0	14.5
2016	166	444	24.0	13.0	28	77	5.0	0.7	194	521	29.0	13.7
2017	160	457	21.0	13.0	27	80	5.0	0.4	187	537	26.0	13.4
2018	169	467	23.0	12.0	29	84	5.0	0.4	198	551	28.0	12.4
2019	175	485	17.0	12.0	30	88	5.0	0.4	205	573	22.0	12.4
2020	154	490	9.0	11.0	27	84	5.0	0.5	181	574	14.0	11.5

Gasoline and diesel oil consumption allocated in the Energy Balances to source category 1A2 'Manufacturing Industries and Construction' has been reallocated to source category 1A3b 'Road Transportation' as they are consumed on national roads for transportation purposes (Table 3-88).

Table 3-88: Gasoline and diesel oil consumption reallocated from source category 1A2 'Manufacturing Industries and Construction' to category 1A3b 'Road Transportation'

	1990	1991	1992	1993	1994	1995	1996	1997
Gasoline, TJ	568	390	211	33	29	29	29	29
Diesel Oil, TJ	3,446	2,566	1,687	807	754	765	623	557
	1998	1999	2000	2001	2002	2003	2004	2005
Gasoline, TJ							16	23
Diesel Oil, TJ	353	205	205	205	205	205	287	322
	2006	2007	2008	2009	2010	2011	2012	2013
Gasoline, TJ	18	21	20	13	12	16	9	
Diesel Oil, TJ	366	328	324	217	271	270	291	313
	2014	2015	2016	2017	2018	2019	2020	%
Gasoline, TJ	11	14	16	12	13	8	7	-98.8
Diesel Oil, TJ	264	207	213	201	407	376	527	-84.7

Consumption of kerosene and other petroleum products has been reallocated from source category 1A3b 'Road Transportation' to source category 1A3a 'Civil Aviation' (Table 3-89)

Table 3-89: Consumption of kerosene and other petroleum products reallocated from source category 1A3b 'Road Transportation' to source category 1A3a 'Civil Aviation'

	1993	1999	2000	2005	2007	2010	2011	2012
Kerosene, TJ	41	29	29	14	15	3	1	
Other petroleum products, TJ						1		2

Recalculations

In the current inventory cycle, the insignificant recalculations of GHG emissions from source category 1A3b 'Road Transport' consisted of the correction of activity data associated with the updated population of the RM. Between 1990 and 2020, direct GHG emissions from the respective category decreased by about 41.1%.

Table 3-90: Recalculation results of GHG emissions from category 1A3b 'Road Transportation' included in the BUR3 of the RM to the UNFCCC (2021) for the period 1990-2020, kt CO_2 equivalent

	1990	1991	1992	1993	1994	1995	1996	1997
BUR3	4,204.8572	3,239.5975	2,274.3236	1,573.0160	1,410.7428	1,433.0203	1,354.2098	1,386.7893
NC5	4,204.8572	3,239.5975	2,274.3236	1,572.6876	1,410.7364	1,432.9646	1,354.1225	1,386.7388
Difference, %	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	1998	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**
BUR3	1,254.5081	833.1358	931.3613	1,029.6355	1,312.7527	1,549.4400	1,718.2850	1,733.9712
NC5	1,254.4799	833.1039	931.3112	1,029.5930	1,312.7013	1,549.3745	1,717.8919	1,733.9282
Difference, %	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	2006	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**
BUR3	1,666.6066	1,776.1668	1889.4471	1,894.8904	2,112.2159	2,241.8367	1,954.7978	2,093.4434
NC5	1,666.5695	1,776.1132	1,889.3814	1,894.8443	2,112.1609	2,241.8367	1,954.7978	2,093.4434
Difference, %	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	2014	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**%**
BUR3	2,157.6253	2,260.4866	2,410.3305	2,438.3632	2,539.1440	2,618.7522		
NC5	2,157.6253	2,260.4866	2,410.3305	2,438.3632	2,539.1440	2,618.7224	2,478.4017	-41.1
Difference, %	0.0	0.0	0.0	0.0	0.0	0.0		

1A3c 'Railways'

GHG emission trends from source category 1A3c 'Railways'

Aggregated direct GHG emissions from source category 1A3c 'Railways' had decreased between 1990 and 2020 by circa 95.3% (Table 3-91).

Table 3-91: Direct GHG emissions from source category 1A3c 'Railways' between 1990-2020 and their share compared to the base year (1990)

	1990	1991	1992	1993	1994	1995	1996	1997
1A3c, kt CO_2 equivalent	450.4461	398.1451	330.7604	305.9782	121.5340	107.1307	103.9447	89.3226
%, compared to 1990	100.0	88.4	73.4	67.9	27.0	23.8	23.1	19.8
	1998	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**
1A3c, kt CO_2 equivalent	66.0888	34.4317	37.2283	40.0201	91.1362	48.4132	66.9536	90.4439
%, compared to 1990	14.7	7.6	8.3	8.9	20.2	10.7	14.9	20.1
	2006	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**
1A3c, kt CO_2 equivalent	113.0672	113.7805	104.6019	57.2949	58.3140	53.8020	57.9864	37.1689
%, compared to 1990	25.1	25.3	23.2	12.7	12.9	11.9	12.9	8.3
	2014	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**%**
1A3c, kt CO_2 equivalent	3.1133	25.1001	52.3706	42.2714	22.8770	27.3825	21.2607	-95.3
%, compared to 1990	0.7	5.6	11.6	9.4	5.1	6.1	4.7	

Direct and indirect GHG emissions between 1990-2020 from source category 1A3c 'Railways' compared to the level in the base year (1990) are shown in Table 3-92.

Table 3-92: Direct and indirect GHG emissions from source category 1A3c 'Railways' and their share compared to the level in the base year (1990)

	1A3c, kt							%, compared to 1990						
	CO_2	CH_4	N_2O	NO_x	CO	NMVOC	SO_x	CO_2	CH_4	N_2O	NO_x	CO	NMVOC	SO_x
1990	403.4745	0.0226	0.1557	6.7071	1.3696	0.5952	0.1024	100.0	100.0	100.0	100.0	100.0	100.0	100.0
1991	356.6274	0.0200	0.1376	5.7352	1.1711	0.5089	0.0876	88.4	88.4	88.4	85.5	85.5	85.5	85.5
1992	296.2694	0.0166	0.1143	4.7633	0.9727	0.4227	0.0727	73.4	73.4	73.4	71.0	71.0	71.0	71.0
1993	274.0715	0.0153	0.1058	4.5560	0.9303	0.4043	0.0696	67.9	67.9	67.9	67.9	67.9	67.9	67.9
1994	108.8607	0.0061	0.0420	1.8096	0.3695	0.1606	0.0276	27.0	27.0	27.0	27.0	27.0	27.0	27.0
1995	95.9593	0.0054	0.0370	1.5952	0.3257	0.1416	0.0244	23.8	23.8	23.8	23.8	23.8	23.8	23.8
1996	93.1056	0.0052	0.0359	1.5477	0.3160	0.1373	0.0236	23.1	23.1	23.1	23.1	23.1	23.1	23.1
1997	80.0082	0.0045	0.0309	1.3300	0.2716	0.1180	0.0203	19.8	19.8	19.8	19.8	19.8	19.8	19.8
1998	59.1972	0.0033	0.0228	0.9840	0.2009	0.0873	0.0150	14.7	14.7	14.7	14.7	14.7	14.7	14.7
1999	30.8413	0.0017	0.0119	0.5127	0.1047	0.0455	0.0078	7.6	7.6	7.6	7.6	7.6	7.6	7.6
2000	33.3462	0.0019	0.0129	0.5543	0.1132	0.0492	0.0063	8.3	8.3	8.3	8.3	8.3	8.3	6.2

	1A3c, kt							%, compared to 1990						
	CO_2	CH_4	N_2O	NO_x	CO	NMVOC	SO_x	CO_2	CH_4	N_2O	NO_x	CO	NMVOC	SO_x
2001	35.8469	0.0020	0.0138	0.5959	0.1217	0.0529	0.0068	8.9	8.9	8.9	8.9	8.9	8.9	6.7
2002	81.6327	0.0046	0.0315	1.3570	0.2771	0.1204	0.0155	20.2	20.2	20.2	20.2	20.2	20.2	15.2
2003	43.3647	0.0024	0.0167	0.7209	0.1472	0.0640	0.0083	10.7	10.7	10.7	10.7	10.7	10.7	8.1
2004	59.9718	0.0034	0.0231	0.9969	0.2036	0.0885	0.0114	14.9	14.9	14.9	14.9	14.9	14.9	11.1
2005	81.0126	0.0045	0.0313	1.3467	0.2750	0.1195	0.0021	20.1	20.1	20.1	20.1	20.1	20.1	2.0
2006	101.2768	0.0057	0.0391	1.6835	0.3438	0.1494	0.0026	25.1	25.1	25.1	25.1	25.1	25.1	2.5
2007	101.9157	0.0057	0.0393	1.6942	0.3459	0.1503	0.0026	25.3	25.3	25.3	25.3	25.3	25.3	2.5
2008	93.6942	0.0052	0.0362	1.5575	0.3180	0.1382	0.0024	23.2	23.2	23.2	23.2	23.2	23.2	2.3
2009	51.3203	0.0029	0.0198	0.8531	0.1742	0.0757	0.0001	12.7	12.7	12.7	12.7	12.7	12.7	0.1
2010	52.2332	0.0029	0.0202	0.8683	0.1773	0.0771	0.0001	12.9	12.9	12.9	12.9	12.9	12.9	0.1
2011	48.1916	0.0027	0.0186	0.8011	0.1636	0.0711	0.0001	11.9	11.9	11.9	11.9	11.9	11.9	0.1
2012	51.9397	0.0029	0.0200	0.8634	0.1763	0.0766	0.0001	12.9	12.9	12.9	12.9	12.9	12.9	0.1
2013	33.2930	0.0019	0.0128	0.5534	0.1130	0.0491	0.0001	8.3	8.3	8.3	8.3	8.3	8.3	0.1
2014	2.7887	0.0002	0.0011	0.0464	0.0095	0.0041	0.0000	0.7	0.7	0.7	0.7	0.7	0.7	0.0
2015	22.4827	0.0013	0.0087	0.3737	0.0763	0.0332	0.0000	5.6	5.6	5.6	5.6	5.6	5.6	0.0
2016	46.9095	0.0026	0.0181	0.7789	0.1590	0.0691	0.0001	11.6	11.6	11.6	11.6	11.6	11.6	0.1
2017	37.8634	0.0021	0.0146	0.6291	0.1285	0.0558	0.0001	9.4	9.4	9.4	9.4	9.4	9.4	0.1
2018	20.4915	0.0011	0.0079	0.3402	0.0695	0.0302	0.0000	5.1	5.1	5.1	5.1	5.1	5.1	0.0
2019	24.5271	0.0014	0.0095	0.4271	0.0872	0.0379	0.0000	6.1	6.1	6.1	6.4	6.4	6.4	0.0
2020	19.0437	0.0011	0.0074	0.2994	0.0611	0.0266	0.0000	4.7	4.7	4.7	4.5	4.5	4.5	0.0

Direct GHG emission trend from source category 1A3c 'Railways' for the period 1990-2020 and the contribution of each direct GHG is shown in Table 3-93.

Table 3-93: Direct GHG emissions from source category 1A3c 'Railways' between 1990-2020 and the contribution of each gas in the structure of emissions at source category level

	1A3c, kt CO_2 equivalent				Share, % of total		
	CO_2	CH_4	N_2O	Total	CO_2	CH_4	N_2O
1990	403.4745	0.5649	46.4066	450.4461	89.6	0.1	10.3
1991	356.6274	0.4993	41.0184	398.1451	89.6	0.1	10.3
1992	296.2694	0.4148	34.0762	330.7604	89.6	0.1	10.3
1993	274.0715	0.3837	31.5230	305.9782	89.6	0.1	10.3
1994	108.8607	0.1524	12.5209	121.5340	89.6	0.1	10.3
1995	95.9593	0.1344	11.0370	107.1307	89.6	0.1	10.3
1996	93.1056	0.1304	10.7088	103.9447	89.6	0.1	10.3
1997	80.0082	0.1120	9.2023	89.3226	89.6	0.1	10.3
1998	59.1972	0.0829	6.8087	66.0888	89.6	0.1	10.3
1999	30.8413	0.0432	3.5473	34.4317	89.6	0.1	10.3
2000	33.3462	0.0467	3.8354	37.2283	89.6	0.1	10.3
2001	35.8469	0.0502	4.1230	40.0201	89.6	0.1	10.3
2002	81.6327	0.1143	9.3892	91.1362	89.6	0.1	10.3
2003	43.3647	0.0607	4.9877	48.4132	89.6	0.1	10.3
2004	59.9718	0.0840	6.8978	66.9536	89.6	0.1	10.3
2005	81.0126	0.1134	9.3179	90.4439	89.6	0.1	10.3
2006	101.2768	0.1418	11.6486	113.0672	89.6	0.1	10.3
2007	101.9157	0.1427	11.7221	113.7805	89.6	0.1	10.3
2008	93.6942	0.1312	10.7765	104.6019	89.6	0.1	10.3
2009	51.3203	0.0719	5.9027	57.2949	89.6	0.1	10.3
2010	52.2332	0.0731	6.0077	58.3140	89.6	0.1	10.3
2011	48.1916	0.0675	5.5429	53.8020	89.6	0.1	10.3
2012	51.9397	0.0727	5.9740	57.9864	89.6	0.1	10.3
2013	33.2930	0.0466	3.8293	37.1689	89.6	0.1	10.3
2014	2.7887	0.0039	0.3207	3.1133	89.6	0.1	10.3
2015	22.4827	0.0315	2.5859	25.1001	89.6	0.1	10.3
2016	46.9095	0.0657	5.3954	52.3706	89.6	0.1	10.3
2017	37.8634	0.0530	4.3550	42.2714	89.6	0.1	10.3
2018	20.4915	0.0287	2.3569	22.8770	89.6	0.1	10.3
2019	24.5271	0.0343	2.8210	27.3825	89.6	0.1	10.3
2020	19.0437	0.0267	2.1904	21.2607	89.6	0.1	10.3

Methodological Issues, Emission Factors and Activity Data

Direct GHG emissions originating from source category 1A3c 'Railways' were estimated following a Tier 1 methodology available in the 2006 IPCC Guidelines, based on AD on default emission factors. In order to estimate non-CO_2 emissions, default emission factors were used, available in the EMEP/EEA Guidebook (2019) (Table 3-94).

Table 3-94: Emission factors used to estimate GHG emissions from source category 1A3 'Railways'

Fuel Type	kg/TJ			kg/t			
	CO_2	CH_4	N_2O	NO_x	CO	NMVOC	SO_x
Diesel Oil	74,100	4.15	28.6	52.4	10.7	4.65	formula
References	2006 IPCC Guidelines, Chapter 1A 'Mobile Combustion' – CO_2, CH_4, Table 3.4.1, p. 3.43			EMEP/EEA Guidebook 2019, Chapter 1.A.3.c 'Railways', Table 3-1, p. 8			

Activity Data

Compared to the previous inventory cycle, the following changes occurred in the current cycle: the series of activity data was extended by another year (2020), and the data regarding the population of both the LBDR and RBDR has been updated.

For category 1A3c 'Railways', fuel consumption for the territory on the RBDR is available in the EBs of the RM. For the territory on the LBDR, fuel consumption was restored based on the specific consumption per capita on the RBDR (Table 3-95).

Table 3-95: Aggregated diesel oil consumption for source category 1A3c 'Railways' for the period 1990-2020, and separately for the RBDR and LBDR, TJ

	1990	1991	1992	1993	1994	1995	1996	1997
RBDR	4,349	3,877	3,220	3,078	1,232	1,086	1,056	910
LBDR	1,096	936	778	621	237	209	200	170
Total, RM	5,445	4,813	3,998	3,699	1,469	1,295	1,256	1,080
	1998	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**
RBDR	675	352	381	410	936	498	690	945
LBDR	124	64	69	74	166	87	119	148
Total, RM	799	416	450	484	1,102	585	809	1093
	2006	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**
RBDR	1,180	1,186	1,089	596	605	557	599	383
LBDR	187	189	175	97	100	93	102	66
Total, RM	1367	1375	1264	693	705	650	701	449
	2014	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**%**
RBDR	32	258	542	437	236	282	227	-94.8
LBDR	6	45	91	74	41	49	30	-97.3
Total, RM	38	303	633	511	277	331	257	-95.3

Calculation methodology of SO_2 emissions

SO_2 emissions have been calculated based on the estimation methodology available in the EMEP/EEA Air Pollutant Emission Inventory (2019) applying the following equation:

$$E_{SO2} = 2 \bullet k \bullet AD,$$

Where:

k - sulphur content in type m fuel [g/g fuel] (EMEP/EEA Guidebook 2019, source category 1A3bi, Table 3-13, p. 24), when:

- for the period 1990-1995 and 1996-2000, the value k – 165 / 1000000 grams of sulphur / grams of gasoline and k – 400 / 1000000 grams of sulphur / grams of diesel;
- for the period 2001-2005, the value k – 130 / 1000000 grams of sulphur / grams of gasoline and k – 300 / 1000000 grams of sulphur / grams of diesel;
- for the period 2006-2009, the value k – 40 / 1000000 grams of sulphur / grams of gasoline and k – 40 / 1000000 grams of sulphur / grams of diesel;
- for the period 2010-2019, the value k – 40 / 1000000 grams of sulphur / grams of gasoline and k – 8 /1000000 grams of sulphur / grams of diesel.

SO_2 emissions from source category 1A3c 'Railways' for the period 1990-2020, are shown on aggregate as well as separately for the RBDR and LBDR in Table 3-96.

Table 3-96: SO_2 emissions from source category 1A3c 'Railways' between 1990-2020, shown on aggregate as well as separately for the RBDR and LBDR, kt

	1990	1991	1992	1993	1994	1995	1996	1997
RBDR	0.0852	0.0729	0.0605	0.0579	0.0232	0.0204	0.0199	0.0171
LBDR	0.0172	0.0147	0.0122	0.0117	0.0045	0.0039	0.0038	0.0032
Total, RM	**0.1024**	**0.0876**	**0.0727**	**0.0696**	**0.0276**	**0.0244**	**0.0236**	**0.0203**

	1998	1999	2000	2001	2002	2003	2004	2005
RBDR	0.0127	0.0066	0.0054	0.0058	0.0132	0.0070	0.0097	0.0018
LBDR	0.0023	0.0012	0.0010	0.0010	0.0023	0.0012	0.0017	0.0003
Total, RM	**0.0150**	**0.0078**	**0.0063**	**0.0068**	**0.0155**	**0.0083**	**0.0114**	**0.0021**
	2006	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**
RBDR	0.0022	0.0022	0.0020	0.0001	0.0001	0.0001	0.0001	0.0001
LBDR	0.0004	0.0004	0.0003	0.0000	0.0000	0.0000	0.0000	0.0000
Total, RM	**0.0026**	**0.0026**	**0.0024**	**0.0001**	**0.0001**	**0.0001**	**0.0001**	**0.0001**
	2014	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**%**
RBDR	0.0000	0.0000	0.0001	0.0001	0.0000	0.0000	0.0000	-99.96
LBDR	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	-99.98
Total, RM	**0.0000**	**0.0000**	**0.0001**	**0.0001**	**0.0000**	**0.0000**	**0.0000**	**-99.97**

It should be noted that no recalculations of direct greenhouse gas emissions from source category 1A3c 'Railways' have been made in the current inventory cycle.

1A3d 'Water-borne Navigation'

GHG emission trends within source category 1A3d 'Water-borne Navigation'

Compared to the base year, emissions from this source category had decreased by circa 96.8% by 2020 (Table 3-97).

Table 3-97: Aggregated direct GHG emissions from source category 1A3d 'Water-borne Navigation' for the period 1990-2020 and their share compared to the base year level (1990), kt

	1990	1991	1992	1993	1994	1995	1996	1997
1A3d, kt CO_2 equivalent	19.1071	0.2907	0.2487	0.2870	0.2241	0.2165	0.2350	0.2532
%, compared to 1990	100.0	1.5	1.3	1.5	1.2	1.1	1.2	1.3
	1998	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**
1A3d, kt CO_2 equivalent	0.1583	0.2636	0.1166	0.2103	0.4874	0.4417	0.4483	0.2599
%, compared to 1990	0.8	1.4	0.6	1.1	2.6	2.3	2.3	1.4
	2006	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**
1A3d, kt CO_2 equivalent	0.3473	0.3477	0.3483	0.2617	0.2623	0.2628	0.2635	0.3473
%, compared to 1990	1.8	1.8	1.8	1.4	1.4	1.4	1.4	1.8
	2014	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**%**
1A3d, kt CO_2 equivalent	2.3774	2.4654	1.8364	1.7509	1.5792	1.8450	0.6151	-96.8
%, compared to 1990	12.4	12.9	9.6	9.2	8.3	9.7	3.2	

Direct and indirect GHG emissions from source category 1A3d 'Water-borne Navigation' for the period 1990-2020 compared to 1990 levels are shown in Table 3-98.

Table 3-98: Direct and indirect GHG emissions from source category 1A3d 'Water-borne Navigation' and their share compared to the level in the base year (1990)

	1A3d, kt							%, compared to 1990						
	CO_2	CH_4	N_2O	NO_x	CO	NMVOC	SO_x	CO_2	CH_4	N_2O	NO_x	CO	NMVOC	SO_x
1990	18.9103	0.0018	0.0005	0.0005	0.0000	0.0000	0.0001	100.0	100.0	100.0	100.0	100.0	100.0	100.0
1991	0.2877	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	1.52	1.52	1.52	1.52	1.52	1.52	1.52
1992	0.2461	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	1.30	1.30	1.30	1.30	1.30	1.30	1.30
1993	0.2841	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	1.50	1.50	1.50	1.50	1.50	1.50	1.50
1994	0.2218	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	1.17	1.17	1.17	1.17	1.17	1.17	1.17
1995	0.2143	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	1.13	1.13	1.13	1.13	1.13	1.13	1.13
1996	0.2325	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	1.23	1.23	1.23	1.23	1.23	1.23	1.23
1997	0.2506	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	1.33	1.33	1.33	1.33	1.33	1.33	1.33
1998	0.1567	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.83	0.83	0.83	0.83	0.83	0.83	0.83
1999	0.2609	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	1.38	1.38	1.38	1.38	1.38	1.38	1.38
2000	0.1154	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.61	0.61	0.61	0.61	0.61	0.61	0.61
2001	0.2082	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	1.10	1.10	1.10	1.10	1.10	1.10	1.10
2002	0.4824	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	2.55	2.55	2.55	2.55	2.55	2.55	2.55
2003	0.4371	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	2.31	2.31	2.31	2.31	2.31	2.31	2.31
2004	0.4437	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	2.35	2.35	2.35	2.35	2.35	2.35	2.35
2005	0.2572	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	1.36	1.36	1.36	1.36	1.36	1.36	1.36
2006	0.5150	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	2.72	2.72	2.72	2.72	2.72	2.72	2.72
2007	0.3437	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	1.82	1.82	1.82	1.82	1.82	1.82	1.82
2008	0.3441	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	1.82	1.82	1.82	1.82	1.82	1.82	1.82
2009	0.3447	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	1.82	1.82	1.82	1.82	1.82	1.82	1.82
2010	0.2590	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	1.37	1.37	1.37	1.37	1.37	1.37	1.37
2011	0.2596	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	1.37	1.37	1.37	1.37	1.37	1.37	1.37

	1A3d, kt							%, compared to 1990						
	CO_2	CH_4	N_2O	NO_x	CO	NMVOC	SO_x	CO_2	CH_4	N_2O	NO_x	CO	NMVOC	SO_x
2012	0.2601	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	1.38	1.38	1.38	1.38	1.38	1.38	1.38
2013	0.2608	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	1.38	1.38	1.38	1.38	1.38	1.38	1.38
2014	2.3529	0.0002	0.0001	0.0001	0.0000	0.0000	0.0000	12.44	12.44	12.44	12.44	12.44	12.44	12.44
2015	2.4400	0.0002	0.0001	0.0001	0.0000	0.0000	0.0000	12.90	12.90	12.90	12.90	12.90	12.90	12.90
2016	1.8175	0.0002	0.0000	0.0000	0.0000	0.0000	0.0000	9.61	9.61	9.61	9.61	9.61	9.61	9.61
2017	1.7329	0.0002	0.0000	0.0000	0.0000	0.0000	0.0000	9.16	9.16	9.16	9.16	9.16	9.16	9.16
2018	1.5629	0.0001	0.0000	0.0000	0.0000	0.0000	0.0000	8.26	8.26	8.26	8.26	8.26	8.26	8.26
2019	1.8260	0.0002	0.0000	0.0000	0.0000	0.0000	0.0000	9.66	9.66	9.66	9.66	9.66	9.66	9.66
2020	0.6088	0.0001	0.0000	0.0000	0.0000	0.0000	0.0000	3.22	3.22	3.22	3.22	3.22	3.22	3.22

Direct GHG emissions from source category 1A3d 'Water-borne Navigation' between 1990 and 2020 are shown in Table 3-99.

Table 3-99: Direct GHG emissions from source category 1A3d 'Water-borne Navigation' for the Republic of Moldova, kt CO_2 equivalent

	1990	1991	1992	1993	1994	1995	1996	1997
CO_2	18.9103	0.2877	0.2461	0.2841	0.2218	0.2143	0.2325	0.2506
N_2O	0.0447	0.0007	0.0006	0.0007	0.0005	0.0005	0.0005	0.0006
CH_4	0.1521	0.0023	0.0020	0.0023	0.0018	0.0017	0.0019	0.0020
Total	**19.1071**	**0.2907**	**0.2487**	**0.2870**	**0.2241**	**0.2165**	**0.2350**	**0.2532**
	1998	1999	2000	2001	2002	2003	2004	2005
CO_2	0.1567	0.2609	0.1154	0.2082	0.4824	0.4371	0.4437	0.2572
N_2O	0.0004	0.0006	0.0003	0.0005	0.0011	0.0010	0.0010	0.0006
CH_4	0.0013	0.0021	0.0009	0.0017	0.0039	0.0035	0.0036	0.0021
Total	**0.1583**	**0.2636**	**0.1166**	**0.2103**	**0.4874**	**0.4417**	**0.4483**	**0.2599**
	2006	2007	2008	2009	2010	2011	2012	2013
CO_2	0.5150	0.3437	0.3441	0.3447	0.2590	0.2596	0.2601	0.2608
N_2O	0.0012	0.0008	0.0008	0.0008	0.0006	0.0006	0.0006	0.0006
CH_4	0.0041	0.0028	0.0028	0.0028	0.0021	0.0021	0.0021	0.0021
Total	**0.5203**	**0.3473**	**0.3477**	**0.3483**	**0.2617**	**0.2623**	**0.2628**	**0.2635**
	2014	2015	2016	2017	2018	2019	2020	%
CO_2	2.3529	2.4400	1.8175	1.7329	1.5629	1.8260	0.6088	-96.8
N_2O	0.0056	0.0058	0.0043	0.0041	0.0037	0.0043	0.0014	-96.8
CH_4	0.0189	0.0196	0.0146	0.0139	0.0126	0.0147	0.0049	-96.8
Total	**2.3774**	**2.4654**	**1.8364**	**1.7509**	**1.5792**	**1.8450**	**0.6151**	**-96.8**

Methodological Issues, Emission Factors and Activity Data

Direct GHG emissions originating from category 1A3d 'Water-borne Navigation' were estimated following a Tier 1 methodology available in the 2006 IPCC Guidelines, based on AD on default emission factors. In order to estimate non-CO_2 emissions, default emission factors were used, available in the EMEP/EEA Guidebook (2019) (Table 3-100).

Table 3-100: Emission factors for direct and indirect GHG from source category 1A3d 'Water-borne Navigation'

	kg/ TJ			kg/t			
	CO_2	CH_4	N_2O	NO_x	CO	NMVOC	SO_x
Diesel Oil	74,100	7	2	78.5	7.4	2.8	20
References	2006 IPCC Guidelines, for CO_2, CH_4, N_2O, Chapter 'Mobile Combustion', Chapter 3.5.2-3, p. 3.50			EMEP/EEA Guidebook 2019, for NO_x, CO, NMVOC, source category 1A3d 'Water-borne Navigation', Table 3-1			

Activity Data

Compared to the previous inventory cycle, the following changes occurred in the current cycle:

- The consumption of diesel oil for water-borne navigation between 1990 and 1992 was distributed among the regions, separately for the territory on the Right and Left Banks of the Dniester River;
- For the territory on the Right Bank of the Dniester River, the activity data associated with the consumption of diesel oil for water-borne navigation were updated, using two reference sources: for the years 1990 and 2005-2019 – the activity data available in the Energy Balances of the Republic of Moldova was applied, and for the years 1991-2004 – the activity data was applied, obtained by official letters at the requests of the ME;

– For the territory on the Left Bank of the Dniester River, the consumption of diesel oil for water-borne navigation for the period 1993-2020 was restored by indirect methods (based on the specific consumption per capita for the territory on the Right Bank of the Dniester River);
– Emission factors for NO_x and NMVOC were updated in accordance with the EMEP/EEA Guidebook (2019). EFs for diesel oil for water-borne navigation have been accepted (the 78.5 kg/t NO_x coefficient has been applied, instead of 79.3 kg/t NO_x; and the 2.8 kg/t NMVOC coefficient has been applied instead of 2.7 kg/t NMVOC);
– Data regarding the population of the RBDR and LBDR territory has been updated.

Table 3-101: Fuel consumption for source category 1A3d 'Water-borne Navigation' between 1990-2020

	TJ			kt			%	
	RBDR	LBDR	RM – total	RBDR	LBDR	RM – total	RBDR	LBDR
1990	212.4	42.8	255.2	4.994	1.005	5.999	83.24	16.76
1991	3.2	0.6	3.9	0.076	0.015	0.091	83.27	16.73
1992	2.8	0.6	3.3	0.065	0.013	0.078	83.25	16.75
1993	3.2	0.6	3.8	0.075	0.015	0.090	83.22	16.78
1994	2.5	0.5	3.0	0.059	0.011	0.070	83.86	16.14
1995	2.4	0.5	2.9	0.057	0.011	0.068	83.86	16.14
1996	2.6	0.5	3.1	0.062	0.012	0.074	84.04	15.96
1997	2.9	0.5	3.4	0.067	0.012	0.079	84.28	15.72
1998	1.8	0.3	2.1	0.042	0.008	0.050	84.49	15.51
1999	3.0	0.5	3.5	0.070	0.013	0.083	84.57	15.43
2000	1.3	0.2	1.6	0.031	0.006	0.037	84.66	15.34
2001	2.4	0.4	2.8	0.056	0.010	0.066	84.79	15.21
2002	5.5	1.0	6.5	0.130	0.023	0.153	84.95	15.05
2003	5.0	0.9	5.9	0.118	0.021	0.139	85.10	14.90
2004	5.1	0.9	6.0	0.120	0.021	0.141	85.26	14.74
2005	3.0	0.5	3.5	0.071	0.011	0.082	86.44	13.56
2006	6.0	0.9	6.9	0.141	0.022	0.163	86.34	13.66
2007	4.0	0.6	4.6	0.094	0.015	0.109	86.23	13.77
2008	4.0	0.6	4.6	0.094	0.015	0.109	86.13	13.87
2009	4.0	0.7	4.7	0.094	0.015	0.109	85.99	14.01
2010	3.0	0.5	3.5	0.071	0.012	0.082	85.83	14.17
2011	3.0	0.5	3.5	0.071	0.012	0.082	85.64	14.36
2012	3.0	0.5	3.5	0.071	0.012	0.083	85.46	14.54
2013	3.0	0.5	3.5	0.071	0.012	0.083	85.24	14.76
2014	27.0	4.8	31.8	0.635	0.112	0.746	85.03	14.97
2015	28.0	4.9	32.9	0.658	0.116	0.774	85.03	14.97
2016	21.0	3.5	24.5	0.494	0.083	0.577	85.62	14.38
2017	20.0	3.4	23.4	0.470	0.080	0.550	85.52	14.48
2018	18.0	3.1	21.1	0.423	0.073	0.496	85.34	14.66
2019	21.0	3.6	24.6	0.494	0.086	0.579	85.22	14.78
2020	7.0	1.2	8.2	0.165	0.029	0.193	85.20	14.80

Recalculations

In the current inventory cycle, a number of measures have been taken in order to improve the quality of the national GHG inventory, as a result of which it was necessary to recalculate GHG emissions from source category 1A3d 'Water-borne Navigation'. In 2020, direct GHG emissions from this category were assessed for the first time. Between 1990 and 2020, direct GHG emissions from the respective category decreased by circa 96.3%.

Table 3-102: Recalculation results of GHG emissions from category 1A3d 'Water-borne Navigation' for the period 1990-2019, included in the BUR3 of the RM to the UNFCCC (2021), kt CO_2 equivalent

	1990	1991	1992	1993	1994	1995	1996	1997
BUR3	19.1071	0.2907	0.2487	0.2870	0.2241	0.2165	0.2350	0.2532
NC5	19.1071	0.2907	0.2487	0.2870	0.2241	0.2165	0.2350	0.2532
Difference, %	0.00	0.00	0.00	0.02	-0.01	-0.01	-0.02	0.00
	1998	1999	2000	2001	2002	2003	2004	2005
BUR3	0.1583	0.2636	0.1166	0.2103	0.487	0.4417	0.4483	0.2599
NC5	0.1583	0.2636	0.1166	0.2103	0.4874	0.4417	0.4483	0.2599
Difference, %	0.01	0.01	0.02	0.02	0.00	-0.01	0.00	-0.02
	2006	2007	2008	2009	2010	2011	2012	2013
BUR3	0.5203	0.3473	0.3477	0.3483	0.262	0.2623	0.2628	0.2635
NC5	0.5203	0.3473	0.3477	0.3483	0.2617	0.2623	0.2628	0.2635
Difference, %	0.00	0.00	0.01	-0.01	0.00	-0.02	0.01	0.00

	2014	2015	2016	2017	2018	2019	2020	%
BUR3	2.3774	2.4654	1.8364	1.7509	1.5792	1.8450		
NC5	2.3774	2.4654	1.8364	1.7509	1.5792	1.8450	0.6151	-96.8
Difference, %	0.00	0.00	0.00	0.00	0.00	0.00		

1A3e 'Other Transportation' (Pipeline Transport)

GHG emission trends from source category 1A3e 'Other Transportation' (Pipeline Transport)

Between 1990 and 2020, aggregated GHG emissions from source category 1A3e 'Other Transportation' (Pipeline Transport) had decreased by circa 91.8% (Table 3-103).

Table 3-103: Direct GHG emissions from source category 1A3e 'Other Transportation' (Pipeline Transport) between 1990-2020 and their share compared to 1990 levels

	1990	1991	1992	1993	1994	1995	1996	1997
1A3e, kt CO_2 equivalent	91.2673	76.0561	57.0420	22.2631	104.1069	99.9419	140.7085	58.5207
%, compared to 1990	100.0	83.3	75.0	39.0	467.6	96.0	140.8	41.6
	1998	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**
1A3e, kt CO_2 equivalent	56.4915	62.2658	34.9539	17.4258	37.9952	26.9934	42.9533	40.6653
%, compared to 1990	61.9	81.9	61.3	78.3	36.5	27.0	30.5	69.5
	2006	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**
1A3e, kt CO_2 equivalent	7.5969	3.5102	4.6871	11.6737	17.7092	26.5862	23.8262	14.8038
%, compared to 1990	8.3	4.6	8.2	52.4	17.0	26.6	16.9	25.3
	2014	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**%**
1A3e, kt CO_2 equivalent	19.3246	19.4599	16.8364	20.6074	18.1388	17.1947	11.5584	-91.8
%, compared to 1990	21.2	25.6	29.5	92.6	17.4	17.2	8.2	

Direct and indirect GHG emissions from source category 1A3e 'Other Transportation' (Pipeline Transport) had decreased significantly between 1990 and 2020, constituting only circa 8.2% in 2020, compared to the base year level (1990) (Table 3-104).

Table 3-104: Direct and indirect GHG emissions from source category 1A3e 'Other Transportation' (Pipeline Transport) between 1990-2020, kt

	CO_2	CH_4	N_2O	NO_x	CO	NMVOC	SO_x
1990	91.1782	0.0016	0.0002	0.1203	0.0471	0.0374	0.0011
1991	75.9818	0.0014	0.0001	0.1002	0.0393	0.0312	0.0009
1992	56.9864	0.0010	0.0001	0.0752	0.0295	0.0234	0.0007
1993	22.2414	0.0004	0.0000	0.0293	0.0115	0.0091	0.0003
1994	104.0053	0.0019	0.0002	0.1372	0.0538	0.0426	0.0012
1995	99.8443	0.0018	0.0002	0.1317	0.0516	0.0409	0.0012
1996	140.5711	0.0025	0.0003	0.1854	0.0727	0.0576	0.0017
1997	58.4636	0.0010	0.0001	0.0771	0.0302	0.0240	0.0007
1998	56.4364	0.0010	0.0001	0.0744	0.0292	0.0231	0.0007
1999	62.2050	0.0011	0.0001	0.0821	0.0322	0.0255	0.0007
2000	34.9198	0.0006	0.0001	0.0461	0.0181	0.0143	0.0004
2001	17.4087	0.0003	0.0000	0.0230	0.0090	0.0071	0.0002
2002	37.9581	0.0007	0.0001	0.0501	0.0196	0.0156	0.0005
2003	26.9671	0.0005	0.0000	0.0356	0.0139	0.0111	0.0003
2004	42.9114	0.0008	0.0001	0.0566	0.0222	0.0176	0.0005
2005	40.6256	0.0007	0.0001	0.0536	0.0210	0.0167	0.0005
2006	7.5894	0.0001	0.0000	0.0100	0.0039	0.0031	0.0001
2007	3.5068	0.0001	0.0000	0.0046	0.0018	0.0014	0.0000
2008	4.6826	0.0001	0.0000	0.0062	0.0024	0.0019	0.0001
2009	11.6623	0.0002	0.0000	0.0154	0.0060	0.0048	0.0001
2010	17.6919	0.0003	0.0000	0.0233	0.0091	0.0073	0.0002
2011	26.5603	0.0005	0.0000	0.0350	0.0137	0.0109	0.0003
2012	23.8030	0.0004	0.0000	0.0314	0.0123	0.0098	0.0003
2013	14.7893	0.0003	0.0000	0.0195	0.0076	0.0061	0.0002
2014	19.3057	0.0003	0.0000	0.0255	0.0100	0.0079	0.0002
2015	19.4409	0.0003	0.0000	0.0256	0.0100	0.0080	0.0002
2016	16.8200	0.0003	0.0000	0.0222	0.0087	0.0069	0.0002
2017	20.5873	0.0004	0.0000	0.0272	0.0106	0.0084	0.0002
2018	18.1211	0.0003	0.0000	0.0239	0.0094	0.0074	0.0002
2019	17.1780	0.0003	0.0000	0.0227	0.0089	0.0070	0.0002
2020	11.5471	0.0002	0.0000	0.0152	0.0060	0.0047	0.0001

Direct GHG emissions from source category 1A3e 'Other Transportation' (Pipeline Transport) and the contribution of each gas between 1990-2020 are shown in Table 3-105.

Table 3-105: Direct GHG emissions from source category 1A3e 'Other Transportation' (Pipeline Transport) and their share in the total structure at source category level

	1A3e, kt CO_2 equivalent				Share, % of total		
	CO_2	CH_4	N_2O	Total	CO_2	CH_4	N_2O
1990	91.1782	0.0406	0.0484	91.2673	99.9	0.0	0.1
1991	75.9818	0.0339	0.0404	76.0561	99.9	0.0	0.1
1992	56.9864	0.0254	0.0303	57.0420	99.9	0.0	0.1
1993	22.2414	0.0099	0.0118	22.2631	99.9	0.0	0.1
1994	104.0053	0.0463	0.0552	104.1069	99.9	0.0	0.1
1995	99.8443	0.0445	0.0530	99.9419	99.9	0.0	0.1
1996	140.5711	0.0626	0.0747	140.7085	99.9	0.0	0.1
1997	58.4636	0.0261	0.0311	58.5207	99.9	0.0	0.1
1998	56.4364	0.0251	0.0300	56.4915	99.9	0.0	0.1
1999	62.2050	0.0277	0.0330	62.2658	99.9	0.0	0.1
2000	34.9198	0.0156	0.0185	34.9539	99.9	0.0	0.1
2001	17.4087	0.0078	0.0092	17.4258	99.9	0.0	0.1
2002	37.9581	0.0169	0.0202	37.9952	99.9	0.0	0.1
2003	26.9671	0.0120	0.0143	26.9934	99.9	0.0	0.1
2004	42.9114	0.0191	0.0228	42.9533	99.9	0.0	0.1
2005	40.6256	0.0181	0.0216	40.6653	99.9	0.0	0.1
2006	7.5894	0.0034	0.0040	7.5969	99.9	0.0	0.1
2007	3.5068	0.0016	0.0019	3.5102	99.9	0.0	0.1
2008	4.6826	0.0021	0.0025	4.6871	99.9	0.0	0.1
2009	11.6623	0.0052	0.0062	11.6737	99.9	0.0	0.1
2010	17.6919	0.0079	0.0094	17.7092	99.9	0.0	0.1
2011	26.5603	0.0118	0.0141	26.5862	99.9	0.0	0.1
2012	23.8030	0.0106	0.0126	23.8262	99.9	0.0	0.1
2013	14.7893	0.0066	0.0079	14.8038	99.9	0.0	0.1
2014	19.3057	0.0086	0.0103	19.3246	99.9	0.0	0.1
2015	19.4409	0.0087	0.0103	19.4599	99.9	0.0	0.1
2016	16.8200	0.0075	0.0089	16.8364	99.9	0.0	0.1
2017	20.5873	0.0092	0.0109	20.6074	99.9	0.0	0.1
2018	18.1211	0.0081	0.0096	18.1388	99.9	0.0	0.1
2019	17.1780	0.0077	0.0091	17.1947	99.9	0.0	0.1
2020	11.5471	0.0051	0.0061	11.5584	99.9	0.0	0.1

Methodological Issues, Emission Factors and Activity Data

A Tier 1 methodology was used for the estimation of GHG emissions from 1A3e 'Other Transportation' (Pipeline Transport).

Emission factors for national direct GHG emissions were taken from the 2006 IPCC Guidelines for the inventory of national direct GHG emissions, whereas the emission factors for indirect GHG emissions were taken from the EMEP/EEA Air Pollutant Emission Inventory (2019) (Table 3-106).

Table 3-106: Emission factors for direct and indirect GHG emissions from source category 1A3e 'Other Transportation' (Pipeline Transport)

	CO_2	CH_4	N_2O	NO_x	CO	NMVOC	SO_x
	kg/TJ						
Natural Gas	56,100	1	0.1	74	29	23	0.67
References	2006 IPCC Guidelines, Chapter 'Mobile Combustion'			EMEP/EEA Guidebook 2019, Chapters 1.A.4.a/c, 1.A.5.a, 1.A.4.a.i, 1.A.4.b.i, 1.A.4.c.i, 1.A.5.a, Table 3.8.			

Activity Data

The main source of activity data for source category 1A3e 'Other Transportation' (Pipeline Transport) is the EBs of the RM for the territory on the Right Bank of the Dniester River.

For the territory on the Left Bank of the Dniester River, the activity data was restored based on the specific consumption per capita on the Right Bank of the Dniester (Table 3-107).

Table 3-107: Fuel consumption in source category 1A3e 'Other Transportation' (Pipeline Transport) between 1990-2020, TJ

	1990	1991	1992	1993	1994	1995	1996	1997
RBDR	1,353	1,128	846	332	1,555	1,496	2,112	880
LBDR	272	227	170	67	299	288	401	164
RM – total	**1,625**	**1,354**	**1,016**	**399**	**1,854**	**1,784**	**2,513**	**1,044**

	1998	1999	2000	2001	2002	2003	2004	2005
RBDR	851	939	528	264	576	410	663	627
LBDR	156	171	96	47	102	72	115	98
RM – total	**1,007**	**1,110**	**624**	**311**	**678**	**482**	**778**	**725**
	2006	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**
RBDR	117	54	72	179	271	406	363	225
LBDR	19	9	12	29	45	68	62	39
RM – total	**136**	**63**	**84**	**208**	**316**	**474**	**425**	**264**
	2014	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**%**
RBDR	293	297	257	314	276	261	175	-87.1
LBDR	52	52	43	53	47	45	31	-88.7
RM – total	**345**	**349**	**300**	**367**	**323**	**306**	**206**	**-87.3**

Source: for the territory on the Right Bank of the Dniester River – EBs of the RM for the years 1990, 1993-2020; for the territory on the Left Bank of the Dniester River – activity data was restored based on the specific consumption per capita on the Right Bank of the Dniester

Recalculations

In the current inventory cycle, a number of measures have been taken in order to improve the quality of the national GHG inventory, as a result of which it is necessary to recalculate GHG emissions from source category 1A3e 'Other Transportation' (Pipeline Transport). The main cause for these recalculations is to restore the natural gas consumption for the territory on the *LBDR*, based on the specific consumption per capita on the *RBDR*, taking into consideration the updated data of the 2014-2020 population census. Compared to the results recorded in the BUR3 of the RM to the UNFCCC (2021), the changes undertaken in the current inventory cycle resulted in an insignificant increase in direct GHG emissions for the period 1990-2020 (Table 3-108).

Table 3-108: Recalculation results of GHG emissions from category 1A3e 'Other Transportation' for the period 1990-2019, included in the BUR3 of the RM to the UNFCCC, kt CO_2 equivalent

	1990	1991	1992	1993	1994	1995	1996	1997
BUR3	91.2673	76.0561	57.0420	22.4028	104.1260	100.1746	141.1154	58.6333
NC5	91.2673	76.0561	57.0420	22.2631	104.1069	99.9419	140.7085	58.5207
Difference, %	0.00	0.00	0.00	-0.62	-0.02	-0.23	-0.29	-0.19
	1998	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**
BUR3	56.5582	62.3482	35.0206	17.4636	38.0746	27.0558	43.6697	40.7340
NC5	56.4915	62.2658	34.9539	17.4258	37.9952	26.9934	42.9533	40.6653
Difference, %	-0.12	-0.13	-0.19	-0.22	-0.21	-0.23	-1.64	-0.17
	2006	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**
BUR3	7.6100	3.5166	4.6945	11.6892	17.7308	26.6202	23.8533	14.8220
NC5	7.5969	3.5102	4.6871	11.6737	17.7092	26.5862	23.8262	14.8038
Difference, %	-0.17	-0.18	-0.16	-0.13	-0.12	-0.13	-0.11	-0.12
	2014	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**%**
BUR3	19.3501	19.6134	16.8563	20.6175	18.1610	17.1983		
NC5	19.3246	19.4599	16.8364	20.6074	18.1388	17.1947	11.5584	-87.3
Difference, %	-0.13	-0.78	-0.12	0.05	-0.12	-0.02		

For 2020, direct GHG emissions from source category 1A3e 'Other Transportation' (Pipeline Transport) were assessed for the first time. Between 1990 and 2020, direct GHG emissions from the respective category had decreased by circa 87.3%.

3.4.3. Uncertainties and Time Series Consistency

The primary uncertainty-related factors pertain to estimation methodology, emission factors used to estimate GHG emissions from category 1A3 'Transport', and the quality of activity data available. Uncertainties associated with EFs utilised to estimate CO_2 emissions were estimated to be circa 5%, CH_4 emissions – circa 40%, and N_2O emissions – circa 50%. Uncertainties associated with statistical data regarding fuel consumption within the Transport Sector of the Republic of Moldova can be considered relatively low (±5%).

In view of ensuring time-series consistency of the obtained results, the same approach was used for the entire period under review, in accordance with sustainable practices applied to GHG inventory (IPCC, 2000).

3.4.4. Quality Assurance and Quality Control

Standard verification and quality control forms and check-lists were filled in for category 1A3 'Transport', following the Tier 1 approach. To be noted, that the AD and methods used for estimating GHG emissions under category 1A3 'Transport' were documented and archived both in hard copies and electronically.

In order to identify the data entry and emission estimation process related errors, verifications and quality control procedures were applied.

The verification and quality control procedures applied in the calculation process for category 1A3 'Transport' included:

- Verification of AD collection and manipulation procedures, including: verifying if disaggregation of AD collected for each source category included in category 1A3 'Transport' complies with the requirements set out in the description of each source category in the 2006 IPCC Guidelines; verifying the correctness of EFs used for each source; verifying if the primary reference sources are correctly indicated; the accuracy of calculations for sources included in 1A3 category are verified randomly;
- Implementation of error minimization procedures for manual entry of AD, with all the spreadsheets provided with the initial sources of activity data in tabular format;
- In the calculation files, the EFs are specified in tabular formats for each source, the import of the respective values into calculation formulas is ensured by automatic connections;
- The consistency of the calculations is also ensured by verifying the correctness of applying conversion factors of natural units to energy units for all sources and the entire range of years covered by the inventory;
- Verification if the same method is used for the entire range of years covered by the inventory;
- Verifying if GHG emissions calculations have been made for all years and for all types of fuels mentioned in the Energy Balances of the RM and other relevant reference sources;
- Verifying to what extent the full geographical coverage of the national GHG inventory of the RM is ensured;
- Verifying the inter-annual evolution trends of emissions by creating representative charts, while unusual fluctuations are explained;
- Regarding recalculations, their need is explained, including by drawing attention to the implemented recommendations resulting from the audit carried out by national and international experts in the previous inventory cycle;
- Verifying maintenance and completion of the national inventory of GHG emissions archive.

3.4.5. Recalculations

Compared to the results recorded in BUR3 of the RM to the UNFCCC (2021), the changes undertaken in the current inventory cycle are insignificant (below 0.02% of the annual values recorded for the period 1990-2019). Between 1990 and 2020, direct GHG emissions from category 1A3 'Transport', decreased in the Republic of Moldova by circa 48.1%.

Table 3-109: Recalculation results of GHG emissions from category 1A3 'Transport' for the period 1990-2019, included in the BUR3 of the RM to the UNFCCC (2021), kt CO_2 equivalent

	1990	1991	1992	1993	1994	1995	1996	1997
BUR3	4,837.9155	3,768.7665	2,699.4911	1,921.2395	1,656.3679	1,660.4315	1,619.5131	1,555.1016
NC5	4,838.6388	3,769.3140	2,699.8627	1,920.9673	1,656.5401	1,660.3423	1,619.2192	1,555.1398
Difference, %	0.0150	0.0145	0.0138	-0.0142	0.0104	-0.0054	-0.0181	0.0025
	1998	1999	2000	2001	2002	2003	2004	2005
BUR3	1,397.7966	932.2067	1,005.7542	1,087.4276	1,442.5357	1,626.0055	1,829.7061	1,867.0868
NC5	1,397.9068	932.1127	1,005.6576	1,087.3482	1,442.4058	1,625.8842	1,828.6001	1,866.9919
Difference, %	0.0079	-0.0101	-0.0096	-0.0073	-0.0090	-0.0075	-0.0604	-0.0051
	2006	2007	2008	2009	2010	2011	2012	2013
BUR3	1,788.0010	1,894.8597	1,999.2424	1,964.2987	2,188.8720	2,322.5910	2,037.0401	2,145.8940
NC5	1,787.9528	1,894.8103	1,999.1709	1,964.2378	2,188.7989	2,322.5577	2,037.0144	2,145.8778
Difference, %	-0.0027	-0.0026	-0.0036	-0.0031	-0.0033	-0.0014	-0.0013	-0.0008

	2014	2015	2016	2017	2018	2019	2020	%
BUR3	2,182.6059	2,307.9763	2,481.6237	2,503.5890	2,581.9145	2,665.4611		
NC5	2,182.5818	2,307.8259	2,481.6061	2,503.5847	2,581.8939	2,665.4305	2,511.9066	-48.1
Difference, %	-0.0011	-0.0065	-0.0007	-0.0002	-0.0008	-0.0011		

Abbreviations: BUR3 – Third Biennial Update Report of the RM to the UNFCCC, NC5 – Fifth National Communication of the RM to the UNFCCC.

3.4.6. Planned Improvements

Potential improvements within source category 1A3 'Transport' could be possible once the available AD on real fuel consumption in the ATULBD for each emission source are updated. Also, for source categories 1A3a 'Civil Aviation' and 1A3c 'Railways', it would be possible to use higher-tier methods (Tier 2), but since these sources are not key categories, this activity is not cost-effective and it would require too much effort for the national inventory team.

3.5. Other Sectors (category 1A4)

3.5.1. Source Category Description

Category 1A4 'Other Sectors' includes the following emission sources: 1A4a 'Commercial/ Institutional'; 1A4b 'Residential'; 1A4c 'Agriculture/Forestry/Fishing' (1A4ci 'Stationary' and 1A4cii 'Mobile' (off-road vehicles and other machinery).

Between 1990 and 2020, GHG emissions from category 1A4 'Other Sectors' tended to decrease by circa 70.3%: from 7,841.31 kt CO_2 equivalent recorded in 1990, to circa 2,332.06 kt CO_2 equivalent in 2020 (Table 3-110).

Table 3-110: GHG emissions from source category 1A4 'Other Sectors' between 1990-2020, kt CO_2 equivalent

	1990	1991	1992	1993	1994	1995	1996	1997
1A4, kt CO_2 equivalent	7,841.3054	6,248.3047	4,221.5181	2,240.2258	2,227.1082	2,286.2222	2,411.7076	2,611.6491
%, compared to 1990	100.0	79.7	53.8	28.6	28.4	29.2	30.8	33.3
	1998	1999	2000	2001	2002	2003	2004	2005
1A4, kt CO_2 equivalent	2,156.4269	1,875.2453	1,552.9485	1,488.1507	1,814.5940	2,161.7781	2,325.2628	2,283.7523
%, compared to 1990	27.5	23.9	19.8	19.0	23.1	27.6	29.7	29.1
	2006	2007	2008	2009	2010	2011	2012	2013
1A4, kt CO_2 equivalent	2,274.8849	1,721.3685	1,732.0776	1,881.5086	2,047.3623	2,375.6672	2,341.9613	2,021.6567
%, compared to 1990	29.0	22.0	22.1	24.0	26.1	30.3	29.9	25.8
	2014	2015	2016	2017	2018	2019	2020	%
1A4, kt CO_2 equivalent	2,067.0698	1,939.2152	1,925.2983	2,175.9589	2,267.8044	2,393.7886	2,332.0606	-70.3
%, compared to 1990	26.4	24.7	24.6	27.7	28.9	30.5	29.7	

Compared to 1990, the level of GHG emissions in 2020 from source category 1A4 'Other Sectors' constituted 27.8% for CO_2 emissions of the base year level, CH_4 – 74.2%, N_2O – 37.8%, NO_x – 30.1%, CO – 60.4%, NMVOC – 82.5%, SO_x – 5.8% (Table 3-111).

Table 3-111: Evolution of direct and indirect GHG emissions from source category 1A4 'Other Sectors' between 1990-2020

	1A4, kt							%, compared to 1990						
	CO_2	CH_4	N_2O	NO_x	CO	NMVOC	SO_x	CO_2	CH_4	N_2O	NO_x	CO	NMVOC	SO_x
1990	7,372.2624	11.5005	0.6092	21.5980	188.2917	20.5488	42.5973	100.0	100.0	100.0	100.0	100.0	100.0	100.0
1991	5,971.5518	8.2940	0.4021	16.0136	135.7317	14.6862	30.9518	81.0	72.1	66.0	74.1	72.1	71.5	72.7
1992	4,047.4223	5.0044	0.2490	10.2209	81.2407	8.8561	18.6039	54.9	43.5	40.9	47.3	43.1	43.1	43.7
1993	2,133.9212	1.7913	0.2065	7.7876	30.6143	3.6883	8.0858	28.9	15.6	33.9	36.1	16.3	17.9	19.0
1994	2,090.7472	2.4402	0.2529	8.6031	41.2528	4.8276	8.8679	28.4	21.2	41.5	39.8	21.9	23.5	20.8
1995	2,172.1646	1.3343	0.2708	9.1456	30.5187	3.2884	4.8320	29.5	11.6	44.5	42.3	16.2	16.0	11.3
1996	2,285.6997	2.3850	0.2228	7.8951	44.6759	4.8360	7.2025	31.0	20.7	36.6	36.6	23.7	23.5	16.9
1997	2,502.5306	1.7835	0.2165	7.8855	35.7839	3.8166	4.8638	33.9	15.5	35.5	36.5	19.0	18.6	11.4
1998	2,078.6760	1.1889	0.1612	6.1632	23.7935	2.6926	3.3628	28.2	10.3	26.5	28.5	12.6	13.1	7.9
1999	1,809.4024	1.2151	0.1190	4.7057	21.2190	2.5511	2.8154	24.5	10.6	19.5	21.8	11.3	12.4	6.6
2000	1,494.1182	1.2084	0.0960	3.8246	19.3419	2.4620	2.4553	20.3	10.5	15.8	17.7	10.3	12.0	5.8
2001	1,434.1009	1.0554	0.0928	3.7425	16.7367	2.1939	2.1063	19.5	9.2	15.2	17.3	8.9	10.7	4.9
2002	1,747.8245	1.3555	0.1103	4.4782	20.7434	2.8052	3.0494	23.7	11.8	18.1	20.7	11.0	13.7	7.2
2003	2,084.6537	1.7920	0.1085	4.7321	26.3815	3.5078	4.7236	28.3	15.6	17.8	21.9	14.0	17.1	11.1
2004	2,260.0278	1.4692	0.0957	4.7005	21.4786	2.9899	3.8578	30.7	12.8	15.7	21.8	11.4	14.6	9.1
2005	2,219.0765	1.5553	0.0866	4.3367	22.7299	3.0691	3.7081	30.1	13.5	14.2	20.1	12.1	14.9	8.7
2006	2,203.6648	1.7981	0.0881	4.2950	25.7482	3.4823	3.8856	29.9	15.6	14.5	19.9	13.7	16.9	9.1

	1A4, kt							%, compared to 1990						
	CO_2	CH_4	N_2O	NO_x	CO	NMVOC	SO_x	CO_2	CH_4	N_2O	NO_x	CO	NMVOC	SO_x
2007	1,666.7458	1.3012	0.0741	3.3949	18.3862	2.5173	2.6494	22.6	11.3	12.2	15.7	9.8	12.3	6.2
2008	1,677.3708	1.3260	0.0723	3.3719	18.2724	2.5708	2.3550	22.8	11.5	11.9	15.6	9.7	12.5	5.5
2009	1,824.9424	1.4331	0.0696	3.4994	18.9129	2.6852	2.6186	24.8	12.5	11.4	16.2	10.0	13.1	6.1
2010	1,985.9921	1.5654	0.0746	3.7644	21.8247	2.9363	2.9155	26.9	13.6	12.2	17.4	11.6	14.3	6.8
2011	2,310.7777	1.6944	0.0756	4.1423	23.3551	3.2990	2.7405	31.3	14.7	12.4	19.2	12.4	16.1	6.4
2012	2,271.4679	1.9260	0.0750	4.0329	26.3885	3.6707	3.1225	30.8	16.7	12.3	18.7	14.0	17.9	7.3
2013	1,947.9381	1.9842	0.0809	3.7783	27.7557	3.7434	3.2852	26.4	17.3	13.3	17.5	14.7	18.2	7.7
2014	1,927.7357	4.0868	0.1247	4.4921	54.5828	8.0026	2.4012	26.1	35.5	20.5	20.8	29.0	38.9	5.6
2015	1,790.2120	4.3428	0.1357	4.5595	58.1877	8.5261	2.3805	24.3	37.8	22.3	21.1	30.9	41.5	5.6
2016	1,767.4874	4.6624	0.1384	4.5317	62.0479	9.2199	1.9853	24.0	40.5	22.7	21.0	33.0	44.9	4.7
2017	1,960.6971	6.3772	0.1874	5.7093	85.0674	12.5450	2.9370	26.6	55.5	30.8	26.4	45.2	61.0	6.9
2018	1,946.2502	10.0301	0.2376	6.3540	133.0922	19.9404	2.3520	26.4	87.2	39.0	29.4	70.7	97.0	5.5
2019	2,105.4914	8.7623	0.2323	6.5829	117.1622	17.3134	3.2791	28.6	76.2	38.1	30.5	62.2	84.3	7.7

In the structure of total GHG emissions from source category 1A4 'Other Sectors', in 2020, the share of direct GHG emissions varied as follows: CO_2 – 87.91%, CH_4 – 9.15% and N_2O – 2.94% (Table 3-112).

Table 3-112: Evolution of direct GHG emissions from source category 1A4 'Other Sectors' between 1990-2020

	1A4, kt CO_2 equivalent				% of total			%, compared to 1990		
	CO_2	CH_4	N_2O	Total	CO_2	CH_4	N_2O	CO_2	CH_4	N_2O
1990	7,372.2624	287.5113	181.5317	7,841.3054	94.02	3.67	2.32	100.00	100.00	100.00
1991	5,925.0237	203.6619	119.6190	6,248.3047	94.83	3.26	1.91	80.37	70.84	65.89
1992	4,024.1583	123.2654	74.0944	4,221.5181	95.32	2.92	1.76	54.59	42.87	40.82
1993	2,133.9212	44.7823	61.5223	2,240.2258	95.25	2.00	2.75	28.95	15.58	33.89
1994	2,090.7472	61.0059	75.3551	2,227.1082	93.88	2.74	3.38	28.36	21.22	41.51
1995	2,172.1646	33.3580	80.6996	2,286.2222	95.01	1.46	3.53	29.46	11.60	44.45
1996	2,285.6997	59.6255	66.3824	2,411.7076	94.78	2.47	2.75	31.00	20.74	36.57
1997	2,502.5306	44.5872	64.5312	2,611.6491	95.82	1.71	2.47	33.95	15.51	35.55
1998	2,078.6760	29.7213	48.0295	2,156.4269	96.39	1.38	2.23	28.20	10.34	26.46
1999	1,809.4024	30.3769	35.4659	1,875.2453	96.49	1.62	1.89	24.54	10.57	19.54
2000	1,494.1182	30.2106	28.6196	1,552.9485	96.21	1.95	1.84	20.27	10.51	15.77
2001	1,434.1009	26.3857	27.6641	1,488.1507	96.37	1.77	1.86	19.45	9.18	15.24
2002	1,747.8245	33.8864	32.8830	1,814.5940	96.32	1.87	1.81	23.71	11.79	18.11
2003	2,084.6537	44.7997	32.3247	2,161.7781	96.43	2.07	1.50	28.28	15.58	17.81
2004	2,260.0278	36.7303	28.5047	2,325.2628	97.19	1.58	1.23	30.66	12.78	15.70
2005	2,219.0765	38.8835	25.7923	2,283.7523	97.17	1.70	1.13	30.10	13.52	14.21
2006	2,203.6648	44.9525	26.2676	2,274.8849	96.87	1.98	1.15	29.89	15.64	14.47
2007	1,666.7458	32.5309	22.0918	1,721.3685	96.83	1.89	1.28	22.61	11.31	12.17
2008	1,677.3708	33.1490	21.5577	1,732.0776	96.84	1.91	1.24	22.75	11.53	11.88
2009	1,824.9424	35.8275	20.7387	1,881.5086	96.99	1.90	1.10	24.75	12.46	11.42
2010	1,985.9921	39.1358	22.2344	2,047.3623	97.00	1.91	1.09	26.94	13.61	12.25
2011	2,310.7777	42.3603	22.5291	2,375.6672	97.27	1.78	0.95	31.34	14.73	12.41
2012	2,271.4679	48.1511	22.3422	2,341.9613	96.99	2.06	0.95	30.81	16.75	12.31
2013	1,947.9381	49.6054	24.1133	2,021.6567	96.35	2.45	1.19	26.42	17.25	13.28
2014	1,927.7357	102.1699	37.1642	2,067.0698	93.26	4.94	1.80	26.15	35.54	20.47
2015	1,790.2120	108.5694	40.4338	1,939.2152	92.32	5.60	2.09	24.28	37.76	22.27
2016	1,767.4874	116.5604	41.2504	1,925.2983	91.80	6.05	2.14	23.97	40.54	22.72
2017	1,960.6971	159.4299	55.8319	2,175.9589	90.11	7.33	2.57	26.60	55.45	30.76
2018	1,946.2502	250.7521	70.8021	2,267.8044	85.82	11.06	3.12	26.40	87.21	39.00
2019	2,105.4970	219.0565	69.2351	2,393.7886	87.96	9.15	2.89	28.56	76.19	38.14
2020	2,050.0916	213.3738	68.5953	2,332.0606	87.91	9.15	2.94	27.81	74.21	37.79

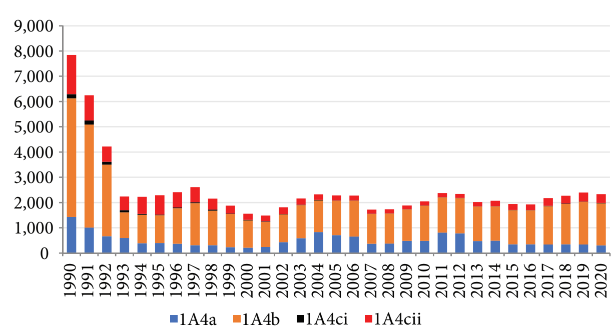


Figure 3-19a: Evolution of direct GHG emissions by emission source within category 1A4 'Other Sectors' between 1990-2020, kt CO_2 equivalent.

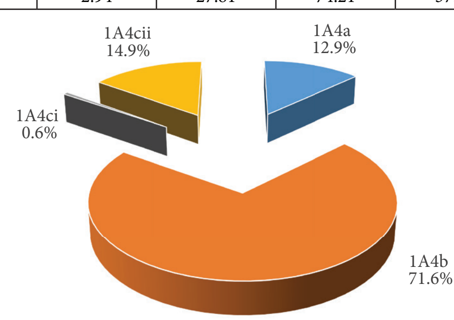


Figure 3-19b: The share of different sources in the structure of total direct GHG emissions from category 1A4 'Other Sectors' in 2020, % .

Trends in the evolution of GHG emissions disaggregated by emission source within category 1A4 'Other Sectors' are shown below (Table 3-113).

Table 3-113: Evolution of direct GHG emissions disaggregated by source within category 1A4 'Other Sectors' between 1990-2020, kt CO_2 equivalent

	1990	1991	1992	1993	1994	1995	1996	1997
1A4a 'Commercial/Institutional'	1,426.11	1,010.66	669.18	594.67	390.57	399.10	366.36	310.28
1A4b 'Residential'	4,701.86	4,079.37	2,828.10	1,021.91	1,123.43	1,100.71	1,409.59	1,666.25
1A4ci 'Agriculture/Forestry/Fishing' (Stationary)	165.95	162.64	113.67	79.25	34.09	19.75	28.26	32.97
1A4cii 'Agriculture/Forestry/Fishing' (Mobile)	1,547.38	995.64	610.56	544.40	679.02	766.67	607.50	602.15
1A4 'Other Sectors'	7,841.31	6,248.30	4,221.52	2,240.23	2,227.11	2,286.22	2,411.71	2,611.65
	1998	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**
1A4a 'Commercial/Institutional'	308.61	230.62	207.23	239.08	430.10	588.02	829.08	707.38
1A4b 'Residential'	1,369.76	1,315.30	1,084.74	994.29	1,100.99	1,309.79	1,255.90	1,370.64
1A4ci 'Agriculture/Forestry/Fishing' (Stationary)	39.38	18.62	20.86	22.11	10.98	12.40	17.25	8.08
1A4cii 'Agriculture/Forestry/Fishing' (Mobile)	438.67	310.71	240.13	232.67	272.52	251.58	223.04	197.65
1A4 'Other Sectors'	2,156.43	1,875.25	1,552.95	1,488.15	1,814.59	2,161.78	2,325.26	2,283.75
	2006	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**
1A4a 'Commercial/Institutional'	649.60	366.07	375.14	483.58	481.51	811.05	782.63	475.30
1A4b 'Residential'	1,425.81	1,185.35	1,190.40	1,243.04	1,392.58	1,395.42	1,393.98	1,362.68
1A4ci 'Agriculture/Forestry/Fishing' (Stationary)	4.77	1.97	6.33	4.82	6.11	6.01	8.78	11.00
1A4cii 'Agriculture/Forestry/Fishing' (Mobile)	194.70	167.98	160.21	150.06	167.17	163.19	156.57	172.67
1A4 'Other Sectors'	2,274.88	1,721.37	1,732.08	1,881.51	2,047.36	2,375.67	2,341.96	2,021.66
	2014	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**%**
1A4a 'Commercial/Institutional'	488.84	344.60	342.38	340.62	349.06	336.36	301.02	-78.9
1A4b 'Residential'	1,357.36	1,350.96	1,348.10	1,515.28	1,599.79	1,694.87	1,670.47	-64.5
1A4ci 'Agriculture/Forestry/Fishing' (Stationary)	6.27	8.48	8.47	10.79	11.73	12.60	13.76	-91.7
1A4cii 'Agriculture/Forestry/Fishing' (Mobile)	214.60	235.19	226.34	309.26	307.23	349.96	346.81	-77.6
1A4 'Other Sectors'	2,067.07	1,939.22	1,925.30	2,175.96	2,267.80	2,393.79	2,332.06	-70.3

The emission source with the largest share in the structure of total GHG emissions from source category 1A4 'Other Sectors' is category 1A4b 'Residential' – 71.6%. The next is 1A4a 'Commercial/Institutional', with a share of 12.9%, followed by 14Acii 'Agriculture/Forestry/Fishing' (Mobile), with a share of 14.9% (Figue 3-19, Table 3-114).

Table 3-114: Share of different sources in the structure of total direct GHG emissions from category 1A4 'Other Sectors', % of total

	1990	1991	1992	1993	1994	1995	1996	1997
1A4a	18.2	16.2	15.9	26.5	17.5	17.5	15.2	11.9
1A4b	60.0	65.3	67.0	45.6	50.4	48.1	58.4	63.8
1A4ci	2.1	2.6	2.7	3.5	1.5	0.9	1.2	1.3
1A4cii	19.7	15.9	14.5	24.3	30.5	33.5	25.2	23.1
	1998	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**
1A4a	14.3	12.3	13.3	16.1	23.7	27.2	35.7	31.0
1A4b	63.5	70.1	69.9	66.8	60.7	60.6	54.0	60.0
1A4ci	1.8	1.0	1.3	1.5	0.6	0.6	0.7	0.4
1A4cii	20.3	16.6	15.5	15.6	15.0	11.6	9.6	8.7
	2006	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**
1A4a	28.6	21.3	21.7	25.7	23.5	34.1	33.4	23.5
1A4b	62.7	68.9	68.7	66.1	68.0	58.7	59.5	67.4
1A4ci	0.2	0.1	0.4	0.3	0.3	0.3	0.4	0.5
A4cii	8.6	9.8	9.2	8.0	8.2	6.9	6.7	8.5
	2014	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**
1A4a	23.6	17.8	17.8	15.7	15.4	14.1	12.9	NA
1A4b	65.7	69.7	70.0	69.6	70.5	70.8	71.6	NA
1A4ci	0.3	0.4	0.4	0.5	0.5	0.5	0.6	NA
1A4cii	10.4	12.1	11.8	14.2	13.5	14.6	14.9	NA

3.5.2. Methodological Issues, Emission Factors and Activity Data

Direct GHG emissions originating from source category 1A4 'Other Sectors' were estimated following a Tier 1 methodology available in the 2006 IPCC Guidelines, based on AD on fuel consumption and default emission factors. In order to estimate non-CO_2 emissions, default emission factors were used, available in the EMEP/EEA Guidebook (2019) (Tables 3-115, 3-116, 3-117 and 3-118).

Table 3-115: Emission factors utilised for the estimation of GHG emissions from 1A4a 'Commercial/ Institutional', kg/TJ

Fuel	CO_2	CH_4	N_2O	NO_x	CO	NMVOC	SO_2
Gasoline	69,300	10	0.6	306	93	20	94
Diesel Oil	74,100	10	0.6	306	93	20	94
Residual Fuel Oil	77,400	10	0.6	306	93	20	94
Kerosene	71,900	10	0.6	306	93	20	94
LPG	63,100	5	0.1	74	29	23	0.67
Other Petroleum Products	73,300	10	0.6	306	93	20	94
Anthracite	98,300	10	1.5	173	931	88.8	840
Bituminous Coal	94,600	10	1.5	173	931	88.8	840
Lignite	101,000	10	1.5	173	931	88.8	840
Brown Coal – briquettes	97,500	10	1.5	173	931	88.8	840
Coke	107,000	10	1.5	173	931	88.8	840
Natural Gas	56,100	5	0.1	74	29	23	0.67
Fuelwood and Wood Waste	112,000	300	4	91	570	300	11
Other Solid Biomass	100,000	300	4	91	570	300	11
Charcoal	112,000	200	1	91	570	300	11

Source: for CO_2,CH_4, N_2O – 2006 IPCC Guidelines, Volume 2, Chapter 2, Table 2.4, 2.20-2.21; for NO_x, CO, NMVOC and SO_2 – EMEP/EEA Air Pollutant Emission Inventory (2019), Table 3.7-3.10, P. 36-39, Category 1.A.4.a.

Table 3-116: Emission factors utilised for the estimation of GHG emissions from 1A4b 'Residential', kg/TJ

Fuel	CO_2	CH_4	N_2O	NO_x	CO	NMVOC	SO_2
Residual Fuel Oil	77,400	10	0.6	51	57	0.69	70
Kerosene	71,900	10	0.6	51	57	0.69	70
LPG	63,100	5	0.1	51	26	1.9	0.3
Other Petroleum Products	73,300	10	0.6	51	57	0.69	70
Anthracite	98,300	300	1.5	110	4,600	484	900
Bituminous Coal	94,600	300	1.5	110	4,600	484	900
Lignite	101,000	300	1.5	110	4,600	484	900
Coke	107,000	300	1.5	110	4,600	484	900
Peat	106,000	300	1.4	110	4,600	484	900
Natural Gas	56,100	5	0.1	51	26	1.9	0.3
Fuelwood and Wood Waste	112,000	300	4	50	4,000	600	11
Other Solid Biomass	100,000	300	4	50	4,000	600	11
Charcoal	112,000	200	1	50	4,000	600	11

Source: for CO_2,CH_4, N_2O – 2006 IPCC Guidelines, Volume 2, Chapter 2, Table 2.5, 2.22-2.23, for NO_x, CO, NMVOC and SO_2 – EMEP/EEA Air Pollutant Emission Inventory (2019), Table 3.3-3.6, P. 32-35, Category 1.A.4.b.

Table 3-117: Emission factors utilised for the estimation of GHG emissions from 1A4ci 'Agriculture/Forestry/Fishing' (Stationary), kg/TJ

Fuel	CO_2	CH_4	N_2O	NO_x	CO	NMVOC	SO_2
Diesel Oil	74,100	10	0.6	306	93	20	94
Residual Fuel Oil	77,400	10	0.6	306	93	20	94
Kerosene	71,900	10	0.6	306	93	20	94
Other Petroleum Products	73,300	10	0.6	306	93	20	94
Anthracite	98,300	300	1.5	173	931	88.8	840
Bituminous Coal	94,600	300	1.5	173	931	88.8	840
Lignite	101,000	300	1.5	173	931	88.8	840
Natural Gas	56,100	5	0.1	74	29	23	0.67
Fuelwood and Wood Waste	112,000	300	4	91	570	300	11
Other Solid Biomass	100,000	300	4	91	570	300	11

Source: for CO_2, CH_4, N_2O emissions – 2006 IPCC Guidelines, Volume. 2, Chapter. 2, Table 2.5, 2.22-2.23; for NO_x, CO, NMVOC and SO_2 emissions – EMEP/EEA Air Pollutant Emission Inventory (2019), Table 3.7-3.10, P. 36-39.

Table 3-118: Emission factors utilised for the estimation of GHG emissions from 1A4ci 'Agriculture/Forestry/Fishing' (Mobile)

Fuel	CO_2	CH_4	N_2O	NO_x	CO	NMVOC
	kg/TJ			kg/kt		
Gasoline	69,300	80	2	7,117	770,368	18,893
Diesel Oil	74,100	4.15	28.6	34,457	11,469	3,542
LPG	63,100	62	0.2	28,571	4,823	6,720

Source: for CO_2 – 2006 IPCC Guidelines, Volume 3, Chapter 3, Table 3.2.1; for CH_4, N_2O (gasoline, diesel oil) – 2006 IPCC Guidelines, Volume 3, Chapter 3, Table 3.3.1; for CH_4, N_2O (LPG) – 2006 IPCC Guidelines, Volume 3, Chapter 3, Table 3.2.2; for NO_x, CO and NMVOC – EMEP/EEA Air Pollutant Emission Inventory (2019), Table 3-1, P. 23.

SO_2 emissions were estimated utilising the data associated with the sulphur content in used fuels applying the following equation:

$$E_{SO_{2,m}} = 2 \sum k_{s,m} b_{j,m} 10^{-6}$$

where:

$E_{SO_{2,m}}$ – SO_2 emissions by type of fuel m [kt];

$k_{s,m}$ – weight of the sulphur content in type *m* fuel [kg / kg] (see Table 3-119);

$b_{j,m}$ – annual type *m* fuel consumption [kg], by source *j*;

10^{-6} – conversion coefficient from kg into kt.

Table 3-119: Typical sulphur content of fuels used

Fuel	1990-1999	2000-2004	2005-2008	2009-2020
Gasoline	165 ppm	130 ppm	40 ppm	5 ppm
Diesel Oil	400 ppm	300 ppm	40 ppm	3 ppm

Source: EMEP/EEA Air Pollutant Emission Inventory (2019), Table 3-14, p. 22, Category 1.A.3.b.i-iv.

AD on fuel consumption within source category 1A4 'Other Sectors' are available in the EBs of the RM and the statistical publications 'Socio-economic development of the ATULBD'. A part of the information used was provided by the JSC 'Moldovagaz'. To be noted that the activity data used in the current inventory cycle were taken from the EBs of the RM directly in energy units (TJ), avoiding conversion from natural units to energy units.

For the territory on the RBDR, the information associated with fuel consumption during the years 1990 and 1993-2020 in the EBs of the RM is available as follows: activity data for source category 'Commercial/Institutional Sector' is aggregated; whereas for the 'Residential Sector' and the 'Agriculture/Forestry/Fishing Sector' is presented separately.

The AD associated with fuel consumption from 'Agriculture/Forestry/Fishing' were disaggregated into two sources: 1A4ci 'Stationary' (it includes: consumption of coal, residual fuel oil, natural gas and others), and 1A4cii 'Mobile' (Off-road Vehicles and Other Machinery) (it includes: consumption of diesel oil, gasoline and LPG). The AD associated with fuel consumption from the LBDR are available only in natural units, being recalculated in energy units (TJ) by using country specific caloric factors. The activity data available for each source considered under Category 1A4 'Other Sectors' is examined below. To be noted that, in the current inventory cycle, LPG was allocated to gaseous fuels, not liquid fuels, unlike in the previous inventory cycle.

1A4a 'Commercial/Institutional'

With reference to source category 1A4a 'Commercial/Institutional', activity data on natural gas consumption for the territory on the LBDR is available for the period 1999-2020, and data on LPG consumption for the period 2011-2020, respectively (Table 3-120).

Table 3-120: Fuel consumption in source category the 1A4a 'Commercial/Institutional' on the LBDR between 1999-2020

	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
Natural Gas, TJ	230	315	460	2,770	2,959	7,754	6,149	5,143	488	670	545
	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Natural Gas, TJ	1,277	7,084	6,850	3,383	3,559	914	599	643	745	637	555
LPG, TJ		0.1	0.1	0.1	0.1	0.1	0.2	0.1	0.1	0.1	0.1

Source: Press Release 'The State of Housing and Communal Services of the ATULBD' for the years 2011-2020.

Table 3-121: Fuel consumption in source category 1A4a 'Commercial/Institutional' on the RBDR between 1990-2020, TJ

	1990	1991	1992	1993	1994	1995	1996	1997
Gasoline	NO	NO	NO	3	NO	NO	NO	NO
Diesel Oil	468	360	252	144	88	117	88	59
Kerosene	NO	NO	NO	47	NO	NO	NO	NO
Residual Fuel Oil	844	732	620	508	235	235	205	59
Fuel for Oven	733	NO	NO	50	29	NO	NO	NO
Fuel for Engines	43	NO	NO	12	NO	NO	NO	NO
LPG	276	199	121	44	NO	59	59	29
Other Petroleum Products	NO	NO	NO	NO	NO	NO	NO	NO
Anthracite	11,616	8,260	4,903	1,546	675	440	440	352
Bituminous Coal	NO	NO	NO	2,363	2,200	2,553	2,171	1,966
Lignite	12	193	375	557	411	352	352	205
Coal-briquettes	36	NO	NO	NO	NO	NO	NO	NO
Coke	NO	NO	NO	3	NO	NO	NO	NO
Natural Gas	1,422	1,327	1,233	1,138	616	557	734	734

Fuelwood	333	258	184	109	117	117	147	117
Wood Waste	NO	NO	NO	6	NO	NO	29	NO
Agricultural Residues	NO	NO	NO	NO	NO	NO	NO	NO
Other types of Fuel	NO	NO	NO	NO	NO	NO	NO	NO
Charcoal	NO	NO	NO	NO	NO	NO	NO	NO
Pellets and Briquettes	NO	NO	NO	NO	NO	NO	NO	NO
	1998	1999	2000	2001	2002	2003	2004	2005
Gasoline	NO	NO	NO	NO	NO	NO	2	1
Diesel Oil	59	88	59	29	29	59	50	46
Kerosene	NO	NO	NO	NO	NO	NO	2	NO
Residual Fuel Oil	29	29	29	59	30	58	47	19
Fuel for Oven	29	29	147	205	58	29	70	11
LPG	NO	NO	NO	29	NO	29	32	72
Other Petroleum Products	NO	NO	NO	NO	NO	NO	NO	NO
Anthracite	323	323	645	264	675	1,846	1,788	1,358
Bituminous Coal	2,200	1,437	734	1,203	1,174	1,115	745	732
Lignite	176	88	59	59	29	29	1	NO
Coal-briquettes	NO	NO	NO	NO	NO	NO	NO	NO
Coke	NO	NO	NO	NO	NO	NO	NO	NO
Natural Gas	616	499	557	734	1,467	1,993	2,257	2,572
Fuelwood	117	88	88	117	147	381	242	210
Wood Waste	NO	NO	NO	NO	NO	146	78	31
Agricultural Residues	NO	NO	NO	NO	NO	NO	14	5
Other types of Fuel	NO	NO	NO	29	NO	NO	NO	NO
Charcoal	NO	NO	NO	NO	NO	NO	NO	NO
Pellets and Briquettes	NO	NO	NO	NO	NO	NO	NO	NO
	2006	2007	2008	2009	2010	2011	2012	2013
Gasoline	3	36	34	6	3	6	NO	NO
Diesel Oil	29	29	26	35	130	121	15	NO
Kerosene	NO	NO	96	177	NO	NO	NO	NO
Residual Fuel Oil	7	6	19	17	30	10	1	6
Fuel for Oven	15	19	42	382	59	15	5	1
LPG	32	41	2	28	291	82	125	135
Other Petroleum Products	NO	NO	801	1,191	7	NO	NO	1
Anthracite	1,136	1,016	673	315	828	867	898	1,032
Bituminous Coal	859	570	NO	NO	243	217	100	67
Lignite	NO	NO	3,105	4,535	NO	NO	NO	NO
Coal-briquettes	NO	NO	NO	NO	NO	NO	1	NO
Coke	NO	1	268	240	NO	NO	NO	NO
Natural Gas	2,799	3,056	15	36	4,722	5,094	5,061	2,925
Fuelwood	254	247	28	NO	209	219	244	185
Wood Waste	26	18	15	36	36	17	18	35
Agricultural Residues	2	14	28	300	41	31	88	68
Other types of Fuel	NO	3	2	NO	NO	NO	NO	NO
Charcoal	NO	NO	NO	NO	NO	NO	NO	3
Pellets and Briquettes	NO	NO	NO	NO	NO	NO	NO	NO
	2014	2015	2016	2017	2018	2019	2020	%
Gasoline	NO	NO	5	5	NO	NO	NO	-
Diesel Oil	NO	153	59	44	22	25	23	-95.1
Kerosene	NO	NO	NO	NO	NO	NO	NO	-
Residual Fuel Oil	NO	5	1	1	NO	NO	NO	-
Fuel for Oven	4	1	NO	NO	NO	NO	NO	-
LPG	193	70	56	46	26	24	18	-93.5
Other Petroleum Produts	NO	3	3	2	NO	2	1	-
Anthracite	587	672	655	689	711	655	604	-94.8
Bituminous Coal	197	77	106	84	42	23	14	-
Lignite	NO	NO	NO	NO	NO	NO	NO	-
Coal-briquettes	NO	NO	NO	NO	NO	NO	NO	-
Coke	NO	NO	NO	NO	NO	NO	NO	-
Natural Gas	3,462	3,545	3,949	3,860	4,001	4,019	3,599	153.1
Fuelwood	232	220	237	226	235	216	188	-43.5
Wood Waste	26	14	13	16	16	11	12	-
Agricultural Residues	118	50	58	130	77	60	46	-
Other types of Fuel	NO	NO	NO	NO	NO	NO	NO	-
Charcoal	21	16	13	11	32	44	25	-
Pellets and Briquettes	94	83	NO	112	150	127	110	-

Source: EBs of the RM for the years 1990 and 1993-2020.

As mentioned above, within source category 1A3c 'Railways', fuel consumption (residual fuel oil, anthracite, lignite, bituminous coal) was reallocated to source category 1A4a 'Commercial/ Institutional' (Table 3-122).

Table 3-122: Consumption of fuels reallocated from source category 1A3c 'Railways' to source category 1A4a 'Commercial/Institutional', TJ

	1990	1993	1994	1995	1996	1997	1998	2005	2007	2008	2009
Residual Fuel Oil	NO	300	88	59	29	29	59	NO	NO	3.5	5.5
Anthracite	80.1	NO	NO	NO	59	59	NO	1	1	2	NO
Bituminous Coal	NO	103	29	29	NO	NO	NO	NO	NO	1.6	1.6
Lignite	46.72	NO	NO	59	29	59	NO	NO	NO	NO	NO
	2010	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**
Residual Fuel Oil	8.3	6.6	9.6	1.7	3.3	1.14	3.1	0.7	NO	0.1	NO
Anthracite	2	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Bituminous Coal	0.3	1.1	8.2	0.9	0.3	0.1	0.1	0.1	0.8	0.5	0.4

Source: EBs of the RM for the years 1990 and 1993-2020.

Table 3-123 and Figure 3-20 below show the fuel consumption by type of fuel in source category 1A4a 'Commercial/Institutional' between 1990 and 2020. The consumption of liquid fuels decreased in the respective period by 98.9% (from 2,088 TJ in 1990 to 24 TJ in 2020); the consumption of solid fuels decreased by 94.8% (from 11,790 TJ in 1990 to 618 TJ in 2020); the consumption of gaseous fuels increased by circa 2.5 times (from 1,698 TJ in 1990 to 4,172 TJ in 2020), and biofuel consumption increased by 15% (from 333 TJ in 1990 to 381 TJ in 2020).

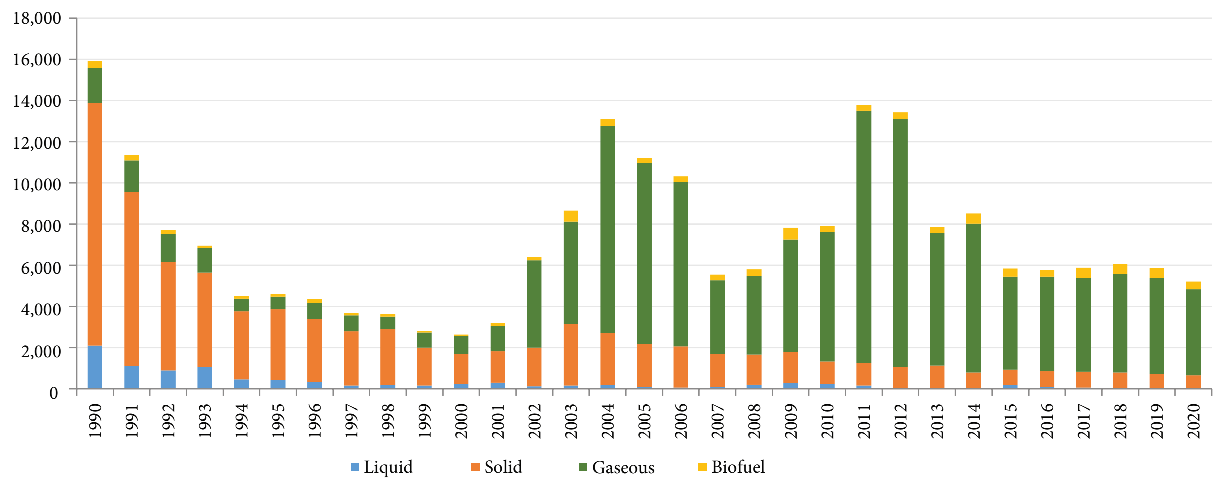


Figure 3-20: Fuel consumption in source category 1A4a 'Commercial/Institutional' between 1990-2020, TJ.

Table 3-123: Consumption by type of fuel within source category 1A4a 'Commercial/Institutional' between 1990-2020, TJ

	1990	1991	1992	1993	1994	1995	1996	1997
Liquid Fuels	2,088	1,092	872	1,064	440	411	322	147
Solid Fuels	11,790	8,453	5,278	4,572	3,315	3,433	3,051	2,641
Gaseous Fuels	1,698	1,526	1,354	1,182	616	616	793	763
Biofuels	333	258	184	115	117	117	176	117
	1998	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**
Liquid Fuels	176	146	235	293	117	146	171	77
Solid Fuels	2,699	1,848	1,438	1,526	1,878	2,990	2,534	2,091
Gaseous Fuels	616	729	872	1,223	4,237	4,981	10,043	8,793
Biofuels	117	88	88	146	147	527	334	246
	2006	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**
Liquid Fuels	54	90	181	269	237	159	31	10
Solid Fuels	1,995	1,588	1,478	1,508	1,073	1,085	1,007	1,100
Gaseous Fuels	7,974	3,585	3,817	5,462	6,290	12,260	12,036	6,443
Biofuels	282	282	313	576	286	267	350	291
	2014	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**%**
Liquid Fuels	7	163	71	53	22	27	24	-98.9
Solid Fuels	784	749	761	773	754	679	618	-94.8
Gaseous Fuels	7,214	4,529	4,604	4,549	4,772	4,680	4,172	145.7
Biofuels	491	383	321	495	510	458	381	14.5

Table 3-124 shows the total fuel consumption in source category 1A4a 'Commercial/Institutional' in the Republic of Moldova between 1990 and 2020.

Table 3-124: Fuel consumption within source category 1A4a 'Commercial/Institutional' between 1990-2020, TJ

	1990	1991	1992	1993	1994	1995	1996	1997
1A4a, LBDR	NO	NO	NO	NO	NO	NO	NO	NO
1A4a, RBDR	15,910	11,330	7,688	6,933	4,488	4,577	4,342	3,668
1A4a, RM – total	15,910	11,330	7,688	6,933	4,488	4,577	4,342	3,668
	1998	1999	2000	2001	2002	2003	2004	2005
1A4a, LBDR	NO	230	315	460	2,770	2,959	7,754	6,149
1A4a, RBDR	3,608	2,581	2,318	2,728	3,609	5,685	5,328	5,058
1A4a, RM – total	3,608	2,811	2,633	3,188	6,379	8,644	13,082	11,207
	2006	2007	2008	2009	2010	2011	2012	2013
1A4a, LBDR	5,143	488	675	552	1,282	7,087	6,852	3,386
1A4a, RBDR	5,162	5,057	5,113	7,262	6,605	6,684	6,572	4,458
1A4a, RM – total	10,305	5,545	5,788	7,814	7,887	13,771	13,424	7,844
	2014	2015	2016	2017	2018	2019	2020	%
1A4a, LBDR	3,563	915	602	644	746	637	556	
1A4a, RBDR	4,934	4,909	5,155	5,226	5,312	5,206	4,640	-70.8
1A4a, RM – total	8,497	5,824	5,757	5,870	6,058	5,843	5,196	-67.3

1A4b 'Residential'

The activity data for source category 1A4b 'Residential' on the LBDR are available for natural gas and LPG consumption for the period 1995-2020, and for fuelwood consumption for the period 2009-2020, respectively (Table 3-125).

Table 3-125: Fuel consumption within source category 1A4b 'Residential' on the LBDR between 1995-2020, TJ

	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
LPG	115	106	64	60	37	18	14	18	23	23	23	23	21
Natural Gas	7,334	5,533	12,014	10,889	9,928	7,378	6,650	5,939	5,980	5,512	5,580	5,458	5,106
	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
LPG	23	18	27	28	22	18	16	13	11	7	7	5	5
Natural Gas	5,079	5,282	5,902	6,247	6,234	6,115	6,098	5,939	6,288	6,456	6,742	6,217	6,122
Fuelwood, TJ	NO	92	97	90	48	42	69	98	62	48	42	74	65

Source: for fuelwood – 'Socio-economic development of the ATULBD', Chapter 'Material and energy resources'; for LPG – Statistical Yearbooks of the ATULBD; for natural gas – JSC 'Moldovagaz' through Official Letters No. 07-730 of 06.06.2007; No. 02/1-476 of 23.02.2011; No. 02/1-288 of 22.01.2014; No. 02/1-507 of 10.02.2015; No. 02/1-2183 of 03.06.2016, No. 03/2-74 of 12.01.2018. Press Release 'The State of Housing and Communal Services of the ATULBD' for the years 2011-2020

Fuel consumption within source category 1A4b 'Residential' on the RBDR between 1990 and 2020 is shown in Table 3-126.

Table 3-126: Fuel consumption within source category 1A4b 'Residential' on the RBDR between 1990-2020 , TJ

	1990	1991	1992	1993	1994	1995	1996	1997
Residual Fuel Oil	NO	1,065	7,714	NO	29	NO	NO	NO
Kerosene	431	NO	NO	26	NO	NO	NO	NO
Diesel Oil	1,191	8,593	553	15	NO	NO	29	NO
LPG	5,758	4,277	2,797	1,317	557	528	704	910
Other Petroleum Products	NO	NO	NO	NO	NO	NO	NO	NO
Anthracite	32,485	22,481	12,477	2,473	3,491	1,350	1,584	1,936
Bituminous Coal	25	506	987	1,468	2,847	440	3,199	734
Ligniite	1,916	1,348	781	214	29	29	29	29
Peat	NO	NO	NO	NO	NO	NO	NO	NO
Coke	NO	NO	NO	6	NO	NO	29	NO
Natural Gas	8,702	8,707	8,712	8,717	7,306	7,834	9,301	11,120
Fuelwood/Wood Waste	1,052	957	861	766	822	1,526	1,848	1,907
Other Solid Biomass	234	NO	NO	NO	NO	NO	NO	NO
Charcoal	NO	NO	NO	NO	NO	NO	NO	NO
	1998	1999	2000	2001	2002	2003	2004	2005
Residual Fuel Oil	NO	NO	NO	NO	NO	NO	NO	2
Kerosene	NO	NO	NO	NO	NO	NO	NO	1
Diesel Oil	29	29	59	29	NO	NO	NO	NO
LPG	910	1,144	1,320	1,232	1,936	1,934	2,098	2,079
Other Petroleum Products	NO	NO	NO	NO	NO	NO	NO	9
Anthracite	440	939	1,115	763	1,526	2,286	1,749	2,012
Bituminous Coal	558	323	147	21	NO	59	57	92
Ligniite	NO	NO	NO	NO	NO	NO	NO	NO
Peat	NO	NO	NO	NO	NO	NO	NO	NO
Coke	NO	NO	NO	NO	NO	NO	NO	NO
Natural Gas	10,152	9,389	7,599	7,775	8,186	10,288	10,693	12,096
Fuelwood/Wood Waste	1,966	1,848	1,731	1,555	1,878	1,964	1,673	1,704
Other Solid Biomass	NO	NO	29	NO	NO	17	130	214
Charcoal	NO	NO	NO	NO	NO	NO	NO	NO

	2006	2007	2008	2009	2010	2011	2012	2013
Residual Fuel Oil	NO	NO	NO	NO	NO	NO	NO	NO
Kerosene	NO	NO	NO	NO	NO	NO	NO	NO
Diesel Oil	NO	NO	NO	2	NO	11	NO	NO
LPG	1,977	2,070	1,982	1,913	1,849	2,486	2,591	2,659
Other Petroleum Products	1	3	1	1	NO	2	NO	NO
Anthracite	2,345	1,334	1,127	1,409	2,161	1,885	2,446	2,538
Bituminous Coal	45	73	42	17	7	70	17	10
Ligniite	NO	NO	NO	NO	NO	NO	NO	NO
Peat	NO	NO	NO	NO	NO	NO	NO	NO
Coke	NO	NO	NO	NO	NO	NO	NO	NO
Natural Gas	12,708	10,620	11,240	11,599	12,308	11,597	10,498	9,788
Fuelwood/Wood Waste	2,123	1,716	1,942	1,767	1,808	2,134	2,543	2,880
Other Solid Biomass	245	197	212	NO	66	419	96	134
Charcoal	NO	NO	NO	NO	NO	NO	17	11
	2014	2015	2016	2017	2018	2019	2020	%
Residual Fuel Oil	NO	NO	NO	NO	NO	NO	NO	
Kerosene	NO	NO	NO	NO	NO	NO	NO	
Diesel Oil	NO	NO	NO	NO	NO	NO	NO	
LPG	2,664	2,722	2,912	2,642	2,610	2,410	2,296	-60.1
Other Petroleum Products	NO	NO	NO	NO	NO	NO	NO	
Anthracite	1758	1,584	1,271	2,235	1,426	2,615	1,779	-94.5
Bituminous Coal	9	149	10	18	48	19	9	-64.6
Ligniite	NO	NO	1	NO	NO	1	NO	
Peat	NO	8	NO	1	NO	NO	NO	
Coke	NO	NO	NO	NO	NO	NO	NO	
Natural Gas	10,012	9,893	9,899	10,476	11,204	12,276	13,645	56.8
Fuelwood/Wood Waste	10,425	11,439	13,131	17,722	29,650	24,908	25,349	2,309.0
Other Solid Biomass	181	244	115	155	1,172	539	232	
Charcoal	NO	2	4	2	5	9	13	

Source: EBs of the RM for the year 1990 and 1993-2020.

Table 3-127 and Figure 3-21 below show the fuel consumption by type of fuel under source category 1A4b 'Residential' between 1990 and 2020. We may observe a significant decrease in liquid fuel consumption in the respective period (from 1,622 TJ in 1990 to 13 TJ in 2011, the consumption of the resepctive fuels was not recorded between 2012 and 2020); gaseous fuel consumption increased by 53% (from 14,460 TJ in 1990 to 22,068 TJ in 2020); and biofuel consumption increased by circa 20 times (from 1,287 TJ in 1990 to 25,659 TJ in 2020).

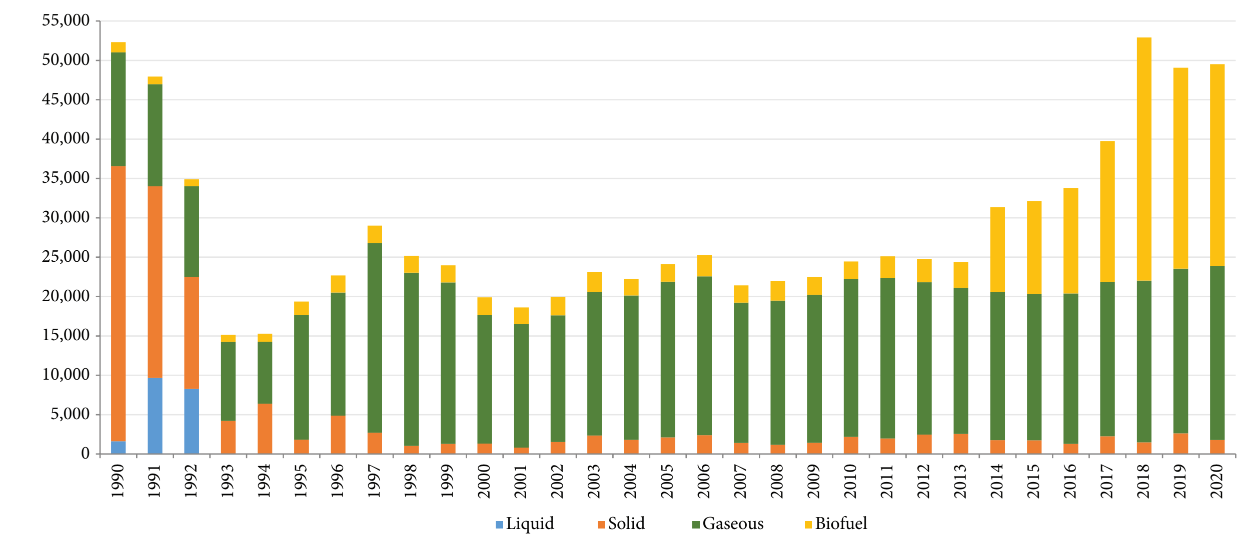


Figure 3-21: Fuel Consumption under source category 1A4b 'Residential' between 1990-2020, TJ.

Table 3-127: Consumption by type of fuel within source category 1A4b 'Residential' between 1990-2020, TJ

	1990	1991	1992	1993	1994	1995	1996	1997
Liquid Fuels	1,622	9,658	8,267	41	29	NO	29	NO
Solid Fuels	34,941	24,827	14,491	4,161	6,367	1,819	4,841	2,699
Gaseous Fuels	14,460	12,984	11,509	10,034	7,863	15,811	15,644	24,108
Biofuels	1,287	957	861	913	1,027	1,731	2,171	2,200
	1998	1999	2000	2001	2002	2003	2004	2005
Liquid Fuels	29	29	59	29	NO	NO	NO	12
Solid Fuels	998	1,262	1,262	784	1,526	2,345	1,806	2,104
Gaseous Fuels	22,011	20,498	16,315	15,671	16,079	18,225	18,326	19,778
Biofuels	2,142	2,171	2,259	2,142	2,377	2,521	2,123	2,212

	2006	2007	2008	2009	2010	2011	2012	2013
Liquid Fuels	1	3	1	3	NO	13	NO	NO
Solid Fuels	2,390	1,407	1,169	1,426	2,168	1,955	2,463	2,548
Gaseous Fuels	20,166	17,817	18,324	18,812	20,086	20,358	1,9345	18,580
Biofuels	2,708	2,184	2,466	2,254	2,208	2,780	2,977	3,231
	2014	2015	2016	2017	2018	2019	2020	%
Liquid Fuels	NO	NO	NO	NO	NO	NO	NO	-
Solid Fuels	1,767	1,741	1,282	2,254	1,474	2,635	1,788	-95
Gaseous Fuels	18,790	18,567	19,110	19,581	20,563	20,908	22,068	53
Biofuels	10,799	11,835	13,401	17,927	30,868	25,530	25,659	1,894

1A4c 'Agriculture/Forestry/Fishing'

Fuel consumption from source category 1A4c 'Agriculture/Forestry/Fishing' was considered under two sources: lA4ci 'Stationary' and 1A4cii 'Mobile' (Off-road Vehicles and Other Machinery).

1A4ci 'Stationary'

The activity data for fuel consumption in source category 1A4ci 'Stationary' on the LBDR is available for natural gas, residual fuel oil, and bituminous coal (Table 3-128).

Table 3-128: Fuel consumption within source category 1A4c 'Agriculture/Forestry/Fishing' – IA4ci 'Stationary' on the LBDR between 2003-2020, TJ

	2003	2004	2005	2006	2007	2008	2009	2010	2011
Residual Fuel Oil, TJ	NO	NO	NO	NO	NO	0.1	0.1	0.1	0.1
Natural Gas, TJ	30.5	23.7	13.5	3.4	NO	3.4	NO	3.4	3.4
Bituminous Coal, TJ	NO	NO	NO	NO	NO	0.4	0.3	0.2	0.8
	2012	2013	2014	2015	2016	2017	2018	2019	2020
Residual Fuel Oil, TJ	0.1	0.1	NO	NO	NO	NO	NO	NO	NO
Natural Gas, TJ	6.8	NO	NO	NO	NO	NO	NO	NO	NO
Bituminous Coal, TJ	0.6	0.6	0.6	0.6	0.95	0.36	0.36	0.15	0.15

Sources: for residual fuel oil – 'Socio-economic development of the ATULBD', Chapter 'Material and energy resources'; for natural gas – JSC 'Moldovagaz' by letter No. 07-730 of 06.06.2007; No. 02/1-476 of 23.02.2011; No. 02/1-288 of 22.01.2014; No. 02/1-507 of 10.02.2015; and No. 02/1-2183 of 03.06.2016, No. 03/2-74 No. 12.01.2018, answer to Letter No. 601/2017-12-03 of 14.12.2017. Press Release 'The State of Housing and Communal Services of the ATULBD' for the years 2011-2020.

Table 3-129: Fuel consumption within source category IA4ci 'Stationary' on the RBDR between 1990-2020, TJ

	1990	1991	1992	1993	1994	1995	1996	1997
Diesel Oil	1,078	1,206	720	235	59	NO	117	88
Residual Fuel Oil	241	1,005	683	200	88	NO	NO	29
Kerosene	43	3,429	2,428	246	29	29	NO	NO
Other Petroleum Products	NO	NO	NO	NO	NO	NO	NO	NO
Anthracite	561	405	250	94	59	29	29	29
Bituminous Coal	NO	3,910	3,834	120	88	59	59	NO
Lignite	NO	NO	NO	18	NO	NO	NO	NO
Natural Gas	68	67	67	67	88	147	176	352
Fuelwood/Wood Waste	36	27	18	12	29	29	29	29
Other Solid Biomass	NO	NO	NO	29	29	NO	29	117
	1998	1999	2000	2001	2002	2003	2004	2005
Diesel Oil	264	117	NO	NO	NO	NO	NO	NO
Residual Fuel Oil	NO	NO	NO	NO	NO	NO	1	3
Kerosene	NO	NO	147	205	59	29	20	9
Other Petroleum Products	NO	NO	NO	NO	NO	NO	NO	2
Anthracite	NO	NO	NO	NO	NO	NO	7	4
Bituminous Coal	29	NO	NO	NO	NO	NO	3	2
Lignite	NO	NO	NO	NO	NO	NO	NO	NO
Natural Gas	293	176	176	117	117	177	259	111
Fuelwood/Wood Waste	NO	NO	NO	29	NO	29	8	15
Other Solid Biomass	29	NO	NO	NO	NO	NO	2	7
	2006	2007	2008	2009	2010	2011	2012	2013
Diesel Oil	NO	NO	NO	1	NO	2	NO	NO
Residual Fuel Oil	2	NO	2	1	NO	1	NO	3
Kerosene	2	NO	NO	NO	NO	NO	NO	NO
Other Petroleum Products	NO	NO	NO	1	NO	NO	NO	NO
Anthracite	3	NO	1	2	2	5	NO	11
Bituminous Coal	2	2	1	NO	NO	NO	6	9
Lignite	NO	NO	NO	NO	NO	NO	NO	NO
Natural Gas	65	29	100	74	96	86	132	148
Fuelwood/Wood Waste	18	13	10	19	25	15	31	29
Other Solid Biomass	12	2	1	2	6	NO	2	3

	2014	2015	2016	2017	2018	2019	2020	%
Diesel Oil	NO	NO	NO	NO	NO	NO	NO	
Residual Fuel Oil	NO	NO	NO	NO	NO	NO	NO	
Kerosene	NO	NO	NO	NO	NO	3	3	-93.0
Other Petroleum Products	NO	1	2	4	2	NO	NO	
Anthracite	12	29	28	44	40	45	52	-90.7
Bituminous Coal	6	NO	NO	4	NO	NO	NO	
Lignite	NO	NO	NO	NO	NO	NO	NO	
Natural Gas	70	89	86	88	122	128	133	96.4
Fuelwood/Wood Waste	39	27	42	44	41	38	42	16.7
Other Solid Biomass	5	2	6	5	6	6	18	

Source: EBs of the RM for the year 1990 and 1993-2020.

Table 3-130 and Figure 3-22 below show the fuel consumption by type of fuel under source category 1A4ci 'Stationary' within 1A4c 'Agriculture/Forestry/Fishing' between 1990 and 2020. We may observe that the consumption of liquid fuels decreased in the respective period by 99.8% (from 1,363 TJ in 1990 to 3 TJ in 2020); the consumption of solid fuels decreased by 92% (from 561 TJ in 1990 to 52 TJ in 2020); the consumption of gaseous fuels increased by circa 2 times (from 68 TJ in 1990 to 133 TJ in 2020); and the consumption of biofuels increased by 66.8% (from 36 TJ in 1990 to 60 TJ in 2020).

Table 3-130: Consumption by type of fuel within source category 1A4ci 'Stationary' between 1990-2020, TJ

	1990	1991	1992	1993	1994	1995	1996	1997
Liquid Fuels	1,363	1,544	1,112	681	176	29	117	117
Solid Fuels	561	405	250	232	147	88	88	29
Gaseous Fuels	68	67	67	67	88	147	176	352
Biofuels	36	27	18	41	58	29	58	146
	1998	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**
Liquid Fuels	264	117	147	205	59	29	21	14
Solid Fuels	29	NO	NO	NO	NO	NO	10	6
Gaseous Fuels	293	176	176	117	117	177	259	111
Biofuels	29			29		29	10	22
	2006	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**
Liquid Fuels	4	NO	2	3	0	3	NO	3
Solid Fuels	5	2	2	2	2	6	7	21
Gaseous Fuels	65	29	103	74	99	89	139	148
Biofuels	30	15	11	21	31	15	33	32
	2014	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**%**
Liquid Fuels	NO	1	2	4	2	3	3	-99.8
Solid Fuels	19	30	29	48	40	45	52	-90.7
Gaseous Fuels	70	89	86	88	122	128	133	96.4
Biofuels	44	29	48	49	51	44	60	66.8

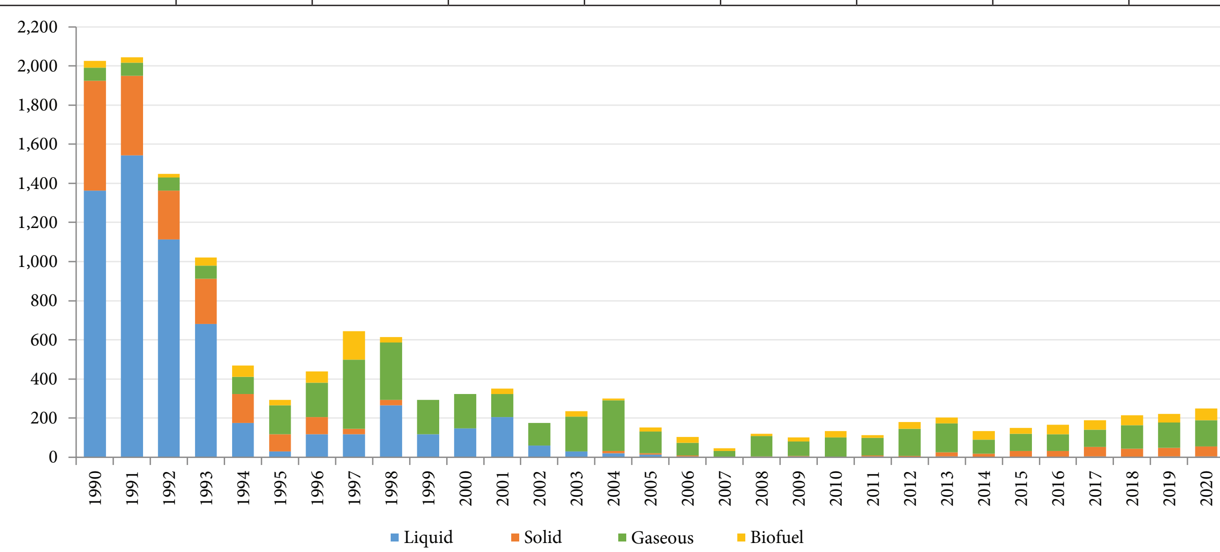


Figure 3-22: Fuel consumption under source category 1A4ci 'Agriculture/Forestry/Fishing' ('Stationary') between 1990-2020, TJ.

1A4cii 'Mobile' ('Off-Road Vehicles and Other Machinery')

For the LBDR, activity data related to fuel consumption in source category 1A4cii 'Mobile' is available for diesel oil and gasoline consumption between 1995-2015 (Table 3-131).

Table 3-131: Fuel consumption in source category 1A4cii 'Mobile' on the LBDR between 1995-2015, kt

	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
Diesel oil	26.8	21.4	28.6	22.1	20.4	14.6	14.4	11.2	7.7	6.9	4.9
Gasoline	9.7	6.1	8.9	5.8	3.1	1.8	1.7	1.2	1.3	0.8	0.6
	2006	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016-2020**
Diesel oil	4.0	2.9	2.7	3.5	7.4	8.4	9.2	10.5	10.2	9.7	NE
Gasoline	0.6	0.4	0.3	0.4	0.6	0.6	0.6	0.8	0.7	0.6	NE

Surse: Statistical Yearbooks of the ATULBD for the period 2000-2016.

Activity data for the RBDR is available on the consumption of diesel oil, gasoline and liquefied petroleum gases (Table 3-132).

Table 3-132: Fuel consumption within spurce category lA4cii 'Mobile' on the RBDR between 1990-2020, TJ

	1990	1991	1992	1993	1994	1995	1996	1997
Diesel oil	18,403	11,792	7,236	6,518	8,106	7,684	6,021	5,598
Gasoline	306	280	166	59	117	88	205	147
LPG	46	NO	NO	15	NO	NO	NO	NO
	1998	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**
Diesel oil	4,066	2,720	2,192	2,112	2,773	2,664	2,370	2,147
Gasoline	88	59	29	29	NO	NO	NO	12
LPG	NO	NO	NO	NO	NO	NO	2	2
	2006	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**
Diesel oil	2,156	1,885	1,805	1,639	1,670	1,578	1,464	1,604
Gasoline	3	6	5	6	4	11	9	NO
LPG	2	1	3	6	9	8	5	6
	2014	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**%**
Diesel oil	2,112	2,401	2,722	3,721	3,707	4,221	4,180	-77
Gasoline	15	NO	13	15	5	8	11	-96
LPG	7	5	4	6	3	3	4	-91

Table 3-133 below shows the fuel consumption by type of fuel in source category 1A4c 'Agriculture/ Forestry/Fishing' (Mobile) in the Republic of Moldova between 1990 and 2020. We may observe that the consumption of gasoline decreased in the respective period by circa 28 times, LPG consumption – by circa 12 times, diesel oil and total – circa 4 times (Table 3-133).

Table 3-133: Total fuel consumption within sources category lA4cii 'Mobile' in the RM between 1990-2020, TJ

	1990	1991	1992	1993	1994	1995	1996	1997
Diesel Oil	18,403	11,792	7,236	6,518	8,106	8,823	6,933	6,814
Gasoline	306	280	166	59	117	511	472	534
LPG	46	NO	NO	15	NO	NO	NO	NO
Total	18,755	12,072	7,402	6,592	8,223	9,334	7,405	7,349
	1998	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**
Diesel Oil	5,006	3,588	2,811	2,723	3,248	2,993	2,665	2,354
Gasoline	341	193	106	103	53	55	34	39
LPG	NO	NO	NO	NO	NO	NO	2	2
Total	5,347	3,781	2,916	2,826	3,301	3,048	2,701	2,395
	2006	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**
Diesel Oil	2,328	2,009	1,917	1,788	1,986	1,935	1,858	2,050
Gasoline	28	23	20	24	32	36	36	37
LPG	2	1	3	6	9	8	5	6
Total	2,358	2,034	1,940	1,818	2,027	1,979	1,898	2,093
	2014	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**%**
Diesel Oil	2,548	2,815	2,722	3,721	3,707	4,221	4,180	-77
Gasoline	47	28	13	15	5	8	11	-96
LPG	7	5	4	6	3	3	4	-91
Total	2,602	2,848	2,739	3,742	3,715	4,232	4,195	-78

Figure 3-23 shows the fuel consumption in the Republic of Moldova by type of fuel under 1A4cii 'Mobile' within source category 1A4c 'Agriculture/Forestry/Fishing' between 1990 and 2020.

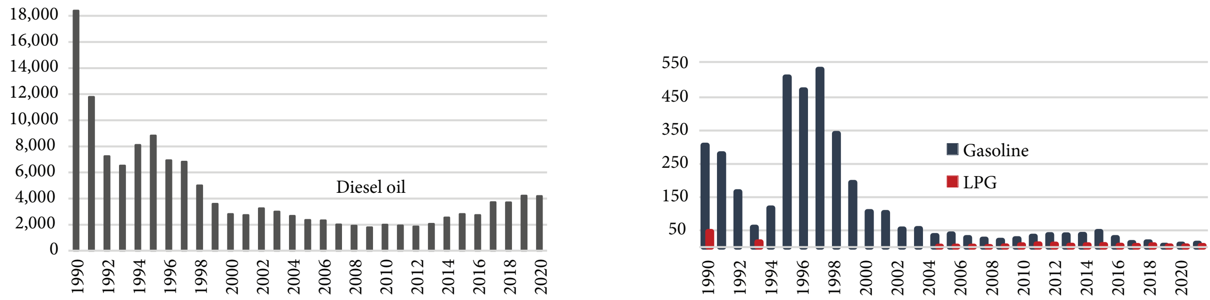


Figure 3-23: Fuel consumption in source category 1A4cii 'Mobile' between 1990-2020, TJ.

3.5.3. Uncertainties and Time Series Consistency

The primary uncertainty-related factors pertain to methodology, emission factors used to estimate GHG emissions from source category 1A4 'Other Sectors', and the quality of activity data available.

Uncertainties associated with EFs used to estimate CO_2 emissions from source category 1A4 'Other Sectors', were estimated to be circa 5%, whereas those related to EFs used to estimate CH_4 and N_2O emissions reach up to ±50%. Uncertainties associated with activity data regarding fuel consumption within source category 1A4 'Other Sectors' in the RM constitute circa 5% for CO_2 and CH_4 emissions, and circa 3% for N_2O emissions, respectively.

In view of ensuring time-series consistency of the obtained results, the same approach was used for the entire period under review, in conformity with the recommendations included in the 2006 IPCC Guidelines.

3.5.4. Quality Assurance and Quality Control

Standard verification and quality control forms and check-lists were filled in for 1A4 'Other Sectors' category, following the Tier 1 approach. To be noted, that the AD and methods used for estimating GHG emissions under source category 1A4 'Other Sectors' were documented and archived both in hard copies and electronically. In order to identify the data entry and emission estimation process related errors, verifications and quality control procedures were applied. The verification and quality control procedures applied in the calculation process for category 1A4 'Other Sectors' included:

- Verification if the same method is used for the entire range of years covered by the inventory;
- Verifying if GHG emissions calculations have been made for all years and for all types of fuels mentioned in the Energy Balances of the RM and other relevant reference sources;
- Verifying to what extent the full geographical coverage of the national GHG inventory of the RM is ensured;
- Verifying the inter-annual evolution trends of emissions by creating representative charts, while unusual fluctuations are explained;
- Verifying maintenance and completion of the national inventory of GHG emissions archive.

3.5.5. Recalculations

In the current inventory cycle, a number of measures have been taken in order to improve the quality of the national GHG inventory. The correction of the data on the consumption of bituminous coal in category 1A4b was carried out for the period 1991-1992 and, consequently, the recalculation of GHG emissions from source category 1A4 'Other Sectors'. Direct GHG emissions for 2020 were estimated for the first time. The results obtained show that between 1990 and 2020, direct GHG emissions from category 1A4 'other sectors' decreased in the RM by about 70.3% (Table 3-134).

Table 3-134: Recalculation results of GHG emissions from source category 1A4 'Other Sectors' for the period 1990-2019, included in the BUR3 of the RM to the UNFCCC (2021), kt CO_2 equivalent

	1990	1991	1992	1993	1994	1995	1996	1997
BUR3	7,841.31	6,298.74	4,246.74	2,240.23	2,227.11	2,286.22	2,411.71	2,611.65
NC5	7,841.31	6,248.30	4,221.52	2,240.23	2,227.11	2,286.22	2,411.71	2,611.65
Difference, %	0.00	-0.80	-0.59	0.00	0.00	0.00	0.00	0.00

	1998	1999	2000	2001	2002	2003	2004	2005
BUR3	2,156.43	1,875.25	1,552.95	1,488.15	1,814.59	2,161.78	2,325.26	2,283.75
NC5	2,156.43	1,875.25	1,552.95	1,488.15	1,814.59	2,161.78	2,325.26	2,283.75
Difference, %	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2006	2007	2008	2009	2010	2011	2012	2013
BUR3	2,274.88	1,721.37	1,732.08	1,881.51	2,047.36	2,375.67	2,341.96	2,021.66
NC5	2,274.88	1,721.37	1,732.08	1,881.51	2,047.36	2,375.67	2,341.96	2,021.66
Difference, %	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2014	2015	2016	2017	2018	2019	2020	%
BUR3	2,067.07	1,939.22	1,925.30	2,175.96	2,267.80	2,393.78		
NC5	2,067.07	1,939.22	1,925.30	2,175.96	2,267.80	2,393.78	2,332.06	-70.3
Difference, %	0.00	0.00	0.00	0.00	0.00	0.00		

3.5.6. Planned Improvements

Potential improvements within source category 1A4 'Other Sectors' could be possible by updating the available AD on real fuel consumption on the territory of the LBDR for all emission sources considered within this category.

3.6. Other (Category 1A5)

3.6.1. Source Category Description

Category 1A5 'Other' includes GHG emissions from fuel combustion for energy purposes and needs within Sector 1 'Energy', including military transportation. The respective category includes two emission sources: 1A5a 'Stationary' (all types of fuels, except diesel oil, gasoline, aviation gasoline and kerosene) and 1A5b 'Mobile', including 1A5bi 'Mobile' ('Aviation component') (aviation gasoline and kerosene), and 1A5biii 'Mobile' (Other) (diesel oil and gasoline).

Between 1990 and 2020, GHG emissions from source category 1A5 'Other' recorded a downward trend, decreasing by circa 80.5%: from circa 115.57 kt CO_2 equivalent in 1990 to circa 22.49 kt CO_2 equivalent in 2020 (Table 3-135).

Table 3-135: Total direct GHG emissions from source category 1A5 'Other' between 1990-2020

	1990	1991	1992	1993	1994	1995	1996	1997
1A5, kt CO_2 equivalent	115.5701	107.5724	78.5337	94.3265	89.0194	126.5495	82.8034	77.4557
%, compared to 1990	100.0	93.1	68.0	81.6	77.0	109.5	71.6	67.0
	1998	1999	2000	2001	2002	2003	2004	2005
1A5, kt CO_2 equivalent	73.6783	49.8010	36.8044	43.8813	40.1303	28.8076	28.0207	26.2833
%, compared to 1990	63.8	43.1	31.8	38.0	34.7	24.9	24.2	22.7
	2006	2007	2008	2009	2010	2011	2012	2013
1A5, kt CO_2 equivalent	39.4920	45.1203	44.1742	10.5966	27.5201	19.9471	7.0060	2.3899
%, compared to 1990	34.2	39.0	38.2	9.2	23.8	17.3	6.1	2.1
	2014	2015	2016	2017	2018	2019	2020	%
1A5, kt CO_2 equivalent	25.1618	22.8721	22.9905	22.7351	23.4607	22.9770	22.4933	-80.5
%, compared to 1990	21.8	19.8	19.9	19.7	20.3	19.9	19.5	

The table below shows the evolution of direct and indirect GHG emissions from 1A5 'Other' (Table 3-136).

Table 3-136: Evolution of direct and indirect GHG emissions from source category 1A5 'Other' fo between 1990-2020

	1A5, kt							%, compared to 1990						
	CO_2	CH_4	N_2O	NO_x	CO	NMVOC	SO_2	CO_2	CH_4	N_2O	NO_x	CO	NMVOC	SO_2
1990	113.9722	0.0109	0.0044	0.7597	0.8286	0.1226	0.3055	100.0	100.0	100.0	100.0	100.0	100.0	100.0
1991	106.3685	0.0072	0.0034	0.6579	0.6170	0.0855	0.2778	93.3	66.4	77.2	86.6	74.5	69.8	90.9
1992	77.7474	0.0046	0.0023	0.4776	0.3429	0.0514	0.1606	68.2	42.3	50.6	62.9	41.4	42.0	52.6
1993	93.4518	0.0058	0.0024	0.4591	0.6253	0.0853	0.3437	82.0	53.4	55.0	60.4	75.5	69.6	112.5
1994	88.3648	0.0069	0.0016	0.3325	0.6071	0.0863	0.2592	77.5	63.0	36.4	43.8	73.3	70.4	84.8
1995	125.6438	0.0104	0.0022	0.5138	0.6299	0.1015	0.2639	110.2	95.0	48.8	67.6	76.0	82.8	86.4
1996	81.8376	0.0109	0.0023	0.4423	0.4659	0.0987	0.2016	71.8	100.1	52.3	58.2	56.2	80.6	66.0
1997	76.6587	0.0081	0.0020	0.2875	0.4997	0.0785	0.2051	67.3	74.0	44.9	37.8	60.3	64.1	67.1
1998	72.8283	0.0088	0.0021	0.3919	0.5862	0.1041	0.2088	63.9	81.1	47.4	51.6	70.7	84.9	68.3
1999	49.1563	0.0065	0.0016	0.1458	0.3630	0.0640	0.1625	43.1	59.6	36.4	19.2	43.8	52.3	53.2

	1A5, kt							%, compared to 1990						
	CO_2	CH_4	N_2O	NO_x	CO	NMVOC	SO_2	CO_2	CH_4	N_2O	NO_x	CO	NMVOC	SO_2
2000	36.3881	0.0046	0.0010	0.1311	0.2320	0.0421	0.1523	31.9	42.0	22.8	17.2	28.0	34.4	49.8
2001	43.3961	0.0050	0.0012	0.1565	0.3569	0.0605	0.1061	38.1	46.0	27.2	20.6	43.1	49.4	34.7
2002	39.4529	0.0083	0.0016	0.1411	0.2860	0.0683	0.1543	34.6	76.2	35.4	18.6	34.5	55.7	50.5
2003	28.4228	0.0043	0.0009	0.1427	0.2811	0.0524	0.1085	24.9	39.0	21.0	18.8	33.9	42.8	35.5
2004	27.6373	0.0031	0.0010	0.2161	0.2875	0.0472	0.0392	24.2	28.7	23.0	28.4	34.7	38.5	12.8
2005	25.9403	0.0024	0.0010	0.2301	0.1272	0.0300	0.0418	22.8	21.8	21.4	30.3	15.3	24.5	13.7
2006	39.0397	0.0029	0.0013	0.3325	0.4037	0.0635	0.1212	34.3	26.5	28.7	43.8	48.7	51.8	39.7
2007	44.5097	0.0039	0.0017	0.3855	0.3075	0.0552	0.0983	39.1	35.8	38.7	50.7	37.1	45.1	32.2
2008	43.6263	0.0036	0.0015	0.3223	0.3060	0.0503	0.1167	38.3	33.1	34.5	42.4	36.9	41.0	38.2
2009	10.4909	0.0011	0.0003	0.1018	0.1540	0.0251	0.0182	9.2	10.5	5.8	13.4	18.6	20.5	5.9
2010	27.2976	0.0023	0.0006	0.1245	0.2519	0.0434	0.0991	24.0	21.3	12.4	16.4	30.4	35.4	32.4
2011	19.7881	0.0013	0.0004	0.1531	0.3469	0.0449	0.0879	17.4	11.7	9.6	20.2	41.9	36.7	28.8
2012	6.9350	0.0006	0.0002	0.0536	0.1342	0.0157	0.0047	6.1	5.5	4.2	7.1	16.2	12.8	1.5
2013	2.3497	0.0003	0.0001	0.0403	0.0297	0.0037	0.0003	2.1	2.6	2.5	5.3	3.6	3.0	0.1
2014	25.0067	0.0006	0.0005	0.0516	0.2560	0.0237	0.2011	21.9	5.3	10.6	6.8	30.9	19.4	65.8
2015	22.7360	0.0005	0.0004	0.0475	0.2309	0.0216	0.1861	19.9	4.4	9.4	6.3	27.9	17.6	60.9
2016	22.8586	0.0005	0.0004	0.0476	0.2260	0.0221	0.1923	20.1	4.2	9.1	6.3	27.3	18.0	63.0
2017	22.6223	0.0002	0.0004	0.0414	0.2226	0.0212	0.2009	19.8	2.2	8.1	5.4	26.9	17.3	65.7
2018	23.3443	0.0002	0.0004	0.0427	0.2297	0.0219	0.2073	20.5	2.3	8.3	5.6	27.7	17.9	67.8
2019	22.8629	0.0002	0.0004	0.0418	0.2250	0.0215	0.2030	20.1	2.2	8.2	5.5	27.2	17.5	66.4
2020	22.3816	0.0002	0.0004	0.0409	0.2203	0.0210	0.1987	19.6	2.2	8.0	5.4	26.6	17.1	65.0

In 2020, direct and indirect GHG emissions from source category 1A5 'Other' constituted: CO_2 emissions – circa 19.6% percent of the level recorded in the base year (1990), whereas emissions of CH_4 – 2.2%, N_2O – 8.0%, NO_x – 5.4%, CO – 26.6%, NMVOC – 17.1%, and SO_2 – 65.0%.

The largest share in the structure of total direct GHG emissions is carbon dioxide, followed by nitrous oxide and methane (Table 3-137).

Table 3-137: Evolution of direct GHG emissions from source category 1A5 'Other' between 1990-2020

	1A5, kt CO_2 equivalent				Share of total, %		
	CO_2	CH_4	N_2O	Total	CO_2	CH_4	N_2O
1990	113.9722	0.2726	1.3253	115.5701	98.6	0.2	1.1
1991	106.3685	0.1809	1.0231	107.5724	98.9	0.2	1.0
1992	77.7474	0.1152	0.6712	78.5337	99.0	0.1	0.9
1993	93.4518	0.1456	0.7291	94.3265	99.1	0.2	0.8
1994	88.3648	0.1716	0.4830	89.0194	99.3	0.2	0.5
1995	125.6438	0.2589	0.6468	126.5495	99.3	0.2	0.5
1996	81.8376	0.2730	0.6929	82.8034	98.8	0.3	0.8
1997	76.6587	0.2017	0.5953	77.4557	99.0	0.3	0.8
1998	72.8283	0.2211	0.6289	73.6783	98.8	0.3	0.9
1999	49.1563	0.1623	0.4823	49.8010	98.7	0.3	1.0
2000	36.3881	0.1145	0.3018	36.8044	98.9	0.3	0.8
2001	43.3961	0.1253	0.3599	43.8813	98.9	0.3	0.8
2002	39.4529	0.2076	0.4698	40.1303	98.3	0.5	1.2
2003	28.4228	0.1063	0.2785	28.8076	98.7	0.4	1.0
2004	27.6373	0.0782	0.3052	28.0207	98.6	0.3	1.1
2005	25.9403	0.0595	0.2836	26.2833	98.7	0.2	1.1
2006	39.0397	0.0722	0.3801	39.4920	98.9	0.2	1.0
2007	44.5097	0.0975	0.5132	45.1203	98.6	0.2	1.1
2008	43.6263	0.0901	0.4578	44.1742	98.8	0.2	1.0
2009	10.4909	0.0286	0.0771	10.5966	99.0	0.3	0.7
2010	27.2976	0.0579	0.1646	27.5201	99.2	0.2	0.6
2011	19.7881	0.0318	0.1273	19.9471	99.2	0.2	0.6
2012	6.9350	0.0149	0.0562	7.0060	99.0	0.2	0.8
2013	2.3497	0.0071	0.0332	2.3899	98.3	0.3	1.4
2014	25.0067	0.0145	0.1406	25.1618	99.4	0.1	0.6
2015	22.7360	0.0120	0.1241	22.8721	99.4	0.1	0.5
2016	22.8586	0.0116	0.1204	22.9905	99.4	0.1	0.5
2017	22.6223	0.0060	0.1069	22.7351	99.5	0.0	0.5
2018	23.3443	0.0062	0.1103	23.4607	99.5	0.0	0.5
2019	22.8629	0.0060	0.1080	22.9770	99.5	0.0	0.5
2020	22.3816	0.0059	0.1058	22.4933	99.5	0.0	0.5

The table and figure below show the evolution of GHG emissions from source category 1A5 'Other' (1A5a 'Stationary' and 1A5b 'Mobile') for the period 1990-2020. In the base year, circa 36.5% of the total emissions originated from the stationary combustion of fuels and circa 63.5% – from mobile combustion of fuels; by 2020, the share of emissions from stationary combustion increased up to 100%, while the those from mobile combustion decreased to zero (Table 3-138, Figure 3-24).

Table 3-138: Direct GHG emissions, disaggregated by source, from source category 1A5 'Other' between 1990-2020

	1A5a 'Stationary', kt				1A5b 'Mobile', kt				1A5, kt	Share, % of total		
	CO_2	CH_4	N_2O	Total	CO_2	CH_4	N_2O	Total	Total	1A5a	1A5b	1A5
1990	41.9609	0.0495	0.2192	42.2296	72.0113	0.2231	1.1061	73.3405	115.5701	36.5	63.5	100.0
1991	51.5108	0.0285	0.1772	51.7165	54.8577	0.1524	0.8458	55.8559	107.5724	48.1	51.9	100.0
1992	42.5895	0.0304	0.1268	42.7466	35.1579	0.0848	0.5444	35.7871	78.5337	54.4	45.6	100.0
1993	62.1343	0.0514	0.2476	62.4333	31.3175	0.0942	0.4816	31.8933	94.3265	66.2	33.8	100.0
1994	71.3256	0.0658	0.2309	71.6223	17.0392	0.1058	0.2521	17.3971	89.0194	80.5	19.5	100.0
1995	104.4054	0.1242	0.3331	104.8627	21.2384	0.1347	0.3137	21.6868	126.5495	82.9	17.1	100.0
1996	58.7906	0.1551	0.3473	59.2930	23.0470	0.1179	0.3456	23.5105	82.8034	71.6	28.4	100.0
1997	51.7920	0.0769	0.2220	52.0909	24.8668	0.1247	0.3733	25.3648	77.4557	67.3	32.7	100.0
1998	50.4380	0.1194	0.2908	50.8482	22.3903	0.1018	0.3380	22.8301	73.6783	69.0	31.0	100.0
1999	30.9893	0.0815	0.2077	31.2785	18.1670	0.0809	0.2746	18.5225	49.8010	62.8	37.2	100.0
2000	26.5856	0.0532	0.1569	26.7957	9.8025	0.0613	0.1450	10.0087	36.8044	72.8	27.2	100.0
2001	28.7767	0.0569	0.1395	28.9731	14.6194	0.0684	0.2204	14.9082	43.8813	66.0	34.0	100.0
2002	25.3685	0.1186	0.2617	25.7488	14.0844	0.0890	0.2081	14.3815	40.1303	64.2	35.8	100.0
2003	20.4111	0.0668	0.1581	20.6360	8.0117	0.0395	0.1204	8.1716	28.8076	71.6	28.4	100.0
2004	11.3982	0.0249	0.0563	11.4794	16.2391	0.0534	0.2489	16.5414	28.0207	41.0	59.0	100.0
2005	11.6992	0.0278	0.0626	11.7896	14.2411	0.0317	0.2210	14.4938	26.2833	44.9	55.1	100.0
2006	21.4826	0.0322	0.1078	21.6226	17.5571	0.0400	0.2723	17.8694	39.4920	54.8	45.2	100.0
2007	17.7980	0.0339	0.0994	17.9313	26.7117	0.0636	0.4138	27.1890	45.1203	39.7	60.3	100.0
2008	20.3604	0.0277	0.0986	20.4867	23.2659	0.0625	0.3591	23.6875	44.1742	46.4	53.6	100.0
2009	7.4748	0.0147	0.0316	7.5211	3.0161	0.0139	0.0455	3.0755	10.5966	71.0	29.0	100.0
2010	23.7958	0.0413	0.1118	23.9490	3.5018	0.0166	0.0527	3.5712	27.5201	87.0	13.0	100.0
2011	15.9259	0.0173	0.0690	16.0122	3.8622	0.0145	0.0583	3.9350	19.9471	80.3	19.7	100.0
2012	3.5864	0.0024	0.0056	3.5943	3.3486	0.0125	0.0506	3.4116	7.0060	51.3	48.7	100.0
2013	0.2064	0.0002	0.0005	0.2071	2.1433	0.0069	0.0327	2.1828	2.3899	8.7	91.3	100.0
2014	22.8029	0.0062	0.1073	22.9163	2.2039	0.0084	0.0332	2.2455	25.1618	91.1	8.9	100.0
2015	21.0924	0.0057	0.0993	21.1974	1.6436	0.0063	0.0248	1.6747	22.8721	92.7	7.3	100.0
2016	21.6596	0.0057	0.1023	21.7677	1.1989	0.0058	0.0180	1.2228	22.9905	94.7	5.3	100.0
2017	22.6223	0.0060	0.1069	22.7351	NO,NE	NO,NE	NO,NE	NO,NE	22.7351	100.0	NO, NE	100.0
2018	23.3443	0.0062	0.1103	23.4607	NO,NE	NO,NE	NO,NE	NO,NE	23.4607	100.0	NO, NE	100.0
2019	22.8629	0.0060	0.1080	22.9770	NO,NE	NO,NE	NO,NE	NO,NE	22.9770	100.0	NO, NE	100.0
2020	22.3816	0.0059	0.1058	22.4933	NO,NE	NO,NE	NO,NE	NO,NE	22.4933	100.0	NO, NE	100.0

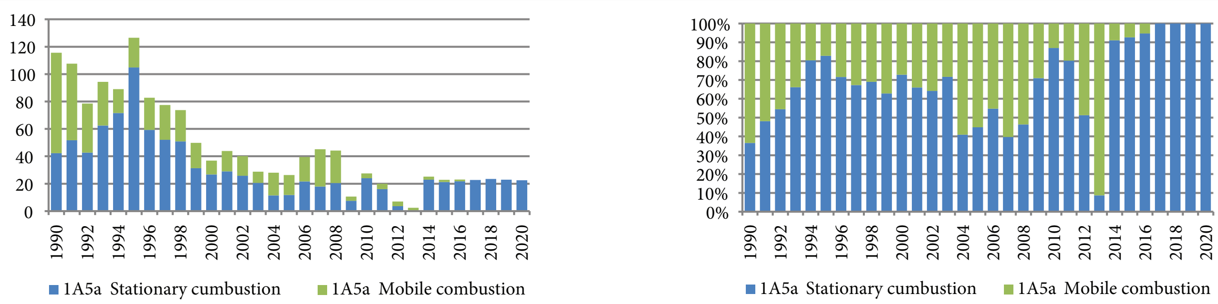


Figure 3-24: Direct GHG emissions from source category 1A5 'Other' in the RM between 1990-2020, kt CO_2 equivalent.

Table 3-139 below shows the evolution of direct and indirect GHG emissions from category 1A5 'Other' by emission source.

Table 3-139: Evolution of direct and indirect GHG emissions from category 1A5 'Other', disaggregated by source, kt

	1A5a 'Stationary'							1A5b 'Mobile'						
	CO_2	CH_4	N_2O	NO_x	CO	NMVOC	SO_2	CO_2	CH_4	N_2O	NO_x	CO	NMVOC	SO_2
1990	41.9609	0.0020	0.0007	0.0908	0.3458	0.0459	0.2890	72.0113	0.0089	0.0037	0.6690	0.4828	0.0767	0.0165
1991	51.5108	0.0011	0.0006	0.1355	0.2916	0.0316	0.2649	54.8577	0.0061	0.0028	0.5224	0.3255	0.0539	0.0128
1992	42.5895	0.0012	0.0004	0.1334	0.1655	0.0202	0.1522	35.1579	0.0034	0.0018	0.3442	0.1774	0.0313	0.0084
1993	62.1343	0.0021	0.0008	0.1586	0.3875	0.0485	0.3369	31.3175	0.0038	0.0016	0.3005	0.2378	0.0369	0.0068
1994	71.3256	0.0026	0.0008	0.1867	0.3052	0.0469	0.2561	17.0392	0.0042	0.0008	0.1458	0.3020	0.0394	0.0031
1995	104.4054	0.0050	0.0011	0.3366	0.3173	0.0599	0.2593	21.2384	0.0054	0.0011	0.1771	0.3125	0.0416	0.0046
1996	58.7906	0.0062	0.0012	0.2011	0.2969	0.0717	0.1964	23.0470	0.0047	0.0012	0.2412	0.1689	0.0271	0.0051
1997	51.7920	0.0031	0.0007	0.1428	0.2585	0.0462	0.2014	24.8668	0.0050	0.0013	0.1447	0.2412	0.0324	0.0038
1998	50.4380	0.0048	0.0010	0.1495	0.2909	0.0624	0.2034	22.3903	0.0041	0.0011	0.2424	0.2953	0.0417	0.0054
1999	30.9893	0.0033	0.0007	0.0812	0.2285	0.0465	0.1608	18.1670	0.0032	0.0009	0.0645	0.1345	0.0175	0.0017

	1A5a 'Stationary'							1A5b 'Mobile'						
	CO_2	CH_4	N_2O	NO_x	CO	NMVOC	SO_2	CO_2	CH_4	N_2O	NO_x	CO	NMVOC	SO_2
2000	26.5856	0.0021	0.0005	0.0540	0.2033	0.0364	0.1515	9.8025	0.0025	0.0005	0.0770	0.0287	0.0057	0.0008
2001	28.7767	0.0023	0.0005	0.0593	0.1541	0.0341	0.1047	14.6194	0.0027	0.0007	0.0973	0.2027	0.0264	0.0014
2002	25.3685	0.0047	0.0009	0.0632	0.2530	0.0620	0.1534	14.0844	0.0036	0.0007	0.0779	0.0330	0.0063	0.0008
2003	20.4111	0.0027	0.0005	0.0565	0.1610	0.0359	0.1069	8.0117	0.0016	0.0004	0.0862	0.1201	0.0166	0.0017
2004	11.3982	0.0010	0.0002	0.0210	0.0596	0.0148	0.0372	16.2391	0.0021	0.0008	0.1951	0.2280	0.0324	0.0019
2005	11.6992	0.0011	0.0002	0.0215	0.0654	0.0163	0.0405	14.2411	0.0013	0.0007	0.2086	0.0618	0.0137	0.0013
2006	21.4826	0.0013	0.0004	0.0397	0.1547	0.0256	0.1197	17.5571	0.0016	0.0009	0.2928	0.2491	0.0379	0.0015
2007	17.7980	0.0014	0.0003	0.0335	0.1302	0.0238	0.0962	26.7117	0.0025	0.0014	0.3520	0.1773	0.0315	0.0020
2008	20.3604	0.0011	0.0003	0.0393	0.1450	0.0228	0.1147	23.2659	0.0025	0.0012	0.2830	0.1610	0.0274	0.0020
2009	7.4748	0.0006	0.0001	0.0162	0.0299	0.0081	0.0181	3.0161	0.0006	0.0002	0.0856	0.1241	0.0170	0.0000
2010	23.7958	0.0017	0.0004	0.0438	0.1389	0.0278	0.0991	3.5018	0.0007	0.0002	0.0806	0.1130	0.0156	0.0000
2011	15.9259	0.0007	0.0002	0.0276	0.1091	0.0164	0.0878	3.8622	0.0006	0.0002	0.1255	0.2378	0.0285	0.0001
2012	3.5864	0.0001	0.0000	0.0057	0.0070	0.0019	0.0046	3.3486	0.0005	0.0002	0.0479	0.1273	0.0138	0.0000
2013	0.2064	0.0000	0.0000	0.0008	0.0002	0.0001	0.0003	2.1433	0.0003	0.0001	0.0395	0.0295	0.0036	0.0000
2014	22.8029	0.0002	0.0004	0.0421	0.2229	0.0213	0.2011	2.2039	0.0003	0.0001	0.0095	0.0331	0.0025	0.0000
2015	21.0924	0.0002	0.0003	0.0389	0.2062	0.0197	0.1861	1.6436	0.0003	0.0001	0.0086	0.0247	0.0019	0.0000
2016	21.6596	0.0002	0.0003	0.0396	0.2132	0.0203	0.1923	1.1989	0.0002	0.0001	0.0080	0.0128	0.0017	0.0000
2017	22.6223	0.0002	0.0004	0.0414	0.2226	0.0212	0.2009	NO, NE	NO, NE	NO, NE	NO, NE	NO, NE	NO, NE	NO, NE
2018	23.3443	0.0002	0.0004	0.0427	0.2297	0.0219	0.2073	NO, NE	NO, NE	NO, NE	NO, NE	NO, NE	NO, NE	NO, NE
2019	22.8629	0.0002	0.0004	0.0418	0.2250	0.0215	0.2030	NO, NE	NO, NE	NO, NE	NO, NE	NO, NE	NO, NE	NO, NE
2020	22.3816	0.0002	0.0004	0.0409	0.2203	0.0210	0.1987	NO, NE	NO, NE	NO, NE	NO, NE	NO, NE	NO, NE	NO, NE

3.6.2. Methodological Issues, Emission Factors and Activity Data

Direct GHG emissions originating from source category 1A5 'Other' were estimated following a Tier 1 methodology, available in the 2006 IPCC Guidelines, based on AD on fuel consumption and default emission factors. In order to estimate non-CO_2 emissions, default emission factors were used, available in the EMEP/EEA Air Pollutant Emission Inventory (2019) (Table 3-140).

Table 3-140: Emission factors utilised for the estimation of GHG emissions from source category 1A5 'Other', kg/TJ – for direct GHGs and kg/t fuel – for indirect GHGs

	Emission Factors							Reference sources for:	
	kg/TJ			kg/t fuel					
	CO_2	CH_4	N_2O	NO_x	CO	NMVOC	SO_2	CO_2, CH_4, N_2O	NO_x, CO, NMVOC and SO_2
1A5a 'Stationary'									
Anthracite	98,300	1	1.5	173	931	88.8	840	2006 IPCC Guidelines, Volume 2, Table 2.2	EMEP/EEA Guidebook (2019), Categories 1.A.4.a/c, 1.A.5.a, Table 3.7
Brown Coal, Lignite	101,000	1	1.5	173	931	88.8	840		
Other Bituminous Coal	94,600	1	1.5	173	931	88.8	840		
Coke	107,000	1	1.5	173	931	88.8	840		
Fuel for Oven	71,900	3	0.6	306	93	20	94		EMEP/EEA Guidebook (2019), Categories 1.A.4.a/c, 1.A.5.a, Table 3.9
Residual Fuel Oil	77,400	3	0.6	306	93	20	94		
Kerosene	71,900	3	0.6	306	93	20	94		
Other Petroleum Products	73,300	3	0.6	306	93	20	94		
Natural Gas	56,100	1	0.1	74	29	23	0.67		EMEP/EEA Guidebook (2019), Categories 1.A.4.a/c, 1.A.5.a, Table 3.8
LPG	63,100	1	0.1	74	29	23	0.67		
Fuelwood	112,000	30	4	91	570	300	11		EMEP/EEA Guidebook (2019), Categories 1.A.4.a/c, 1.A.5.a, Table 3.10
Other types of Fuel	112,000	30	4	91	570	300	11		
Wood Waste	100,000	30	4	91	570	300	11		
Agricultural Residues	100,000	30	4	91	570	300	11		
Charcoal	112,000	30	4	91	570	300	11		
Pellets and Briquettes and other Vegetable Waste	100,000	30	4	91	570	300	11		
Biogas	54,600	1	0.1	74	29	23	0.67		EMEP/EEA Guidebook (2019), Categories 1.A.4.a/c, 1.A.5.a, Table 3.8
1A5bi 'Mobile' ('Aviation component')									
Aviation Gasoline	70,000	0.5	2	4	1,200	19	1	2006 IPCC Guidelines, Volume 2, Table 3.6.4 and Table 3.6.5	EMEP/EEA Guidebook (2019), Categories 1.A.3.a, 1.A.5.b, 1.A.3.a.ii.(i), Table 3.3
Kerosene	71,500	0.5	2	4	1,200	19	1		
1A5biii 'Mobile' ('Other')									
Gasoline	69,300	33	3.2	8.73	84.7	10.05	-	2006 IPCC Guidelines, Volume 2, Table 3.2.1 and Table 3.2.2	EMEP/EEA Guidebook (2019), Categories 1.A.3.b.i, 1.A.3.b.ii, 1.A.3.b.iii, 1.A.3.b.iv Table 3.5 and Table. 3.6. SO_2 emissions are calculated for each year separately based on formula No. 2 and Table 3-14
Diesel Oil	74,100	3.9	3.9	33.37	7.58	1.92	-		

The Energy Balances of the RM (Chapter S.2.1 'Consumed as Fuel or Energy' and columns: 'For Other Works and Needs' and 'Use for other purposes') represented the main source of reference for AD associated with fuel consumption on the territory of the RBDR. Another relevant reference source was the Ministry of Defence of the RM, which provides information on fuel combustion for military transportation. The activity data associated with fuel consumption on the territory of the LBDR was collected from the Statistical Publications of the ATULBD (available for a single type of fuel – coal) for the period 2014-2020 (Table 3-141).

Table 3-141: Fuel consumption within source category 1A5 'Other' on the LBDR between 2014-2020

	2014	2015	2016	2017	2018	2019	2020
Other Bituminous Coal, TJ	239.136	221.328	228.960	239.136	246.768	241.680	236.592
Other Bituminous Coal, kt	9.4	8.7	9.0	9.4	9.7	9.5	9.3

Activity data associated with fuel consumption within category 1A5 'Other', by emission source, is available in Tables 3-142, 3-143, 3-144 and Figure 3-25.

Table 3-142: Fuel consumption within source category 1A5 'Other' ('Stationary') between 1990 and 2020, TJ

	1990	1991	1992	1993	1994	1995	1996	1997
Anthracite	334.1	238.1	142.0	46.0	59.0	88.0	60.0	60.0
Brown Coal	NO	46.7	NO	91.0	29.0	29.0	30.0	30.0
Other Bituminous Coal	NO	NO	NO	230.0	144.5	59.0	85.0	116.0
Coke	NO	NO	NO	3.0	29.0	30.0	1.0	NO
Kerosene for Oven	43.1	NO	NO	NO	NO	NO	NO	NO
Residual Fuel Oil	40.2	273.4	349.7	27.0	264.0	850.0	411.0	264.0
Kerosene	NO	NO	NO	247.0	118.0	59.0	88.0	29.0
Other Petroleum Products	NO	NO	NO	NO	NO	NO	NO	NO
Natural Gas	NO	NO	NO	100.0	235.0	118.0	30.0	117.0
LPG	46.1	35.4	24.7	14.0	59.0	117.0	30.0	44.5
Fuelwood	45.0	NO	NO	13.0	30.0	30.0	89.0	30.0
Other types of Fuel	NO	NO	NO	NO	NO	NO	30.0	1.0
Wood Waste	NO	NO	NO	12.0	1.0	30.0	30.0	30.0
Agriculture Residues	NO	NO	NO	NO	NO	NO	NO	NO
Total	**508.5**	**593.5**	**516.5**	**783.0**	**968.5**	**1,410**	**884.0**	**721.5**
	1998	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**
Anthracite	30.0	30.0	30.0	59.0	58.0	1.0	16.0	27.0
Brown Coal	59.0	29.0	29.0	NO	NO	NO	NO	NO
Other Bituminous Coal	88.0	118.0	88.0	58.0	118.0	116.0	26.0	20.0
Coke	29.0	NO	29.0	NO	NO	NO	1.0	NO
Residual Fuel Oil	161.5	59.0	30.0	59.0	41.0	23.0	5.0	3.0
Kerosene	147.0	59.0	1.0	1.0	1.0	59.0	2.0	2.0
Other Petroleum Products	NO	NO	NO	NO	NO	NO	1.0	1.0
Natural Gas	59.0	59.0	89.0	30.0	60.0	58.0	104.0	106.0
LPG	59.0	29.0	30.0	177.0	30.0	1.0	13.0	12.0
Fuelwood	88.0	59.0	29.0	30.0	87.0	59.0	24.0	24.0
Other types of Fuel	NO	NO	NO	NO	29.0	NO	NO	NO
Wood Waste	29.5	29.0	29.0	29.0	29.0	16.0	3.0	7.0
Agriculture Residues	NO	NO	NO	NO	NO	NO	NO	NO
Total	**750.0**	**471.0**	**384.0**	**443.0**	**453.0**	**333.0**	**195.0**	**202.0**
	2006	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**
Anthracite	33.0	98.0	49.0	13.0	25.0	30.0	5.0	NO, NE
Other Bituminous Coal	108.0	15.0	85.0	5.0	90.0	74.0	NO, NE	NO, NE
Coke	NO	NO	NO	1.0	NO	NO	NO	NO
Residual Fuel Oil	7.0	7.0	18.0	20.0	19.0	1.0	3.0	2.7
Kerosene	1.0	1.0	1.0	1.0	1.0	1.0	1.0	NO
Other Petroleum Products	1.0	1.0	NO	NO	NO	NO	NO	NO
Natural Gas	115.0	90.0	93.0	60.0	83.0	87.0	34.0	NO, NE
LPG	14.0	16.0	13.0	10.0	105.0	15.0	14.0	NO, NE
Fuelwood	27.0	26.0	23.0	9.0	28.0	12.0	NO	NO, NE
Wood Waste	4.0	10.0	3.0	5.5	8.0	2.0	1.0	NO, NE
Agriculture Residues	2.0	1.0	1.0	NO	7.0	2.0	NO, NE	NO, NE
Total	**312.0**	**265.0**	**286.0**	**124.5**	**366.0**	**224.0**	**58.0**	**2.7**
	2014	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**
Anthracite	NO, NE	NO, NE	NO, NE	NO, NE	NO, NE	NO, NE	NO, NE	N/A
Other Bituminous Coal	239.1	221.3	229.0	239.1	246.8	241.7	236.6	N/A
Residual Fuel Oil	2.3	2.0	NO, NE	NO, NE	NO, NE	NO, NE	NO, NE	N/A
Kerosene	NO, NE	NO, NE	NO, NE	NO, NE	NO, NE	NO, NE	NO, NE	N/A
Natural Gas	NO, NE	NO, NE	NO, NE	NO, NE	NO, NE	NO, NE	NO, NE	N/A
LPG	NO, NE	NO, NE	NO, NE	NO, NE	NO, NE	NO, NE	NO, NE	N/A
Fuelwood	NO, NE	NO, NE	NO, NE	NO, NE	NO, NE	NO, NE	NO, NE	N/A
Wood Waste	NO, NE	NO, NE	NO, NE	NO, NE	NO, NE	NO, NE	NO, NE	N/A
Agriculture Residues	NO, NE	NO, NE	NO, NE	NO, NE	NO, NE	NO, NE	NO, NE	N/A
Total	**241.5**	**223.3**	**229**	**239.1**	**246.8**	**241.7**	**236.6**	**N/A**

Table 3-143: Fuel consumption within category 1A5bi 'Mobile' ('Aviation component') between 2011 and 2020

	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Aviation Gasoline, TJ	0.9169	0.7859	0.3297	0.5175	0.4366	NO, NE	NO, NE	NO, NE	NO, NE	NO, NE
Aviation Gasoline, kt	0.0210	0.0180	0.0080	0.0120	0.0100	NO, NE	NO, NE	NO, NE	NO, NE	NO, NE
Kerosene, TJ	0.1294	0.0863	0.0346	0.0910	NO, NE	NO, NE	NO, NE	NO, NE	NO, NE	NO, NE
Kerosene, kt	0.0030	0.0020	0.0010	0.0020	NO, NE	NO, NE	NO, NE	NO, NE	NO, NE	NO, NE

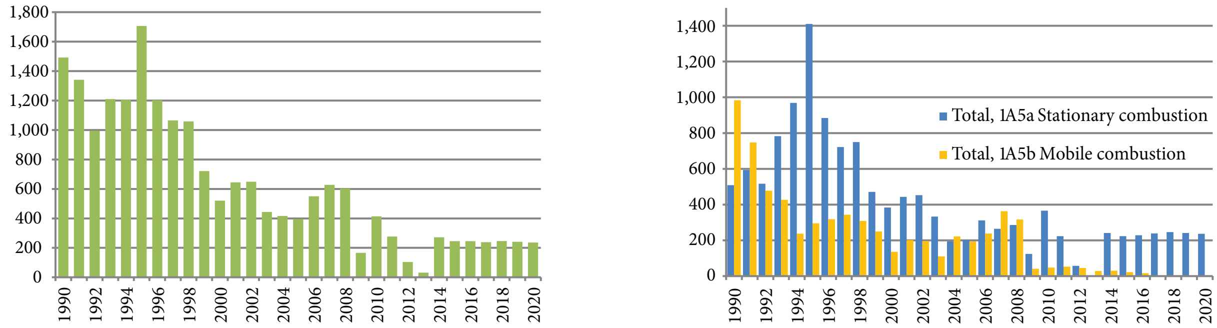


Figure 3-25: Total fuel consumption within source category 1A5 'Other' in 1990-2020 years, TJ.

Table 3-144: Fuel consumption within 1A5biii 'Mobile' (Other) source category between 1990-2020

	1990	1991	1992	1993	1994	1995	1996	1997
Gasoline, TJ	174.88	109.30	52.46	72.28	113.65	145.49	119.33	125.41
Gasoline, kt	4.00	2.50	1.20	2.05	3.25	3.29	1.38	2.52
Diesel Oil (including for 'Fuel for Oven' and 'Fuel for Engines'), TJ	808.26	638.10	425.40	355.04	123.66	150.56	199.42	218.30
Diesel Oil (including for 'Fuel for Oven' and 'Fuel for Engines'), kt	19.00	15.00	10.00	8.47	3.52	4.45	6.87	3.68
	1998	1999	2000	2001	2002	2003	2004	2005
Gasoline, TJ	98.52	77.63	65.95	67.04	96.09	39.40	43.62	17.61
Gasoline, kt	2.90	1.45	0.14	2.18	0.19	1.22	2.22	0.17
Diesel Oil (including for 'Fuel for Oven' and 'Fuel for Engines'), TJ	210.02	172.57	70.61	134.59	100.21	71.27	178.36	175.72
Diesel Oil (including for 'Fuel for Oven' and 'Fuel for Engines'), kt	6.51	1.55	2.27	2.34	2.29	2.27	5.27	6.21
	2006	2007	2008	2009	2010	2011	2012	2013
Gasoline, TJ	23.05	38.74	43.39	13.59	16.34	12.96	11.12	5.55
Gasoline, kt	2.21	1.18	1.17	1.27	1.15	2.18	1.12	0.13
Diesel Oil (including for 'Fuel for Oven' and 'Fuel for Engines'), TJ	215.38	324.25	273.40	28.00	31.98	39.00	33.96	23.38
Diesel Oil (including for 'Fuel for Oven' and 'Fuel for Engines'), kt	8.20	10.24	8.17	2.24	2.12	3.19	1.14	1.15
	2014	2015	2016	2017	2018	2019	2020	%
Gasoline, TJ	7.52	5.68	5.81	NO, NE	NO, NE	NO, NE	NO, NE	NO, NE
Gasoline, kt	0.17	0.13	0.13	NO, NE	NO, NE	NO, NE	NO, NE	NO, NE
Diesel Oil (including for 'Fuel for Oven' and 'Fuel for Engines'), TJ	22.12	16.44	10.74	NO, NE	NO, NE	NO, NE	NO, NE	NO, NE
Diesel Oil (including for 'Fuel for Oven' and 'Fuel for Engines'), kt	0.24	0.22	0.21	NO, NE	NO, NE	NO, NE	NO, NE	NO, NE

The table and figure below show activity data associated with the fuel consumption by type within category 1A5 'Other'. Compared to the level recorded in the base year, by 2020, the share of liquid fuels had decreased, and the share of solid fuels in the structure of total fuel consumption at category level had increased, respectively (Table 3-145 and Figure 3-26).

Table 3-145: Total fuel consumption within category 1A5 'Other' by fuel type between 1990 and 2020

	Consumption by type of fuel, TJ					Share of total, %			
	Solid	Liquid	Gaseous	Biofuels	Total	Solid	Liquid	Gaseous	Biofuels
1990	334.10	1,066.47	46.06	44.97	1,491.60	22.4	71.5	3.1	3.0
1991	284.79	1,020.76	35.37	NA	1,340.92	21.2	76.1	2.6	NA
1992	142.03	827.60	24.69	NA	994.32	14.3	83.2	2.5	NA
1993	370.00	701.32	114.00	25.00	1,210.32	30.6	57.9	9.4	2.1
1994	261.50	619.31	294.00	31.00	1,205.81	21.7	51.4	24.4	2.6
1995	206.00	1,205.04	235.00	60.00	1,706.04	12.1	70.6	13.8	3.5
1996	176.00	817.76	60.00	149.00	1,202.76	14.6	68.0	5.0	12.4
1997	206.00	636.71	161.50	61.00	1,065.21	19.3	59.8	15.2	5.7
1998	206.00	617.05	118.00	117.50	1,058.55	19.5	58.3	11.1	11.1
1999	177.00	368.20	88.00	88.00	721.20	24.5	51.1	12.2	12.2
2000	176.00	167.56	119.00	58.00	520.56	33.8	32.2	22.9	11.1
2001	117.00	261.64	207.00	59.00	644.64	18.1	40.6	32.1	9.2
2002	176.00	238.30	90.00	145.00	649.30	27.1	36.7	13.9	22.3
2003	117.00	192.67	59.00	75.00	443.67	26.4	43.4	13.3	16.9
2004	43.00	229.98	117.00	27.00	416.98	10.3	55.2	28.1	6.5
2005	47.00	199.33	118.00	31.00	395.33	11.9	50.4	29.8	7.8

	Consumption by type of fuel, TJ					Share of total, %			
	Solid	Liquid	Gaseous	Biofuels	Total	Solid	Liquid	Gaseous	Biofuels
2006	141.00	247.43	129.00	33.00	550.43	25.6	45.0	23.4	6.0
2007	113.00	371.99	106.00	37.00	627.99	18.0	59.2	16.9	5.9
2008	134.00	335.79	106.00	27.00	602.79	22.2	55.7	17.6	4.5
2009	19.00	62.58	70.00	14.50	166.08	11.4	37.7	42.1	8.7
2010	115.00	68.32	188.00	43.00	414.32	27.8	16.5	45.4	10.4
2011	104.00	55.00	102.00	16.00	277.00	37.5	19.9	36.8	5.8
2012	5.00	49.94	48.00	1.00	103.94	4.8	48.0	46.2	1.0
2013	NO	31.96	NO, NE	NO, NE	31.96	NO	100.0	NO, NE	NO, NE
2014	239.14	32.59	NO, NE	NO, NE	271.72	88.0	12.0	NO, NE	NO, NE
2015	221.33	24.56	NO, NE	NO, NE	245.89	90.0	10.0	NO, NE	NO, NE
2016	228.96	16.56	NO, NE	NO, NE	245.52	93.3	6.7	NO, NE	NO, NE
2017	239.14	NO, NE	NO, NE	NO, NE	239.14	100.0	NO, NE	NO, NE	NO, NE
2018	246.77	NO, NE	NO, NE	NO, NE	246.77	100.0	NO, NE	NO, NE	NO, NE
2019	241.68	NO, NE	NO, NE	NO, NE	241.68	100.0	NO, NE	NO, NE	NO, NE
2020	236.59	NO, NE	NO, NE	NO, NE	236.59	100.0	NO, NE	NO, NE	NO, NE

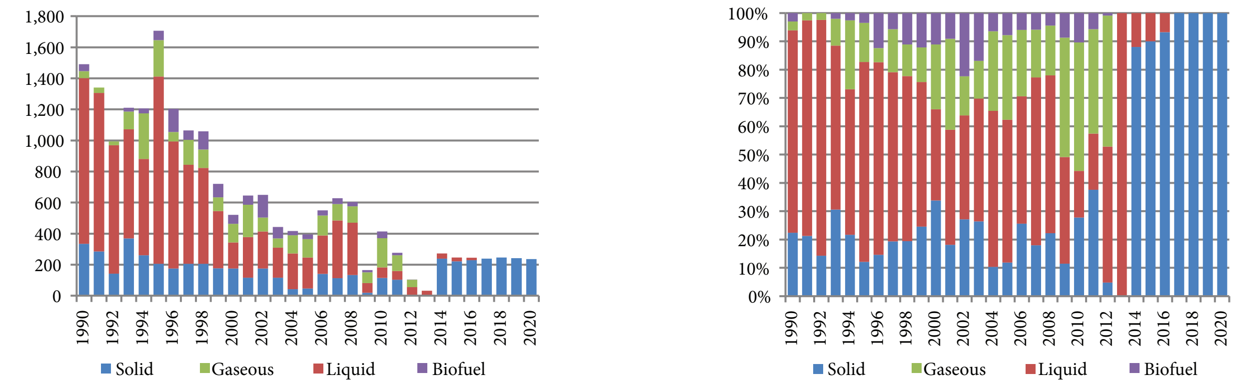


Figure 3-26: Total fuel consumption within category 1A5 'Other' between 1990 and 2020, TJ.

3.6.3. Uncertainties and Time Series Consistency

The primary factors which affect uncertainties pertain to the estimation methodology, emission factors utilised to calculate GHG emissions from source category 1A5 'Other' and the quality of the available activity data. Uncertainties associated with activity data on fuel consumption in source category 1A5 'Other' are estimated to be circa 5% for CO_2 and CH_4 emissions, and circa 3% for N_2O emissions, respectively. In order to ensure the stability over time of the results obtained, the same methodology was used for the entire study period in accordance with sustainable practices applied to the inventory of GHG emissions.

3.6.4. Quality Assurance and Quality Control

Standard verification and quality control forms and check-lists were filled in for source category 1A5 'Other', following a Tier 1 approach. To be noted that the AD and methods used for estimating GHG emissions from category 1A5 'Other' were documented and archived both in hard copies and electronically.

In order to identify the data entry and emission estimation process related errors, verifications and quality control procedures were applied. In accordance with sustainable practices, AD and national EFs from official reference sources were used in the assessment of GHG emissions.

The verification and quality control procedures applied in the calculation process for category 1A5 'Other' included:

- Verification of AD collecting and manipulation procedures, including: verifying if disaggregation of AD collected for each source category included in category 1A5 'Other' complies with the requirements set out in the description of each source category in the 2006 IPCC Guidelines (for each emission source activity data is available in separate files in natural and energy units);
- Verifying the correctness of EFs used for each source;
- Verifying if the primary reference sources are correctly indicated;
- The accuracy of calculations for sources included in category 1A5 'Other' are verified randomly;

- Implementation of error minimization procedures for manual entry of AD, with all the spreadsheets provided with the initial sources of activity data in tabular format;
- In the calculation files, the EFs are specified in tabular formats for each source, the import of the respective values into calculation formulas is ensured by automatic connections;
- The consistency of the calculations is also ensured by verifying the correctness of applying conversion factors of natural units to energy units for all sources and the entire range of years covered by the inventory;
- Verification if the same method is used for the entire range of years covered by the inventory;
- Verifying if GHG emissions calculations have been made for all years and for all types of fuels mentioned in the Energy Balances of the RM;
- Verifying to what extent the full geographical coverage of the national GHG inventory of the RM is ensured (for the years 2014-2020, emission assessment was performed for the entire territory of the country; whereas for 1990-2014, only for the territory on the RBDR);
- Verifying the inter-annual evolution trends of emissions by creating representative charts, while unusual fluctuations are explained;
- Verifying maintenance and completion of the national inventory of GHG emissions archive.

3.6.5. Recalculations

In the current inventory cycle, no recalculations have been made with respect to source category 1A5 'Other' for the period 1990-2020. Direct GHG emissions for 2020 were estimated for the first time. The results obtained show that direct GHG emissions from category 1A5 'Other' decreased in the RM by about 80.5% between 1990 and 2020.

3.6.6. Planned Improvements

Potential improvements in source category 1A5 'Other' could be made should new AD be available regarding fuel consumption on the LBDR and additional information provided by the Ministry of Defence on fuel combustion for the operation of military transportion for years 2017-2020. Due to the fact that primary data is confidential, negotiations with the responsible authorities on the format in which final emissions will be presented/calculated are currently underway.

3.7. Fugitive Emissions from Oil and Natural Gas (Category 1B2)

3.7.1. Source Category Description

Source category 1B2 'Fugitive Emissions from Oil and Natural Gas' includes GHG emissions originating from oil and natural gas distribution systems, except distribution systems of energy resources, which are combusted as fuel.

Distribution systems include the entire infrastructure needed to produce, collect, process, refine and distribute oil products and natural gases to final consumers. The system begins at the well heads and ends at the final sale points to the consumer.

The sources of fugitive emissions on oil and gas systems include equipment leaks, evaporation losses, venting, flaring, incineration and accidental releases (e.g., pipeline dig-ins, well blow-outs and spills, etc.).

In the Republic of Moldova, oil extraction is performed nearby Valeni village, Cahul district, on the territory of national reservation 'Prutul de Jos'. The estimated amount of oil reserves in the oil fields of Valeni is estimated to be circa 0.5-1.0 million tons.

After removing water, oil is pumped through pipelines into storage tanks, from where it is transported in tanks to the refinery owned by JSC Arnaut Petrol (Comrat, ATU Gagauzia). The following types of secondary fuels are produced at the respective refinery: gasoline, diesel oil, residual fuel oil and other petroleum products.

About 30 wells were drilled in the oil fields of Valeni. Extraction takes place only on some of them, the rest being preserved. Between 2003 and 2005, 8 wells were operational, 5 being in service. Between 2006 and 2012, 10 wells were operational, whereas since 2013 – circa 15 wells.

During this period, the amount of extracted oil varied between 1 and 17 kt annually or between 1 or 18 thousand m^3 annually (Table 3-146 and Figure 3-27).

Table 3-146: Oil extraction in the Republic of Moldova between 2003 and 2020

	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Oil, kt	1	8	5	4	8	15	17	11	13	11	10	8	7	6	5	5	5	6
Oil, thousand m^3	1.000	8.502	5.313	4.251	8.502	15.940	18.066	11.690	13.815	11.690	10.627	8.502	7.439	6.376	5.313	5.313	5.313	6.376

Source: Energy Balances of the RM for the years 2003-2020.

The specific density of the oil extracted in Valeni is circa 0.941 t/m^3 (according to the information from the 'Norms on Limited Permitted Pollutant Emissions in Atmospheric Air Report at Oil Exploration Valeni', 2015).

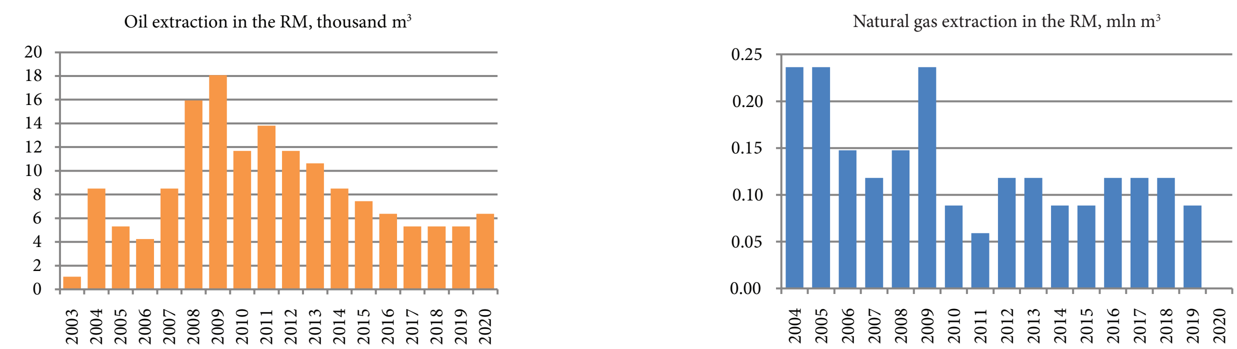


Figure 3-27: Oil and natural gas extracted in the Republic of Moldova between 2003 and 2020.

Natural gas and oil resources were initially extracted (between 1995 and 2007) by an American company (Redeco Ltd), and since 2007, by Valiexchimp Ltd. In 2016, the right to extract the resources in Valeni was granted to the American company 'Fontera Resources Corporation'. Natural gas extraction is currently being carried out at about six wells in the natural gas field in the vicinity of Victorovca village (Table 3-147). In 2020, according to NBS data, the volume of natural gas extracted on the territory of the Republic of Moldova was null.

Table 3-147: Natural gas extraction between 2004 and 2020

	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Natural Gas, TJ	8	8	5	4	5	8	3	2	4	4	3	3	4	4	4	3	NO
Natural Gas, million m^3	0.2363	0.2363	0.1477	0.1181	0.1477	0.2363	0.0886	0.0591	0.1181	0.1181	0.0886	0.0886	0.1181	0.1181	0.1181	0.0886	NO

Source: Energy Balances of the RM for the years 2004-2020.

The methane content reaches circa 86-92%. The natural gas explored at Victorovca field is supplied to the following nearby settlements: Ciobaclia, Suhata, Baimaclia, Flocoasa and Victorovca. The supply is made both from the natural gas fields in Victorovca, in particular during the warm period of the year, when the natural gas consumption in the respective localities is reduced, as well as through the national gas distribution and transportation network, especially during the cold season of the year, when natural gas consumption is increased (during this time of the year, the capacities of the Victorovca reservoir cannot meet the needs of the population in these localities).

The natural gas transport system in the RM currently includes: high, medium and low-pressure main gas pipelines. Natural gas supply is operated by JSC 'Moldovagaz', which distributes natural gas to consumers in the country and transits Russian natural gas to South-Eastern European countries. Information on natural gas consumption is available for both the RBDR and LBDR. The total natural gas consumption is presented in Table 3-148 and Figure 3-28.

Table 3-148: Natural gas consumption in the RM and natural gas transiting the territory of the RM between 1990 and 2020

	1990	1991	1992	1993	1994	1995	1996	1997
Natural gas transiting the RM, billion m^3	25.0000	23.0000	21.0000	19.0000	18.2650	20.9090	22.3960	16.9340
Natural gas consumption in the RM, million m^3	3813.7	3843.1	3377.38	2959.8	2861.0	2791.0	3222.0	3491.9

	1998	1999	2000	2001	2002	2003	2004	2005
Natural gas transiting the RM, billion m^3	16.0210	17.1424	19.3649	18.6248	21.3323	22.1319	23.8727	25.3129
Natural gas consumption in the RM, million m^3	3168.58	2685.3	2320.2	2628.0	2231.6	2405.4	2565.7	2715.6
	2006	2007	2008	2009	2010	2011	2012	2013
Natural gas transiting the RM, billion m^3	22.3388	23.6928	23.2902	17.8911	17.0343	19.8895	19.6200	19.6511
Natural gas consumption in the RM, million m^3	2376.2	2489.9	2505.0	2775.0	2970.9	3099.5	3078.1	2386.0
	2014	2015	2016	2017	2018	2019	2020	%
Natural gas transiting the RM, billion m^3	17.9859	16.9700	18.706	20.4878	18.2985	10.2295	0,8906	-96.4
Natural gas consumption in the RM, million m^3	2823.5	2782.0	2799.0	2615.6	2859.7	2865.9	2997,5	-21.4

Source: JSC 'Moldovagaz' by letter No. 604 of 01.04.1999, answer to Letter No. 02-541 of 28.05.2001; No. 02-156 of 06.02.2004, answer to Letter No. 257-01-07 of 26.01.2004; No. 06-1253 of 27.09.2006, answer to Letter No. 01-07/1400 of 25.08.2006; No. 07-730 of 06.06.2007, answer to Letter No. 47/21-103 of 31.05.2007; No. 02/1-476 of 23.02.2011, answer to Letter No. 03-07/175 of 02.02.2011; No. 02/1-288 of 22.01.2014, answer to Letter No. 320/2014-01-01 of 03.01.2014; No. 02/1-507 of 10.02.2015, answer to Letter No. 407/2015-01-09 of 29.01.2015; No. 02/1-2183 of 03.06.2016, answer to Letter No. 512/2016-05-01 of 10.05.2016 No. 03/2-74 of 12.01.2018, answer to Letter No. 601/2017-12-03 of 14.12.2017; No. 03/4-676 of 03.03.2020, answer to Letter No. 08-310/1 of 11.02.2020; No. 03/4-1539 of 24.06.2021, answer to letter No. 08/136/2021 of 09.06.2021.

Figure 3-28: Natural gas consumption in the RM, and transiting the territory of the RM to be delivered to South-Eastern European countries between 1990 and 2020.

Information on LPG amounts are available for the territory on the RBDR for the entire period under review, while for the LBDR only for the period 2011-2020 (Table 3-149, Figure 3-29).

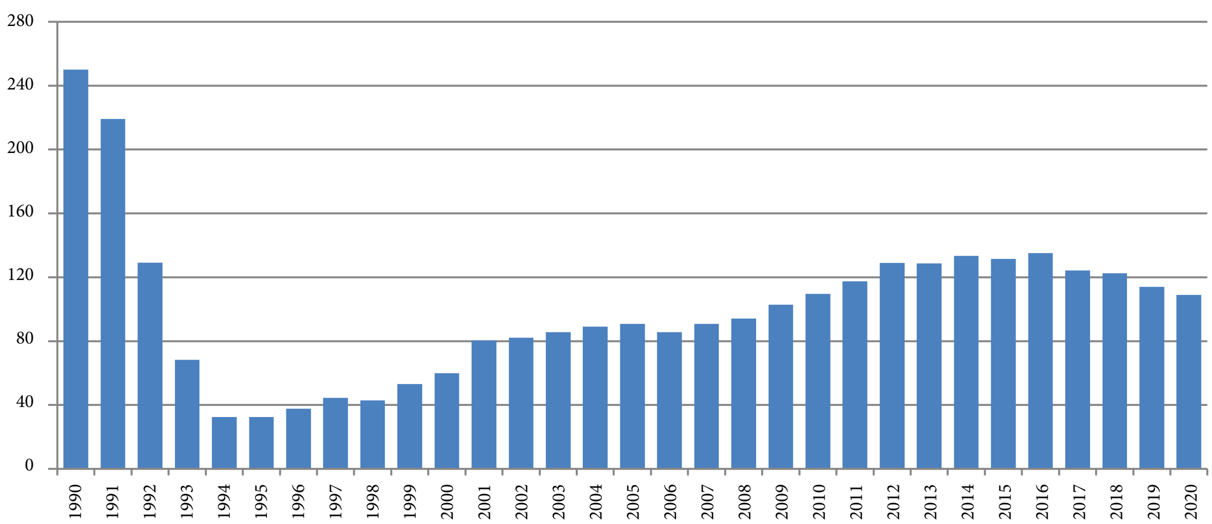


Figure 3-29: Liquefied Petroleum Gas consumption between 1990 and 2020, thousand m^3.

Table 3-149: LPG consumption between 1990 and 2020

		1990	1991	1992	1993	1994	1995	1996	1997
RBDR	thousand t	146	128	75.4	39.9	19	19	22	26
	thousand m^3	250.00	219.18	129.11	68.32	32.53	32.53	37.67	44.52
		1998	1999	2000	2001	2002	2003	2004	2005
RBDR	thousand t	25	31	35	47	48	50	52	53
	thousand m^3	42.81	53.08	59.93	80.48	82.19	85.62	89.04	90.75
		2006	2007	2008	2009	2010	2011	2012	2013
RBDR	thousand t	50	53	55	60	64	67	74	74
	thousand m^3	85.62	90.75	94.18	102.74	109.59	114.73	126.71	126.71
LBDR	thousand t	NA	NA	NA	NA	NA	2.68	2.18	1.87
RM – total	thousand m^3	85.62	90.75	94.18	102.74	109.59	117.41	128.89	128.59
		2014	2015	2016	2017	2018	2019	2020	%
RBDR	thousand t	77	76	78	72	71	66	63	-56.8
	thousand m^3	131.85	130.14	133.56	123.29	121.58	113.01	107.88	-
LBDR	thousand t	1.56	1.41	1.52	0.890	0.938	0.916	0.640	-
RM – total	thousand m^3	133.41	131.54	135.08	124.18	122.51	113.93	108.97	-

Sources: Energy Balances of the RM for 1990, 1993-2020 for the RBDR; Press Release 'The State of Housing and Communal Services of the Republic' for 2011-2020 for the LBDR.

Trends in GHG emissions

Between 1990 and 2020, GHG emissions from source category 1B2 'Fugitive Emissions from Oil and Natural Gas' tended to decrease by circa 73.5%: from 911.41 kt CO_2 equivalent recorded in 1990, to 241.81 kt CO_2 equivalent in 2020 (Table 3-150, Figure 3-30).

Table 3-150: Evolution of GHG emissions from source category 1B2 'Fugitive Emissions from Oil and Natural Gas' between 1990 and 2020

	1990	1991	1992	1993	1994	1995	1996	1997
CO_2, kt	0.6632	0.6397	0.5403	0.4587	0.4285	0.4393	0.4958	0.4895
CH_4, kt	36.4298	34.4624	31.1252	27.9730	26.9587	29.5357	32.3317	27.4107
N_2O, kt	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Total, kt CO_2 equivalent	**911.4074**	**862.2000**	**778.6694**	**699.7829**	**674.3966**	**738.8306**	**808.7889**	**685.7562**
NMVOC	0.6558	0.6186	0.5594	0.5033	0.4850	0.5341	0.5834	0.4886
	1998	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**
CO_2, kt	0.4495	0.4121	0.3924	0.4274	0.4062	1.0765	1.1223	1.1406
CH_4, kt	25.5413	25.3327	26.5648	26.6212	28.3628	29.7385	32.1242	33.9070
N_2O, kt	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Total, kt CO_2 equivalent	**638.9819**	**633.7301**	**664.5129**	**665.9580**	**709.4758**	**744.5398**	**804.2298**	**848.8182**
NMVOC	0.4559	0.4558	0.4819	0.4805	0.5164	0.5825	0.9073	0.8196
	2006	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**
CO_2, kt	1.2424	1.2757	1.2929	1.2930	1.2958	1.3347	1.3309	1.6599
CH_4, kt	29.8644	31.8364	31.6922	26.9712	26.4485	29.5932	29.1916	27.2439
N_2O, kt	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Total, kt CO_2 equivalent	**747.8554**	**797.1880**	**793.6008**	**675.5742**	**662.5090**	**741.1669**	**731.1218**	**682.7608**
NMVOC	0.7069	0.9033	1.1807	1.1698	0.9181	1.0564	0.9690	0.8989
	2014	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**%**
CO_2, kt	1.6908	1.6776	1.6900	1.6760	1.6852	1.6282	1.5797	138.2
CH_4, kt	26.7070	25.6632	27.4735	28.7461	27.1103	18.8024	9.6091	-73.6
N_2O, kt	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	-
Total, kt CO_2 equivalent	**669.3684**	**643.2608**	**688.5313**	**720.3305**	**679.4463**	**471.6920**	**241.8100**	**-73.5**
NMVOC	0.8052	0.7458	0.7398	0.7251	0.6924	0.5359	0.4018	-38.7

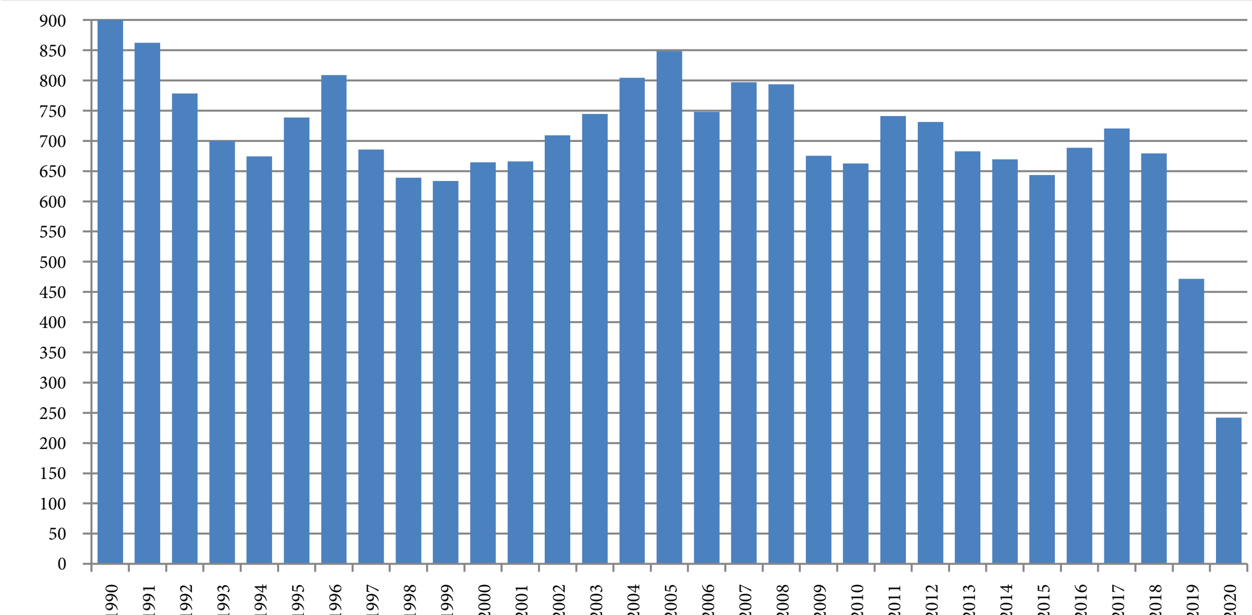


Figure 3-30: Direct GHG emissions from source category 1B2 'Fugitive Emissions from Oil and Natural Gas' between 1990 and 2020, kt CO_2 equivalent.

3.7.2. Methodological Issues, Emission Factors and Data Sources

GHG emissions originating from source category 1B2 'Fugitive Emissions from Oil and Natural Gas' were estimated following a Tier 1 methodology (2006 IPCC Guidelines). Fugitive emissions of CH_4, N_2O, CO_2 and NMVOC were monitored.

The basic equations used to estimate GHG emissions under this source category are:

$$E_{\text{gas, industry segment}} = A_{\text{industry segment}} \bullet EF_{\text{gas, industry segment}}$$

$$E_{gas} = \Sigma E_{gas,\ industry\ segment}$$

where:

$E_{gas,\ industry\ segment}$ – annual emissions (kt);

$A_{industry\ segment}$ – activity data for the respective industry segment;

$EF_{gas,\ industry\ segment}$ – emission factor (kt/activity unit).

Average default EF values were used to estimate GHG emission according to the 2006 IPCC Guidelines (Tables 3-151, 3-152, 3-153, and 3-154).

Table 3-151: Default EF values from 'Well Drilling, Testing and Servicing'

Category	Source	CO_2	CH_4	N_2O	NMVOC
		Ranges and Average for EF Values Used			
Oil and Natural Gas well drilling, kg/well/yr	1B2a ii, 1B2b ii	100-1700	33-560	-	0.87-15.0
		900	**296.5**		**7.935**
Oil and Natural Gas well testing, kg/well/yr	1B2a ii, 1B2b ii	9000-150000	51-850	0.068-1.1	12-200
		79500	**450.5**	**0.584**	**106**
Oil and Natural Gas well servicing, kg/well/yr	1B2a ii, 1B2b ii	1.9-32.0	110-1800	-	17-280
		17	**955**		**148.5**

Table 3-152: Default EF values from 'Oil Extraction, Transportation and Storage in Tanks'

Category	Source	CO_2	CH_4	N_2O	NMVOC
		Ranges and Average for EFs Values Used			
Fugitive emissions from oil production, kg/1000 m³/yr	1B2a iii 2	0.1-4300	1,5-60000	-	1.8-75000
		2150	**30000.8**		**37500.9**
Ventilation at oil extraction, kg/1000 m³/yr	1B2a i	95-130	720-990	-	430-590
		112.5	**855**		**510**
Flaring at oil production, kg/1000 m³/yr	1B2a ii	41000-56000	25-34	0.64-0.88	21-29
		48500	**30**	**0.76**	**25**
Oil transportation in tanks, kg/1000 m³/yr	1B2a i	**2.30**	**25**	**-**	**250**

Table 3-153: Default EF values from 'Natural Gas Extraction, Transportation and Distribution'

Category	Source	CO_2	CH_4	N_2O	NMVOC
		Ranges and Average for EFs Values Used			
Fugitive emissions from natural gas production, kg/million m³/yr	1B2b iii 2	14-180	380-24000	-	91-1200
		97	**12190**		**645.5**
Fugitive emissions from natural gas transportation, kg/million m³/yr	1B2b iii 4	0.88-2.00	166-1100	-	7.0-16.0
		1.44	**633**		**11.50**
Fugitive emissions from natural gas distribution, kg/million m³/yr	1B2b iii 5	51-140	1100-2500	-	16-36
		95.5	**1800**		**26**
Flaring at natural gas production, kg/million m³/yr	1B2b ii	1200-1600	0.76-1.00	0.021-0.029	0.62-0.85
		1400	**0.88**	**0.025**	**0.74**
Ventilation at natural gas transportation, kg/million m³/yr	1B2b i	3.1-7.3	44-740	-	4.6-11.0
		5.20	**392**		**7.80**

Table 3-154: Default EF values from 'LPG Transportation'

Category	Source	CO_2	CH_4	N_2O	NMVOC
Fugitive emissions from liquefied petroleum gas transportation, kg/1000 m³/yr	1B2a iii 3	430	-	0.0022	-

The activity data associated with the amounts of natural gas transited across the Republic of Moldova, as well as data regarding amounts of natural gas sold in the Republic of Moldova were provided by JSC 'Moldovagaz' (Table 3-155).

Table 3-155: Natural Gas transited, imported and consumed in the RM between 1990 and 2020

	1990	1991	1992	1993	1994	1995	1996	1997
Natural gas imported, million m³	**3,844**	**3,873**	**3,435**	**3,093**	**3,012**	**3,005**	**3,489**	**3,676**
Net caloric values for natural gas, kcal/m³	NA	NA	NA	NA	NA	NA	NA	7,980
Net caloric values for natural gas, TJ/million m³	NA	NA	NA	NA	NA	NA	NA	33.404
Methane density, kg/m³	NA	NA	NA	NA	NA	NA	NA	0.683
Share of methane in natural gas imported, %	NA	NA	NA	NA	NA	NA	NA	97.9
Technological losses, including:	30	30	58	133	151	214	267	184
in distribution networks	30	30	58	133	52	71	112	68
in main networks	0	0	0	0	98	143	155	116
Natural gas transited, billion m³	**25.000**	**23.000**	**21.000**	**19.000**	**18.265**	**20.909**	**22.396**	**16.934**
Natural gas sold in the RM:	**3,813.7**	**3,843.1**	**3,377.4**	**2,959.8**	**2,861.0**	**2,791.0**	**3,222.0**	**3,491.9**
On the RBDR	NA	NA	NA	NA	1,149.95	1,557.88	1,769.61	1,882.9
On the LBDR	NA	NA	NA	NA	1,711.05	1,233.12	1,452.39	1,609.00

	1998	1999	2000	2001	2002	2003	2004	2005
Natural gas imported, million m³	**3,333**	**2,856.8**	**2,477.5**	**2,732.1**	**2,419.8**	**2,614.6**	**2,687.2**	**2,819.2**
Net caloric values for natural gas, kcal/m³	7,970	7,976	7,978	7,972	7,992	8,007	8,019	8,026
Net caloric values for natural gas, TJ/million m³	33.362	33.388	33.396	33.371	33.455	33.517	33.568	33.597
Methane density, kg/m³	0.683	0.683	0.683	0.683	0.683	0.683	0.683	0.683
Share of methane in natural gas imported, %	97.9	97.9	97.9	97.9	97.9	97.9	97.9	97.9
Technological losses, including:	164	154.7	116.9	90.1	92.6	103.3	73.3	102.8
in distribution networks	107	102.5	79.4	72.8	65.5	66.1	52.9	54.2
in main networks	58	52.2	37.5	17.3	27.0	37.2	20.4	48.6
Natural gas transited, billion m³	**16.021**	**17.1424**	**19.3649**	**18.6248**	**21.3323**	**22.1319**	**23.8727**	**25.3129**
Natural gas sold in the RM:	**3,168.6**	**2,685.3**	**2,320.2**	**2,628.0**	**2,231.6**	**2,405.4**	**2,565.7**	**2,715.6**
On the RBDR	1,699.58	1,219.8	918.3	1,055.7	1,050.6	1,129.9	1,141.5	1,314.9
On the LBDR	1,469.00	1,465.5	1,401.9	1,572.3	1,181	1,275.5	1,424.2	1,400.7
	2006	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**
Natural gas imported, million m³	**2,472.3**	**2,714.7**	**2,725.5**	**2,979.4**	**3,176.2**	**3,213.1**	**3,182.5**	**2,472.5**
Net caloric values for natural gas, kcal/m³	8,035	8,038	8,041	8,074	8,071	8,081	8,107	8,137
Net caloric values for natural gas, TJ/million m³	33.635	33.647	33.660	33.798	33.785	33.827	33.936	34.061
Methane density, kg/m³	0.683	0.683	0.683	0.683	0.683	0.6914	0.6906	0.6946
Share of methane in natural gas imported, %	97.9	97.9	97.9	97.9	97.9	96.9	97.0	96.5
Technological losses, including:	94	96.2	94.7	93.9	98.6	113.6	104.4	86.5
in distribution networks	55.6	54.5	55.5	55.7	57.9	54.4	52.1	49.8
in main networks	38.4	41.7	39.2	38.2	40.7	59.2	52.3	36.7
Natural gas transited, billion m³	**22.3388**	**23.6928**	**23.2902**	**17.8911**	**17.0343**	**19.8895**	**19.6200**	**19.6511**
Natural gas sold in the RM:	**2,376.2**	**2,489.9**	**2,505.0**	**2,775.0**	**2,970.9**	**3,099.5**	**3,078.1**	**2,386.0**
On the RBDR	1,322.0	1,208.0	1,130.8	1,029.9	1,089.8	1,152.1	1,095.5	1,031.2
On the LBDR	1,054.2	1,281.9	1,374.2	1,745.1	1,881.1	1,974.4	1,982.6	1,354.8
	2014	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**%**
Natural gas imported, million m³	2,915.6	2,926.0	2,956.0	2,771.8	2,936.6	2,889.8	2,997.5	-22.0
Net caloric values for natural gas, kcal/m³	8,175	8,246	8,237	8,205	8,186	8,203	8,231	-
Net caloric values for natural gas, TJ/million m³	34.221	34.518	34.480	34.33	34.25	34.32	34.43	-
Methane density, kg/m³	0.6992	0.705	0.706	-	-	-	0.7	-
Share of methane in natural gas imported, %	96.1	95.5	95.34	-	-	-	95.4	-
Technological losses, including:	92.1	144.0	155.0	69.3	56.1	42.6	33.5	11.7
in distribution networks	48.3	43.0	49.0	38.3	35.2	31.2	28.1	-6.3
in main networks	43.8	101.0	106.0	31	20.9	11.4	5.4	-
Natural gas transited, billion m³	**17.9859**	**16.9700**	**18.7080**	**20.4878**	**18.2985**	**10.2295**	**0.8906**	-96.4
Natural gas sold in the RM:	**2,823.5**	**2,782.0**	**2,799.0**	**2,615.6**	**2,859.7**	**2,865.9**	**2,997.5**	-21.4
On the RBDR	1,053.1	928.0	965.0	1,004.4	1,105.9	1,047.9	1,076.3	-
On the LBDR	1,770.4	1,854.0	1,834.0	1,611.2	1,753.8	1,818.0	1,921.2	-

Source: JSC 'Moldovagaz' by letters No. 604 of 01.04.1999, answer to Letter No. 02-541 of 28.05.2001; No. 02-156 of 06.02.2004, answer to Letter No. 257-01-07 of 26.01.2004; No. 06-1253 of 27.09.2006, answer to Letter No.01-07/1400 of 25.08.2006; No. 07-730 of 6.6.2007, answer to Letter No. 47/21-103 of 31.05.2007; No. 02/1-476 of 23.02.2011, answer to Letter No. 03-07/175 of 02.02.2011; No. 02/1-288 of 22.01.2014, answer to Letter No. 320/2014-01-01 of 03.01.2014; No. 02/1-507 of 10.02.2015, answer to Letter No. 407/2015-01-09 of 29.01.2015; No. 02/1-2183 of 03.06.2016, answer to Letter No. 512/2016-05-01 of 10.05.2016; No. 03/2-74 of 12.01.2018, answer to Letter No. 601/2017-12-03 of 14.12.2017; No. 03/4-676 of 03.03.2020, answer to Letter No. 08-310/1 of 11.02.2020; No. 03/4-1539 of 24.06.2021, answer to Letter No. 08/136/2021 of 09.06.2021.

The activity data associated with oil and natural gas extraction, and on LPG consumption, respectively, are available in the Energy Balances of the Republic of Moldova. The AD on imported LPG (information is used for quality assurance and quality control procedures) are available in the Annual Reports on the Activity of the National Agency for Energy Regulation (2009-2020)[42].

3.7.3. Uncertainties and Time Series Consistency

The primary uncertainty-related factors pertain to methodology, emission factors used to estimate GHG emissions from source category 1B2 'Fugitive Emissions from Oil and Natural Gas', and quality of available activity data. Thus, uncertainties associated with emission factors used to estimate direct GHG emissions were estimated to be circa 25%. Uncertainties related to activity data pertaining to fuel consumption in the industrial sector is considered quite significant, up to circa 25%. In view of ensuring time-series consistency of the obtained results, the same approach was used for the entire period under review, in conformity with the recommendations included in the 2006 IPCC Guidelines.

3.7.4. Quality Assurance and Quality Control

Standard verification and quality control forms and checklists were filled in for 1B2 'Fugitive Emissions from Oil and Natural Gas' source category, following a Tier 1 approach.

The AD and methods used for estimating GHG emissions from this category were documented and archived both in hard copies and electronically. In order to identify the data entry and emission estimation process related errors verifications and quality control procedures were applied. Following the

[42] <http:// http://anre.md/raport-de-activitate-3-10>

recommendations included in the 2006 IPCC Guidelines, GHG emissions originating from source category 1B2 'Fugitive Emissions from Oil and Natural Gas' were estimated based on AD and CS NCVs from official sources of information.

The specific verifications and quality control procedures applied for this category included:

- Verification of AD collecting and manipulation procedures, including: verifying if disaggregation of AD collected for each source included in source category 1B2 'Fugitive Emissions from Oil and Natural Gas' complies with the requirements set out in the description of each source in the 2006 IPCC Guidelines (1B2a 'Oil', 1B2b 'Natural Gas', 1B2c 'Venting', 1B2d 'Other'); for each source, AD are available in separate files in natural and energy units; verifying the correctness of EFs used for each source; verifying if the primary reference sources are correctly indicated; the accuracy of calculations for sources included in source category 1B2 are verified randomly;
- Implementation of error minimization procedures for manual entry of AD, with all the spreadsheets provided with the initial sources of activity data in tabular format;
- In the calculation files the EFs are specified in tabular formats for each source, the import of the respective values into calculation formulas is ensured by automatic connections;
- The consistency of the calculations is also ensured by verifying the correctness of applying conversion factors of natural units to energy units for all subcategories and the entire range of years covered by the inventory;
- Verification if the same method is used for the entire range of years covered by the inventory;
- Verifying if GHG emissions calculations have been made for all years and for all types of fuels mentioned in the Energy Balances of the RM;
- Verifying to what extent the full geographical coverage of the national GHG inventory of the RM is ensured;
- Verifying the inter-annual evolution trends of emissions by creating representative charts, while unusual fluctuations are explained;
- in the case of recalculations, their need is explained, including by drawing attention to the implemented recommendations resulting from the audit carried out by national and international experts in the previous inventory cycle;
- Verifying maintenance and completion of the national inventory of GHG emission archive.

In accordance with sustainable practices, national emission activity data and factors from official reference sources were used to assess GHG emissions.

3.7.5. Recalculations

In the current inventory cycle, a number of measures have been taken to improve the quality of the national GHG inventory and this implied the recalculation of emissions from source category 1B2 'Fugitive Emissions from Oil and Natural Gas'. The main cause of these recalculations consists of considering the activity data associated with the volume of imported natural gas in the calculation of GHG emissions from 1B2bii4 sources 'Transmission and storage of natural gas' and 1B2bi 'Venting gas'. Compared to the results recorded in BUR3 of the RM to the UNFCCC (2021), the changes undertaken in the current inventory cycle resulted in an upward trend in direct GHG emissions for the entirety of the study period (Table 3-156). Direct GHG emissions for 2020 have been estimated for the first time. Between 1990 and 2020, direct GHG emissions from category 1B2 'Fugitive Emissions from Oil and Natural Gas' decreased in the Republic of Moldova by circa 73.5%.

Table 3-156: Recalculation results of GHG emissions from source category 1B2 'Fugitive Emissions from Oil and Natural Gas' for the period 1990-2019, included in the BUR3 of the RM to the UNFCCC (2021), kt CO_2 equivalent

	1990	1991	1992	1993	1994	1995	1996	1997
BUR3	812.8794	762.9286	690.6247	620.5042	597.1941	661.8075	719.3601	591.5343
NC5	911.4074	862.2000	778.6694	699.7829	674.3966	738.8306	808.7889	685.7562
Difference, %	12.1	13.0	12.7	12.8	12.9	11.6	12.4	15.9

	1998	1999	2000	2001	2002	2003	2004	2005
BUR3	553.5516	560.5056	601.0105	595.9298	647.4524	677.5233	735.3524	776.5574
NC5	638.9819	633.7301	664.5129	665.9580	709.4758	744.5398	804.2298	848.8182
Difference, %	15.4	13.1	10.6	11.8	9.6	9.9	9.4	9.3
	2006	2007	2008	2009	2010	2011	2012	2013
BUR3	684.4863	727.6057	723.7417	599.2073	581.0977	661.7217	652.2250	621.6037
NC5	747.8554	797.1880	793.6008	675.5742	662.5090	741.1669	731.1218	682.7608
Difference, %	9.3	9.6	9.7	12.7	14.0	12.0	12.1	9.8
	2014	2015	2016	2017	2018	2019	2020	%
BUR3	596.9975	568.2626	612.7641	649.2847	604.1765	397.6217		
NC5	669.3684	643.2608	688.5313	720.3305	679.4463	471.6920	241.8100	-73.47
Difference, %	12.1	13.2	12.4	10.9	12.5	18.6		

Abbreviations: BUR3 – Third Biennial Update Report of the RM to the UNFCCC, NC5 – Fifth National Communication of the RM to the UNFCCC.

3.7.6. Planned Improvements

Potential improvements within source category 1B2 'Fugitive Emissions from Oil and Natural Gas' could be possible should new data related to fugitive leaks from oil and natural gas distribution networks be available (from the infrastructure needed to produce, collect, process, refine and distribute oil products and natural gases to final consumers; from equipment functioning, evaporation and flashing losses, flaring, accidental releases from pipeline dig-ins, etc.); respectively, in the case of adopting a higher estimation methodology. The possibility to obtain AD associated to LPG consumption on the LBDR for the entire period under review will also be assessed.

3.8. International Aviation (Memo Items)

3.8.1. Source Category Description

GHG emissions from 'International Aviation' (Memo Items) comes from the combustion of jet fuel used in the international air transport (in case of aircraft which operate international flights, emissions are allocated to the country in which the aircraft was fuelled). In the Republic of Moldova, international aviation includes jet propelled aircraft using jet kerosene.

In 2017-2020, international flights were operated by the following aircraft: (1) productions from CIS countries: IL-76, AN-26, Mi-2, Mi-8, Mi-17, Ka-2; (2) production from other countries: large commercial jet aircraft - A-319 (320, 321); Boeing-707 (737, 739, 747, 757), EMB-190, A-300-600; small aircraft – Cessna C-150F, C-150M (domestic flights only).

In previous years, flights were operated with other types of aircraft: (a) large commercial jet aircraft: A-319 (320, 321); Boeing-707 (737, 739, 747,757), EMB-190 (120, 135, 145, 170), Fokker 70 and Fokker 100, MD-81 (82, 83) RJ-85, RJ-100, CRJ, Rombac-561 Rc; A-300-600; (b) short and medium range turboprop aircraft: Saab-340 (SF-340), Saab-2000 (SF-2000), L410, DHC8, ATR-42; (c) light turboprop aircraft – X-32 Becas; (d) small jet aircraft: Falcon-2000EX, Learjet-35; (e) aircraft produced in CIS countries are represented by a group of aircraft such as TU-134, TU-154, AN-2 (12, 24, 26, 28, 32, 72, 74), IL-18, IL-76, YAK-18 (40, 42); (k) helicopters: Mi-8 (2, 17, 26), Ka-26 and Ka-32, Robinson 44 (partly domestic flights).

The total number of flights with aircraft produced in other countries between 1995 and 2019 had an upward trend, whereas flights with aircraft produced in CIS countries – a downward trend (Figure 3-31).

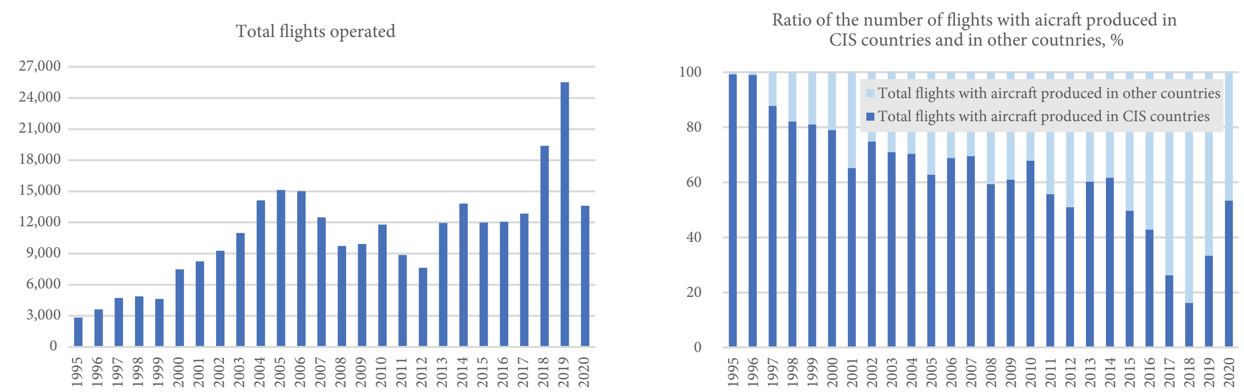


Figure 3-31: Total number of flights in the Republic of Moldova between 1995 and 2020.

The largest share in total GHG emissions from international aviation is covered by CO_2 (circa 70%), less than 30% of the total emissions are covered by water vapours and as little as circa 1% by other gases (NO_x, CO, SO_2, NMVOC). The share of methane and nitrous oxide emissions is insignificant (according to the 2006 IPCC Guidelines, it is considered that modern engines emit little or no CH_4, in particular, during the cruise cycle).

The aircraft flight is divided into two cycles: (i) the landing/take-off cycle (LTO), produced at altitudes lower than 914 metres and (ii) the cruise flight cycle (c), produced at altitudes higher than 914 metres. It is estimated that only circa 10% of the emissions recorded during the flight come from the LTO cycle, the remaining 90% – from the cruise cycle. Exceptions are CO and NMVOC emissions: 30% are emissions recorded during the LTO cycle, the remaining 70% come from the cruise cycle.

The evolution of GHG emissions from source category 'International Aviation' (Memo Items) is shown in Table 3-157.

Table 3-157: Evolution of GHG emissions from source category 'International Aviation' (Memo Items) in the Republic of Moldova between 1990 and 2020

	1990	1991	1992	1993	1994	1995	1996	1997
CO_2, kt	193.4599	147.3846	108.5369	55.2342	30.8414	41.9508	56.7300	66.1918
CH_4, kt	0.0153	0.0117	0.0086	0.0044	0.0024	0.0066	0.0048	0.0054
N_2O, kt	0.0063	0.0048	0.0036	0.0018	0.0010	0.0014	0.0018	0.0021
NO_x, kt	0.7651	0.5829	0.4293	0.2184	0.1220	0.1676	0.2197	0.2640
CO, kt	0.5859	0.4464	0.3287	0.1673	0.0934	0.1539	0.1539	0.1777
NMVOC, kt	0.2298	0.1751	0.1289	0.0656	0.0366	0.0809	0.0822	0.0937
SO_2, kt	0.0613	0.0467	0.0344	0.0175	0.0098	0.0133	0.0180	0.0210
	1998	1999	2000	2001	2002	2003	2004	2005
CO_2, kt	53.5923	63.0390	63.0779	50.4863	59.9541	34.7676	34.7903	37.9260
CH_4, kt	0.0041	0.0040	0.0043	0.0039	0.0036	0.0035	0.0035	0.0035
N_2O, kt	0.0017	0.0020	0.0020	0.0016	0.0020	0.0012	0.0012	0.0013
NO_x, kt	0.2144	0.2517	0.2591	0.1936	0.2413	0.1317	0.1283	0.1433
CO, kt	0.1439	0.1574	0.1688	0.1468	0.1619	0.1223	0.1296	0.1362
NMVOC, kt	0.0721	0.0796	0.0773	0.0630	0.0653	0.0403	0.0344	0.0373
SO_2, kt	0.0170	0.0200	0.0200	0.0160	0.0190	0.0110	0.0110	0.0120
	2006	2007	2008	2009	2010	2011	2012	2013
CO_2, kt	37.9241	44.2052	44.1680	44.1719	41.0593	41.0082	47.3142	41.0717
CH_4, kt	0.0039	0.0027	0.0016	0.0017	0.0026	0.0028	0.0028	0.0046
N_2O, kt	0.0013	0.0015	0.0014	0.0014	0.0014	0.0013	0.0015	0.0013
NO_x, kt	0.1428	0.1782	0.1855	0.1878	0.1667	0.1611	0.1806	0.1592
CO, kt	0.1424	0.1296	0.1080	0.1094	0.1218	0.1246	0.1322	0.1584
NMVOC, kt	0.0397	0.0393	0.0365	0.0380	0.0377	0.0496	0.0558	0.0571
SO_2, kt	0.0120	0.0140	0.0140	0.0140	0.0130	0.0130	0.0150	0.0130
	2014	2015	2016	2017	2018	2019	2020	%
CO2, kt	53.6855	56.8077	100.9698	148.2788	170.4060	151.5015	35.2495	-81.8
CH4, kt	0.0034	0.0056	0.0062	0.0058	0.0071	0.0055	0.0002	-98.4
N2O, kt	0.0018	0.0018	0.0033	0.0048	0.0058	0.0051	0.0010	-84.5
NOx, kt	0.2110	0.2255	0.4139	0.5821	0.6507	0.6236	0.1233	-83.9
CO, kt	0.1599	0.1841	0.2665	0.3478	0.5113	0.4162	0.0493	-91.6
NMVOC, kt	0.0553	0.0817	0.1113	0.1423	0.1537	0.1199	0.0247	-89.3
SO_2, kt	0.0170	0.0180	0.0320	0.0470	0.0540	0.0480	0.0000	-100.0

For the period 1990-1994, the results were restored using the partial overlapping method, whereas for 1995-2020 – by using a Tier 2b approach, available in the 2006 IPCC Guidelines. By 2020, compared to the base year level (1990), GHG emissions from source category 'International Aviation' (Memo Items) consituted: for CO_2 – 18.2% of the emission levels recorded in 1990, whereas CH_4 – 1.6%, N_2O – 15.5%, NO_x – 16.1%, CO – 8.4%, NMVOC – 10.7%, and SO_2 – NE, respectively (Table 3-158).

Table 3-158: Evolution of GHG emissions from source category 'International Aviation' (Memo Items) between 1990 and 2020, where 1990 represents 100%

	1990	1991	1992	1993	1994	1995	1996	1997
CO_2	100.0	76.2	56.1	28.6	15.9	21.7	29.3	34.2
CH_4	100.0	76.2	56.1	28.6	15.9	42.8	31.2	35.0
N_2O	100.0	76.2	56.1	28.6	15.9	21.5	28.7	33.5
NO_x	100.0	76.2	56.1	28.6	15.9	21.9	28.7	34.5
CO	100.0	76.2	56.1	28.6	15.9	26.3	26.3	30.3
NMVOC	100.0	76.2	56.1	28.6	15.9	35.2	35.8	40.8
SO_2	100.0	76.2	56.1	28.6	15.9	21.7	29.4	34.3

	1998	1999	2000	2001	2002	2003	2004	2005
CO_2	27.7	32.6	32.6	26.1	31.0	18.0	18.0	19.6
CH_4	26.8	26.0	28.4	25.5	23.7	22.8	22.6	22.8
N_2O	27.2	31.9	32.2	26.0	30.9	18.4	18.8	20.3
NO_x	28.0	32.9	33.9	25.3	31.5	17.2	16.8	18.7
CO	24.6	26.9	28.8	25.0	27.6	20.9	22.1	23.3
NMVOC	31.4	34.6	33.6	27.4	28.4	17.5	15.0	16.2
SO_2	27.7	32.6	32.6	26.1	31.0	17.9	17.9	19.6
	2006	2007	2008	2009	2010	2011	2012	2013
CO_2	19.6	22.8	22.8	22.8	21.2	21.2	24.5	21.2
CH_4	25.6	17.8	10.7	11.2	16.9	18.2	18.3	30.0
N_2O	20.4	23.3	22.8	22.8	21.5	20.7	23.9	21.1
NO_x	18.7	23.3	24.2	24.5	21.8	21.1	23.6	20.8
CO	24.3	22.1	18.4	18.7	20.8	21.3	22.6	27.0
NMVOC	17.3	17.1	15.9	16.5	16.4	21.6	24.3	24.8
SO_2	19.6	22.8	22.8	22.8	21.2	21.2	24.5	21.2
	2014	2015	2016	2017	2018	2019	2020	%
CO_2	27.8	29.4	52.2	76.6	88.1	78.3	18.2	18.2
CH_4	22.3	36.4	40.2	38.0	46.6	35.8	1.6	1.6
N_2O	27.9	28.8	51.9	75.6	90.7	81.0	15.5	15.5
NO_x	27.6	29.5	54.1	76.1	85.0	81.5	16.1	16.1
CO	27.3	31.4	45.5	59.4	87.3	71.0	8.4	8.4
NMVOC	24.1	35.5	48.4	61.9	66.9	52.2	10.7	10.7
SO_2	27.7	29.4	52.2	76.7	88.1	78.3	NE	NE

Regarding the evolution of direct GHG emissions from source category 'International Aviation' (Memo Items), the amount of these emissions recorded a downward trend from circa 195.73 kt CO_2 equivalent in 1990, to circa 153.17 kt CO_2 equivalent in 2020. The cause for this accentuated decrease recorded in 2020 was the COVID-19 pandemic (Table 3-159).

Table 3-159: Evolution of direct GHG emissions from source category 'International Aviation' (Memo Items) in the Republic of Moldova between 1990 and 2020

	direct GHG emissions, kt CO_2 equivalent				%, compared to 1990				Share, % of total		
	CO_2	CH_4	N_2O	Total	CO_2	CH_4	N_2O	Total	CO_2	CH_4	N_2O
1990	193.4599	0.3828	1.8920	195.7347	100.0	100.0	100.0	100.0	98.8	0.2	1.0
1991	147.3846	0.2917	1.4414	149.1177	76.2	76.2	76.2	76.2	98.8	0.2	1.0
1992	108.5369	0.2148	1.0615	109.8132	56.1	56.1	56.1	56.1	98.8	0.2	1.0
1993	55.2342	0.1093	0.5402	55.8837	28.6	28.6	28.6	28.6	98.8	0.2	1.0
1994	30.8414	0.0610	0.3016	31.2041	15.9	15.9	15.9	15.9	98.8	0.2	1.0
1995	41.9508	0.1638	0.4066	42.5212	21.7	42.8	21.5	21.7	98.7	0.4	1.0
1996	56.7300	0.1196	0.5436	57.3932	29.3	31.2	28.7	29.3	98.8	0.2	0.9
1997	66.1918	0.1341	0.6341	66.9600	34.2	35.0	33.5	34.2	98.9	0.2	0.9
1998	53.5923	0.1025	0.5152	54.2100	27.7	26.8	27.2	27.7	98.9	0.2	1.0
1999	63.0390	0.0994	0.6040	63.7425	32.6	26.0	31.9	32.6	98.9	0.2	0.9
2000	63.0779	0.1086	0.6101	63.7967	32.6	28.4	32.2	32.6	98.9	0.2	1.0
2001	50.4863	0.0977	0.4911	51.0751	26.1	25.5	26.0	26.1	98.8	0.2	1.0
2002	59.9541	0.0909	0.5847	60.6297	31.0	23.7	30.9	31.0	98.9	0.1	1.0
2003	34.7676	0.0873	0.3479	35.2028	18.0	22.8	18.4	18.0	98.8	0.2	1.0
2004	34.7903	0.0863	0.3548	35.2315	18.0	22.6	18.8	18.0	98.7	0.2	1.0
2005	37.9260	0.0872	0.3848	38.3980	19.6	22.8	20.3	19.6	98.8	0.2	1.0
2006	37.9241	0.0979	0.3865	38.4085	19.6	25.6	20.4	19.6	98.7	0.3	1.0
2007	44.2052	0.0681	0.4402	44.7135	22.8	17.8	23.3	22.8	98.9	0.2	1.0
2008	44.1680	0.0409	0.4319	44.6408	22.8	10.7	22.8	22.8	98.9	0.1	1.0
2009	44.1719	0.0429	0.4319	44.6466	22.8	11.2	22.8	22.8	98.9	0.1	1.0
2010	41.0593	0.0648	0.4071	41.5312	21.2	16.9	21.5	21.2	98.9	0.2	1.0
2011	41.0082	0.0696	0.3921	41.4700	21.2	18.2	20.7	21.2	98.9	0.2	0.9
2012	47.3142	0.0701	0.4520	47.8362	24.5	18.3	23.9	24.4	98.9	0.1	0.9
2013	41.0717	0.1149	0.3986	41.5852	21.2	30.0	21.1	21.2	98.8	0.3	1.0
2014	53.6855	0.0852	0.5281	54.2988	27.8	22.3	27.9	27.7	98.9	0.2	1.0
2015	56.8077	0.1395	0.5458	57.4930	29.4	36.4	28.8	29.4	98.8	0.2	0.9
2016	100.9698	0.1538	0.9827	102.1063	52.2	40.2	51.9	52.2	98.9	0.2	1.0
2017	148.2788	0.1454	1.4311	149.8553	76.6	38.0	75.6	76.6	98.9	0.1	1.0
2018	170.4060	0.1782	1.7154	172.2996	88.1	46.6	90.7	88.0	98.9	0.1	1.0
2019	151.5015	0.1369	1.5333	153.1717	78.3	35.8	81.0	78.3	98.9	0.1	1.0
2020	35.2495	0.0062	0.2938	35.5495	18.2	1.6	15.5	18.2	99.2	0.0	0.8

3.8.2. Methodological Issues, Emission Factors and Data Sources

GHG emissions from source category 'International Aviation' (Memo Items) were estimated using a Tier 2 methodological approach. Unlike the Tier 1 methodology, which requires only activity data on fuel consumption and default EFs, the Tier 2 methodology can be applied only on the availability of activity data on the number of flights by each type of aircraft used in the international air transportation, and the amount of fuels used for LTO and cruise cycles of the flights.

The basic equations used to estimate emissions are as follows:

$$Total\ Emissions = LTO\ Emissions + Cruise\ Emissions$$

where:

$$LTO\ Emissions = Number\ of\ LTOs \bullet Emission\ Factor_{LTO}$$

$$LTO\ Fuel\ Consumption = Number\ of\ LTOs \bullet Fuel\ Consumption\ per\ LTO$$

$$Cruise\ Emissions = (Total\ Fuel\ Consumption - LTO\ Fuel\ Consumption) \bullet Emission\ Factor_{Cruise}$$

Emission factors available both in the Revised 1996 IPCC Guidelines, and the 2006 IPCC Guidelines (2007 IPCC) were used to estimate GHG emissions originating from this category (Table 3-160).

Table 3-160: Default EFs available in the 1996 IPCC Guidelines used to estimate GHG emissions from source category 'International Aviation' (Memo Items)

	CO_2	CH_4	N_2O	NO_x	CO	NMVOC	SO_x
New Aircraft Types: LTO, kg/LTO	7,900	1.5	0.2	41	50	15	2.5
Old aircraft types: LTO (kg/LTO)	7,560	7	0.2	23.6	101	66	2.4
All aircraft types: cruise (kg/t)	3,150	0	0.1	17	5	2.7	1.0

Source: Revised 1996 IPCC Guidelines, Volume 3, Tables 1-52, 1.98.

Thus, in order to estimate GHG emissions from the cruise phase of the flight, emission factors available in the Revised 1996 IPCC Guidelines (IPCC, 1997) were used, except for NO_x EFs, which EFs are available in the 2006 IPCC Guidelines; whereas for the LTO phase of the flight – EFs available in the 2006 IPCC Guidelines were used.

For a number of aircraft, EFs are available in the 2006 IPCC Guidelines (Volume 2, Chapter 3, Tables 3.6.9, 3.70-3-71). In the process of selecting emission factors, information on the suitability of different types of aircraft to representative classes can be useful (2006 IPCC Guidelines, Volume 2, Chapter 3, Tables 3.6.3, 3.63). If EFs for a given type of aircraft are missing, the emission factors characteristic to the representative classes are used. For the types of aircraft operating international flights in the RM, a table of their correspondence to the representative classes was filled in, with a short description of their technical characteristics (Table 3-161).

Table 3-161: The correspondence between the most representative aircraft and the aircraft operating international flights in the Republic of Moldova

Generic name of the aircraft	Aircraft Class	Aircraft operating international flights in the RM	Short technical description of aircraft
Large commercial jet aircraft			
Airbus A319 Airbus A320 Airbus A321	Large commercial jet aircraft	A319, A320, A321	A320: length – 37.6 m; weight –73.5 t; maximum speed – 890 km/h; number of passengers – 320; flight interval – 5500 km.
Boeing 707	Large commercial jet aircraft	B707	B707: length – 37.6 м; weight –151.3 t; maximum speed – 890 km/h; number of passengers – 189 (economy); flight interval – 6000 km; engines: P&WJT.
Boeing 737	Large commercial jet aircraft	B737 (EFs similar for B737-300/400/500)	B737: length – 31 m, weight – 60 t, maximum speed – 910 km/h, number of passengers – 132, flight interval – 3400 km.
Boeing 747	Large commercial jet aircraft	B747 (EFs similar for B-747/400 and 281F)	
Boeing 757	Large commercial jet aircraft	B757 (EFs similar for B757/4300)	
Fokker 70 and Fokker 100	Regional jet aircraft	Fokker 70 and Fokker 100	Fokker 100: length 35 m, weight – 45 t, number of passengers – 109, flight interval – 2390 km.
McDonnell Douglas MD-80	Aircraft with medium haul	MD-81, MD-82, MD-83 (EFs similar for MD-80)	MD-82: length 45 m, weight -67 t, maximum speed – 925 km/h, number of passengers – 135/155/172, flight interval – 3100 km, engines: 2 x 9455 kgc.
Avro RJ-85	Jet aircraft with medium haul (similar to RJ-70, RJ-80, RJ-100, BAE 146-200)	RJ-85, RJ-100 (EFs similar for RJ-85)	RJ-85: length – 26 m, weight – 44 t, maximum speed – 831 km/h, number of passengers – 85 or 100, flight interval – 2963 km, engines: 4 turbo-propelled jet engines.
Embraer 190	Aircraft family E-Jet, with 4 types (E170, E175, E190, E195)	E190	E190: length 36 m, weight – 50.3 t, maximum speed – 890 km/h, number of passengers – 98/106, flight interval – 2963 km, engines: 2 turbo-propelled jet engines.
Embraer 170	Regional aircraft, the smallest type of E-Jet class, extended name E175	E170	E170: length 29.9 m, weight – 21.1 t, maximum speed – 890 km/h, number of passengers – 70/110, flight interval – 2963 km, engines: 2 turbo-propelled jet engines.
BAC-111	Large commercial jet aircraft for regional lines	Rombac-561 Rc	BAC-111: length 21 m, weight – 47.4 t, maximum speed – 850 km/h, number of passengers – 119, flight interval – 2780 km.

Generic name of the aircraft	Aircraft Class	Aircraft operating international flights in the RM	Short technical description of aircraft
Bombardier CRJ-100/200	Jet aircraft for regional lines	CRJ	CRJ-100/200: length – 26.8 m, weight – 21 t, maximum speed – 860 km/h, number of passengers – 50, flight interval – 1800/2500/3150 km, engines: 2 x 4180 kgc.
A-300-600	Large commercial jet aircraft for medium and long haul	A-300-600	French aircraft A-300-600: length – 54,08 m, 2 engines Pratt & Whitney JT9D-7R4H1 or General Electric2 (turbofan engines 249-273,6 kgc, Pratt & Whitney JT9D-7R4H1, PW 4156, General Electric CF6-80-C2A1 or CF6-80-C2A5), number of passengers – 361, flight interval – 7000 km maximum speed – 890 km / h, cruise speed – 875 km / h. Until 2005, world airlines used 407 Airbus A300 aircraft of all models. In 2015, these have been decommissioned by the largest airline companies in the world and Europe and have been replaced by a more recent Airbus A330 model
Medium turbo-propelled aircraft			
Saab-340	Jet aircraft for regional lines with short haul	Saab-340 (SF-340) (EFs similar for DHC8-100)	Saab-340 (SF-340): length - 19 m, weight – 13 t, maximum speed – 525 km/h, number of passengers – 37, flight interval – 1500 km, engines: 2 x 1870 shp.
Saab-2000	Turbo-propelled aircraft for regional lines	Saab-2000 (SF-2000) (EFs similar for ATR-42)	Saab-2000 (SF-2000): length – 27 m, weight – 23 t, maximum speed – 560 km/h, number of passengers – 50, flight interval – 2300 km, engines: 2 x 4155 shp.
ATR-42 (ATR-42-320, ATR-42-500)	Turbo-propelled aircraft for regional lines	L410 – Turbo-propelled aircraft for 20 passengers (EFs similar for ATR-42)	ATR-42: length – 22 m, weight –16,700 t, maximum speed – 860 km/h, number of passengers – 50, flight interval – 1950 km, engines: 2 x 2400 shp.
DHC8-100	Turbo-propelled aircraft produced in Canada with Pratt & Whitney engines	SA-227 (EFs similar for DHC8)	DHC8-100: length – 33 m, maximum speed – 650 km/h, number of passengers – 80, flight interval – 2430 km, engines: 2 x 1115 shp.
Beech King Air	Light turbo-propelled aircraft for private and corporate flights	X-32 Becas (EFs similar for Beech King Air)	Beech King Air: length – 12 m, weight - 6800 kg, maximum speed – 580 km/h, number of passengers – 7, flight interval – 2430 km, engines: 2 x 1050 shp. X-32 Becas: length – 6.5 m, weight – 450 kg, maximum speed – 168 km/h, number of passengers – 1, flight interval – 300-400 km, engines: 1 x 100 shp.
Light turbo-propelled aircraft			
Cessna 525/560	Light turbo-propelled jet aircraft	Falcon-2000EX Turbo-propelled jet aircraft for 10-19 passengers (engines 2 x TRDD Pratt & Whitney Canada) (EFs similar for Cessna 525/560); Learjet-35 aircraft for 8 passengers (engines - General Electric CJ610-8) (EFs similar for Cessna 525/560)	Cessna 525/560: length –13.26 m, weight – 5.3 t, maximum speed – 650 km/h, number of passengers – 5, flight interval – 300-400 km, engines: 2 x 9.77 кН.

Notes: Conversion factors for the engine power: 1kW=1.36 shp; 1 shp = 735 W (shp. metric); 1 kgc = 0.0098 кН; 1 shp = 75 kgc (www.covert-me.com). Since light and medium aircraft have very different characteristics, for these the 2006 IPCC Guidelines does not provide specific EFs; in that case, for these aircraft the representative EFs will be selected (ATR-42; DHC8-100; Beech Kipr Air). For light turbo-propelled aircraft, in case of missing EFs, emission factors characteristic for aircraft model Cesna 525/560 will be applied.

Default emission factors used, available in the 2006 IPCC Guidelines, used to estimate GHG emissions from 'International Aviation' (Memo Items) (Table 3-162 and Table 3-163).

Table 3-162: Default EFs, available in the 2006 IPCC Guidelines, used to estimate GHG emissions from 'International Aviation' (Memo Items)

Generic name of aircraft	Representative aircraft (according to the 2006 IPCC Guidelines, V.2, Ch. 3, Table 3.6.3, 3.6.9)	Consumption, t per LTO	Emission Factors							
			CO_2		CH_4		N_2O		NO_x	
			kg / LTO	kg / c	kg / LTO	kg / c	kg / LTO	kg / c	kg / LTO	kg / c
TU-154	TU-154B	2.23	7,030	3,150	11.9	0	0.2	0.1	14.33	9.1
TU-134	TU-134	0.93	2,930	3,150	1.8	0	0.1	0.1	8.68	8.5
YAK-40	YAK-42M	0.91	2,880	3,150	0.25	0	0.1	0.1	10.66	15.6
YAK-42	YAK-42M	0.91	2,880	3,150	0.25	0	0.1	0.1	10.66	15.6
IL-18		2.31	7,300	3,150	7.4	0	0.2	0.1	31.64	15.7
IL-76		2.31	7,300	3,150	7.4	0	0.2	0.1	31.64	15.7
AN-12 - AN-74	YAK-42M	0.91	2,880	3,150	0.25	0	0.1	0.1	10.66	15.6
A319	A319	0.73	2,310	3,150	0.06	0	0.1	0.1	8.73	11.6
A320	A320	0.77	2,440	3,150	0.06	0	0.1	0.1	9.01	12.9
A321	A321	0.96	3,020	3,150	0.14	0	0.1	0.1	16.72	16.1
B707	B707	1.86	5,890	3,150	9.75	0	0.2	0.1	10.96	5.9
B737	B737/300/400/500	0.78	2,480	3,150	0.08	0	0.1	0.1	7.19	11
B739	B737/800/900	0.8	2,780	3,150	0.07	0	0.1	0.1	12.3	14
B747	B747/400 and 281F	3.24	10,240	3,150	0.22	0	0.3	0.1	42.88	12.4
B747	B747/200	3.6	11,370	3,150	1.82	0	0.4	0.1	49.52	12.8
B757	B-757/300	1.46	4,630	3,150	0.01	0	0.1	0.1	17.85	9.8
L-410	DHC-8-400	0.2	640	3,150	0	0	0.02	0.1	1.51	12.8
MD-83, MD-81, MD-82	MD-80	1.01	3,180	3,150	0.19	0	0.1	0.1	11.97	12.4
RJ-85, RJ-70, RJ-100	RJ-RJ85	0.6	1,910	3,150	0.13	0	0.1	0.1	4.34	15.6
BAE-146	BAE-146	0.57	1,800	3,150	0.14	0	0.1	0.1	4.07	8.4
E-120ER	ERJ-145	0.31	990	3,150	0.06	0	0.03	0.1	2.69	7.9
E145, E135	E145	0.31	990	3,150	0.06	0	0.03	0.1	2.69	7.9
Fokker-70	Fokker 100/70/28	0.76	2,390	3,150	0.14	0	0.1	0.1	5.75	8.4

Generic name of aircraft	Representative aircraft (according to the 2006 IPCC Guidelines, V.2, Ch. 3, Table 3.6.3, 3.6.9)	Consumption, t per LTO	Emission Factors							
			CO_2		CH_4		N_2O		NO_x	
			kg / LTO	kg / c	kg / LTO	kg / c	kg / LTO	kg / c	kg / LTO	kg / c
Fokker-100	Fokker 100/70/28	0.76	2,390	3,150	0.14	0	0.1	0.1	5.75	8.4
CRJ-2	CRJ-100ER	0.33	1,060	3,150	0.06	0	0.03	0.1	2.27	8
ATR-42	ATR-42	0.2	620	3,150	0.03	0	0.02	0.1	1.82	14.2
SF-340B	DHC8-100	0.2	640	3,150	0	0	0.02	0.1	1.51	12.8
SF-2000	ATR-42	0.2	620	3,150	0.03	0	0.02	0.1	1.82	14.2
DHC-8	DHC-8-400	0.2	640	3,150	0	0	0.02	0.1	1.51	12.8
E190	E145	0.31	990	3,150	0.06	0	0.03	0.1	2.69	7.9
HS-25	Cessna-525/500	0.34	1,070	3,150	0.33	0	0.03	0.1	0.74	7.2
Learjet-35	Cessna 525/500	0.34	1,070	3,150	0.33	0	0.03	0.1	0.74	7.2
Rom Bac 561R	BAC111	0.8	2,520	3,150	0.15	0	0.10	0.1	7.40	12
SA-227	DHC-8-400	0.2	640	3,150	0.00	0	0.02	0.1	1.51	12.8
Falcon 2000EX	Cessna 525/500	0.34	1,070	3,150	0.33	0	0.03	0.1	0.74	7.2
X32-912 Becas	Beech King Air	0.07	230	3,150	0.06	0	0.01	0.1	0.3	8.5
CRJ	CRJ-100ER	0.33	1,060	3,150	0.06	0	0.03	0.1	2.27	8
A-300-600	A-300	1.72	5,450	3,150	0.12	0	0.2	0.1	25.86	14.8

Table 3-163: Default EFs, available in the 2006 IPCC Guidelines, used to estimate GHG emissions from 'International Aviation' (Memo Items)

Generic name of aircraft	Representative aircraft (according to the 2006 IPCC Guidelines, V.2, Ch. 3, Table 3.6.3, 3.6.9)	Consumption, t per LTO	Emission Factors					
			CO_2		NMVOC		SO_x	
			kg / LTO	kg / c	kg / LTO	kg / c	kg / LTO	kg / c
TU-154	ТУ-154B	2.23	143.05	5	107.13	2.7	2.22	1
TU-134	ТУ-134	0.93	27.98	5	16.19	2.7	0.93	1
YAK-40	YAK-42M	0.91	10.22	5	2.27	2.7	0.91	1
YAK-42	YAK-42M	0.91	10.22	5	2.27	2.7	0.91	1
IL-18		2.31	103.33	5	66.56	2.7	2.31	1
IL-76		2.31	103.33	5	66.56	2.7	2.31	1
AN-12 - AN-74	YAK-42M	0.91	10.22	5	2.27	2.7	0.91	1
A319	A-319	0.73	6.35	5	0.54	2.7	0.73	1
A320	A-320	0.77	6.19	5	0.51	2.7	0.77	1
A321	A-321	0.96	7.55	5	1.27	2.7	0.96	1
B707	B-707	1.86	92.37	5	87.81	2.7	1.86	1
B737	B737/300/400/500	0.78	13.03	5	0.75	2.7	0.78	1
B739	B737/800/900	0.8	7.07	5	0.65	2.7	0.88	1
B747	B747/400 and 281F	3.24	26.72	5	2.02	2.7	3.24	1
B747	B747/200	3.6	79.78	5	16.41	2.7	3.6	1
B757	B757/300	1.46	11.62	5	0.1	2.7	1.46	1
L-410	DHC-8-400	0.2	2.24	5	0	2.7	0.2	1
MD-83, MD-81,MD-82	MD-80	1.01	6.46	5	1.69	2.7	1.01	1
RJ-85,RJ-70,RJ-100	RJ-RJ85	0.6	11.21	5	1.21	2.7	0.6	1
BAE-146	BAE-146	0.57	11.18	5	1.27	2.7	0.57	1
E120ER	E145	0.31	6.18	5	0.5	2.7	0.31	1
E145, E135	E145	0.31	6.18	5	0.5	2.7	0.31	1
Fokker-70	Fokker100/70/28	0.76	13.84	5	1.29	2.7	0.76	1
Fokker-100	Fokker100/70/28	0.76	13.84	5	1.29	2.7	0.76	1
CRJ-2	CRJ-100ER	0.33	6.7	5	0.56	2.7	0.33	1
ATR-42	ATR-42	0.2	2.33	5	0.26	2.7	0.2	1
SF-340B	DHC8-100	0.2	2.24	5	0	2.7	0.2	1
SF-2000	ATR-42	0.2	2.33	5	0.26	2.7	0.2	1
DHC-8	DHC-8-400	0.2	2.24	5	0	2.7	0.2	1
E190	E145	0.31	6.18	5	0.5	2.7	0.31	1
HS-25	Cessna-525/500	0.34	34.07	5	3.01	2.7	0.34	1
Learjet-35	Cessna 525/500	0.34	34.07	5	3.01	2.7	0.34	1
Rom Bac 561R	BAC111	0.8	13.07	5	1.36	2.7	0.8	1
SA-227	DHC-8-400	0.2	2.24	5	0	2.7	0.2	1
Falcon 2000EX	Cessna 525/500	0.34	34.07	5	3.01	2.7	0.34	1
X32-912 Becas	Beech King Air	0.07	2.97	5	0.58	2.7	0.07	1
CRJ	CRJ-100ER	0.33	6.7	5	0.56	2.7	0.33	1
A300-600	A300	1.72	14.8	5	1.12	2.7	1.72	1

In the RM, large commercial jet aircraft produced in CIS countries were less exploited between 2005 and 2020, compared to 1995-2004. On the contrary, foreign produced aircraft were distinctly more intensely used for the operation of international flights between 2005 and 2020 (Table 3-164 and Table

3-165). It is also worth mentioning that during the period under review, the fleet of aircraft used in the Republic of Moldova for international air transportation has essentially changed its structure.

Table 3-164: Number of international flights operated from the Republic of Moldova between 1995 and 2005

	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
AN-2											1
AN-12			23	9	13	15	7	25	27	197	111
AN-24	729	929	950	1,037	755	976	749	562	124	3,241	2,811
AN-26	3			12	7	570	182	1	6	243	861
AN-28					1	6	6		3	2	3
AN-32				55	95	964	968	850	250	1,131	1,038
AN-72	23	15	19	17	21	49	53	24	28	27	87
AN-74	31	7	5	11	7	4	1	2	1	2	1
Il-18	15	23	23	45	71	62	18			10	98
Il-76	22	23		20	28	20		7	8	2	5
Mi-8						688	1,300	3,294	5,375	3,906	3,375
Mi-26											4
TU134	1,001	1,395	1,261	1,299	1,325	1,268	1,329	1,024	887	403	15
TU154	287	114	189	53	23	26	25	16	5	12	14
YAK-40	169	561	779	662	770	655	283	289	304	230	94
YAK-42	371	342	527	642	531	499	367	668	638	283	518
Others	158	176	366	137	104	102	91	178	142	255	475
Total flights with aircrafts of CIS production	**2,809**	**3,585**	**4,142**	**3,999**	**3,751**	**5,904**	**5,379**	**6,940**	**7,798**	**9,944**	**9,511**
A320					15				142	924	1,256
ATR-42			58	131	141	141	151	145	159	198	199
BAE-146										115	253
B-MD-83										16	10
B707	9	7									1
B737		27	84	128	110	16	35	102	201	341	311
B747								2			
B757				7				2	2	5	1
CRJ-2							96	103	218	350	356
CRJ					36	100					
DHC-8			45								
E120							667	627	495	842	821
E145							323	208	1	2	2
Fokker-70					23						7
HS-25			9								
L410	11			56	45	19		7	7	37	3
Learjet-35			8								
RJ-70						7	10	22	5	2	
RJ-85											36
RJ-100					2	25	118	51	19	10	
RomBac-561RC								39			
SAAB-340			372	550	505	1,259	1,467	1,024	1,671	369	132
SAAB-2000									269	970	2,238
Total flights with aircrafts of other countries	**20**	**34**	**576**	**872**	**877**	**1,567**	**2,867**	**2,332**	**3,189**	**4,181**	**5,626**
Total flights	**2,829**	**3,619**	**4,718**	**4,871**	**4,628**	**7,471**	**8,246**	**9,272**	**10,987**	**14,125**	**15,137**

Table 3-165: Number of international flights operated from the RM between 2006 and 2020

	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
AN-2	144	126	145	227	202										
AN-12	194	149	1												
AN-24	2,782	1,573	5												
AN-26	3,085	1,690	264	1,175	863	463	652	689	302	765	383	216	166	285	
AN-32	672	379	47												
AN-72	68	198													
Il-18	155	12	1	31	78	247	128	6	0						
Il-76							52	377	216	577	622	567	86		
Ka-32	42	283	126	126	139	300	284	309	268	171	193	144	287	303	244
Mi-2						1,297	1,022			1,249	796		675	923	
Mi-8	3,088	3,974	5,032	4,321	6,720	2,315	1,264	3,462	4,133	2,661	3,021	2,413	1,921	7,007	6,806
Mi-17						320	493	1,129	969	376	153	34			
Mi-26	3	64	84	84											
TU134	65	236	52	1											
YAK-18		2	16	88	5										
YAK-40	52	3	1												
YAK-42								3	3	161					

Sub-total	**10,350**	**8,689**	**5,774**	**6,053**	**8,007**	**4,942**	**3,895**	**5,975**	**5,891**	**5,960**	**5,168**	**2,705**	**2,374**	**7,595**	**7,050**
A319										445	965	1,620	3,850	4,023	1,002.5
A320	1,679	1,340	1,517	1,935	1,779	1,524	1,399	1,041.5	1,239	1,955	2,701	3,574	1,615	3,913	984
A321	2									640	473	63	34	1,300	661
B-MD-81		9	134												
B-MD-82		196	182		11	20	35	3.50	157.5				36	22	
B-MD-83		28	54	31		6									
B707							58								
B737		61	1				6	22	6	104	40				
B-737-800/900												92	24	15	
B-737-300/400/500												53	847	762	
B739									1						
B747										361	614				
B747-400												1,447		299	2,320
B747-200												80	2,783	1461	430
BAE-146												2			
DHC-8		11													
EMB-120	525	600	614	622	555	604	767	779	828	131					
EMB-135								0	16	306					
EMB-190					458	711	744	1,500.5	1,559	1,654	1,839	2,483	4,023	1,667	373
Fokker-70	455	85	10	12	13	3.5	3								
Fokker-100	58			5	4	26	25	8	2						
L410	1	2				117	258	144,5							
Learjet-35						415	399	425	215	149					
SAAB-340	21	2				12									
SAAB-2000	1,934	1,469	1,442	1,269	969	486	48								
SA-227								95							
Falcon 2000EX								350	298						
X32-912 BECAS										228					
F28F Enstrom										21					
A-300-600											251	5	38	229	
Sub-total	**2,994**	**2,402**	**2,436**	**1,939**	**2,010**	**2,400**	**2,337**	**2,955**	**4,016**	**5,930**	**6,890**	**9,419**	**16,250**	**13,691**	**5,770.5**
Total	**1,3175**	**10,946**	**8,035**	**7,657**	**9,768**	**5,521**	**5,198**	**9,322**	**10,195**	**10,882**	**11,449**	**12,691**	**18,710**	**21,286**	**13,611.5**

Source: Civil Aviation State Administration of the RM by Official Letters No. 3978 of 02.10.2006, No. 1328 of 13.09.2011; Civil Aeronautical Authority of the RM by Official Letters No. 474 of 13.02.2014, No. 366 of 02.03.2015, No. 1156 of 27.05.2016, No. 4040 of 28.12.2017 and No. 1871 of 18.07.2020, No. 2535 of 10.08.2021

Domestic flights in the current cycle are excluded from the table above as there had been a double counting of fuel for domestic aviation (from 2001 to 2016) in category 1A3a and in this category. The flights of all aircraft were taken into consideration when estimating emissions from international aviation. Domestic aviation fuel consumption is extremely low (in 2019 – 92.7 tons), and double-track records led to a marginal increase in total emissions. But according to the 2006 IPCC Guidelines, flights need to be departmentalised. Table 3-166 shows the information associated with the number of domestic aircraft flights.

Table 3-166: Number of domestic flights operated between 2001 and 2020 in the RM

	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Mi-8	8	3	29	41	31	169	145	175	335	249
	2011	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**
Ka-32	204									
Mi-2	1,297	1,022	822	2,338	1,008	609		675	923	219
Mi-8							102			
Mi-17	320	12								
A-319								1	8	6
A-320								4	1	3
A-321									1	
EMB-190							7	5	3	3
Falcon 2000EX			350	298	535	200				
Robinson R44				19			55			
X32-912 BECAS			384	865						
F28F Enstrom				89						
Cessna-150F									2,215	
Cessna C-150M									1,093	560

Source: Civil Aviation State Administration of the RM through Official Letters No. 3978 of 02.10.2006, No. 1328 of 13.09.2011; Civil Aeronautical Authority of the RM through Official Letters No. 474 of 13.02.2014, No. 366 of 02.03.2015, No. 1156 of 27.05.2016, No. 4040 of 28.12.2017 and No. 1871 of 18.07.2020, No. 2535 of 10.08.2021

AD related to the consumption of jet kerosene for international aviation was provided by the Civil Aeronautical Authority (CAA) of the RM. To be noted that certain discrepancies were revealed regarding data on jet kerosene consumption for international aviation included in the Energy Balances of the Republic of Moldova for years 1990 and 1993-2020 and data provided by the CAA (for 2003-2020 there being a significant difference) (Table 3-167).

Table 3-167: Jet kerosene consumption for the operation of international aviation in the RM between 1990 and 2020, kt

	1990	1991	1992	1993	1994	1995	1996	1997
Data available in the EBs	69.00	N/A	N/A	19.70	11.00	11.00	18.00	21.00
Data provided by CAA	68.69	73.85	30.54	19.70	12.00	13.30	20.90	24.00
Difference, %	-0.4	N/A	N/A	0.0	9.1	20.9	16.1	14.3
	1998	1999	2000	2001	2002	2003	2004	2005
Data available in the EBs	17.00	20.00	20.00	16.00	19.00	11.00	11.00	12.00
Data provided by CAA	23.00	23.00	21.00	19.62	19.67	22.22	21.33	21.44
Difference, %	35.3	15.0	5.0	22.6	3.5	102.0	93.9	78.6
	2006	2007	2008	2009	2010	2011	2012	2013
Data available in the EBs	12.00	14.00	14.00	14.00	13.00	13.00	15.00	13.00
Data provided by CAA	24.07	25.33	28.32	26.22	26.21	30.26	34.16	41.38
Difference, %	100.6	80.9	102.3	87.3	101.7	132.8	127.7	218.3
	2014	2015	2016	2017	2018	2019	2020	%
Data available in the EBs	17.00	18.00	32.00	47.00	54.00	48.00	12.00	-82.6
Data provided by CAA	49.01	69.30	99.50	148.96	217.14	177.75	157.89	129.7
Difference, %	188.3	285.0	210.9	216.9	302.1	270.3	1215.8	

Source: EBs of the RM for years 1990 and 1993-2019; Civil Aviation State Administration of the RM through Official Letters No. 3978 of 02.10.2006 and No. 1328 of 13.09.2011; Civil Aeronautical Authority through Official Letters No. 474 of 13.02.2014, No. 366 of 02.03.2015, No. 1156 of 27.05.2016, No. 4040 of 28.12.2017 and No. 1871 of 18.07.2020.

The international expert who carried out the quality expertise of the national inventory in the previous inventory cycle recommended that the emission calculations be performed using data available in the EBs of the RM on kerosene consumption for the operation of international aviation (the recommendation has been implemented).

3.8.3. Uncertainties and Time Series Consistency

The primary uncertainties factors pertain to methodology, emission factors used to estimate GHG emissions from source category 'International Aviation' (Memo Items) and quality available AD. Uncertainties associated with EFs used to estimate CO_2 emissions are estimated to be circa 5%, whereas those pertaining to EFs used to estimate CH_4 emissions – circa 10%, those associated with EFs used to estimate N_2O emissions – up to circa 100%. Uncertainties associated with AD regarding fuel consumption for international air transportation – circa 5%. In order to ensure stability of obtained results over time, the same methodology was used for the entire study period in accordance with sustainable practices applied to the inventory of GHG emissions.

3.8.4. Quality Assurance and Quality Control

Standard verification and quality control forms and checklists were filled in for 'International Aviation' source category, following a Tier 1 approach. The AD and methods used for estimating GHG emissions under this source category were documented and archived both in hard copies and electronically. In order to identify the data entry and emission estimation process related errors, verifications and quality control procedures were applied. Following the recommendations included in the 2006 IPCC Guidelines, GHG emissions originating from the 'International Aviation' source category were estimated based on AD and EF available in the official sources of reference.

3.8.5. Recalculations

In the current inventory cycle, recalculations for the period 1990-2020 have not been carried out. Between 1990 and 2020, direct GHG emissions from this category decreased by circa 81.8%.

3.8.6. Planned Improvements

Within source category 'International Aviation' (Memo Items), potential improvements could be achieved once a higher methodology is used (for example, a Tier 3 approach available in the EMEP/EEA

Air Pollutant Emission Inventory Guidebook (2019), which considers the real values of emissions for each type of aircraft depending on the flight distance.

3.9 CO_2 Emissions from Biomass (Memo Items)

3.9.1. Source Category Description

Within source category 'Memo Items', 'CO_2 emissions from Biomass' are monitored. In conformity with recommendations provided in the 2006 IPCC Guidelines, the amount of biomass consumed and GHG emissions generated are estimated under each individual source category of Sector 1 'Energy', with the specification that non-CO_2 emissions shall be reported under the respective source category, whereas CO_2 emissions shall be reported separately, not being included in the national total.

By 2020, in comparison with the base year level (1990), CO_2 emissions from source category 'CO_2 Emissions from Biomass' increased by circa 13 times i (Table 3-168, Figure 3-32).

Table 3-168: CO_2 Emissions from biomass in the RM between 1990 and 2020, kt

	1990	1991	1992	1993	1994	1995	1996	1997
CO_2 Emissions from Biomass	232.8	201.2	169.6	143.2	157.5	230.0	294.0	291.1
	1998	1999	2000	2001	2002	2003	2004	2005
CO_2 Emissions from Biomass	269.0	266.1	272.4	282.2	322.1	373.6	307.7	307.4
	2006	2007	2008	2009	2010	2011	2012	2013
CO_2 Emissions from Biomass	361.4	304.7	352.5	362.1	341.0	384.6	403.4	429.3
	2014	2015	2016	2017	2018	2019	2020	%
CO_2 Emissions from Biomass	1,314.5	1,428.4	1,603.2	2,122.7	3,583.1	2,976.2	2,985.9	13 ori

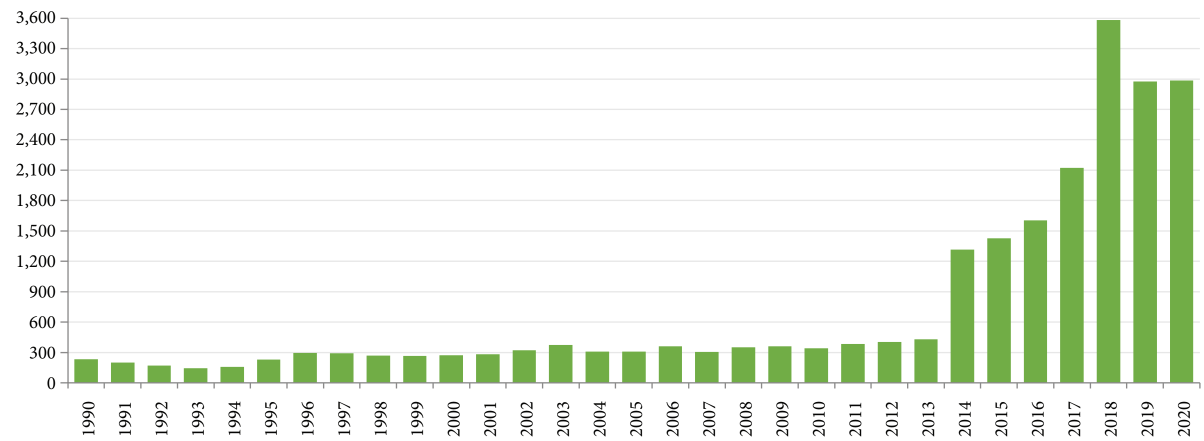


Figure 3-32: CO_2 emissions from biomass in the RM between 1990 and 2020, kt.

3.9.2. Methodological Issues, Emission Factors and Data Sources

CO_2 emissions from biomass were estimated following a Tier 1 methodological approach, available in the 2006 IPCC Guidelines.

The basic equations used to estimate CO_2 emissions from biomass are:

$$CO_2 \text{ emissions (kt)} = \text{amount of biomass (TJ)} \bullet CO_2 \text{ emission factor (kg /TJ)} \bullet 10^{(-6)},$$

$$CO_2 \text{ emissions (fuelwood), kt} = \text{fuel consumption (thousand } m^3 \text{ comp.)} \bullet \text{conversion factor in natural units (kt/thousand } m^3 \text{ comp.)} \bullet \text{conversion factor in energy units (TJ/kt)} \bullet CO_2 \text{ emission factor (kg/TJ)} \bullet 10^{(-6)}.$$

AD for the RBDR is taken from the EBs of the RM in energy units (TJ). For the LBDR, regarding source category 14Ab 'Residential', AD is available in natural units (thousand m^3 comp.), thereby conversion into energy units has been made by applying conversion factors from Table 3-169.

Table 3-169: Conversion factors from natural units into energy units

Fuel	Caloric Value	UM
Fuelwood, thousand m^3 comp.	0.73	mii tone/mii m^3 comp.
Fuelwood, kt	12.32	TJ/mii tone

For the estimation of direct GHG emissions, EFs used by default were applied, available in Tables 2.2-2.5, Chapter 2, Volume 2 of the 2006 IPCC Guidelines (Table 3-170 and 3-171).

Table 3-170: CO_2 EFs (kg/TJ) by type of biomass for categories 1A1, 1A2, 1A4a, 1A4b, 1A4c and 1A5

	Fuelwood/ Wood Waste	Charcoal	Agricultural Residues	Pellets and Briquettes / Other types of Biomass	Biogas
CO_2	112,000	112,000	100,000	100,000	54,600

Source: 2006 IPCC Guidelines, Volume 2, Chapter 2, Table 2.2-2.5, pages 17, 19, 21 and 23.

Table 3-171: CH_4 and N_2O EFs (kg/TJ) by type of biomass for categories 1A1, 1A2, 1A4a, 1A4b, 1A4ci and 1A5

Category		Fuelwood	Wood Waste	Agricultural Residues	Charcoal	Pellets and Briquettes	Biogas	Other types of solid Biomass
1A1,1A2,1A5	CH_4	30	30	30	200	30	1	30
	N_2O	4	4	4	4	4	0.1	4
1A4a,1A4b, 1A4c	CH_4	300	300	300	200	300	5	300
	N_2O	4	4	4	1	4	0.1	4

Source: 2006 IPCC Guidelines, Volume 2, Chapter 2, Table 2.2-2.5, pages 17, 19, 21 and 23.

Emission factors for non-CO_2 gases from biomass consumption are taken from the EMEP/EEA Guidebook (2019) (Table 3-172).

Table 3-172: Emission factors utilised in the estimation of indirect GHG emissions from biomass consumption by source category within Sector 1 'Energy', kg/TJ

Category	Fuel	NO_x	CO	NMVOC	SO_x
1A1	biomass	81	90	7.31	10.8
	biogas	89	39	2.6	0.281
1A2, 1A4a, 1A4ci, 1A5	biomass	91	570	300	11
	biogas	74	29	23	0.67
1A4b	biomass	50	4,000	600	11
	biogas	51	26	1.9	0.3

Source: for NO_x, CO, NMVOC, SO_x emissions – EMEP/EEA Guidebook 2019, category 1A1 - Table 3-4, 3-7; category 1.A.2 - Table 3-3, 3-5; categories 1.A.4.a.i, 1.A.4.c.i and 1.A.5.a - Table 3-8 and 3-10; category 1.A.4.b.i - Table 3-4 and 3-6.

In the sectoral statistical publications of the ATULBD, information associated with biomass consumption – fuelwood in the residential sector, is available in natural units (thousand m^3 comp.), but only for the period 2009-2020 (Table 3-173).

Table 3-173: Fuelwood consumption on the LBDR within source category 1A4b 'Residential' between 2009-2020

	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Fuelwood, thousand m^3 comp.	10.2	10.8	10.0	5.4	4.7	7.7	10.9	6.9	5.4	4.6	8.2	7.2
Fuelwood, TJ	92	97	90	48	42	69	98	62	48	41	74	65

For the territory on the RBDR, with regard to the types of biomass included in the national GHG inventory, in the EBs for the years 1990 and 1993-2002, there is information on the consumption of fuelwood and wood waste; in the EBs of the RM for the years 2003-2012 there is information on the consumption of fuel wool, wood waste and agricultural residues (Table 3-174), and AD in the EBs for the years 2003-2020 AD is available on the consumption of biogas, pellets and briquettes (Table 3-175). For a number of years, there are also numerical values for 'Other types of fuel'.

Table 3-174: Biomass consumption in the RM between 1990-2004, TJ

		1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
1A1aii	Biogas															
1A1a iii	Fuelwood	9	8	7	6											3
	Wood Waste	59	56	53	50	147	88		59	29	29	59	147		29	16
	Agricultural Residues							88						235	205	226
1A2	Fuelwood	135	112	88	65		29	29	29							9
	Wood Waste / Agricultural Residues	176	140	103	67	29										39
1A4a	Fuelwood	333	258	184	109	117	117	147	117	117	88	88	117	147	381	242
	Wood Waste / Agricultural Residues				6			29							146	78
	Other Primary Solid Biomass												29			14
1A4b	Fuelwood	1,052	957	861	766	822	1,526	1,848	1,907	1,966	1,848	1,731	1,555	1,878	1,964	1,673
	Wood Waste	234	205	176	147	205	205	323	293	176	323	499	587	499	440	320
	Agricultural Residues											29			117	130
	Other Primary Solid Biomass				29	29		29	117	29						

		1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
1A4c	Fuelwood	36	27	18	9	29	29	29	29				29		29	8
	Wood Waste / Agri-cultural Residues				3											2
	Other Primary Solid Biomass				29	29		29	117	29						
1A5	Fuelwood	45	34	24	13	30	30	89	30	88	59	29	30	87	59	24
	Wood Waste / Agri-cultural Residues				12	1	30		30		29		29	29		3
	Other Primary Solid Biomass							30	1					29		
1A	Total, TJ	2,079	1,823	1,567	1,311	1,438	2,054	2,670	2,729	2,434	2,376	2,435	2,523	2,904	3,370	2,787

Table 3-175: Biomass consumption in the RM between 2005-2020, TJ

		2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
1A1ai	Biogas									10	18	14	2	84	150	126	153
1A1aii	Biogas									29	79						
1A1aiii	Fuelwood	3	2		1	1	2	1	1	37	29						
	Wood Waste	16	1	1	1	2	2	1	3	3	5						
	Agricultural Residues	226	214	239	373	435	514	399	226	229	321						3
	Pellets and Briquettes												22	23	32	10	10
	Biogas									7	99	387	359				
1A2	Fuelwood	11	7	6	7	4	11	17	17	20	13	33	33	14	21	16	18
	Wood Waste	26	1	5	14	10	16	25	36	5	16	11	2	7	30	2	9
	Agricultural Residues							5	2	10		345	290	241	392	367	407
	Charcoal													1	1		
	Pellets and Briquettes											62	83	145	144	138	66
	Biogas											387	359	198	163	166	140
1A4a	Fuelwood	210	254	247	268	240	209	219	244	185	232	220	237	226	235	216	188
	Wood Waste	31	26	18	15	36	36	17	18	35	26	14	13	16	16	11	12
	Agricultural Residues	5	2	14	28	300	41	31	88	68	118	50	58	130	77	60	46
	Charcoal									3	21	16	13	11	32	44	25
	Pellets and Briquettes										94	83		112	150	127	110
1A4b	Fuelwood	1,704	2,123	1,716	1,942	1,767	1,808	2,134	2,543	2,880	10,425	11,439	13,131	17,474	27,599	23,098	25,130
	Wood Waste	294	340	271	312	395	237	137	273	164	124	52	89	248	2,051	1,810	219
	Agricultural Residues	214	245	197	212		66	419	96	134	105	135	53	46	1,030	370	52
	Charcoal								17	11		2	4	2	5	9	13
	Pellets and Briquettes										76	109	62	109	142	169	180
	Fuelwood					92	97	90	48	42	69	98	62	48	41	74	65
1A4c	Fuelwood	12	18	12	10	17	25	15	31	28	37	27	42	44	41	38	42
	Wood Waste	3		1		2				1	2						
	Agricultural Residues	7	12	2	1	2	6		2	3	5	1	2		3	2	3
	Charcoal														4		
	Pellets and Briquettes											1	4	5	4	4	15
1A5	Fuelwood	24	27	26	23	9	28	12									
	Wood Waste	7	4	10	3		8	2	1								
	Agricultural Residues		2	1	1		7	2									
1A	Total, TJ	2,793	3,278	2,769	3,213	3,312	3,113	3,526	3,646	3,904	11,914	13,099	14,539	19,184	32,363	26,857	26,906

3.9.3. Uncertainties and Time Series Consistency

The primary uncertainty-related factors pertain to methodology, emission factors used to estimate CO_2 emissions from biomass, and quality of available activity data. Uncertainties associated with EFs are estimed to be circa 80%, whereas those associated with AD – circa 20%. In view of ensuring time-series consistency of the obtained results, the same approach was used for the entire period under review, in conformity with the recommendations included in the 2006 IPCC Guidelines.

3.9.4. Quality Assurance and Quality Control

Standard verification and quality control forms and checklists were filled in for 'CO_2 emissions from biomass' (Memo Items), following a Tier 1 approach. The specific quality control and control procedures applied in the calculation process for category 'CO_2 Emissions from Biomass' included:

– Verification of AD collection procedures,
– Implementation of error minimization procedures for manual entry of AD, with all the spreadsheets provided with the initial sources of activity data in tabular format;
– In the calculation files the EFs are specified in tabular formats for each category, the import of the respective values into calculation formulas is ensured by automatic connections;
– The consistency of the calculations is also ensured by verifying the correctness of applying conversion factors of natural units to energy units for all categories and the entire range of years covered by the inventory;
– Verification if the same method is used for the entire range of years covered by the inventory;
– Verifying if GHG emissions calculations have been made for all years and for all types of fuels mentioned in the Energy Balances of the RM;
– In the case of recalculations, their need is explained;
– Verifying maintenance and completion of the national inventory of GHG emissions archive.

Following the recommendations included in the 2006 IPCC Guidelines, the 'CO_2 emissions from biomass' (Memo Items) were estimated based on AD and EFs from official sources of reference.

3.9.5. Recalculations

In the current inventory cycle, data regarding biomass for years 2016, 2018 and 2019 has been corrected. Consequently, a recalculation of CO_2 emissions from biomass combustion was needed. CO_2 emissions for 2020 have been estimated for the first time. The obtained results show that CO_2 emissions increased by circa 13 times between 1990 and 2020. (Table 3-176).

Table 3-176: Recalculation results of CO_2 emissions from source category 'CO_2 Emissions from Biomass'for the period 1990-2019, included in the BUR3 of the RM to the UNFCCC (2021), kt

	1990	1991	1992	1993	1994	1995	1996	1997
BUR3	232.81	201.20	169.59	143.24	157.46	230.05	294.03	291.13
NC5	232.81	201.20	169.59	143.24	157.46	230.05	294.03	291.13
Difference, %	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	1998	1999	2000	2001	2002	2003	2004	2005
BUR3	269.01	266.11	272.37	282.23	322.08	373.58	307.68	307.39
NC5	269.01	266.11	272.37	282.23	322.08	373.58	307.68	307.39
Difference, %	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2006	2007	2008	2009	2010	2011	2012	2013
BUR3	361.44	304.66	352.45	362.10	341.05	384.64	403.38	429.28
NC5	361.44	304.66	352.45	362.10	341.05	384.64	403.38	429.28
Difference, %	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2014	2015	2016	2017	2018	2019	2020	%
BUR3	1,314.49	1,428.44	1,600.99	2,122.72	3,567.96	2,963.22		
NC5	1,314.49	1,428.44	1,603.19	2,122.72	3,583.06	2,976.22	2,985.92	1,182.6
Difference, %	0.00	0.00	0.14	0.00	0.42	0.44		

Abbreviations: BUR3 – Third Biennial Update Report of the RM to the UNFCCC, NC5 – Fifth National Communication of the RM to the UNFCCC.

3.9.6. Planned Improvements

Potential improvements within source category 'CO_2 emissions from biomass' (Memo Items) could be achieved by collecting new available AD on fuel consumption on the territory of the LBDR.

3.10. Comparison of CO_2 Emissions Estimated by using Reference and Sectoral Approaches

In accordance with the recommendations provided in the 2006 IPCC Guidelines, CO_2 emissions were compared, having been calculated by using two distinct approaches: the reference approach (top-down) and the sectoral approach (bottom-up). It may be observed that the differences between the two methodological approaches do not exceed the acceptable 2.0% threshold (Table 3-177).

Table 3-177: Comparison of CO_2 emissions estimated by using reference (RA) and sectoral (SA) approaches in the Republic of Moldova for the period 1990-2020, kt

	1990	1991	1992	1993	1994	1995	1996	1997
RA	35,187.66	29,735.50	23,190.82	17,279.54	14,457.31	11,441.96	11,323.84	10,209.96
SA	35,400.44	29,897.61	23,310.19	17,340.29	14,491.23	11,475.88	11,379.35	10,274.72
Difference, %	-0.6	-0.5	-0.5	-0.4	-0.2	-0.3	-0.5	-0.6
	1998	1999	2000	2001	2002	2003	2004	2005
RA	8,838.160	6,851.691	6,127.814	6,769.596	6,479.308	7,144.538	7,595.395	7,835.838
SA	8,890.585	6,913.366	6,189.490	6,818.937	6,537.901	7,178.460	7,629.316	7,872.844
Difference, %	-0.6	-0.9	-1.0	-0.7	-0.9	-0.5	-0.4	-0.5
	2006	2007	2008	2009	2010	2011	2012	2013
RA	7,075.98	7,206.81	7,504.21	8,049.40	8,677.67	8,885.47	8,567.27	8,185.90
SA	7,112.98	7,249.98	7,547.38	8,092.57	8,717.76	8,925.56	8,613.52	8,225.98
Difference, %	-0.5	-0.6	-0.6	-0.5	-0.5	-0.5	-0.5	-0.5
	2014	2015	2016	2017	2018	2019	2020	%
RA	8,160.74	8,220.44	8,253.52	7,787.74	8,182.34	8,434.03	8,933.52	-74.6
SA	8,213.17	8,275.94	8,352.20	7,932.67	8,348.86	8,582.05	8,970.53	-74.7
Difference, %	-0.6	-0.7	-1.2	-1.9	-2.0	-1.8	-0.4	

4. INDUSTRIAL PROCESSES AND PRODUCT USE

4.1. Overview

Sector 2 'Industrial Processes and Product Use' (IPPU) includes greenhouse gas emissions generated directly from non-energy industrial activities, inventoried using the 2006 IPCC Guidelines for National Greenhouse Gas Inventories (IPCC, 2006) and EMEP/EEA Air Pollutant Emission Inventory Guidebook (2019).

In the Republic of Moldova, the source categories covered by this sector are: 2A 'Mineral Industry' (*2A1 'Cement Production', 2A2 'Lime Production', 2A3 'Glass Production', 2A4 'Other Process Uses of Carbonates'*, 2B 'Chemical Industry' (*2B10 'Other')*, 2C 'Metal Production' (*2C1 'Iron and Steel Production'*), 2D 'Non-energy Products from Fuels and Solvent Use' (*2D1 'Lubricant Use', 2D2 'Paraffin Wax Use', 2D3 'Solvent Use', 2D4* 'Other'*)*, 2F 'Product uses as substitutes for ODS' (*2F1 'Refrigeration and Air Conditioning', 2F2 'Foam Blowing Agents', 2F3 'Fire Protection', 2F4 'Aerosols'*), 2G 'Other Products Manufacture and Use' (*2G1 'Electrical Equipment', 2G3 'N_2O from Product Uses' (medical applications), 2G4 'Other')* and 2H 'Other' (*2H2 'Food and Beverages Industry'*).

A brief overview, methodological issues and data sources, uncertainty assessment and times-series consistency, quality assurance and quality control, recalculations made and planned improvements are described for each source category in this sector.

4.1.1. Summary of Emission Trends

In 2020, Sector 2 'IPPU' accounted for circa 7.3% of total national direct GHG emissions (without LULUCF), being a relevant source of GHG emissions in the RM. This sector constituted an important source of CO_2 national emissions (circa 7.7% of the national total), and F-gas emissions (HFC, PFC and SF_6).

Table 4-1: Evolution of direct GHG emissions from Sector 2 'IPPU' in the RM between 1990 and 2020, kt CO_2 equivalent

	1990	1991	1992	1993	1994	1995	1996	1997
CO_2	1605.2224	1411.2739	822.4617	737.8604	556.5852	455.6262	415.2620	452.4924
N_2O	0.0197	0.0164	0.0149	0.0179	0.0149	0.0003	0.0006	0.0009
HFC	NO	NO	NO	NO	NO	1.0298	1.6593	2.3137
PFC	NO	NO	NO	NO	NO	NO	NO	NO
SF_6	NO	NO	NO	NO	NO	NO	NO	NO
Total	**1605.2421**	**1411.2903**	**822.4766**	**737.8783**	**556.6001**	**456.6563**	**416.9219**	**454.8070**
	1998	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**
CO_2	375.5168	338.2305	310.6441	312.9423	361.1500	386.3885	456.1463	550.4807
N_2O	0.0015	0.0128	0.0131	0.0131	0.0131	0.0131	0.0149	0.0182
HFC	3.1372	4.0002	5.1199	6.8681	9.1227	12.1632	16.0027	22.5106
PFC	NO	NO	NO	NO	NO	NO	NO	NO
SF_6	NO	NO	NO	NO	NO	0.0071	0.0071	0.0427
Total	**378.6554**	**342.2435**	**315.7771**	**319.8235**	**370.2858**	**398.5720**	**472.1710**	**573.0521**
	2006	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**
CO_2	645.4865	892.1071	967.6859	462.2951	482.3543	573.6077	581.6659	623.1087
N_2O	0.0176	NO	NO	NO	NO	NO	NO	NO
HFC	33.2493	44.7872	57.3610	67.4790	78.1507	90.5042	100.4768	109.0841
PFC	0.0231	0.0231	0.0288	0.0288	0.0403	0.0403	0.0403	0.0403
SF_6	0.3088	0.4084	0.4988	0.5422	0.6616	0.7043	0.7646	0.9651
Total	**679.0853**	**937.3258**	**1025.5746**	**530.3451**	**561.2070**	**664.8566**	**682.9476**	**733.1983**
	2014	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**%**
CO_2	636.1602	606.9922	579.1078	592.6872	764.3984	754.2055	751.8959	-53.2
N_2O	NO	NO	NO	NO	NO	NO	NO	N/A
HFC	122.9816	157.0394	166.7099	185.8945	198.8877	235.5397	245.3168	23721.5
PFC	0.0403	0.0403	0.0403	0.0403	0.0403	0.0403	0.0403	75.0
SF_6	1.0540	1.0545	1.0829	1.1145	1.3348	1.4373	1.5790	22096.5
Total	**760.2361**	**765.1264**	**746.9409**	**779.7366**	**964.6613**	**991.2229**	**998.8320**	**-37.8**

Abbreviations: NO – Not Occurring.

Between 1990 and 2020, the evolution of total GHG emissions originating from Sector 2 'IPPU' recorded a downward trend, decreasing by circa 37.8%, from 1.6052 Mt CO_2 equivalent in 1990 to 0.9988

Mt CO_2 equivalent in 2020 (Table 4-1, Figure 4-1), mainly due to reduced industrial output, such as mineral products (for example, cement production decreased by 45.2%; clinker production – by 51.3%; lime production – by 92.0%; glass production – by 18.6%; brick production – by 81.9%; soda ash use – by 53.1%), steel production – by 34.4%, rolling mill production – by 25.8% and lubricants use decreased by 79.5%, etc.

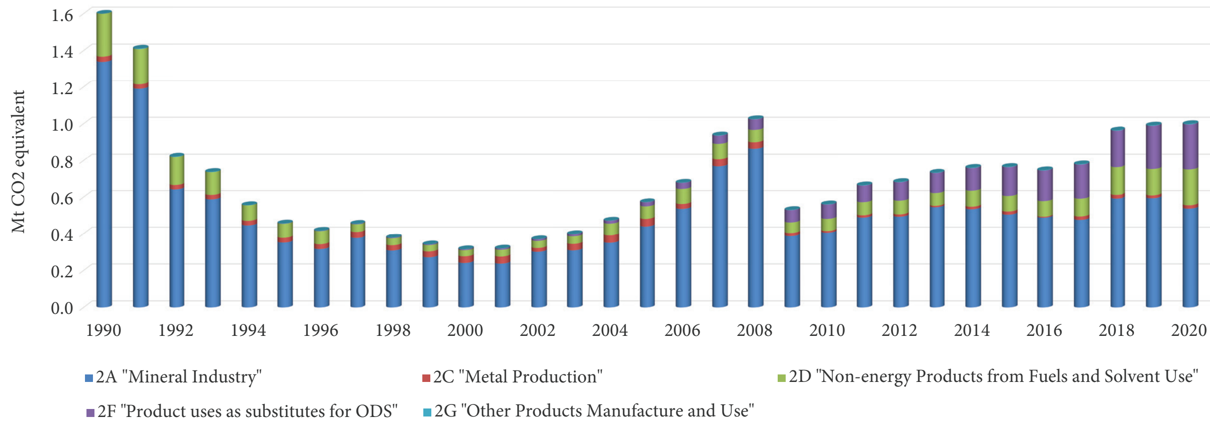


Figure 4-1: Evolution of total direct GHG emissions from Sector 2 'IPPU' in the RM between 1990 and 2020.

In 1990, there were recorded only CO_2 and N_2O emissions within this sector, whereas in 2020, the share in the total GHG emissions covered by Sector 2 'IPPU' constituted: CO_2 – 75.3%, HFC – 24.6%, PFC – 0.004% and SF_6 – 0.158%.

It should be noted that categories 2A 'Mineral Industry', 2D 'Non-Energy Products from Fuels and Solvent Use', and 2F 'Product Uses as Substitutes for Ozone Depleting Substances' (Table 4-2 and 4-3) are major sources of direct GHG emissions in Sector 2 'IPPU', with shares varying from a minimum of 53.8% (2020) and a maximum of 84.3% (1991); between a minimum of 6.5% (2008) and a maximum of 19.6% (2020); and, respectively, between a minimum of 0.2% (1995) and a maximum of 24.6% (2020) of the total.

Table 4-2: Evolution of total direct GHG emissions from the Sector 2 'IPPU' by category between 1990 and 2020, kt CO_2 equivalent

	1990	1991	1992	1993	1994	1995	1996	1997
2A. Mineral industry	1338.9600	1190.1632	641.7935	587.5786	445.3398	351.6610	316.3598	377.0608
2C. Metal industry	28.5023	24.7297	23.9922	24.4250	25.3289	26.2369	26.7261	32.3806
2D. Non-energy products from fuel and solvent use	234.3591	193.3185	154.2628	123.8759	84.4738	76.5607	71.0712	42.0528
2F. Product uses as substitutes for ODS	NO	NO	NO	NO	NO	1.0298	1.6593	2.3137
2G. Other products manufacture and use	3.4207	3.0789	2.4281	1.9988	1.4575	1.1679	1.1056	0.9991
2. IPPU	**1605.2421**	**1411.2903**	**822.4766**	**737.8783**	**556.6001**	**456.6563**	**416.9219**	**454.8070**
	1998	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**
2A. Mineral industry	308.4801	271.7103	240.7803	237.0750	301.4884	309.0730	350.4572	439.1892
2C. Metal industry	28.6822	31.7942	36.2689	38.6274	20.5030	35.4283	40.5084	41.9358
2D. Non-energy products from fuel and solvent use	37.6084	34.0839	32.6395	36.4195	38.3743	40.9252	64.1303	68.1910
2F. Product uses as substitutes for ODS	3.1372	4.0002	5.1199	6.8681	9.1227	12.1632	16.0027	22.5106
2G. Other products manufacture and use	0.7475	0.6549	0.9685	0.8335	0.7974	0.9823	1.0724	1.2255
2. IPPU	**378.6554**	**342.2435**	**315.7771**	**319.8235**	**370.2858**	**398.5720**	**472.1710**	**573.0521**
	2006	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**
2A. Mineral industry	535.4220	767.6859	864.4658	386.8478	405.3915	488.1986	493.1587	544.8742
2C. Metal industry	27.0182	38.6127	35.4118	17.0619	9.6985	12.8556	12.6973	7.6569
2D. Non-energy products from fuel and solvent use	81.9807	84.7433	66.7047	57.5805	66.2398	71.3244	74.6523	69.4810
2F. Product uses as substitutes for ODS	33.2493	44.7872	57.3610	67.4790	78.1507	90.5042	100.4768	109.0841
2G. Other products manufacture and use	1.4150	1.4967	1.6312	1.3759	1.7265	1.9738	1.9625	2.1020
2. IPPU	**679.0853**	**937.3258**	**1025.5746**	**530.3451**	**561.2070**	**664.8566**	**682.9476**	**733.1983**
	2014	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**%**
2A. Mineral industry	533.8710	504.2041	488.0182	475.6060	591.9454	593.6612	536.8930	-59.9
2C. Metal industry	13.8464	17.2792	5.2203	18.8842	20.2133	15.7926	18.6972	-34.4
2D. Non-energy products from fuel and solvent use	87.2367	84.5691	84.8044	97.0212	151.1809	143.6217	195.3645	-16.6
2F. Product uses as substitutes for ODS	122.9816	157.0394	166.7099	185.8945	198.8877	235.5397	245.3168	23721.5
2G. Other products manufacture and use	2.3005	2.0346	2.1882	2.3306	2.4340	2.6076	2.5605	-25.1
2. IPPU	**760.2361**	**765.1264**	**746.9409**	**779.7366**	**964.6613**	**991.2229**	**998.8320**	**-37.8**

Abbreviations: NO – Not Occurring.

It should be noted that the share of source category 2F 'Product Uses as Substitutes for ODS' in the total direct GHG emissions from Sector 2 'IPPU' tends to significantly increase lately (Table 4-3).

Table 4-3: Breakdown of total direct GHG emissions from Sector 2 'IPPU' for the period 1990-2020, %

	1990	1991	1992	1993	1994	1995	1996	1997
2A. Mineral industry	83.4	84.3	78.0	79.6	80.0	77.0	75.9	82.9
2C. Metal industry	1.8	1.8	2.9	3.3	4.6	5.7	6.4	7.1
2D. Non-energy products from fuel and solvent use	14.6	13.7	18.8	16.8	15.2	16.8	17.0	9.2
2F. Product uses as substitutes for ODS	NO	NO	NO	NO	NO	0.2	0.4	0.5
2G. Other products manufacture and use	0.2	0.2	0.3	0.3	0.3	0.3	0.3	0.2
	1998	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**
2A. Mineral industry	81.5	79.4	76.3	74.1	81.4	77.5	74.2	76.6
2C. Metal industry	7.6	9.3	11.5	12.1	5.5	8.9	8.6	7.3
2D. Non-energy products from fuel and solvent use	9.9	10.0	10.3	11.4	10.4	10.3	13.6	11.9
2F. Product uses as substitutes for ODS	0.8	1.2	1.6	2.1	2.5	3.1	3.4	3.9
2G. Other products manufacture and use	0.2	0.2	0.3	0.3	0.2	0.2	0.2	0.2
	2006	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**
2A. Mineral industry	78.8	81.9	84.3	72.9	72.2	73.4	72.2	74.3
2C. Metal industry	4.0	4.1	3.5	3.2	1.7	1.9	1.9	1.0
2D. Non-energy products from fuel and solvent use	12.1	9.0	6.5	10.9	11.8	10.7	10.9	9.5
2F. Product uses as substitutes for ODS	4.9	4.8	5.6	12.7	13.9	13.6	14.7	14.9
2G. Other products manufacture and use	0.2	0.2	0.2	0.3	0.3	0.3	0.3	0.3
	2014	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**%**
2A. Mineral industry	70.2	65.9	65.3	61.0	61.4	59.9	53.8	-35.6
2C. Metal industry	1.8	2.3	0.7	2.4	2.1	1.6	1.9	5.4
2D. Non-energy products from fuel and solvent use	11.5	11.1	11.4	12.4	15.7	14.5	19.6	34.0
2F. Product uses as substitutes for ODS	16.2	20.5	22.3	23.8	20.6	23.8	24.6	10791.0
2G. Other products manufacture and use	0.3	0.3	0.3	0.3	0.3	0.3	0.3	20.3

Abbreviations: NO – Not Occurring.

4.1.2. Key Categories

The results of key category analysis carried out following a Tier 1 approach are provided in Chapter 1.5 of this Report, as well as in the Annex 1-2. Table 4-4 provides information on identified key categories by level (L) and trend (T) under Sector 2 'IPPU'.

Table 4-4: Key categories identified under Sector 2 'IPPU'

IPCC	GHG	IPCC Categories	without LULUCF				with LULUCF			
			T1		T2		T1		T2	
			L	T	L	T	L	T	L	T
2A1	CO_2	Cement Production	X	X			X	X		
2A2	CO_2	Lime Production								
2A3	CO_2	Glass Production								
2A4	CO_2	Other Process Uses of Carbonates								
2C1	CO_2	Iron and Steel Production								
2D1	CO_2	Lubricants Use								
2D2	CO_2	Paraffin Wax Use								
2D3	CO_2	Solvent Use	X	X	X	X	X	X	X	X
2D4	CO_2	Other (Urea-Based Catalysts)								
2F1	HFC	Refrigeration and Air Conditioning Equipment	X	X	X	X	X	X	X	X
2F2	HFC	Foam Blowing		X		X				X
2F4	HFC	Aerosols								
2G1	PFC	Electrical Equipment								
2G1	SF_6	Electrical Equipment								
2G3	N_2O	N_2O from Product Uses (Medical Applications)								
2G4	CO_2	Other								

Abbreviations: L – Level Assessment; T – Trend Assessment; T1 – Tier 1; T2 – Tier 2.

4.1.3. Methodological Issues

Emissions from source categories 2A 'Mineral Industry', 2C 'Metal Industry', 2D 'Non-Energy Products from Fuels and Solvent Use', 2F 'Product Uses as Substitutes for ODS', 2G 'Other Products Manufacture and Use' and 2H 'Other' were estimated using both the Tier 1 methodological approach and default EFs, as well as the Tier 2 methodological approach and country-specific emission factors.

A summary description of methods used to estimate emissions by source category is provided in Table 4-5, whereas a more detailed description is available in subchapters 4.2-4.8 of this report.

Table 4-5: Summary of methods and EFs utilised to estimate GHG emissions from Sector 2 'IPPU'

IPCC Codes	Source Category	CO_2		N_2O		HFC		PFC		SF_6	
		Method	EF	Method	EF	Method	EF	Method	EF	Method	EF
2A	Mineral Industry	T2, T1	CS, D	NA	NA	NA	NA	NA	NA	NA	NA
2B	Chemical Industry	NO	NO	NO	NO	NA	NA	NA	NA	NA	NA
2C	Metal Industry	T2	CS, D	NA	NA	NA	NA	NA	NA	NO	NO
2D	Non-Energy Products from Fuels and Solvent Use	T2, T1	D	NO	NO	NA	NA	NA	NA	NA	NA
2E	Electronics Industry	NA	NA	NA	NA	NA	NA	NO	NO	NO	NO
2F	Product Uses as Substitutes for ODS	NA	NA	NA	NA	T2, T1	CS, D	NO	NO	NO	NO
2G	Other Product Manufacture and Use	T2, T1	D	T1	D	NA	NA	T1	D	T1	D
2H	Other	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

Abbreviations: T1 – Tier 1; T2 – Tier 2; CS – Country-Specific; D – Default; NA – Not Applicable; NO – Not Occurring.

4.1.4. Uncertainties and Time-Series Consistency

The uncertainty analysis of GHG emissions from Sector 2 'IPPU' (by category) is described in detail in subchapters 4.2-4.8, as well as in Annex 5-3.2 of this report. Combined uncertainties as a percentage of total sectoral emissions were estimated to be circa 11.95%. Uncertainties introduced in the trend of total direct GHG emissions from this sector were estimated to be circa 7.22%.

In view of ensuring time-series consistency of the results, the same approach was used for the entire period under review, in conformity with the recommendations included in the 2006 IPCC Guidelines.

4.1.5. Quality Assurance and Quality Control

Standard verification and quality control check-lists were filled in for each source category, following a Tier 1 approach. AD and methods used for the estimation of GHG emissions originating from this sector were documented and archived both in hard copies and electronically. In order to identify the data entry and emission estimation process related errors, verifications and quality control procedures are constantly applied. Following the recommendations included in the 2006 IPCC Guidelines, GHG emissions were estimated using AD and CS EFs from official sources of reference.

4.1.6. Recalculations

GHG emissions from Sector 2 'IPPU' were recalculated as a result of using an updated set of AD available in the Statistical Yearbooks of the Republic of Moldova and of the ATULBD, as well as in the Statistical Reports PRODMOLD-A 'Total production, as a natural expression, in the Republic of Moldova, by product type, for 2005-2020', and as a result of updated EFs, coefficients, and CS parameters, respectively. In comparison with the results included in the BUR3 of the RM to the UNFCCC (2021), the recalculations made in the current inventory cycle resulted in an insignificant increase in GHG emissions for 1990-2010, 2012-2013, 2015 and 2017-2018, and a decrease in direct GHG emissions for 2011, 2014, 2016-2019 (Table 4-6).

Table 4-6: Recalculation results of GHG emissions from Sector 2 'IPPU' for years 1990-2019, included in the BUR3 of the RM to the UNFCCC (2021), kt CO_2 equivalent

	1990	1991	1992	1993	1994	1995	1996	1997
BUR3	1603.6964	1409.7958	821.5770	737.0699	556.2487	456.1769	416.2595	454.3577
NC5	1605.2421	1411.2903	822.4766	737.8783	556.6001	456.6563	416.9219	454.8070
Difference, %	0.10	0.11	0.11	0.11	0.06	0.11	0.16	0.10
	1998	1999	2000	2001	2002	2003	2004	2005
BUR3	378.1683	341.9290	314.4396	318.6243	368.7520	397.1342	470.6623	571.3202
NC5	378.6554	342.2435	315.7771	319.8235	370.2858	398.5720	472.1710	573.0521
Difference, %	0.13	0.09	0.43	0.38	0.42	0.36	0.32	0.30
	2006	2007	2008	2009	2010	2011	2012	2013
BUR3	677.4915	936.1118	1024.2442	529.5169	559.9521	664.9270	682.8958	732.6114
NC5	679.0853	937.3258	1025.5746	530.3451	561.2070	664.8566	682.9476	733.1983
Difference, %	0.24	0.13	0.13	0.16	0.22	-0.01	0.01	0.08
	2014	2015	2016	2017	2018	2019	2020	%
BUR3	760.4540	762.7907	747.9643	776.7911	959.2291	992.1906		
NC5	760.2361	765.1264	746.9409	779.7366	964.6613	991.2229	998.8320	-37.8
Difference, %	-0.03	0.31	-0.14	0.38	0.57	-0.10		

Abbreviations: BUR3 – Third Biennial Update Report of the RM to the UNFCCC, NC5 – Fifth National Communication of the RM to the UNFCCC.

4.1.7. Assessment of Completeness

The current inventory covers GHG emissions from 7 source categories of the 8 which are monitored within Sector 2 'IPPU' (Table 4-7).

Table 4-7: Assessment of completeness under Sector 2 'IPPU'

IPCC Code	Source Category	CO_2	N_2O	HFC	PFC	SF_6	NF_3
2A	Mineral Industry	X	NO	NA	NA	NA	NA
2B	Chemical Industry	NO	NO	NA	NA	NA	NA
2C	Metal Industry	X	NO	NA	NA	NO	NA
2D	Non-Energy Products from Fuels and Solvent Use	X	NO	NA	NA	NA	NA
2E	Electronics Industry	NA	NA	NA	NO	NO	NO
2F	Product Uses as Substitutes for ODS	NA	NA	X	NA	NA	NA
2G	Other Product Manufacture and Use	X	X	NA	X	X	NA
2H	Other	NO	NO	NA	NA	NA	NA

Abbreviations: X – source categories included in the inventory; NO – Not Occurring; NA – Not Applicable.

4.1.8. Planned Improvements

Planned improvements at source category level are described more in-depth in subchapters 4.2-4.8 of this Report.

4.2. Mineral Industry (Category 2A)

4.2.1. Source Category Description

Category 2A 'Mineral Industry' includes GHG emissions from the following sources: 2A1 'Cement Production', 2A2 'Lime Production', 2A3 'Glass Production', 2A4 'Other Process Uses of Carbonates' (brick, expanded clay and ceramic production). Between 1990 and 2020, direct GHG emissions originating from category 2A 'Mineral Industry' decreased by circa 59.9% (Table 4-8).

Table 4-8: Total direct GHG emissions from the category 2A 'Mineral Industry' by source between 1990 and 2020, kt CO_2 equivalent

	1990	1991	1992	1993	1994	1995	1996	1997
2A1 Cement Production	971.6967	900.7877	474.3138	405.7165	328.4361	248.5258	193.1220	270.1273
2A2 Lime Production	264.3143	192.2260	116.1612	112.7887	83.8378	78.0227	97.7677	81.2988
2A3 Glass Production	27.4888	27.1894	13.5306	12.1968	4.3269	5.5292	8.2108	5.4581
2A4 Other Process Uses of Carbonates	75.4601	69.9600	37.7879	56.8766	28.7391	19.5834	17.2592	20.1767
2A Mineral Industry	**1338.9600**	**1190.1632**	**641.7935**	**587.5786**	**445.3398**	**351.6610**	**316.3598**	**377.0608**
	1998	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**
2A1 Cement Production	215.0572	210.8122	172.7600	173.8847	219.1917	245.6276	282.5765	365.0817
2A2 Lime Production	68.5945	37.8903	31.4020	28.4519	38.2546	20.5213	20.5790	27.8408
2A3 Glass Production	5.8586	3.9427	18.0314	16.3227	22.0121	20.3190	21.0712	24.2258
2A4 Other Process Uses of Carbonates	18.9698	19.0650	18.5869	18.4157	22.0299	22.6051	26.2305	22.0409
2A Mineral Industry	**308.4801**	**271.7103**	**240.7803**	**237.0750**	**301.4884**	**309.0730**	**350.4572**	**439.1892**
	2006	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**
2A1 Cement Production	457.0753	702.6656	789.9160	340.5679	349.8333	427.2624	442.1615	476.9104
2A2 Lime Production	30.1048	21.9382	29.1378	8.4641	15.3644	16.6236	15.5304	20.7696
2A3 Glass Production	24.9541	21.5727	24.1759	18.0724	21.2694	25.9476	20.8569	27.7204
2A4 Other Process Uses of Carbonates	23.2878	21.5093	21.2360	19.7434	18.9244	18.3651	14.6099	19.4739
2A Mineral Industry	**535.4220**	**767.6859**	**864.4658**	**386.8478**	**405.3915**	**488.1986**	**493.1587**	**544.8742**
	2014	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**%**
2A1 Cement Production	464.6082	443.2441	433.9022	404.9290	511.1209	523.8755	467.5178	-51.9
2A2 Lime Production	23.8218	15.7407	13.6470	28.8043	27.7944	27.5851	21.0641	-92.0
2A3 Glass Production	26.2533	27.4550	23.8582	26.6873	37.2220	25.8705	32.8367	19.5
2A4 Other Process Uses of Carbonates	19.1877	17.7643	16.6109	15.1853	15.8081	16.3302	15.4743	-79.5
2A Mineral Industry	**533.8710**	**504.2041**	**488.0182**	**475.6060**	**591.9454**	**593.6612**	**536.8930**	**-59.9**

The significant decrease in emissions recorded in 2008 and 2009 can be explained by the effects of the global economic crisis in 2009, which affected the national economy, including the industrial sector, particularly due to a sharp decrease in customer purchasing power from traditional Moldovan markets. The subsequent economic recovery of the industrial sector had slow growth rates. Between 2019 and 2020, there was a 9.6% decrease in GHG emissions from category 2A 'Mineral Industry', mainly due to the decrease in clinker, lime, brick and expanded clay (Figure 4-2).

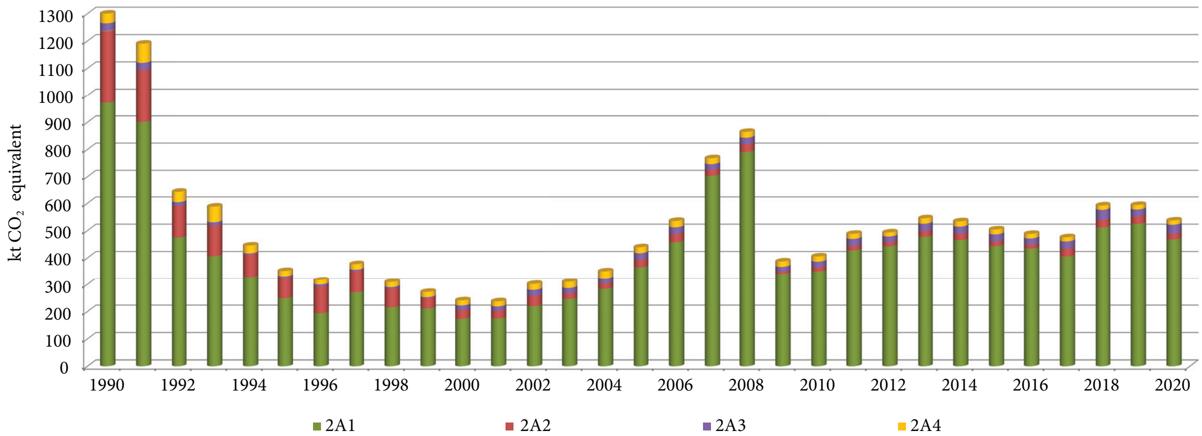


Figure 4-2: Evolution of direct GHG emissions from category 2A 'Mineral Industry' by source between 1990 and 2020.

The same trends were recorded for indirect GHG emissions (NO_x, CO, NMVOC) and SO_2 from the respective category (Table 4-9).

Table 4-9: Evolution of indirect GHG emissions and SO_2 from the category 2A 'Mineral Industry' between 1990 and 2020, kt

	1990	1991	1992	1993	1994	1995	1996	1997
NO_x	3.6040	3.3045	1.7257	1.6352	1.2757	1.0921	0.9331	1.1298
CO	3.4372	3.0431	1.6459	1.4853	1.1521	0.9044	0.8037	0.9721
NMVOC	0.0340	0.0316	0.0166	0.0144	0.0116	0.0090	0.0070	0.0097
SO_2	1.3202	1.2438	0.6316	0.6172	0.4870	0.4438	0.3697	0.4479
	1998	1999	2000	2001	2002	2003	2004	2005
NO_x	1.0014	0.8542	0.9987	0.9409	1.1650	1.1464	1.2780	1.5556
CO	0.7878	0.6973	0.5762	0.5713	0.7266	0.7495	0.8629	1.1045
NMVOC	0.0079	0.0076	0.0068	0.0068	0.0085	0.0092	0.0106	0.0135
SO_2	0.4198	0.3494	0.4842	0.4470	0.5475	0.5274	0.5790	0.6890
	2006	2007	2008	2009	2010	2011	2012	2013
NO_x	1.7321	2.2296	2.4282	1.2106	1.3115	1.5879	1.5008	1.6927
CO	1.3597	1.9983	2.2832	0.9874	1.0242	1.2450	1.2782	1.3902
NMVOC	0.0165	0.0245	0.0278	0.0123	0.0127	0.0156	0.0159	0.0172
SO_2	0.7272	0.8593	0.9032	0.4962	0.5525	0.6681	0.6001	0.6929
	2014	2015	2016	2017	2018	2019	2020	%
NO_x	1.6295	1.5589	1.4633	1.4527	1.9255	1.7986	1.7673	-51.0
CO	1.3602	1.2767	1.2375	1.2025	1.4894	1.5265	1.3540	-60.6
NMVOC	0.0167	0.0159	0.0154	0.0146	0.0186	0.0187	0.0171	-49.8
SO_2	0.6601	0.6393	0.5879	0.5922	0.8185	0.7216	0.7550	-42.8

2A1 'Cement Production'

CO_2 is generated in the process of clinker production, an intermediary product used to produce cement. $CaCO_3$ from limestone and other calcium rich materials, as well as $MgCO_3$ from dolomite, are heated at high temperatures in a kiln, thus forming the lime (CaO) and/or dolomitic lime (CaO • MgO) and carbon dioxide (CO_2) in a process called 'calcination'.

$$CaCO_3 \text{ (limestone)} + \text{heat} \rightarrow CaO \text{ (lime)} + CO_2$$

$$CaMg\,(CO_3)_2 \text{ (dolomite)} + \text{heat} \rightarrow CaO \bullet MgO \text{ (dolomitic lime)} + 2CO_2$$

Lime and/or dolomitic lime is then combined with silicon containing materials (SiO_2), aluminium (Al_2O_3) and iron oxide (Fe_2O_3) to produce clinker (greyish-black pellets 12 mm in diameter). The clinker is then removed from the kiln, cooled and pulverised, and gypsum is added to obtain 'Portland Cement', which is currently all cement produced in the Republic of Moldova, in which, according to ORTECH Corporation (1994), CaO content varies between 60-67%, and MgO content is circa 2%.

It should be noted that two cement producing plants are currently operating in the RM: JSC Lafarge Cement (Moldova) in Rezina and Cement and Slate Combined Works in Ribnita (ATULBD). CO_2 emissions from cement production are directly proportionate to the CaO fraction from the clinker used in its production. GHG emissions resulting from the combustion of fossil fuel used to produce heat, which induces reaction in the kiln, are covered by the Energy Sector and are not discussed in this sector.

2A2 'Lime Production'

Lime (CaO) is formed by heating limestone to decompose the carbonates. This reaction takes place at high temperatures, usually in a rotating kiln, and CO_2 is emitted in the process of calcination. Primary limestone (calcite) is processed from the rock mined in quarries to produce caustic lime (quicklime) using the above-mentioned reaction (see *'Cement Production'* section). Dolomitic limestone can also be heated at high temperatures to obtain dolomitic lime, consequently, producing CO_2 emissions as a result of the chemical reaction described above.

2A3 'Glass Production'

This source category includes GHG emissions from glass production divided into several main categories: flat glass for windows, containers, glassware and tableware, and specialty glass. The glass is obtained from a mixture of raw materials consisting of silica (SiO_2), sodium (Na_2O), lime (CaO) or other carbonates ($CaCO_3$, $CaMg(CO_3)_2$, Na_2CO_3, $BaCO_3$, K_2CO_3, $SrCO_3$, etc.), with small amounts of alumina (Al_2O_3), and other alkaline substances, plus some minor ingredients. A certain amount of recycled scrap glass can also be used in the production process (its share may vary between 10-80% of the total raw material used). The process of glass melting for different purposes is similar. The process of glass production consists of the following steps: selection and preparation of raw material, melting, moulding, hardening, tempering and finishing. During this process, the main pollutants emitted are CO_2, as well as NO_x, CO and SO_x. CO_2 emissions result from the calcination of lime and other carbonates at high temperatures. The main mechanisms for NO_x formation are those related to fuel combustion and emission of NO_x, as well as those resulting from the use of nitrates within the raw materials for some types of glass. The SO_x emitted in the process of glass production is determined particularly by the sulphur content of the molten dose and the sulphur absorption capacity, the excess air and the combustion temperature.

2A4 'Other Process Uses of Carbonates'

a. Ceramics

Ceramics production includes mining, processing and refining raw materials (clay) using additives such as kaolin or limestone, forming, cutting, drying and burning the final product in the kiln. The main pollutants resulting from the calcination of carbonates at high temperatures in the process of ceramic production are CO_2 and SO_x.

b. Other Uses of Soda Ash

Besides glass production, soda ash or sodium carbonate (Na_2CO_3) is used as raw material in a number of industries, such as: soap and detergent production, paper production, as well as in wastewater treatment. CO_2 emissions are produced from the use of sodium carbonate and during the production process, depending on its type (it should be noted that no sodium carbonate is produced in the RM).

4.2.2. Methodological Issues, Emission Factors and Data Sources

2A1 'Cement Production'

GHG emissions from cement production were estimated using a Tier 2 methodology (2006 IPCC Guidelines), based on activity data on clinker production. Data obtained directly from the producer on CaO and MgO ratio in clinker and cement were used for calculating the CO_2 emission factors.

$$EF_{clinker} = CaO\ Content \bullet mass\ ratio\ CO_2/CaO + MgO\ Content \bullet mass\ ratio\ CO_2/MgO$$

$$CO_2\ emissions = clinker\ production \bullet EF_{clinker} \bullet CKD\ correction\ factor$$

This approach involves that all the CaO and MgO from the clinker comes from $CaCO_3$ (limestone) and $CaMg(CO_3)_2$ (dolomite). Since no data on other non-carbonate sources were available, it was no need to adjust (reduce) the emission factors.

The value of the CKD correction factor was also considered. Cement Kiln Dust (CKD) is a mixture of raw materials, the state of which varies from uncalcined to completely calcined. Generally, all cement kilns produce CKD, its quantity depending on the technologies used by the respective plant. It should be noted that cement kiln dust may be recovered via electrostatic precipitation or filtration from the exhaust stacks; the recovered CKD may be recycled in the kiln as a raw material. Any CKD not recycled in the kiln is lost to the cement system in terms of CO_2 emissions. The default CKD correction factor is 1.02, and in the Republic of Moldova its value varied between 1990 and 2020 from a maximum of 1.013 to a minimum of 1.0002.

Country-specific CO_2 emission factors were estimated based on information obtained directly from the producers on the CaO and MgO fractions in the produced clinker, mass ratio on CO_2/CaO and CO_2/MgO and CKD correction factor values (Table 4-10).

Table 4-10: CS EFs used to estimate CO_2 emissions from clinker production in the RM, 1990-2020

	1990	1991	1992	1993	1994	1995	1996	1997
CaO fraction	0.6576	0.6576	0.6576	0.6566	0.6566	0.6577	0.6577	0.6577
CO_2/CaO mass ratio	0.7848	0.7848	0.7848	0.7848	0.7848	0.7848	0.7848	0.7848
MgO fraction	0.0160	0.0160	0.0160	0.0160	0.0160	0.0160	0.0160	0.0160
CO_2/MgO mass ratio	1.0919	1.0919	1.0919	1.0919	1.0919	1.0919	1.0919	1.0919
CKD fraction	1.0110	1.0130	1.0110	1.0120	1.0130	1.0130	1.0130	1.0120
$EF_{clinker}$	**0.5394**	**0.5405**	**0.5394**	**0.5392**	**0.5397**	**0.5406**	**0.5406**	**0.5400**
	1998	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**
CaO fraction	0.6577	0.6577	0.6569	0.6599	0.6602	0.6621	0.6586	0.6591
CO_2/CaO mass ratio	0.7848	0.7848	0.7848	0.7848	0.7848	0.7848	0.7848	0.7848
MgO fraction	0.0160	0.0160	0.0160	0.0160	0.0160	0.0181	0.0160	0.0160
CO_2/MgO mass ratio	1.0919	1.0919	1.0919	1.0919	1.0919	1.0919	1.0919	1.0919
CKD fraction	1.0130	1.0120	1.0120	1.0090	1.0060	1.0060	1.0060	1.0060
$EF_{clinker}$	**0.5406**	**0.5400**	**0.5394**	**0.5402**	**0.5388**	**0.5426**	**0.5376**	**0.5379**
	2006	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**
CaO fraction	0.6605	0.6570	0.6570	0.6510	0.6550	0.6529	0.6521	0.6551
CO_2/CaO mass ratio	0.7848	0.7848	0.7848	0.7848	0.7848	0.7848	0.7848	0.7848
MgO fraction	0.0140	0.0190	0.0120	0.0170	0.0160	0.0166	0.0168	0.0156
CO_2/MgO mass ratio	1.0919	1.0919	1.0919	1.0919	1.0919	1.0919	1.0919	1.0919
CKD fraction	1.0070	1.0060	1.0050	1.0030	1.0040	1.0008	1.0015	1.0003
$EF_{clinker}$	**0.5374**	**0.5396**	**0.5314**	**0.5311**	**0.5336**	**0.5310**	**0.5309**	**0.5313**
	2014	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**%**
CaO fraction	0.6569	0.6565	0.6602	0.6565	0.6565	0.6565	0.6565	-0.2
CO_2/CaO mass ratio	0.7848	0.7848	0.7848	0.7848	0.7848	0.7848	0.7848	0.0
MgO fraction	0.0158	0.0166	0.0166	0.0166	0.0166	0.0166	0.0166	3.7
CO_2/MgO mass ratio	1.0919	1.0919	1.0919	1.0919	1.0919	1.0919	1.0919	0.0
CKD fraction	1.0002	1.0002	1.0002	1.0002	1.0002	1.0002	1.0002	-1.1
$EF_{clinker}$	**0.5329**	**0.5335**	**0.5363**	**0.5334**	**0.5334**	**0.5334**	**0.5334**	**-1.1**

Table 4-11 shows the default EFs utilised to calculate indirect GHG emissions (NO_x, CO, NMVOC) and SO_2 from cement production.

Table 4-11: Default EFs used to estimate indirect GHG and SO_2 emissions from source category 2A1 'Cement Production'

Category	Process Description	NO_x	CO	NMVOC	SO_x
		g/t clinker			
Mineral Industry	Cement production	1241	1455	18	374

Source: EMEP/EEA Atmospheric Emissions Inventory Guidebook (2019), SNAP Code 030311 Cement, Category 1.A.2.f.i, Table 3-24.

Information on clinker production at JSC 'Lafarge Cement (Moldova)' plant in Rezina was obtained directly from the manufacturer.

As for the Cement and Slate Combined Works in Ribnita, activity data on clinker production are available in the statistical publications of the ATULBD only since 2009[43] (for the period 2007-2020). For the period between 1990 and 2006, following the recommendations in the 2006 IPCC Guidelines, activity data on clinker production at Cement and Slate Combined Works in Ribnita were inferred from statistical data on cement production, by using the equation below:

$$Clinker\ Production = Cement\ Production \bullet Clinker\ Fraction\ in\ Cement$$

[43] Express Information, Key Performance Indicators for the Industry Sector in the Republic for 2009-2019 (other than the small industries). State Statistical Service of the Transnistrian Moldovan Republic – Tiraspol.

In accordance with the technological documentation for Portland type cement production, in order to produce one ton of cement, cement plants in the Republic of Moldova use 786.9 kg of clinker (Annex 3-2).

The information provided by JSC Lafarge Cement (Moldova) in Rezina by Official Letter No. 74 of 02.03.2011 and No. 67 of 06.02.2014 was qualified as '*trade secret with commercial value*', in accordance with the stipulations of the Articles 1, 2 and 5, paragraph (1) of the Law on 'Commercial Secrets' No. 171-XII dated 06.07.1994, the respective information cannot be divulged. In these circumstances, the activity data used to calculate GHG emissions from source category 2A1 'Cement Production' is presented below only on aggregate at national level (Table 4-12).

Table 4-12: AD on cement and clinker production in the RM for 1990-2020, kt

	1990	1991	1992	1993	1994	1995	1996	1997
Cement production, kt	2,288.0	1,800.0	1,088.2	960.3	769.1	518.8	494.4	611.8
Clinker production, kt	1,801.3	1,666.6	879.3	752.5	608.6	459.7	357.3	500.2
	1998	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**
Cement production, kt	493.0	462.0	431.9	402.1	477.0	484.4	667.6	772.8
Clinker production, kt	397.8	390.4	320.3	321.9	406.8	452.7	525.7	678.7
	2006	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**
Cement production, kt	1,051.1	1,531.0	1,775.9	869.4	861.4	1,018.0	1,051.4	1,095.3
Clinker production, kt	850.6	1,302.2	1,486.6	641.3	655.6	804.7	832.8	897.6
	2014	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**%**
Cement production, kt	1,086.2	1,122.8	900.2	1,045.9	1,174.9	1,220.2	1,253.3	-45.2
Clinker production, kt	871.9	830.9	809.0	759.1	958.2	982.1	876.4	-51.3

Source: 'Lafarge Cement (Moldova)' JSC in Rezina through Letter 245 dated 01.07.2021, as a response to the Environment Agency No. 08/136/2021 dated 09.06.2021; Letter No. 114 dated 02.03.2020, as a response to the request from the Environment Agency No. 08-310/1 dated 11.02.2020; Letter No. 780 dated 22.12.2017, as a response to the request from the Climate Change Office of the Ministry of Environment No. 601/2017-12-03 dated 14.12.2017; Letter No. 395 dated 24.05.2016, as a response to the request from the Climate Change Office of the Ministry of Environment No. 512/2016-05-01 dated 10.05.2016; Letter No. 82 dated 18.02.2015, as a response to the request from the Climate Change Office of the Ministry of Environment No. 407/2015-01-09 dated 29.01.2015; Letter No. 67 dated 06.02.2014, as a response to the request from the Climate Change Office of the Ministry of Environment No. 320/2014-01-01 dated 03.01.2014; Letter No. 74 dated 02.03.2011, as a response to the request from the Climate Change Office of the Ministry of Environment No. 03-07/175 dated 02.02.2011; and Letter No. 186 dated 18.04.2007, as a response to the request from the Institute of Ecology and Geography No. 84 dated 26.03.2007; Statistical Yearbooks of the ATULBD for 1998 (page 176), 2000 (page 99), 2002 (page 103), 2005 (page 94), 2006 (page 93), 2007 (page 92), 2009 (page 92), 2010 (page 93), 2011 (page 94), 2012 (page 98), 2013 (page 99), 2014 (page 88), 2015 (page 88), 2016 (page 98), 2017 (page 101), 2019 (page 99), 2020 (page 102), 2021 (page 100).

2A2 'Lime Production'

The amount of CO_2 generated per unit of lime manufactured is estimated taking into account the molecular weight and the lime content in the obtained product (ORTECH, 1991). In the calcination reaction, one mole of carbon dioxide is formed for each mole of quicklime produced from burning calcium carbonate, and two moles of CO_2 is formed for each mole of dolomitic quicklime. This principle was used to calculate emission factors according to the equations below:

$$EF_{quicklime} = Mass\ Ratio\ (CO_2/CaO) \bullet CaO\ Content$$

$$EF_{dolomitic\ lime} = MASS\ Ratio\ (CO_2/\mathrm{CaO} \bullet \mathrm{MgO}) \bullet (\mathrm{CaO} \bullet \mathrm{MgO})\ Content$$

It should be noted that there are three types of lime: high-calcium lime (CaO + impurities); dolomitic lime (CaO • MgO + impurities); hydraulic lime (CaO + calcium silicates), which is a substance between lime and cement (the first two types have different mass ratios, and the third has a reduced CaO content). Considering these types of lime, it allows improved emission estimates.

As there is no statistic information on lime production by type in the Republic of Moldova, following the set of good practices, the total lime production was disaggregated for the breakdown of lime types according to the default values for high-calcium/dolomitic lime (85% high calcium lime and 15% dolomitic lime), the proportion of hydraulic lime considered to be zero. The basic parameters used for estimating CO_2 emission factors from lime production are shown in Table 4-13.

Table 4-13: Basic parameters for estimating EFs for category 2A2 'Lime Production'

Type of lime	Mass ratio (1)	Range of CaO content (%)	Range of MgO content (%)	Default values for CaO/CaO·MgO content (2)	Default EFs, t CO_2/t lime (1) · (2)
High-calcium lime	0.7848	93-98	0.3-2.5	0.95	0.7456
Dolomitic lime	0.9132	55-57	38-41	0.85	0.7763
Hydraulic lime	0.7848	65-92		0.75	0.5886

Source: 2006 IPCC Guidelines, Chapter 2.3 'Lime Production', Table 2.4, page. 2.22.

Emission factors for indirect GHG emissions and SO_2 originating from source category 2A2 'Lime Production' are available in Table 4-14 below.

Table 4-14: Default EFs used to estimate indirect GHG and SO_x emissions from source category 2A2 'Lime Production'

Category	Process description	NO_x	CO	SO_2
		g/t lime		
Mineral Industry	Lime Production	1369	1940	316

Source: EMEP/EEA Atmospheric Emissions Inventory Guidebook (2019), SNAP Code 030312 Lime, Category 1.A.2.f.i, Table 3-23.

Statistical Yearbooks of the RM contain aggregated AD on lime production for the period until 1992. From 1993 to 2020, AD on commercial lime production are available separately for the right and left banks of Dniester, in the Statistical Yearbooks of the RM and ATULBD (Table 4-15).

Table 4-15: AD on lime production in the RM for 1990-2020, kt

	1990	1991	1992	1993	1994	1995	1996	1997
RM: LBDR	90.00	78.60	55.00	48.00	45.00	28.00	34.00	39.00
RM: RBDR	114.30	100.00	32.80	30.00	15.90	10.80	19.90	9.70
RM: total	**204.30**	**178.60**	**87.80**	**78.00**	**60.90**	**38.80**	**53.90**	**48.70**
	1998	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**
RM: LBDR	26.00	19.00	12.00	2.00	8.00	0.00	1.00	7.00
RM: RBDR	12.70	5.20	3.10	3.30	3.30	2.90	2.10	2.08
RM: total	**38.70**	**24.20**	**15.10**	**5.30**	**11.30**	**2.90**	**3.10**	**9.08**
	2006	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**
RM: LBDR	8.00	14.00	14.00	4.28	3.18	7.44	6.84	5.49
RM: RBDR	2.15	1.14	0.34	0.33	0.19	0.18	0.13	0.08
RM: total	**10.15**	**15.14**	**14.34**	**4.61**	**3.37**	**7.61**	**6.97**	**5.57**
	2014	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**%**
RM: LBDR	8.33	8.01	4.02	22.26	24.73	27.90	22.22	-75.3
RM: RBDR	0.05	0.17	0.05	0.13	0.09	0.04	0.00	-100.0
RM: total	**8.38**	**8.18**	**4.07**	**22.38**	**24.81**	**27.94**	**22.22**	**-89.1**

Source: National Bureau of Statistics of the Republic of Moldova through the Statistical Yearbooks of the RM for years 1994 (page 286), 1999 (page 302), 2003 (page 392), 2006 (page 312); Statistical Reports PRODMOLD-A 'Total production, as a natural expression, in the Republic, by product type for the years 2005-2020'; Statistical Yearbooks of the ATULBD for the years 1998 (page 176), 2000 (page 99), 2002 (page 103), 2005 (page 94), 2006 (page 93), 2007 (page 92), 2009 (page 92), 2011 (page 94), 2012 (page 98), 2013 (page 99), 2014 (page 88), 2015 (page 88), 2016 (page 98), 2017 (page 101), 2019 (page 99), 2020 (page 102), 2021 (page 100).

As revealed in Table 4-15, commercial lime production has plunged drastically in the RM in recent years (RBDR). In this context, the amount of commercial lime needed for domestic consumption is substituted with imported amounts. Table 4-16 provides statistical data on lime imports between 1995 and 2020. According to this data, lime imports increased by circa 147 times over this period.

Table 4-16: Lime imports in the RM (RBDR) between 1995 and 2020, kt

	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
Lime imports in the RM, kt	0.063	0.234	0.336	0.515	0.405	0.603	1.783	2.109	3.243	3.662	3.953	5.121	6.423
	2008	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**
Lime imports in the RM, kt	7.540	3.798	4.826	4.699	5.053	4.256	5.260	4.657	5.330	6.527	6.803	7.390	9.320

Source: Customs Service of the RM, Official Letter No. 28/07-1893 dated 23.02.2011, as a response to Letter No. 03-07/175 dated 02.02.2011 from the Ministry of Environment; Letter No. 15-03-05 dated 24.01.2014, as a response to Letter No. 320/2014-01-01 dated 03.01.2014, from the Climate Change Office of the Ministry of Environment; Letter No. 28/07-2231 dated 26.02.2015, Letter No. 407/2015-01-09 dated 29.01. 2015, from the Climate Change Office of the Ministry of Environment; Letter No. 28/07-8785 dated 26.05.2016, as a response to Letter No. 512/2016-05-01 dated 10.05.2016, from the Climate Change Office of the Ministry of Environment; Letter No. 28/07-612 dated 12.01.2018, as a response to Letter No. 601/2017-12-03 dated 14.12.2017, from the Climate Change Office of the Ministry of Environment; Letter No. 28/07-3025 dated 28.02.2020, as a response to Letter No. 08-310/1 dated 11.02.2020, from the Environment Agency; from the MARDE dated 19.02.2021, as a response to Letter No. 13-07/519 dated 09.02.2021.

According to the 2006 IPCC Guidelines (Volume 3, Chapter 2.5, Table 2-7), emissions from lime production at sugar factories should be reported under 2A2 'Lime production'.

As the amount of lime produced and utilised by self-producers is not accounted for by the statistical system, this information was requested from sugar-producing enterprises in the Republic of Moldova (in the current inventory cycle, the information was submitted by two enterprises: Sudzucker-Moldova Ltd. and Moldova Sugar Ltd., the market share of these two enterprises varied in the period 2013-2020 between 93% and 100% of the total amount of sugar produced in the Republic of Moldova).

Table 4-17: AD on lime production at sugar factories in the RM between 1990 and 2020, kt

	1990	1991	1992	1993	1994	1995	1996	1997
Granulated sugar from sugar beet[1]	435.800	236.900	208.000	230.200	166.700	218.700	264.500	213.300
Specific consumption of quicklime, kg/t produced sugar	348.4	339.3	330.3	321.3	312.3	303.3	294.2	285.2
Amount of lime used in sugar production, kt[2]	151.8144	80.3888	68.7056	73.9618	52.0558	66.3210	77.8238	60.8349
	1998	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**
Granulated sugar from sugar beet[1]	194.500	100.500	105.400	132.600	167.600	107.100	110.900	133.472
Specific consumption of quicklime, kg/t produced sugar	276.2	267.2	258.1	249.1	240.1	231.1	222.1	213.0
Amount of lime used in sugar production, kt[2]	53.7184	26.8501	27.2084	33.0337	40.2410	24.7487	24.6263	28.4345

	2006	2007	2008	2009	2010	2011	2012	2013
Granulated sugar from sugar beet[1]	149.046	73.964	133.966	38.373	103.209	88.436	83.440	140.297
Specific consumption of quicklime, kg/t produced sugar	204.0	195.0	186.0	177.0	167.9	169.8	175.0	167.3
Amount of lime used in sugar production, kt[2]	30.4078	14.4226	24.9141	6.7902	17.3320	14.7827	13.9536	22.4142
	2014	2015	2016	2017	2018	2019	2020	%
Granulated sugar from sugar beet[1]	177.695	84.519	99.999	128.980	73.906	86.925	54.366	-87.5
Specific consumption of quicklime, kg/t produced sugar	148.3	155.4	153.4	129.2	199.2	112.1	136.5	-60.8
Amount of lime used in sugar production, kt[2]	23.7175	13.0270	14.3120	16.4270	12.6335	9.2278	6.1580	-95.9

Source: [1]Statistical Yearbooks of the Republic of Moldova for the years 1994 (page 289), 1999 (page 304), 2003 (page 393), 2006 (page 310), Statistical Reports PRODMOLD-A 'Total production, as a natural expression, in the RM, by product type, for the years 2005-2020'; Statistical Yearbooks of the ATULBD for years 1998 (page 177), 2000 (page 100), 2002 (page 104), 2005 (page 94); [2]Sudzucker-Moldova Ltd., through Letter No. 03-1-191 dated 19.04.2011, as a response to the interpellation of the Letter of the Ministry of Agriculture, and Food Industry No. 19/348 dated 15.04.2011; Letter from February 28, 2020, as a response to the interpellation of the Environment Agency No. 08-310/1 dated 11.02.2020; Letter from August 25, 2021, as a response to the interpellation of the Environment Agency No. 08/136/2021 dated 09.06.2021. Moldova Sugar Ltd., Letter from August 14, 2020, as a response to the interpellation of the Environment Agency No. 08-310/1 dated 11.02.2020. Letter from August 2, 2021, as a response to the interpellation of the Environment Agency No. 08/136/2021 dated 09.06.2021.

The total amount of lime produced in the country between 1990 and 2020 (commercial lime and the lime produced by self-producers, particularly at sugar factories) is presented below (Table 4-18).

Table 4-18: AD on hydrated lime production in the RM for 1990-2020, kt

	1990	1991	1992	1993	1994	1995	1996	1997
Commercial lime produced	204.300	178.600	87.800	78.000	60.900	38.800	53.900	48.700
Lime from self-producers	151.814	80.389	68.706	73.962	52.056	66.321	77.824	60.835
Total lime produced in the RM, kt	**356.114**	**258.989**	**156.506**	**151.962**	**112.956**	**105.121**	**131.724**	**109.535**
	1998	1999	2000	2001	2002	2003	2004	2005
Commercial lime produced	38.700	24.200	15.100	5.300	11.300	2.900	3.100	9.076
Lime from self-producers	53.718	26.850	27.208	33.034	40.241	24.749	24.626	28.435
Total lime produced in the RM, kt	**92.418**	**51.050**	**42.308**	**38.334**	**51.541**	**27.649**	**27.726**	**37.510**
	2006	2007	2008	2009	2010	2011	2012	2013
Commercial lime produced	10.153	15.135	14.344	4.614	3.369	7.615	6.971	5.569
Lime from self-producers	30.408	14.423	24.914	6.790	17.332	14.783	13.954	22.414
Total lime produced in the RM, kt	**40.561**	**29.558**	**39.258**	**11.404**	**20.701**	**22.397**	**20.924**	**27.983**
	2014	2015	2016	2017	2018	2019	2020	%
Commercial lime produced	8.378	8.181	4.075	22.382	24.814	27.938	22.222	-89.1
Lime from self-producers	23.717	13.027	14.312	16.427	12.634	9.228	6.158	-95.9
Total lime produced in the RM, kt	**32.095**	**21.208**	**18.387**	**38.808**	**37.448**	**37.166**	**28.380**	**-92.0**

As the produced amount of hydrated lime (by means of slaking, lime is disaggregated into hydrated lime, i.e. $Ca(OH)_2$ or $Ca(OH)_2 \cdot Mg(OH)_2$) is unknown in the country, following the good practices, this value was inferred from AD on total amount of lime produced in the RM, by multiplying it by a correction factor (the default value being 0.97).

At the same time, the amount of high-calcium lime and dolomitic lime was inferred from AD on the amount of hydrated lime by using the default value for high calcium/dolomitic lime 85/15 (Table 4-19).

Table 4-19: AD on hydrated lime production in the RM for 1990-2020, kt

	1990	1991	1992	1993	1994	1995	1996	1997
High-calcium lime	302.6972	220.1405	133.0297	129.1676	96.0124	89.3529	111.9652	93.1047
Dolomitic lime	53.4172	38.8483	23.4758	22.7943	16.9434	15.7682	19.7586	16.4302
Total hydrated lime produced	**356.1144**	**258.9888**	**156.5056**	**151.9618**	**112.9558**	**105.1210**	**131.7238**	**109.5349**
	1998	1999	2000	2001	2002	2003	2004	2005
High-calcium lime	78.5556	43.3926	35.9621	32.5836	43.8099	23.5014	23.5674	31.8838
Dolomitic lime	13.8628	7.6575	6.3463	5.7501	7.7312	4.1473	4.1589	5.6266
Total hydrated lime produced	**92.4184**	**51.0501**	**42.3084**	**38.3337**	**51.5410**	**27.6487**	**27.7263**	**37.5103**
	2006	2007	2008	2009	2010	2011	2012	2013
High-calcium lime	34.4765	25.1240	33.3691	9.6932	17.5956	19.0376	17.7857	23.7857
Dolomitic lime	6.0841	4.4337	5.8887	1.7106	3.1051	3.3596	3.1387	4.1975
Total hydrated lime produced	**40.5606**	**29.5577**	**39.2578**	**11.4038**	**20.7007**	**22.3972**	**20.9243**	**27.9832**
	2014	2015	2016	2017	2018	2019	2020	%
High-calcium lime	27.2811	18.0265	15.6287	32.9872	31.8306	31.5909	24.1230	-92.0
Dolomitic lime	4.8143	3.1811	2.7580	5.8213	5.6172	5.5749	4.2570	-92.0
Total hydrated lime produced	**32.0955**	**21.2076**	**18.3868**	**38.8085**	**37.4478**	**37.1658**	**28.3800**	**-92.0**

CO_2 emissions were estimated following a Tier 2 methodological approach available in the 2006 IPCC Guidelines, by multiplying the above-mentioned emission factors by annual activity data on hydrated lime production, considering the type of lime produced, the correction factor or the amount of lime kiln dust, LKD representing a mixture of raw materials varying from an uncalcined state to a completely calcined state. Virtually, all types of kilns used to produce lime generate such dust, but the amount depends on the technology applied within the respective factory. It should be noted that the lime kiln dust can be retained by electrostatic precipitation or filtration, and it is possible to return it to the kiln as raw material. Related to CO_2 emissions, any amount of dust that is not returned to the kiln is considered to be a system loss.

$$Total_{l} = P_{i} \bullet EF_{lime,\, i} \bullet correction\ factor\ (LKD)$$

Where:

Total $_{l}$ – CO_2 emissions from type *i* lime production (Kt/yr);

EF $_{lime,\ i}$ – emission factor for type *i* lime (0.7456 t CO_2/t high-calcium lime and 0.7763 t CO_2/t dolomitic lime);

P $_{i}$ – type *i* lime production (kt/yr);

LKD – correction factor, the default value used is 1.02, the country-specific value is unknown.

2A3 'Glass Production'

This source category covers GHG emissions originating from the production of different types of glass (flat window glass, multi-layer insulating glass, mirrors, glassware, tableware, specialty glass, etc.). Glass is produced from a raw material mix containing silica (SiO_2), sodium (Na_2O), lime (CaO) or other carbonates ($CaCO_3$, $CaMg(CO_3)_2$, Na_2CO_3, $BaCO_3$, K_2CO_3, $SrCO_3$, etc.), with small admixture of aluminium (Al_2O_3) and alkaline substances, plus other minor ingredients. The process of glass production allows for a small quantity of recycled glass (cullet) to be used (its share can vary between 10-80% of the total raw material used). The melting process for different types of glass is similar. The process of glass production implies the following phases: selection and preparation of the raw material, melting, moulding, hardening, tempering, and finishing.

Methodological issues regarding the estimation of indirect GHG emissions from glass production are addressed in the 2006 IPCC Guidelines for National Greenhouse Gas Inventories, as well as in the EMEP/EEA Atmospheric Emissions Inventory Guidebook (2019).

CO_2 emissions were estimated following a Tier 2 methodological approach available in the 2006 IPCC Guidelines.

$$Total\ CO_2\ emissions = \Sigma\ [M_{g,i} \bullet FE_{g,\, i} \bullet (1 - CR_i)]$$

Where:

Total – CO_2 emissions from glass production (kt/yr);

M $_{g,\ i}$ – mass of melted type *i* glass (kt/yr);

EF $_{i}$ – emission factor for type *i* glass (t CO_2/t melted glass);

CR $_{i}$ – cullet ratio for manufacturing of type *i* glass, fraction.

Default EFs used to estimate CO_2, respectively the cullet ratio for manufacturing different types of glass are provided in Table 4-20.

Table 4-20: Default EFs used to estimate CO_2 emissions from glass production

Type of glass	Default EF, t CO_2 / t glass	CR for manufacturing glass	Average CR value in glass production
Flat glass production for windows	0.21	10%-25%	17.5%
Glass for flint type containers	0.21	30%-60%	45.0%
Glass for green or amber containers	0.21	30%-80%	55.0%
Fiberglass (type E-glass)	0.19	0%-15%	7.5%
Fiberglass for insulation	0.25	10%-50%	30.0%
Specialty glass (TV panels)	0.18	20%-75%	47.5%
Specialty glass (TV funnels)	0.13	20%-70%	45.0%
Glass for glassware and tableware	0.10	20%-60%	35.0%
Lab/Pharma Glass	0.03	30%-75%	52.5%
Glass for lighting	0.20	40%-70%	55.0%

Source: 2006 IPCC Guidelines for National Greenhouse Gas Inventories, Volume 3, Chapter 2.4, Table 2.6, Page 2.30.

The following glass factories operated in the RM: SOE 'Chisinau Glass Factory', ME 'Glass Container Company', and ME 'Glass Container Prim' Ltd. in Chisinau (since 2002); 'Cristal-Flor' Glass Factory in Floresti and the Glass Factory in Tiraspol (ATULBD), but the last two plants ceased their activity.

Activity data on glass production are available in the Statistical Yearbooks of the RM and of the ATULBD, as well as in the Statistical Reports PRODMOLD-A 'Total production, as a natural expression, in the Republic, by product type' (Table 4-21). To be noted that the information regarding the production of glass jars, expressed in millions of pieces is available in the Statistical Yearbooks of the Republic of Moldova only for 1990-2011; at the same time, information regarding the production of glass jars, expressed in kt, is available for 2004-2013 in the Statistical Reports PRODMOLD-A 'Total production, as a natural expression, in the Republic, by product type'. For 2014-2020, the information is missing due to confidential reasons (C).

Table 4-21: AD on glass production in the RM for 1990-2020

	1990	1991	1992	1993	1994	1995	1996	1997
Flat glass for windows, thousand m^2	226.000	287.000	184.000	NO	NO	NO	NO	NO
Glass jars, mil. conventional units	657.600	693.700	187.400	248.900	152.700	87.400	39.600	86.400
Glass containers and bottles, mil. units	165.500	153.000	138.800	138.200	133.400	184.000	165.200	172.200
Fiberglass products, tonnes	NO	NO	NO	NO	NO	NO	NO	NO
Other products not included elsewhere, tonnes	NO	NO	NO	NO	NO	NO	NO	NO
	1998	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**
Flat glass for windows, thousand m^2	NO	NO	NO	NO	NO	NO	NO	NO
Glass jars, mil. conventional units	84.200	104.600	156.200	148.800	137.400	107.400	98.900	103.100
Glass jars, kt	NA	NA	NA	NA	NA	NA	25.714	26.686
Glass containers and bottles, mil. units	189.100	125.200	260.500	228.300	296.100	281.400	308.000	354.639
Fiberglass products, tonnes	NO	NO	NO	NO	NO	NO	NO	0.055
Other products not included elsewhere, tonnes	NO	NO	NO	NO	NO	NO	NO	141.184
	2006	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**
Flat glass for windows, thousand m^2	NO	NO	NO	NO	NO	NO	NO	NO
Glass jars, mil. conventional units	121.300	98.700	80.700	92.200	99.800	48.200	NA	NA
Glass jars, kt	30.072	22.723	17.936	20.760	22.149	10.707	24.654	31.029
Glass containers and bottles, mil. units	321.450	302.716	284.707	201.299	246.213	326.270	223.109	272.534
Fiberglass products, tonnes	0.011	40.638	32.612	14.785	18.148	26.365	392.821	1711.140
Other products not included elsewhere, tonnes	291.123	77.990	87.905	61.682	35.988	51.108	63.127	89.829
	2014	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**%**
Flat glass for windows, thousand m^2	NO	NO	NO	NO	NO	NO	NO	N/A
Glass jars, kt	C	C	C	C	C	C	C	N/A
Glass containers and bottles, mil. units	243.722	228.942	218.546	205.973	235.067	215.025	306.836	42.0
Fiberglass products, tonnes	1917.709	2124.277	2330.846	2537.415	2743.983	2755.532	2636.413	N/A
Other products not included elsewhere, tonnes	147.435	182.205	150.750	69.392	6.884	21.751	26.198	N/A

Source: Statistical Yearbooks of the RM for the years 1988 (page 228), 1994 (page 287), 1999 (page 303), 2003 (page 393), 2004 (page 443), 2005 (pages 321-322), 2006 (page 312), 2010 (page 305), 2012 (page 309); Statistical Yearbooks of the ATULBD for the years 1998 (page 180), 2000 (page 100), 2002 (page 104), 2005 (page 94), 2007 (page 93), 2010 (page 93). Statistical Reports PRODMOLD-A 'Total production, as a natural expression, in the Republic, by product type, for 2005-2020'.

With reference to the CS values of the share of recyclable glass in the production process of glass jars, containers and glass bottles, the information was received through questionnaires from the SOE 'Chisinau Glass Factory', and from the 'Glass Container Company' in Chisinau, respectively. The share of these enterprises in the total glass production at national level was taken into account, thus determining the weighted average value of the CR coefficient. The default EF for glass used to produce jars, glass containers and bottles is 210 kg CO_2 per ton of glass produced. Country-specific emission factors were calculated considering the annual country-specific CR values (Table 4-22).

Table 4-22: CS EFs used to estimate CO_2 emissions from glass production (glass jars, glass containers and bottles) in the RM, 1990-2020

	1990	1991	1992	1993	1994	1995	1996	1997
Average value of CR in the production process of glass jars, glass containers and bottles, %	49.7	51.0	47.8	57.5	81.1	77.8	59.4	76.8
CS EF, kg CO_2/t glass used for the production of glass jars, glass containers and bottles	105.6	102.9	109.6	89.3	39.7	46.7	85.4	48.7
	1998	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**
Average value of CR in the production process of glass jars, glass containers and bottles, %	76.8	79.7	51.2	50.6	44.7	44.5	46.0	45.4
CS EF, kg CO_2/t glass used for the production of glass jars, glass containers and bottles	48.7	42.7	102.4	103.7	116	116.6	113.4	114.7
	2006	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**
Average value of CR in the production process of glass jars, glass containers and bottles, %	39.8	43.0	30.7	31.4	32.6	31.5	29.6	24.4
CS EF, kg CO_2/t glass used for the production of glass jars, glass containers and bottles	126.4	119.7	145.6	144	141.6	143.8	147.8	158.7
	2014	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**%**
Average value of CR in the production process of glass jars, glass containers and bottles, %	22.9	19.0	18.8	14.4	21.7	28.6	25.9	-47.8
CS EF, kg CO_2/t glass used for the production of glass jars, glass containers and bottles	161.9	170.2	170.5	179.7	164.3	150.0	155.5	47.3

Source: SOE 'Chisinau Glass Factory', Official Letter No. 31 dated 21.02.2011, as a response to request No. 03-07/175 dated 02.02.2011; Letter No. 9/01-01 dated 16.01.2014, as a response to request No. 320/2014-01-01 dated 03.01.2014; Letter No. 16 dated 12.02.2015 as a response to request No. 407/2015-01-09 dated 29.01.2015; Letter No. 86 dated 19.05.2016, as a response to request No. 512/2016-05-01 dated 10.05.2016; Letter from 20.02.2018, as a response to request No. 601/2017-12-03 dated 14.12.2017; Letter from 28.02.2020, as a response to request No. 08-310/1 dated 11.02.2020; Letter No. 244 dated 24.06.2021, as a response to the interpellation of the Environment Agency No. 08/136/2021 dated 09.06.2021. Glass Container Company Chisinau and Glass Container Prim, Letter from 28.02.2011, as a response to request No. 03-07/175 dated 02.02.2011; Letter No. 01-1C-78 dated 19.02.2014, as a response to request No. 320/2014-01-01 dated 03.01.2014; Letter No. 01-3C-63 dated 30.03.2015, as a response to request No. 407/2015-01-09 dated 29.01.2015; Letter from 23.05.2016, as a response to request No. 512/2016-05-01 dated 10.05.2016; Letter from 23.02.2018, as a response to request No. 601/2017-12-03 dated 14.12.2017; Letter from 02.06.2020, as a response to request No. 08-310/1 dated 11.02.2020. Letter from 29.06.2021, as a response to the interpellation of the Environment Agency No. 08/136/2021 dated 09.06.2021

As for other types of glass produced in the Republic of Moldova, default EF values available in the 2006 IPCC Guidelines were used (Volume 3, Chapter 2.4, Table 2.6, Page 2.30).

In order to convert the AD in metric mass units (kilotons), a series of conversion coefficients were used: the specific density of flat glass for windows used in the construction sector[44] – 2.5 g/cm^3; the average thickness of flat glass for windows used in the construction sector – 3.5 mm; the average thickness of multi-layer insulating glass used in construction – 6.75 mm[45]; the average weight of a conventional glass container – 0.52 kg and the average weight of a glass jar – 0.26 kg (with reference to the last two conversion coefficients, they were determined after requesting information from SOE 'Glass Factory in Chisinau', respectively glass factories JSC 'Glass Container Company' and JSC 'Glass Container Prim'.

It should be noted that flat glass is no longer produced in the Republic of Moldova since 1993, glass bottles for the wine industry are produced only on the right bank of the Dniester River whereas the production of glass jars for the canning industry on the left bank of the Dniester River was ceased in 2009. AD on glass production in the Republic of Moldova, is available below (Table 4-23).

Table 4-23: AD on glass production in the RM for 1990-2020, kt

	1990	1991	1992	1993	1994	1995	1996	1997
Flat glass for windows	1.978	2.511	1.610	NO	NO	NO	NO	NO
Glass jars	170.976	180.362	48.724	64.714	39.702	22.724	10.296	22.464
Glass containers and bottles	86.060	79.560	72.176	71.864	69.368	95.680	85.904	89.544
Fiberglass products	NO	NO	NO	NO	NO	NO	NO	NO
Other products not included elsewhere	NO	NO	NO	NO	NO	NO	NO	NO
Total glass produced in the RM	**259.014**	**262.433**	**122.510**	**136.578**	**109.070**	**118.404**	**96.200**	**112.008**
	1998	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**
Flat glass for windows	NO	NO	NO	NO	NO	NO	NO	NO
Glass jars	21.892	27.196	40.612	38.688	35.724	27.924	25.714	26.686
Glass containers and bottles	98.332	65.104	135.460	118.716	153.972	146.328	160.160	184.412
Fiberglass products	NO	NO	NO	NO	NO	NO	NO	0.000
Other products not included elsewhere	NO	NO	NO	NO	NO	NO	NO	0.141
Total glass produced in the RM	**120.224**	**92.300**	**176.072**	**157.404**	**189.696**	**174.252**	**185.874**	**211.239**
	2006	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**
Flat glass for windows	NO	NO	NO	NO	NO	NO	NO	NO
Glass jars	30.072	22.723	17.936	20.760	22.149	10.707	24.654	31.029
Glass containers and bottles	167.154	157.412	148.048	104.675	128.031	169.660	116.017	141.718
Fiberglass products	0.000	0.041	0.033	0.015	0.018	0.026	0.393	1.711
Other products not included elsewhere	0.291	0.078	0.088	0.062	0.036	0.051	0.063	0.090
Total glass produced in the RM	**197.517**	**180.254**	**166.104**	**125.512**	**150.234**	**180.445**	**141.127**	**174.547**
	2014	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**%**
Flat glass for windows	NO	NO	NO	NO	NO	NO	NO	N/A
Glass jars	33.316	40.008	23.842	38.897	101.325	57.482	48.614	-66.4
Glass containers and bottles	126.736	119.050	113.644	107.106	122.235	111.813	159.555	29.9
Fiberglass products	1.918	2.124	2.331	2.537	2.744	2.756	2.636	N/A
Other products not included elsewhere	0.147	0.182	0.151	0.069	0.007	0.022	0.026	N/A
Total glass produced in the RM	**162.117**	**161.365**	**139.967**	**148.610**	**226.311**	**172.072**	**210.832**	**-33.6**

For comparison, the table below presents AD on glass production at two glass factories in Chisinau municipality (Table 4-24). The share of glass produced at the respective factories varies in time between 70 and 100% of the total glass production in the Republic of Moldova.

Table 4-24: AD on glass production at two glass factories in Chisinau for 2002-2020, kt

	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
Glass Factory in Chisinau	84.706	81.837	88.121	80.579	69.956	60.240	48.026	47.267	47.143	34.932
JSC Glass Container Company and JSC Glass Container Prime	59.096	56.358	50.264	61.122	59.028	62.741	61.174	59.265	60.110	97.119
Total	**143.802**	**138.195**	**138.385**	**141.701**	**128.984**	**122.981**	**109.200**	**106.532**	**107.254**	**132.051**
	2012	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**%**
Glass Factory in Chisinau	47.040	61.566	59.792	57.407	35.661	28.185	60.162	60.877	56.418	-33.4
JSC Glass Container Company and JSC Glass Container Prime	84.381	59.108	57.869	94.101	96.685	119.373	165.400	104.700	145.900	146.9
Total	**131.421**	**120.674**	**117.661**	**151.508**	**132.346**	**147.558**	**225.562**	**165.577**	**202.318**	**40.7**

Source: SOE Glass Factory, Chisinau, Letter No. 31 dated 21.02.2011, as a response to request No. 03-07/175 dated 02.02.2011; Letter No. 9/01-01 dated 16.01.2014, as a response to request No. 320/2014-01-01 dated 03.01.2014; Letter No. 16 dated 12.02.2015, as a response to request No. 407/2015-01-09 dated 29.01.2015; Letter No. 86 dated 19.05.2016, as a response to request No. 512/2016-05-01 dated 10.05.2016; Letter from 20.02.2018, as a response to request No. 601/2017-12-03 dated 14.12.2017; Letter from 28.02.2020, as a response to request No. 08-310/1 dated 11.02.2020; Letter No. 244 dated 24.06.2021, as a response to request of Environment Agency No. 08/136/2021 dated 09.06.2021; JSC Glass Container Company Chisinau and Glass Container Prim, Letter from 28.02.2011, as a response to request No. 03-07/175 dated 02.02.2011; Letter No. 01-1C-78 dated 19.02.2014, as a response to request No. 320/2014-01-01 dated 03.01.2014; Letter No. 01-3C-63 dated 30.03.2015, as a response to request No. 407/2015-01-09 dated 29.01.2015; Letter from 23.05.2016, as a response to request No. 512/2016-05-01 dated 10.05.2016; Letter from 23.02.2018, as a response to request No. 601/2017-12-03 dated 14.12.2017; Letter from 02.06.2020, as a response to request No. 08-310/1 dated 11.02.2020. Letter from 29.06.2021 as a response to interpellation of the Environment Agency No. 08/136/2021 dated 09.06.2021

Default EF values used for NO_x, NMVOC and SO_2 are shown in Table 4-25.

[44] National Report of the Russian Federation on the Inventory of anthropogenic emissions by sources and removals by sinks of greenhouse gases not controlled by the Montreal Protocol for 1990-2014, developed and in accordance with the obligations of the Russian Federation under the United Nations Framework Convention on Climate Change and the Kyoto Protocol to the United Nations Framework Convention on Climate Change. Moscow, 2016. 476 p.

[45] Airapetov G.A., Bezrodnii O.C., Jolobov A.L. (2005), Building materials: teaching handbook. – Rostov-on-Don, Phoenix, 2005.

Table 4-25: Default EFs used to estimate indirect GHG emissions from glass production

Category	Process description	NO_x	NMVOC	SO_2
		g / t		
Mineral Industry	Glass Production (flat glass for windows, glass containers, specialty glass, glass for glassware and tableware, fiberglass, etc.)	2930	6.13	1960

Source: : EMEP/EEA Atmospheric Emissions Inventory Guidebook (2019), SNAP Code 030314-030317 Glass, Category 1.A.2.f.i, Table 3-26.

2A4. 'Other Process Uses of Carbonates'

2A4a. 'Ceramics'

Methodological issues regarding the estimation of CO_2 emissions resulting from the production of bricks, expanded clay and ceramics are addressed in the 2006 IPCC Guidelines for National Greenhouse Gas Inventories (Volume 3, Chapter 2.5, Pages 2.32-2.40, respectively by considering the data available in Volume 3, Chapter 2.1, Table 2.1, Page 2.7).

In the process of ceramics production, CO_2 emissions result from the calcination of the raw material used. Similar to the cement and lime production processes, carbonates are heated to high temperatures in a kiln, producing CO_2 emissions, which can be estimated by multiplying the annual data on the amount of carbonates used by a specific emission factor that takes into account the CaO and MgO content.

$$CO_2\ emissions = M_c \bullet EF_{c,}$$

Where:

M_c – mass of carbonate consumed for bricks and ceramics production (tonnes);

EF_c – emission factor for carbonate calcination (t CO_2/t).

In the calcination of the carbonates in the clay, each mole of CaO and MgO, respectively, forms one mole of CO_2. This principle was used for the development of the emission factor.

$$EF = Mass\ Ratio\ (CO_2/CaO) \bullet CaO\ Content\ in\ clay + Mass\ Ratio\ (CO_2/MgO) \bullet MgO\ Content\ in\ clay$$

It should be noted that the content of CaO in clay varies between 6-9%, whereas the content of MgO – between 2.4%[46], respectively . The data provided by the main national producer of bricks (the share of bricks production from JSC 'MACON' between 1998 and 2020 varied between a minimum of 45.5% and a maximum of 83.7% in 2018 of the national total), was used to calculate the annual values of the country-specific EF used to estimate CO_2 emissions from brick and ceramic production in the RM (Table 4-26), according to which the annual emission factor values varied in the period 1990-2020 between a minimum of 72.9 kg of CO_2 per ton of clay consumed (2007) and a maximum of 103.8 kg of CO_2 per ton of clay consumed (2016). According to the information available in the 2006 IPCC Guidelines (Volume 3, Chapter 2.5, page 2.34), the value of the default emission factor utilised is 100 kg of CO_2 per ton of clay consumed or 10% of the mass of carbonates used as raw material.

Table 4-26: CS EFs used to estimate CO_2 emissions from brick, expanded clay and ceramic production, 1990-2020

Indicators	1990	1991	1992	1993	1994	1995	1996	1997
Content of CaO in clay used	0.0844	0.0844	0.0844	0.0844	0.0844	0.0844	0.0844	0.0822
Mass Ratio CO_2/CaO	0.7848	0.7848	0.7848	0.7848	0.7848	0.7848	0.7848	0.7848
EF, t CO_2/t clay used (only CaO)	0.0662	0.0662	0.0662	0.0662	0.0662	0.0662	0.0662	0.0645
Content of MgO in clay used	0.0303	0.0303	0.0303	0.0303	0.0303	0.0303	0.0303	0.0357
Mass Ratio CO_2/MgO	1.0919	1.0919	1.0919	1.0919	1.0919	1.0919	1.0919	1.0919
EF, t CO_2/t clay used (only MgO)	0.0331	0.0331	0.0331	0.0331	0.0331	0.0331	0.0331	0.0390
EF, t CO_2/t clay used (total)	**0.0993**	**0.0993**	**0.0993**	**0.0993**	**0.0993**	**0.0993**	**0.0993**	**0.1035**
Indicators	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**
Content of CaO in clay used	0.0822	0.0822	0.0822	0.0800	0.0787	0.0753	0.0710	0.0534
Mass Ratio CO_2/CaO	0.7848	0.7848	0.7848	0.7848	0.7848	0.7848	0.7848	0.7848
EF, t CO_2/t clay used (only CaO)	0.0645	0.0645	0.0645	0.0628	0.0618	0.0591	0.0557	0.0419
Content of MgO in clay used	0.0357	0.0357	0.0357	0.0355	0.0354	0.0351	0.0321	0.0302
Mass Ratio CO_2/MgO	1.0919	1.0919	1.0919	1.0919	1.0919	1.0919	1.0919	1.0919
EF, t CO_2/t clay used (only MgO)	0.0390	0.0390	0.0390	0.0388	0.0387	0.0383	0.0351	0.0330
EF, t CO_2/t clay used (total)	**0.1035**	**0.1035**	**0.1035**	**0.1015**	**0.1005**	**0.0974**	**0.0908**	**0.0749**

[46] In conformity with the information provided by 'MACON' JSC, the average content of CaO in clay extracted in Purcel quarry is circa 8.44%, in Pruncul quarry – 8.22%, in Micauti – 6.70%, in Haruza Mica – 6.66%; while the average content of MgO in clay extracted in Purcel quarry is 3.03%, in Pruncul – 3.57%, in Micautil – 2.93%, and in Haruza Mica – 2.60%

Indicators	2006	2007	2008	2009	2010	2011	2012	2013
Content of CaO in clay used	0.0606	0.0509	0.0529	0.0757	0.0773	0.0733	0.0669	0.0889
Mass Ratio CO_2/CaO	0.7848	0.7848	0.7848	0.7848	0.7848	0.7848	0.7848	0.7848
EF, t CO_2/t clay used (only CaO)	0.0476	0.0399	0.0415	0.0594	0.0607	0.0575	0.0525	0.0698
Content of MgO in clay used	0.0304	0.0302	0.0305	0.0319	0.0326	0.0314	0.0283	0.0285
Mass Ratio CO_2/MgO	1.0919	1.0919	1.0919	1.0919	1.0919	1.0919	1.0919	1.0919
EF, t CO_2/t clay used (only MgO)	0.0332	0.0330	0.0334	0.0349	0.0356	0.0343	0.0310	0.0311
EF, t CO_2/t clay used (total)	**0.0808**	**0.0729**	**0.0748**	**0.0943**	**0.0963**	**0.0918**	**0.0834**	**0.1009**
Indicators	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**%**
Content of CaO in clay used	0.0898	0.0909	0.0922	0.0874	0.0885	0.0814	0.0828	-1.9
Mass Ratio CO_2/CaO	0.7848	0.7848	0.7848	0.7848	0.7848	0.7848	0.7848	0.0
EF, t CO_2/t clay used (only CaO)	0.0705	0.0713	0.0723	0.0686	0.0695	0.0638	0.0650	-1.9
Content of MgO in clay used	0.0286	0.0288	0.0289	0.0289	0.0299	0.0291	0.0295	-2.6
Mass Ratio CO_2/MgO	1.0919	1.0919	1.0919	1.0919	1.0919	1.0919	1.0919	0.0
EF, t CO_2/t clay used (only MgO)	0.0312	0.0315	0.0315	0.0316	0.0327	0.0318	0.0322	-2.6
EF, t CO_2/t clay used (total)	**0.1017**	**0.1028**	**0.1038**	**0.1002**	**0.1022**	**0.0957**	**0.0972**	**-2.1**

Source: JSC 'MACON', through Letter No. 01/01-R dated 17.01.2014, as a response to the Climate Change Office's interpellation No. 320/2014-01-01 dated 03.01.2014; Letter No. 17/01-G dated 09.02.2015, as a response to the Climate Change Office's interpellation No.407/2015-01-09 dated 29.01.2015; Letter No. 28/01-V dated 28.06.2016, as a response to the Climate Change Office's interpellation No. 512/2016-05-01 dated 10.05.2016; Letter from 07.08.2020, as a response to the Environment Agency's interpellation No. 08-310/1 dated 11.02.2020. Letter from 22.06.2021, as a response to the Environment Agency's interpellation No. 08/136/2021 dated 09.06.2021.

Activity data on brick production are available in the Statistical Yearbooks of the Republic of Moldova and those of the ATULBD (Table 4-27). Activity data expressed in million conventional units are available in the Statistical yearbooks of the RM for the period 1990-2009, and for the period 2004-2020, activity data expressed in thousand m^3 are available in Statistical Reports PRODMOLD-A 'Total production, as a natural expression, in the Republic, by product type'. The conversion coefficient applied is 0.484 thousand conventional bricks/m^3.

Table 4-27: AD on Brick Production within 1990-2020 million conventional units

	1990	1991	1992	1993	1994	1995	1996	1997
RM: RBDR, mil. conventional units	190.500	177.500	83.200	149.700	64.300	39.200	37.200	47.700
RM: RBDR, thousand m^3	NA	NA	NA	NA	NA	NA	NA	NA
RM: LBDR, mil. conventional units	45.000	40.000	35.000	30.000	25.000	20.000	16.000	12.000
RM: total	**235.500**	**217.500**	**118.200**	**179.700**	**89.300**	**59.200**	**53.200**	**59.700**
	1998	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**
RM: RBDR, mil. conventional units	48.700	44.800	39.900	38.100	45.800	52.200	54.900	55.700
RM: RBDR, thousand m^3	NA	NA	NA	NA	NA	NA	114.196	108.594
RM: LBDR, mil. conventional units	7.000	12.000	13.000	15.000	17.000	16.000	21.000	18.000
RM: total	**55.700**	**56.800**	**52.900**	**53.100**	**62.800**	**68.200**	**75.900**	**73.700**
	2006	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**
RM: RBDR, mil. conventional units	52.800	55.900	53.000	38.100	37.373	40.995	28.325	35.765
RM: RBDR, thousand m^3	117.508	108.008	79.733	77.273	84.763	58.565	73.949	117.508
RM: LBDR, mil. conventional units	18.000	19.000	20.697	13.523	11.582	13.010	14.657	14.618
RM: total	**70.800**	**74.900**	**73.697**	**51.623**	**48.955**	**54.005**	**42.982**	**50.383**
	2014	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**%**
RM: RBDR, mil. conventional units	35.895	37.775	34.571	30.600	33.008	36.544	33.562	-82.4
RM: RBDR, thousand m^3	74.218	78.106	71.480	63.269	68.247	75.559	69.393	N/A
RM: LBDR, mil. conventional units	14.669	9.063	9.305	8.521	5.529	6.750	9.099	-79.8
RM: total	**50.564**	**46.838**	**43.876**	**39.121**	**38.537**	**43.294**	**42.661**	**-81.9**

Source: Statistical Yearbooks of the Rm for the years 1988 (page 228), 1994 (page 287), 1999 (page 303), 2005 (page 322), 2010 (page 305); Statistical Yearbooks of the ATULBD for the years 1998 (page 177), 2000 (page 99), 2002 (page 103), 2005 (page 94), 2006 (page 93), 2007 (page 92), 2009 (page 92), 2010 (page 93), 2011 (page 94), 2012 (page 98), 2013 (page 99), 2014 (page 88), 2015 (page 88), 2016 (page 98), 2017 (page 101), 2019 (page 99), 2020 (page 102); Statistical Reports PRODMOLD-A 'Total production, as a natural expression, in the Republic, by product type, for 2005-2020'.

To convert the AD in metric mass units (kilotons), conversion coefficients were used based on the data available on the web pages of domestic and foreign construction companies [47].

According to them, the standard size of a conventional brick is: 250 x 120 x 65 mm, with a specific density variation between 1500 and 1900 kg/m^3 (in the RM – between 1020 and 1869 kg/m^3). Under such circumstances, the volume of a conventional brick is – 0.25 • 0.12 • 0.065 = 0.00195 m^3; the minimum weight – 1020 • 0.00195/1 = 1.989 kg; the maximum weight – 1869 • 0.00195/1 = 3.644 kg; the average weight – 1444.5 • 0.00195/1 = 2.817 kg; this particular value was used in order to calculate the weight in tonnes in the national production of bricks.

At the same time, in order to estimate the mass of carbonates used for brick production, the method recommended by the 2006 IPCC Guidelines was utilised; the mass of clay used for brick production is determined by multiplying total brick production (in kilotons) by the default factor – 1.1 (Volume 3, Chapter 2.5, Page 2.36) (Table 4-28).

[47] <http://aquagroup.ru/articles/ves-kirpicha.html>, <http://www.lucceram.ro/index.php/products>

Table 4-28: AD on the amount of clay used in brick production in the RM for 1990-2020

	1990	1991	1992	1993	1994	1995	1996	1997
Total brick production, kt	663.3505	612.6486	332.9428	506.1745	251.5380	166.7531	149.8524	168.1615
Clay used in brick production, kt	729.6856	673.9134	366.2371	556.7919	276.6918	183.4284	164.8377	184.9776
	1998	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**
Total brick production, kt	156.8944	159.9928	149.0074	149.5708	176.8935	192.1041	213.7932	207.5963
Clay used in brick production, kt	172.5838	175.9921	163.9081	164.5278	194.5828	211.3145	235.1725	228.3559
	2006	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**
Total brick production, kt	199.4277	210.9764	207.5879	145.4104	137.8941	152.1211	121.0700	141.9181
Clay used in brick production, kt	219.3704	232.0741	228.3467	159.9514	151.6835	167.3332	133.1770	156.1100
	2014	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**%**
Total brick production, kt	142.4287	131.9335	123.5886	110.1951	108.5489	121.9488	120.1660	-81.9
Clay used in brick production, kt	156.6715	145.1268	135.9475	121.2146	119.4038	134.1437	132.1826	-81.9

AD regarding expanded clay production between 2001 and 2019 (*expressed in thousand m^3*) was provided directly by JSC 'MACON', the only expanded clay producer in the RM (Table 4-29).

Table 4-29: AD on the amount of clay used in expanded clay production for 2001-2020

	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Expanded clay production, thousand m^3	3.5958	17.1730	12.7545	55.0500	63.4000	72.2000	80.5550	64.9630	61.1990	61.4200
Specific weight, kg/m^3	390.1	388.9	387.3	371.1	392.9	399.7	385.4	376.2	399.4	353.3
Expanded clay production, kt	1.4028	6.6791	4.9394	20.4307	24.9067	28.8591	31.0435	24.4384	24.4404	21.6991
Clay used, t/m^3 expanded clay	0.715	0.711	0.717	0.731	0.710	0.711	0.550	0.624	0.629	0.572
Clay used in expanded clay production, kt	**2.5710**	**12.2100**	**9.1450**	**40.2416**	**45.0140**	**51.3342**	**44.3053**	**40.5369**	**38.4942**	**35.1322**
	2011	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**
Expanded clay production, thousand m^3	30.3630	38.1500	42.0110	34.5680	22.9780	19.5810	26.7040	30.4175	34.1310	14.3350
Specific weight, kg/m^3	324.8	403.5	376.9	375.7	389.8	368.1	377.5	375.9	374.3	376.5
Expanded clay production, kt	9.8631	15.3939	15.8331	12.9875	8.9568	7.2078	10.0808	11.4339	12.7752	5.3971
Clay used, t/m^3 expanded clay	0.617	0.717	0.639	0.639	0.680	0.703	0.673	0.658	0.642	0.703
Clay used in expanded clay production, kt	**18.7340**	**27.3536**	**26.8450**	**22.0890**	**15.6250**	**13.7654**	**17.9718**	**19.9995**	**21.9121**	**10.0775**

Source: JSC 'MACON', through Letter No. 01/01-R dated 17.01.2014, as a response to the Climate Change Office's interpellation No. 320/2014-01-01 dated 03.01.2014; Letter No. 17/01-G dated 09.02.2015, as a response to the Climate Change Office's interpellation No. 407/2015-01-09 dated 29.01.2015; Letter No. 28/01-V dated 28.06.2016, as a response to the Climate Change Office's interpellation No. 512/2016-05-01 dated 10.05.2016; Letter from 07.08.2020, as a response to the Environment Agency's interpellation No. 08-310/1 dated 11.02.2020. Letter from 22.06.2021, as a response to the Environment Agency's interpellation No. 08/136/2021 dated 09.06.2021.

Activity data on ceramic production for the period 2005-2018 (activity data on ceramics productions was not recorded in 2019 and 2020) was provided by the National Bureau of Statistics, the information being available in the Statistical Reports PRODMOLD-A 'Total production, as a natural expression, in the Republic, by product type' in Table 4-30.

Table 4-30: AD regarding the amount of clay utilised in ceramic production in the RM for 2005-2018

	2005	2006	2007	2008	2009	2010	2011
Roof tiles, pieces	243.510	182.978	288.253	223.355	86.665	7.210	66.870
Non-refractory ceramics for construction, tonnes	303.800	260.800	201.300	150.500	138.800	68.900	55.400
Table and ornamental ware (household ceramics), tonnes	579.719	478.955	838.189	276.802	188.722	169.089	136.854
Wall and floor tiles, thousand m^2	625.200	734.000	1248.500	808.700	9.800	1.900	1.600
Total ceramics produced, kt	1.8906	1.5105	2.2586	1.3635	0.6747	0.2669	0.4598
Total clay used to produce ceramics, kt	**2.0797**	**1.6616**	**2.4844**	**1.4999**	**0.7422**	**0.2936**	**0.5058**
	2012	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**
Roof tiles, pieces	4.550	1.890	NO	NO	NO	NO	NO
Non-refractory ceramics for construction, tonnes	12.700	24.400	NO	NO	NO	NO	NO
Table and ornamental ware (household ceramics), tonnes	118.369	89.630	105.969	89.866	92.231	57.242	38.246
Wall and floor tiles, thousand m^2	0.700	0.500	0.600	1.500	248.200	NO	NO
Total ceramics produced, kt	0.1493	0.1216	0.1060	0.0899	0.1054	0.0572	0.0382
Total clay used to produce ceramics, kt	**0.1642**	**0.1338**	**0.1166**	**0.0989**	**0.1159**	**0.0630**	**0.0421**

Source: Statistical Reports PRODMOLD-A 'Total production, as a natural expression, in the Republic, by product type for 2005-2020'.

As shown in the table, activity data on the production of ceramic roof tiles are available in pieces. In order to transform this data into tonnes, the following conversion factor was used: one piece of roof tile has an average weight of circa 4 kg. The value of the conversion factor is determined by the National Standard of the Russian Federation GOST R 56688-2015[48], according to which, the mass of 1 m^2 of roof tile varies between 54 and 74 kg, while 1 m^2 of light roof tile contains circa 14.8-16.6 pieces with an average weight of circa 3.4 kg, and 1 m^2 of heavy roof tile contains circa 15-17 pieces with an average weight of circa 4.6 kg. As a comparison, web pages of companies importing roof tiles in the Republic of Moldova and Romania were consulted[49], and similar values of the conversion factors were

[48] Federal Agency for Technical Regulation and Metrology, National Standard of the Russian Federation, GOST R 56688—2015, Ceramic tiles. Specifications. <http://allgosts.ru/91/100/gost_r_56688-2015>.
[49] <http://www.acoperisuldetigla.ro/tigla-ceramica-tondach/>, <https://acoperisuldetigla.wordpress.com/tigla-ceramica-siceram/>.

found. AD regarding the production of wall and floor tiles is available in thousand m². In order to transform this data, the following conversion factor was used: 18.9 kg for 1 m² of wall and floor tiles (Table 4-31), determined after consulting the web pages of those companies that sell these product[50]. For comparison, similar conversion factors used in the Russian Federation are: 19 kg for 1 m² of floor tiles and 14 kg for 1 m² of wall tiles[51].

Table 4-31: Data used to determine the average value of the conversion factor used to transform AD from thousand m² into kilotons for wall and floor tiles

Size of one floor tile, cm	Weight, kg per 1 m²	Size of a wall tile, cm	Weight, kg per 1 m²
14.7 x 44.5	20.7	10 x 10	13.5
15.0 x 44.5	19.9	20 x 30	12.1
30 x 30	15.9	25 x 40	13.6
33 x 33	17.0		
33.3 x 33.3	16.3	20.2 x 40.2	11.7
33.5 x 33.5	16.1		
30 x 60	22.7	25.2 x 40.2	13.8
42 x 42	20.4		
45 x 45	20.7	25.0 x 50.3	17.2
Average	**18.9**	**Average**	**13.6**

In order to estimate the mass of carbonates used in the production of ceramics, the methodological approach recommended by the 2006 IPCC Guidelines was utilised; the mass of clay used for ceramics production is determined by multiplying total production (kt) by the default factor – 1.1 (Volume 3, Chapter 2.5, Page 2.36).

The methodology for the estimation of indirect GHG emissions from brick and ceramic production is available in the EMEP/EEA Atmospheric Emissions Inventory Guidebook (2019) (Table 4-32).

Table 4-32: EFs used to estimate indirect GHG emissions from brick and ceramic production

Category	Process Description	NO_x	CO	SO_2
		g / t		
Mineral Industry	Brick and Ceramics Production	184	189	39.6

Source: EMEP/EEA Atmospheric Emissions Inventory Guidebook (2019), SNAP Code 030319 Brick and Ceramics, Category 1.A.2.f.i, Table 3-28.

2A4b. 'Other Uses of Soda Ash'

Methodological issues regarding the estimation of CO_2 emissions from soda ash production and use are addressed in the 2006 IPCC Guidelines (Volume 3, Chapter 2.1, Table 2.1, Page 2.7; and in Chapter 2.5, Pages 2.32-2.40, respectively). Soda ash is used as raw material in a variety of industries, including glass production, soaps and detergents, pulp and paper, as well as in wastewater treatment. According to the 2006 IPCC Guidelines, CO_2 emissions from other uses of soda ash should be reported in the respective end use sector where it is used. In these circumstances, in order to avoid double counting, the amount of soda ash used in the glass production industry was excluded from the calculation of CO_2 emissions within source category 2A4b 'Other Uses of Soda Ash'.

Activity data on soda ash imports in the RM for 1990-2020 is available in Table 4-33, and were provided by the Customs Service (no exports were recorded during the respective time period). There is no information regarding the years 1990-1994 and, in order to fill this gap, data was reconstructed based on the evolution of glass production during the respective period. The amount of imported soda ash is not fully used in the same calendar year, some of which is stored for use in the following years. The imported quantities do not thereby correspond to the annual consumption of soda ash.

Table 4-33: AD on soda ash imports in the RM for 1990-2020, kt

	1990	1991	1992	1993	1994	1995	1996	1997
Soda ash import, kt	67.8693	69.0646	30.8983	34.7574	27.2963	28.8486	19.6869	25.2708
	1998	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**
Soda ash import, kt	20.2975	16.1479	33.7542	34.649	34.2346	30.4387	38.4227	43.7608
	2006	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**
Soda ash import, kt	38.698	34.1175	33.7002	24.2468	29.028	37.0516	22.5167	37.4016

[50] <http://www.cesarom.ro/calculator-placi-gresie-si-faianta>.
[51] National Report of the Russian Federation on the Inventory of anthropogenic emissions by sources and removals by sinks of greenhouse gases not controlled by the Montreal Protocol for 1990-2014, developed and in accordance with the obligations of the Russian Federation under the United Nations Framework Convention on Climate Change and the Kyoto Protocol to the United Nations Framework Convention on Climate Change. Moscow, 2016. 476 p.

	2014	2015	2016	2017	2018	2019	2020	%
Soda ash import, kt	33.8123	26.3379	25.7534	26.1895	31.4446	31.8334	36.3115	-46.5

Source: Customs Service of the RM, through Letter from 19.02.2021, as a response to the interpellation of the Ministry of Agriculture, Regional Development and Environment No. 13-07/519 dated 09.02.2021; Letter No. 28/07-3025 dated 28.02.2020, as a response to the Environment Agency's interpellation No. 08-310/1 dated 11.02.2020; Letter No. 28/07-612 dated 12.01.2018, as a response to request from the Climate Change Office of the MARDE No. 601/2017-12-03 dated 14.12.2017; Letter No. 28/07-8785 dated 26.05.2016, as a response to request from the Climate Change Office of the Ministry of Environment No. 512/2016-05-01 dated 10.05.2016; Letter No. 28/07-2231 dated 26.02.2015, as a response to request from the Climate Change Office of the Ministry of Environment No. 407/2015-01-09 dated 29.01.2015; Letter No. 15-03-05 dated 24.01.2014, as a response to request from the Climate Change Office of the Ministry of Environment No. 320/2014-01-01 dated 03.01.2014; Letter No. 28/07-1893 dated 23.02.2011, as a response to request from the Ministry of Environment No. 03-07/175 dated 02.02.2011.

By enquiring the glass producing companies in the Republic of Moldova (SOE 'Chisinau Glass Factory' 'Glass Container Company', and JSC 'Glass Container Prim'), it was established that during the reference period, circa 90% of the imported soda ash was used in glass production. The average specific consumption of soda ash in the production of one ton of glass during the period under review ranged from circa 250 kg of soda ash per ton of glass produced between 1990 and 1995 (world average consumption of soda ash in the glass industry[52]) to 200 kg of soda ash per ton of glass produced between 1996 and 2001; between a maximum of 181.1 kg and a minimum of 124.4 kg of soda ash per ton of glass produced during 2002-2020, respectively. These values were used to reconstruct the activity data regarding the consumption of soda ash in glass production in the Republic of Moldova between 1990 and 2020 (Table 4-34).

Table 4-34: AD on soda ash consumption in the RM for 1990-2020, kt

	1990	1991	1992	1993	1994	1995	1996	1997
Average soda ash consumption, kt	71.9482	72.8981	34.0306	37.9383	30.2972	32.8900	21.3778	24.8907
Soda ash used in the glass industry, kt	64.7534	65.6083	30.6275	34.1445	27.2675	29.6010	19.2400	22.4016
Soda ash used in other industries	**7.1948**	**7.2898**	**3.4031**	**3.7938**	**3.0297**	**3.2890**	**2.1378**	**2.4891**
	1998	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**
Average soda ash consumption, kt	26.7164	20.5111	39.1271	34.9787	30.2909	27.0857	29.7078	33.6574
Soda ash used in the glass industry, kt	24.0448	18.4600	35.2144	31.4808	27.2618	24.3771	26.7370	30.2917
Soda ash used in other industries	**2.6716**	**2.0511**	**3.9127**	**3.4979**	**3.0291**	**2.7086**	**2.9708**	**3.3657**
	2006	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**
Average soda ash consumption, kt	30.7796	28.4338	24.0916	23.3657	21.8837	29.6320	28.9443	24.2299
Soda ash used in the glass industry, kt	27.7016	25.5905	21.6824	21.0291	19.6954	26.6688	26.0498	21.8070
Soda ash used in other industries	**3.0780**	**2.8434**	**2.4092**	**2.3366**	**2.1884**	**2.9632**	**2.8944**	**2.4230**
	2014	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**%**
Average soda ash consumption, kt	24.1749	29.6334	25.3664	29.8372	37.6472	33.7714	39.6535	-53.1
Soda ash used in the glass industry, kt	21.7574	26.6701	22.8298	26.8534	33.8825	30.3943	35.6882	-53.1
Soda ash used in other industries	**2.4175**	**2.9633**	**2.5366**	**2.9837**	**3.7647**	**3.3771**	**3.9654**	**-53.1**

Source: SOE 'Chisinau Glass Factory', Letter No. 31 dated 21.02.2011, as a response to request No. 03-07/175 dated 02.02.2011; Letter No. 9/01-01 dated 16.01.2014, as a response to request No. 320/2014-01-01 dated 03.01.2014; Letter No. 16 dated 12.02.2015, as a response to request No. 407/2015-01-09 dated 29.01.2015; Letter No. 86 dated 19.05.2016, as a response to request No. 512/2016-05-01 dated 10.05.2016; Letter from 20.02.2018, as a response to request No. 601/2017-12-03 dated 14.12.2017; Letter from 28.02.2020, as a response to request No. 08-310/1 dated 11.02.2020; Letter No. 244 din 24.06.2021, answer to request of the Environment Agency No. 08/136/2021 dated 09.06.2021; 'Glass Container Company' and 'Glass Container Prim', Letter from 28.02.2011, as a response to request No. 03-07/175 dated 02.02.2011; Letter No. 01-1C-78 dated 19.02.2014, as a response to request No. 320/2014-01-01 dated 03.01.2014; Letter No. 01-3C-63 dated 30.03.2015, as a response to request No. 407/2015-01-09 dated 29.01.2015; Letter from 23.05.2016, as a response to request No. 512/2016-05-01 dated 10.05.2016; Letter No from 23.02.2018, as a response to request No. 601/2017-12-03 dated 14.12.2017; Letter from 02.06.2020, as a response to request No. 08-310/1 dated 11.02.2020; Letter from 29.06.2021, as a response to the interpellation of the Environment Agency No. 08/136/2021 dated 09.06.2021.

The emission factor used to calculate CO_2 emissions from soda ash use is estimated using the stoichiometry of the chemical process according to the following equation:

$$EF_{sa} = 44.0099 \text{ g/mole } CO_2 / 106.0685 \text{ g/mole } Na_2CO_3 = 0.41492 \text{ t } CO_2 / \text{t } Na_2CO_3$$

CO_2 emissions from soda ash use are estimated using the following equation:

$$Total_{sa} = A_{sa} \bullet EF_{sa}$$

Where:

$Total_{sa}$ – CO_2 emissions from soda ash use (kt);

A_{sa} – soda ash consumption (kt);

EF_{sa} – default emission factor used (0.41492 t CO_2/t of soda ash).

4.2.3. Uncertainties and Time-Series Consistency

2A1 'Cement Production'

Cumulative uncertainties associated with the EFs are considered to be circa 3%. Uncertainties associated with activity data are also estimated to be low (±2%), in the case of AD provided by JSC Lafarge Cement (Moldova), uncertainties account for circa 1% and are provided directly by the producer, while in the case of Cement and Slake Integrated Works in Ribnita, uncertainties reach up to circa 3% and are collected from statistical publications. Combined uncertainties associated with GHG emissions from source

[52] Russian Center for Foreign Trade. Conjuncture, goods and markets. Soda ash on the international market. <http://www.rusimpex.ru/Content/Economics/Conjuncture/99_11002.htm>

category 2A1 'Cement Production' are thereby considered to be circa 3.61% (Annex 5-3.2). In view of ensuring time-series consistency of the obtained results, the same approach was used for the entire period under review, in conformity with the recommendations included in the 2006 IPCC Guidelines.

2A2 'Lime Production'

Uncertainties associated with the EFs are considered to be circa 2%. Uncertainties associated with activity data are estimated to be circa 10%, as a result of indirect generation of activity data on lime production directly by self-producers (sugar factories) as well as due to the correction factor used for hydrated lime. Combined uncertainties associated with GHG emissions from source category 2A2 'Lime Production' thereby account for circa 10.20% (Annex 5-3.2). In view of ensuring time-series consistency of the obtained results, the same approach was used for the entire period under review, in conformity with the recommendations included in the 2006 IPCC Guidelines.

2A3 'Glass Production'

Uncertainties associated with the EF used having applied a Tier 2 method account for circa 10% (2006 IPCC Guidelines). Uncertainties associated with activity data are estimated to be circa 15%, including due to the conversion in other units (from thousand m^2 and million conventional pieces to kilotons, respectively due to the use of an average value for glass containers within the conversion process from a specific unit to another one). Combined uncertainties associated with GHG emissions from source category 2A3 'Glass Production' thereby account for circa 18.03% (Annex 5-3.2). In view of ensuring time-series consistency of the obtained results, the same approach was used for the entire period under review, in conformity with the recommendations included in the 2006 IPCC Guidelines.

2A4 'Other Process Uses of Carbonates'

Uncertainties associated with the EFs used having applied a Tier 2 method account for circa 5% (2006 IPCC Guidelines). Uncertainties associated with activity data regarding 'Other process Uses of Carbonates' (ceramic, expanded clay, and other uses of soda ash production) are estimated to be circa 20%, including due to the conversion to other units (from thousand m^3, thousand m^2 and pieces to kilotons, respectively due to the indirect assessment of carbonate consumption in the production processes by using default factors, 1.1 tonnes of clay to 1.0 ton of production). Combined uncertainties associated with GHG emissions from source category 2A4 'Other Process Uses of Carbonates' thereby account for circa 20.62% (Annex 5-3.2). In view of ensuring time-series consistency of the obtained results, the same approach was used for the entire period under review, in conformity with the recommendations included in the 2006 IPCC Guidelines.

4.2.4. Quality Assurance and Quality Control

Standard verification and quality control forms and check-lists were filled in for the respective source category, following a Tier 1 approach. Also, verification was focused on ensuring correct use of the emission factors, including default EFs, available in the 2006 IPCC Guidelines; verification was also focused on correct use of AD obtained from different sources of reference, including official sources, especially for the conversion of AD into mass units compatible with GHG emission estimation methods; comparing the results obtained by using different estimation methodologies and explaining the identified discrepancies, etc. It should be noted that AD and methods used for the estimation of GHG emissions from category 2A 'Mineral Industry' were documented and archived both in hard copies and electronically.

4.2.5. Recalculations

2A1 'Cement Production'

Compared to the results included in the BUR3 of the RM to the UNFCCC (2021), GHG emissions from the clinker production were not recalculated in the current inventory cycle. For 2020, the respective emissions were estimated for the first time. Between 1990 and 2020, CO_2 emissions from cement production decreased by circa 52% (Table 4-35).

Table 4-35: GHG emissions from the 2A1 'Cement Production' in the RM, 1990-2020, kt

	1990	1991	1992	1993	1994	1995	1996	1997
CO_2	971.6967	900.7877	474.3138	405.7165	328.4361	248.5258	193.1220	270.1273
NO_x	2.2355	2.0682	1.0912	0.9338	0.7552	0.5705	0.4434	0.6207
CO	2.6210	2.4249	1.2794	1.0949	0.8854	0.6689	0.5198	0.7278
NMVOC	0.0324	0.0300	0.0158	0.0135	0.0110	0.0083	0.0064	0.0090
SO_2	0.6737	0.6233	0.3289	0.2814	0.2276	0.1719	0.1336	0.1871
	1998	1999	2000	2001	2002	2003	2004	2005
CO_2	215.0572	210.8122	172.7600	173.8847	219.1917	245.6276	282.5765	365.0817
NO_x	0.4937	0.4844	0.3975	0.3995	0.5048	0.5618	0.6524	0.8422
CO	0.5788	0.5680	0.4660	0.4684	0.5919	0.6586	0.7649	0.9874
NMVOC	0.0072	0.0070	0.0058	0.0058	0.0073	0.0081	0.0095	0.0122
SO_2	0.1488	0.1460	0.1198	0.1204	0.1521	0.1693	0.1966	0.2538
	2006	2007	2008	2009	2010	2011	2012	2013
CO_2	457.0753	702.6656	789.9160	340.5679	349.8333	427.2624	442.1615	476.9104
NO_x	1.0555	1.6161	1.8448	0.7959	0.8135	0.9986	1.0335	1.1139
CO	1.2376	1.8948	2.1630	0.9331	0.9538	1.1709	1.2118	1.3060
NMVOC	0.0153	0.0234	0.0268	0.0115	0.0118	0.0145	0.0150	0.0162
SO_2	0.3181	0.4870	0.5560	0.2398	0.2452	0.3010	0.3115	0.3357
	2014	2015	2016	2017	2018	2019	2020	%
CO_2	464.6082	443.2441	433.9022	404.9290	511.1209	523.8755	467.5178	-51.9
NO_x	1.0820	1.0311	1.0040	0.9420	1.1891	1.2187	1.0876	-51.3
CO	1.2686	1.2089	1.1771	1.1045	1.3941	1.4289	1.2752	-51.3
NMVOC	0.0157	0.0150	0.0146	0.0137	0.0172	0.0177	0.0158	-51.3
SO_2	0.3261	0.3107	0.3026	0.2839	0.3584	0.3673	0.3278	-51.3

2A2 'Lime Production'

CO_2 emissions from lime production were not recalculated in the current inventory cycle. For 2020, the respective emissions were estimated for the first time. Between 1990 and 2020, CO_2 emissions from lime production decreased by circa 90% (Table 4-36).

Table 4-36: GHG emissions from source category 2A2 'Lime Production' in the RM, 1990-2020, kt

	1990	1991	1992	1993	1994	1995	1996	1997
CO_2	264.3143	192.2260	116.1612	112.7887	83.8378	78.0227	97.7677	81.2988
NO_x	0.4875	0.3546	0.2143	0.2080	0.1546	0.1439	0.1803	0.1500
CO	0.6909	0.5024	0.3036	0.2948	0.2191	0.2039	0.2555	0.2125
SO_2	0.1125	0.0818	0.0495	0.0480	0.0357	0.0332	0.0416	0.0346
	1998	1999	2000	2001	2002	2003	2004	2005
CO_2	68.5945	37.8903	31.4020	28.4519	38.2546	20.5213	20.5790	27.8408
NO_x	0.1265	0.0699	0.0579	0.0525	0.0706	0.0379	0.0380	0.0514
CO	0.1793	0.0990	0.0821	0.0744	0.1000	0.0536	0.0538	0.0728
SO_2	0.0292	0.0161	0.0134	0.0121	0.0163	0.0087	0.0088	0.0119
	2006	2007	2008	2009	2010	2011	2012	2013
CO_2	30.1048	21.9382	29.1378	8.4641	15.3644	16.6236	15.5304	20.7696
NO_x	0.0555	0.0405	0.0537	0.0156	0.0283	0.0307	0.0286	0.0383
CO	0.0787	0.0573	0.0762	0.0221	0.0402	0.0435	0.0406	0.0543
SO_2	0.0128	0.0093	0.0124	0.0036	0.0065	0.0071	0.0066	0.0088
	2014	2015	2016	2017	2018	2019	2020	%
CO_2	23.8218	15.7407	13.6470	28.8043	27.7944	27.5851	21.0641	-89.6
NO_x	0.0439	0.0290	0.0252	0.0531	0.0513	0.0509	0.0389	-89.6
CO	0.0623	0.0411	0.0357	0.0753	0.0726	0.0721	0.0551	-89.6
SO_2	0.0101	0.0067	0.0058	0.0123	0.0118	0.0117	0.0090	-89.6

2A3 'Glass Production'

CO_2 emissions from glass production were recalculated for the period 1990-2019 as a result of updated activity data regarding the amount of glass produced based on the information collected through surveys from SOE 'Chisinau Glass Factory', as well as glass factories JSC 'Glass Container Company' and 'Glass Container Prim' from Chisinau, at the same time, the conversion factor associated with the average weight of a conventional glass container was updated: the average weight of a conventional glass container was changed from 0.48 kg to 0.52 kg, the average weight of a glass jar was changed from 0.25 kg to 0.26 kg.

Compared to the values recorded in the BUR3 of the RM to the UNFCCC (2021), the alterations undertaken resulted in an upward trend in CO_2 emissions, varying from a minimum increase by 2.7% in 2018 to a maximum increase by 7.9% in 1996, except for the 2011-2017 and 2019, when a downward trend in CO_2 emissions from this source category was recorded, varying from a minimum decrease by 0.4% in 2013 to a maximum decrease by 20.5% in 2019.

CO_2 emissions from glass production for 2020 were calculated in the Republic of Moldova for the first time. Between 1990 and 2020, CO_2 emissions from glass production increased by circa 19.5% (Table 4-37), mainly due to the decrease in the share of glass bits per batch, and the increase of the country-specific EF value by circa 47.3%, from 105.6 kg CO_2/t of glass in 1990 to 155.5 kg CO_2/t of glass in 2020.

Table 4-37: Comparative results of inventoried CO_2 emissions from glass production included in the BUR3 and NC5 of the RM to the UNFCCC, kt

	1990	1991	1992	1993	1994	1995	1996	1997
BUR3	26.0951	25.8454	12.7167	11.4809	4.0547	5.1447	7.6130	5.0803
NC5	27.4888	27.1894	13.5306	12.1968	4.3269	5.5292	8.2108	5.4581
Difference, %	5.3	5.2	6.4	6.2	6.7	7.5	7.9	7.4
	1998	1999	2000	2001	2002	2003	2004	2005
BUR3	5.4490	3.6841	16.8043	15.2214	20.4783	18.8812	19.5625	22.4939
NC5	5.8586	3.9427	18.0314	16.3227	22.0121	20.3190	21.0712	24.2258
Difference, %	7.5	7.0	7.3	7.2	7.5	7.6	7.7	7.7
	2006	2007	2008	2009	2010	2011	2012	2013
BUR3	23.3604	20.3570	22.8439	17.2425	20.2715	26.3926	21.2592	27.8304
NC5	24.9541	21.5727	24.1759	18.0724	21.2694	25.9476	20.8569	27.7204
Difference, %	6.8	6.0	5.8	4.8	4.9	-1.7	-1.9	-0.4
	2014	2015	2016	2017	2018	2019	2020	%
BUR3	27.8833	28.3000	28.3761	27.1229	36.2388	32.5310		
NC5	26.2533	27.4550	23.8582	26.6873	37.2220	25.8705	32.8367	19.5
Difference, %	-5.8	-3.0	-15.9	-1.6	2.7	-20.5		

Abbreviations: BUR3 – Third Biennial Update Report of the RM to the UNFCCC, NC5 – Fifth National Communication of the RM to the UNFCCC.

Indirect GHG emissions from glass production between 1990 and 2020 are presented below (Table 4-38). Between 1990 and 2020, indirect GHG emissions from glass production decreased by circa 18.6% due to the decreased production in the RM.

Table 4-38: Indirect GHG emissions from 2A3 'Glass Production' between 1990-2020, kt

	1990	1991	1992	1993	1994	1995	1996	1997
NO_x	0.7589	0.7689	0.3590	0.4002	0.3196	0.3469	0.2819	0.3282
NMVOC	0.0016	0.0016	0.0008	0.0008	0.0007	0.0007	0.0006	0.0007
SO_2	0.5077	0.5144	0.2401	0.2677	0.2138	0.2321	0.1886	0.2195
	1998	1999	2000	2001	2002	2003	2004	2005
NO_x	0.3523	0.2704	0.5159	0.4612	0.5558	0.5106	0.5446	0.6189
NMVOC	0.0007	0.0006	0.0011	0.0010	0.0012	0.0011	0.0011	0.0013
SO_2	0.2356	0.1809	0.3451	0.3085	0.3718	0.3415	0.3643	0.4140
	2006	2007	2008	2009	2010	2011	2012	2013
NO_x	0.5787	0.5281	0.4867	0.3678	0.4402	0.5287	0.4135	0.5114
NMVOC	0.0012	0.0011	0.0010	0.0008	0.0009	0.0011	0.0009	0.0011
SO_2	0.3871	0.3533	0.3256	0.2460	0.2945	0.3537	0.2766	0.3421
	2014	2015	2016	2017	2018	2019	2020	%
NO_x	0.4750	0.4728	0.4101	0.4354	0.6631	0.5042	0.6177	-18.6
NMVOC	0.0010	0.0010	0.0009	0.0009	0.0014	0.0011	0.0013	-18.6
SO_2	0.3177	0.3163	0.2743	0.2913	0.4436	0.3373	0.4132	-18.6

2A4 'Other Process Uses of Carbonates'

'Brick Production'

Compared to the results included in the BUR3 of RM to the UNFCCC (2021), GHG emissions from brick production were not recalculated in the current inventory cycle. For 2020, the respective emissions were estimated for the first time. Between 1990 and 2020, CO_2 emissions from brick production decreased by circa 82.3% (Table 4-39).

Table 4-39: GHG emissions from source category 'Other Process Uses of Carbonates' (brick production) in the RM between 1990 and 2020, kt

	1990	1991	1992	1993	1994	1995	1996	1997
CO_2	72.4748	66.9354	36.3759	55.3025	27.4820	18.2187	16.3722	19.1439
NO_x	0.1221	0.1127	0.0613	0.0931	0.0463	0.0307	0.0276	0.0309
CO	0.1254	0.1158	0.0629	0.0957	0.0475	0.0315	0.0283	0.0318
SO_2	0.0263	0.0243	0.0132	0.0200	0.0100	0.0066	0.0059	0.0067

	1998	1999	2000	2001	2002	2003	2004	2005
CO_2	17.8613	18.2140	16.9634	16.7033	19.5466	20.5902	21.3454	17.1148
NO_x	0.0289	0.0294	0.0274	0.0275	0.0325	0.0353	0.0393	0.0382
CO	0.0297	0.0302	0.0282	0.0283	0.0334	0.0363	0.0404	0.0392
SO_2	0.0062	0.0063	0.0059	0.0059	0.0070	0.0076	0.0085	0.0082
	2006	2007	2008	2009	2010	2011	2012	2013
CO_2	17.7279	16.9185	17.0902	15.0758	14.6053	15.3686	11.1127	15.7471
NO_x	0.0367	0.0388	0.0382	0.0268	0.0254	0.0280	0.0223	0.0261
CO	0.0377	0.0399	0.0392	0.0275	0.0261	0.0288	0.0229	0.0268
SO_2	0.0079	0.0084	0.0082	0.0058	0.0055	0.0060	0.0048	0.0056
	2014	2015	2016	2017	2018	2019	2020	%
CO_2	15.9272	14.9184	14.1169	12.1409	12.1986	12.8328	12.8494	-82.3
NO_x	0.0262	0.0243	0.0227	0.0203	0.0200	0.0224	0.0221	-81.9
CO	0.0269	0.0249	0.0234	0.0208	0.0205	0.0230	0.0227	-81.9
SO_2	0.0056	0.0052	0.0049	0.0044	0.0043	0.0048	0.0048	-81.9

'Expanded Clay Production'

GHG emissions from expanded clay production were not recalculated for the period 2001-2019. For 2020, the respective emissions were estimated in the Republic of Moldova for the first time (Table 4-40). Between 2001 and 2020, CO_2 emissions from expanded clay production increased by circa 3.8 times, due to the increased production in the RM.

Table 4-40: GHG emissions from expanded clay production between 2001-2020, kt

	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
CO_2	0.2610	1.2265	0.8911	3.6525	3.3737	4.1485	3.2299	3.0339	3.6282	3.3828
NO_x	0.0003	0.0012	0.0009	0.0038	0.0046	0.0053	0.0057	0.0045	0.0045	0.0040
CO	0.0003	0.0013	0.0009	0.0039	0.0047	0.0055	0.0059	0.0046	0.0046	0.0041
SO_2	0.0001	0.0003	0.0002	0.0008	0.0010	0.0011	0.0012	0.0010	0.0010	0.0009
	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
CO_2	1.7206	2.2825	2.7079	2.2456	1.6062	1.4294	1.8001	2.0432	2.0962	0.9796
NO_x	0.0018	0.0028	0.0029	0.0024	0.0016	0.0013	0.0019	0.0021	0.0024	0.0010
CO	0.0019	0.0029	0.0030	0.0025	0.0017	0.0014	0.0019	0.0022	0.0024	0.0010
SO_2	0.0004	0.0006	0.0006	0.0005	0.0004	0.0003	0.0004	0.0005	0.0005	0.0002

'Ceramic Production'

GHG emissions from ceramics production were recalculated for the period 2016-2019 as a result of the updated activity data used. The impact of the recalculation is non-essential, a decrease in GHG emissions from ceramic production by circa 0.1% being recorded over that period.

Since 2018, in the Statistical Reports PRODMOLD-A 'Total production, as a natural expression, in the Republic of Moldova, by product type', information regarding ceramics productions in the RM cannot be found. In the previous inventory cycle, the activity data for 2019 were extrapolated based on the trend recorded in previous years. In the current inventory cycle, this approach has been discarded until the cause of non-inclusion of ceramic production in the respective statistical report is identified (activity data could be confidential, or, alternatively, the production of ceramics may have ceased starting with 2019).

CO_2 emissions from ceramic production decreased for the reporting period as a result of cessation of production in the RM starting with 2019 (Table 4-41).

Table 4-41: GHG emissions from ceramic production between 2005 and 2018, kt

	2005	2006	2007	2008	2009	2010	2011
CO_2	0.15587	0.13427	0.18112	0.11225	0.06995	0.02827	0.04645
NO_x	0.00035	0.00028	0.00042	0.00025	0.00012	0.00005	0.00008
CO	0.00036	0.00029	0.00043	0.00026	0.00013	0.00005	0.00009
SO_2	0.00007	0.00006	0.00009	0.00005	0.00003	0.00001	0.00002
	2012	2013	2014	2015	2016	2017	2018
CO_2	0.01370	0.01349	0.01185	0.01017	0.01204	0.00631	0.00430
NO_x	0.00003	0.00002	0.00002	0.00002	0.00002	0.00001	0.00001
CO	0.00003	0.00002	0.00002	0.00002	0.00002	0.00001	0.00001
SO_2	0.00001	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000

'Other Uses of Soda Ash'

CO_2 emissions from the other uses of soda ash were recalculated for the period 1990-2001 due to the updated information on annual consumption of soda ash in glass industry in the RM (considering that soda ash use in glass production constituted 250 kg of soda ash per ton of glass produced[53] between 1990-1994, 200 kg of soda ash per ton of glass produced between 1995-2001). Recalculations were not made for the period 2002-2019, since the values associated with the annual consumption of soda ash in the glass industry were estimated by directly enquiring operational glass factories in the Republic of Moldova.

Compared to the values recorded in the RBA3 of the RM to the UNFCCC (2021), the changes undertaken in the current inventory cycle have resulted in an upward trend in CO_2 emissions from other uses of soda ash, varying from a minimum increase by circa 5.2% in 1991 to a maximum increase by circa 7.9% in 1996. For 2020, the respective emissions were estimated in the RM for the first time. Between 1990 and 2020, CO_2 emissions from other uses of soda ash decreased by circa 53.1% due to the decreased consumption of soda ash in uses other than glass production (Table 4-42).

Table 4-42: Comparative results of CO_2 emissions from other uses of soda ash included in the BUR3 and NC5 of the RM to the UNFCCC, kt

	1990	1991	1992	1993	1994	1995	1996	1997
BUR3	2.8332	2.8742	1.3264	1.4817	1.1780	1.2698	0.8224	0.9613
NC5	2.9853	3.0247	1.4120	1.5741	1.2571	1.3647	0.8870	1.0328
Difference, %	5.4	5.2	6.5	6.2	6.7	7.5	7.9	7.4
	1998	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**
BUR3	1.0310	0.7952	1.5130	1.3534	1.2568	1.1238	1.2326	1.3965
NC5	1.1085	0.8510	1.6235	1.4513	1.2568	1.1238	1.2326	1.3965
Difference, %	7.5	7.0	7.3	7.2	0.0	0.0	0.0	0.0
	2006	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**
BUR3	1.2771	1.1798	0.9996	0.9695	0.9080	1.2295	1.2010	1.0053
NC5	1.2771	1.1798	0.9996	0.9695	0.9080	1.2295	1.2010	1.0053
Difference, %	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	2014	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**%**
BUR3	1.0031	1.2296	1.0525	1.2380	1.5621	1.4012		
NC5	1.0031	1.2296	1.0525	1.2380	1.5621	1.4012	1.6453	-53.1
Difference, %	0.0	0.0	0.0	0.0	0.0	0.0		

Abbreviations: BUR3 – Third Biennial Update Report of the RM to the UNFCCC, NC5 – Fifth National Communication of the RM to the UNFCCC.

4.2.6. Planned Improvements

Possible improvements under category 2A 'Mineral Industry' aim at updating the activity data used to estimate GHG emissions within this category for the reporting period within the previous inventory cycles.

4.3. Chemical Industry (Category 2B)

4.3.1. Source Category Description

Category 2B 'Chemical Industry' comprises the following emission sources: 2B1 'Ammonia Production', 2B2 'Nitric Acid Production', 2B3 'Adipic Acid Production', 2B4 'Caprolactam, Glyoxal and Glyoxylic Acid Production', 2B5 'Carbide Production', 2B6 'Titanium Dioxide Production', 2B7 'Soda Ash Production', 2B8 'Petrochemical and Carbon Black Production', 2B9 'Fluorochemical Production' and 2B10 'Other'. Between 1990 and 2020, no emissions were recorded from categories 2B1-2B9 (NO) in the Republic of Moldova. Within 2B10 'Other', NMVOC emissions in the RM were monitored from the following sources: polyethylene, acrylonitrile butadiene styrene (ABS) resins and polystyrene production. Between 1990 and 2020, NMVOC emissions from 2B 'Chemical Industry' decreased by circa 72.7% (Table 4-43).

Table 4-43: NMVOC emissions from 2B10 'Other' in the RM between 1990 and 2020, kt

	1990	1991	1992	1993	1994	1995	1996	1997
Polyethylene production	0.0125	0.0106	0.0063	0.0055	0.0028	0.0017	0.0044	0.0030
ABS resins production	0.0525	0.0438	0.0175	0.0144	0.0045	0.0043	0.0040	0.0038
Polystyrene production	NO	NO	NO	NO	NO	NO	NO	NO
2B10 'Other'	**0.0650**	**0.0544**	**0.0238**	**0.0199**	**0.0074**	**0.0060**	**0.0085**	**0.0068**

[53] Russian Centre for Foreign Trade. Conjuncture. Goods and Markets. Soda Ash on the World Market. http://www.rusimpex.ru/Content/Economics/Conjuncture/99_11002.htm>.

	1998	1999	2000	2001	2002	2003	2004	2005
Polyethylene production	0.0030	0.0016	0.0041	0.0050	0.0080	0.0102	0.0102	0.0111
ABS resins production	0.0036	0.0034	0.0032	0.0029	0.0023	0.0021	0.0027	0.0031
Polystyrene production	NO	NO	NO	NO	NO	NO	NO	0.0007
2B10 'Other'	**0.0066**	**0.0050**	**0.0073**	**0.0080**	**0.0104**	**0.0123**	**0.0129**	**0.0149**
	2006	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**
Polyethylene production	0.0094	0.0096	0.0088	0.0070	0.0092	0.0101	0.0090	0.0098
ABS resins production	0.0025	0.0031	0.0029	0.0023	0.0045	0.0050	0.0053	0.0055
Polystyrene production	0.0012	0.0012	0.0006	0.0007	0.0005	0.0006	0.0007	0.0005
2B10 'Other'	**0.0130**	**0.0139**	**0.0122**	**0.0100**	**0.0143**	**0.0157**	**0.0150**	**0.0159**
	2014	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**%**
Polyethylene production	0.0109	0.0086	0.0085	0.0080	0.0088	0.0093	0.0109	-12.8
ABS resins production	0.0052	0.0028	0.0044	0.0040	0.0064	0.0074	0.0066	-87.5
Polystyrene production	0.0005	0.0005	0.0003	0.0003	0.0003	0.0002	0.0003	N/A
2B10 'Other'	**0.0166**	**0.0119**	**0.0131**	**0.0123**	**0.0155**	**0.0170**	**0.0177**	**-72.7**

2B10 'Other'

a) *Polyethylene Production*

There are three types of polyethylene: low density polyethylene (LDPE), linear low-density polyethylene (LLDPE) and high-density polyethylene (HDPE). Polyethylene is a polymer of ethylene and has the general empirical formula $(\text{-}CH_2CH_2\text{-})_n$. The manufacturing process used depends on the type of polymer produced. LDPE is a tough waxy polymer, with approximately 2% branching between polymer chains and has a density of about 0.92 t/m^3. LDPE is generally produced by high pressure and high temperature catalytic polymerization of ethylene in a tubular or autoclave reactor. LLDPE is a crystalline polymer with no chain branching and a density comparable to that of LDPE. A low-pressure method is generally used in which ethylene and a co-monomer such as butane or hexane is catalytically polymerized. HDPE is a crystalline polymer with no chain branching and a density of about $0.96t/m^3$. HDPE is produced by low pressure polymerization of ethylene in a reactor containing a liquid hydrocarbon diluent and in the presence of Ziegler catalysts. The polymer produces slurry as it forms and is filtered from the solvent. NMVOC emissions are produced primarily through leakages, and depend on the duration of the production process. Control techniques are mainly the replacement of leaking valves etc., and regular maintenance.

b) *Acrylonitrile Butadiene Styrene Resins (ABS) Production*

Acrylonitrile Butadiene Styrene (ABS) is a combination of a graft copolymer and a polymer mixture (graft copolymer – a polymer with a 'backbone' of one type of monomer and with 'ribs' of copolymers of two other monomers). ABS resins can be produced in three ways: (1) emulsion polymerization: it is a two-step process; in the first step a rubber latex is made, usually in a furnace; in the second step, which can be operated continuously in the furnace, styrene and acrylonitrile are polymerized in the rubber latex solution to form an ABS latex; the ABS polymer is recovered through coagulation of the ABS latex by adding a destabilising agent; the resulting slurry is filtered or centrifuged to recover the ABS resin; the ABS resin is then dried; (2) mass polymerization: two or more continuous flow reactors are used in this process; rubber is dissolved in the monomers: styrene and acrylonitrile; during the reaction, the dissolved rubber is replaced by the Styrene Acrylonitrile Copolymer (SAN) and forms rubber particles; part of the SAN is grafted onto the rubber particles; the reaction mixture contains several additives, needed in the polymerization process; the product is devolatilized to remove the unreacted monomer; (3) mass suspension: this batch process starts with a mass polymerization which is stopped at a monomer conversion of 15-30%; after that, a suspension reaction completes the polymerization; for this reaction, the mixture of polymer and monomer is suspended in water using a suspending agent and then the polymerization process is continued; unreacted monomers are then separated, then the product is centrifuged and dried. NMVOC emissions at plants which produce acrylonitrile butadiene styrene resins can be subdivided as follows: leakage losses from use, pumps, and other leakage. The losses due to leakage can be limited by use of certain types of seals, including pumps.

c) *Polystyrene Production*

Polystyrene is a rigid plastic material, transparent or opaque, which has a high refractive index (1.59) and a specific low weight (1.054). It is a polymer in which the high molecular weight hydrocarbon $(C_8H_8)n$ is predominant, with the value of n between 500 and 2000. The polymer also contains small amounts of styrene, ethyl-benzene, traces of catalysts and low molecular weight polymers, in shares that vary according to the polymerization process used. The styrene homopolymer, the copolymers and their components are thermoplastic materials with a predominantly amorphous structure. The molecular weight distribution influences polystyrene properties and in particular the tensile strength, shock resistance, viscosity and the so important flow during moulding through injection or extrusion. The low molecular weight component of the polymer also influences the flow, light stability, electrical properties, chemical stability, etc. Low molecular weight components can be: unpolymerized styrene, saturated or non-polymerizable substances such as aldehydes, ethyl-benzene and di-, tri-, tetramers, etc. Styrene polymerization at industrial scale is carried out on the basis of the radical mechanism. The conjugated double vinyl bond and benzene nucleus give the styrene a particular reactivity as a monomer in the radical polymerization and, at the same time, a low activity of the respective radical. The initiation of radical styrene polymerization can be done thermally, photochemically, radiochemically or with initiators. Thermal polymerization is a consequence of the high reactivity of this monomer. Styrene polymerization can also be initiated by a large number of substances capable of decomposing into radicals under the action of heat. Peroxides, hydroperoxides or nitrocombinations are commonly used. Styrene polymerization can be carried out in bulk, solution, emulsion and suspension. Bulk polymerization is more widespread and can be conducted in the presence of initiators or under the influence of temperature. The use of initiators can lead to an uncontrolled process or to oxidation reactions, which lead to the yellowing of the polymer. For this reason, on an industrial scale, thermal initiation is applied at 150-260°C. Such high temperatures are due to the fact that, at 100°C, the reaction rate is low (conversions of 2% per hour), and at the end (at conversions higher than 90%) the polymerization rate drops greatly and only when temperature reaches 220-260°C, it can lead to a polymer with a monomer content of less than 1%. On industrial scale, bulk polymerization can take place in discontinuous or continuous installations, the latter being the most used. The main difficulty in this process is to increase the viscosity of the environment, making it difficult to remove reaction heat. Discontinuous mass polymerization consists in introducing previously purified styrene in glass forms, which, under heat, in the presence or absence of initiators, in the air or inert gas environment is transformed into a hard mass taking the container's shape. The continuous mass polymerization allows the production of a polymer free of monomer traces, characterised by a high molecular mass. This is carried out in polymerization towers or vacuum drying chambers. In order to overcome certain drawbacks, different types of reactors were used, with the following bulk polymerization installations being known: with a tubular displacement reactor, with shaking tubular reactors, rolling mill and horizontal reactors.

4.3.2. Methodological Issues, Emission Factors and Data Sources

2B10 'Other'

a) *Polyethylene Production*

Methodological issues for estimating NMVOC emissions from polyethylene production are addressed in the EMEP/EEA Atmospheric Emissions Inventory Guidebook (2019). The methodology used relied on the use of an emission factor for the type of polyethylene produced in the RM – linear low-density polyethylene (LLDPE) (Table 4-44), combined with activity data from the Statistical Yearbooks of the Republic of Moldova and those of the ATULBD (Table 4-45).

Table 4-44: Default EFs used to estimate NMVOC emissions from polyethylene production

Source	SNAP Code	Description	NMVOC Emissions, kg/t
Other Chemical Products	040506 040507	LDPE Production HDPE Production	2.4 2.3

Source: EMEP/EEA Atmospheric Emissions Inventory Guidebook (2019), SNAP Code 040506 LDPE Production, Category 2.B.5.a, Table 3.39. SNAP Code 040507 HDPE Production, Category 2.B.5.a, Table 3.40.

Table 4-45: AD on polyethylene production in the RM for 1990-2020, kt

	1990	1991	1992	1993	1994	1995	1996	1997
RBDR	3.519	3.100	1.715	1.601	0.878	0.717	1.552	1.168
LBDR	1.681	1.300	0.900	0.700	0.300	0.012	0.296	0.085
RM: total	**5.200**	**4.400**	**2.615**	**2.301**	**1.178**	**0.729**	**1.848**	**1.253**
	1998	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**
RBDR	1.170	0.683	1.689	2.050	3.324	4.225	4.239	4.254
LBDR	0.068	0.001	0.034	0.041	0.024	0.011	0.000	0.364
RM: total	**1.238**	**0.684**	**1.723**	**2.091**	**3.348**	**4.236**	**4.239**	**4.618**
	2006	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**
RBDR	3.514	3.637	3.417	2.795	3.626	4.105	3.635	3.987
LBDR	0.385	0.353	0.234	0.131	0.201	0.116	0.125	0.112
RM: total	**3.899**	**3.990**	**3.651**	**2.926**	**3.827**	**4.221**	**3.760**	**4.099**
	2014	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**%**
RBDR	4.196	3.290	3.242	2.939	3.246	3.355	4.022	14.3
LBDR	0.336	0.291	0.285	0.412	0.428	0.539	0.512	-69.5
RM: total	**4.532**	**3.581**	**3.527**	**3.351**	**3.673**	**3.894**	**4.534**	**-12.8**

Source: National Bureau of Statistics through the Statistical Yearbooks of the RM for 1994 (page 284), 1999 (page 302), 2005 (page 391), 2011 (page 305); Statistical Reports PRODMOLD-A 'Total production, as a natural expression, in the Republic of Moldova, by product type, for 2005-2020'; Statistical Yearbooks of the ATULBD for 1998 (page 176), 2002 (page 103), 2005 (page 94), 2007 (page 92), 2010 (page 95), 2012 (page 100), 2014 (page 90), 2017 (page 103), 2019 (page 101), 2020 (page 104), 2021 (page 102).

b) *Acrylonitrile Butadiene Styrene Resins (ABS) Production*

Methodological issues for estimating NMVOC emissions from synthetic resin (ABS) production are addressed in the EMEP/EEA Atmospheric Emissions Inventory Guidebook (2019).

The methodology used relied on the use of a default emission factor (Table 4-46) multiplied by activity data from the national statistics (Table 4-47).

Table 4-46: Default EF used to estimate NMVOC emissions from acrylonitrile butadiene styrene resin (ABS) production

Source	SNAP Code	Description	NMVOC Emissions, kg/t
Other Chemical Products	040515	Production of ABS Resins	3.0

Source: EMEP/EEA Atmospheric Emissions Inventory Guidebook (2019), SNAP Code 040515 Production of ABS resins, Category 2.B.5.a, Table 3.51.

Table 4-47: AD on acrylonitrile butadiene styrene resin (ABS) production for 1990-2020, kt

	1990	1991	1992	1993	1994	1995	1996	1997
Production of ABS resins	17.500	14.600	5.839	4.792	1.510	1.424	1.350	1.276
	1998	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**
Production of ABS resins	1.202	1.127	1.053	0.979	0.776	0.708	0.910	1.048
	2006	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**
Production of ABS resins	0.825	1.026	0.961	0.777	1.516	1.657	1.774	1.842
	2014	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**%**
Production of ABS resins	1.739	0.929	1.453	1.346	2.128	2.470	2.186	-87.5

Source: Statistical Yearbooks of the RM for 1994 (page 284); Statistical Yearbooks of the ATULBD for 1998 (page 176), 2002 (page 103), 2005 (page 94), 2007 (page 92), 2010 (page 95), 2012 (page 100), 2014 (page 90), 2017 (page 101), 2019 (page 99), 2020 (page 102), 2021 (page 100).

c) *Polystyrene Production*

Methodological issues for estimating NMVOC emissions from polystyrene production are addressed in the EMEP/EEA Atmospheric Emissions Inventory Guidebook (2019).

The methodology used relied on the use of a default emission factor (Table 4-48), multiplied by activity data from the national statistics (Table 4-49).

Table 4-48: Default EF used to estimate NMVOC emissions from polystyrene production

Source	SNAP Code	Description	NMVOC Emissions, kg/t
Other Chemical Products	040511	Production of general-purpose polystyrene (GPPS) Production of high impact polystyrene (HIPS) Production of expandable polystyrene (EPS)	0.12 0.12 3.20

Source: EMEP/EEA Atmospheric Emissions Inventory Guidebook (2019), SNAP Code 040511 Polystyrene Production, Category 2.B.5.a, Tables 3.45-3.47, page 42.

Table 4-49: AD on polystyrene production for 2005-2020, kt

	2005	2006	2007	2008	2009	2010	2011	2012
Polystyrene plates, sheets and alveolar strips	0.249	0.706	0.804	0.559	1.582	1.876	2.169	2.013
Polystyrenes, copolymers and other styrene polymers in primary forms	0.210	0.425	0.437	0.235	0.255	0.099	0.093	0.143
Total polystyrene production	**0.459**	**1.131**	**1.242**	**0.794**	**1.837**	**1.975**	**2.262**	**2.155**
	2013	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**
Polystyrene plates, sheets and alveolar strips	2.119	2.471	2.806	2.474	2.054	2.042	1.921	2.303
Polystyrenes, copolymers and other styrene polymers in primary forms	0.075	0.060	0.038	NO	NO	NO	NO	NO
Total polystyrene production	**2.194**	**2.532**	**2.844**	**2.474**	**2.054**	**2.042**	**1.921**	**2.303**

Source: Statistical Reports PRODMOLD-A 'Total production, as a natural expression, in the RM, by product type, for 2005-2020'.

4.3.3. Uncertainties and Time-Series Consistency

The primary uncertainty-related factors pertain to methodology, emission factors used to estimate NMVOC emissions from category 2B 'Chemical Industry', as well as the quality of activity data available. Uncertainties associated with default emission factors were considered to be circa 100%, whereas those associated with activity data – circa 5%, respectively. In view of ensuring time-series consistency of the obtained results, the same approach was used for the entire period under review, in conformity with the recommendations included in the 2006 IPCC Guidelines.

4.3.4. Quality Assurance and Quality Control

Standard verification and quality control forms and check-lists were filled in for the respective category, following a Tier 1 approach. Also, verification was focused on ensuring correct use of the emission factors, including default EFs, available in the EMEP/EEA Atmospheric Emissions Inventory Guidebook (2019); verification was also focused on correct use of AD obtained from different reference sources, including official sources, etc. AD and methods used for estimating GHG emissions from category 2B 'Chemical Industry' were documented and archived both in hard copies and electronically.

4.3.5. Recalculations

NMVOC emissions from source category 2B10 'Other' (polyethylene, acrylonitrile butadiene styrene (ABS) resins and polystyrene production) were not recalculated in the current inventory cycle. For 2020, the respective emissions were estimated for the first time in the RM. Between 1990-2020, NMVOC emissions from the respective category decreased by circa 72.7% as a result of the decrease in polyethylene, ABS resin, and polystyrene production.

4.3.6. Planned Improvements

The inventory improvement plan for category 2B 'Chemical Industry' identify areas which require updating of activity data used to estimate NMVOC emissions within this category for the reporting period within the previous inventory cycles.

4.4. Metal Industry (Category 2C)

4.4.1. Source Category Description

Category 2C 'Metal Industry' covers GHG emissions from the following emission sources: 2C1 'Iron and Steel Production', 2C2 'Ferroalloy Production', 2C3 'Aluminium Production', 2C4 'Magnesium Production', 2C5 'Lead Production', 2C6 'Zinc Production' and 2C7 'Other'. Currently, 2C1 'Iron and Steel Production' is the only source category relevant for the Republic of Moldova in terms of GHG emissions originating from category 2C 'Metal Industry'.

Iron and steel production can occur at primary integrated facilities, by reducing the iron ore with metallurgical coke; and at secondary facilities, particularly by melting the recycled steel scrap using electrical energy imparted to the charge through carbon electrodes. Primary facilities are: open hearth furnaces (OHFs) accounting for circa 4% of the world iron and steel production, and basic oxygen steelmaking furnaces (BOFs), accounting for circa 63% of the world iron and steel production. The metallurgical coke used in furnaces and ovens is oxidized to CO_2 and then emitted into the atmosphere (a certain amount of carbon is retained in iron).

Secondary steelmaking most often occurs in electric arc furnaces (EAFs) accounting for circa 33% of the world iron and steel production. It should be noted that the technology used in the Republic of Moldova to produce steel is, exclusively, in electric arc furnaces (EAFs) of different capacities. Electric arc furnaces are equipped with carbon electrodes (usually made from graphite with a carbon content of circa 97%[54]), when a high voltage is applied between the electrodes. The resulting electric arc leads to the melting of iron pieces at temperatures up to 1700°C. Limestone, or lime with high calcium and

[54] <http://ukrgrafit.zp.ua/elektrody>, <http://tdvial.ru/ge.htm>, <http://www.ruscastings.ru/work/168/441/449/4785>

dolomite content, coke, cast iron and other metals (chromium, magnesium, molybdenum, or vanadium compounds) are added in the molten metal, depending on the desired quality of the steel.

CO_2 emissions from steel production in electric arc furnaces are determined by carbon losses in electrodes, as well as from the use of carbonates. When electrodes are placed above the electric arc furnace, the electric arc oxidises the carbon to CO or CO_2. Also, electrodes are immersed in the molten metal to increase carbon concentration in steel, thus contributing to additional CO_2 emissions.

Between 1990 and 2020, CO_2 emissions from category 2C 'Metal Industry' decreased in the Republic of Moldova by circa 34.4% (Table 4-50).

Table 4-50: Evolution of CO_2 emissions from category 2C 'Metal Industry' between 1990-2020, kt

	1990	1991	1992	1993	1994	1995	1996	1997
RM: LBDR	28.2916	24.5575	23.8586	24.3298	25.2723	26.2189	26.7141	32.3652
RM: RBDR	0.2107	0.1722	0.1337	0.0951	0.0566	0.0180	0.0120	0.0154
RM: total	**28.5023**	**24.7297**	**23.9922**	**24.4250**	**25.3289**	**26.2369**	**26.7261**	**32.3806**
	1998	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**
RM: LBDR	28.6750	31.7901	36.2631	38.6194	20.4879	35.3845	40.4565	41.8543
RM: RBDR	0.0072	0.0040	0.0058	0.0080	0.0152	0.0438	0.0519	0.0815
RM: total	**28.6822**	**31.7942**	**36.2689**	**38.6274**	**20.5030**	**35.4283**	**40.5084**	**41.9358**
	2006	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**
RM: LBDR	26.9577	38.5395	35.3429	17.0110	9.6449	12.8029	12.6474	7.5915
RM: RBDR	0.0605	0.0732	0.0689	0.0509	0.0536	0.0527	0.0499	0.0654
RM: total	**27.0182**	**38.6127**	**35.4118**	**17.0619**	**9.6985**	**12.8556**	**12.6973**	**7.6569**
	2014	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**%**
RM: LBDR	13.7620	17.1721	5.0940	18.7484	20.0837	15.6612	18.5667	-34.4
RM: RBDR	0.0844	0.1071	0.1263	0.1358	0.1295	0.1315	0.1305	-38.1
RM: total	**13.8464**	**17.2792**	**5.2203**	**18.8842**	**20.2133**	**15.7926**	**18.6972**	**-34.4**

Non-CO_2 emissions from category 2C 'Metal Industry' between 1990-2020 are presented below (Table 4-51). In the period under review, the respective emissions recorded an evolution trend similar that of CO_2 emissions.

Table 4-51: Non-CO_2 emissions from category 2C 'Metal Industry' in the RM between 1990 and 2020, kt

	1990	1991	1992	1993	1994	1995	1996	1997
NO_x	0.0925	0.0803	0.0780	0.0794	0.0824	0.0854	0.0870	0.1054
CO	1.2102	1.0502	1.0194	1.0383	1.0774	1.1166	1.1375	1.3781
NMVOC	0.0370	0.0323	0.0314	0.0315	0.0322	0.0327	0.0332	0.0401
SO_2	0.0427	0.0371	0.0360	0.0366	0.0380	0.0394	0.0401	0.0486
	1998	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**
NO_x	0.0934	0.1035	0.1181	0.1257	0.0667	0.1153	0.1318	0.1364
CO	1.2208	1.3533	1.5438	1.6441	0.8725	1.5074	1.7236	1.7839
NMVOC	0.0371	0.0408	0.0462	0.0500	0.0263	0.0456	0.0522	0.0545
SO_2	0.0431	0.0478	0.0545	0.0580	0.0308	0.0532	0.0608	0.0630
	2006	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**
NO_x	0.0879	0.1256	0.1152	0.0555	0.0315	0.0418	0.0413	0.0249
CO	1.1492	1.6426	1.5064	0.7255	0.4121	0.5465	0.5398	0.3250
NMVOC	0.0355	0.0508	0.0465	0.0227	0.0128	0.0169	0.0171	0.0100
SO_2	0.0406	0.0580	0.0532	0.0256	0.0145	0.0193	0.0191	0.0115
	2014	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**%**
NO_x	0.0450	0.0561	0.0169	0.0613	0.0657	0.0513	0.0607	-34.4
CO	0.5882	0.7340	0.2204	0.8019	0.8586	0.6704	0.7940	-34.4
NMVOC	0.0159	0.0199	0.0060	0.0217	0.0232	0.0181	0.0215	-34.4
SO_2	0.0208	0.0259	0.0078	0.0283	0.0303	0.0237	0.0280	-34.4

4.4.2. Methodological Issues, Emission Factors and Data Sources

CO_2 emissions from source category 2C1 'Iron and Steel Production' were estimated using a Tier 2 methodology (2006 IPCC Guidelines), based on carbon track throughout the production process.

Total CO_2 emissions from category 2C1 'Iron and Steel Production' were estimated using equation 4.9 from the 2006 IPCC Guidelines (Volume 3, Chapter 4.2, page 4.22). The simplified version of this equation is presented below, adapted to national circumstances.

$$E_{CO2} = [L \bullet C_L + D \bullet C_D + CE \bullet C_{CE} - S \bullet C_S] \bullet 44/12$$

Where:

E_{CO2} – total CO_2 emissions from steel production, tonnes;

L – quantity of limestone consumed in steel production, tonnes;

C_L – carbon content in limestone consumed in steel production, tC/t limestone;

D – quantity of dolomite consumed in steel production, tonnes;

C_D – carbon content in dolomite consumed in steel production, tC/t dolomite;

CE – quantity of carbon electrodes consumed in EAFs, tonnes;

C_{CE} – carbon content in electrodes consumed in EAFs, tC/t electrodes;

S – quantity of steel produced, tonnes;

C_S – carbon content in steel produced, tC/t steel;

44/12 – mass ratio CO_2/C.

In the Republic of Moldova, the carbon content in steel is circa 0.25% (according to the information provided by the producer, the carbon content in steel varies between 0.17 and 0.33%)[55]. According to the 2006 IPCC Guidelines, depending on the type and quality of steel, the carbon content in steel varies between 0.5 and 2%, the default value used is 1% (Volume 3, Chapter 4.2, Table 4.3, page 4.27).

Other relevant coefficients used to estimate CO_2 emissions from steel production are presented below (Table 4-52).

Table 4-52: Carbon content of various materials used in steel production

Raw Material	Carbon content, default values, t C / t	Raw Material	Carbon content values used at national level, t C / t
Limestone	0.12	Lime with high calcium content	0.2142
Dolomite	0.13	Dolomitic lime	0.2492
Carbon electrodes from petroleum coke for EAF	0.82		
Carbon electrodes from coal coke for EAF	0.83	Graphite electrodes for EAF	0.97
Scrap metal	0.04		
Steel	0.01	Steel	0.0025

In order to estimate CO_2 emissions from steel production, the specific consumption of raw materials and graphite electrodes for producing 1 ton of steel was also considered, this information being identified in the literature in the field and on the web pages of metallurgical companies. Thus, for example, the consumption of graphite electrodes in electric arc furnaces with a capacity of 30-50 tonnes, specific to enterprises on the RBDR, was agreed to be 7 kg/t of steel produced[56]. The specific consumption of graphite electrodes in electric furnaces with higher capacity (such as that from the Metal Integrated Works in Ribnita with a capacity of 120 tonnes[57]) was agreed to be 1.3 kg/t of steel produced[58]. The specific consumption of lime with high calcium content and/or dolomitic lime is considered to be 55 kg/t of steel produced[59] (of which 45 kg of lime with high calcium content, and 10 kg of dolomitic lime, respectively).

Metal Integrated Works in Ribnita is situated on the left bank of the Dniester River, which is one of the two mini-metallurgical works (the second is located in Jlobino, Belarus) bought by the USSR in the early 1980s of the twentieth century. These plants were, at the time, at the level of Western European plants, well provided with advanced equipment and efficient technologies. Production capacity at the launch in 1985 was about 684 kt of steel and 500 kt of rolling mills. Between 2004 and 2005, steel production reached 1 million tonnes of steel and 800 thousand tonnes of rolling mills. The Metal Integrated Works in Ribnita uses scrap metal collected mainly in the Republic of Moldova, but also from Ukraine. At the same time, there are several enterprises on the right bank of the Dniester River (such as: JSC 'Incomas', JSC 'Fiting' Plant, JSC 'Protos' Pipe Plant owned by ME 'Orvento Metall Trading Co' Ltd., etc.) which use low-capacity electric arc furnaces (less than 50 tonnes). Steel production of these enterprises is insignificant compared to that of the Metal Integrated Works in Ribnita.

[55] Metal Integrated Works in Ribnita, <http://www.aommz.com/pls/webus/webus.main.show>.
[56] <http://metal-archive.ru/tyazhelye-metally/1468-vyplavka-stali-v-dugovyh-pechah.html>.
[57] <http://www.aommz.com/pls/web/web.main.show?main_id=10&m_id=11>.
[58] <http://elar.urfu.ru/bitstream/10995/40661/1/978-5-7996-1725-7_2016.pdf>.
[59] <https://rep.bntu.by/bitstream/handle/data/6984/%D0%A1.%20128-130.pdf?sequence=1>.

AD associated with steel (Table 4-53) and rolling mills production (Table 4-54) in the Republic of Moldova is available in the statistical publications of the RM and those of the ATULBD.

Table 4-53: AD on steel production for 1990-2020, kt

	1990	1991	1992	1993	1994	1995	1996	1997
RM: RBDR	3.500	2.860	2.220	1.580	0.940	0.299	0.199	0.255
RM: LBDR	708.400	614.900	597.400	609.200	632.800	656.500	668.900	810.400
RM: total	**711.900**	**617.760**	**599.620**	**610.780**	**633.740**	**656.799**	**669.099**	**810.655**
	1998	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**
RM: RBDR	0.120	0.067	0.097	0.133	0.252	0.727	0.862	1.354
RM: LBDR	718.000	796.000	908.000	967.000	513.000	886.000	1013.000	1048.000
RM: total	**718.120**	**796.067**	**908.097**	**967.133**	**513.252**	**886.727**	**1013.862**	**1049.354**
	2006	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**
RM: RBDR	1.005	1.215	1.145	0.845	0.890	0.876	0.828	1.087
RM: LBDR	675.000	965.000	884.958	425.943	241.501	320.574	316.682	190.086
RM: total	**676.005**	**966.215**	**886.103**	**426.788**	**242.391**	**321.450**	**317.510**	**191.173**
	2014	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**%**
RM: RBDR	1.401	1.778	2.098	2.255	2.151	2.183	2.167	-38.1
RM: LBDR	344.590	429.976	127.549	469.446	502.881	392.144	464.896	-34.4
RM: total	**345.991**	**431.754**	**129.647**	**471.701**	**505.032**	**394.327**	**467.063**	**-34.4**

Source: Statistical Yearbooks of the RM for 1994 (page 224), 1999 (page 302), 2003 (page 391), 2004 (page 441), 2010 (page 305); Statistical Reports PRODMOLD-A 'Total production, as a natural expression, in the RM, by product type, for 2005-2020'; Statistical Yearbooks of the ATULBD for 1998 (page 178), 2000 (page 99), 2002 (page 103), 2006 (page 93), 2007 (page 92), 2010 (page 93), 2013 (page 99), 2017 (page 101), 2019 (page 99), 2020 (page 102), 2021 (page 100).

Methodological issues associated with the estimation of non-CO_2 emissions from steel production in electric arc furnaces are addressed in the EMEP/EEA Atmospheric Emissions Inventory Guidebook (2019).

Table 4-54: AD regarding rolling mill production for 1990-2020, kt

	1990	1991	1992	1993	1994	1995	1996	1997
Rolling mill production	614.200	561.300	547.600	487.200	438.000	357.000	341.000	407.000
	1998	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**
Rolling mill production	588.000	593.000	636.000	791.000	381.000	693.000	791.000	890.000
	2006	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**
Rolling mill production	633.000	914.000	818.035	437.515	237.710	302.162	360.402	173.146
	2014	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**%**
Rolling mill production	389.260	318.840	222.489	451.393	497.899	394.586	455.602	-25.8

Source: Statistical Yearbooks of the RM for 1994 (page 224); Statistical Yearbooks of the ATULBD for 1998 (page 178), 2000 (page 99), 2002 (page 103), 2006 (page 93), 2007 (page 92), 2010 (page 93), 2013 (page 99), 2017 (page 101), 2019 (page 99), 2020 (page 102), 2021 (page 100).

The estimation method used is based on default emission factors (Table 4-55), multiplied by activity data available in the national statistics (Table 4-53 and 4-54).

Table 4-55: Default EFs used to estimate non-CO_2 emissions from steel production in EAFs

Source	Description	NO_x	CO	NMVOC	SO_2
		g / t			
Steel Production in EAFs	Steel production[1]	130	1700	46	60
	Rolling mill production[2]			7	

Source: : EMEP/EEA Atmospheric Emissions Inventory Guidebook, 2019, [1] 2.C.1 Steel Production, 040207 – Steel Production in Electric Arc Furnaces, Table 3.19, page 44; [2] 2.C.1 Steel Production, 040208 – Production of Rolling Mills, Table 3.22, page 47.

4.4.3. Uncertainties and Time-Series Consistency

Uncertainties associated with EFs used to estimate CO_2 emissions from this category, were estimated using a Tier 2 method and are considered to be circa 10% (2006 IPCC Guidelines).

Uncertainties associated with activity data on steel and rolling mill production in the RM are low (circa 1-2%), but, considering that in the assessment process, AD regarding the consumption of electrodes, lime and dolomite is also used, which are estimated according to the specific consumption per specific sector; total uncertainties associated with AD could increase to circa 5%. Thus, combined uncertainties of total sectoral emissions are considered to be circa 11.18% (Annex 5-3.2).

In view of ensuring time-series consistency of the obtained results, the same approach was used for the entire period under review, in conformity with the recommendations included in the 2006 IPCC Guidelines.

4.4.4. Quality Assurance and Quality Control

Standard verification and quality control forms and checklists were filled in for the respective category, following a Tier 1 approach. Verification was focused on ensuring correct use of the emission factors, including default EFs, available in the 2006 IPCC Guidelines and the EMEP/EEA Atmospheric Emissions Inventory Guidebook (2019); verification was also focused on correct use of AD obtained from different reference sources, including official sources (NBS of the RM through Statistical Yearbooks of the RM and the Statistical Reports PRODMOLD-A 'Total production, as a natural expression, in the RM, by product type', Statistical Yearbooks of the ATULBD, as well as web pages of national and foreign enterprises in the field) as well as the correct application of these, etc. It should be noted that AD and methods used for the estimation of GHG emissions under source category 2C1 'Iron and Steel Production' were documented and archived both in hard copies and electronically.

4.4.5. Recalculations

CO_2 emissions from source category 2C1 'Iron and Steel Production' were not recalculated for the years 1990-2019. For 2020, the CO_2 emissions from steel production were estimated for the first time. The obtained results show that the respective emissions have decreased in the RM by circa 34.4% between 1990 and 2020 as a result of the reduction in the volume of this production.

4.4.6. Planned Improvements

Possible improvements under category 2C 'Metal Industry' might include updating activity data on raw material consumption per ton of production, as well as the specific electrode consumption per ton of steel produced by enterprises in the Republic of Moldova. Should new country-specific data be available, uncertainties associated with GHG emissions from category 2C1 'Iron and Steel Production' could be reduced in the following inventory cycles.

4.5. Non-Energy Products from Fuels and Solvent Use (Category 2D)

4.5.1. Source Category Description

Category 2D 'Non-Energy Products from Fuels and Solvent Use' covers GHG emissions generated from the following emission sources: 2D1 'Lubricant Use', 2D2 'Paraffin Wax Use', 2D3 'Solvent Use', 2D4 'Other'.

2D1 'Lubricant Use'

Lubricants are mostly used in the industrial and transportation sectors. The use of lubricants in internal combustion engines is primarily for their lubricating properties and associated CO_2 emissions from these substances are therefore considered as non-combustion emissions to be reported in Sector 2 'IPPU', not in Sector 1 'Energy'.

2D2 'Paraffin Wax Use'

Within this category, CO_2 emissions are monitored from the use of products, such as: petroleum jelly, solid paraffin waxes and other waxes, including ozokerite. Waxes are used in a number of various applications. Paraffin waxes are used in applications such as candles, corrugated boxes, paper coating, food production, wax polishes, surfactants (detergents) and many others.

2D3 'Solvent Use'

This category includes indirect GHG and CO_2 emissions from domestic solvent use, road paving with asphalt, asphalt roofing manufacture, paint/coating application, degreasing, dry cleaning, chemical products manufacturing, printing and other solvent use (fat, edible and non-edible oil extraction, preservation of wood, vehicle underseal treatment and vehicle dewaxing).

2D4 'Other' (Use of Urea-Based Catalysts)

This category includes CO_2 emissions from the use of urea-based catalysts. Between 1990 and 2020, direct CO_2 emissions from category 2D 'Non-energy Products from Fuels and Solvent Use' decreased by circa 16.6% (Table 4-56).

Table 4-56: CO_2 emissions from category 2D 'Non-energy Products from Fuels and Solvent Use' by source between 1990 and 2020, kt

	1990	1991	1992	1993	1994	1995	1996	1997
2D1 Lubricant Use	24.7987	20.7617	12.1110	10.9576	10.1022	10.1316	9.7676	9.2153
2D2 Paraffin Wax Use	0.1138	0.0953	0.0556	0.0503	0.0464	0.0465	0.0448	0.0423
2D3 Solvent Use	204.1460	167.7797	138.5232	110.2218	72.1539	64.2795	59.4608	31.0929
2D4 Other	5.3005	4.6818	3.5730	2.6463	2.1713	2.1031	1.7979	1.7024
2D Non-energy Products from Fuels and Solvent Use	**234.3591**	**193.3185**	**154.2628**	**123.8759**	**84.4738**	**76.5607**	**71.0712**	**42.0528**
	1998	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**
2D1 Lubricant Use	7.0105	4.9998	3.9115	4.3872	4.3239	6.5825	6.5622	6.4692
2D2 Paraffin Wax Use	0.0322	0.0230	0.0180	0.0201	0.0198	0.0302	0.0301	0.0149
2D3 Solvent Use	29.1892	28.0692	27.6403	30.8429	32.6053	32.7216	55.7321	59.8981
2D4 Other	1.3765	0.9920	1.0697	1.1693	1.4252	1.5908	1.8059	1.8088
2D Non-energy Products from Fuels and Solvent Use	**37.6084**	**34.0839**	**32.6395**	**36.4195**	**38.3743**	**40.9252**	**64.1303**	**68.1910**
	2006	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**
2D1 Lubricant Use	6.9861	5.7679	6.1481	5.0916	5.4648	5.7762	4.9418	4.8461
2D2 Paraffin Wax Use	0.0594	0.0595	0.0295	0.0742	0.1795	0.0747	0.1351	0.0751
2D3 Solvent Use	73.0967	76.9812	58.4959	50.5522	58.2796	63.0079	67.3666	62.1274
2D4 Other	1.8385	1.9347	2.0312	1.8625	2.3159	2.4656	2.2088	2.4324
2D Non-energy Products from Fuels and Solvent Use	**81.9807**	**84.7433**	**66.7047**	**57.5805**	**66.2398**	**71.3244**	**74.6523**	**69.4810**
	2014	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**%**
2D1 Lubricant Use	4.7832	4.8165	4.9177	4.8069	5.0147	4.9454	5.0839	-79.5
2D2 Paraffin Wax Use	0.0301	0.0600	0.0449	0.0599	0.1198	0.2546	0.1198	5.2
2D3 Solvent Use	79.8615	76.9346	76.8520	88.9719	142.7958	134.9938	186.8249	-8.5
2D4 Other	2.5619	2.7580	2.9897	3.1825	3.2507	3.4279	3.3358	-37.1
2D Non-energy Products from Fuels and Solvent Use	**87.2367**	**84.5691**	**84.8044**	**97.0212**	**151.1809**	**143.6217**	**195.3645**	**-16.6**

A similar trend was recorded for indirect GHG emissions (NO_x, CO, NMVOC) and SO_2 from this category (Table 4-57).

Table 4-57: Evolution of indirect GHG emissions from category 2D 'Non-energy Products from Fuels and Solvent Use' between 1990 and 2020, kt

	1990	1991	1992	1993	1994	1995	1996	1997
NO_x	0.0434	0.0361	0.0304	0.0241	0.0146	0.0132	0.0119	0.0040
CO	0.2441	0.2030	0.1706	0.1356	0.0820	0.0740	0.0671	0.0227
NMVOC	92.7937	76.2635	62.9651	50.1008	32.7972	29.2180	27.0276	14.1331
SO_2	0.0216	0.0180	0.0151	0.0120	0.0073	0.0065	0.0059	0.0020
	1998	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**
NO_x	0.0033	0.0031	0.0025	0.0031	0.0027	0.0026	0.0082	0.0077
CO	0.0185	0.0172	0.0139	0.0174	0.0153	0.0145	0.0459	0.0431
NMVOC	13.2678	12.7587	12.5638	14.0195	14.8206	14.8735	25.3328	27.2264
SO_2	0.0016	0.0015	0.0012	0.0015	0.0013	0.0013	0.0041	0.0038
	2006	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**
NO_x	0.0124	0.0130	0.0075	0.0056	0.0069	0.0078	0.0088	0.0088
CO	0.0697	0.0732	0.0427	0.0316	0.0392	0.0443	0.0500	0.0501
NMVOC	33.2258	34.9915	26.5891	22.9783	26.4907	28.6400	30.6212	28.2397
SO_2	0.0062	0.0065	0.0037	0.0028	0.0034	0.0039	0.0044	0.0044
	2014	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**%**
NO_x	0.0128	0.0089	0.0076	0.0097	0.0273	0.0186	0.0301	-30.8
CO	0.0723	0.0501	0.0429	0.0547	0.1534	0.1047	0.1689	-30.8
NMVOC	36.3007	34.9703	34.9327	40.4418	64.9072	61.3608	84.9204	-8.5
SO_2	0.0064	0.0044	0.0038	0.0048	0.0136	0.0093	0.0149	-30.8

4.5.2. Methodological Issues, Emission Factors and Data Sources

2D1 'Lubricant Use'

The methodology used to estimate CO_2 emissions from lubricant use is a Tier 1 methodological approach provided by the 2006 IPCC Guidelines, based on AD on lubricant consumption available in the Energy Balances of the Republic of Moldova and the statistical publication Socio-Economic Development of ATULBD.

CO_2 emissions from lubricant use are calculated according to Equation 5.2 (2006 IPCC Guidelines, Volume 3, Chapter 5.2, page 5.7).

$$CO_2\ Emissions = LC \bullet CC_{Lubricant} \bullet ODU_{Lubricant} \bullet 44/12$$

Where:

CO_2 Emissions – emissions from lubricants, t CO_2;

LC – total lubricant consumption, TJ;

$CC_{Lubricant}$ – carbon content of lubricant, t C/TJ; the default value used is 20 t C/TJ (2006 IPCC Guidelines, Volume 3, Chapter 5.2, page 5.9);

$ODU_{Lubricant}$ – ODU factor (oxidized during use); the default value used is 20% for oil and 5% for grease (2006 IPCC Guidelines, Vol. 3, Chapter 5.2, Table 5.2, P. 5.9);

44/12 – mass ratio of CO_2/C.

In accordance with the recommendations of the 2006 IPCC Guidelines, if statistical data on lubricant consumption is aggregated without the possibility of delimiting oil and grease consumption, it is recommended to consider that 90% of total lubricants are oils and 10% – grease. AD used to estimate CO_2 emissions from source category 2D1 'Lubricant Use' is presented below (Table 4-58).

Table 4-58: AD regarding lubricant use for 1990-2020, TJ

	1990	1991	1992	1993	1994	1995	1996	1997
Total lubricant used, of which:	1827.9	1530.3	892.7	807.7	744.6	746.8	720.0	679.3
Oil	1645.1	1377.3	803.4	726.9	670.2	672.1	648.0	611.3
Grease	182.8	153.0	89.3	80.8	74.5	74.7	72.0	67.9
	1998	1999	2000	2001	2002	2003	2004	2005
Total lubricant used, of which:	516.7	368.5	288.3	323.4	318.7	485.2	483.7	476.8
Oil	465.1	331.7	259.5	291.0	286.8	436.7	435.3	429.2
Grease	51.7	36.9	28.8	32.3	31.9	48.5	48.4	47.7
	2006	2007	2008	2009	2010	2011	2012	2013
Total lubricant used, of which:	514.9	425.1	453.2	375.3	402.8	425.8	364.3	357.2
Oil	463.5	382.6	407.9	337.8	362.5	383.2	327.8	321.5
Grease	51.5	42.5	45.3	37.5	40.3	42.6	36.4	35.7
	2014	2015	2016	2017	2018	2019	2020	%
Total lubricant used, of which:	352.6	355.0	362.5	354.3	369.6	364.5	374.7	-79.5
Oil	317.3	319.5	326.2	318.9	332.7	328.1	337.3	-79.5
Grease	35.3	35.5	36.2	35.4	37.0	36.5	37.5	-79.5

Source: Energy Balances of the RM for the years 1990, 1993-2020; Socio-Economic Development of the TMR for the years 2009-2020.

2D2 'Paraffin Wax Use'

The methodology used to estimate CO_2 emissions from paraffin wax use is a Tier 1 methodological approach provided by the 2006 IPCC Guidelines, based on AD regarding paraffin wax consumption available in the Energy Balances of the Republic of Moldova (since 2004; between 1990 and 2003 – paraffin wax consumption was estimated indirectly based on lubricant consumption and its evolution). In contrast to the previous inventory cycle, paraffin wax use on the left bank of the Dniester River was also estimated indirectly in the current cycle: it was considered that the share of paraffin consumption on the LBDR of the total national consumption is identical to the share of lubricant consumption in the LBRD of the total national.

CO_2 emissions from paraffin wax use are calculated according to Equation 5.4 (2006 IPCC Guidelines, Volume 3, Chapter 5.3, page 5.11).

$$CO_2\ Emissions = PW \bullet CC_{Wax} \bullet ODU_{Wax} \bullet 44/12$$

Where:

CO_2 Emissions – emissions from waxes, t CO_2;

PW – total wax consumption, TJ;

CC_{Wax} – carbon content of paraffin wax (default), t C/TJ; the default value used is 20 t C/TJ (2006 IPCC Guidelines, Volume 3, Chapter 5.3, page 5.12);

ODU_{Wax} – ODU factor for paraffin wax, fraction; the default value used is 20% (2006 IPCC Guidelines, Volume 3, Chapter 5.3, page 5.12);

44/12 – mass ratio of CO_2/C.

AD used to estimate CO_2 emissions from source category 2D2 'Paraffin Wax Use' is presented below (Table 4-59).

Table 4-59: AD on Paraffin Wax Use in the Republic of Moldova for 1990-2020, TJ

	1990	1991	1992	1993	1994	1995	1996	1997
Paraffin wax used	7.8	6.5	3.8	3.4	3.2	3.2	3.1	2.9
	1998	1999	2000	2001	2002	2003	2004	2005
Paraffin wax used	2.2	1.6	1.2	1.4	1.4	2.1	2.1	1.0
	2006	2007	2008	2009	2010	2011	2012	2013
Paraffin wax used	4.0	4.1	2.0	5.1	12.2	5.1	9.2	5.1
	2014	2015	2016	2017	2018	2019	2020	%
Paraffin wax used	2.0	4.1	3.1	4.1	8.2	17.4	8.2	5.2

2D3 'Solvent Use'

Between 1990 and 2020, indirect CO_2 emissions from source category 2D3 'Solvent Use' had decreased by circa 8.5% (Table 4-60). Similar trends were recorded for indirect GHG emissions (NO_x, CO, NMVOC) and SO_2 from the respective category (Table 4-57).

Table 4-60: Evolution of indirect CO_2 emissions from category 2D3 'Solvent Use' by source between 1990 and 2020, kt

	1990	1991	1992	1993	1994	1995	1996	1997
2D3a Domestic Solvent Use	11.5146	11.5270	11.5080	11.4782	11.4911	11.4785	11.4428	11.4048
2D3b Production and Use of Asphalt for Road Paving	80.5401	66.9773	56.2980	44.7480	27.0600	24.4200	22.1496	7.5060
2D3c Asphalt Roofing	NO	NO	NO	NO	NO	NO	NO	NO
2D3d Paint Application	22.0667	16.1929	11.3743	7.1827	4.0437	1.5391	1.9353	1.2475
2D3e Degreasing	2.6034	1.4818	0.8383	0.5482	0.4094	0.4626	0.1545	0.2217
2D3f Dry Cleaning	1.4018	0.7979	0.4514	0.2952	0.2204	0.2491	0.0832	0.1194
2D3g Chemical Products Manufacturing and Processing	78.6836	65.5702	54.3484	42.8017	25.9697	23.3207	21.1118	7.7410
2D3h Printing	0.5406	0.3631	0.2489	0.1796	0.1349	0.0782	0.0961	0.0703
2D3i Other Solvent Use	6.7953	4.8695	3.4559	2.9881	2.8247	2.7315	2.4875	2.7822
2D3 Solvent Use	**204.1460**	**167.7797**	**138.5232**	**110.2218**	**72.1539**	**64.2795**	**59.4608**	**31.0929**
	1998	1999	2000	2001	2002	2003	2004	2005
2D3a Domestic Solvent Use	11.4201	11.3916	11.3612	11.3158	11.2720	11.2234	11.1688	10.7908
2D3b Production and Use of Asphalt for Road Paving	6.0936	5.6777	4.5942	5.7518	5.0328	4.7652	15.1338	14.1948
2D3c Asphalt Roofing	NO	NO	NO	NO	NO	0.0025	0.0019	0.0020
2D3d Paint Application	1.2211	1.2900	2.8430	3.6133	5.8351	6.1180	8.1444	13.5648
2D3e Degreasing	0.4572	0.3971	0.3982	0.4081	0.5864	0.3329	0.4382	0.4186
2D3f Dry Cleaning	0.2462	0.2138	0.2144	0.2198	0.3157	0.1793	0.2360	0.2254
2D3g Chemical Products Manufacturing and Processing	6.3694	6.1214	5.2725	6.3463	5.8998	5.7279	15.3565	15.0309
2D3h Printing	0.0872	0.0645	0.0776	0.1103	0.1412	0.1599	0.2088	0.2823
2D3i Other Solvent Use	3.2943	2.9131	2.8792	3.0775	3.5224	4.2125	5.0437	5.3883
2D3 Solvent Use	**29.1892**	**28.0692**	**27.6403**	**30.8429**	**32.6053**	**32.7216**	**55.7321**	**59.8981**
	2006	2007	2008	2009	2010	2011	2012	2013
2D3a Domestic Solvent Use	10.5779	10.3650	10.1515	9.9410	9.7330	9.5264	9.3196	9.1144
2D3b Production and Use of Asphalt for Road Paving	22.9614	24.1157	13.8172	10.3574	12.8330	14.5076	16.3806	16.3904
2D3c Asphalt Roofing	0.0030	0.0032	0.0259	0.0050	0.0107	0.0098	0.0113	0.0117
2D3d Paint Application	9.1459	11.3119	11.1305	10.6405	11.6314	14.5764	14.0092	10.6746
2D3e Degreasing	0.5858	0.5388	0.5382	0.4990	0.6128	0.6838	1.9442	1.2663
2D3f Dry Cleaning	0.3154	0.2901	0.2898	0.2687	0.3300	0.3682	1.0469	0.6819
2D3g Chemical Products Manufacturing and Processing	23.2269	24.8340	17.2385	13.9175	17.2798	17.9677	19.7555	19.4641
2D3h Printing	0.2160	0.2509	0.2652	0.2378	0.2957	0.2786	0.2569	0.2894
2D3i Other Solvent Use	6.0645	5.2716	5.0392	4.6854	5.5533	5.0894	4.6425	4.2347
2D3 Solvent Use	**73.0967**	**76.9812**	**58.4959**	**50.5522**	**58.2796**	**63.0079**	**67.3666**	**62.1274**
	2014	2015	2016	2017	2018	2019	2020	%
2D3a Domestic Solvent Use	8.9084	8.8317	8.7091	8.5815	8.4463	8.3191	8.2096	-28.7
2D3b Production and Use of Asphalt for Road Paving	23.7660	16.5279	14.1464	18.0620	50.6226	34.5472	55.7217	-30.8
2D3c Asphalt Roofing	0.0092	NO	NO	NO	NO	NO	NO	N/A
2D3d Paint Application	13.8369	18.8792	22.6164	21.0754	21.5945	21.8157	23.6874	7.3
2D3e Degreasing	1.1002	0.9206	0.7758	1.0541	1.2783	1.2922	1.1512	-55.8
2D3f Dry Cleaning	0.5924	0.4957	0.4177	0.5676	0.6883	0.6958	0.6199	-55.8
2D3g Chemical Products Manufacturing and Processing	26.7433	20.5848	18.0659	21.9635	50.8160	36.8142	56.3110	-28.4
2D3h Printing	0.3099	0.4044	0.3280	0.3369	0.3681	0.3747	0.4209	-22.1
2D3i Other Solvent Use	4.5953	10.2903	11.7928	17.3310	8.9816	31.1349	40.7032	499.0
2D3 Solvent Use	**79.8615**	**76.9346**	**76.8520**	**88.9719**	**142.7958**	**134.9938**	**186.8249**	**-8.5**

2D3a 'Domestic Solvent Use'

In the Republic of Moldova there are no recorded statistical data on domestic solvent use. AD for certain applications can be generated indirectly based on the information on production, import and export of domestic products containing solvents. It should be noted that their production within the country is insignificant. The Customs Service of the Republic of Moldova is the primary source of information on national import operations (Table 4-61). Albeit AD on the production and imports of certain household products is available, the solvent share in these products is unknown.

Table 4-61: AD on domestic solvent use for 1995-2020

	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
Perfumes and eau de toilette, kt	0.0925	0.1429	0.1454	0.0068	0.0170	0.0991	0.1585	0.2607	0.2364	0.2087	0.2404	0.2858	0.4660
Beauty or make-up products and skin care, manicure or pedicure products, kt	0.0667	0.0713	0.1068	0.0580	0.0532	0.0800	0.1974	0.3326	0.5557	0.5567	0.7338	0.8086	0.9913
Hair care products, kt	0.2130	0.3283	0.3816	0.3358	0.5573	1.0675	1.2892	1.5030	1.8767	1.9802	2.3080	2.4143	2.8395
Pre-shave, shave or after-shave products, deodorants, bath products, depilatories, other perfumery or toiletries and other cosmetics, air freshener, kt	0.0399	0.0397	0.0807	0.0687	0.0478	0.0864	0.1897	0.4108	0.6529	0.7696	1.2069	1.3931	1.6538
	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Perfumes and eau de toilette, kt	0.2012	0.1323	0.1114	0.0918	0.1441	0.1502	0.1122	0.1006	0.1103	0.1959	0.1436	0.1479	0.1868
Beauty or make-up products and skin care, manicure or pedicure products, kt	1.0283	0.8313	0.8856	0.9429	0.9405	1.0121	1.0180	0.9784	0.1409	1.0518	1.1811	1.3333	1.3113
Hair care products, kt	2.6788	2.6876	2.7463	2.8667	3.0558	2.9765	3.1153	1.1279	1.1515	3.0687	2.2181	3.9899	4.0419
Pre-shave, shave or after-shave products, deodorants, bath products, depilatories, other perfumery or toiletries and other cosmetics, air freshener, kt	1.8950	1.5354	1.6036	1.8711	2.1028	2.2754	2.2930	1.3670	2.0612	2.0584	2.4312	2.8181	2.5844

Source: Customs Service of the RM, through Letter dated 19.02.2021, as a response to the interpellation of the Ministry of Environment No. 13-07/519 dated 09.02.2021; Letter No. 28/07-3025 dated 28.02.2020, as a response to the request of the Environment Agency No. 08-310/1 dated 11.02.2020; Letter No. 28/07-612 dated 12.01.2018, as a response to the request of the Climate Change Office of the MARDE No. 601/2017-12-03 dated 14.12.2017; Letter No. 28/07-8785 dated 26.05.2016, as a response to the request of the Climate Change Office of the Ministry of Environment No. 512/2016-05-01 dated 10.05.2016; Letter No. 28/07-2231 dated 26.02.2015, as a response to the request from the Climate Change Office of the Ministry of Environment No. 407/2015-01-09 dated 29.01.2015; Letter No. 15-03-05 dated 24.01.2014, as a response to the request from the Climate Change Office of the Ministry of Environment No. 320/2014-01-01 dated 03.01.2014; Letter No. 28/07-1893 dated 23.02.2011, as a response to the request from the Ministry of Environment No. 03-07/175 dated 02.02.2011

The methodology used to estimate NMVOC emissions from source category 2D3a 'Domestic Solvent Use' is available in the EMEP/EEA Air Pollutant Emission Inventory Guidebook (2019), represented by the following equation:

$$E_{pollutant} = (P \bullet EF_{pollutant}) / 10^3$$

Where:

- $E_{pollutant}$ – emissions from domestic solvent use, t/yr;
- P – population, thousand inhabitants/yr (Table 4-62);
- $EF_{pollutant}$ – Emission Factor for this pollutant gas, kg/person/yr.

Table 4-62: Population of the Republic of Moldova for 1990-2020

	1990	1991	1992	1993	1994	1995	1996	1997
Total population (including ATULBD), thousand inhabitants	4.3616	4.3663	4.3591	4.3478	4.3527	4.3479	4.3344	4.3200
	1998	1999	2000	2001	2002	2003	2004	2005
Total population (including ATULBD), thousand inhabitants	4.3258	4.3150	4.3035	4.2863	4.2697	4.2513	4.2306	4.0874
	2006	2007	2008	2009	2010	2011	2012	2013
Total population (including ATULBD), thousand inhabitants	4.0068	3.9261	3.8453	3.7655	3.6868	3.6085	3.5301	3.4524
	2014	2015	2016	2017	2018	2019	2020	%
Total population (including ATULBD), thousand inhabitants	3.3744	3.3454	3.2989	3.2506	3.1994	3.1512	3.1097	-28.7

Source: Statistical Yearbooks of the RM for 1991-2020; Statistical Yearbooks of the ATULBD for 1998-2021.

The EMEP/EEA Air Pollutant Emission Inventory Guidebook (2019) provides default values for the EF used when applying a Tier 1 methodological approach (Table 4-63).

Table 4-63: Tier 1 default EF used to estimate NMVOC emissions from category 2D3a 'Domestic Solvent Use'

Source	NMVOC Emission Factor	Unit
'Domestic Solvent Use'	1.2	kg/person/yr

Source: EMEP/EEA Air Pollutant Emission Inventory Guidebook (2019), Category 2.D.3.a 'Domestic Solvent Use' (including fungicides), Chapter 3.1, Table 3.1, page 9.

Indirect CO_2 emissions were estimated based on the carbon content in NMVOC emissions. The default value used is 60% (2006 IPCC Guidelines, Volume 3, Chapter 5.5, page 5.17). By oxidation, this carbon converts into CO_2 in the atmosphere (it is assumed that all solvents from household products are fossil-based).

CO_2 emissions from domestic solvent use were estimated using the following equation:

$$CO_2\ Emissions = NMVOC \bullet CC \bullet 44/12$$

Where:

CO_2 emissions – CO_2 emissions from domestic solvent use, kt/yr;

NMVOC – total NMVOC emissions within the respective category, kt/yr;

CC – carbon content in NMVOC, fraction (the default value used is 60%, with a margin of 50-70%; 2006 IPCC Guidelines, Volume 3, Chapter 5.5, page 5.17);

44/12 – mass ratio of CO_2/C.

2D3b 'Road Paving with Asphalt'

The methodology used to estimate GHG emissions from road paving with asphalt is a Tier 1 methodological approach provided by the EMEP/EEA Air Pollutant Emission Inventory Guidebook (2019).

Default emission factor values are presented in Table 4-64, whereas the annual data related to asphalt production was provided by the Ministry of Transport and Road Infrastructure for the period 1990-2002, the National Bureau of Statistics for 2003-2015, and the State Road Administration for 2016-2020, respectively (Table 4-65).

Table 4-64: Default EFs used to estimate GHG emissions from road paving with asphalt

Description	NO_x	CO	SO_2	NMVOC
	g / t			kg / t
Asphalt Plants[1] Asphalt Use for Road Paving[2]	35.6	200	17.7	30

Source: EMEP/EEA Atmospheric Emissions Inventory Guidebook (2019). [1]SNAP Code 030313 Asphalt Plants, Category 1.A.2.f.i, Table 3-25, page 32. [2]SNAP Code 040611 Road Paving with Asphalt, Category 2.D.3.b, Table 3.4, page 12.

Table 4-65: AD regarding road paving with asphalt for 1990-2020

	1990	1991	1992	1993	1994	1995	1996	1997
Road paving with asphalt, kt	1220.305	1014.808	853.000	678.000	410.000	370.000	335.600	113.727
	1998	1999	2000	2001	2002	2003	2004	2005
Road paving with asphalt, kt	92.328	86.026	69.609	87.148	76.254	72.200	229.300	215.073
	2006	2007	2008	2009	2010	2011	2012	2013
Road paving with asphalt, kt	347.899	365.390	209.351	156.931	194.440	219.812	248.191	248.339
	2014	2015	2016	2017	2018	2019	2020	%
Road paving with asphalt, kt	360.090	250.423	214.339	273.666	767.009	523.443	844.268	-30.8

Source: Ministry of Transport and Road Infrastructure, through Letter No. 03-5-2/2-32 dated 31.03.1999, as a response to the request of the Ministry of Environment No. 01-7/172 dated 12.03.1999; Letter No. 04-02-3/101 dated 18.02.2004, as a response to the request of the Ministry of Ecology No. 257-01-07 dated 26.01.2004; Letter No. 04-01-3/754 dated 2.10.2006, as a response to the request of the Ministry of Ecology and Natural Resources No. 01-07/1400 dated 25.08.2006; National Bureau of Statistics of the RM, through Letter No. 06-39/08 dated 23.02.2011, as a response to Letter No. 03-07/175 dated 02.02.2011 from the Ministry of Environment; Statistical Reports PRODMOLD-A 'Total production, as a natural expression, in the Republic of Moldova, by product type, for 2005-2019'; State Road Administration through Letter No. 09-02/43, as a response to Letter No. 601/2017-12-03 dated 14.12.2017; Letter No. 09-02/768 dated 27.02.2020, as a response to Letter No. 08-310/1 dated 11.02.2020; Letter No. 08-05/3907 dated 21.06.2021, as a response to the interpellation of the Environment Agency No. 08/136/2021 dated 09.06.2021.

GHG emissions were estimated using the following equation.

$$E_{pollutant} = (A \bullet EF_{pollutant}) / 10^6$$

Where:

$E_{pollutant}$ – NMVOC, CO, NO_x and SO_x emissions, kt/yr;

A – Annual production of asphalt, kt/yr;

$EF_{pollutant}$ – Default Emission Factor, g/t.

Indirect CO_2 emissions were estimated considering the carbon content in NMVOC emissions. The default value used is 60% (2006 IPCC Guidelines, Volume 3, Chapter 5.5, page 5.17). By oxidation, this carbon is converted into CO_2 in the atmosphere (it is assumed that all solvents from asphalt are fossil-based).

In order to estimate indirect CO_2 emissions from asphalt production, the following equation was used:

$$CO_2\ Emissions = NMVOC \bullet CC \bullet 44/12$$

Where:

CO_2 Emissions – CO_2 emissions from road paving with asphalt, kt/yr;

NMVOC – total NMVOC emissions within the respective category, kt/yr;

CC – carbon content in NMVOC, fraction (the default value used is 60%, with a margin of 50-70%; IPCC 2006 Guidelines, Volume 3, Chapter 5.5, page 5.17);

44/12 – mass ratio of CO_2/C.

2D3c 'Asphalt Roofing'

The methodology used to estimate GHG emissions from asphalt roofing is a Tier 1 methodological approach provided by the EMEP/EEA Air Pollutant Emission Inventory Guidebook (2019). Default EF values (for production technologies and typical or medium mitigation measures) are presented below (Table 4-66).

Table 4-66: Default EFs used to estimate GHG emissions from asphalt roofing

Description	CO	NMVOC
	g / t	
Asphalt Roofing	9.5	130

Source: EMEP/EEA Atmospheric Emissions Inventory Guidebook (2019), SNAP Code 040610 Asphalt Roofing, Category 2.D.3.c, Table 3.1, page 7.

AD regarding asphalt roofing production was provided by the National Bureau of Statistics of the Republic of Moldova only for the period 2003-2014 (Table 4-67). According to this data, domestic asphalt roofing production was recorded only between 2003 and 2014, after which the production has been imported only.

Table 4-67: AD on asphalt roofing production for 2003-2014, kt

	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
Production of asphalt or similar materials, in rolls exclusively	8.8	6.7	6.9	10.4	11.2	90.5	17.6	37.3	34.2	39.6	40.9	32.2

Source: National Bureau of Statistics, Letter No. 06-39/08 dated 23.02.2011, as a response to the request No. 03-07/175 dated 02.02.2011 of the Ministry of Environment; Statistical Reports PRODMOLD-A 'Total production, as a natural expression, in the Republic of Moldova, by product type, for 2005-2015'.

Total GHG emissions from asphalt roofing production are estimated using the following equation:

$$E_{pollutant} = (A \bullet EF_{pollutant}) / 10^6$$

Where:

$E_{pollutant}$ – GHG emissions from asphalt roofing, kt/yr;

A – Annual production of asphalt roofing, kt/yr;

$EF_{pollutant}$ – Default Emission Factor, g/t.

Indirect CO_2 emissions were estimated considering the carbon content in NMVOC emissions. The default value used is 60% (2006 IPCC Guidelines, Volume 3, Chapter 5.5, page 5.17). By oxidation, this carbon is converted into CO_2 in the atmosphere (it is assumed that all solvents from asphalt are fossil-based).

In order to estimate indirect CO_2 emissions from asphalt roofing, the following equation was used:

$$CO_2\ Emissions = NMVOC \bullet CC \bullet 44/12$$

Where:

CO_2 Emissions – CO_2 emissions from asphalt roofing, kt/yr;

NMVOC – total NMVOC emissions from the respective category, kt/yr;

CC – carbon content in NMVOC, fraction (the default value used is 60%, with a margin of 50-70%; 2006 IPCC Guidelines, Volume 3, Chapter 5.5, page 5.17);

44/12 – mass ratio of CO_2/C.

2D3d 'Paint Application'

Under this category, emissions are reported from decorative coating application, particularly in construction (SNAP 060103) and domestic paint application (SNAP 060104); industrial coating application, particularly in automobile manufacture (SNAP 060101), car repairing (SNAP 060102), coil coating (SNAP 060105), painting ships and boats (SNAP 060106), wood treatment and painting (SNAP 060107), other industrial application (painting aircraft, carriages, steel bridges, military vehicles, engines, pumps, tanks, office equipment, plastic items, toys, etc.) (SNAP 060108); respectively, other non-industrial paint application (paint or varnish application to protect large metal constructions from corrosion, road marking, etc.) (SNAP 060109). Because the breakdown of activity data on paint and varnish consumption in the RM by sector was not possible, the respective emissions were aggregated at national level.

It is known from the literature in the field that the share of solvents in different types of paints varies according to the technology applied during their production (Table 4-68).

Table 4-68: Carbon and solvent content in different types of products

Products Containing Solvents	Carbon Content, %[1]	Solvent Content, %[2]
Varnishes and paints based on polyesters and polymers dissolved in a non-aqueous solution	60	40-70
Varnishes and paints based on polymers dispersed or dissolved in an aqueous solution		<20

Source: [1]2006 IPCC Guidelines, Volume 3, Chapter 5.4, page 5.17; [2]EMEP/EEA Atmospheric Emissions Inventory Guidebook (2019), Source Category 2.D.3.d 'Paint Application', (NFR) Table 2-1, page 9.

The methodology used to estimate NMVOC emissions from paint application is provided by the EMEP/EEA Air Pollutant Emission Inventory Guidebook (2019) and uses the following equation:

$$E_{pollutant} = (AR_{product} \bullet EF_{pollutant}) / 10^3$$

Where:

- $E_{pollutant}$ – pollutant gas emissions from paint application, kt/yr;
- $AR_{product}$ – activity rate for the coating application (consumption of paint), kt/yr;
- $EF_{pollutant}$ – the emission factor for the pollutant, kg/t.

The EMEP/EEA Air Pollutant Emission Inventory Guidebook (2019) provides default EFs for the Tier 1 approach (Table 4-69). Mitigation actions for NMVOC emission from paint producing plants were taken into consideration in order to determine the EF values.

Table 4-69: Default Tier 1 EFs for source category 2D3d 'Paint Application'

Source	NMVOC Emission Factor	Unit
Decorative Coating Application	150	g/kg paint applied
Industrial Coating Application	400	g/kg paint applied
Other Coating Application	200	g/kg paint applied

Source: EMEP/EEA Atmospheric Emissions Inventory Guidebook (2019), Category 2.D.3.d 'Coating Application', Tables 3-1, 3-2 and 3-3, page 17.

The total consumption of varnishes and paints was estimated considering domestic production and statistical data on import and export of such substances in the RM. The Statistical Yearbooks of the RM contain aggregated data on total production of varnishes and paints in the country (Table 4-70). The NBS also provides disaggregated activity data on production of different types of varnishes and paints.

Table 4-70: AD on the production of varnishes and paints for 1990-2020, kt

	1990	1991	1992	1993	1994	1995	1996	1997
Varnishes and paints based on polyesters and polymers dissolved in a non-aqueous solution	10.100	8.250	5.549	2.714	1.131	0.738	0.664	0.451
Varnishes and paints based on polymers dispersed or dissolved in an aqueous solution	1.600	0.550	0.451	0.386	0.069	0.062	0.036	0.058
Total varnish and paint production	**11.700**	**8.800**	**6.000**	**3.100**	**1.200**	**0.800**	**0.700**	**0.509**
	1998	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**
Varnishes and paints based on polyesters and polymers dissolved in a non-aqueous solution	0.350	0.674	2.025	2.701	3.379	2.417	3.872	5.085
Varnishes and paints based on polymers dispersed or dissolved in an aqueous solution	0.020	0.000	0.029	0.169	0.716	1.026	1.264	1.184
Total varnish and paint production	**0.370**	**0.674**	**2.054**	**2.870**	**4.095**	**3.443**	**5.136**	**6.269**
	2006	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**
Varnishes and paints based on polyesters and polymers dissolved in a non-aqueous solution	6.693	8.793	8.768	8.270	9.657	12.915	13.673	9.474
Varnishes and paints based on polymers dispersed or dissolved in an aqueous solution	1.626	2.252	2.789	3.553	3.208	5.097	4.234	2.857
Total varnish and paint production	**8.319**	**11.045**	**11.557**	**11.822**	**12.864**	**18.011**	**17.907**	**12.345**
	2014	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**%**
Varnishes and paints based on polyesters and polymers dissolved in a non-aqueous solution	13.540	20.573	25.626	21.877	20.314	21.858	22.574	123.5
Varnishes and paints based on polymers dispersed or dissolved in an aqueous solution	4.131	6.268	7.104	7.648	9.189	7.403	8.429	426.8
Total varnish and paint production	**17.685**	**26.858**	**32.746**	**29.555**	**29.598**	**29.358**	**31.152**	**166.3**

Source: NBS through Letter No. 06-39/08 dated 23.02.2011, as a response to Letter No. 03-07/175 dated 02.02.2011, from the Ministry of Environment of the RM; Letter No. 06-39/38 dated 22.09.2011, as a response to Letter No. 101/2011-09-01 dated 02.09.2011, from the Climate Change Office of the Ministry of Environment of the RM; Letter No. 15-03/05 dated 24.01.2014, as a response to Letter No. 320/2014-01-01 dated 03.01.2014, from the Climate Change Office of the Ministry of Environment of the RM; Letter No. 15-03-09 dated 13.02.2015, as a response to Letter No. 407/2015-01-09 dated 29.01.2015, from the Climate Change Office of the Ministry of Environment of the RM; Statistical Reports PRODMOLD-A 'Total production, as a natural expression, in the Republic of Moldova, by product type, for 2005-2020'.

The Customs Service of the Republic of Moldova is the primary source of information on varnish and paint import-export operations undertaken by economic agents (varnishes and paints based on synthetic polymers or modified, natural polymers, dispersed or dissolved in a non-aqueous solution, code

3208; varnishes and paints based on synthetic polymers or modified, natural polymers, dispersed or dissolved in an aqueous solution, code 3209; other paints and varnishes, prepared water pigments, e.g. used for leather coating, code 3210; prepared driers, code 3211; pigment dispersed in a non-aqueous solution as liquid or paste used in paint manufacture, code 3212) (Table 4-71).

AD on the consumption of varnishes and paints in the RM (Table 4-72) was inferred from information on production (Table 4-70) and import (Table 4-71) of these products (no exports of these products were recorded within the reference period).

Table 4-71: AD on import and export of varnishes and paints for 1990-2020, kt

	1990	1991	1992	1993	1994	1995	1996	1997
Varnishes and paints based on polyesters and polymers dissolved in a non-aqueous solution	16.522	12.189	9.122	6.703	4.522	1.694	2.462	1.401
Varnishes and paints based on polymers dispersed or dissolved in an aqueous solution	11.112	7.875	5.153	3.000	1.486	0.250	0.288	0.313
Total varnish and paint import	**27.635**	**20.064**	**14.275**	**9.703**	**6.008**	**1.943**	**2.750**	**1.715**
	1998	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**
Varnishes and paints based on polyesters and polymers dissolved in a non-aqueous solution	1.381	1.063	1.853	1.678	3.718	4.688	7.131	15.642
Varnishes and paints based on polymers dispersed or dissolved in an aqueous solution	0.426	0.563	1.161	1.892	2.588	2.774	2.251	2.268
Total varnish and paint import	**1.807**	**1.625**	**3.014**	**3.571**	**6.306**	**7.463**	**9.382**	**17.911**
	2006	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**
Varnishes and paints based on polyesters and polymers dissolved in a non-aqueous solution	5.582	6.264	5.197	4.634	5.142	4.888	3.892	3.668
Varnishes and paints based on polymers dispersed or dissolved in an aqueous solution	2.402	2.854	3.087	2.511	2.726	3.084	3.172	3.028
Total varnish and paint import	**7.984**	**9.118**	**8.283**	**7.145**	**7.869**	**7.972**	**7.064**	**6.696**
	2014	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**%**
Varnishes and paints based on polyesters and polymers dissolved in a non-aqueous solution	3.904	3.673	4.214	4.349	4.701	4.850	5.576	-66.3
Varnishes and paints based on polymers dispersed or dissolved in an aqueous solution	3.090	3.138	3.371	3.693	4.289	4.775	5.644	-49.2
Total varnish and paint import	**6.994**	**6.811**	**7.585**	**8.042**	**8.990**	**9.626**	**11.220**	**-59.4**

Source: Customs Service of the RM, through Letter dated 19.02.2021, as a response to the interpellation of the MARDE No. 13-07/519 dated 09.02.2021; Letter No. 28/07-3025 dated 28.02.2020, as a response to the request of the Environment Agency No. 08-310/1 dated 11.02.2020; Letter No. 28/07-612 dated 12.01.2018, as a response to the request of the Climate Change Office of the MARDE No. 601/2017-12-03 dated 14.12.2017; Letter No. 28/07-8785 dated 26.05.2016, as a response to the request of the Climate Change Office of the Ministry of Environment No. 512/2016-05-01 dated 10.05.2016; Letter No. 28/07-2231 dated 26.02.2015 as a response to the request of the Climate Change Office of the Ministry of Environment No. 407/2015-01-09 dated 29.01.2015; Letter No. 15-03-05 dated 24.01.2014, as a response to the request of the Climate Change Office of the Ministry of Environment No. 320/2014-01-01 dated 03.01.2014; Letter No. 28/07-1893 dated 23.02.2011, as a response to the request of the Ministry of Environment No. 03-07/175 dated 02.02.2011.

Table 4-72: AD on varnish and paint consumption for 1990-2020, kt

	1990	1991	1992	1993	1994	1995	1996	1997
Varnishes and paints based on polyesters and polymers dissolved in a non-aqueous solution	26.622	20.439	14.671	9.417	5.653	2.432	3.126	1.852
Varnishes and paints based on polymers dispersed or dissolved in an aqueous solution	12.712	8.425	5.604	3.386	1.555	0.312	0.324	0.371
Total varnish and paint consumption	**39.335**	**28.864**	**20.275**	**12.803**	**7.208**	**2.743**	**3.450**	**2.224**
	1998	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**
Varnishes and paints based on polyesters and polymers dissolved in a non-aqueous solution	1.731	1.737	3.878	4.379	7.097	7.105	11.003	20.728
Varnishes and paints based on polymers dispersed or dissolved in an aqueous solution	0.446	0.563	1.190	2.061	3.304	3.800	3.515	3.452
Total varnish and paint consumption	**2.177**	**2.299**	**5.068**	**6.441**	**10.401**	**10.906**	**14.518**	**24.180**
	2006	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**
Varnishes and paints based on polyesters and polymers dissolved in a non-aqueous solution	12.275	15.058	13.964	12.904	14.799	17.802	17.565	13.142
Varnishes and paints based on polymers dispersed or dissolved in an aqueous solution	4.028	5.106	5.876	6.063	5.934	8.181	7.406	5.886
Total varnish and paint consumption	**16.303**	**20.164**	**19.840**	**18.967**	**20.733**	**25.983**	**24.972**	**19.028**
	2014	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**%**
Varnishes and paints based on polyesters and polymers dissolved in a non-aqueous solution	17.444	24.246	29.839	26.226	25.016	26.709	28.150	5.7
Varnishes and paints based on polymers dispersed or dissolved in an aqueous solution	7.221	9.407	10.475	11.342	13.477	12.179	14.074	10.7
Total varnish and paint consumption	**24.665**	**33.653**	**40.314**	**37.567**	**38.493**	**38.887**	**42.224**	**7.3**

No statistical data regarding the consumption of varnishes and paints in various applications is available. Under such circumstances, it was considered that the share of paints in decorative coating application constitutes 50% of the total national consumption, the share of varnishes and paints in the industrial sector – 40%, while the share of other coating application – 10% (Table 4-73).

Table 4-73: AD on varnish and paint consumption in various applications for 1990-2020, kt

	1990	1991	1992	1993	1994	1995	1996	1997
Decorative coating application	19.667	14.432	10.137	6.402	3.604	1.372	1.725	1.112
Industrial coating application	15.734	11.546	8.110	5.121	2.883	1.097	1.380	0.890
Other coating application	3.933	2.886	2.027	1.280	0.721	0.274	0.345	0.222
Total varnish and paint consumption	**39.335**	**28.864**	**20.275**	**12.803**	**7.208**	**2.743**	**3.450**	**2.224**
	1998	1999	2000	2001	2002	2003	2004	2005
Decorative coating application	1.088	1.150	2.534	3.220	5.201	5.453	7.259	12.090
Industrial coating application	0.871	0.920	2.027	2.576	4.160	4.362	5.807	9.672
Other coating application	0.218	0.230	0.507	0.644	1.040	1.091	1.452	2.418
Total varnish and paint consumption	**2.177**	**2.299**	**5.068**	**6.441**	**10.401**	**10.906**	**14.518**	**24.180**
	2006	2007	2008	2009	2010	2011	2012	2013
Decorative coating application	8.151	10.082	9.920	9.483	10.367	12.991	12.486	9.514
Industrial coating application	6.521	8.065	7.936	7.587	8.293	10.393	9.989	7.611
Other coating application	1.630	2.016	1.984	1.897	2.073	2.598	2.497	1.903
Total varnish and paint consumption	**16.303**	**20.164**	**19.840**	**18.967**	**20.733**	**25.983**	**24.972**	**19.028**
	2014	2015	2016	2017	2018	2019	2020	%
Decorative coating application	12.332	16.826	20.157	18.784	19.246	19.444	21.112	7.3
Industrial coating application	9.866	13.461	16.126	15.027	15.397	15.555	16.889	7.3
Other coating application	2.466	3.365	4.031	3.757	3.849	3.889	4.222	7.3
Total varnish and paint consumption	**24.665**	**33.653**	**40.314**	**37.567**	**38.493**	**38.887**	**42.224**	**7.3**

Indirect CO_2 emissions were estimated taking into consideration the carbon content in NMVOC emissions. The default value used is 60% (2006 IPCC Guidelines, Volume 3, Chapter 5.5, page 5.17). By oxidation, this carbon is converted into CO_2 in the atmosphere (it is assumed that all solvents from paint application are fossil-based).

In order to estimate indirect CO_2 emissions from paint application, the following equation was used:

$$CO_2\ Emissions = NMVOC \bullet CC \bullet 44/12$$

Where:

CO_2 Emissions – CO_2 emissions from paint application, kt/yr;

NMVOC – total NMVOC emissions within the respective category, kt/yr;

CC – carbon content in NMVOC, fraction (the default value used is 60%, with a margin of 50-70%; 2006 IPCC Guidelines, Volume 3, Chapter 5.5, page 5.17);

44/12 – mass ratio of CO_2/C.

2D3e 'Degreasing'

Within category 2D3e 'Degreasing', the GHG emissions from solvent use in industry are monitored, especially for metal degreasing – SNAP 060201; manufacturing of electronic components – SNAP 060203, as well as other industrial cleaning – SNAP 060204. Typically, solvents used for degreasing are obtained by distillation of fossil fuels. For example, chlorinated solvents, including trichloroethylene (TRI) (code 2903 22 000), tetrachloroethylene (PER) (code 2903 23 000) and dichloromethane (MC) (code 2903 12 000) are widely used in the industrial sector for cleaning metal items, electronic products and other industrial products (in closed-type cleaning equipment). Previously, 1,1,1-trichloroethane (TCA) (2903 19 100) was particularly used until recently when it was replaced by trichloroethylene (TRI). As for the open-type cleaning equipment, the most commonly used solvents are those obtained from white-spirit (code 2710 11 210) and alcohols, such as propylene glycol 2905 32 000).

The methodology used to estimate NMVOC emissions from solvent use for degreasing is provided by the EMEP/EEA Air Pollutant Emission Inventory Guidebook (2019) and uses the following equation:

$$E_{pollutant} = (AR_{product} \bullet EF_{pollutant}) / 10^3$$

Where:

$E_{pollutant}$ – emissions from solvent application for degreasing, kt/yr;

$AR_{product}$ – activity rate for the use of solvents for degreasing, kt/yr;

$EF_{pollutant}$ – emission factor for this pollutant technology, kg/t.

The EMEP/EEA Air Pollutant Emission Inventory Guidebook (2019) provides default EFs for Tier 1 approach (Table 4-74).

Table 4-74: Tier 1 default EF for estimating NMVOC emissions from source category 2D3e 'Degreasing'

Source	NMVOC Emission Factor	Unit
'Degreasing'	460	g/kg of degreased products

Source: EMEP/EEA Atmospheric Emissions Inventory Guidebook (2019), Category 2.D.3.e 'Degreasing', Table 3-1, page 8.

Because no AD breakdown on solvent consumption for degreasing in various industrial applications is available in the Republic of Moldova, an alternative approach was used, represented by the following formula:

$$E_{pollutant} = AR_{product} \bullet EF_{pollutant}$$

Where:

$E_{pollutant}$ – emissions from the use of solvent application for degreasing, kt/yr;

$AR_{product}$ – activity rate for the use of solvents for degreasing (consumption), kt/yr;

$EF_{pollutant}$ – the emission factor for this pollutant technology kg/yr.

According to the available methodology, the content of organic solvents in substances used in degreasing and dry cleaning is considered to be 100% (EMEP/EEA Air Pollutant Emission Inventory Guidebook (2019), source category 2D3e 'Degreasing', Table 3-5, page 12). It is considered that the total amount of solvents for degreasing evaporates into the atmosphere, NMVOC emissions thus being equal to the quantity of solvents used.

Total consumption of organic solvents for degreasing is estimated using the following equation:

$$Total\ Consumption = Production + Import - Export$$

There is no statistical data for activities involving the use of solvents for degreasing in the RM. Under such circumstances, the total consumption of solvents used for degreasing was estimated based on information on solvent import (domestic production of solvents is insignificant; also, it was assumed that such substances are not re-exported). The Customs Service is the primary source of information on solvent import-export operations by enterprises and economic agents in the Republic of Moldova.

Table 4-75: AD on solvent consumption used in degreasing for 1990-2020

	1990	1991	1992	1993	1994	1995	1996	1997
Cyclic and Acyclic Hydrocarbons, kt	1.2254	0.7601	0.4932	0.3530	0.2559	0.2852	0.0586	0.1109
Alcohols, kt	0.5952	0.2761	0.0930	0.0304	0.0304	0.0383	0.0494	0.0441
Total solvents used	**1.8205**	**1.0363**	**0.5862**	**0.3834**	**0.2863**	**0.3235**	**0.1080**	**0.1550**
	1998	1999	2000	2001	2002	2003	2004	2005
Cyclic and Acyclic Hydrocarbons, kt	0.1241	0.0282	0.1537	0.0604	0.1700	0.1197	0.1907	0.1089
Alcohols, kt	0.1956	0.2495	0.1247	0.2251	0.2401	0.1131	0.1158	0.1838
Total solvents used	**0.3197**	**0.2777**	**0.2784**	**0.2854**	**0.4101**	**0.2328**	**0.3064**	**0.2927**
	2006	2007	2008	2009	2010	2011	2012	2013
Cyclic and Acyclic Hydrocarbons, kt	0.1259	0.1273	0.1115	0.1165	0.1752	0.2036	0.9318	0.3641
Alcohols, kt	0.2837	0.2495	0.2649	0.2325	0.2534	0.2746	0.4277	0.5214
Total solvents used	**0.4096**	**0.3768**	**0.3764**	**0.3489**	**0.4285**	**0.4782**	**1.3596**	**0.8855**
	2014	2015	2016	2017	2018	2019	2020	%
Cyclic and Acyclic Hydrocarbons, kt	0.1567	0.1937	0.1173	0.1499	0.3563	0.2617	0.3788	-69.1
Alcohols, kt	0.6126	0.4500	0.4253	0.5872	0.5376	0.6419	0.4262	-28.4
Total solvents used	**0.7694**	**0.6438**	**0.5425**	**0.7372**	**0.8939**	**0.9037**	**0.8050**	**-55.8**

Source: Customs Service of the RM, through Letter dated 19.02.2021, as a response to the interpellation of the Ministry of Agriculture, Regional Development and Environment No. 13-07/519 dated 09.02.2021; Letter No. 28/07-3025 dated 28.02.2020, as a response to the request of the Environment Agency No. 08-310/1 dated 11.02.2020; Letter No. 28/07-612 dated 12.01.2018, as a response to the request of the Climate Change Office of the MARDE No. 601/2017-12-03 dated 14.12.2017; Letter No. 28/07-8785 dated 26.05.2016, as a response to the request of the Climate Change Office of the Ministry of Environment No. 512/2016-05-01 dated 10.05.2016; Letter No. 28/07-2231 dated 26.02.2015, as a response to the request of the Climate Change Office of the Ministry of Environment No. 407/2015-01-09 dated 29.01.2015; Letter No. 15-03-05 dated 24.01.2014, as a response to the request of the Climate Change Office of the Ministry of Environment No. 320/2014-01-01 dated 03.01.2014; Letter No. 28/07-1893 dated 23.02.2011, as a response to the request of the Ministry of Environment No. 03-07/175 dated 02.02.2011.

Because the same substances are widely used for both degreasing and dry cleaning, it was accepted that out of the total amount consumed, 65% were used for degreasing, and 35% – for dry cleaning.

Table 4-76: AD on solvent consumption used in dry cleaning of textiles for 1990-2020

	1990	1991	1992	1993	1994	1995	1996	1997
Cyclic and Acyclic Hydrocarbons, kt	0.7965	0.4941	0.3206	0.2294	0.1663	0.1854	0.0381	0.0721
Alcohols, kt	0.3869	0.1795	0.0604	0.0198	0.0198	0.0249	0.0321	0.0287
Total solvents used, kt	**1.1834**	**0.6736**	**0.3811**	**0.2492**	**0.1861**	**0.2103**	**0.0702**	**0.1008**
	1998	1999	2000	2001	2002	2003	2004	2005
Cyclic and Acyclic Hydrocarbons, kt	0.0807	0.0183	0.0999	0.0392	0.1105	0.0778	0.1239	0.0708
Alcohols, kt	0.1272	0.1622	0.0811	0.1463	0.1561	0.0735	0.0753	0.1195
Total solvents used, kt	**0.2078**	**0.1805**	**0.1810**	**0.1855**	**0.2665**	**0.1513**	**0.1992**	**0.1903**

	2006	2007	2008	2009	2010	2011	2012	2013
Cyclic and Acyclic Hydrocarbons, kt	0.0819	0.0827	0.0725	0.0757	0.1138	0.1323	0.6057	0.2367
Alcohols, kt	0.1844	0.1622	0.1722	0.1511	0.1647	0.1785	0.2780	0.3389
Total solvents used, kt	**0.2663**	**0.2449**	**0.2446**	**0.2268**	**0.2785**	**0.3108**	**0.8837**	**0.5756**
	2014	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**%**
Cyclic and Acyclic Hydrocarbons, kt	0.1019	0.1259	0.0762	0.0974	0.2316	0.1701	0.2462	-69.1
Alcohols, kt	0.3982	0.2925	0.2764	0.3817	0.3495	0.4173	0.2770	-28.4
Total solvents used, kt	**0.5001**	**0.4185**	**0.3526**	**0.4792**	**0.5811**	**0.5874**	**0.5233**	**-55.8**

Indirect CO_2 emissions were estimated taking into consideration the carbon content in NMVOC emissions. The default value used is 60% (2006 IPCC Guidelines, Volume 3, Chapter 5.5, page 5.17). By oxidation, this carbon is converted into CO_2 in the atmosphere (it is assumed that all solvents are fossil-based).

In order to estimate indirect CO_2 emissions, the following equation was used:

$$CO_2\ Emissions = NMVOC \bullet CC \bullet 44/12$$

Where:

CO_2 Emissions – CO_2 emissions from degreasing, kt/yr;

NMVOC – total NMVOC emissions from the respective category, kt/yr;

CC – carbon content in NMVOC, fraction (the default value used is 60%, with a margin of 50-70%; 2006 IPCC Guidelines, Volume 3, Chapter 5.5, page 5.17);

44/12 – mass ratio of CO_2/C.

2D3f 'Dry Cleaning'

Within category 2D3f 'Dry Cleaning', GHG emissions from solvent use are monitored in dry cleaning of clothes and other textiles of animal grease, oils, wax, tar, etc. (SNAP 060202).

Tetrachloroethylene (PER) (code 2903 23 000) is the most widely used solvent for dry cleaning. Previously, 1,1,1-trichloroethane (TCA) (2903 19 100) was particularly used until recently when it was replaced by trichloroethylene (TRI).

The methodology used to estimate NMVOC emissions from solvent use for dry cleaning is provided by the EMEP/EEA Air Pollutant Emission Inventory Guidebook (2019) and uses the following equation:

$$E_{pollutant} = (AR_{product} \bullet EF_{pollutant}) / 10^3$$

Where:

$E_{pollutant}$ – emissions from the use of solvents for dry cleaning, kt/yr;

$AR_{product}$ – activity rate for the use of solvents for dry cleaning, kt/yr;

$EF_{pollutant}$ – emission factor for this pollutant technology, kg/t.

The EMEP/EEA Air Pollutant Emission Inventory Guidebook (2019) provides default EFs for Tier 1 approach (Table 4-77).

Table 4-77: Tier 1 default EF for estimating NMVOC emissions from source category 2D3f 'Dry Cleaning'

Source	NMVOC Emission Factor	Unit
2D3f 'Dry Cleaning'	40	g/kg treated textiles

Source: EMEP/EEA Atmospheric Emissions Inventory Guidebook (2019), Category 2.D.3.f 'Dry Cleaning', Table 3-1, page 7.

Because there is no AD breakdown on solvent consumption for dry cleaning, an alternative approach was used, represented by the following formula:

$$E_{pollutant} = AR_{product} \bullet EF_{pollutant}$$

Where:

$E_{pollutant}$ – emissions from the use of solvents for dry cleaning, kt/yr;

$AR_{product}$ – activity rate for the use of solvents for dry cleaning (consumption), kt/yr;

$EF_{pollutant}$ – emission factor for this pollutant technology.

According to the available methodology, the content of organic solvents in substances used in dry cleaning is considered to be 100% (EMEP/EEA Air Pollutant Emission Inventory Guidebook (2019), source category 2D3f 'Dry Cleaning', page 10).

It is considered that the total amount of solvents for dry cleaning evaporates into the atmosphere, NMVOC emissions thus being equal to the quantity of solvents used. For dry cleaning of clothes and other textiles, it is assumed that the solvents used are emitted directly into the atmosphere or retained in clothes and textiles, with subsequent evaporation into the atmosphere.

Total consumption of organic solvents for dry cleaning is estimated using the following equation:

$$Total\ Consumption = Production + Import - Export$$

It should be noted that for most activities involving use of organic solvents for dry cleaning in the RM there is no statistical data. Under such circumstances, the total consumption of solvents used for dry cleaning was estimated based on information on solvent import in the RM (domestic production of solvents is insignificant; also, it was assumed that such substances are not re-exported).

Because the same substances are widely used for both degreasing and dry cleaning, it was accepted that out of the total amount consumed (Table 4-75), 65% were used for degreasing (Table 4-76), and 35% – for dry cleaning (Table 4-78).

Table 4-78: AD on solvent consumption used in dry cleaning of textiles in the RM for 1990-2020

	1990	1991	1992	1993	1994	1995	1996	1997
Cyclic and acyclic hydrocarbons, kt	0.4289	0.2660	0.1726	0.1235	0.0896	0.0998	0.0205	0.0388
Alcohols, kt	0.2083	0.0966	0.0325	0.0106	0.0106	0.0134	0.0173	0.0154
Total solvents used, kt	**0.6372**	**0.3627**	**0.2052**	**0.1342**	**0.1002**	**0.1132**	**0.0378**	**0.0543**
	1998	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**
Cyclic and acyclic hydrocarbons, kt	0.0434	0.0099	0.0538	0.0211	0.0595	0.0419	0.0667	0.0381
Alcohols, kt	0.0685	0.0873	0.0436	0.0788	0.0840	0.0396	0.0405	0.0643
Total solvents used, kt	**0.1119**	**0.0972**	**0.0975**	**0.0999**	**0.1435**	**0.0815**	**0.1073**	**0.1025**
	2006	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**
Cyclic and acyclic hydrocarbons, kt	0.0441	0.0445	0.0390	0.0408	0.0613	0.0712	0.3261	0.1274
Alcohols, kt	0.0993	0.0873	0.0927	0.0814	0.0887	0.0961	0.1497	0.1825
Total solvents used, kt	**0.1434**	**0.1319**	**0.1317**	**0.1221**	**0.1500**	**0.1674**	**0.4758**	**0.3099**
	2014	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**%**
Cyclic and acyclic hydrocarbons, kt	0.0549	0.0678	0.0410	0.0525	0.1247	0.0916	0.1326	-69.1
Alcohols, kt	0.2144	0.1575	0.1488	0.2055	0.1882	0.2247	0.1492	-28.4
Total solvents used, kt	**0.2693**	**0.2253**	**0.1899**	**0.2580**	**0.3129**	**0.3163**	**0.2818**	**-55.8**

Indirect CO_2 emissions were estimated taking the carbon content in NMVOC emissions into consideration. The default value used is 60% (2006 IPCC Guidelines, Volume 3, Chapter 5.5, page 5.17). By oxidation, this carbon is converted into CO_2 in the atmosphere (it is assumed that all solvents are fossil-based).

In order to estimate indirect CO_2 emissions, the following equation was used:

$$CO_2\ Emissions = NMVOC \bullet CC \bullet 44/12$$

Where:

CO_2 Emissions – CO_2 emissions from solvent consumption in dry cleaning, kt/yr;

NMVOC – total NMVOC emissions within the respective category, kt/yr;

CC – carbon content in NMVOC, fraction (the default value used is 60%, with a margin of 50-70%; 2006 IPCC Guidelines, Volume 3, Chapter 5.5, page 5.17);

44/12 – mass ratio of CO_2/C.

2D3g 'Chemical Products'

Under source category 2D3g 'Chemical Products', NMVOC emissions are reported from polyester processing (SNAP 060301); polyurethane foam processing (SNAP 060303) and polystyrene foam processing (SNAP 060304); rubber processing (SNAP 060305); pharmaceutical product manufacturing (SNAP 060306); paint manufacture (SNAP 060307); ink manufacture (SNAP 060308); glue manufacturing (SNAP 060309); asphalt blowing (SNAP 060310); adhesive, magnetic tapes, film and photograph manufacturing (SNAP 060311); textile finishing (SNAP 060312); leather tanning (SNAP 060313).

The methodology used to estimate NMVOC emissions from chemical products is provided by the EMEP/EEA Air Pollutant Emission Inventory Guidebook (2019) and uses the following equation:

$$E_{pollutant} = (AR_{product} \bullet EF_{pollutant}) / 10^3$$

Where:

$E_{pollutant}$ – emissions of the specified pollutant, kt/yr;

$AR_{product}$ – activity rate for the use of solvents for manufacture and processing of chemical products, kt/yr;

$EF_{pollutant}$ – emission factor for this pollutant technology, kg/t.

The EMEP/EEA Air Pollutant Emission Inventory Guidebook (2019) provides default EFs for the Tier 2 approach (Table 4-79).

Table 4-79: Tier 2 default EFs for estimating emissions from 2D3g 'Chemical Products'

Source	NMVOC Emission Factor	Unit
SNAP 060301, Polystyrene processing	50	g/kg monomer
SNAP 060303, Polyurethane foam processing	120	g/kg foam
SNAP 060304, Polystyrene foam processing	60	g/kg foam
SNAP 060305, Rubber processing	8	g/kg rubber
SNAP 060306, Pharmaceutical products manufacturing	300	g/kg solvent
SNAP 060307, Paints manufacturing	11	g/kg product
SNAP 060308, Inks manufacturing	11	g/kg product
SNAP 060309, Glues manufacturing	11	g/kg product
SNAP 060310, Asphalt blowing	27.2	kg/t asphalt
SNAP 060310, Saturated asphalt blowing	0.66	kg/t asphalt
SNAP 060310, Asphalt (in layers) blowing	1.71	kg/t asphalt
SNAP 060314, Tire production	10	g/kg tire
Adhesive tapes manufacturing	3	g/m^2
Shoe manufacture	0.045	kg/pair of shoes

Source: EMEP/EEA Atmospheric Emissions Inventory Guidebook (2019), Category 2.D.3.g 'Chemical Products', Tables 3-2 – 3-13, pages 17-23.

Statistical publications of the RM provide activity data on manufacturing different industrial products, including: polyurethane and polystyrene products, refurbished tires and rubber soles, varnishes and paints, glues, inks, pharmaceutical products, shoes (Table 4-80).

Table 4-80: AD on processing chemical products in the RM for 1990-2020

	1990	1991	1992	1993	1994	1995	1996	1997
Polyurethane processing, kt	0.830	0.699	0.589	0.496	0.418	0.352	0.286	0.179
Polystyrene processing, kt	5.917	3.707	2.323	1.455	0.912	0.571	0.231	0.206
Rubber processing, kt	46.900	44.300	20.700	4.200	0.900	1.400	1.512	1.361
Pharmaceutical product processing, kt	1.853	1.648	1.069	0.683	0.334	0.321	0.289	0.315
Paint and varnish production, kt	11.700	8.800	6.000	3.100	1.200	0.800	0.700	0.509
Ink production, kt	NO	NO	NO	NO	NO	NO	NO	NO
Adhesive production, kt	NO	NO	NO	NO	NO	NO	NO	NO
Asphalt production, kt	1220.305	1014.808	853.000	678.000	410.000	370.000	335.600	113.727
Refurbished tires, thousand pieces	75.300	73.100	40.100	1.500	4.500	6.600	8.000	9.800
Refurbished tires, kt	1.443	1.401	0.768	0.029	0.086	0.126	0.153	0.188
Shoes, mil. pairs	23.200	20.800	16.268	13.197	9.467	7.606	6.929	6.193
	1998	1999	2000	2001	2002	2003	2004	2005
Polyurethane processing, kt	0.116	0.154	0.187	0.225	0.438	0.596	0.755	1.536
Polystyrene processing, kt	0.216	0.187	0.410	0.391	0.750	1.290	1.388	2.881
Rubber processing, kt	1.234	0.853	1.598	1.801	3.071	2.425	2.259	0.061
Pharmaceutical product processing, kt	0.450	0.760	0.512	0.646	0.726	0.522	0.628	0.701
Paint and varnish production, kt	0.370	0.674	2.054	2.870	4.095	3.443	5.136	6.269
Ink production, kt	NO	NO	NO	NO	NO	NO	NO	NO
Adhesive production, kt	NO	NO	NO	NO	NO	NO	0.361	0.655
Asphalt production, kt	92.328	86.026	69.609	87.148	76.254	72.200	229.300	215.073
Refurbished tires, thousand pieces	7.100	10.200	7.000	9.200	4.600	6.000	4.600	3.200
Refurbished tires, kt	0.136	0.195	0.134	0.176	0.088	0.115	0.088	0.061
Shoes, mil. pairs	4.591	3.747	5.912	4.944	4.925	6.038	6.633	7.450
	2006	2007	2008	2009	2010	2011	2012	2013
Polyurethane processing, kt	1.691	2.215	2.551	2.134	2.376	2.220	1.583	1.593
Polystyrene processing, kt	4.141	4.494	4.449	4.889	5.711	5.944	6.141	6.209
Rubber processing, kt	0.296	0.511	0.189	0.036	0.058	0.063	0.070	0.072
Pharmaceutical product processing, kt	0.760	1.261	3.713	3.832	4.994	3.347	3.745	3.347
Paint and varnish production, kt	8.319	11.045	11.557	11.822	12.864	18.011	17.907	12.345
Ink production, kt	NO	NO	NO	NO	NO	0.010	0.016	0.027
Adhesive production, kt	0.853	1.465	0.580	0.921	1.373	1.323	1.077	0.953
Asphalt production, kt	347.899	365.390	209.351	156.931	194.440	219.812	248.191	248.339
Refurbished tires, thousand pieces	2.800	2.600	2.252	5.829	6.735	6.852	18.361	17.299
Refurbished tires, kt	0.054	0.050	0.055	0.080	0.161	0.157	0.248	0.268
Shoes, mil. pairs	6.774	6.696	7.083	4.829	6.247	7.692	7.448	8.329

	2014	2015	2016	2017	2018	2019	2020	%
Polyurethane processing, kt	1.320	1.979	0.951	1.208	1.467	1.424	1.410	69.9
Polystyrene processing, kt	7.019	7.932	7.496	6.969	7.067	7.900	8.328	40.7
Rubber processing, kt	0.066	0.049	0.048	0.042	0.123	0.110	0.029	-99.9
Pharmaceutical product processing, kt	4.101	4.063	3.800	4.353	3.524	3.644	3.724	101.0
Paint and varnish production, kt	17.685	26.858	32.746	29.555	29.598	29.358	31.152	166.3
Ink production, kt	NO	NO	NO	NO	NO	NO	NO	N/A
Adhesive production, kt	1.118	5.997	7.607	12.263	4.937	23.871	32.145	N/A
Asphalt production, kt	360.090	250.423	214.339	273.666	767.009	523.443	844.268	-30.8
Refurbished tires, thousand pieces	11.947	6.035	7.272	7.423	8.555	8.123	9.614	-87.2
Refurbished tires, kt	0.200	0.139	0.156	0.137	0.168	0.138	0.198	-86.3
Shoes, mil. pairs	7.607	5.547	5.156	4.647	4.352	3.785	3.269	-85.9

Source: National Bureau of Statistics of the RM through Statistical Yearbooks for the years 1994 (pages 284, 288, 291), 1995 (pages 253, 257, 260), 1997 (pages 320, 322, 324), 1999 (pages 302, 304, 306), 2003 (pages 391, 393, 395), 2006 (page 311), 2011 (page 305), 2014 (pages 302); Statistical Reports PRODMOLD-A 'Total production, as a natural expression, in the Republic of Moldova, by product type, for 2005-2020'; Customs Service of the RM, through Letter dated 19.02.2021, as a response to the interpellation of the Ministry of Agriculture, Regional Development and Environment No. 13-07/519 dated 09.02.2021; Letter No. 28/07-3025 dated 28.02.2020, as a response to the request of the Environment Agency No. 08-310/1 dated 11.02.2020; Letter No. 28/07-612 dated 12.01.2018, as a response to the request of the Climate Change Office of the MARDE No. 601/2017-12-03 dated 14.12.2017; Letter No. 28/07-8785 dated 26.05.2016, as a response to the request of the Climate Change Office of the Ministry of Environment No. 512/2016-05-01 dated 10.05.2016; Letter No. 28/07-2231 dated 26.02.2015, as a response to the request of the Climate Change Office of the Ministry of Environment No. 407/2015-01-09 dated 29.01.2015; Letter No. 15-03-05 dated 24.01.2014, as a response to the request of the Climate Change Office of the Ministry of Environment No. 320/2014-01-01 dated 03.01.2014; Letter No. 28/07-1893 dated 23.02.2011, as a response to the request of the Ministry of Environment No. 03-07/175 dated 02.02.2011.

The Customs Service of the Republic of Moldova is the primary source of information on import-export operations regarding primary polyurethane products (code 3909 50); alveolar polyurethane products (code 3921 13); primary polystyrene products (code 3903 11), and styrene polymer products (code 3921 11), respectively. In order to convert AD into mass metric units (tonnes), the following conversion coefficients were used: a car tire weighs circa 7.1 kg; a minibus and small tonnage truck tire – circa 11.1 kg; bus and heavy truck tire – circa 46.0 kg; a tractor tire – circa 69.9 kg).

Indirect CO_2 emissions were estimated taking into consideration the carbon content in NMVOC emissions. The default value used is 60% (2006 IPCC Guidelines, Volume 3, Chapter 5.5, page 5.17). By oxidation, this carbon is converted into CO_2 in the atmosphere (it is assumed that all solvents are fossil-based).

In order to estimate indirect CO_2 emissions from solvent use in chemical products, the following equation was used:

$$CO_2\ Emissions = NMVOC \bullet CC \bullet 44/12$$

Where:

CO_2 Emissions – CO_2 emissions from solvents used in chemical products, kt/yr;

NMVOC – total NMVOC emissions within the respective category, kt/yr;

CC – carbon content in NMVOC, fraction (the default value used is 60%, with a margin of 50-70%; 2006 IPCC Guidelines, Volume 3, Chapter 5.5, page 5.17);

44/12 – mass ratio of CO_2/C.

2D3h 'Printing'

The methodology used to estimate NMVOC emissions from printing is provided by the EMEP/EEA Air Pollutant Emission Inventory Guidebook (2019) and uses the following equation:

$$E_{pollutant} = (AR_{product} \bullet EF) / 10^3$$

Where:

$E_{pollutant}$ – emissions of the specified pollutant from ink consumption for printing, kt/yr;

$AR_{product}$ – activity rate for the use of inks for printing, kt/yr;

EF – default emission factor (Table 4-81), kg/t.

Table 4-81: Tier 1 default EF for category 2D3h 'Printing'

Source	NMVOC Emission Factor	Unit
Printing	500	kg/t ink

Source: EMEP/EEA Atmospheric Emissions Inventory Guidebook (2019), Category 2.D.3.h 'Printing', Table 3-1, page 11.

No statistical data on solvents and/or printing inks used are available in the RM. Under such circumstances, the total ink consumption was estimated considering statistical data on production (Table 4-80), import and export (Table 4-82) (according to the Statistical Reports PRODMOLD-A 'Total production, as a natural expression, by product type, for 2005-2020' inks were produced only during 2011-2013; there is no information on the export of inks during the reference period).

The Customs Service of the RM is the primary source of information on import-export operations by economic agents in the RM (including for printing, writing or drawing and other inks – code 3215 10-90; as well as paints for artistic painting, educational use, firm painting, amusement, and other similar products – code 3213 10-90).

Table 4-82: AD on ink import between 1990-2020

	1990	1991	1992	1993	1994	1995	1996	1997
Inks for printing, writing and drawing, as well as other inks, kt	0.3557	0.2214	0.1427	0.1026	0.0788	0.0405	0.0577	0.0604
Paints for artistic painting, for educational use, firms painting, amusement and other similar products, kt	0.1358	0.1086	0.0836	0.0607	0.0438	0.0306	0.0297	0.0035
Total inks, kt	**0.4914**	**0.3301**	**0.2262**	**0.1633**	**0.1226**	**0.0711**	**0.0874**	**0.0639**
	1998	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**
Inks for printing, writing and drawing, as well as other inks, kt	0.0596	0.0444	0.0553	0.0838	0.1024	0.1175	0.1568	0.2260
Paints for artistic painting, for educational use, firms painting, amusement and other similar products, kt	0.0197	0.0142	0.0152	0.0164	0.0259	0.0278	0.0330	0.0306
Total inks, kt	**0.0793**	**0.0586**	**0.0706**	**0.1002**	**0.1284**	**0.1453**	**0.1898**	**0.2566**
	2006	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**
Inks for printing, writing and drawing, as well as other inks, kt	0.1502	0.1925	0.1906	0.1721	0.2209	0.2009	0.1789	0.2008
Paints for artistic painting, for educational use, firms painting, amusement and other similar products, kt	0.0462	0.0356	0.0505	0.0441	0.0479	0.0524	0.0546	0.0623
Total inks, kt	**0.1964**	**0.2281**	**0.2411**	**0.2162**	**0.2688**	**0.2533**	**0.2335**	**0.2631**
	2014	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**%**
Inks for printing, writing and drawing, as well as other inks, kt	0.2112	0.2979	0.2207	0.2209	0.2455	0.2402	0.2432	-31.6
Paints for artistic painting, for educational use, firms painting, amusement and other similar products, kt	0.0706	0.0698	0.0774	0.0854	0.0892	0.1004	0.1395	2.7
Total inks, kt	**0.2818**	**0.3677**	**0.2981**	**0.3063**	**0.3346**	**0.3406**	**0.3827**	**-22.1**

Source: Customs Service of the RM, through Letter dated 19.02.2021, as a response to the interpellation of the MARDE No. 13-07/519 dated 09.02.2021; Letter No. 28/07-3025 dated 28.02.2020, response to the request of the Environment Agency No. 08-310/1 dated 11.02.2020; Letter No. 28/07-612 dated 12.01.2018, response to the request of the Climate Change Office of the MARDE No. 601/2017-12-03 dated 14.12.2017; Letter No. 28/07-8785 dated 26.05.2016, response to the request of the Climate Change Office of the Ministry of Environment No. 512/2016-05-01 dated 10.05.2016; Letter No. 28/07-2231 dated 26.02.2015, response to the request of the Climate Change Office of the Ministry of Environment No. 407/2015-01-09 dated 29.01.2015; Letter No. 15-03-05 dated 24.01.2014, response to the request of the Climate Change Office of the Ministry of Environment No. 320/2014-01-01 dated 03.01.2014; Letter No. 28/07-1893 dated 23.02.2011, response to the request of the Ministry of Environment No. 03-07/175 dated 02.02.2011.

Indirect CO_2 emissions were estimated taking into consideration the carbon content in NMVOC emissions. The default value used is 60% (2006 IPCC Guidelines, Volume 3, Chapter 5.5, page 5.17). By oxidation, this carbon is converted into CO_2 in the atmosphere (it is assumed that all solvents are fossil-based).

In order to estimate indirect CO_2 emissions from solvent use in inks, the following equation was used:

$$CO_2\ Emissions = NMVOC \bullet CC \bullet 44/12$$

Where:

CO_2 Emissions – CO_2 emissions from solvents used in printing, kt/yr;

NMVOC – total NMVOC emissions within the respective category, kt/yr;

CC – carbon content in NMVOC, fraction (the default value used is 60%, with a margin of 50-70%; IPCC 2006 Guidelines, Volume 3, Chapter 5.5, page 5.17);

44/12 – mass ratio of CO_2/C.

2D3i 'Other Solvent and Product Use'

'Seed Oil Extraction'

A certain amount of solvents, hexane in particular, is used in the extraction of oil from seeds (mechanical extraction does not require solvent use). The cleaned and prepared seeds are washed several times in warm hexane solvent until all oil is extracted, while the remaining seed residue is treated with steam to capture the solvent and oil that remains in it. After drying, the remaining seed residue may be used as animal feed (having a content rich in proteins and mineral salts). The oil is separated from the oil-enriched wash solvent and from the steamed-out solvent. The solvent (hexane) is recovered and re-used. Recovery efficiency is quite high, although it is dictated by some economic aspects specific to enterprises in this branch. The obtained oil is further refined.

The methodology used to estimate NMVOC emissions from 2D3i 'Other Solvent and Product Use' (SNAP 060404 'Fat, edible and non-edible oil extraction'), available in the EMEP/EEA Air Pollutant Emission Inventory Guidebook (2019), is represented by the following equation:

$$E_{pollutant} = (AR_{product} \bullet EF_{pollutant}) / 10^3$$

Where:

$E_{pollutant}$ – emission of the specified pollutant, kt/yr;

$AR_{product}$ – activity rate for the use of solvents in seed oil extraction, kt/yr;

$EF_{pollutant}$ – emission factor for this pollutant technology, kg/t.

The EMEP/EEA Air Pollutant Emission Inventory Guidebook (2019) provides the default EF for the Tier 2 approach (Table 4-83).

Table 4-83: Tier 2 default EF for estimating NMVOC emissions from seed oil extraction

Source	NMVOC Emission Factor	Unit
Seed Oil Extraction	1.57	g/kg seeds

Source: EMEP/EEA Atmospheric Emissions Inventory Guidebook (2019), Category 2.D.3.i 'Other Solvent and Product Use', SNAP 060404, Table 3-4, page 16.

In order to estimate NMVOC emissions, statistical data on the amount of oil extracted at the Moldovan enterprises is used. At national level, there are over 100 enterprises specialised in oil production, the largest being JSC 'Floarea-Soarelui' in Balti municipality. Current technologies used in seed oil extraction in the RM by solvent use involve obtaining circa 450 kg of oil per one ton of seeds. This particular conversion factor was used to estimate the quantity of seeds consumed for oil extraction (Table 4-84).

Table 4-84: AD on oil production and quantity of seeds used for oil extraction for the period 1990-2020, kt

	1990	1991	1992	1993	1994	1995	1996	1997
Total crude oil non-chemically modified	125.600	117.900	57.317	60.271	50.439	50.715	39.374	35.168
Total refined oil non-chemically modified	57.525	53.998	26.251	27.604	23.101	23.227	18.033	16.107
Seeds from which refined oils were extracted	127.833	119.996	58.336	61.342	51.336	51.617	40.074	35.793
	1998	1999	2000	2001	2002	2003	2004	2005
Total crude oil non-chemically modified	28.747	125.600	117.900	57.317	60.271	50.439	50.715	39.374
Total refined oil non-chemically modified	13.166	57.525	53.998	26.251	27.604	23.101	23.227	18.033
Seeds from which refined oils were extracted	29.258	127.833	119.996	58.336	61.342	51.336	51.617	40.074
	2006	2007	2008	2009	2010	2011	2012	2013
Total crude oil non-chemically modified	35.168	28.747	79.307	83.881	80.705	89.787	96.828	65.502
Total refined oil non-chemically modified	16.107	13.166	34.578	28.446	26.506	20.942	20.618	14.418
Seeds from which refined oils were extracted	35.793	29.258	76.840	63.213	58.901	46.539	45.817	32.039
	2014	2015	2016	2017	2018	2019	2020	%
Total crude oil non-chemically modified	113.223	109.534	79.963	86.811	106.306	124.662	154.932	23.4
Total refined oil non-chemically modified	16.197	16.697	25.722	13.748	13.852	11.251	26.353	-54.2
Seeds from which refined oils were extracted	35.992	37.105	57.161	30.550	30.782	25.003	58.562	-54.2

Source: National Bureau of Statistics of the RM through Letter No. 06-39/08 dated 23.02.2011, response to letter No. 03-07/175 dated 02.02.2011 of the Ministry of Environment of the RM; Letter No. 06-39/38 dated 22.09.2011, response to Letter No. 101/2011-09-01 dated 02.09.2011 from the Climate Change Office of the Ministry of Environment of the RM; Statistical Reports PRODMOLD-A 'Total production, as a natural expression, in the Republic of Moldova, by product type, for 2005-2020'; Statistical Yearbooks of the ATULBD for 1998 (page 183), 2000 (page 100), 2002 (page 104), 2003 (page 99), 2006 (page 94), 2007 (page 93), 2009 (page 93), 2011 (page 95), 2013 (page 100), 2017 (page 102), 2020 (page 103). 2021 (page 101).

Indirect CO_2 emissions were estimated taking into consideration the carbon content in NMVOC emissions. The default value used is 60% (2006 IPCC Guidelines, Volume 3, Chapter 5.5, page 5.17). By oxidation, this carbon is converted into CO_2 in the atmosphere (it is assumed that all solvents are fossil-based).

In order to estimate indirect CO_2 emissions from solvent use seed oil extraction, the following equation was used:

$$CO_2\ Emissions = NMVOC \bullet CC \bullet 44/12$$

Where:

CO_2 Emissions – CO_2 emissions from seed oil extraction, kt/yr;

NMVOC – total NMVOC emissions within the respective category, kt/yr;

CC – carbon content in NMVOC, fraction (the default value used is 60%, with a margin of 50-70%; 2006 IPCC Guidelines, Volume 3, Chapter 5.5, page 5.17);

44/12 – mass ratio of CO_2/C.

'Use of Glues and Other Adhesives'

The methodology used to estimate NMVOC emissions from use of glues and other adhesives (SNAP 060405), available in the EMEP/EEA Air Pollutant Emission Inventory Guidebook (2019), is represented by the following equation:

$$E_{pollutant} = (AR \bullet EF_{pollutant}) / 10^3$$

Where:

$E_{pollutant}$ – emission of the specified pollutant from use of glues and other adhesives, t/yr;

AR – activity rate for the use of glues and other adhesives, t/yr;

$EF_{pollutant}$ – emission factor for this pollutant technology, kg/t (Table 4-85).

The EMEP/EEA Air Pollutant Emission Inventory Guidebook (2019) provides default EFs for the Tier 2 approach.

Table 4-85: Tier 2 default EF for category 2D3i 'Use of Glues and Other Adhesives'

Source	NMVOC Emission Factor	Unit
Use of Glues and Other Adhesives	522	g/kg glue

Source: EMEP/EEA Atmospheric Emissions Inventory Guidebook (2019), Category 2.D.3.i 'Other Solvent and Product Use', SNAP 060405, Table 3-11, page 20.

For most activities related to other solvent use in the Republic of Moldova, there are no reliable statistical reference sources. Under such circumstances, the total consumption of glues and other adhesives was estimated based on information on production, import and export.

It should be noted that the production of glues and other adhesives in the Republic of Moldova was relatively low and is recorded only since 2003, albeit it has increased significantly in recent years (Table 4-86).

Table 4-86: AD on glue and other adhesive production, import and consumption for 1990-2020, kt

	1990	1991	1992	1993	1994	1995	1996	1997
Glue and other adhesive production	NO	NO	NO	NO	NO	NO	NO	NO
Glue and other adhesive import	3.2508	1.7106	0.9162	0.6208	0.5598	0.4962	0.3323	0.6172
Glue and other adhesive consumption	**3.2508**	**1.7106**	**0.9162**	**0.6208**	**0.5598**	**0.4962**	**0.3323**	**0.6172**
	1998	1999	2000	2001	2002	2003	2004	2005
Glue and other adhesive production	NO	NO	NO	NO	NO	0.3611	0.6552	0.8533
Glue and other adhesive import	1.0852	0.7549	0.7264	0.8643	1.2217	1.3874	1.7522	1.9457
Glue and other adhesive consumption	**1.0852**	**0.7549**	**0.7264**	**0.8643**	**1.2217**	**1.7485**	**2.4074**	**2.7990**
	2006	2007	2008	2009	2010	2011	2012	2013
Glue and other adhesive production	1.4646	0.7735	0.5797	0.9211	1.3725	1.3234	1.0774	0.9527
Glue and other adhesive import	1.9679	1.9609	1.9713	1.4342	1.8004	1.5226	1.4106	1.2544
Glue and other adhesive consumption	**3.4326**	**2.7344**	**2.5509**	**2.3552**	**3.1729**	**2.8460**	**2.4880**	**2.2070**
	2014	2015	2016	2017	2018	2019	2020	%
Glue and other adhesive production	1.1179	5.9971	7.6074	12.2625	4.9374	23.8708	32.1448	N/A
Glue and other adhesive import	1.4043	1.4872	1.1646	1.4187	1.4758	1.8719	1.8080	30.3
Glue and other adhesive consumption	**2.5222**	**7.4843**	**8.7719**	**13.6813**	**6.4132**	**25.7427**	**33.9528**	**1841.8**

Source: Customs Service of the RM, through Letter dated 19.02.2021, response to the interpellation of the MARDE No. 13-07/519 dated 09.02.2021; Letter No. 28/07-3025 dated 28.02.2020, response to request of the Environment Agency No. 08-310/1 dated 11.02.2020; Letter No. 28/07-612 dated 12.01.2018, response to request of the Climate Change Office of the MARDE No. 601/2017-12-03 dated 14.12.2017; Letter No. 28/07-8785 dated 26.05.2016, response to request of the Climate Change Office of the Ministry of Environment No. 512/2016-05-01 dated 10.05.2016; Letter No. 28/07-2231 dated 26.02.2015, response to request of the Climate Change Office of the Ministry of Environment No. 407/2015-01-09 dated 29.01.2015; Letter No. 15-03-05 dated 24.01.2014, response to request of the Climate Change Office of the Ministry of Environment No. 320/2014-01-01 dated 03.01.2014; Letter No. 28/07-1893 dated 23.02.2011, response to request of the Ministry of Environment No. 03-07/175 dated 02.02.2011; Statistical Reports PRODMOLD-A 'Total production, as a natural expression, in the Republic of Moldova, by product type, for 2005-2020'.

The Customs Service of the RM is the primary source of information on national import operations (no data on glue and other adhesives exports from the RM was recorded during the period under review).

Indirect CO_2 emissions were estimated taking into consideration the carbon content in NMVOC emissions. The default value used is 60% (2006 IPCC Guidelines, Volume 3, Chapter 5.5, page 5.17). By oxidation, this carbon is converted into CO_2 in the atmosphere (it is assumed that all solvents are fossil-based).

In order to estimate indirect CO_2 emissions from solvent use in glues and other adhesives, the following equation was used:

$$CO_2\ Emissions = NMVOC \bullet CC \bullet 44/12$$

Where:

CO_2 Emissions – CO_2 emissions from solvent used in glues and other adhesives, kt/yr;

NMVOC – total NMVOC emissions within the respective category, kt/yr;

CC – carbon content in NMVOC, fraction (the default value used is 60%, with a margin of 50-70%; 2006 IPCC Guidelines, Volume 3, Chapter 5.5, page 5.17);

44/12 – mass ratio of CO_2/C.

'Preservation of Wood'

The methodology used to estimate NMVOC emissions from 2D3i 'Other Solvent and Product Use' (SNAP 060406 preservation of wood), available in the EMEP/EEA Air Pollutant Emission Inventory Guidebook (2019), is represented by the following equation:

$$E_{pollutant} = (AR_{product} \bullet EF_{pollutant}) / 10^3$$

Where:

- $E_{pollutant}$ – emission of the specified pollutant from solvent use in preservation of wood, t/yr;
- $AR_{product}$ – activity rate for preservation of wood, t/yr;
- $EF_{pollutant}$ – emission factor for this pollutant technology, kg/t.

The EMEP/EEA Air Pollutant Emission Inventory Guidebook (2019) provides the default EF for the Tier 2 approach (Table 4-87).

Table 4-87: Tier 2 default EF for estimating NMVOC emissions from 'Preservation of Wood'

Source	NMVOC Emission Factor	Unit
Preservation of Wood	105	g/kg creosote
	945	g/kg preservative based on organic solvents
	5	g/kg preservatives based on aqueous solutions

Source: EMEP/EEA Atmospheric Emissions Inventory Guidebook (2019), Category 2.D.3.i 'Other Solvent and Product Use', SNAP 060406, Tables 3-5, 3-6 and 3-7, pages 17-18.

In order to estimate NMVOC emissions, statistical data on the total amount of timber produced at Moldovan enterprises is used (Table 4-88).

Table 4-88: AD on timber production for the period 1990-2020

	1990	1991	1992	1993	1994	1995	1996	1997
Total timber production, thousand m^3	265.0	215.0	106.0	55.0	32.0	25.1	21.2	17.2
Timber treated with creosote-based preservatives, thousand m^3	39.8	32.3	15.9	8.3	4.8	3.8	3.2	2.6
	1998	1999	2000	2001	2002	2003	2004	2005
Total timber production, thousand m^3	15.2	21.2	14.9	16.2	17.1	17.2	24.1	23.1
Timber treated with creosote-based preservatives, thousand m^3	2.3	3.2	2.2	2.4	2.6	2.6	3.6	3.5
	2006	2007	2008	2009	2010	2011	2012	2013
Total timber production, thousand m^3	27.0	31.8	46.5	34.0	25.6	18.5	19.4	16.8
Timber treated with creosote-based preservatives, thousand m^3	4.0	4.8	7.0	5.1	3.8	2.8	2.9	2.5
	2014	2015	2016	2017	2018	2019	2020	%
Total timber production, thousand m^3	15.8	16.5	14.3	17.1	18.5	13.4	11.3	-95.7
Timber treated with creosote-based preservatives, thousand m^3	2.4	2.5	2.1	2.6	2.8	2.0	1.7	-95.7

Source: Statistical Yearbooks of the RM for 1994 (page 273), 1999 (page 273), 2003 (page 273), 2006 (page 273); Statistical Reports PRODMOLD-A 'Total production, as a natural expression, in the Republic of Moldova, by product type, for 2005-2020'; Statistical Yearbooks of the ATULBD for 2000 (page 99), 2003 (page 98), 2006 (page 93), 2009 (page 92), 2011 (page 95), 2012 (page 98), 2017 (page 101), 2019 (page 99), 2020 (page 102), 2021 (page 100).

The literature in the field reveals that about 50% of the total timber is used in construction, 15% in the furniture industry and other finished wood products, 15% in the packaging industry and 20% in other uses. Since the share of timber treated with preservatives is unknown (it is assumed that preservatives in the RM are creosote-based) it is admitted that this corresponds to the share of timber used in the furniture industry and other finished wood products (15% of the total).

Current technologies for preservation of wood by creosote impregnation imply the use of circa 75 kg of creosote in order to treat one cubic metre of wood, while for the same volume of wood, 24 kg of organic solvents can be used (EMEP/EEA Air Pollutant Emission Inventory Guidebook (2019), source category 2D3i 'Other Solvent and Product Use', SNAP 060406 'Preservation of Wood', page 16). The respective conversion factor was used to estimate the amount of creosote used in timber treatment at Moldovan enterprises (Table 4-89).

Table 4-89: AD on creosote use in preservation of wood for the period 1990-2020

	1990	1991	1992	1993	1994	1995	1996	1997
Creosote use in preservation of wood	2.9813	2.4188	1.1925	0.6188	0.3600	0.2824	0.2385	0.1935
	1998	1999	2000	2001	2002	2003	2004	2005
Creosote use in preservation of wood	0.1710	0.2385	0.1676	0.1823	0.1924	0.1935	0.2711	0.2596
	2006	2007	2008	2009	2010	2011	2012	2013
Creosote use in preservation of wood	0.3032	0.3580	0.5228	0.3822	0.2880	0.2081	0.2183	0.1885
	2014	2015	2016	2017	2018	2019	2020	%
Creosote use in preservation of wood	0.1779	0.1851	0.1611	0.1929	0.2082	0.1511	0.1273	-95.7

Indirect CO_2 emissions were estimated taking into consideration the carbon content in NMVOC emissions. The default value used is 60% (2006 IPCC Guidelines, Volume 3, Chapter 5.5, page 5.17). By oxidization, this carbon is converted into CO_2 in the atmosphere (it is assumed that all solvents are fossil-based).

In order to estimate indirect CO_2 emissions from solvent use in preservation of wood, the following equation was used:

$$CO_2\ Emissions = NMVOC \bullet CC \bullet 44/12$$

Where:

CO_2 Emissions – CO_2 emissions from solvent used in preservation of wood, kt/yr;

NMVOC – total NMVOC emissions within the respective category, kt/yr;

CC – carbon content in NMVOC, fraction (the default value used is 60%, with a margin of 50-70%; 2006 IPCC Guidelines, Volume 3, Chapter 5.5, page 5.17);

44/12 – mass ratio of CO_2/C.

'Underseal Treatment and Conservation of Vehicles'

The methodology used to estimate NMVOC emissions from 'Underseal Treatment and Conservation of Vehicles' (SNAP 060407), available in the EMEP/EEA Air Pollutant Emission Inventory Guidebook (2019), is represented by the following equation:

$$E_{pollutant} = (AR \bullet EF) / 10^3$$

Where:

$E_{pollutant}$ – emission of the specified pollutant from underseal treatment and conservation of vehicles', t/yr;

AR – activity rate, population;

EF – emission factor, kg/person.

The EMEP/EEA Air Pollutant Emission Inventory Guidebook (2019) provides default EFs for the Tier 2 approach (Table 4-90).

Table 4-90: Tier 2 default EF for estimating NMVOC emissions from 'Underseal Treatment and Conservation of Vehicles'

Source	NMVOC Emission Factor	Unit
'Underseal Treatment and Conservation of Vehicles'	0.2	kg/person
	636	g/kg underseal agent
	950	g/kg organic solvent

Source: EMEP/EEA Atmospheric Emissions Inventory Guidebook (2019), Category 2D3i 'Other Solvent and Product Use', SNAP 060407, Table 3-10, page 19-20.

Since the amount of underseal agent and/or solvent used for underseal treatment and conservation of vehicles is unknown, AD on the number of the population was used (Table 4-62).

Indirect CO_2 emissions were estimated taking into consideration the carbon content in NMVOC emissions. The default value used is 60% (2006 IPCC Guidelines, Volume 3, Chapter 5.5, page 5.17). By oxidation, this carbon is converted into CO_2 in the atmosphere (it is assumed that all solvents are fossil-based).

In order to estimate indirect CO_2 emissions from solvent use in underseal treatment and conservation of vehicles, the following equation was used:

$$CO_2\ Emissions = NMVOC \bullet CC \bullet 44/12$$

Where:

CO_2 Emissions – CO_2 emissions from solvent use in underseal treatment and conservation of vehicles, kt/yr;

NMVOC – total NMVOC emissions within the respective category, kt/yr;

CC – carbon content in NMVOC, fraction (the default value used is 60%, with a margin of 50-70%; 2006 IPCC Guidelines, Volume 3, Chapter 5.5, page 5.17);

44/12 – mass ratio of CO_2/C.

'Vehicles Dewaxing'

The methodology used to estimate NMVOC emissions from vehicles dewaxing after long storage and long-distance transport (SNAP 060409), available in the EMEP/EEA Air Pollutant Emission Inventory Guidebook (2019), is represented by the following equation:

$$E_{pollutant} = (AR \bullet EF) / 10^3$$

Where:

$E_{pollutant}$ – the emission of the specified pollutant from vehicles dewaxing, kt/yr;

AR – the activity rate on vehicles import, units;

EF – the emission factor, kg/vehicle.

The EMEP/EEA Air Pollutant Emission Inventory Guidebook (2019) provides default EFs for the Tier 2 approach (Table 4-91).

Table 4-91: Tier 2 default EF for category 2D3i 'Vehicles Dewaxing'

Source	NMVOC Emission Factor	Unit
'Vehicles Dewaxing'	1.0	kg/vehicle

Source: EMEP/EEA Atmospheric Emissions Inventory Guidebook (2019), Category 2D3i 'Other Solvent and Product Use', SNAP 060409, Table 3-9, page 19.

No vehicles are produced in the Republic of Moldova. The Customs Service is the primary source of information on new imported vehicles (Table 4-92).

Table 4-92: AD on new imported vehicles in the RM for the period 1990-2020

	1990	1991	1992	1993	1994	1995	1996	1997
Imported vehicles – total, units	5,803	4,836	4,030	3,358	2,798	2,332	2,334	1,922
	1998	1999	2000	2001	2002	2003	2004	2005
Imported vehicles – total, units	1,947	3,281	1,161	1,841	3,503	8,431	7,768	10,030
	2006	2007	2008	2009	2010	2011	2012	2013
Imported vehicles – total, units	7,477	10,523	14,368	7,832	7,923	11,126	10,604	12,233
	2014	2015	2016	2017	2018	2019	2020	%
Imported vehicles – total, units	22,103	23,844	14,951	17,764	24,780	29,140	50,826	775.9

Source: Customs Service of the RM, through Letter dated 19.02.2021, response to the interpellation of the MARDE No. 13-07/519 dated 09.02.2021; Letter No. 28/07-3025 dated 28.02.2020, response to request of the Environment Agency No. 08-310/1 dared 11.02.2020; Letter No. 28/07-612 dated 12.01.2018, response to request of the Climate Change Office of the MARDE No. 601/2017-12-03 dated 14.12.2017; Letter No. 28/07-8785 dated 26.05.2016, response to request of the Climate Change Office of the Ministry of Environment No. 512/2016-05-01 dated 10.05.2016; Letter No. 28/07-2231 dated 26.02.2015, response to request of the Climate Change Office of the Ministry of Environment No. 407/2015-01-09 dated 29.01.2015; Letter No. 15-03-05 dated 24.01.2014, response to request of the Climate Change Office of the Ministry of Environment No. 320/2014-01-01 dated 03.01.2014; Letter No. 28/07-1893 dated 23.02.2011, response to request of the Ministry of Environment No. 03-07/175 dated 02.02.2011.

Indirect CO_2 emissions were estimated taking into consideration the carbon content in NMVOC emissions. The default value used is 60% (2006 IPCC Guidelines, Volume 3, Chapter 5.5, page 5.17). By oxidation, this carbon is converted into CO_2 in the atmosphere (it is assumed that all solvents are fossil-based).

In order to estimate indirect CO_2 emissions from solvent use in vehicles dewaxing, the following equation was used:

$$CO_2\ Emissions = NMVOC \bullet CC \bullet 44/12$$

Where:

CO_2 Emissions – CO_2 emissions from solvent use in vehicles dewaxing, kt/yr;

NMVOC – total NMVOC emissions within the respective category, kt/yr;

CC – carbon content in NMVOC, fraction (the default value used is 60%, with a margin of 50-70%; 2006 IPCC Guidelines, Volume 3, Chapter 5.5, page 5.17);

44/12 – mass ratio of CO_2/C.

2D4 'Other' (Urea-Based Catalysts)

The methodology used to estimate CO_2 emissions from use of urea-based catalysts, available in the 2006 IPCC Guidebook (Volume 2, Chapter 3.2, page 3.12), is represented by the following equation:

$$E = A \bullet 12/60 \bullet Purity \bullet 44/12$$

Where:

E – CO_2 emissions from urea-based additive in catalytic converters, kt/yr;

A – Amount of urea-based additive consumed for use in catalytic converters, kt/yr;

12/60 – mass ratio of carbon (C) and urea ($CO(NH_2)_2$;

Purity – Mass fraction of urea in the urea-based additive (the default value used is 32.5%);

44/12 – mass ratio of carbon (C) and carbon dioxide (CO_2).

AD on the amount of urea-based additive used in catalytic converters is determined indirectly from diesel oil consumption at national level (additives consumed is between 1 and 3% of the diesel oil consumption).

Activity data on diesel oil consumption is available in the EBs of the RM for 1990 and 1993-2020 (in 1991 and 1992 the EBs were not compiled, but the information for the respective years was provided to the Ministry of Environment by the NBS through Official Letter No. 05-96-08 dated 10.03.1999, as a response to the request of the Ministry of Environment No. 01-7/138 dated 24.02.1999). The statistical information is available for the entire territory of the country only for 1990 and 1991, whereas for the rest of the period, it covers only the RBDR.

The table below shows data on the population number between 1990 and 2020, separately for the two banks of the Dniester River (Table 4-93).

Table 4-93: Population of the RM for the period 1990-2020, mil. inhabitants

	1990	1991	1992	1993	1994	1995	1996	1997
RM: RBDR	3.6306	3.6356	3.6288	3.6182	3.6502	3.6462	3.6428	3.6409
RM: LBDR	0.7310	0.7307	0.7303	0.7296	0.7025	0.7017	0.6916	0.6791
RM: total	**4.3616**	**4.3663**	**4.3591**	**4.3478**	**4.3527**	**4.3479**	**4.3344**	**4.3200**
	1998	1999	2000	2001	2002	2003	2004	2005
RM: RBDR	3.6550	3.6493	3.6435	3.6345	3.6272	3.6177	3.6068	3.5330
RM: LBDR	0.6708	0.6657	0.6600	0.6518	0.6425	0.6336	0.6238	0.5544
RM: total	**4.3258**	**4.3150**	**4.3035**	**4.2863**	**4.2697**	**4.2513**	**4.2306**	**4.0874**
	2006	2007	2008	2009	2010	2011	2012	2013
RM: RBDR	3.4593	3.3855	3.3118	3.2380	3.1643	3.0905	3.0167	2.9430
RM: LBDR	0.5475	0.5406	0.5335	0.5275	0.5225	0.5180	0.5134	0.5094
RM: total	**4.0068**	**3.9261**	**3.8453**	**3.7655**	**3.6868**	**3.6085**	**3.5301**	**3.4524**
	2014	2015	2016	2017	2018	2019	2020	%
RM: RBDR	2.8692	2.8447	2.8244	2.7800	2.7304	2.6861	2.6439	-27.2
RM: LBDR	0.5052	0.5007	0.4745	0.4706	0.4690	0.4651	0.4658	-36.3
RM: total	**3.3744**	**3.3454**	**3.2989**	**3.2506**	**3.1994**	**3.1512**	**3.1097**	**-28.7**

Source: Statistical Yearbooks of the RM for 1991-2020. Statistical Yearbooks of the ATULBD for 1998-2020.

In order to generate data on diesel oil consumption on the LBDR, information on specific diesel oil consumption per capita on the RBDR was used: the population number in the ATULBD was multiplied by the specific diesel oil consumption per capita (for 1990 and 1991 the information was representative for the entire country) (Table 4-94).

Table 4-94: Specific diesel oil consumption between 1990 and 2020

	1990	1991	1992	1993	1994	1995	1996	1997
Specific diesel oil consumption, kg/per capita/yr	255.0	225.0	172.0	127.7	104.7	101.5	87.0	82.7
	1998	1999	2000	2001	2002	2003	2004	2005
Specific diesel oil consumption, kg/per capita/yr	66.8	48.2	52.1	57.2	70.0	78.5	89.6	92.8
	2006	2007	2008	2009	2010	2011	2012	2013
Specific diesel oil consumption, kg/per capita/yr	96.3	103.4	110.8	103.8	131.8	143.3	131.3	147.8
	2014	2015	2016	2017	2018	2019	2020	%
Specific diesel oil consumption, kg/per capita/yr	159.3	173.0	190.1	205.4	213.2	228.2	225.0	-11.7

Table 4-95 shows the total diesel oil consumption as energy and fuel in the RM between 1990 and 2020.

Table 4-95: Total diesel oil consumption as energy and fuel between 1990 and 2020, kt

	1990	1991	1992	1993	1994	1995	1996	1997
RM: RBDR	925.6	817.8	624.0	462.0	382.0	370.0	317.0	301.0
RM: LBDR	186.4	164.4	125.6	93.2	73.5	71.2	60.2	56.1
RM: total	**1 112.0**	**982.2**	**749.6**	**555.2**	**455.5**	**441.2**	**377.2**	**357.1**

	1998	1999	2000	2001	2002	2003	2004	2005
RM: RBDR	244.0	176.0	190.0	208.0	254.0	284.0	323.0	328.0
RM: LBDR	44.8	32.1	34.4	37.3	45.0	49.7	55.9	51.5
RM: total	**288.8**	**208.1**	**224.4**	**245.3**	**299.0**	**333.7**	**378.9**	**379.5**
	2006	2007	2008	2009	2010	2011	2012	2013
RM: RBDR	333.0	350.0	367.0	336.0	417.0	443.0	396.0	435.0
RM: LBDR	52.7	55.9	59.1	54.7	68.9	74.3	67.4	75.3
RM: total	**385.7**	**405.9**	**426.1**	**390.7**	**485.9**	**517.3**	**463.4**	**510.3**
	2014	2015	2016	2017	2018	2019	2020	%
RM: RBDR	457.0	492.0	537.0	571.0	582.0	613.0	595.0	-35.7
RM: LBDR	80.5	86.6	90.2	96.7	100.0	106.1	104.8	-43.8
RM: total	**537.5**	**578.6**	**627.2**	**667.7**	**682.0**	**719.1**	**699.8**	**-37.1**

Source: National Bureau of Statistics, Energy Balances of the RM for the years 1990, 1993-2020.

The amount of urea-based additives in catalytic converters was determined indirectly based on the total diesel oil consumption as energy and fuel, considering that additive consumption is 2% of the total amount of diesel oil consumed in the Republic of Moldova (Table 4-96).

Table 4-96: Urea-based additives in catalytic converters in the Republic of Moldova, 1990-2020

	1990	1991	1992	1993	1994	1995	1996	1997
Urea-based additive, kt	22.2	19.6	15.0	11.1	9.1	8.8	7.5	7.1
	1998	1999	2000	2001	2002	2003	2004	2005
Urea-based additive, kt	5.8	4.2	4.5	4.9	6.0	6.7	7.6	7.6
	2006	2007	2008	2009	2010	2011	2012	2013
Urea-based additive, kt	7.7	8.1	8.5	7.8	9.7	10.3	9.3	10.2
	2014	2015	2016	2017	2018	2019	2020	%
Urea-based additive, kt	10.7	11.6	12.5	13.4	13.6	14.4	14.0	-37.1

4.5.3. Uncertainties and Time-Series Consistency

2D1 'Lubricant Use'

Uncertainties associated with the emission factors used to calculate CO_2 emissions from source category 2D1 'Lubricant Use' following a Tier 1 approach reach up to circa 50% (2006 IPCC Guidelines). Uncertainties associated with activity data on lubricant use in the RM are low (circa 5%). Thus, combined uncertainties associated with GHG emissions from 2D1 'Lubricant Use' are circa 50.25% (Annex 5-3.2). In view of ensuring time-series consistency of the obtained results, the same approach was used for the entire period under review, in accordance with the recommendations included in the 2006 IPCC Guidelines.

2D2 'Paraffin Wax Use'

Uncertainties associated with the emission factors used to calculate CO_2 emissions from source category 2D2 'Paraffin Wax Use' following a Tier 1 approach reach up to circa 100% (2006 IPCC Guidelines). Uncertainties associated with activity data on paraffin wax use in the RM can be considered moderate (circa 20%). Thus, combined uncertainties associated with GHG emissions from 2D2 'Paraffin Wax Use' are estimated to be circa 101.98% (Annex 5-3.2). In view of ensuring time-series consistency of the obtained results, the same approach was used for the entire period under review, in conformity with the recommendations included in the 2006 IPCC Guidelines.

2D3 'Solvent Use'

Uncertainties associated with the emission factors used to calculate indirect CO_2 emissions from source category 2D3 'Solvent Use' were estimated to be circa 35% (2006 IPCC Guidelines). Uncertainties associated with activity data on solvent use in the RM are moderate (circa 20%). Thus, combined uncertainties associated with GHG emissions from 2D3 'Solvent Use' are circa 40.31% (Annex 5-3.2). In view of ensuring time-series consistency of the obtained results, the same approach was used for the entire period under review, in conformity with the recommendations included in the 2006 IPCC Guidelines.

2D4 'Other' (Urea-Based Catalysts)

Uncertainties associated with the emission factors used to calculate CO_2 emissions from source category 2D4 'Other' (Urea-Based Catalysts) are low (circa 2%). Uncertainties associated with activity data on use of urea catalysts in the RM are moderate (circa 20%). Thus, combined uncertainties associated with GHG emissions from 2D4 'Other' (urea-based catalysts) are circa 20.10% (Annex 5-3.2). In view of ensuring time-series consistency of the obtained results, the same approach was used for the entire period under review, in conformity with the recommendations included in the 2006 IPCC Guidelines.

4.5.4. Quality Assurance and Quality Control

Standard verification and quality control forms and check-lists were filled in for the respective source category, following a Tier 1 approach.

Verification was focused on ensuring correct use of the default emission factors available in the 2006 IPCC Guidelines for National Greenhouse Gas Inventories; verification was also focused on correct use of AD obtained from different reference sources, including official sources, especially for the conversion of AD into mass units compatible with GHG emission estimation methods; comparing the results obtained by using different estimating methodologies and explaining the identified discrepancies.

AD and methods used for estimating GHG emissions from category 2D 'Non-energy Products from Fuels and Solvent Use' were documented and archived both in hard copies and electronically.

4.5.5. Recalculations

2D1 'Lubricant Use'

CO_2 emissions from source category 2D1 'Lubricant Use' were recalculated for 2019 after using the updated value of lubricant use, available in the Energy Balance of the RM for 2019. The results obtained in the current inventory cycle show that CO_2 emissions from the respective source category decreased by 2.2% in 2019 compared to the results included in the BUR3 of the RM to the UNFCCC (2021).

2D2 'Paraffin Wax Use'

CO_2 emissions from source category 'Paraffin Wax Use' were recalculated for 2019 after using the updated value of paraffin wax use, available in Energy Balance of the RM for 2019. The results obtained in the current inventory cycle show that CO_2 emissions from the respective source category increased by 88.9% in 2019, compared to the results included in the BUR3 of the RM to the UNFCCC (2021).

2D3 'Solvent Use'

GHG emissions from source category 2D3 'Solvent Use' were not recalculated for 1990-2019.

2D4 'Other' (Urea-Based Catalysts)

GHG emissions from urea-based catalysts were not recalculated for the period 1990-2019.

CO_2 emissions from source category 2D4 'Other' were recalculated for 2019, after using the updated value of diesel consumption, available in Energy Balance of the RM for 2019. The results obtained in the current inventory cycle show that CO_2 emissions from the respective source category increased by 3.3%, compared to the results included in the BUR3 of the RM to the UNFCCC (2021).

4.5.6. Planned Improvements

There are no planned improvements for category 2D 'Non-Energy Products from Fuels and Solvent Use' in the next inventory cycle.

4.6. Product Uses as Substitutes for ODS (Category 2F)

4.6.1. Source Category Description

A large number of hydrofluorocarbons are used to substitute ozone depleting substances (ODS) (Table 4-97).

Globally, wide scale production of halocarbons started in 1991 as alternative substances to chlorofluorocarbons (ozone layer depleting substances). According to the Montreal Protocol, the Parties to this treaty committed to phase out the import and domestic consumption of ODS, with further complete elimination starting with 2008 (because halocarbons do not contain chlorine atoms, they do not have any impact on the ozone layer).

Category 2F 'Product Uses as Substitutes for ODS' includes GHG emissions from the following emission sources: 2F1 'Refrigeration and Air Conditioning', 2F2 'Foam Blowing Agents', 2F3 'Fire Protection', 2F4 'Aerosols', 2F5 'Solvents' and 2F6 'Other Applications'.

Table 4-97: GWP for 100 years and the atmospheric lifetime of hydrofluorocarbons used to substitute ozone depleting substances[60]

GHG	Chemical Formula	Atmospheric Lifetime, according to AR5	SAR	TAR	AR4	AR5
HFC-23	CHF_3	222	11700	12000	14800	12140
HFC-32	CH_2F_3	5.2	650	550	675	677
HFC-125	C_2HF_5	28.2	2800	3400	3500	3170
HFC-134a	$C_2H_2F_2$ (CH_2FCF_3)	13.4	1300	1300	1430	1300
HFC-143a	$C_2H_3F_3$ (CF_3CH_3)	47.1	3800	4300	4470	4800
HFC-152a	C_2H4F_2 (CH_3CHF_2)	1.5	140	120	124	138
HFC-227ea	CF_3CHFCF_3	38.9	2900	3500	3220	3350
HFC-236fa	$CF_3CH_2CF_3$	242	6300	9400	9810	8060
HFC-245fa	$CHF_2CH_2CF_3$	7.7	NA	950	1030	858
HFC-365mfc	$CH_3CF_2CH_2CF_3$	8.7	NA	890	794	804
HFC-43-10mee	$CF_3CHFCHFCF_2CF_3$	16.1	1300	1500	1640	1650

Sources: SAR – Second Assessment Report (IPCC, 1996), TAR – Third Assessment Report (IPCC, 2001), AR4 – Fourth Assessment Report (IPCC, 2007), AR5 – Fifth Assessment Report (IPCC, 2013).

In the current inventory cycle, the Republic of Moldova monitored emissions generated from HFC consumption from source categories 2F1, 2F2, 2F3 and 2F4. Emissions from source categories 2F5 and 2F6 were not estimated due to lack of such activities in the country (NO).

It should be noted that the process of collecting activity data on the consumption of alternative substances to ODS is extremely difficult at national level. The primary difficulty is due to the fact that import, export, re-export and circulation of these substances on the market is not regulated at national level (for example, the ODS[61] since 01.01.2013). Import of substitutes for ODS in bulk, as well as products and equipment charged with halocarbons do not require a license and/or environmental authorization, being allowed to almost any legal entity or natural person. Secondly, there are difficulties in monitoring the import of disaggregated HFCs by type of substance, as ODS and their alternatives are aggregated in the Nomenclature of Goods of the RM in several tariff positions (2903 3919-2903 3990; 2903 7900-2903 7919; 3824 7100; 3824 7400, 3824 7800 and 3824 7900). Another difficulty is that halocarbons may be imported both in 'standard' packaging of 10-15 kg, and in small containers (300-500 g), which can be imported by almost any natural person.

Under these circumstances, HFC emissions from source category 2F 'Product Uses as Substitutes for ODS' were estimated based on estimation methodologies available in the 2006 IPCC Guidelines, considering data on import and consumption of halocarbons provided by economic agents, including through the Annual Reports submitted by enterprises to the National Ozone Unit under the PI 'EPIU' (to be noted that between 2003 and 2020, only a limited number of enterprises were licensed to import, export, re-export, transit and place ODS and equipment containing ODS on the market: 'Ecolux' Ltd., 'Frigoinds' Ltd., 'Frio-Dins' Ltd., 'York Refrigerent' Ltd., 'Dina Cociug' Ltd).

In addition, the Generalised Reports were also used on the production, consumption, import/export of ozone-depleting substances, regulated by the Montreal Protocol in the RM between 2001 and 2008 according to the Statistical Report No. 1-Ozone, provided by the NBS (between 2009 and 2016, the responsibility for collecting statistical information in conformity with the Statistical Report No. 1-Ozone lay with the Environmental Protection Inspectorate, but due to the lack of capacities, the respective information was not collected).

It should be noted that the Republic of Moldova does not produce HFCs; and that these substances had a relatively narrow use before 1995, being imported in insignificant amounts.

2F1 'Refrigeration and Air Conditioning'

Refrigeration equipment (refrigerators, freezers, refrigerated display cases, industrial refrigeration equipment) and air conditioning equipment (stationary and mobile air conditioners) are a primary source of HFC emissions in the Republic of Moldova.

[60] < http://www.epa.gov/climatechange/Downloads/ghgemissions/US-GHG-Inventory-2014-Annex-6-Additional-Information.pdf>
[61] <http://mediu.gov.md/index.php/activitate/autorizatii>.

Because since 1995, in accordance with the Montreal Protocol, developed countries are not supposed to produce CFCs and equipment using CFCs, the RM uses R-22 and R-600a refrigerants as transit substances, and R-134a, R-404a, R-407c, R-410a and R-507a as alternative refrigerants to CFCs (Table 4-98).

Table 4-98: Composition of refrigerants preponderantly used in the RM

Commercial Name	Sector of Use	Composition
R-32	Commercial Refrigerant, Air Conditioning	HFC-32 (100%)
R-134a	Transport, commercial, industrial refrigerant	HFC-134a (100%)
R-404a	Commercial, industrial refrigerant	HFC-125 (44%)/HFC-143a (52%)/HFC-134a (4%)
R-406a	Commercial refrigerant	HCFC-22 (55%)/HC-600a (14%)/HCFC-142B (41%)
R-407a	Commercial, industrial refrigerant	HFC-32 (20%)/HFC-125 (40%)/HFC-134a (40%)
R-407b	Commercial refrigerant	HFC-32 (10%)/HFC-125 (70%)/HFC-134a (20%)
R-407c	Commercial refrigerant, Air Conditioning	HFC-32 (23%)/HFC-125 (25%)/HFC-134a (52%)
R-407d	Transport refrigerant	HFC-32 (15%)/HFC-125 (15%)/HFC-134a (70%)
R-407f	Commercial, industrial refrigerant	HFC-32 (30%)/HFC-125 (40%)/HFC-134a (40%)
R-408a	Commercial refrigerant	HCFC-22 (47%)/HFC-143a (46%)/HFC-125 (7%)
R-410a	Air Conditioning	HFC-32 (50%)/HFC-125 (50%)
R-422d	Commercial, industrial refrigerant	HFC-125 (65.1%)/HFC-134a (31.5%)/R-600a (3.4%)
R-507a	Transport, commercial, industrial refrigerant	HFC-125 (50%)/HFC-143a (50%)

Since 2017, relatively large amounts of R-407f (circa 1.7 tonnes) were introduced on the domestic market as an alternative substance for the refrigerant agent R-404a, and R-422d (circa 13.0 tonnes) as an alternative substance for the refrigerant agent R-22, respectively.

2F2 'Foam Blowing Agents'

Since 1995, hydrofluorocarbons have been also used to replace CFCs and HCFCs used in foam blowing agents (closed and opened cell foams), used in insulation, cushioning and packaging. The basic components for the production of these foams are: HFC-245f, HFC-365mfc, HFC-134a, HFC-152a, HCFC-22, HCFC-141b, HCFC-142b, Pentane (C,I,N) and CO_2+ethanol.

In the Republic of Moldova, foams have been produced since 2005. Foams produced as well as imported ones are mostly closed cell foams (the emissions from these last longer, circa 20 years).

2F3 'Fire Protection'

There are two types of fire extinguishers which use HFCs (mainly HFC-227ea and HFC-236fa) as halon substitutes (halon-1211 or bromoclorodifluoromethane; halon-1301 or bromotrifluoromethane and halon-2402 or dibromotetrafluoroethane): (1) portable fire extinguishing systems and (2) fixed fire extinguishing systems.

According to the information received from the General Inspectorate for Emergency Situations of the Ministry of Internal Affairs, only CO_2 had been used in fixed fire extinguishing systems as an extinguishing agent until 2016 (halon and HFC-based fixed and portable extinguishing systems were not in use) (Table 4-99).

Table 4-99: Import of portable fire extinguishers between 1995-2020

	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
Portable fire extinguishers	12 195	11 086	10 078	9 162	8 329	7 572	4 178	9 247	13 806	20 913	18 494	26 666	41 232
	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Portable fire extinguishers	46 428	154 462	43 347	29 374	42 465	51 143	51 942	42 613	42 601	58 547	90 623	87 879	76 092

Source: Customs Service of the RM, through Letter dated 19.02.2021, response to the interpellation of the MARDE No. 13-07/519 dated 09.02.2021; Letter No. 28/07-3025 dated 28.02.2020, response to the request from the Environment Agency No. 08-310/1 dated 11.02.2020; Letter No. 28/07-612 dated 12.01.2018, response to the request of the Climate Change Office of the MARDE No. 601/2017-12-03 dated 14.12.2017; Letter No. 28/07-8785 dated 26.05.2016, response to the request of the Climate Change Office of the Ministry of Environment No. 512/2016-05-01 dated 10.05.2016; Letter No. 28/07-2231 dated 26.02.2015, response to the request from the Climate Change Office of the Ministry of Environment No. 407/2015-01-09 dated 29.01.2015; Letter No. 15-03-05 dated 24.01.2014, response to the request from the Climate Change Office of the Ministry of Environment No. 320/2014-01-01 dated 03.01.2014; Letter No. 28/07-1893 dated 23.02.2011, response to the request from the Ministry of Environment No. 03-07/175 dated 02.02.2011.

The import of HFC-227ea for use in fire protection systems has been recorded in the Republic of Moldova since 2017 (Table 4-100).

Table 4-100: Import and export of HFC-227ea between 2017-2020, tonnes

	2017	2018	2019	2020
Import of HFC-227ea, t	2.0	20.0	22.0	11.0
Export of HFC-227ea, t	0.0	14.5	9.3	0.0
Total amount of HFC-227ea utilised in domestic fire protection systems, t	2.0	5.5	12.7	11.0

Source: Customs Service of the RM, through Letter dated 19.02.2021, response to the interpellation of the MARDE No. 13-07/519 dated 09.02.2021; Letter No. 28/07-3025 dated 28.02.2020, response to the request from the Environment Agency No. 08-310/1 dated 11.02.2020.

2F4 'Aerosols' (Metered Dose Aerosols)

HFCs are used as propellant in most aerosol products. Emissions from aerosols are usually released shortly after production, on average 1-2 years after sale. When used, the entire amount of propellant is considered to be emitted into the atmosphere. Most frequently, HFC-134a is used as a propellant (less frequently – HFC-227ea and HFC-152a).

In the Republic of Moldova, aerosols containing chemical substances included in Annex A, Group I of the Montreal Protocol cannot be imported, exported, re-exported, transited and put into circulation on the market. The interdiction does not extend on medical care goods: pharmaceutical aerosols in the form of sprays used in treatment of chronic lung obstructions, cardiac conditions and treatment substances that can be used as aerosols only; as well as goods needed to ensure public order (special products manufactured commissioned and used by the Ministry of Internal Affairs or other organisations entitled to ensure public order, and used in cases stipulated by legislation).

HFC emissions from category 2F 'Product Uses as Substitutes for ODS' had increased in the RM between 1995 and 2020 by circa 238.2 times, from 1.03 kt CO_2 equivalent in 1995 to 245.32 kt CO_2 equivalent in 2020 (Table 4-101, Figure 4-3).

Table 4-101: HFC emissions from source category 2F 'Product Uses as Substitutes for ODS' in the RM between 1995-2020, kt CO_2 equivalent

	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
HFCs	1.0298	1.6593	2.3137	3.1372	4.0002	5.1199	6.8681	9.1227	12.1632	16.0027	22.5106	33.2493	44.7872
	2008	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**
HFCs	57.3610	67.4790	78.1507	90.5042	100.4768	109.0841	122.9816	157.0394	166.7099	185.8945	198.8877	235.5397	245.3168

Categories 2F1 'Refrigeration and Air Conditioning' and 2F2 'Foam Blowing Agents' had the largest share in the structure of total HFC emissions from category 2F 'Product Uses as Substitutes for ODS'.

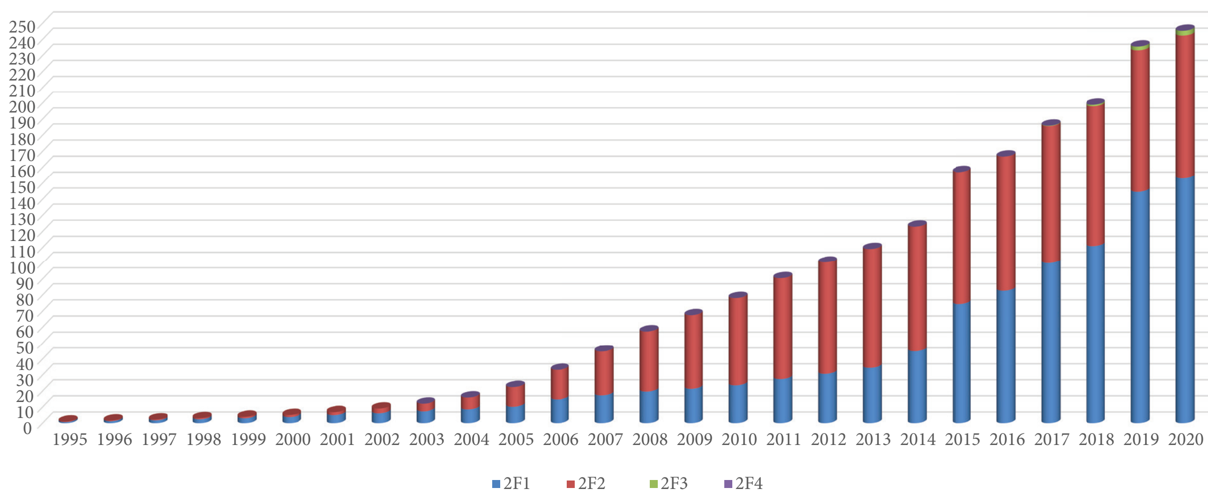


Figure 4-3: F-gases Emissions from category 2F 'Product Uses as Substitutes for ODS', by source, between 1995-2020, kt CO_2 equivalent.

4.6.2. Methodological Issues, Emission Factors and Data Sources

2F1 'Refrigeration and Air Conditioning'

Refrigeration equipment (refrigerators, freezers, refrigerated display cases, industrial refrigeration equipment) and air conditioning equipment (stationary and mobile air conditioners) are a primary source of HFC emissions in the Republic of Moldova.

GHG emissions from the consumption of halocarbons in this category were estimated using a Tier 2 approach (2006 IPCC Guidelines, Volume 3, Chapter 7.5, Equation 7.10, page 7.49).

$$E_{total,\ t} = E_{containers,\ t} + E_{Charge,\ t} + E_{lifetime,\ t} + E_{end\text{-}of\text{-}life,\ t}$$

Where:

$E_{containers,\ t}$ – emissions related to the management of refrigerant containers;

$E_{charge,\ t}$ – emissions related to the refrigerant charge: connection and disconnection of the refrigerant container and the new equipment to be charged;

$E_{lifetime,\ t}$ – annual emissions from the banks of refrigerants associated with the six sub-applications during operation (fugitive emissions and ruptures) and servicing;

$E_{end\text{-}of\text{-}life,\ t}$ – emissions at system disposal.

The assessment process involves several steps, using the following equations.

Step 1: Refrigerant management of containers

The emissions related to the refrigerant container comprises all the emissions related to the refrigerant transfer, from bulk containers (typically 40 tonnes) down to small capacities (from 0.5 kg to 1 tonne). Emissions are estimated using Equation 7.11 from the 2006 IPCC Guidelines (Volume 3, Chapter 7.5, page 7.49).

$$E_{containers,\ t} = RM_t \bullet (c / 100)$$

Where:

RM_t – HFC market for new equipment and servicing of all refrigeration application in year t, kg;

c – emission factor of HFC container management of the current refrigerant market, percent (varies between 2 and 10% of the refrigerant market; on average, circa 6%).

Step 2: Refrigerant charge emissions of new equipment

The emissions of refrigerant due to the charging process of new equipment are related to the process of connecting and disconnecting the refrigerant container to and from the equipment when it is initially charged. The respective emissions are estimated using Equation 7.12 from the 2006 IPCC Guidelines (Volume 3, Chapter 7.5, page 7.50).

$$E_{charge,\ t} = M_t \bullet (k / 100)$$

Where:

M_t – amount of HFC charged into new equipment in year t (per sub-application), kg; it should be noted that systems that are imported pre-charged are not been taking into consideration;

k – emission factor of assembly losses of the HFC charged into new equipment (per sub-application),

percent, (varies between 0.1% and 3%).

Step 3: Emissions during lifetime (operation and servicing)

Annual leakage from the refrigerant bank during lifetime represent fugitive emissions and are estimated using Equation 7.13 from the 2006 IPCC Guidelines (Volume 3, Chapter 7.5, page. 7.50).

$$E_{lifetime,\ t} = B_t \bullet (x / 100)$$

Where:

B_t – amount of HFC banked in existing systems in year t (per sub-application), kg;

x – annual emission rate (i.e., emission factor) of HFC of each sub-application bank during operation, accounting for average annual leakage and average annual emissions during servicing, percent.

Step 4: Emissions at end-of-life

Emissions at system disposal are estimated using Equation 7.14 from the 2006 IPCC Guidelines (Volume 3, Chapter 7.5, page 7.51).

$$E_{end\text{-}of\text{-}life,\ t} = M_{t\text{-}d} \bullet (p / 100) \bullet (1 - \eta_{rec,\ d} / 100)$$

Where:

$M_{t\text{-}d}$ – = amount of HFC initially charged into new systems installed in year (t-d), kg;

p – residual charge of HFC in equipment being disposed of expressed in percentage of full charge, percent;

$\eta_{rec,\,d}$ – recovery efficiency at disposal, which is the ratio of recovered HFC referred to the HFC contained in the system, percent.

During the estimation process, default EFs available in the 2006 IPCC Guidelines were used, as well as country-specific EFs provided by the members of the Republican Association of Refrigeration Technicians, and from the reports submitted by companies to the National Ozone Unit of the Ministry of Environment, respectively (Table 4-102).

Table 4-102: EFs and parameters used to estimate HFC emissions from refrigeration and air conditioning equipment imported into the Republic of Moldova

Equipment Type (sub-application)	Charge, kg (margin and value used)	Lifetime, years (margin and value used)	Emission Factor (% of the initial charge/year)		End-of-Life Emissions (%)	
			Initial Emissions	Lifetime Emissions	Recovery Efficiency	Residual Charge
Factors in Equations	**(M)**	**(d)**	**(k)**	**(x)**	**($\eta_{rec,\,d}$)**	**(p)**
Domestic refrigeration	0.05 ≤ M ≤ 0.5 **0.10**	12 ≤ d ≤ 20 **16**	0.2 ≤ k ≤ 1 **0.6**	0.1 ≤ x ≤ 0.5 **0.5**	0 < $\eta_{rec,\,d}$ < 70 **0**	0 < p < 80 **50**
Chest freezers	0.05 ≤ M ≤ 0.5 **0.20**	12 ≤ d ≤ 20 **16**	0.2 ≤ k ≤ 1 **0.6**	0.1 ≤ x ≤ 0.5 **0.5**	0 < $\eta_{rec,\,d}$ < 70 **0**	0 < p < 80 **50**
Upright freezers	0.05 ≤ M ≤ 0.5 **0.18**	12 ≤ d ≤ 20 **16**	0.2 ≤ k ≤ 1 **0.6**	0.1 ≤ x ≤ 0.5 **0.5**	0 < $\eta_{rec,\,d}$ < 70 **0**	0 < p < 80 **50**
Stand-alone commercial application	0.2 ≤ M ≤ 6 **0.4**	10 ≤ d ≤ 15 **12**	0.5 ≤ k ≤ 3 **1.5**	1 ≤ x ≤ 15 **16.8**	0 < $\eta_{rec,\,d}$ < 70 **30**	0 < p < 80 **50**
Medium commercial refrigeration	3 ≤ M ≤ 30 **6**	10 ≤ d ≤ 15 **12**	0.5 ≤ k ≤ 3 **1.5**	1 ≤ x ≤ 15 **16.8**	0 < $\eta_{rec,\,d}$ < 70 **30**	0 < p < 80 **50**
Large commercial refrigeration	100 ≤ M ≤ 200 **150**	10 ≤ d ≤ 15 **12**	0.5 ≤ k ≤ 3 **1.5**	1 ≤ x ≤ 15 **16.8**	0 < $\eta_{rec,\,d}$ < 70 **50**	0 < p < 80 **50**
Industrial refrigeration	10 ≤ M ≤ 10000 **150**	15 ≤ d ≤ 30 **20**	0.5 ≤ k ≤ 3 **1.5**	7 ≤ x ≤ 25 **16**	0 < $\eta_{rec,\,d}$ < 90 **50**	50 < p < 100 **75**
Residential and Commercial A/C, including Heat Pumps	0.5 ≤ M ≤ 100 **0.6**	10 ≤ d ≤ 20 **12**	0.2 ≤ k ≤ 1 **0.6**	1 ≤ x ≤ 10 **5**	0 < $\eta_{rec,\,d}$ < 80 **0**	0 < p < 80 **50**
Mobile A/C – personal cars	0.4 ≤ M ≤ 0.8 **0.6**	9 ≤ d ≤ 16 **16**	0.2 ≤ k ≤ 0.5 **0.5**	10 ≤ x ≤ 20 **15**	0 < $\eta_{rec,\,d}$ < 50 **0**	0 < p < 50 **50**
Mobile A/C – buses, trains, passenger carriages	10 ≤ M ≤ 20 **12**	9 ≤ d ≤ 16 **12**	0.2 ≤ k ≤ 0.5 **0.5**	10 ≤ x ≤ 20 **15**	0 < $\eta_{rec,\,d}$ < 50 **30**	0 < p < 50 **50**
Mobile A/C – minibuses	0.5 ≤ M ≤ 1.5 **1.2**	9 ≤ d ≤ 16 **12**	0.2 ≤ k ≤ 0.5 **0.5**	10 ≤ x ≤ 20 **15**	0 < $\eta_{rec,\,d}$ < 50 **30**	0 < p < 50 **50**
Mobile A/C – trucks	0.5 ≤ M ≤ 1.5 **1**	9 ≤ d ≤ 16 **12**	0.2 ≤ k ≤ 0.5 **0.5**	10 ≤ x ≤ 20 **15**	0 < $\eta_{rec,\,d}$ < 50 **30**	0 < p < 50 **50**
Refrigeration vehicles	3 ≤ M ≤ 8 **7**	6 ≤ d ≤ 9 **9**	0.2 ≤ k ≤ 1 **0.6**	15 ≤ x ≤ 50 **30**	0 < $\eta_{rec,\,d}$ < 70 **30**	0 < p < 50 **50**

Source: 2006 IPCC Guidelines, Volume 3, Chapter 7.5, Table 7.9, page 7.52. Republican Association of Refrigeration Technicians of the Republic of Moldova and reports submitted by companies to the National Ozone Unit of the Ministry of Environment.

I) Domestic Refrigeration

The refrigerator plant in Chisinau was founded in November 1964 and had produced, between 1965 and 1998, a series of refrigerator models ('Nistru', 'Iarna', 'Iarna-2', 'Iarna-3', 'Iarna-4', 'Codru') and one freezer model 'Ghiocel'. The plant production had been exhibited at international fairs and exhibitions, enjoying popularity in the RM, other union republics of the former USSR as well as in socialist countries.

Once the transition to the market economy began, production could face the competition from imported items, as a result, in 1997, the company went bankrupt. No domestic refrigerators and freezers have been produced in the Republic of Moldova since 1998 (Table 4-103).

Refrigerant R-12 was used in the production process at the respective plant.

Table 4-103: AD on refrigerator and freezer production for 1990-1998, thousand units

Refrigeration Equipment	1990	1991	1992	1993	1994	1995	1996	1997	1998
Refrigerators	2.6	1.3	1.1	1.0	0.9	0.8	0.2	0.2	0.0
Freezers	131.0	118.0	55.0	58.0	53.0	23.0	0.9	1.5	0.1

AD used to estimate HFC emissions from consumption of hydrofluorocarbons charged into domestic refrigeration equipment (refrigerators and freezers) were provided by the Customs Service of the RM. Between 1995 and 2020, the import of domestic refrigerators increased by circa 4.5 times, whereas for domestic freezers – by circa 741 times (Table 4-104).

Table 4-104: AD on import of domestic refrigeration equipment for 1995-2020, units

Equipment	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
Refrigerators	18,958	8,376	11,597	15,230	8,498	12,092	19,937	30,689	42,524	52,694	70,412	87,034	112,982
Chest freezers	36	243	100	148	96	242	428	97	442	457	1,265	1,713	1,549
Upright freezers	43	337	22	320	200	393	558	995	2,033	1,481	1,965	5,180	9,574
Equipment	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**
Refrigerators	78,880	65,306	72,824	66,900	63,433	55,638	60,963	55,713	51,245	60,255	77,510	93,196	85,944
Chest freezers	2,834	2,529	2,492	3,395	2,107	2,870	3,151	5,413	6,822	10,142	15,188	25,608	39,267
Upright freezers	3,169	4,323	8,825	9,239	7,994	6,164	8,242	7,482	5,660	6,115	6,783	11,090	19,289

Source: Customs Service of the RM, through Letter dated 19.02.2021, response to the interpellation of the MARDE No. 13-07/519 dated 09.02.2021; Letter No. 28/07-3025 dated 28.02.2020, response to the request from the Environment Agency No. 08-310/1 dated 11.02.2020; Letter No. 28/07-612 dated 12.01.2018, response to the request from the Climate Change Office of the MARDE No. 601/2017-12-03 dated 14.12.2017; Letter No. 28/07-8785 dated 26.05.2016, response to the request from the Climate Change Office of the Ministry of Environment No. 512/2016-05-01 dated 10.05.2016; Letter No. 28/07-2231 dated 26.02.2015, response to the request from the Climate Change Office of the Ministry of Environment No. 407/2015-01-09 dated 29.01.2015; Letter No. 15-03-05 dated 24.01.2014, response to the request from the Climate Change Office of the Ministry of Environment No. 320/2014-01-01 dated 03.01.2014; Letter No. 28/07-1893 dated 23.02.2011, response to the request from the Ministry of Environment No. 03-07/175 dated 02.02.2011.

The share of refrigerants charged into domestic refrigeration equipment in the RM varied from one year to another (Table 4-105).

Table 4-105: Share of refrigerants charged into domestic refrigeration equipment for 1995-2020, %

Equipment	Refrigerant	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
Refrigerators	R-134a	0	0	0	0	0	0	0	0	30	40	55	65	70
	R-600a	0	0	0	0	0	0	0	0	0	0	0	0	0
	R-12	100	100	100	100	100	100	100	100	70	60	45	35	30
Freezers	R-134a	0	0	0	0	0	0	0	0	20	30	40	50	50
	R-404a	0	0	0	0	0	0	0	0	15	25	35	40	45
	R-290	0	0	0	0	0	0	0	0	0	0	0	0	0
	R-12	100	100	100	100	100	100	100	100	65	45	25	10	5
Equipment	**Refrigerant**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**
Refrigerators	R-134a	75	70	65	55	45	30	20	10	0	0	0	0	0
	R-600a	0	30	35	45	55	40	80	90	100	100	100	100	100
	R-12	25	0	0	0	0	0	0	0	0	0	0	0	0
Freezers	R-134a	45	40	35	35	35	30	25	15	5	0	0	0	0
	R-404a	50	60	65	65	65	65	70	80	90	95	95	95	95
	R-290	0	0	0	0	0	5	5	5	5	5	5	5	5
	R-12	5	0	0	0	0	0	0	0	0	0	0	0	0

Source: Republican Association of Refrigeration Technicians of the Republic of Moldova.

The information on the composition of refrigerants charged into the refrigeration equipment imported into the country (Table 4-98), the share of refrigerants charged into the refrigeration equipment imported into the country between 1995 and 2020 (Table 4-105), the average charge of equipment with refrigerant (Table 4-102), and statistical data on import of domestic refrigeration equipment (Table 4-104) was used to estimate the total amount of refrigerant imported into the country in domestic refrigeration equipment (Table 4-106) and the cumulative amount of refrigerant used in domestic refrigeration equipment imported into the Republic of Moldova (Table 4-107).

Table 4-106: AD on import of refrigerants charged into domestic refrigeration equipment for 2003-2020, t/yr

	2003	2004	2005	2006	2007	2008	2009	2010	2011
R-134a	1.3666	2.2152	4.1153	6.2947	8.9253	6.4277	5.0850	5.4640	4.4992
R-404a	0.0682	0.0895	0.2123	0.5100	0.9149	0.5686	0.7704	1.3565	1.5223
	2012	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**
R-134a	3.5056	2.1742	1.7477	0.9215	0.1192	0.0000	0.0000	0.0000	0.0000
R-404a	1.2092	1.0943	1.4796	1.9435	2.1449	2.9726	4.0456	6.7619	10.7591

Activity data on the total amount of refrigerants imported into the country were provided through reports submitted by economic agents presented annually to the National Ozone Unit within the Public Institution 'Environmental Project Implementation Unit' of the Ministry of Environment. However, this information is aggregated for the entire country, the share used for domestic refrigeration equipment servicing being unspecified.

Table 4-107: Cumulative amount of refrigerants charged into domestic refrigeration equipment imported between 2003-2020, t/yr

	2003	2004	2005	2006	2007	2008	2009	2010	2011
R-134a	1.3666	3.5817	7.6971	13.9918	22.9171	29.3448	34.4298	39.8938	44.3930
R-404a	0.0682	0.1576	0.3700	0.8800	1.7949	2.3635	3.1339	4.4904	6.0127
	2012	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**
R-134a	47.8986	50.0728	51.8205	52.7420	52.8612	52.8612	52.8612	51.4946	49.2795
R-404a	7.2219	8.3162	9.7958	11.7393	13.8842	16.8568	20.9024	27.5962	38.2658
R-404a	7.2219	8.3162	9.7958	11.7393	13.8842	16.8568	20.9024	27.5962	40 392.7

In order to identify this information (Table 4-108) it is admitted that circa 0.5% of the total amount of refrigerants charged into domestic refrigeration equipment is used for servicing, considering that circa 6% (margin used by default: between 2 and 10%) of the total amount of imported refrigerant is lost through fugitive emissions during the management of containers loaded with refrigerants.

Table 4-108: AD on imported refrigerants for servicing domestic refrigeration equipment for 2003-2020, t/yr

	2003	2004	2005	2006	2007	2008	2009	2010	2011
R-134a	0.0072	0.0190	0.0408	0.0742	0.1215	0.1555	0.1825	0.2114	0.2353
R-404a	0.0004	0.0008	0.0020	0.0047	0.0095	0.0125	0.0166	0.0238	0.0319
	2012	2013	2014	2015	2016	2017	2018	2019	2020
R-134a	0.2539	0.2654	0.2746	0.2795	0.2802	0.2802	0.2802	0.2729	0.2612
R-404a	0.0383	0.0441	0.0519	0.0622	0.0736	0.0893	0.1108	0.1463	0.2028

II) Commercial Refrigeration

AD used to estimate HFC emissions from consumption of hydrofluorocarbons charged into commercial refrigeration equipment (refrigerated display cases, chests and upright freezers as well as other similar equipment) was provided by the Customs Service. Between 1995 and 2020, the import of commercial refrigeration equipment increased by circa 139% (Table 4-109).

Table 4-109: AD on import of commercial refrigeration equipment for the period 1995-2020, units

Equipment	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
Refrigerated display cases for frozen products	102	583	558	2,286	622	822	977	1,122	1,605	1,260	1,173	1,246	1,436
Showcases and industrial refrigerated counters	2,696	1,037	1,411	2,714	913	1,195	1,696	3,153	1,803	2,465	2,830	3,621	8,978
Industrial refrigerated cabinets	652	775	446	305	669	587	1,796	1,695	1,434	1,213	1,001	1,851	3,808
Total showcases, counters, crates, cabinets and other similar furniture for producing the cold	**3,450**	**2,395**	**2,415**	**5,305**	**2,204**	**2,604**	**4,469**	**5,970**	**4,842**	**4,938**	**5,004**	**6,718**	**14,222**
Equipment	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Refrigerated display cases for frozen products	478	422	403	441	224	343	252	837	675	821	1,121	796	1,329
Showcases and industrial refrigerated counters	8,692	4,908	4,296	4,997	4,000	5,333	3,961	3,565	3,079	4,423	6,464	6,365	4,912
Industrial refrigerated cabinets	2,675	1,054	1,273	1,777	570	566	780	1,038	753	2,215	1,143	1,804	2,003
Total showcases, counters, crates, cabinets and other similar furniture for producing the cold	**11,845**	**6,384**	**5,972**	**7,215**	**4,794**	**6,242**	**4,993**	**5,440**	**4,507**	**7,459**	**8,728**	**8,965**	**8,244**

Source: Customs Service of the RM, through Letter dated 19.02.2021, response to the interpellation of the MARDE No. 13-07/519 dated 09.02.2021; Letter No. 28/07-3025 dated 28.02.2020, response to the request from the Environment Agency No. 08-310/1 dated 11.02.2020; Letter No. 28/07-612 dated 12.01.2018, response to the request from the Climate Change Office of the MARDE No. 601/2017-12-03 dated 14.12.2017; Letter No. 28/07-8785 dated 26.05.2016, response to the request from the Climate Change Office of the Ministry of Environment No. 512/2016-05-01 dated 10.05.2016; Letter No. 28/07-2231 dated 26.02.2015, response to the request from the Climate Change Office of the Ministry of Environment No. 407/2015-01-09 dated 29.01.2015; Letter No. 15-03-05 dated 24.01.2014, response to the request from the Climate Change Office of the Ministry of Environment No. 320/2014-01-01 dated 03.01.2014; Letter No. 28/07-1893 dated 23.02.2011 response to the request from the Ministry of Environment No. 03-07/175 dated 02.02.2011.

The share of refrigerants charged into domestic refrigeration equipment in the Republic of Moldova varied from one year to another (Table 4-110).

Table 4-110: Share of refrigerants charged into commercial refrigeration equipment imported between 1995-2020, %

Equipment	Refrigerant	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
Commercial refrigeration equipment	R-12	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	50.0	35.0	25.0	20.0	12.0
	R-22	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	30.0	45.0	50.0	55.0	55.0
	R-134a	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	12.0	12.0	12.0	12.0	18.0
	R-404a	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5.0	5.0	5.0	5.0	5.6
	R-407c	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.0	2.0	2.0	2.0	3.0
	R-408a	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	1.0	1.0	1.0	1.4
	R-507a	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5.0	5.0	5.0
	R-290	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Equipment	Refrigerant	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Commercial refrigeration equipment	R-12	7.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	R-22	56.5	60.5	57.5	54.5	52.0	49.5	48.5	44.5	44.0	41.5	41.0	39.0	37.0
	R-134a	21.0	23.0	25.0	24.0	23.5	23.0	22.0	21.5	20.5	19.5	18.0	16.0	15.0
	R-404a	6.0	6.0	7.0	8.5	9.0	11.0	12.5	15.5	16.5	18.5	20.0	21.5	23.0
	R-407c	3.0	3.0	3.0	3.0	3.0	3.0	3.5	3.5	3.5	3.5	3.5	3.5	3.5
	R-408a	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5
	R-507a	5.0	6.0	7.0	9.5	10.0	10.5	11.0	11.5	12.0	12.5	13.0	13.5	14.0
	R-290	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.0	2.0	3.0	3.0	5.0	6.0

Source: Republican Association of Refrigeration Technicians of the Republic of Moldova.

The information on the share of refrigerants charged into the refrigeration equipment imported into the country (Table 4-98), the share of refrigerants charged into the commercial refrigeration equipment imported into the country for the period 1997-2020 (Table 4-110), the average charge of equipment with refrigerant (Table 4-102) and statistical data on import of commercial refrigeration equipment (Table 4-109), was used to estimate the total amount of refrigerants imported into the country within the commercial refrigeration equipment (Table 4-111) and the cumulative amount of refrigerants used in the commercial refrigeration equipment imported into the Republic of Moldova (Table 4-112).

Table 4-111: AD on imported refrigerants charged into commercial refrigeration equipment for the period 2003-2020, t/yr

	2003	2004	2005	2006	2007	2008	2009	2010	2011
R-134a	2.4077	2.7086	2.8146	3.9996	13.9123	14.3626	8.2664	8.3938	9.7969
R-404a	1.0032	1.1286	1.1728	1.6665	4.3283	4.1036	2.1564	2.3503	3.4697
R-407c	0.4013	0.4514	0.4691	0.6666	2.3187	2.0518	1.0782	1.0073	1.2246
R-408a	0.2006	0.2257	0.2346	0.3333	1.0821	1.0259	0.5391	0.5036	0.6123
R-507a	NO	NO	1.1728	1.6665	3.8645	3.4197	2.1564	2.3503	3.8779
	2012	2013	2014	2015	2016	2017	2018	2019	2020
R-134a	6.4648	8.1722	6.2803	6.0099	4.7687	7.8305	8.2963	7.8932	6.3032
R-404a	2.4759	3.9084	3.5684	4.3327	3.8382	7.4289	9.2181	10.6065	9.6650
R-407c	0.8253	1.0659	0.9991	0.9783	0.8142	1.4055	1.6132	1.7266	1.4708
R-408a	0.4126	0.5330	0.4282	0.4193	0.3489	0.6023	0.6914	0.7400	0.6303
R-507a	2.7510	3.7308	3.1401	3.2146	2.7914	5.0196	5.9918	6.6599	5.8830

Table 4-112: Cumulative amount of refrigerants charged into commercial refrigeration equipment imported for the period 2003-2020, t/yr

	2003	2004	2005	2006	2007	2008	2009	2010	2011
R-134a	2.4077	5.1163	7.9309	11.9306	25.8429	40.2054	48.4718	56.8656	66.6625
R-404a	1.0032	2.1318	3.3046	4.9711	9.2993	13.4029	15.5594	17.9096	21.3794
R-407c	0.4013	0.8527	1.3218	1.9884	4.3071	6.3589	7.4372	8.4444	9.6690
R-408a	0.2006	0.4264	0.6609	0.9942	2.0763	3.1022	3.6413	4.1449	4.7572
R-507a	0.0000	0.0000	1.1728	2.8393	6.7038	10.1235	12.2799	14.6302	18.5081
	2012	2013	2014	2015	2016	2017	2018	2019	2020
R-134a	73.1273	81.2994	87.5797	91.1819	93.2420	98.2579	102.5545	96.5354	88.4761
R-404a	23.8552	27.7637	31.3320	34.6615	37.3711	43.6273	51.1789	57.4571	63.0185
R-407c	10.4943	11.5603	12.5594	13.1365	13.4992	14.4356	15.3821	14.7900	14.2090
R-408a	5.1699	5.7028	6.1310	6.3497	6.4729	6.8407	7.1987	6.8567	6.4611
R-507a	21.2591	24.9898	28.1300	31.3446	34.1360	37.9828	42.3080	45.1034	47.5667

Activity data on the total amount of refrigerants imported into the country (Table 4-113) were provided through reports submitted by economic agents presented annually to The National Ozone Unit within the Public Institution 'Environmental Project Implementation Unit' of the Ministry of Environment. However, this information is aggregated for the entire country, the share used for servicing commercial refrigeration equipment being unspecified. In order to identify this information, it is admitted that circa 16.8% of the total amount of refrigerants charged into commercial refrigeration equipment (a value provided by economic agents in the field), taking into account that circa 6% (margin used by default: between 2 and 10%) of the total amount of imported refrigerants for servicing refrigeration equipment is lost through fugitive emissions during the management of containers loaded with refrigerants.

Table 4-113: AD on imported refrigerants for servicing commercial refrigeration equipment for the period 2003-2020, t/yr

	2003	2004	2005	2006	2007	2008	2009	2010	2011
R-134a	0.4288	0.9111	1.4123	2.1246	4.6021	7.1598	8.6319	10.1266	11.8713
R-404a	0.1786	0.3796	0.5885	0.8852	1.6560	2.3868	2.7708	3.1893	3.8072
R-407c	0.0715	0.1519	0.2354	0.3541	0.7670	1.1324	1.3244	1.5038	1.7219
R-408a	0.0357	0.0759	0.1177	0.1770	0.3697	0.5524	0.6484	0.7381	0.8472
R-507a	NO	NO	0.2088	0.5056	1.1938	1.8028	2.1868	2.6053	3.2959
	2012	2013	2014	2015	2016	2017	2018	2019	2020
R-134a	13.0225	14.4778	15.5962	16.2377	16.6045	17.4978	18.2629	17.1910	15.7558
R-404a	4.2481	4.9442	5.5796	6.1725	6.6551	7.7692	9.1139	10.2320	11.2223
R-407c	1.8688	2.0587	2.2366	2.3393	2.4039	2.5707	2.7392	2.6338	2.5303
R-408a	0.9207	1.0156	1.0918	1.1308	1.1527	1.2182	1.2820	1.2210	1.1506
R-507a	3.7858	4.4502	5.0094	5.5818	6.0789	6.7640	7.5342	8.0320	8.4707

III) Industrial Refrigeration

Activity data used to estimate HFC emissions from consumption of hydrofluorocarbons charged into industrial refrigeration equipment (Table 4-114) was identified having requested information from economic agents in the field, as well as on the web-page of the Ministry of Agriculture, Regional Development and Environment (http://madrm.gov.md/ro/content/depozite-frigorifice), and by using other public sources of information, respectively.

Table 4-114: AD on use of industrial refrigeration equipment for the period 1995-2020

	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
Agro-industrial refrigerated warehouses	208	216	217	221	222	225	227	228	230	236	241	253	264
Enterprises in the milk processing industry with industrial refrigeration equipment	23	23	23	23	23	23	23	23	23	23	23	23	23
Enterprises in the meat and sausage processing industry with industrial refrigeration equipment	76	76	76	76	76	76	76	76	76	76	76	76	76
Enterprises in the wine industry with industrial refrigeration equipment	196	196	196	196	196	196	196	196	196	196	192	188	184
Total enterprises that own industrial refrigerators	503	511	512	516	517	520	522	523	525	531	532	540	547
Amount of refrigerant charged into industrial refrigeration equipment, t	75.5	76.7	76.8	77.4	77.6	78.0	78.3	78.5	78.8	79.7	79.8	81.0	82.1
	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Agro-industrial refrigerated warehouses	285	306	337	370	414	450	498	539	564	586	626	666	698
Enterprises in the milk processing industry with industrial refrigeration equipment	23	23	23	23	20	20	20	20	20	20	20	20	20
Enterprises in the meat and sausage processing industry with industrial refrigeration equipment	76	76	76	76	76	76	76	76	76	76	76	76	76
Enterprises in the wine industry with industrial refrigeration equipment	180	176	172	168	164	160	156	152	148	144	140	140	140
Total enterprises that own industrial refrigerators	564	581	608	637	674	706	750	787	808	826	862	902	934
Amount of refrigerant charged into industrial refrigeration equipment, t	84.6	87.2	91.2	95.6	101.1	105.9	112.5	118.1	121.2	123.9	129.3	135.3	140.1

Source: Republican Association of Refrigeration Technicians of the Republic of Moldova, Ministry of Agriculture, Regional Development and Environment.

The share of refrigerants charged into industrial refrigeration equipment in the Republic of Moldova varied from one year to another (Table 4-115). The information on the share of refrigerants charged into refrigeration equipment imported into the country (Table 4-98), the share of refrigerants charged into industrial refrigeration equipment imported into the country over the period between 1995 and 2020 (Table 4-115) and activity data on the charge of industrial equipment with refrigerant (Table 4-114) were used to estimate the total amount of refrigerants depending on the type of refrigerant used within the industrial refrigeration equipment (Table 4-116) and the cumulative amount of refrigerants used in industrial refrigeration equipment in the Republic of Moldova (Table 4-117).

Table 4-115: Share of refrigerants charged into industrial refrigeration equipment imported for the period 1995-2020, %

Equipment	Refrigerant	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
Industrial refrigeration equipment	R-134a	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	1.0	1.0	1.0	1.0
	R-404a	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	1.5	2.5	2.5	3.0
	R-407c	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.5	1.0	1.0
	R-410a	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	R-507c	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	1.5	2.0	2.5	3.0
	R-22	0.0	0.0	0.0	0.0	0.0	5.0	10.0	20.0	37.0	46.0	49.0	53.0	62.0
	R-422d	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	R-290	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	R-717	100.0	100.0	100.0	100.0	100.0	95.0	90.0	80.0	60.0	50.0	45.0	40.0	30.0
Equipment	Refrigerant	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Industrial refrigeration equipment	R-134a	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5
	R-404a	3.5	4.0	6.0	6.5	7.3	8.0	9.0	9.5	11.5	12.5	13.5	15.0	16.5
	R-407c	1.0	1.0	1.5	1.5	2.0	2.5	2.5	3.0	3.5	3.5	4.0	4.0	4.0
	R-410a	0.0	0.0	1.0	1.0	1.1	2.0	3.0	3.5	4.0	4.5	5.0	5.5	6.0
	R-507c	3.5	4.0	4.5	5.0	5.6	6.0	7.0	7.5	8.0	9.0	9.0	9.5	9.5
	R-22	63.0	62.5	59.0	58.0	56.0	54.0	52.0	50.0	43.0	40.0	37.0	34.0	31.5
	R-422d	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.5	4.0	5.0	5.5	6.0
	R-290	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	R-717	27.5	27.0	26.5	26.5	26.5	26.0	25.0	25.0	25.0	25.0	25.0	25.0	25.0

Source: Republican Association of Refrigeration Technicians of the Republic of Moldova.

Table 4-116: AD on the amount of refrigerants charged into industrial refrigeration equipment for the period 2003-2020, t/yr

	2003	2004	2005	2006	2007	2008	2009	2010	2011
R-134a	0.7875	0.7965	0.7980	0.8100	0.8205	1.2690	1.3073	1.3680	1.4333
R-404a	0.7875	1.1948	1.9950	2.0250	2.4615	2.9610	3.4860	5.4720	6.2108
R-407c	NO	NO	0.3990	0.8100	0.8205	0.8460	0.8715	1.3680	1.4333
R-410a	NO	NO	NO	NO	NO	NO	NO	0.9120	0.9555
R-422d	NO	NO	NO	NO	NO	NO	NO	NO	NO
R-507c	0.7875	1.1948	1.5960	2.0250	2.4615	2.9610	3.4860	4.1040	4.7775
	2012	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**
R-134a	1.5165	1.5885	1.6875	1.7708	1.8180	1.8585	1.9395	2.0295	2.1015
R-404a	7.3803	8.4720	10.1250	11.2148	13.9380	15.4875	17.4555	20.2950	23.1165
R-407c	2.0220	2.6475	2.8125	3.5415	4.2420	4.3365	5.1720	5.4120	5.6040
R-410a	1.1121	2.1180	3.3750	4.1318	4.8480	5.5755	6.4650	7.4415	8.4060
R-422d	NO	NO	NO	NO	4.2420	4.9560	6.4650	7.4415	8.4060
R-507c	5.6111	6.3540	7.8750	8.8538	9.6960	11.1510	11.6370	12.8535	13.3095

Table 4-117: Cumulative amount of refrigerants charged into industrial refrigeration equipment for the period 2003-2020, t/yr

	2003	2004	2005	2006	2007	2008	2009	2010	2011
R-134a	0.7875	1.5840	2.3820	3.1920	4.0125	5.2815	6.5888	7.9568	9.3900
R-404a	0.7875	1.9823	3.9773	6.0023	8.4638	11.4248	14.9108	20.3828	26.5935
R-407c	NO	NO	0.3990	1.2090	2.0295	2.8755	3.7470	5.1150	6.5483
R-410a	NO	NO	NO	NO	NO	NO	NO	0.9120	1.8675
R-422d	NO	NO	NO	NO	NO	NO	NO	NO	NO
R-507c	0.7875	1.9823	3.5783	5.6033	8.0648	11.0258	14.5118	18.6158	23.3933
	2012	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**
R-134a	10.9065	12.4950	14.1825	15.9533	17.7713	19.6298	21.5693	23.5988	25.7003
R-404a	33.9738	42.4458	52.5708	63.7856	77.7236	93.2111	110.6666	130.9616	154.0781
R-407c	8.5703	11.2178	14.0303	17.5718	21.8138	26.1503	31.3223	36.7343	42.3383
R-410a	2.9796	5.0976	8.4726	12.6044	17.4524	23.0279	29.4929	36.9344	45.3404
R-422d	NO	NO	NO	NO	4.2420	9.1980	15.6630	23.1045	31.5105
R-507c	29.0043	35.3583	43.2333	52.0871	61.7831	72.9341	84.5711	97.4246	110.7341

Activity data on the total amount of refrigerants imported into the country for servicing industrial refrigeration equipment (Table 4-118) were provided through reports submitted by economic agents presented periodically to the National Ozone Unit within the Public Institution 'Environmental Project Implementation Unit' of the Ministry of Environment. However, this information is aggregated for the entire country, the share used for servicing industrial refrigeration equipment being unspecified. In order to identify this information, it is admitted that circa 16% of the total amount of refrigerants charged into industrial refrigeration is used for servicing this equipment, considering that circa 6% (margin used by default: between 2 and 10%) of the total amount of imported refrigerants is lost through fugitive emissions during management of containers loaded with refrigerants.

Table 4-118: AD on imported refrigerants for servicing industrial refrigeration equipment for the period 2003-2020, t/yr

	2003	2004	2005	2006	2007	2008	2009	2010	2011
R-134a	0.1336	0.2686	0.4040	0.5414	0.6805	0.8957	1.1175	1.3495	1.5925
R-404a	0.1336	0.3362	0.6745	1.0180	1.4355	1.9376	2.5289	3.4569	4.5103
R-407c	NO	NO	0.0677	0.2050	0.3442	0.4877	0.6355	0.8675	1.1106
R-410a	NO	NO	NO	NO	NO	NO	NO	0.1547	0.3167
R-422d	NO	NO	NO	NO	NO	NO	NO	NO	NO
R-507c	0.1336	0.3362	0.6069	0.9503	1.3678	1.8700	2.4612	3.1572	3.9675
	2012	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**
R-134a	1.8497	2.1192	2.4054	2.7057	3.0140	3.3292	3.6581	4.0023	4.3588
R-404a	5.7620	7.1988	8.9160	10.8180	13.1819	15.8086	18.7690	22.2111	26.1316
R-407c	1.4535	1.9025	2.3795	2.9802	3.6996	4.4351	5.3123	6.2301	7.1806
R-410a	0.5053	0.8646	1.4370	2.1377	2.9599	3.9055	5.0020	6.2641	7.6897
R-422d	NO	NO	NO	NO	0.7194	1.5600	2.6564	3.9185	5.3442
R-507c	4.9191	5.9968	7.3324	8.8340	10.4784	12.3696	14.3433	16.5232	18.7805

IV) Stationary Air Conditioning

AD used to estimate HFC emissions from hydrofluorocarbons charged into stationary air conditioning equipment was provided by the Customs Service of the RM. Between 1995 and 2020, the imports of this type of equipment increased by circa 23.5 times (Table 4-119).

Table 4-119: AD on imported stationary air conditioning equipment for the period 1995-2020, units

	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
AC equipment	2,245	424	1,247	1,177	794	1,654	1,212	2,160	5,767	5,750	7,843	11,284	38,256
	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
AC equipment	36,130	8,199	17,429	28,010	25,820	32,545	17,149	12,091	30,889	36,780	44,924	52,702	55,620

Source: Customs Service of the RM, Letter No. 28/07-3025 dated 28.02.2020, response to request from the Environment Agency No. 08-310/1 dated 11.02.2020; Letter No. 28/07-612 dated 12.01.2018, response to request from the Climate Change Office of the MARDE No. 601/2017-12-03 dated 14.12.2017; Letter No. 28/07-8785 dated 26.05.2016, response to request from the Climate Change Office of the Ministry of Environment No. 512/2016-05-01 dated 10.05.2016; Letter No. 28/07-2231 dated 26.02.2015 response to request from the Climate Change Office of the Ministry of Environment No. 407/2015-01-09 dated 29.01.2015; Letter No. 15-03-05 dated 24.01.2014, response to request from the Climate Change Office of the Ministry of Environment No. 320/2014-01-01 dated 03.01.2014; Letter No. 28/07-1893 dated 23.02.2011, response to request from the Ministry of Environment No. 03-07/175 dated 02.02.2011.

The share of refrigerants charged into stationary air conditioning equipment in the Republic of Moldova varied from one year to another (Table 4-120).

Table 4-120: Share of refrigerants charged into stationary air conditioning equipment imported into the RM for the period 1995-2020, %

Equipment	Refrigerant	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
Air conditioning equipment	R-410a	0	0	0	0	0	0	0	0	35	65	70	70	75
	R-22	100	100	100	100	100	100	100	100	65	35	30	30	25
	R-32	0	0	0	0	0	0	0	0	0	0	0	0	0
Equipment	Refrigerant	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Air conditioning equipment	R-410a	80	80	85	85	85	83	80	65	35	45	35	25	15
	R-22	20	20	15	15	10	9	5	0	0	0	0	0	0
	R-32	0	0	0	0	5	8	15	35	45	55	65	75	85

Source: Republican Association of Refrigeration Technicians of the Republic of Moldova.

The information on the share of refrigerants charged into refrigeration equipment imported into the country (Table 4-98), the share of refrigerants charged into stationary air conditioning equipment imported into the country between 1995-2020 (Table 4-120), the average charge of equipment with refrigerant (Table 4-102) the average charge of equipment with refrigerant (Table 4-119), were used to estimate the total amount of refrigerants imported into the country within the stationary air conditioning equipment (Table 4-121) and the cumulative amount of refrigerants charged into stationary air conditioning equipment imported (Table 4-122).

Table 4-121: AD on imported refrigerants charged into stationary air conditioning equipment for the period 2003-2020, t/yr

	2003	2004	2005	2006	2007	2008	2009	2010	2011
R-410a	1.2111	2.2425	3.2941	4.7393	17.2152	16.2585	3.9355	8.3659	14.2851
R-32	NO	NO	NO	NO	NO	NO	NO	NO	NO
	2012	2013	2014	2015	2016	2017	2018	2019	2020
R-410a	13.1682	16.2074	8.2315	4.7155	6.4867	9.9306	9.4340	7.9053	5.0058
R-32	0.7746	1.5622	1.5434	2.5391	8.3400	12.1374	17.5204	23.7159	28.3662

Activity data on the total amount of refrigerants imported into the country for servicing stationary air conditioning equipment (Table 4-123) was identified through reports submitted by companies periodically to The National Ozone Unit within the Public Institution 'Environmental Project Implementation Unit' of the Ministry of Environment.

Table 4-122: Cumulative amount of refrigerants charged into stationary air conditioning equipment imported into the RM for the period 2003-2020, t/yr

	2003	2004	2005	2006	2007	2008	2009	2010	2011
R-410a	1.2111	3.4536	6.7476	11.4869	28.7021	46.0445	49.9800	58.8688	73.1539
R-32	NO	NO	NO	NO	NO	NO	NO	NO	NO
	2012	2013	2014	2015	2016	2017	2018	2019	2020
R-410a	86.3221	102.5295	110.7611	114.2655	118.5097	125.1462	129.8410	120.5311	108.1945
R-32	0.7746	2.3368	3.8802	6.4193	14.7593	26.8967	44.4171	68.1330	96.4992

However, this information is aggregated for the entire country, the amount used for servicing stationary air conditioning equipment being unspecified. In order to identify this information, it is admitted that circa 5% of the cumulative amount of refrigerants charged into stationary air conditioning equipment is used for servicing this equipment, considering that circa 6% (margin used by default: between 2 and 10%) of the total amount of imported refrigerants is lost through fugitive emissions during management of containers loaded with refrigerants.

Table 4-123: AD on imported refrigerants for servicing stationary air conditioning equipment for the period 2003-2020, t/yr

	2003	2004	2005	2006	2007	2008	2009	2010	2011
R-410a	0.0642	0.1830	0.3576	0.6088	1.5212	2.4404	2.6489	3.1200	3.8772
R-32	NO	NO	NO	NO	NO	NO	NO	NO	NO
	2012	2013	2014	2015	2016	2017	2018	2019	2020
R-410a	4.5751	5.4341	5.8703	6.0561	6.2810	6.6327	6.8816	6.3881	5.7343
R-32	0.0411	0.1238	0.2056	0.3402	0.7822	1.4255	2.3541	3.6110	5.1145

V) Mobile Air-Conditioning Systems

AD used to estimate HFCs emissions from the consumption of hydrofluorocarbons charged into mobile air-conditioning equipment was provided by the NBS of the RM (Statistical Yearbooks of the RM before 2000, and the Bank for Statistical Data after 2000, respectively), as well as by the SOE 'State Information Resources Centre 'Register' (SOE CRIS 'Register') (for the period 1995-2013), respectively by the Public Services Agency of the RM (for 2014-2020) based on the information included in the State Transport Register.

In order to estimate the amount of HFCs used in mobile air-conditioning equipment, the information on the total number of transportation units registered in the country was considered (Table 4-124 and 4-125), as well as the share of transportation units equipped air conditioning equipment (Table 4-126).

Table 4-124: Vehicles registered between 1995-2020 (end of calendar year total), units

	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
Passenger cars	165,941	173,618	205,973	222,769	232,278	238,380	256,459	268,882	265,841	269,551	292,994	319,311	338,944
Buses and Minibuses	9,181	9,798	11,169	12,917	13,582	12,769	14,703	15,777	15,723	19,741	19,825	21,056	21,095
Trucks	59,888	57,138	56,924	57,404	52,430	46,351	45,809	46,277	46,905	73,774	81,798	84,087	94,828
	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Passenger cars	366,351	386,365	404,290	426,973	456,379	487,418	512,561	529,813	546,781	588,119	616,800	648,780	677,670
Buses and Minibuses	21,491	21,346	21,395	21,349	21,433	21,344	21,359	21,134	20,968	20,944	21,050	21,087	21,014
Trucks	115,967	120,174	131,243	141,696	151,830	154,163	160,199	164,533	168,618	173,384	179,392	185,669	185,878

Source: Statistical Yearbooks of the RM for 1999 (page 390), 2003 (pages 515-516), 2005 (page 407), 2008 (pages 399); Bank for Statistical Data of the RM: <http://statbank.statistica.md/PxWeb/pxweb/ro/40%20Statistica%20economica/40%20Statistica%20economica__19%20TRA__TRA020/TRA020100.px/table/tableViewLayout1/?rxid=b2ff27d7-0b96-43c9-934b-42e1a2a9a774>

For passenger cars, the number of units manufactured after 1993 was considered (particularly Euro-1, Euro-2, Euro-3, Euro-4 and Euro-5); whereas for trains, it was considered that 100% of these transportation units are equipped with air conditioning equipment.

Table 4-125: Railway transportation vehicles inventoried between 1995-2020 (end of calendar year total), units

	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
Diesel locomotives	163	163	162	162	162	162	162	160	159	156	156	154	154
Locomotives for manoeuvring	114	100	75	72	50	42	44	48	54	50	56	56	56
Diesel trains	29	28	26	26	24	22	22	22	22	18	20	20	20
Passengers carriages	463	463	462	462	460	460	440	460	452	452	440	436	416
	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Diesel locomotives	152	152	152	150	139	138	138	138	138	134	134	134	146
Locomotives for manoeuvring	53	39	39	67	67	67	67	67	67	25	23	30	31
Diesel trains	18	15	15	21	21	21	21	21	21	21	21	16	13
Passengers carriages	398	423	411	399	399	388	381	381	346	268	263	262	264

Source: Statistical Yearbooks of the RM for 1999 (page 390), 2003 (pages 515-516), 2005 (page 407), 2008 (page 399); Bank for Statistical Data of the RM: <http://statbank.statistica.md/PxWeb/pxweb/ro/40%20Statistica%20economica/40%20Statistica%20economica__19%20TRA__TRA020/TRA020300.px/table/tableViewLayout1/?rxid=b2ff27d7-0b96-43c9-934b-42e1a2a9a774>

Table 4-126: Transportation units equipped with air conditioning equipment between 1995-2020 (end of calendar year total), % of total

	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
Passenger cars	2.9	5.9	8.9	11.9	14.9	17.9	22.1	25.3	27.6	34.7	39.6	43.4	46.2
Buses and Minibuses	2.4	5.4	8.4	11.4	14.4	17.4	20.1	21.8	22.6	28.7	30.8	31.9	33.1
Trucks	2.9	8.9	14.9	20.9	26.9	32.9	41.8	49.6	56.6	53.4	54.7	55.6	56.4
	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Passenger cars	48.5	49.5	50.1	50.9	51.3	51.7	52.1	53.7	55.2	61.6	62.0	62.2	63.9
Buses and Minibuses	34.0	34.2	34.5	34.7	34.9	35.0	35.4	36.1	36.7	38.6	38.9	39.0	39.3
Trucks	56.9	57.0	57.1	57.2	57.3	57.4	57.4	58.5	59.4	62.8	62.9	63.0	64.2

Based on the information on the average refrigerant charge (HFC-134a in proportion of 100%) of air conditioning equipment in mobile sources (Table 4-102) and information on the total number of transportation units registered in the Republic of Moldova equipped with air conditioning systems (Table 4-127) the total amount of HFC-134a charged into mobile air-conditioning equipment in the Republic of Moldova was estimated (Table 4-128).

Table 4-127: Estimated number of transportation units equipped with air conditioning equipment for the period 1995-2020 (end of year total), units

	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
Passenger cars	7,124	15,125	23,768	33,053	42,979	53,547	70,353	85,228	98,502	130,447	161,118	188,223	211,084
Buses and Minibuses	331	777	1,257	1,772	2,322	2,906	3,491	3,922	4,228	5,557	6,139	6,464	6,826
Trucks	2,077	7,001	12,770	19,383	26,840	35,141	49,535	64,648	80,482	82,163	86,568	89,686	92,632
	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Passenger cars	231,504	240,614	246,895	254,433	258,714	263,144	267,042	284,508	301,823	393,086	399,483	403,541	433,031
Buses and Minibuses	7,112	7,177	7,265	7,329	7,402	7,436	7,567	7,637	7,705	8,078	8,186	8,224	8,259
Trucks	94,550	94,993	95,376	95,788	96,129	96,494	96,603	100,601	104,306	119,620	120,146	120,569	126,346

In order to estimate the cumulative amount of refrigerants charged into air-conditioning equipment, it was considered that all transportation units are imported and the share of second-hand vehicles is dominant; under these circumstances, it can be considered that mobile air-conditioning systems were functional (in working condition) in the case of vehicles and trucks only partially: between 2003-2014 – 90%, and between 2015-2020 – 95%.

Table 4-128: AD on cumulative amount of HFC-134a charged into mobile air-conditioning systems recorded for the period 1995-2020, t

	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
HFC-134a	3.3028	5.4629	7.8549	10.5749	13.5052	16.7394	21.9214	27.0249	30.3406	33.6344	38.0581	41.7155	44.8708
	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
HFC-134a	47.5232	48.6424	49.4107	50.3830	50.9213	51.4562	79.3800	171.9362	179.8335	219.5127	222.1326	223.8329	237.3562

Activity data on the total amount of refrigerants imported into the country for servicing mobile air-conditioning equipment (Table 4-129) was provided through reports submitted annually to the National Ozone Unit within the Public Institution 'Environmental Project Implementation Unit' of the Ministry of Environment.

Table 4-129: AD on imported refrigerants for servicing mobile air conditioning systems for 1995-2020, t/yr

	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
HFC-134a	0.5251	0.8686	1.2489	1.6814	2.1473	2.6616	3.4855	4.2970	4.8242	5.3479	6.0512	6.6328	7.1345
	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
HFC-134a	7.5562	7.7341	7.8563	8.0109	8.0965	8.1815	12.6214	27.3379	28.5935	34.9025	35.3191	35.5894	37.7396

However, this information is aggregated for the entire country, the share used for servicing mobile air-conditioning equipment being unspecified. In order to identify this information, it is admitted that circa 15% of the cumulative amount of refrigerants charged into mobile air-conditioning equipment is used for servicing this equipment, considering that circa 6% (margin used by default: between 2 and 10%) of the total amount of imported refrigerant used for servicing mobile air-conditioning equipment is lost through fugitive emissions during management of containers loaded with refrigerants.

VI) Transport Refrigeration

Equipment used for the refrigerated transportation of fresh and frozen food includes: Battery-operated aggregates, closed-type aggregates, refrigerators, split-off and monoblock for the transportation of small and medium-sized rooms. The respective equipment and systems use R-404a refrigerant (average charge – 7 kg/unit), specific to refrigerated trucks with a capacity of 20 tonnes and more, and with a capacity less than 5 tonnes, respectively. AD used to estimate HFC emissions from consumption of hydrofluorocarbons charged into transport refrigeration systems was provided by SOE 'State Information Resources Centre 'Register' (SOE 'CRIS 'Register') (for the period 1995-2013), and by the Public Services Agency of the RM (for 2014-2020) based on the information included in the State Transport Register.

In order to estimate the amount of R-404a used in transport refrigeration systems, the information on the total number of transportation means used for transport refrigeration of fresh and frozen food was considered (Table 4-130).

Table 4-130: Number of refrigerators between 1995-2020 (end of calendar year total), units

	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
Refrigerators ≥ 20 t	897	1,059	1,223	1,386	1,550	1,712	1,886	2,060	2,236	2,410	2,490	2,566	2,686
Refrigerators 5-20 t	451	454	457	459	462	465	467	469	470	472	473	473	476
Refrigerators < 5 t	396	398	399	401	402	404	406	408	409	411	411	415	416
Total	**1,744**	**1,911**	**2,079**	**2,246**	**2,414**	**2,581**	**2,759**	**2,937**	**3,115**	**3,293**	**3,374**	**3,454**	**3,578**
	2008	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**
Refrigerators ≥ 20 t	2,756	2,760	2,791	2,814	2,822	2,828	2,836	2,844	2,798	2,301	2,303	2,303	2,112
Refrigerators 5-20 t	476	476	476	476	476	476	476	480	471	452	452	452	448
Refrigerators < 5 t	416	418	418	419	419	419	419	399	411	401	401	401	401
Total	**3,648**	**3,654**	**3,685**	**3,709**	**3,717**	**3,723**	**3,731**	**3,723**	**3,680**	**3,154**	**3,156**	**3,156**	**2,961**

According to the information received from the International Association of Road Haulers of Moldova (AITA), circa 60-65 enterprises in the country own refrigerators with a capacity of 20 tonnes and more (the cooling capacity is circa 10 kw per unit), which are used predominantly for international freight transportation. Refrigerators with a capacity up to 5 tonnes (the cooling capacity is circa 5 kw per unit) are used predominantly on the domestic market of transport refrigeration for fresh and frozen food and there are a number of companies such as Incomlac, Drancor, Sandriliona, Amir, Carmez, Basarabia-Nord, Rogob, Pegas and others with a truck fleet of circa 10-50 units each.

The share of refrigerants used in food transport refrigeration equipment in the Republic of Moldova varied from one year to another (Table 4-131).

Table 4-131: Share of refrigerants charged into food transport refrigeration equipment for the period 1995-2020, %

	Refrigerant	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
Refrigerators	R-22	100	100	100	100	100	100	100	100	100	100	100	63.1	60.1
	R-404a	0	0	0	0	0	0	0	0	0	0	0	36.9	39.9
	Refrigerant	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**
Refrigerators	R-22	56.7	52.9	49.2	45.5	41.8	38.0	34.2	30.6	26.6	21.9	18.2	11.5	7.1
	R-404a	43.3	47.1	50.8	54.5	58.2	62.0	65.8	69.4	73.4	78.1	81.8	88.5	92.9

Source: Republican Association of Refrigeration Technicians of the Republic of Moldova.

The information on the share of refrigerants used in refrigeration equipment imported into the country (Table 4-198), the share of refrigerants charged into the equipment for refrigerated transport of food for the period 1995-2020 (Table 4-131), the average refrigerant charge of the respective equipment (Table 4-102) and statistical data on the import of refrigerated food transport equipment (Table 4-130) was used to estimate the cumulative amount of R-404a charged into transport refrigeration in the Republic of Moldova (Table 4-132).

Table 4-132: AD on the cumulative amount of R-404a charged into food transport refrigeration equipment for the period 1995-2020, t

	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
R-404a	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	8.9103	10.0044
	2008	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**
R-404a	11.0670	12.0540	13.0960	14.1442	15.1543	16.1630	17.1836	18.0978	18.9049	17.2459	18.0618	19.5529	19.2486

Activity data on the total amount of refrigerants imported into the country for servicing transport refrigeration equipment (Table 4-133) was provided through reports submitted by economic agents annually to The National Ozone Unit within the Public Institution 'Environmental Project Implementation Unit' of the Ministry of Environment.

Table 4-133: AD on refrigerants imported for servicing food transport refrigeration equipment for the period 1995-2020, t/yr

	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
R-404a	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	1.4167	1.5907
	2008	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**
R-404a	1.7597	1.9166	2.0823	2.2489	2.4095	2.5699	2.7322	2.8776	3.0059	2.7421	2.8718	3.1089	3.0605

However, this information is aggregated for the entire country, the share used for servicing transport refrigeration equipment being unspecified. In order to identify this information, it is admitted that circa 15% of the total amount of refrigerants charged into transport refrigeration equipment is used for servicing this equipment, considering that circa 6% (margin used by default: between 2 and 10%)

of the total amount of imported refrigerant is lost through fugitive emissions during the management of containers loaded with refrigerants.

VII) Refrigeration and Air Conditioning – Total

Based on the above information regarding the estimates of refrigerant import for servicing refrigeration and air conditioning equipment (domestic, commercial, industrial, transport refrigeration, and stationary and mobile air-conditioning equipment), the amount of refrigerants imported into the RM for the period 1995-2020 was calculated (Table 4-134).

Table 4-134: Imported refrigerants for refrigeration and air conditioning for 1995-2020, tone

	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
R-32	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
R-134a	0.5251	0.8686	1.2489	1.6814	2.1473	2.6616	3.4855	4.2970	5.3937	6.5466	7.9084	9.3729	12.5385	15.7672
R-404a	NO	NO	NO	NO	NO	NO	NO	NO	0.3126	0.7167	1.2650	3.3246	4.6917	6.0966
R-407c	NO	NO	NO	NO	NO	NO	NO	NO	0.0715	0.1519	0.3031	0.5591	1.1112	1.6201
R-408a	NO	NO	NO	NO	NO	NO	NO	NO	0.0357	0.0759	0.1177	0.1770	0.3697	0.5524
R-410a	NO	NO	NO	NO	NO	NO	NO	NO	0.0642	0.1830	0.3576	0.6088	1.5212	2.4404
R-422d	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
R-507a	NO	NO	NO	NO	NO	NO	NO	NO	0.1336	0.3362	0.8157	1.4559	2.5616	3.6728
TOTAL	**0.5251**	**0.8686**	**1.2489**	**1.6814**	**2.1473**	**2.6616**	**3.4855**	**4.2970**	**6.0112**	**8.0103**	**10.7674**	**15.4985**	**22.7940**	**30.1495**
	2009	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**TOTAL**
R-32	NO	NO	NO	NO	NO	0.2056	0.3402	0.7822	1.4255	2.3541	3.6110	5.1145	NA	13.8332
R-134a	17.6659	19.5438	21.7100	23.2226	25.0439	30.8976	46.5607	48.4922	56.0097	57.5203	57.0557	58.1154	NA	536.2807
R-404a	7.2329	8.7523	10.5983	12.4579	14.7570	17.2797	19.9303	22.9164	26.4092	30.8656	35.6982	40.6173	NA	263.9222
R-407c	1.9599	2.3713	2.8324	3.3223	3.9612	4.6161	5.3195	6.1035	7.0058	8.0515	8.8639	9.7109	NA	67.9353
R-408a	0.6484	0.7381	0.8472	0.9207	1.0156	1.0918	1.1308	1.1527	1.2182	1.2820	1.2210	1.1506	NA	13.7456
R-410a	2.6489	3.2747	4.1939	5.0804	6.2986	7.3073	8.1938	9.2409	10.5383	11.8836	12.6522	13.4240	NA	99.9119
R-422d	NO	NO	NO	NO	NO	NO	NO	0.7194	1.5600	2.6564	3.9185	5.3442	NA	14.1986
R-507a	4.6480	5.7626	7.2634	8.7049	10.4470	12.3418	14.4158	16.5573	19.1336	21.8775	24.5552	27.2512	NA	181.9340
TOTAL	**34.8041**	**40.4429**	**47.4452**	**53.7089**	**61.5232**	**73.7400**	**95.8911**	**105.9649**	**123.3002**	**136.4909**	**147.5759**	**160.7280**	**NA**	**1,191.7614**

Between 2009 and 2020, periodical questionnaires were submitted to economic agents with a license for import, export, re-export, transit and circulation of ozone layer depleting substances (ODS) and ODS equipment. The number of these companies was relatively low and varied insignificantly during the period under review. The National Ozone Unit within the Public Institution 'Environmental Project Implementation Unit' of the Ministry of Environment has information on refrigerants imported into the country between 2003 and 2020, but due to the few responses to these questionnaires from economic agents (Coral Ltd. reported information for 2004-2005, 'Ecolux' Ltd. – for 2003-2020, 'Frio-Dins' Ltd. – for 2010-2020, 'Frigoinds' Ltd. – for 2003-2020, 'Frig Industrial' Ltd. – for 2019-2020, 'York Regrigerent' Ltd. – for 2011-2020, CS Dina-Cociug Ltd. – for 2013-2020), this information is considered incomplete). For the last 8 years (2013-2020), available information is considered more complete, including the fact that starting with 01.01.2013, the former Ministry of Environment of the RM established the procedure for granting the import, export and re-export authorizations for chemical ODS and for the equipment and products charged with such substances. The respective companies report annually to the National Ozone Unit of the Public Institution "Environmental Projects Implementation Unit" (PI "EPIU") of the ME, including information on the following indicators: stock at the beginning of the year, imports during the reporting year, the amount of substances purchased within the country during the reporting year, the amount sold and used during the reporting year and the stock at the end of the year.

Below, for comparison, AD on actual refrigerants imported is presented for refrigeration and air conditioning service in the country for the period 1995-2020 (Table 4-135).

Table 4-135: Amount of main types of refrigerants actually imported between 1995-2020, t

	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
R-32	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
R-134a	0.1124	0.1730	0.2662	0.4095	0.6299	0.9692	1.4910	2.2939	3.5293	2.6596	2.4480	2.3360	4.3760	9.7940
R-404a	NO	NO	NO	NO	NO	NO	NO	NO	0.4496	1.1095	2.2890	2.5060	2.8460	7.1920
R-407c	NO	NO	NO	NO	NO	NO	NO	NO	NO	0.2885	1.4490	0.5200	0.4520	1.2430
R-408a	NO	NO	NO	NO	NO	NO	NO	NO	NO	0.4473	0.3350	0.0000	0.4360	0.4360
R-410a	NO	NO	NO	NO	NO	NO	NO	NO	NO	0.0113	0.0000	0.4520	0.0000	0.4540
R-422d	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
R-507a	NO	NO	NO	NO	NO	NO	NO	NO	0.0565	3.5990	1.6008	0.8840	0.4068	6.1140
TOTAL	**0.1124**	**0.1730**	**0.2662**	**0.4095**	**0.6299**	**0.9692**	**1.4910**	**2.2939**	**4.0354**	**8.1152**	**8.1218**	**6.6980**	**8.5168**	**25.2330**

	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	TOTAL
R-32	NO	NO	NO	NO	NO	0.0900	0.0000	0.0000	0.5900	1.5000	3.1880	8.5107	NA	13.8787
R-134a	3.5360	15.3600	12.0440	9.0240	65.5928	49.9577	36.2990	32.0140	27.6080	125.3212	62.3590	65.7544	NA	536.3580
R-404a	4.3600	1.6350	15.5849	5.7770	12.6220	21.2758	29.6480	18.5300	18.5739	44.8426	44.2110	30.5197	NA	263.9720
R-407c	3.0510	0.0000	2.0340	2.2600	1.4690	2.1490	2.9945	3.7490	9.2670	20.1140	8.7640	8.1360	NA	67.9400
R-408a	0.4360	0.2180	0.2180	0.2180	0.2180	0.3815	0.2180	0.0000	0.0000	10.2830	0.0000	0.0000	NA	13.8448
R-410a	2.5990	0.5650	1.1300	1.1300	5.4240	3.3920	4.5200	7.5060	7.3881	41.8033	12.6057	11.0245	NA	100.0048
R-422d	NO	NO	NO	NO	NO	NO	NO	NO	4.7970	2.3600	5.8500	1.2300	NA	14.2370
R-507a	2.9380	0.0000	3.9650	2.7120	7.6730	6.7200	18.5920	16.7760	37.9110	38.5330	13.3792	20.1340	NA	181.9943
TOTAL	**16.9200**	**17.7780**	**34.9759**	**21.1210**	**92.9988**	**83.9660**	**92.2715**	**78.5750**	**106.1350**	**284.7571**	**150.3569**	**145.3093**	**NA**	**1192.2296**

As it can be seen from the information presented above, the differences between the total amount of the main types of refrigerants actually imported into the Republic of Moldova between 2003 and 2020 (as previously explained, as the information was collected through questionnaires, there is no certainty that the data is complete) (Table 4-135) and those calculated for the same period following the estimation methodology available in the 2006 IPCC Guidelines (Table 4-134) are relatively small.

2F2 'Foam Blowing Agents'

HFC emissions from foam blowing consumption (particularly closed-cell foams) used in insulation, cushioning and packaging, with blowing agents such as HFC-245fa, HFC-365mfc, HFC-134a and HFC-152a, were calculated using a Tier 2 approach.

The IPCC 2006 Guidelines suggests that HFC emissions from closed-cell foams should be calculated separately from open-cell foams.

Hydrofluorocarbons used in the production of expanded foams with open cells are emitted into the atmosphere instantly, all emissions being generated during their production. Since no open-cell foams are produced in the Republic of Moldova, no emissions are recorded from this category, respectively.

Emissions from closed-cell foam occur at three distinct points:

1) First year losses from foam manufacture and application, these emissions occur where the product is manufactured and applied;
2) Annual losses (in situ losses from foam use); closed-cells foam will lose a fraction of their initial charge each year until decommissioning;
3) Decommissioning losses: emissions upon decommissioning also occur where the product is used.

Emissions from closed-cell foam were estimated following Equation 7.7 in the 2006 IPCC Guidelines (Volume 3, Chapter 7.4, page 7.38).

$$Emissions_t = M_t \bullet EF_{FYL} + Bank \bullet EF_{AL} + DL_t - RD_t$$

Where:

$Emissions_t$ – emissions from closed-cell foam in year *t*, tonnes;

M_t – total HFC used in manufacturing new closed-cell foam in year *t*, tonnes;

EF_{FYL} – first year loss emission factor, fraction (%);

$Bank_t$ – HFC charge blown into closed-cell foam manufacturing between year *t* and *year t-n*, tonnes;

EF_{AL} – annual loss emission factor, fraction (%);

DL_t – decommissioning losses in year *t* at the end of the period of exploitation of the production from closed-cell expanded foams, tonnes;

RD_t – HFC emissions prevented by recovery and destruction of foams and their blowing agents in year *t*, tonnes;

n – product lifetime of closed-cell foam;

t – Current year;

(*t-n*) – The total period over which HFCs used in foams could still be present.

This equation is applied to each chemical and major foam application individually. Total emissions expressed in CO_2 equivalent are equal to the sum of CO_2 equivalent emissions of each combination of chemical type and foam application. If country-specific data is not available, default emission factors can be used (Table 4-136).

Table 4-136: Default emission factors for source category 2F2 'Foam Blowing Agents'

Emission Factor	Default Value
Product lifetime of closed-cell foam	n = 20 years
First Year Losses	10% of the original HFC charge/year
Annual Losses	4.5% of the original HFC charge/year

Source: 2006 IPCC Guidelines, Volume 3, Chapter 7.4, Table 7.5, page 7.35.

In the RM, foam blowing production has been recorded since 2005. AD on the production of foam blowing is available in the Statistical Reports PRODMOLD-A 'Total production, as a natural expression, in the Republic of Moldova, by product type' (Table 4-137).

Table 4-137: Production of foam blowing products between 2005-2020, kt

	2005	2006	2007	2008	2009	2010	2011	2012
Polystyrene in primary forms	0.2102	0.3471	0.3428	0.1605	0.1538	0.0992	0.0932	0.1425
Cellular products of polystyrene	0.2485	0.7064	0.8043	0.5590	1.5819	1.8756	2.1692	2.0126
Polyurethane in primary forms	0.4901	0.3787	0.1472	0.5350	0.8896	0.8318	0.6823	0.3711
Cellular products of polyurethane	NO	NO	NO	NO	NO	NO	NO	0.0016
	2013	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**
Polystyrene in primary forms	0.0748	0.0601	0.0382	NO	NO	NO	NO	NO
Cellular products of polystyrene	2.1187	2.4715	2.8987	2.5468	2.1178	2.0968	1.9339	2.3033
Polyurethane in primary forms	0.2805	NO	NO	NO	NO	NO	NO	NO
Cellular products of polyurethane	0.2064	0.3429	NO	NO	NO	NO	NO	NO

Source: Statistical Reports PRODMOLD-A 'Total production, as a natural expression, in the Republic of Moldova, by product type, for 2005-2020'.

It is unknown which blowing agents are used in the production of foam blowing products, but since the production is relatively recent, it was considered that the polystyrene in primary forms are ethanol- and CO_2-based, whereas the polyurethane in primary forms are pentane-based (C,I,N).

AD on imported foam blowing products in the country is provided by the Customs Service of the Republic of Moldova (Table 4-138).

Table 4-138: Import of foam blowing products between 1995-2020, kt

	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
Polystyrene in primary forms, kt (product code: 3903 11)	0.5536	0.2219	0.1566	0.1699	0.1664	0.3989	0.2947	0.5041	0.8946	0.8966	1.8168	2.4757	2.7488
Cellular products of polystyrene, kt (product code: 3921 11)	0.0178	0.0090	0.0494	0.0462	0.0210	0.0112	0.0959	0.2456	0.3957	0.4913	0.6055	0.6123	0.5979
Polyurethane in primary forms, kt (product code: 3909 50)	0.2163	0.1401	0.0660	0.0290	0.0408	0.0394	0.0222	0.0142	0.0679	0.1815	0.3647	0.3061	0.5404
Cellular products of polyurethane, kt (product code: 3921 13)	0.1360	0.1463	0.1128	0.0869	0.1130	0.1472	0.2024	0.4243	0.5286	0.5734	0.6816	1.0061	1.5276
Total foam blowing products, kt	**0.9237**	**0.5173**	**0.3848**	**0.3320**	**0.3411**	**0.5968**	**0.6151**	**1.1882**	**1.8867**	**2.1428**	**3.4687**	**4.4001**	**5.4147**
	2008	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**
Polystyrene in primary forms, kt (product code: 3903 11)	3.0178	2.5255	3.0971	3.1368	3.2978	3.3007	3.6391	3.9539	3.6553	3.5936	3.6205	4.4201	3.9773
Cellular products of polystyrene, kt (product code: 3921 11)	0.7121	0.6277	0.6388	0.5445	0.6879	0.7153	0.8484	1.0409	1.2934	1.2578	1.3496	1.5463	1.8438
Polyurethane in primary forms, kt (product code: 3909 50)	0.7696	0.5989	0.6841	0.7048	0.3633	0.1630	0.1642	1.0715	0.1328	0.2489	0.3566	0.3571	0.3221
Cellular products of polyurethane, kt (product code: 3921 13)	1.2466	0.6455	0.8602	0.8332	0.8468	0.9430	0.8133	0.9074	0.8186	0.9586	1.1100	1.0666	1.0232
Total foam blowing products, kt	**5.7461**	**4.3975**	**5.2802**	**5.2193**	**5.1958**	**5.1220**	**5.4650**	**6.9737**	**5.9002**	**6.0589**	**6.4367**	**7.3901**	**7.1664**

Source: Customs Service of the RM, through Letter dated 19.02.2021, as a response to the interpellation of the MARDE No. 13-07/519 dated 09.02.2021; Letter No. 28/07-3025 dated 28.02.2020, as a response to the request from the Environment Agency No. 08-310/1 dated 11.02.2020; Letter No. 28/07-612 dated 12.01.2018, as a response to the request from the Climate Change Office of the MARDE No. 601/2017-12-03 dated 14.12.2017; Letter No. 28/07-8785 dated 26.05.2016, as a response to the request from the Climate Change Office of the Ministry of Environment No. 512/2016-05-01 dated 10.05.2016; Letter No. 28/07-2231 dated 26.02.2015, as a response to the request from the Climate Change Office of the Ministry of Environment No. 407/2015-01-09 dated 29.01.2015; Letter No. 15-03-05 dated 24.01.2014, as a response to the request from the Climate Change Office of the Ministry of Environment No. 320/2014-01-01 dated 03.01.2014; Letter No. 28/07-1893 dated 23.02.2011, as a response to the request from the Ministry of Environment No. 03-07/175 dated 02.02.2011

The most frequently used blowing agents in polyurethane and polystyrene foam manufacturing can be considered HFC-134a, HFC-152a, HFC-245fa, HFC-365mfc, Pentane (C,I,N) and CO_2/ethanol.

Since the share of blowing agents in foam products in total imports is unknown, it has been determined considering expert opinions (Table 4-139 and Table 4-140), especially the European and international experience regarding HFC emissions inventory process within the respective category, as well as the recent trend among the manufacturers of foam blowing products to decrease the use of HFCs as blowing agents, following the international commitments to phasing out F-gas consumption, especially when there already are competitive alternative technologies on the foam blowing market[62],[63].

Table 4-139: Share of blowing agents charged into polyurethane products imported into the RM for the period 1995-2020, %

	Blowing Agent	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
Polyurethane in primary forms	HCFC-22	50	50	50	50	50	50	45	45	45	40	30	25	20
	HCFC-141b	45	45	45	40	40	40	40	40	40	40	30	30	25
	HFC-134a	5	5	5	10	10	10	15	15	15	20	20	20	25
	HFC-365mfc	0	0	0	0	0	0	0	0	0	0	5	5	5
	HFC-245fa	0	0	0	0	0	0	0	0	0	0	5	5	5
	Pentane (C,I,N)	0	0	0	0	0	0	0	0	0	0	10	15	20
	Blowing Agent	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**
Polyurethane in primary forms	HCFC-22	15	5	0	0	0	0	0	0	0	0	0	0	0
	HCFC-141b	15	5	0	0	0	0	0	0	0	0	0	0	0
	HFC-134a	20	20	15	15	10	10	5	5	0	0	0	0	0
	HFC-365mfc	10	15	15	15	15	15	20	20	15	15	10	10	5
	HFC-245fa	10	15	15	15	15	10	10	10	10	10	10	10	5
	Pentane (C,I,N)	30	40	55	55	60	65	65	65	75	75	75	80	90

The volume of blowing agents in foam products imported into the RM was identified based on the information available in the literature in the field, with the assumption that for the polyurethane products HCFC-22, HCFC-141b and HFC-134a have a volume of circa 6% of the total mass of the product[64], HFC-365mfc – 9%, HFC-254fa – 10%, and Pentane (C,I,N) – 7.5%; as for the polystyrene products HFC-134a has a volume of circa 13% of the total mass of the product, HFC-152a – 8%, HCFC-22 and HFCF-142b – 12%, and CO_2 + ethanol – 6% of the total[65].

Table 4-140: Share of blowing agents charged into polystyrene products imported into the RM for the period 1995-2020, %

	Blowing Agent	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
Polystyrene in primary forms	HCFC-22	50	50	50	45	45	40	35	35	35	30	25	20	15
	HCFC-142b	45	45	45	45	45	45	45	45	40	40	35	30	25
	HFC-134a	5	5	5	10	10	10	15	15	15	20	20	20	25
	HFC-152a	0	0	0	0	0	5	5	5	10	10	10	15	15
	CO_2 / ethanol	0	0	0	0	0	0	0	0	0	0	10	15	20
	Blowing Agent	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**
Polystyrene in primary forms	HCFC-22	10	5	0	0	0	0	0	0	0	0	0	0	0
	HCFC-142b	20	10	0	0	0	0	0	0	0	0	0	0	0
	HFC-134a	25	25	20	20	15	10	5	5	0	0	0	0	0
	HFC-152a	20	25	30	30	30	30	35	35	35	35	30	30	25
	CO_2 / ethanol	25	35	50	50	55	60	60	60	65	65	70	70	75

Considering the AD provided in Table 4-138 as well as the share of different blowing agents used in foam products imported into the Republic of Moldova between 1995 and 2020 (Tables 4-139 and 4-140), respectively considering the volume of blowing agents in foams, the share of blowing agents contained in polyurethane products (Table 4-141) and polystyrene products (Table 4-142) imported into the country was estimated for the period 1995-2020.

Table 4-141: AD on import of blowing agents charged into polyurethane products for the period 1995-2020, kt

	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
HCFC-22	0.0095	0.0077	0.0048	0.0031	0.0042	0.0050	0.0055	0.0107	0.0145	0.0163	0.0170	0.0177	0.0223
HCFC-141b	0.0086	0.0070	0.0043	0.0025	0.0033	0.0040	0.0048	0.0095	0.0129	0.0163	0.0170	0.0213	0.0279
HFC-134a	0.0010	0.0008	0.0005	0.0006	0.0008	0.0010	0.0018	0.0036	0.0048	0.0082	0.0113	0.0142	0.0279
HFC-365mfc	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0.0042	0.0053	0.0084
HFC-245fa	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0.0047	0.0059	0.0093
Pentane (C,I,N)	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0.0071	0.0133	0.0279
Total	**0.0190**	**0.0155**	**0.0097**	**0.0063**	**0.0083**	**0.0101**	**0.0121**	**0.0237**	**0.0322**	**0.0408**	**0.0612**	**0.0776**	**0.1238**

[62] Natural Foam Blowing Agents, Sustainable Ozone- and Climate-Friendly Alternatives to HCFCs (2012), PROKLIMA International Programme of the Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH, commissioned by the Federal Ministry for Economic Cooperation and Development (BMZ) Environment and Sustainable Use of Natural Resources Division. Eschborn, September 2012, page 178.

[63] Danish Ministry of the Environment, Environment Protection Agency (2010), Greenhouse Gases HFCs, PFCs and SF6, Danish Consumption and Emissions, 2008, Environmental Project No. 1323 2010, <http://www2.mst.dk/udgiv/publications/2010/978-87-92617-66-8/pdf/978-87-92617-67-5.pdf>.

[64] EMEP/EEA Emission Inventory Guidebook 2009, Category 3.C, Chemical products', 3.3.2.2 'Polyurethane foam processing' and Chapter 3.3.2.3 'Polystyrene processing', page 17.

[65] Natural Foam Blowing Agents, Sustainable Ozone- and Climate-Friendly Alternatives to HCFCs (2012), PROKLIMA International Programme of the Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH, commissioned by the Federal Ministry for Economic Cooperation and Development (BMZ) Environment and Sustainable Use of Natural Resources Division. Eschborn, September 2012. page 178.

	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
HCFC-22	0.0163	0.0034	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
HCFC-141b	0.0163	0.0034	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
HFC-134a	0.0218	0.0134	0.0125	0.0125	0.0065	0.0060	0.0026	0.0053	NO	NO	NO	NO	NO
HFC-365mfc	0.0163	0.0151	0.0188	0.0187	0.0147	0.0134	0.0158	0.0321	0.0116	0.0147	0.0119	0.0115	0.0054
HFC-245fa	0.0181	0.0168	0.0208	0.0208	0.0163	0.0100	0.0088	0.0178	0.0086	0.0109	0.0132	0.0128	0.0061
Pentane (C,I,N)	0.0408	0.0336	0.0573	0.0571	0.0490	0.0485	0.0429	0.0868	0.0482	0.0611	0.0742	0.0769	0.0817
Total	**0.1297**	**0.0857**	**0.1094**	**0.1090**	**0.0866**	**0.0779**	**0.0702**	**0.1420**	**0.0683**	**0.0867**	**0.0993**	**0.1012**	**0.0932**

Table 4-142: AD on import of blowing agents charged into polystyrene products in the RM for the period 1995-2020, kt

	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
HCFC-22	0.0309	0.0125	0.0111	0.0105	0.0091	0.0177	0.0148	0.0283	0.0488	0.0450	0.0654	0.0667	0.0542
HCFC-142b	0.0278	0.0112	0.0100	0.0105	0.0091	0.0199	0.0190	0.0364	0.0557	0.0600	0.0916	0.1000	0.0904
HFC-134a	0.0033	0.0014	0.0012	0.0025	0.0022	0.0048	0.0069	0.0132	0.0226	0.0325	0.0567	0.0723	0.0979
HFC-152a	NO	NO	NO	NO	NO	0.0015	0.0014	0.0027	0.0093	0.0100	0.0174	0.0333	0.0361
CO_2+etanol	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0.0131	0.0250	0.0361
Total	**0.0620**	**0.0250**	**0.0223**	**0.0235**	**0.0204**	**0.0439**	**0.0420**	**0.0806**	**0.1364**	**0.1474**	**0.2442**	**0.2974**	**0.3148**
	2008	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**
HCFC-22	0.0403	0.0170	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
HCFC-142b	0.0806	0.0341	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
HFC-134a	0.1091	0.0922	0.0874	0.0861	0.0699	0.0470	0.0263	0.0292	NO	NO	NO	NO	NO
HFC-152a	0.0537	0.0568	0.0807	0.0795	0.0861	0.0867	0.1131	0.1259	0.1247	0.1223	0.1074	0.1289	0.1048
CO_2+etanol	0.0504	0.0596	0.1009	0.0994	0.1184	0.1301	0.1454	0.1618	0.1737	0.1703	0.1879	0.2255	0.2358
Total	**0.3340**	**0.2597**	**0.2690**	**0.2651**	**0.2744**	**0.2638**	**0.2847**	**0.3169**	**0.2984**	**0.2925**	**0.2952**	**0.3544**	**0.3405**

Activity data on the cumulative amount of blowing agents charged into foam blowing products imported between 1995 and 2020 are presented below (Tables 4-143 and 4-144).

Table 4-143: AD on the cumulative amount (bank) of blowing agents charged into polyurethane products imported into the RM for the period 1995-2020, kt

	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
HCFC-22	0.0095	0.0172	0.0221	0.0252	0.0294	0.0344	0.0398	0.0505	0.0650	0.0813	0.0983	0.1160	0.1383
HCFC-141b	0.0086	0.0155	0.0199	0.0224	0.0257	0.0297	0.0346	0.0440	0.0569	0.0732	0.0902	0.1114	0.1394
HFC-134a	0.0010	0.0017	0.0022	0.0028	0.0037	0.0047	0.0065	0.0100	0.0149	0.0230	0.0343	0.0485	0.0764
HFC-365mfc	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0.0042	0.0096	0.0179
HFC-245fa	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0.0047	0.0106	0.0199
Pentane (C,I,N)	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0.0071	0.0203	0.0483
Total	**0.0190**	**0.0345**	**0.0441**	**0.0504**	**0.0587**	**0.0688**	**0.0809**	**0.1046**	**0.1368**	**0.1776**	**0.2388**	**0.3164**	**0.4402**
	2008	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**
HCFC-22	0.1546	0.1580	0.1580	0.1580	0.1580	0.1580	0.1580	0.1485	0.1408	0.1359	0.1328	0.1286	0.1236
HCFC-141b	0.1557	0.1590	0.1590	0.1590	0.1590	0.1590	0.1590	0.1505	0.1435	0.1392	0.1367	0.1334	0.1293
HFC-134a	0.0982	0.1116	0.1241	0.1366	0.1431	0.1491	0.1517	0.1561	0.1554	0.1549	0.1543	0.1534	0.1524
HFC-365mfc	0.0343	0.0494	0.0681	0.0868	0.1015	0.1150	0.1308	0.1629	0.1744	0.1891	0.2010	0.2125	0.2180
HFC-245fa	0.0381	0.0549	0.0757	0.0965	0.1128	0.1228	0.1316	0.1494	0.1579	0.1688	0.1820	0.1948	0.2009
Pentane (C,I,N)	0.0891	0.1227	0.1800	0.2371	0.2861	0.3347	0.3775	0.4644	0.5125	0.5737	0.6479	0.7248	0.8065
Total	**0.5699**	**0.6556**	**0.7651**	**0.8741**	**0.9606**	**1.0385**	**1.1087**	**1.2317**	**1.2845**	**1.3616**	**1.4546**	**1.5475**	**1.6307**

Table 4-144: AD on the cumulative amount (bank) of blowing agents charged into polystyrene products imported into the RM for the period 1995-2020, kt

	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
HCFC-22	0.0309	0.0433	0.0544	0.0650	0.0741	0.0918	0.1065	0.1349	0.1836	0.2286	0.2940	0.3607	0.4149
HCFC-142b	0.0278	0.0390	0.0490	0.0595	0.0686	0.0885	0.1075	0.1440	0.1997	0.2597	0.3512	0.4513	0.5416
HFC-134a	0.0033	0.0047	0.0059	0.0084	0.0106	0.0154	0.0223	0.0354	0.0581	0.0905	0.1472	0.2195	0.3174
HFC-152a	NO	NO	NO	NO	NO	0.0015	0.0029	0.0056	0.0149	0.0249	0.0423	0.0757	0.1118
CO_2+ethanol	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0.0131	0.0381	0.0742
Total	**0.0620**	**0.0870**	**0.1094**	**0.1329**	**0.1533**	**0.1972**	**0.2392**	**0.3198**	**0.4563**	**0.6037**	**0.8479**	**1.1452**	**1.4600**
	2008	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**
HCFC-22	0.4552	0.4722	0.4722	0.4722	0.4722	0.4722	0.4722	0.4414	0.4289	0.4178	0.4073	0.3982	0.3805
HCFC-142b	0.6222	0.6562	0.6562	0.6562	0.6562	0.6562	0.6562	0.6285	0.6173	0.6072	0.5967	0.5876	0.5677
HFC-134a	0.4265	0.5187	0.6061	0.6923	0.7622	0.8092	0.8355	0.8613	0.8600	0.8588	0.8563	0.8541	0.8493
HFC-152a	0.1655	0.2223	0.3030	0.3825	0.4686	0.5553	0.6684	0.7943	0.9190	1.0412	1.1486	1.2775	1.3822
CO_2+ethanol	0.1246	0.1842	0.2851	0.3844	0.5028	0.6329	0.7783	0.9402	1.1139	1.2841	1.4720	1.6976	1.9333
Total	**1.7940**	**2.0536**	**2.3226**	**2.5877**	**2.8621**	**3.1260**	**3.4107**	**3.6656**	**3.9390**	**4.2092**	**4.4809**	**4.8149**	**5.1130**

2F3 'Fire Protection'

HFC emissions from fire protection were calculated using a Tier 1 methodology, based on a default emission factor. The respective emissions were estimated using Equation 7.17 in the 2006 IPCC Guidelines (Volume 3, Chapter 7.6, page 7.61).

$$Emissions_t = Bank_t \bullet EF + RRL_t$$
and
$$Bank_t = \Sigma_{i-t^0} (Production_t + Import_t - Export_t - Destruction_t - Emissions_t) - RRL_t$$

Where:

Emissions $_t$ – emissions of agent from fire protection equipment in year *t*, tonnes;

Bank $_t$ – bank of agent in fire protection equipment in year *t*, tonnes;

EF – the emission factor or fraction of the extinguishing agent in the fire protection systems emitted each year (excluding emissions from retired equipment or otherwise removed from service), (%);

RRL $_t$ – Recovery Release or Loss: emissions of agent during recovery, recycling or disposal at the time of removal from use of existing fire protection equipment in year *t*, tonnes;

Production $_t$ – amount of newly supplied agent in fire protection equipment produced in year *t*, tonnes;

Import $_t$ – amount of agent in fire protection equipment imported in year *t*, tonnes;

Export $_t$ – amount of agent in fire protection equipment exported in year *t*, tonnes;

Destruction $_t$ – amount of agent from retired fire protection equipment that is collected and destroyed, tonnes;

t – year for which emissions are being estimated;

t_0 – first year of chemical production and/or use;

i – counter from first year of chemical production and/or use t_0 to current year t.

AD regarding the amount of extinguishing agent imported and re-exported from the Republic of Moldova was provided by the Customs Service for the period 2017-2020 (Table 4-109). The year in which the extinguishing agent HFC-227ea was introduced into the Republic of Moldova is considered the year 2017. Based on the respective information, the cumulative extinguishing agent bank for the period 2017-2020 was calculated (Table 4-145).

Table 4-145: Extinguishing agent HFC-227ea used in fire protection between 2017-2020, t

	2017	2018	2019	2020
Production of HFC-227ea, t	NO	NO	NO	NO
Import of HFC-227ea, t	2.0000	20.0000	22.0000	11.0000
Export of HFC-227ea, t	NO	14.5438	9.2834	NO
Total amount of HFC-227ea used in domestic fire protection systems, t	2.0000	5.4562	12.7166	11.000
Bank of extinguishing agent used in domestic fire protection systems, t	2.0000	7.3762	17.8777	23.0015

2F4 'Aerosols' (Metered Dose Aerosols)

HFC emissions from aerosol consumption (particularly metered dose aerosols, where HFC-134a is used as propellant) were estimated using a Tier 2 methodology. It is considered that during the use of aerosols 100% of the chemical is emitted into the atmosphere. The respective emissions occur within 1-2 years after sales and should be estimated using Equation 7.6 in the 2006 IPCC Guidelines (Volume 3, Chapter 7.3, page 7.28).

$$Emissions_t = S_t \bullet EF + S_{t-1} \bullet (1 - EF)$$

Where:

Emissions $_t$ – emissions in year *t*, tonnes;

S $_t$ – quantity of HFC and PFC contained in aerosol products sold in year *t*, tonnes;

EF – emission factor (= fraction of chemical emitted during the first year), fraction (%);

S $_{t-1}$ – quantity of HFC and PFC contained in aerosol products sold in year *t*–1, tonnes.

AD on the amount of medical substances imported into the Republic of Moldova (metered dose inhalers used in the treatment of asthma and chronicle pulmonary diseases, including tuberculosis was provided by the Agency for Medicines and Medical Devices for the period 2003-2020 (Table 4-146).

Table 4-146: Import of metered dose inhalers using HFC-134a as propellant between 2003-2020

	2003	2004	2005	2006	2007	2008	2009	2010	2011
Salbutamol sulphate - Salbutamol pressurized inhalation suspension, 100 mcg/dose, 200 doses	-	-	-	87,200	60,640	68,960	109,500	100,184	118,779
Salbutamol sulphate - Ventolin Inhaler 100 mcg/dose, 200 doses	-	4,500	7,923	12,206	5,448	12,800	13,236	19,450	14,500
Fenoterol hydrobromide - Berotec N pressurized inhalation solution 100 mcg/dose, 200 doses	3,014	6,548	4,320	3,524	4,363	1,558	5,138	4,164	7,984
Ipratropium bromide/Fenoterol hydrobromide - Berodual N pressurized inhalation solution 0.25 mg/dose, 200 doses	-	-	-	200	500	586	1,300	1,726	4,248
Ipratropium bromide / Fenoterol hydrobromide - Berodual N pressurized inhalation solution 20+50mcg/dose 10 ml	-	-	-	-	-	-	-	-	-
Fluticasone propionate - Flixotide 50 Evohaler 50 µg/dose, 120 doses	500	1,630	1,690	1,160	1,200	300	1,150	1,896	500
Fluticasone propionate - Flixotide 125 Evohaler 125 µg/dose, 60 doses	-	-	-	-	612	800	250	-	-
Fluticasone propionate - Flixotide 125 Evohaler 125 µg/dose, 120 doses	282	3,170	2,650	1,370	-	1,933	1,400	1,650	282
Fluticasone propionate - Flixotide 250 Evohaler 250 µg/dose, 60 doses	250	950	1,330	2,170	-	2,990	620	-	250
Fluticasone propionate - Flixotide 250 Evohaler 250 µg/dose, 120 doses	-	-	-	-	850	480	2,750	3,018	-
Salmeterol xinafoate / Fluticasone propionate - Seretide™/Diskus ™ Inhaler - pressurized inhalation suspension 50 mcg + 100 mcg/dose, 60 doses	-	-	-	-	-	-	-	-	-
Salmeterol xinafoate / Fluticasone propionate - Seretide™/Diskus ™ Inhaler - pressurized inhalation suspension 50 mcg + 250 mcg/dose, 60 doses	-	-	-	-	-	-	-	-	-
Salmeterol xinafoate / Fluticasone propionate - Seretide™/Diskus ™ Inhaler - pressurized inhalation suspension 50 mcg + 500 mcg/dose, 60 doses	-	-	-	-	-	-	-	-	-
Salmeterol xinafoate / Fluticasone propionate - Seretide Inhaler 25 µg + 50 µg, 120 doses	-	-	-	-	-	250	299	530	-
Salmeterol xinafoate / Fluticasone propionate - Seretide Inhaler 25 µg + 125 µg, 120 doses	-	-	-	-	-	-	-	-	-
Salmeterol xinafoate / Fluticasone propionate - Seretide Inhaler 25 µg + 250 µg, 120 doses	-	-	-	-	-	-	-	-	-
Salmeterol xinafoate - Serevente Inhaler 25 µg 120 doses	-	-	-	-	-	1,200	1,637	2,100	-
Fluticasone propionate - Flixotide 250 Evohaler 250 µg/dose, 60 doses	-	-	-	-	-	200	3,040	620	-
Fluticasone propionate - Flixotide 50 Evohaler 50 µg /dose, 120 doses	-	-	-	-	-	850	300	-	-
Fluticasone propionate - Flixotide 125 Evohaler 125 µg/dose, 120 doses	-	-	-	-	-	1,413	-	-	-
Fluticasone propionate - Flixotide 250 Evohaler 250 µg/dose, 60 doses	-	-	-	-	-	100	2,990	620	-
Combiwave SF 125 pressurized inhalation solution 25+125 mcg/dose, 120 doses (DCI - Salmeterol + Fluticasone)	-	-	-	-	-	-	-	-	-
Combiwave SF 250 pressurized inhalation solution 25+250 mcg/dose, 120 doses N1 (DCI - Salmeterol + Fluticasone)	-	-	-	-	-	-	-	-	-
Beclomethasone Dipropionate inhaler pressurized inhalation suspension 50 mcg/dose, 200 doses N1 (DCI - Beclomethasone)	-	-	-	-	-	-	-	-	-
Airtec Pressurised Inhalation 25 + 125 mcg / dose 120 dose	-	-	-	-	-	-	-	-	-
Airtec Pressurised Inhalation 25 + 250 mcg / dose 120 dose	-	-	-	-	-	-	-	-	-
Airtec Pressurised Inhalation 25 + 150 mcg / dose 120 dose	-	-	-	-	-	-	-	-	-
Pefsal pressurized inhalation suspension 25 + 125 mcg/dose, 120 doses (DCI - Salmeterol + Fluticasone)	-	-	-	-	-	-	-	-	-
Pefsal pressurized inhalation suspension 25 + 250 mcg/dose, 120 doses (DCI - Salmeterol + Fluticasone)	-	-	-	-	-	-	-	-	-
Total Metered Dose Inhalers using HFC-134a as propellant	**3,014**	**12,080**	**17,993**	**108,800**	**75,651**	**88,016**	**137,613**	**134,324**	**152,075**
	2012	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**
Salbutamol sulphate - Salbutamol pressurized inhalation suspension, 100 mcg/dose, 200 doses	109,144	85,200	90,840	-	-	900	-	-	-
Salbutamol sulphate - Ventolin Inhaler 100 mcg/dose, 200 doses	10,885	14,741	33,400	132,852	142,000	149,110	158,530	129,971	153,078
Fenoterol hydrobromide - Berotec N pressurized inhalation solution 100 mcg/dose, 200 doses	11,348	18,576	17,926	-	7,136	12,424	17,382	6,624	7,071
Ipratropium bromide/Fenoterol hydrobromide - Berodual N pressurized inhalation solution 0.25 mg/dose, 200 doses	5,096	-	-	14,736	-	-	-	-	-
Ipratropium bromide / Fenoterol hydrobromide - Berodual N pressurized inhalation solution 20+50mcg/dose 10 ml	-	6,568	5,712	7,212	7,428	8,209	10,948	12,078	10,920
Fluticasone propionate - Flixotide 50 Evohaler 50 µg/dose, 120 doses	3,116	2,400	2,930	3,230	7,973	3,891	4,350	3,596	3,220
Fluticasone propionate - Flixotide 125 Evohaler 125 µg/dose, 60 doses	300	496	820	930	10,598	8,458	8,650	9,703	13,040
Fluticasone propionate - Flixotide 125 Evohaler 125 µg/dose, 120 doses	600	3,108	4,739	5,715	7,375	323	-	-	-
Fluticasone propionate - Flixotide 250 Evohaler 250 µg/dose, 60 doses	300	200	400	-	-	-	-	-	-
Fluticasone propionate - Flixotide 250 Evohaler 250 µg/dose, 120 doses	-	-	-	-	-	-	-	-	-
Salmeterol xinafoate / Fluticasone propionate - Seretide™/Diskus ™ Inhaler - pressurized inhalation suspension 50 mcg + 100 mcg/dose, 60 doses	-	-	-	-	-	-	-	-	-
Salmeterol xinafoate / Fluticasone propionate - Seretide™/Diskus ™ Inhaler - pressurized inhalation suspension 50 mcg + 250 mcg/dose, 60 doses	-	50	50	-	-	-	-	-	-
Salmeterol xinafoate / Fluticasone propionate - Seretide™/Diskus ™ Inhaler - pressurized inhalation suspension 50 mcg + 500 mcg/dose, 60 doses	-	-	100	-	-	-	-	-	-
Salmeterol xinafoate / Fluticasone propionate - Seretide Inhaler 25 µg + 50 µg, 120 doses	-	-	-	-	-	-	-	-	-

	2012	2013	2014	2015	2016	2017	2018	2019	2020
Salmeterol xinafoate / Fluticasone propionate - Seretide Inhaler 25 µg + 125 µg, 120 doses	-	-	-	-	-	-	-	-	-
Salmeterol xinafoate / Fluticasone propionate - Seretide Inhaler 25 µg + 250 µg, 120 doses	-	-	-	-	-	-	-	-	-
Salmeterol xinafoate - Serevente Inhaler 25 µg 120 doses	-	-	-	-	-	-	-	-	-
Fluticasone propionate - Flixotide 250 Evohaler 250 µg/dose, 60 doses	-	-	-	-	-	-	-	-	-
Fluticasone propionate - Flixotide 50 Evohaler 50 µg /dose, 120 doses	-	-	-	4,207	6,049	2,476	2,346	5,042	4,488
Fluticasone propionate - Flixotide 125 Evohaler 125 µg/dose, 120 doses	-	-	-	7,475	18,870	9,160	6,731	18,858	27,301
Fluticasone propionate - Flixotide 250 Evohaler 250 µg/dose, 60 doses	-	-	-	2,710	13,480	6,860	6,150	12,631	17,684
Combiwave SF 125 pressurized inhalation solution 25+125 mcg/dose, 120 doses (DCI - Salmeterol + Fluticasone)	-	-	-	-	-	-	5,000	-	-
Combiwave SF 250 pressurized inhalation solution 25+250 mcg/dose, 120 doses N1 (DCI - Salmeterol + Fluticasone)	-	-	-	-	-	-	12,836	-	-
Beclomethasone Dipropionate inhaler pressurized inhalation suspension 50 mcg/dose, 200 doses N1 (DCI - Beclomethasone)	-	-	-	-	-	600	-	-	-
Airtec Pressurised Inhalation 25 + 125 mcg / dose 120 dose	-	-	-	-	-	-	-	6,000	9,000
Airtec Pressurised Inhalation 25 + 250 mcg / dose 120 dose	-	-	-	-	-	-	-	6,000	1,979
Airtec Pressurised Inhalation 25 + 150 mcg / dose 120 dose	-	-	-	-	-	-	-	6,000	-
Pefsal pressurized inhalation suspension 25 + 125 mcg/dose, 120 doses (DCI - Salmeterol + Fluticasone)	-	-	-	-	-	-	-	1,527	900
Pefsal pressurized inhalation suspension 25 + 250 mcg/dose, 120 doses (DCI - Salmeterol + Fluticasone)	-	-	-	-	-	-	-	903	5,006
Total Metered Dose Inhalers using HFC-134a as propellant	**140,789**	**131,339**	**156,917**	**179,067**	**220,909**	**202,411**	**232,923**	**218,933**	**253,687**

Sources: Ministry of Health of the RM: through Letter No. 019/550 dated March 1, 2011, as a response to the request from the Ministry of Environment No. 03-07/175 dated 02.02.2011; Letter No. 019/2045, dated September 14, 2011, as a response to the request from the Ministry of Environment No. 05-07/1321 dated 05.08.2011; Letter No. 01-9/220, dated 05.02.2014, as a response to the request from the Climate Change Office of the Ministry of Environment No. 320/2014-01-01 dated 03.01.2014; Letter No. 01-10/315, dated 04.03.2015, as a response to the request from the Climate Change Office of the Ministry of Environment No. 407/2015-01-09 dated 29.01.2015; Letter No. 01-10/483, dated 30.05.2016, as a response to the request from the Climate Change Office of the Ministry of Environment No. 512/2016-05-01 dated 10.05.2016; Agency for Medicines and Medical Devices: Letter No. Rg 02-359, dated 26.01.2018, as a response to the request from the Climate Change Office of the MARDE No. 612/2018-01-02 dated 10.01.2018; and Letter No. Rg 02-002625 dated 15.07.2020, as a response to the request from the MARDE No. 13-07/3044 dated 13.07.2020; Letter No. RG 02-003639 dated 10.08.2021, as a response to the request from the Environment Agency No. 08/136/2021 dated 09.06.2021.

It should be noted that metered dose inhalers are not produced in the Republic of Moldova and, in the past, these substances were imported mainly from Ukraine, Russia, India and China, whereas recently they have been imported from EU member states such as Spain, France, Germany, Poland, Turkey, and Great Britain. The amount of HFC-134a contained in metered dose aerosols was estimated based on activity data presented above (Table 4-147).

Table 4-147: AD on HFC-134a incorporated in metered dose aerosols imported between 2003-2020, kg

	2003	2004	2005	2006	2007	2008	2009	2010	2011
HFC-134a	0.0603	0.2319	0.3164	2.1384	1.4941	1.7696	2.8184	2.7135	3.1643
	2012	2013	2014	2015	2016	2017	2018	2019	2020
HFC-134a	2.9168	2.7674	3.2339	4.1284	4.4310	4.1703	5.0154	4.7211	5.3902

4.6.3. Uncertainties and Time-Series Consistency

2F1 'Refrigeration and Air Conditioning'

Uncertainties associated with the emission factors used to estimate HFC emissions from source category 2F1 'Refrigeration and Air Conditioning' reach up to circa 50%. Uncertainties associated with activity data on the use of refrigeration and air conditioning equipment are considered moderate (circa 20%). Thus, combined uncertainties for this source category are estimated to be circa 53.85% (Annex 5-3.2). In view of ensuring time-series consistency of the obtained results, the same approach was used for the entire period under review, in conformity with the recommendations included in the 2006 IPCC Guidelines.

2F2 'Foam Blowing Agents'

Uncertainties associated with the emission factors used to estimate HFC from source category 2F2 'Foam Blowing Agents' were estimated to be circa 30% (2006 IPCC Guidelines). Uncertainties associated with activity data on the use of foams in the RM are considered relatively high (circa 30%), including due to the fact that the current statistical system does not offer the possibility to disaggregate activity data by type of foams (open-cell or closed-cell), it is thereby not possible to know all types of blowing agents used. Thus, combined uncertainties for this source category are estimated to be circa 42.43% (Annex 5-3.2). In view of ensuring time-series consistency of the obtained results, the same approach was used for the entire period under review, in conformity with the recommendations included in the 2006 IPCC Guidelines.

2F3 'Fire Protection'

Uncertainties associated with the emission factors used to estimate HFC emissions from source category 2F3 'Fire Protection' were estimated to be 5% (2006 IPCC Guidelines). Uncertainties associated with activity data on the use of HFC-227ea in fire protection systems in the RM are considered moderate (circa 15%). Thus, combined uncertainties for source category 2F3 'Fire Protection' are estimated to be circa 15.81% (Annex 5-3.2). In view of ensuring time-series consistency of the obtained results, the same approach was used for the entire period under review, in conformity with the recommendations included in the 2006 IPCC Guidelines.

2F4 'Aerosols'

Uncertainties associated with the emission factors used to estimate HFC emissions from source category 2F4 'Aerosols' were estimated to be circa 5% (2006 IPCC Guidelines). Uncertainties associated with activity data on the use of metered dose aerosols using HFC-134a as propellant in the RM are considered low (circa 10%). Thus, combined uncertainties for source category 2F4 'Aerosols' are estimated to be circa 7.07% (Annex 5-3.2). In view of ensuring time-series consistency of the obtained results, the same approach was used for the entire period under review, in conformity with the recommendations included in the 2006 IPCC Guidelines.

4.6.4. Quality Assurance and Quality Control

Standard verification and quality control forms and checklists were filled in for the respective category following the Tier 1 approach. For source category 2F 'Product Uses as Substitutes for ODS', comparison and verification was focused on ensuring correct use of the default emission factors available in the 2006 IPCC Guidelines; on correct use of AD obtained from different reference sources, including official sources (i.e., National Bureau of Statistics, Customs Service, Republican Association of Refrigeration Technicians and reports submitted by economic agents annually to the National Ozone Unit within the Public Institution 'Environmental Project Implementation Unit' of the Ministry of Environment) and the correct use of them. It should be noted that AD and methods used for estimating GHG emissions from source category 2F 'Consumption of halocarbon and SF_6' were documented and archived both in hard copies and electronically.

4.6.5. Recalculations

2F1 'Refrigeration and Air Conditioning'

HFC emissions from source category 2F1 'Refrigeration and Air Conditioning' were recalculated for the period 2007-2019, as a result of: (a) updated share of refrigerants incorporated in refrigeration and air conditioning equipment in the RM; (b) updated information on the share of transport units equipped with air conditioning equipment, provided by the Public Services Agency of the Republic of Moldova, based on the information included in the State Transport Register.

In comparison with the results recorded in the BUR3 of the RM to the UNFCCC (2021), the recalculations resulted in an insignificant downward trend in HFC emissions from source category 2F1 'Refrigeration and Air Conditioning' for the period 2007-2009, and a slight upward trend in HFC emissions from source category 2F1 'Refrigeration and Air Conditioning' for the period 2010-2019 (Table 4-148).

Table 4-148: Comparative results of HFC emissions from source category 2F1 'Refrigeration and Air Conditioning' included in the BUR3 and NC5 of the RM to the UNFCCC, kt CO_2 equivalent

	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
BUR3	0.7535	1.2463	1.7920	2.4126	3.0811	3.8190	5.0012	6.1655	7.3862	8.5552	10.2213	14.7472	17.2579
NC5	0.7535	1.2463	1.7920	2.4126	3.0811	3.8190	5.0012	6.1655	7.3862	8.5552	10.2213	14.7472	17.2562
Difference, %	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-0.01
	2008	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**
BUR3	19.6858	21.3675	23.2625	27.0796	30.2879	33.8193	43.5320	71.1976	79.1826	96.6091	106.2543	138.6362	
NC5	19.6842	21.3659	23.5195	27.4542	30.7420	34.5161	44.9496	74.3853	82.6858	100.0113	110.8793	144.6478	153.0784
Difference, %	-0.01	-0.01	1.10	1.38	1.50	2.06	3.26	4.48	4.42	3.52	4.35	4.34	

Abbreviations: BUR3 – Third Biennial Update Report of the RM to the UNFCCC, NC5 – Fifth National Communication of the RM to the UNFCCC.

For 2020, HFC emissions from the respective category were estimated for the first time. The obtained results show that between 1995-2020, HFC emissions from source category 2F1 'Refrigeration and Air Conditioning' had increased by circa 203 times (Table 4-149).

Table 4-149: HFC emissions from source category 2F1 'Refrigeration and Air Conditioning' in the RM between 1995-2020

	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
	2F1a 'Domestic Refrigeration Equipment'"												
HFC-125, t	NO	NO	NO	NO	NO	NO	NO	NO	0.0002	0.0004	0.0009	0.0021	0.0042
HFC-134a, t	NO	NO	NO	NO	NO	NO	NO	NO	0.0073	0.0191	0.0410	0.0746	0.1223
HFC-143a, t	NO	NO	NO	NO	NO	NO	NO	NO	0.0002	0.0004	0.0010	0.0024	0.0050
2F1a, kt CO_2 eq.	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**0.0118**	**0.0305**	**0.0663**	**0.1248**	**0.2117**
	2F1b 'Commercial Refrigeration Equipment'												
HFC-32, t	NO	NO	NO	NO	NO	NO	NO	NO	0.0012	0.0026	0.0040	0.0060	0.0131
HFC-125, t	NO	NO	NO	NO	NO	NO	NO	NO	0.0073	0.0156	0.0319	0.0551	0.1144
HFC-134a, t	NO	NO	NO	NO	NO	NO	NO	NO	0.0351	0.0745	0.1155	0.1738	0.3757
HFC-143a, t	NO	NO	NO	NO	NO	NO	NO	NO	0.0081	0.0172	0.0344	0.0589	0.1207
2F1b, kt CO_2 eq.	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**0.1129**	**0.2399**	**0.4336**	**0.7089**	**1.4863**
	2F1c 'Industrial Refrigeration Equipment'												
HFC-32, t	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0.0041	0.0098	0.0127
HFC-125, t	NO	NO	NO	NO	NO	NO	NO	NO	0.0333	0.0616	0.1078	0.1492	0.1993
HFC-134a, t	NO	NO	NO	NO	NO	NO	NO	NO	0.0368	0.0502	0.0737	0.1002	0.1213
HFC-143a, t	NO	NO	NO	NO	NO	NO	NO	NO	0.0361	0.0668	0.1128	0.1507	0.2016
2F1c, kt CO_2 eq.	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**0.3307**	**0.5862**	**0.9897**	**1.3456**	**1.7809**
	2F1d 'Stationary Air Conditioning Equipment'												
HFC-32, t	NO	NO	NO	NO	NO	NO	NO	NO	0.0021	0.0060	0.0117	0.0200	0.0499
HFC-125, t	NO	NO	NO	NO	NO	NO	NO	NO	0.0021	0.0060	0.0117	0.0200	0.0499
2F1d, kt CO_2 eq.	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**0.0088**	**0.0251**	**0.0490**	**0.0834**	**0.2085**
	2F1e 'Mobile Air Conditioning Equipment'												
HFC-134a, t	0.5269	0.8716	1.2532	1.6871	2.1546	2.6706	3.4973	4.3116	4.8405	5.3660	6.0718	6.6553	7.1587
2F1e, kt CO_2 eq.	**0.7535**	**1.2463**	**1.7920**	**2.4126**	**3.0811**	**3.8190**	**5.0012**	**6.1655**	**6.9220**	**7.6734**	**8.6827**	**9.5171**	**10.2369**
	2F1f 'Transport Refrigeration'												
HFC-32, t	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0.7108	0.7981
HFC-125, t	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0.7108	0.7981
2F1f, kt CO_2 eq.	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**2.9675**	**3.3319**
	2F1 'Refrigeration and Air Conditioning'												
2F1, kt CO_2 eq.	**0.7535**	**1.2463**	**1.7920**	**2.4126**	**3.0811**	**3.8190**	**5.0012**	**6.1655**	**7.3862**	**8.5552**	**10.2213**	**14.7472**	**17.2562**
	2008	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**
	2F1a 'Domestic Refrigeration Equipment'												
HFC-125, t	0.0055	0.0073	0.0105	0.0141	0.0169	0.0195	0.0229	0.0275	0.0325	0.0394	0.0489	0.0797	0.1096
HFC-134a, t	0.1566	0.1838	0.2131	0.2374	0.2563	0.2681	0.2777	0.2830	0.2841	0.2847	0.2856	0.9712	1.3974
HFC-143a, t	0.0065	0.0087	0.0124	0.0166	0.0200	0.0230	0.0271	0.0325	0.0384	0.0466	0.0578	0.0942	0.1295
2F1a, kt CO_2 eq.	**0.2725**	**0.3272**	**0.3970**	**0.4630**	**0.5149**	**0.5542**	**0.5984**	**0.6459**	**0.6916**	**0.7535**	**0.8379**	**2.0889**	**2.9606**
	2F1b 'Commercial Refrigeration Equipment'												
HFC-32, t	0.0193	0.0226	0.0256	0.0294	0.0319	0.0351	0.0381	0.0722	0.0773	0.0816	0.1004	0.2316	0.2083
HFC-125, t	0.1686	0.1994	0.2324	0.2827	0.3184	0.3697	0.4149	0.6521	0.7119	0.9909	1.2489	2.2590	2.1681
HFC-134a, t	0.5816	0.6993	0.8183	0.9579	1.0503	1.1676	1.2593	2.2423	2.3897	2.5066	3.0314	6.7585	6.7569
HFC-143a, t	0.1777	0.2100	0.2447	0.2979	0.3356	0.3903	0.4381	0.6984	0.7631	1.0483	1.3231	2.3722	2.2965
2F1b, kt CO_2 eq.	**2.2292**	**2.6520**	**3.0948**	**3.7108**	**4.1378**	**4.7319**	**5.2370**	**8.6594**	**9.3719**	**11.7935**	**14.6880**	**28.3314**	**27.6568**
	2F1c 'Industrial Refrigeration Equipment'												
HFC-32, t	0.0157	0.0189	0.0476	0.0608	0.0825	0.1268	0.1818	0.2413	0.3078	0.3761	0.4614	0.5521	0.6501
HFC-125, t	0.2585	0.3258	0.4574	0.5676	0.7089	0.8834	1.1096	1.3399	1.7453	2.1050	2.5203	2.9901	3.4868
HFC-134a, t	0.1632	0.1938	0.2402	0.2804	0.3363	0.3990	0.4598	0.5358	0.6801	0.7857	0.9280	1.0669	1.2132
HFC-143a, t	0.2621	0.3315	0.4450	0.5508	0.6811	0.8228	1.0092	1.1945	1.4308	1.6809	1.9419	2.2588	2.5893
2F1c, kt CO_2 eq.	**2.3203**	**2.9117**	**3.9658**	**4.8908**	**6.0620**	**7.4260**	**9.1750**	**10.9582**	**13.6845**	**16.2584**	**19.1401**	**22.4604**	**25.9516**
	2F1d 'Stationary Air Conditioning Equipment'												
HFC-32, t	0.0801	0.0870	0.1024	0.1273	0.1529	0.1865	0.2062	0.5239	0.8182	1.1349	1.5653	4.7506	4.8597
HFC-125, t	0.0801	0.0870	0.1024	0.1273	0.1502	0.1784	0.1927	0.5016	0.7668	1.0413	1.4107	4.5135	4.5239
2F1d, kt CO_2 eq.	**0.3345**	**0.3631**	**0.4277**	**0.5314**	**0.6289**	**0.7503**	**0.8137**	**2.1092**	**3.2362**	**4.4105**	**5.9942**	**19.0040**	**19.1138**
	2F1e 'Mobile Air Conditioning Equipment'												
HFC-134a, t	7.5819	7.7604	7.8830	9.1941	10.0360	10.9586	16.3655	32.1575	34.5494	42.6935	44.8978	46.3295	49.6398
2F1e, kt CO_2 eq.	**10.8420**	**11.0974**	**11.2727**	**13.1475**	**14.3515**	**15.6707**	**23.4027**	**45.9853**	**49.4057**	**61.0518**	**64.2038**	**66.2512**	**70.9850**
	2F1f 'Transport Refrigeration'												
HFC-32, t	0.8828	0.9615	1.0447	1.1283	1.2089	1.2893	1.3707	1.4437	1.5080	1.3757	1.4408	1.5597	1.5355
HFC-125, t	0.8828	0.9615	1.0447	1.1283	1.2089	1.2893	1.3707	1.4437	1.5080	1.3757	1.4408	1.5597	1.5355
2F1f, kt CO_2 eq.	**3.6858**	**4.0145**	**4.3615**	**4.7106**	**5.0470**	**5.3829**	**5.7228**	**6.0273**	**6.2961**	**5.7436**	**6.0153**	**6.5119**	**6.4105**
	2F1 'Refrigeration and Air Conditioning'												
2F1, kt CO_2 eq.	**19.6842**	**21.3659**	**23.5195**	**27.4542**	**30.7420**	**34.5161**	**44.9496**	**74.3853**	**82.6858**	**100.0113**	**110.8793**	**144.6478**	**153.0784**

2F2 'Foam Blowing Agents'

HFC emissions from source category 2F2 'Foam Blowing Agents' were recalculated for the period 2018 and 2019 having updated and completed the information on the import of foam blowing products into the RM. In comparison with the emission values recorded in the BUR3 of the RM to the UNFCCC (2021), the recalculations resulted in a downward trend in HFC emissions from source category 2F2 'Foam Blowing Agents' for the period 2018-2019 (Table 4-150). For 2020, HFC emissions from the respective category were estimated for the first time. The obtained results show that HFC emissions from source category 2F2 'Foam Blowing Agents' had increased by circa 323 times between 1995 and 2020.

Table 4-150: Comparative results of HFC emissions from source category 2F2 'Foam Blowing Agents included in the BUR3 and NC5 of the RM to the UNFCCC (2021), kt CO_2 equivalent

	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
BUR3	0.2763	0.4130	0.5216	0.7246	0.9191	1.3010	1.8669	2.9571	4.7770	7.4473	12.2889	18.5004	27.5284
NC5	0.2763	0.4130	0.5216	0.7246	0.9191	1.3010	1.8669	2.9571	4.7770	7.4473	12.2889	18.5004	27.5284
Difference, %	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
BUR3	37.6745	46.1098	54.6272	63.0458	69.7304	74.5640	78.0278	82.6488	84.0180	85.6195	87.2640	89.0005	
NC5	37.6745	46.1098	54.6272	63.0458	69.7304	74.5640	78.0278	82.6488	84.0180	85.6195	87.0518	88.5823	89.2686
Difference, %	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.2	-0.5	

Abbreviations: BUR3 – Third Biennial Update Report of the RM to the UNFCCC, NC5 – Fifth National Communication of the RM to the UNFCCC.

2F3 'Fire Protection'

HFC-227ea emissions from source category 2F3 'Fire Protection' were not recalculated in the current inventory cycle (Table 4-151). For 2020, HFC-227ea emissions from the respective category were estimated for the first time. The obtained results show that HFC emissions from source category 2F3 'Fire Protection' had increased in the RM by circa 11.5 times between 2017 and 2020.

Table 4-151: Comparative results of HFC emissions from source category 2F3 'Fire Protection' included in the BUR3 of the RM to the UNFCCC, kt CO_2 eq.

	2017	2018	2019	2020
HFC-227ea Emissions, t	0.0800	0.2950	0.7151	0.9201
HFC-227ea Emissions, kt CO_2 eq.	**0.2576**	**0.9500**	**2.3026**	**2.9626**

2F4 'Aerosols'

HFC emissions from source category 2F4 'Aerosols' were recalculated for 2019 as a result of updated activity data associated with the import of metered dose aerosols to treat asthma and chronic obstructive pulmonary diseases, tuberculosis provided by the Agency for Medicines and Medical Devices. In comparison with the emission values recorded in the BUR3 of the RM to the UNFCCC (2021), the changes have resulted in a downward trend in HFC emissions from source category 2F4 'Aerosols' in 2019 (Table 4-152).

Table 4-152: Comparative results of HFC emissions from source category 2F4 included in the BUR3 and NC5 of the RM to the UNFCCC (2021), kt CO_2 equivalent

	2003	2004	2005	2006	2007	2008	2009	2010	2011
BUR3	0.0001	0.0002	0.0004	0.0018	0.0026	0.0023	0.0033	0.0040	0.0042
NC5	0.0001	0.0002	0.0004	0.0018	0.0026	0.0023	0.0033	0.0040	0.0042
Difference, %	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	2012	2013	2014	2015	2016	2017	2018	2019	2020
BUR3	0.0043	0.0041	0.0043	0.0053	0.0061	0.0061	0.0066	0.0075	
NC5	0.0043	0.0041	0.0043	0.0053	0.0061	0.0061	0.0066	0.0070	0.0072
Difference, %	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-6.8	

Abbreviations: BUR3 – Third Biennial Update Report of the RM to the UNFCCC, NC5 – Fifth National Communication of the RM to the UNFCCC.

For 2020, HFC emissions from the respective category have been estimated for the first time. The obtained results show that HFC emissions from source category 2F4 'Aerosols' had increased by circa 111.8 times between 2003 and 2020.

2F 'Product Uses as Substitutes for ODS'

HFC emissions from source category 2F 'Product Uses as Substitutes for ODS' were recalculated for the period 2007-2019, as a result of the previously-mentioned reasons. In comparison with the emission values recorded in the BUR3 of the RM to the UNFCCC (2021), the changes have resulted into an insignificant downward trend in HFC emissions from source category 2F 'Product Uses as Substitutes for ODS' between 2007 and 2009, and an upward trend in HFC emissions in 2010-2019 (Table 4-513). For 2020, HFC emissions from the respective category have been estimated for the first time. The obtained results show that HFC emissions from source category 2F 'Product Uses as Substitutes for ODS' had increased in the RM by circa 238 times between 1995 and 2020.

Table 4-153: Comparative results of HFC emissions from category 2F 'Product Uses as Substitutes for ODS' included in the BUR3 and NC5 of the RM to the UNFCCC (2021), kt CO_2 equivalent

	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
BUR3	1.0298	1.6593	2.3137	3.1372	4.0002	5.1199	6.8681	9.1227	12.1632	16.0027	22.5106	33.2493	44.7889
NC5	1.0298	1.6593	2.3137	3.1372	4.0002	5.1199	6.8681	9.1227	12.1632	16.0027	22.5106	33.2493	44.7872
Difference, %	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2008	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**
BUR3	57.3627	67.4807	77.8936	90.1296	100.0227	108.3873	121.5640	153.8517	163.2067	182.4923	194.4750	229.9469	
NC5	57.3610	67.4790	78.1507	90.5042	100.4768	109.0841	122.9816	157.0394	166.7099	185.8945	198.8877	235.5397	245.3168
Difference, %	0.00	0.00	0.33	0.42	0.45	0.64	1.17	2.07	2.15	1.86	2.27	2.43	

Abbreviations: BUR3 – Third Biennial Update Report of the RM to the UNFCCC, NC5 – Fifth National Communication of the RM to the UNFCCC.

Table 4-154 below shows HFC emissions by substances and emission sources.

Table 4-154: HFC emissions from source category 2F 'Product Uses as Substitutes for ODS' between 1995-2020

	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
	2F1 'Refrigeration and Air Conditioning'												
HFC-32, t	NO	NO	NO	NO	NO	NO	NO	NO	0.0033	0.0086	0.0199	0.7466	0.8737
HFC-125, t	NO	NO	NO	NO	NO	NO	NO	NO	0.0429	0.0836	0.1523	0.9371	1.1659
HFC-134a, t	0.5269	0.8716	1.2532	1.6871	2.1546	2.6706	3.4973	4.3116	4.9197	5.5099	6.3021	7.0039	7.7780
HFC-143a, t	NO	NO	NO	NO	NO	NO	NO	NO	0.0444	0.0845	0.1483	0.2120	0.3273
2F1, kt CO_2 eq.	**0.7535**	**1.2463**	**1.7920**	**2.4126**	**3.0811**	**3.8190**	**5.0012**	**6.1655**	**7.3862**	**8.5552**	**10.2213**	**14.7472**	**17.2562**
	2F2 'Foam Blowing Agents'												
HFC-134a, t	0.1932	0.2888	0.3648	0.5067	0.6427	0.9040	1.2943	2.0462	3.2825	5.1109	8.1701	12.0594	17.7208
HFC-152a, t	NO	NO	NO	NO	NO	0.0664	0.1297	0.2512	0.6692	1.1189	1.9037	3.4044	5.0309
HFC-365mfc, t	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0.1907	0.4298	0.8067
HFC-245fa, t	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0.2119	0.4776	0.8964
2F2, kt CO_2 eq.	**0.2763**	**0.4130**	**0.5216**	**0.7246**	**0.9191**	**1.3010**	**1.8669**	**2.9571**	**4.7770**	**7.4473**	**12.2889**	**18.5004**	**27.5284**
	2F3 'Fire Protection'												
HFC-227ea, t	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
2F4, kt CO_2 eq.	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**
	2F4 'Aerosols'												
HFC-134a, t	NO	NO	NO	NO	NO	NO	NO	NO	0.0000	0.0001	0.0003	0.0012	0.0018
2F4, kt CO_2 eq.	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**0.0001**	**0.0002**	**0.0004**	**0.0018**	**0.0026**
	2F 'Product Uses as Substitutes for ODS'												
2F, kt CO_2 eq.	**1.0298**	**1.6593**	**2.3137**	**3.1372**	**4.0002**	**5.1199**	**6.8681**	**9.1227**	**12.1632**	**16.0027**	**22.5106**	**33.2493**	**44.7872**
	2008	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**
	2F1 'Refrigeration and Air Conditioning'												
HFC-32, t	0.9980	1.0900	1.2203	1.3457	1.4761	1.6378	1.7969	2.2811	2.7114	2.9682	3.5679	7.0940	7.2536
HFC-125, t	1.3955	1.5810	1.8474	2.1200	2.4032	2.7403	3.1109	3.9647	4.7646	5.5523	6.6697	11.4021	11.8238
HFC-134a, t	8.4832	8.8373	9.1546	10.6697	11.6789	12.7932	18.3622	35.2186	37.9033	46.2705	49.1428	55.1261	59.0074
HFC-143a, t	0.4464	0.5502	0.7022	0.8653	1.0366	1.2361	1.4744	1.9254	2.2322	2.7758	3.3228	4.7252	5.0153
2F1, kt CO_2 eq.	**19.6842**	**21.3659**	**23.5195**	**27.4542**	**30.7420**	**34.5161**	**44.9496**	**74.3853**	**82.6858**	**100.0113**	**110.8793**	**144.6478**	**153.0784**
	2F2 'Foam Blowing Agents'												
HFC-134a, t	23.6102	28.3653	32.8621	37.2991	40.7408	43.1240	44.4241	45.7862	45.6906	45.6146	45.4727	45.3367	45.0754
HFC-152a, t	7.4479	10.0019	13.6333	17.2115	21.0856	24.9891	30.0779	35.7419	41.3538	46.8552	51.6862	57.4856	62.2007
HFC-365mfc, t	1.5417	2.2220	3.0663	3.9072	4.5689	5.1736	5.8862	7.3289	7.8491	8.5093	9.0439	9.5628	9.8080
HFC-245fa, t	1.7129	2.4689	3.4070	4.3414	5.0765	5.5245	5.9204	6.7218	7.1072	7.5962	8.1902	8.7668	9.0392
2F2, kt CO_2 eq.	**37.6745**	**46.1098**	**54.6272**	**63.0458**	**69.7304**	**74.5640**	**78.0278**	**82.6488**	**84.0180**	**85.6195**	**87.0518**	**88.5823**	**89.2686**
	2F3 'Fire Protection'												
HFC-227ea, t	NO	NO	NO	NO	NO	NO	NO	NO	NO	0.0800	0.2950	0.7151	0.9201
2F4, kt CO_2 eq.	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**0.2576**	**0.9500**	**2.3026**	**2.9626**
	2F4 'Aerosols'												
HFC-134a, t	0.0016	0.0023	0.0028	0.0029	0.0030	0.0028	0.0030	0.0037	0.0043	0.0043	0.0046	0.0049	0.0051
2F4, kt CO_2 eq.	**0.0023**	**0.0033**	**0.0040**	**0.0042**	**0.0043**	**0.0041**	**0.0043**	**0.0053**	**0.0061**	**0.0061**	**0.0066**	**0.0070**	**0.0072**
	2F 'Product Uses as Substitutes for ODS'												
2F, kt CO_2 eq.	**57.3610**	**67.4790**	**78.1507**	**90.5042**	**100.4768**	**109.0841**	**122.9816**	**157.0394**	**166.7099**	**185.8945**	**198.8877**	**235.5397**	**245.3168**

4.6.6. Planned Improvements

Potential improvements could include capacity building activities by setting up an on-line information system for collecting AD from companies that import, use, dispose, recover and recycle refrigerants and refrigerant equipment. This information system will provide the Ministry of Environment, respectively the Environment Agency and the National Agency for the Regulation of Nuclear and Radiological Activities with more accurate AD, which could potentially contribute to reducing uncertainties in the assessment of GHG emissions from ˙category 2F 'Product Uses as Substitutes for ODS' in the Republic of Moldova.

4.7. Other Product Manufacture and Use (category 2G)

4.7.1. Source Category Description

Category 2G 'Other Product Manufacture and Use', covers GHG emissions generated from the following emission sources: 2G1 'Electrical Equipment', 2G3 'N_2O from Product Uses' and 2G4 'Other' ('Use of Tobacco' and 'Use of Shoes').

2G1 'Electrical Equipment'

Sulphur hexafluoride (SF_6) and perfluorocarbons (particularly CF_4) are used for insulation in medium and high tension electrical equipment. SF_6 is also used in gas insulated switchgear and chemical lasers.

In order to determine how sulphur hexafluoride and PFC are used in the Republic of Moldova, a series of enterprises subordinated to the current Ministry of Economy and Infrastructure (SOE 'Moldelectrica' and SOE RED-North), Premier Energy Ltd., as well as the Ministry of Health, Labour and Social Protection and the Academy of Sciences of Moldova were surveyed.

The survey of the above-mentioned organisations revealed the following: no activity data is available on the application of SF_6 in gas insulated chemical lasers at the Academy of Sciences of Moldova and the Ministry of Health, Labour and Social Protection for the period 1990-2020; at the Ministry of Economy and Infrastructure (SOE 'Moldelectrica' SOE RED-North) and Premier Energy Ltd., by 2020, SF_6 was used in 391 medium tension circuit breakers, the charge varying between 0.95 kg and 4.92 kg of SF_6, respectively 224 high tension circuit breakers, the charge varying between 6 kg and 45 kg of SF_6. As one can see, the use of PFCs in the Republic of Moldova, particularly CF_4 is currently being recorded only as an insulation medium in high tension electrical equipment.

The share of SF_6 and CF_4 emissions in the total GHG emissions generated from source category 2G1 'Electrical Equipment' is insignificant, these emissions being recorded only since 2003, and 2006, respectively.

2G3 'N_2O from Product Uses'

Under this category, N_2O emissions from medical applications for anaesthetic use are estimated (SNAP 060508 – N_2O for anaesthetic use in medical application).

2G4 'Other'

Under this category, NO_x, CO, NMVOC, SO_x, and indirect CO_2 emissions from use of tobacco (SNAP 060602 – use of tobacco) and use of shoes (SNAP 060603 – use of shoes), and use of fireworks (SNAP 060601) are estimated. Between 1990 and 2020, direct GHG emissions from category 2G 'Other Product Manufacture and Use' decreased by circa 25.1% (Table 4-155).

Table 4-155: Evolution of direct GHG emissions from category 2G 'Other Product Manufacture and Use', by source, between 1990-2020, kt CO_2 equivalent

	1990	1991	1992	1993	1994	1995	1996	1997
2G1. Electrical equipment	NO	NO	NO	NO	NO	NO	NO	NO
2G3. N_2O from medical applications	0.0197	0.0164	0.0149	0.0179	0.0149	0.0003	0.0006	0.0009
2G4. Other	3.4010	3.0625	2.4132	1.9809	1.4426	1.1676	1.1050	0.9982
2G. Other product manufacture and use	**3.4207**	**3.0789**	**2.4281**	**1.9988**	**1.4575**	**1.1679**	**1.1056**	**0.9991**

	1998	1999	2000	2001	2002	2003	2004	2005
2G1. Electrical equipment	NO	NO	NO	NO	NO	0.0071	0.0071	0.0427
2G3. N_2O from medical applications	0.0015	0.0128	0.0131	0.0131	0.0131	0.0131	0.0149	0.0182
2G4. Other	0.7460	0.6421	0.9554	0.8204	0.7843	0.9620	1.0504	1.1646
2G. Other product manufacture and use	**0.7475**	**0.6549**	**0.9685**	**0.8335**	**0.7974**	**0.9823**	**1.0724**	**1.2255**
	2006	2007	2008	2009	2010	2011	2012	2013
2G1. Electrical equipment	0.3319	0.4315	0.5277	0.5710	0.7020	0.7447	0.8050	1.0055
2G3. N_2O from medical applications	0.0176	NO	NO	NO	NO	NO	NO	NO
2G4. Other	1.0655	1.0652	1.1036	0.8048	1.0245	1.2291	1.1575	1.0965
2G. Other product manufacture and use	**1.4150**	**1.4967**	**1.6312**	**1.3759**	**1.7265**	**1.9738**	**1.9625**	**2.1020**
	2014	2015	2016	2017	2018	2019	2020	%
2G1. Electrical equipment	1.0943	1.0948	1.1232	1.1549	1.3752	1.4777	1.6193	N/A
2G3. N_2O from medical applications	NO	NO	NO	NO	NO	NO	NO	-100.0
2G4. Other	1.2062	0.9397	1.0649	1.1757	1.0589	1.1299	0.9412	-72.3
2G. Other product manufacture and use	**2.3005**	**2.0346**	**2.1882**	**2.3306**	**2.4340**	**2.6076**	**2.5605**	**-25.1**

The table below shows the evolution of indirect GHG emissions (NO_x, CO, NMVOC, SO_x) from the respective category (Table 4-156).

Table 4-156: Evolution of indirect GHG emissions from category 2G 'Other Product Manufacture and Use' between 1990-2020, kt

	1990	1991	1992	1993	1994	1995	1996	1997
NO_x	0.0197	0.0199	0.0186	0.0190	0.0173	0.0153	0.0210	0.0205
CO	0.6017	0.6083	0.5686	0.5819	0.5290	0.4695	0.6414	0.6281
NMVOC	1.5459	1.3920	1.0969	0.9004	0.6557	0.5307	0.5023	0.4537
SO_x	NE	NE	NE	NE	NE	NE	NE	NE
	1998	1999	2000	2001	2002	2003	2004	2005
NO_x	0.0162	0.0189	0.0200	0.0203	0.0147	0.0181	0.0188	0.0186
CO	0.4967	0.5773	0.6124	0.6229	0.4503	0.5545	0.5759	0.5683
NMVOC	0.3391	0.2919	0.4343	0.3729	0.3565	0.4373	0.4774	0.5294
SO_x	NE	NE	NE	NE	NE	NE	NE	NE
	2006	2007	2008	2009	2010	2011	2012	2013
NO_x	0.0180	0.0198	0.0170	0.0205	0.0237	0.0237	0.0174	0.0133
CO	0.5508	0.6066	0.5217	0.6267	0.7247	0.7248	0.5326	0.4062
NMVOC	0.4843	0.4842	0.5016	0.3658	0.4657	0.5587	0.5261	0.4984
SO_x	NE	NE	NE	NE	NE	NE	NE	0.0003
	2014	2015	2016	2017	2018	2019	2020	%
NO_x	0.0117	0.0116	0.0105	0.0078	0.0085	0.0077	0.0098	-50.0
CO	0.3565	0.3561	0.3198	0.2396	0.2587	0.2360	0.3004	-50.1
NMVOC	0.5483	0.4271	0.4841	0.5344	0.4813	0.5136	0.4278	-72.3
SO_x	0.0007	0.0003	0.0003	0.0003	0.0007	0.0008	0.0008	N/A

4.7.2. Methodological Issues, Emission Factors and Data Sources

2G1 'Electrical Equipment'

SF_6 and PFC emissions from use of sulphur hexafluoride as gas insulation medium in high and medium tension electrical circuit breakers were estimated based on Tier 1 estimation methodology (2006 IPCC Guidelines, Volume 3, Chapter 8.1, Equation 8.1, page 8.8).

$$Total\ Emissions = M \bullet EF + EI \bullet EF + EU \bullet EF + ED \bullet EF$$

Where:

Total Emissions – emissions from use of SF6 and PFC as insulation medium in high and medium tension electrical circuit breakers, tonnes;

M – manufacturing emissions, tonnes;

EF – manufacturing EF, fraction SF_6 and PFC consumption by manufacturers; default emission factors: 7% for sealed pressure electrical equipment (MV switchgear) containing SF_6 (2006 IPCC Guidelines, Volume 3, Chapter 8.1, Table 8.2, page 8.15) and 8.5% for closed pressure electrical equipment (HV switchgear) containing SF_6 (2006 IPCC Guidelines, Volume 3, Chapter 8.1, Table 8.3, page 8.16);

EI – installation emissions, tonnes;

EF – emission factor or fraction SF_6 and PFC emitted when installing medium and high voltage electrical switches;

EU – equipment use emissions, tonnes;

EF – equipment use EF; total nameplate capacity of installed equipment (includes emissions due to leakage, servicing, and maintenance as well as failures); default emission factors: 0.2% for sealed pressure electrical equipment (MV switchgear) containing SF_6 (2006 IPCC Guidelines, Volume 3, Chapter 8.1, Table 8.2, page 8.15) and 2.6% for closed pressure electrical equipment (HV switchgear) containing SF_6 (2006 IPCC Guidelines, Volume 3, Chapter 8.1, Table 8.3, page 8.16);

ED – equipment disposal emissions, tonnes;

EF – equipment disposal EF; total nameplate capacity of retiring equipment, fraction of SF6 and PFC remaining at retirement (the life expectancy of the equipment in European countries is over 35 years); default emission factors: 93% for sealed pressure electrical equipment (MV switchgear) containing SF6 (2006 IPCC Guidelines, Volume 3, Chapter 8.1, Table 8.2, page 8.15) and 95% for closed pressure electrical equipment (HV switchgear) containing SF6 (2006 IPCC Guidelines, Volume 3, Chapter 8.1, Table 8.3, page 8.16).

Only since 2003 have Moldovan companies initiated the use of medium-tension electrical circuit breakers (10 and 35 kV) and high-tension electrical circuit breakers (110 kV, 330 kV and 400 kV), the SF_6 charge in each case varying between 0.95 and 45.0 kg. In accordance with the manufacturer's technical log, the first repairs shall take place after 35 years of operation.

The installation of medium and high-tension electrical circuit breakers, as well as the number of available units in bulk at the end of the calendar year are provided in Table 4-157, and in Tables 4-158 and 4-159, respectively.

Table 4-157: The installation of medium and high-tension electrical circuit breakers using SF_6 and CF_4 for the period 2003-2020, units installed per year

Enterprises	2003	2004	2005	2006	2007	2008	2009	2010	2011
SOE Moldelectrica	1	0	5	28	8	2	0	8	1
Premier Energy Ltd.	0	0	0	6	6	34	11	5	34
SOE 'Red-North'	0	0	0	0	0	0	0	0	0
Total	**1**	**0**	**5**	**34**	**14**	**36**	**11**	**13**	**35**
Enterprises	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**
SOE Moldelectrica	3	4	0	0	0	0	45	20	31
Premier Energy Ltd.	48	25	26	5	44	16	23	6	27
SOE 'Red-North'	0	0	0	2	3	25	42	5	66
Total	**51**	**29**	**26**	**7**	**47**	**41**	**110**	**31**	**124**

Sources: JSC Red Union Fenosa through Letter No. 0201/65392 dated 15.08.2011, as a response to the request from the Ministry of Environment No. 03-07/1337 dated 08.08.2011; Letter from 13.01.2014, as a response to the request from the Climate Change Office No. 320/2014-01-01 dated 03.01.2014; Letter from 10.05.2016, as a response to the request from the Climate Change Office No. 512/2016-05-09 dated 10.05.2016; Letter from 23.01.2018, as a response to the request from the Climate Change Office No. 601/2017-12-03 dated 14.12.2017; Premier Energy Ltd. through Letter from 19.02.2020, as a response to the request from the Environment Agency No. 08-310/1 dated 11.02.2020; Letter dated 14.06.2021, as a response to the request from the Environment Agency No. 08/136/2021 dated 09.06.2021; SOE 'MOLDELECTRICA' through Letter No. 46-47/1795 dated 23.08.2011, as a response to the request from the Ministry of Environment No. 03-07/1337 dated 08.08.2011; Letter No. 46-47/112 dated 17.01.2014, as a response to the request from the Climate Change Office No. 320/2014-01-01 dated 03.01.2014; Letter No. 46-74/937 dated 25.05.2016, as a response to the request from the Climate Change Office No. 512/2016-05-01 dated 10.05.2016; Letter No. 46-74/1 dated 03.01.2018, as a response to the request from the Climate Change Office No. 601/2017-12-03 dated 14.12.2017; Letter No. 46-74/333 dated 28.02.2020, as a response to the request from the Environment Agency No. 08-310/1 dated 11.02.2020; Letter No. 46-47/908 dated 28.06.2021, as a response to the request from the Environment Agency No. 08/136/2021 dated 09.06.2021; JSC 'Red-North' through Letter dated 06.07.2021, as a response to the request from the Environment Agency No. 08/136/2021 dated 09.06.2021.

Table 4-158: Total medium-tension electrical circuit breakers available in bulk at the end of calendar year for the period 2006-2020, units

	2006	2007	2008	2009	2010	2011	2012	2013
Circuit breaker 10 kV, PT COMPACT 3L1P (Ormazabal), 0.605 kg S_F6	0	0	0	0	0	0	0	1
Circuit breaker 10 kV, CGMCOSMOS-L, 0.605 kg SF_6	0	0	0	0	0	0	0	0
Circuit breaker 10 KV, THO 24/SO5/E/THO-T1, 0.98 kg SF_6	0	0	0	0	0	28	52	52
Circuit breaker 10 kV, GAE630, 1.2 kg SF_6	0	0	0	0	0	0	0	0
Circuit breaker 10 kV, PT COMPACT 1P (Ormazabal), 1.25 kg SF_6	0	0	0	0	0	0	0	1
Circuit breaker 10 kV, PT COMPACT 2L1P, 1.3 kg SF_6	0	0	0	0	0	0	0	0
Circuit breaker 10 kV, AUGUSTE 2012 / 1.5 kg SF_6	0	0	0	0	0	0	0	0
Circuit breaker 10 kV, PT COMPACT 1P (ZPUE), 1.6 kg SF_6	0	0	0	0	0	0	0	0
Circuit breaker 10 kV, CGMCOSMOS-LP, 1.855 kg SF_6	0	0	0	0	0	0	0	0
Circuit breaker 10 kV, GMA-24 / 2.2 kg SF_6	0	0	24	24	24	24	36	36
Circuit breaker 10 kV, PT COMPACT 2L1P (ZPUE), 2.25 kg SF_6	0	0	0	0	0	0	0	0
Circuit breaker 10 kV, PT COMPACT 2L1P (Ormazabal), 2.46 kg SF_6	0	0	0	0	0	0	3	15
Circuit breaker 10 kV, CGMCOSMOS-2LP, 2.460 kg SF_6	0	0	0	0	0	0	0	0
Circuit breaker 10 kV, PT COMPACT 3L1P (ZPUE), 2.9 kg SF_6	0	0	0	0	0	0	0	0
Circuit breaker 10 kV, CGMCOSMOS-3LP, 3.065 kg SF_6	0	0	0	0	0	0	0	0
Circuit breaker 10 kV, CGMCOSMOS-2LP+L, 3.067 kg SF_6	0	0	0	0	0	0	0	0
Circuit breaker 10 kV, PT COMPACT 2LP+L, 3.067 kg SF_6	0	0	0	0	0	0	0	0
Circuit breaker 10 kV, PT COMPACT 2L2P (ZPUE), 3.2 kg SF_6	0	0	0	0	0	0	0	0
Circuit breaker 10 kV, PT COMPACT 2LP+2L, 3.670 kg SF_6	0	0	0	0	0	0	0	0
Circuit breaker 10 kV, CGMCOSMOS-2LP+2L, 3.670 kg SF_6	0	0	0	0	0	0	0	0
Circuit breaker 10 kV, CGMCOSMOS-3L+LP, 3.670 kg SF_6	0	0	0	0	0	0	0	0
Circuit breaker 10 kV, PT COMPACT 2LP+P, 3.710 kg SF_6	0	0	0	0	0	0	0	0

	2006	2007	2008	2009	2010	2011	2012	2013
Circuit breaker 10 kV, CGMCOSMOS-2LP+P, 3.710 kg SF_6	0	0	0	0	0	0	0	0
Circuit breaker 10 kV, CGMCOSMOS-3L+2LP, 4.275 kg SF_6	0	0	0	0	0	0	0	0
Circuit breaker 10 kV, CGMCOSMOS-2LP+LP, 4.315 kg SF_6	0	0	0	0	0	0	0	0
Circuit breaker 10 kV, PT COMPACT 2LP+LP, 4.315 kg SF_6	0	0	0	0	0	0	0	0
Circuit breaker 10 kV, CGMCOSMOS-2LP+2LP, 4.920 kg SF_6	0	0	0	0	0	0	0	0
Circuit breaker 35 kV, THO 36 / 0.98 kg SF_6	0	0	0	0	0	0	0	0
Circuit breaker 35 kV, GL-107X (2012) / 2.4 kg SF_6	0	0	0	0	0	0	1	1
Circuit breaker 35 kV, GL-107X (2005) / 2.6 kg SF_6	5	5	5	5	5	5	5	4
Circuit breaker 35 kV, VOX 36 / 2.9 kg SF_6	0	0	2	7	7	7	12	12
Total circuit breakers installed	**5**	**5**	**31**	**36**	**36**	**64**	**109**	**122**
	2014	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**
Circuit breaker 10 kV, PT COMPACT 3L1P (Ormazabal), 0.605 kg SF_6	2	2	2	2	2	2	2	NA
Circuit breaker 10 kV, CGMCOSMOS-L, 0.605 kg SF_6	0	0	0	0	0	0	1	NA
Circuit breaker 10 KV, THO 24/SO5/E/THO-T1, 0.98 kg SF_6	59	64	65	65	67	67	84	NA
Circuit breaker 10 kV, GAE630, 1.2 kg SF_6	0	0	0	15	44	44	69	NA
Circuit breaker 10 kV, PT COMPACT 1P (Ormazabal), 1.25 kg SF_6	1	1	1	1	1	1	1	NA
Circuit breaker 10 kV, PT COMPACT 2L1P, 1.3 kg SF_6	0	1	2	2	4	9	10	NA
Circuit breaker 10 kV, AUGUSTE 2012 / 1.5 kg SF_6	0	0	29	36	44	45	70	NA
Circuit breaker 10 kV, PT COMPACT 1P (ZPUE), 1.6 kg SF_6	0	0	1	1	3	3	3	NA
Circuit breaker 10 kV, CGMCOSMOS-LP, 1.855 kg SF_6	0	0	0	1	2	2	2	NA
Circuit breaker 10 kV, GMA-24 / 2.2 kg SF_6	36	36	36	36	36	36	36	NA
Circuit breaker 10 kV, PT COMPACT 2L1P (ZPUE), 2.25 kg SF_6	0	0	7	9	14	16	16	NA
Circuit breaker 10 kV, PT COMPACT 2L1P (Ormazabal), 2.46 kg SF_6	22	22	22	22	22	22	22	NA
Circuit breaker 10 kV, CGMCOSMOS-2LP, 2.460 kg SF_6	0	0	0	2	2	2	10	NA
Circuit breaker 10 kV, PT COMPACT 3L1P (ZPUE), 2.9 kg SF_6	0	0	0	2	2	2	2	NA
Circuit breaker 10 kV, CGMCOSMOS-3LP, 3.065 kg SF_6	0	0	0	0	1	1	1	NA
Circuit breaker 10 kV, CGMCOSMOS-2LP+L, 3.067 kg SF_6	0	0	0	1	2	2	5	NA
Circuit breaker 10 kV, PT COMPACT 2LP+L, 3.067 kg SF_6	0	0	1	1	1	1	1	NA
Circuit breaker 10 kV, PT COMPACT 2L2P (ZPUE), 3.2 kg SF_6	0	0	0	0	2	2	2	NA
Circuit breaker 10 kV, PT COMPACT 2LP+2L, 3.670 kg SF_6	0	0	0	1	1	1	1	NA
Circuit breaker 10 kV, CGMCOSMOS-2LP+2L, 3.670 kg SF_6	0	0	0	1	3	3	3	NA
Circuit breaker 10 kV, CGMCOSMOS-3L+LP, 3.670 kg SF_6	0	0	0	1	1	1	1	NA
Circuit breaker 10 kV, PT COMPACT 2LP+P, 3.710 kg SF_6	0	0	0	1	1	1	1	NA
Circuit breaker 10 kV, CGMCOSMOS-2LP+P, 3.710 kg SF_6	0	0	0	2	5	5	8	NA
Circuit breaker 10 kV, CGMCOSMOS-3L+2LP, 4.275 kg SF_6	0	0	0	0	1	1	3	NA
Circuit breaker 10 kV, CGMCOSMOS-2LP+LP, 4.315 kg SF_6	0	0	0	0	2	2	3	NA
Circuit breaker 10 kV, PT COMPACT 2LP+LP, 4.315 kg SF_6	0	1	2	2	2	2	2	NA
Circuit breaker 10 kV, CGMCOSMOS-2LP+2LP, 4.920 kg SF_6	0	0	0	0	0	0	1	NA
Circuit breaker 35 kV, THO 36 / 0.98 kg SF_6	2	2	2	2	2	2	8	NA
Circuit breaker 35 kV, GL-107X (2012) / 2.4 kg SF_6	1	1	1	1	1	1	1	NA
Circuit breaker 35 kV, GL-107X (2005) / 2.6 kg SF_6	4	4	4	4	4	4	4	NA
Circuit breaker 35 kV, VOX 36 / 2.9 kg SF_6	16	16	18	18	18	18	18	NA
Total circuit breakers installed	**143**	**150**	**193**	**229**	**290**	**298**	**391**	**NA**

Table 4-159: Total high-tension electrical circuit breakers available in bulk at the end of calendar year for the period 2003-2020, units

	2003	2004	2005	2006	2007	2008	2009	2010	2011
Circuit breaker 110 kV, LTB 145D / 1B / 6 kg SF_6	0	0	0	2	2	2	2	2	4
Circuit breaker 110 kV, GL-311 F1 / 12 kg SF_6	0	0	0	4	10	18	24	29	33
Circuit breaker 110 kV, PASS MO 145 kV / 15 kg SF_6	0	0	0	0	0	0	0	0	0
Circuit breaker 110 kV, HYpact / 45 kg SF_6	0	0	0	0	0	0	0	0	0
Circuit breaker 110 kV, GL-311 F1 / 12 kg SF_6	1	1	6	21	29	29	29	29	29
Circuit breaker 110 kV, GL-311 F1 P / 9.9 kg SF_6	0	0	0	0	0	0	0	3	4
Circuit breaker 110 kV, GL-312F1/4031 P / VR / 7.8 kg SF_6	0	0	0	0	0	0	0	1	1
Circuit breaker 110 kV, 120-SFM-32B / 6.8 kg SF_6	0	0	0	0	0	0	0	0	0
Circuit breaker 330 kV, GL-315 F3 / 26 kg SF_6 and 15 kg CF_4	0	0	0	8	8	10	10	14	14
Circuit breaker 400 kV, LTB 420 E2/ 30 kg SF_6	0	0	0	0	0	0	0	0	0
Total circuit breakers installed	**1**	**1**	**6**	**35**	**49**	**59**	**65**	**78**	**85**
	2012	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**
Circuit breaker 110 kV, LTB 145D / 1B / 6 kg SF_6	6	6	8	8	9	11	11	11	11
Circuit breaker 110 kV, GL-311 F1 / 12 kg SF_6	35	41	41	41	44	47	48	51	51
Circuit breaker 110 kV, PASS MO 145 kV / 15 kg SF_6	0	0	0	0	0	0	3	3	3
Circuit breaker 110 kV, HYpact / 45 kg SF_6	0	5	8	8	8	8	8	8	8
Circuit breaker 110 kV, GL-311 F1 / 12 kg SF_6	29	29	29	29	29	29	29	29	32
Circuit breaker 110 kV, GL-311 F1 P / 9.9 kg SF_6	4	4	4	4	4	4	4	4	4
Circuit breaker 110 kV, GL-312F1/4031 P / VR / 7.8 kg SF_6	1	6	6	6	6	6	6	6	7
Circuit breaker 110 kV, 120-SFM-32B / 6.8 kg SF_6	0	0	0	0	0	0	45	65	92
Circuit breaker 330 kV, GL-315 F3 / 26 kg SF_6 and 15 kg CF_4	14	14	14	14	14	14	14	14	14
Circuit breaker 400 kV, LTB 420 E2/ 30 kg SF_6	2	2	2	2	2	2	2	2	2
Total circuit breakers installed	**91**	**107**	**112**	**112**	**116**	**121**	**170**	**193**	**224**

The amount of insulating gas (SF_6) in bulk charged into medium-tension electrical circuit breakers in the Republic of Moldova is shown in Table 4-160.

Table 4-160: Total amount of insulating gas – SF_6, available in bulk, charged into medium-tension electrical circuit breakers for the period 2006-2020, kg

	2006	2007	2008	2009	2010	2011	2012	2013
Circuit breaker 10 kV, PT COMPACT 3L1P (Ormazabal), 0.605 kg SF_6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.6
Circuit breaker 10 kV, CGMCOSMOS-L, 0.605 kg SF_6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Circuit breaker 10 KV, THO 24/SO5/E/THO-T1, 0.98 kg SF_6	0.0	0.0	0.0	0.0	0.0	27.4	51.0	51.0
Circuit breaker 10 kV, GAE630, 1.2 kg SF_6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Circuit breaker 10 kV, PT COMPACT 1P (Ormazabal), 1.25 kg SF_6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.3
Circuit breaker 10 kV, PT COMPACT 2L1P, 1.3 kg SF_6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Circuit breaker 10 kV, AUGUSTE 2012 / 1.5 kg SF_6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Circuit breaker 10 kV, PT COMPACT 1P (ZPUE), 1.6 kg SF_6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Circuit breaker 10 kV, CGMCOSMOS-LP, 1.855 kg SF_6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Circuit breaker 10 kV, GMA-24 / 2.2 kg SF_6	0.0	0.0	52.8	52.8	52.8	52.8	79.2	79.2
Circuit breaker 10 kV, PT COMPACT 2L1P (ZPUE), 2.25 kg SF_6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Circuit breaker 10 kV, PT COMPACT 2L1P (Ormazabal), 2.46 kg SF_6	0.0	0.0	0.0	0.0	0.0	0.0	7.4	36.9
Circuit breaker 10 kV, CGMCOSMOS-2LP, 2.460 kg SF_6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Circuit breaker 10 kV, PT COMPACT 3L1P (ZPUE), 2.9 kg SF_6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Circuit breaker 10 kV, CGMCOSMOS-3LP, 3.065 kg SF_6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Circuit breaker 10 kV, CGMCOSMOS-2LP+L, 3.067 kg SF_6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Circuit breaker 10 kV, PT COMPACT 2LP+L, 3.067 kg SF_6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Circuit breaker 10 kV, PT COMPACT 2L2P (ZPUE), 3.2 kg SF_6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Circuit breaker 10 kV, PT COMPACT 2LP+2L, 3.670 kg SF_6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Circuit breaker 10 kV, CGMCOSMOS-2LP+2L, 3.670 kg SF_6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Circuit breaker 10 kV, CGMCOSMOS-3L+LP, 3.670 kg SF_6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Circuit breaker 10 kV, PT COMPACT 2LP+P, 3.710 kg SF_6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Circuit breaker 10 kV, CGMCOSMOS-2LP+P, 3.710 kg SF_6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Circuit breaker 10 kV, CGMCOSMOS-3L+2LP, 4.275 kg SF_6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Circuit breaker 10 kV, CGMCOSMOS-2LP+LP, 4.315 kg SF_6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Circuit breaker 10 kV, PT COMPACT 2LP+LP, 4.315 kg SF_6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Circuit breaker 10 kV, CGMCOSMOS-2LP+2LP, 4.920 kg SF_6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Circuit breaker 35 kV, THO 36 / 0.98 kg SF_6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Circuit breaker 35 kV, GL-107X (2012) / 2.4 kg SF_6	0.0	0.0	0.0	0.0	0.0	0.0	2.4	2.4
Circuit breaker 35 kV, GL-107X (2005) / 2.6 kg SF_6	13.0	13.0	13.0	13.0	13.0	13.0	13.0	10.4
Circuit breaker 35 kV, VOX 36 / 2.9 kg SF_6	0.0	0.0	5.8	20.3	20.3	20.3	34.8	34.8
Total circuit breakers installed	**13.0**	**13.0**	**71.6**	**86.1**	**86.1**	**113.5**	**187.7**	**216.5**
	2014	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**
Circuit breaker 10 kV, PT COMPACT 3L1P (Ormazabal), 0.605 kg SF_6	1.2	1.2	1.2	1.2	1.2	1.2	1.2	NA
Circuit breaker 10 kV, CGMCOSMOS-L, 0.605 kg SF_6	0.0	0.0	0.0	0.0	0.0	0.0	0.6	NA
Circuit breaker 10 KV, THO 24/SO5/E/THO-T1, 0.98 kg SF_6	57.8	62.7	63.7	63.7	65.7	65.7	82.3	NA
Circuit breaker 10 kV, GAE630, 1.2 kg SF_6	0.0	0.0	0.0	18.0	52.8	52.8	82.8	NA
Circuit breaker 10 kV, PT COMPACT 1P (Ormazabal), 1.25 kg SF_6	1.3	1.3	1.3	1.3	1.3	1.3	1.3	NA
Circuit breaker 10 kV, PT COMPACT 2L1P, 1.3 kg SF_6	0.0	1.3	2.6	2.6	5.2	11.7	13.0	NA
Circuit breaker 10 kV, AUGUSTE 2012 / 1.5 kg SF_6	0.0	0.0	43.5	54.0	66.0	67.5	105.0	NA
Circuit breaker 10 kV, PT COMPACT 1P (ZPUE), 1.6 kg SF_6	0.0	0.0	1.6	1.6	4.8	4.8	4.8	NA
Circuit breaker 10 kV, CGMCOSMOS-LP, 1.855 kg SF_6	0.0	0.0	0.0	1.9	3.7	3.7	3.7	NA
Circuit breaker 10 kV, GMA-24 / 2.2 kg SF_6	79.2	79.2	79.2	79.2	79.2	79.2	79.2	NA
Circuit breaker 10 kV, PT COMPACT 2L1P (ZPUE), 2.25 kg SF_6	0.0	0.0	15.8	20.3	31.5	36.0	36.0	NA
Circuit breaker 10 kV, PT COMPACT 2L1P (Ormazabal), 2.46 kg SF_6	54.1	54.1	54.1	54.1	54.1	54.1	54.1	NA
Circuit breaker 10 kV, CGMCOSMOS-2LP, 2.460 kg SF_6	0.0	0.0	0.0	4.9	4.9	4.9	24.6	NA
Circuit breaker 10 kV, PT COMPACT 3L1P (ZPUE), 2.9 kg SF_6	0.0	0.0	0.0	5.8	5.8	5.8	5.8	NA
Circuit breaker 10 kV, CGMCOSMOS-3LP, 3.065 kg SF_6	0.0	0.0	0.0	0.0	3.1	3.1	3.1	NA
Circuit breaker 10 kV, CGMCOSMOS-2LP+L, 3.067 kg SF_6	0.0	0.0	0.0	3.1	6.1	6.1	15.3	NA
Circuit breaker 10 kV, PT COMPACT 2LP+L, 3.067 kg SF_6	0.0	0.0	3.1	3.1	3.1	3.1	3.1	NA
Circuit breaker 10 kV, PT COMPACT 2L2P (ZPUE), 3.2 kg SF_6	0.0	0.0	0.0	0.0	6.4	6.4	6.4	NA
Circuit breaker 10 kV, PT COMPACT 2LP+2L, 3.670 kg SF_6	0.0	0.0	0.0	3.7	3.7	3.7	3.7	NA
Circuit breaker 10 kV, CGMCOSMOS-2LP+2L, 3.670 kg SF_6	0.0	0.0	0.0	3.7	11.0	11.0	11.0	NA
Circuit breaker 10 kV, CGMCOSMOS-3L+LP, 3.670 kg SF_6	0.0	0.0	0.0	3.7	3.7	3.7	3.7	NA
Circuit breaker 10 kV, PT COMPACT 2LP+P, 3.710 kg SF_6	0.0	0.0	0.0	3.7	3.7	3.7	3.7	NA
Circuit breaker 10 kV, CGMCOSMOS-2LP+P, 3.710 kg SF_6	0.0	0.0	0.0	7.4	18.6	18.6	29.7	NA
Circuit breaker 10 kV, CGMCOSMOS-3L+2LP, 4.275 kg SF_6	0.0	0.0	0.0	0.0	4.3	4.3	12.8	NA
Circuit breaker 10 kV, CGMCOSMOS-2LP+LP, 4.315 kg SF_6	0.0	0.0	0.0	0.0	8.6	8.6	12.9	NA
Circuit breaker 10 kV, PT COMPACT 2LP+LP, 4.315 kg SF_6	0.0	4.3	8.6	8.6	8.6	8.6	8.6	NA
Circuit breaker 10 kV, CGMCOSMOS-2LP+2LP, 4.920 kg SF_6	0.0	0.0	0.0	0.0	0.0	0.0	4.9	NA
Circuit breaker 35 kV, THO 36 / 0.98 kg SF_6	2.0	2.0	2.0	2.0	2.0	2.0	7.8	NA
Circuit breaker 35 kV, GL-107X (2012) / 2.4 kg SF_6	2.4	2.4	2.4	2.4	2.4	2.4	2.4	NA
Circuit breaker 35 kV, GL-107X (2005) / 2.6 kg SF_6	10.4	10.4	10.4	10.4	10.4	10.4	10.4	NA
Circuit breaker 35 kV, VOX 36 / 2.9 kg SF_6	46.4	46.4	52.2	52.2	52.2	52.2	52.2	NA
Total circuit breakers installed	**254.8**	**265.3**	**341.6**	**412.4**	**523.9**	**536.4**	**686.2**	**NA**

The amount of insulating gas (SF_6 and CF_4) in bulk charged into high-tension electrical circuit breakers in the Republic of Moldova is shown in Tables 4-161 and 4-162.

Table 4-161: Total amount of insulating gas – SF_6, available in bulk, charged into high-tension electrical circuit breakers for the period 2003-2020, kg

	2003	2004	2005	2006	2007	2008	2009	2010	2011
Circuit breaker 110 kV, LTB 145D / 1B / 6 kg SF_6	0.0	0.0	0.0	12.0	12.0	12.0	12.0	12.0	24.0
Circuit breaker 110 kV, GL-311 F1 / 12 kg SF_6	0.0	0.0	0.0	48.0	120.0	216.0	288.0	348.0	396.0
Circuit breaker 110 kV, PASS MO 145 kV / 15 kg SF_6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Circuit breaker 110 kV, HYpact / 45 kg SF_6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Circuit breaker 110 kV, GL-311 F1 / 12 kg SF_6	12.0	12.0	72.0	252.0	348.0	348.0	348.0	348.0	348.0
Circuit breaker 110 kV, GL-311 F1 P / 9.9 kg SF_6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	29.7	39.6
Circuit breaker 110 kV, GL-312F1/4031 P / VR / 7.8 kg SF_6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	7.8	7.8
Circuit breaker 110 kV, 120-SFM-32B / 6.8 kg SF_6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Circuit breaker 330 kV, GL-315 F3 / 26 kg SF_6 and 15 kg CF_4	0.0	0.0	0.0	208.0	208.0	260.0	260.0	364.0	364.0
Circuit breaker 400 kV, LTB 420 E2/ 30 kg SF_6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total circuit breakers installed	**12.0**	**12.0**	**72.0**	**520.0**	**688.0**	**836.0**	**908.0**	**1109.5**	**1179.4**

	2012	2013	2014	2015	2016	2017	2018	2019	2020
Circuit breaker 110 kV, LTB 145D / 1B / 6 kg SF_6	36.0	36.0	48.0	48.0	54.0	66.0	66.0	66.0	66.0
Circuit breaker 110 kV, GL-311 F1 / 12 kg SF_6	420.0	492.0	492.0	492.0	528.0	564.0	576.0	612.0	612.0
Circuit breaker 110 kV, PASS MO 145 kV / 15 kg SF_6	0.0	0.0	0.0	0.0	0.0	0.0	45.0	45.0	45.0
Circuit breaker 110 kV, HYpact / 45 kg SF_6	0.0	225.0	360.0	360.0	360.0	360.0	360.0	360.0	360.0
Circuit breaker 110 kV, GL-311 F1 / 12 kg SF_6	348.0	348.0	348.0	348.0	348.0	348.0	348.0	348.0	384.0
Circuit breaker 110 kV, GL-311 F1 P / 9.9 kg SF_6	39.6	39.6	39.6	39.6	39.6	39.6	39.6	39.6	39.6
Circuit breaker 110 kV, GL-312F1/4031 P / VR / 7.8 kg SF_6	7.8	46.8	46.8	46.8	46.8	46.8	46.8	46.8	54.6
Circuit breaker 110 kV, 120-SFM-32B / 6.8 kg SF_6	0.0	0.0	0.0	0.0	0.0	0.0	306.0	442.0	625.6
Circuit breaker 330 kV, GL-315 F3 / 26 kg SF_6 and 15 kg CF_4	364.0	364.0	364.0	364.0	364.0	364.0	364.0	364.0	364.0
Circuit breaker 400 kV, LTB 420 E2/ 30 kg SF_6	60.0	60.0	60.0	60.0	60.0	60.0	60.0	60.0	60.0
Total circuit breakers installed	**1275.4**	**1611.4**	**1758.4**	**1758.4**	**1800.4**	**1848.4**	**2211.4**	**2383.4**	**2610.8**

Table 4-162: Total amount of insulating gas – CF_4 available in bulk, charged into medium and high-tension electrical circuit breakers for the period 2006-2020, kg

	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Circuit breaker 330 kV, GL-315 F3/26 kg SF_6 and 15 kg CF_4	120	120	150	150	210	210	210	210	210	210	210	210	210	210	210

2G3 'N_2O from Product Uses'

The methodology used to estimate N_2O emissions from source category 2G3 'N_2O from Product Uses' (in anaesthesia) is represented by the following formula:

$$E_{pollutant} = (AR_{product} \bullet {}_{pollutant\ technology}) / 10^3$$

Where:

- $E_{pollutant}$ – pollutant gas emissions from N_2O use in anaesthesia, t/yr;
- $AR_{product}$ – activity rate for N_2O consumption in anaesthesia, t/yr;
- $EF_{pollutant\ technology}$ – the emission factor for this pollutant technology, t/t (by default, 100% of the whole amount of N_2O used in anaesthesia is deemed to be emitted into the atmosphere).

AD for estimating nitrous oxide emissions from use of N_2O in anaesthesia was based on activity data provided by the former Ministry of Health, as a response to the Official Letters of the former Ministry of Ecology and Natural Resources (Table 4-163). In accordance with the response to the last Letter, dated March 1st, 2011, N_2O has not been used in anaesthesia anymore in the Republic of Moldova since 2007.

Table 4-163: Amount of nitrous oxide used in anaesthesia between 1990-2006

	1990	1991	1992	1993	1994	1995	1996	1997	1998
N_2O consumption in anaesthesia, kg	66	55	50	60	50	1	2	3	5
	1999	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007-2020**
N_2O consumption in anaesthesia, kg	43	44	44	44	44	50	61	59	NO

Source: Ministry of Health of the RM, through Letter No. 01-9/2513 dated 9.11.2007, as a response to Official request No. 01-07/1608 dated 15.10.2007 from the Ministry of Ecology and Natural Resources of the RM and through Letter No. 01-9/550 dated 01.03.2011, as a response to Official request No. 03-07/175 dated 02.02.2011 from the Ministry of Environment of the RM.

2G4 'Other'

Tobacco Combustion

The methodology used to estimate NO_x, CO, and NMVOC emissions from tobacco combustion (SNAP 060602), available in the EMEP/EEA Air Pollutant Emission Inventory Guidebook (2019) is represented by the following formula:

$$E_{pollutant} = (AR_{product} \bullet EF_{pollutant\ technology}) / 10^3$$

Where:

$E_{pollutant}$ – the emission of the specified pollutant from tobacco combustion, t/yr;

$AR_{product}$ – activity rate for burnt tobacco products, t/yr;

$EF_{pollutant\ technology}$ – default emission factor, kg/t.

The EMEP/EEA Air Pollutant Emission Inventory Guidebook (2019) provides default emission factors (Table 4-164) for the Tier 2 approach.

Table 4-164: Tier 2 default EFs for category 2G4 'Other' (Tobacco Combustion)

Source	GHG	Emission Factor	Unit
2G4 'Other' (Tobacco Combustion)	NO_x CO NMVOC	1.80 55.10 4.84	kg/t of tobacco

Source: EMEP/EEA Air Pollutant Emission Inventory Guidebook (2019), Category 2D3i, SNAP 060602, Table 3-15, page 22-23.

Statistical data regarding cigar and cigarette production is available in the Statistical Yearbooks of the RM, the Statistical Reports PRODMOLD-A 'Total production, as a natural expression, in the Republic of Moldova, by product type, for 2005-2020', as well as in the statistical database which can be accessed on-line on the NBS website[66].

At the same time, statistical data associated with the import and export of cigars and cigarettes was provided by the Customs Service of the Republic of Moldova, from the Automated System for Customs Data ASYCUDA World, which ensures the management and processing of customs forms and documents used in customs procedures, but offered only for the period 2013-2020; other available sources of information were consulted[67].

Table 4-165: AD on cigar and cigarette consumption in the Republic of Moldova for 1990-2020

	1990	1991	1992	1993	1994	1995	1996	1997
Cigars and Cigarettes Imported, billion units	NA	NA	NA	NA	NA	NA	NA	NA
Cigars and Cigarettes Produced, billion units	9.100	9.200	8.600	8.800	8.000	7.100	9.700	9.500
Cigars and Cigarettes Exported, billion units	NA	NA	NA	NA	NA	NA	NA	NA
Cigars and Cigarettes Consumed, billion units	9.100	9.200	8.600	8.800	8.000	7.100	9.700	9.500
Amount of Tobacco in Cigars and Cigarettes Consumed, kt	10.920	11.040	10.320	10.560	9.600	8.520	11.640	11.400
	1998	1999	2000	2001	2002	2003	2004	2005
Cigars and Cigarettes Imported, billion units	NA	NA	NA	NA	0.600	1.300	1.700	2.500
Cigars and Cigarettes Produced, billion units	7.512	8.731	9.262	9.421	6.310	7.126	7.050	6.195
Cigars and Cigarettes Exported, billion units	NA	NA	NA	NA	0.100	0.040	0.040	0.100
Cigars and Cigarettes Consumed, billion units	7.512	8.731	9.262	9.421	6.810	8.386	8.710	8.595
Amount of Tobacco in Cigars and Cigarettes Consumed, kt	9.014	10.477	11.114	11.305	8.172	10.063	10.452	10.314
	2006	2007	2008	2009	2010	2011	2012	2013
Cigars and Cigarettes Imported, billion units	3.400	4.300	4.200	4.800	4.900	4.800	4.400	3.284
Cigars and Cigarettes Produced, billion units	5.031	4.975	3.990	4.878	6.261	6.462	4.656	3.472
Cigars and Cigarettes Exported, billion units	0.100	0.100	0.300	0.200	0.200	0.300	1.000	0.624
Cigars and Cigarettes Consumed, billion units	8.331	9.175	7.890	9.478	10.961	10.962	8.056	6.132
Amount of Tobacco in Cigars and Cigarettes Consumed, kt	9.997	11.010	9.468	11.373	13.153	13.154	9.667	7.359
	2014	2015	2016	2017	2018	2019	2020	%
Cigars and Cigarettes Imported, billion units	3.567	4.395	4.530	4.999	3.641	3.230	4.305	N/A
Cigars and Cigarettes Produced, billion units	2.322	1.776	1.839	1.411	0.660	0.650	0.494	-94.6
Cigars and Cigarettes Exported, billion units	0.524	0.793	1.544	2.798	0.413	0.341	0.285	N/A
Cigars and Cigarettes Consumed, billion units	5.365	5.377	4.825	3.612	3.889	3.539	4.515	-50.4
Amount of Tobacco in Cigars and Cigarettes Consumed, kt	6.438	6.453	5.790	4.334	4.667	4.247	5.417	-50.4

Source: National Bureau of Statistics of the RM through Statistical Yearbooks for 1994 (page 290), 1999 (page 305), 2003 (page 395), 2006 (page 311), 2007 (page 310), 2008 (page 306), 2009 (page 303), 2010 (page 303), 2011 (page 304), 2012 (page 307), 2013 (page 305), 2014 (page 301); Statistical Reports PRODMOLD-A 'Total production, as a natural expression, in the Republic of Moldova, by product type, for 2005-2019'; Customs Service of the Republic of Moldova, through Letter No. 28/07-3025 dated 28.02.2020, as a response to the request from the Environment Agency No. 08-310/1 dated 11.02.2020; through Letter dated 19.02.2021, as a response to the Letter 13-07/519 dated 09.02.2021, from MARDE.

[66] National Bureau of Statistics of the RM, Statistical database: <http://statbank.statistica.md/pxweb/Dialog/varval.asp?ma=IND0301&ti=Productia+ principalelor+produse+industriale%2C+1997-2009&-path= ../ Database/RO/14%20IND/IND03/&lang=1>

[67] <https://www.mold-street.com/?go=news&n=6123>, <https://www.mold-street.com/?go=news&n=9744>

According to the EMEP/EEA Air Pollutant Emission Inventory Guidebook (2019), (source category 2D3i 'Other Solvent and Product Use' Snap 060602, page 21), a cigar contains 5 g of tobacco, whereas a cigarette – only 1 g of tobacco. In order to estimate the amount of tobacco burnt (Table 4-165), it was considered that the market share of cigarettes is 95%, whereas cigars – 5%.

Indirect CO_2 emissions were estimated taking into consideration the carbon content in NMVOC emissions. The default value used is 60% (IPCC 2006 Guidelines, Volume 3, Chapter 5.5, page 5.17). By oxidation, this carbon is converted into CO_2 in the atmosphere.

In order to estimate indirect CO_2 emissions from use of tobacco, the following equation was used:

$$CO_2\ Emissions = NMVOC \bullet CC \bullet 44/12$$

Where:

CO_2 Emissions – CO_2 emissions from use of tobacco, kt/yr;

NMVOC – total NMVOC emissions within the respective category, kt/yr;

CC – carbon content in NMVOC, fraction (the default value used is 60%, with a margin of 50-70%; 2006 IPCC Guidelines, Volume 3, Chapter 5.5, page 5.17);

44/12 – mass ratio of CO_2/C.

Use of Shoes

The methodology used to estimate NMVOC emissions from use of shoes (SNAP 060603), is available in the EMEP/EEA Air Pollutant Emission Inventory Guidebook (2019) and uses the following equation:

$$E_{pollutant} = (AR_{product} \bullet EF_{pollutant\ technology}) / 10^3$$

Where:

$E_{pollutant}$ – emission of the specified pollutant from use of shoes, t/yr;

$AR_{product}$ – activity rate for use of shoes, million pairs/yr;

$EF_{pollutant\ technology}$ – default emission factor, kg/t.

The EMEP/EEA Air Pollutant Emission Inventory Guidebook (2019) provides a default emission factor (Table 4-166) for the Tier 2 approach.

Table 4-166: Tier 2 default EF for 2G4 'Other' (Use of Shoes)

Source	GHG	Emission Factor	Unit
2G4 'Other' (Use of Shoes)	NMVOC	60	g/pairs of shoes

Source: EMEP/EEA Air Pollutant Emission Inventory Guidebook (2019), Category 2D3i, SNAP 060603, Table 3-16, p. 24.

Statistical data regarding shoe production (Table 4-167) is available in the Statistical Yearbooks of the ATULBD and the RM, as well as in the Statistical Reports PRODMOLD-A 'Total production, as a natural expression, in the Republic of Moldova, by product type, for 2005-2020'; at the same time, statistical data associated with the import and export of shoes was provided by the Customs Service of the Republic of Moldova.

Table 4-167: AD on shoe consumption in the Republic of Moldova for the 1990-2020, million pairs

	1990	1991	1992	1993	1994	1995	1996	1997
Shoe Production, million pairs	23.200	20.800	16.268	13.197	9.467	7.606	6.929	6.193
Shoe Export, million pairs	13.041	11.692	9.144	7.418	5.321	4.275	3.895	3.481
Shoe Import, million pairs	14.725	13.202	10.325	8.376	6.009	4.828	4.398	3.931
Shoe Consumption, million pairs	24.884	22.310	17.449	14.155	10.154	8.158	7.432	6.643
	1998	1999	2000	2001	2002	2003	2004	2005
Shoe Production, million pairs	4.591	3.747	5.912	4.944	4.925	6.038	6.633	7.450
Shoe Export, million pairs	2.581	2.106	3.323	2.779	2.768	3.394	3.728	4.188
Shoe Import, million pairs	2.914	2.378	3.752	3.138	3.126	3.832	4.210	4.729
Shoe Consumption, million pairs	4.924	4.019	6.341	5.303	5.283	6.476	7.114	7.991
	2006	2007	2008	2009	2010	2011	2012	2013
Shoe Production, million pairs	6.774	6.696	7.083	4.829	6.247	7.692	7.448	8.329
Shoe Export, million pairs	3.808	3.764	3.981	2.715	3.511	4.324	4.187	3.435
Shoe Import, million pairs	4.299	4.250	4.495	3.065	3.965	4.882	4.728	2.819
Shoe Consumption, million pairs	7.266	7.182	7.597	5.180	6.701	8.250	7.989	7.713

	2014	2015	2016	2017	2018	2019	2020	%
Shoe Production, million pairs	7.607	5.547	5.156	4.647	4.352	3.785	3.269	-85.9
Shoe Export, million pairs	5.158	3.226	2.871	2.603	2.514	2.559	2.299	-82.4
Shoe Import, million pairs	6.169	4.278	5.316	6.513	5.807	6.991	5.723	-61.1
Shoe Consumption, million pairs	8.618	6.599	7.601	8.557	7.645	8.217	6.693	-73.1

Source: Statistical Yearbooks of the ATULBD for 1998-2021; Statistical Yearbooks of the RM for 1991-2021; Statistical Reports PRODMOLD-A 'Total production, as a natural expression, in the Republic of Moldova, by product type, for 2005-2020'; Customs Service of the RM, through Letter dated 19.02.2021, as a response to Letter No. 13-07/519 dated 09.02.2021, from MARDE; Letter No. 28/07-3025 dated 28.02.2020, as a response to the request from the Environment Agency No. 08-310/1 dated 11.02.2020; Letter No. 28/07-612 dated 12.01.2018, as a response to the request from the Climate Change Office of the MARDE No. 601/2017-12-03 dated 14.12.2017; Letter No. 28/07-8785 dated 26.05.2016, as a response to the request from the Climate Change Office of the Ministry of Environment No. 512/2016-05-01 dated 10.05.2016; Letter No. 28/07-2231 dated 26.02.2015, as a response to the request from the Climate Change Office of the Ministry of Environment No. 407/2015-01-09 dated 29.01.2015; Letter No. 15-03-05 dated 24.01.2014, as a response to the request from the Climate Change Office of the Ministry of Environment No. 320/2014-01-01 dated 03.01.2014; Letter No. 28/07-1893 dated 23.02.2011, as a response to the request from the Ministry of Environment No. 03-07/175 dated 02.02.2011.

Indirect CO_2 emissions were estimated taking into consideration the carbon content in NMVOC emissions. The default value used is 60% (2006 IPCC Guidelines, Volume 3, Chapter 5.5, page 5.17). By oxidation, this carbon is converted into CO_2 in the atmosphere.

In order to estimate indirect CO_2 emissions from use of shoes, the following equation was used:

$$CO_2\ Emission = NMVOC \bullet CC \bullet 44/12$$

Where:

CO_2 Emissions – CO_2 emissions from use of shoes, kt/yr;

NMVOC – total NMVOC emissions within the respective category, kt/yr;

CC – carbon content in NMVOC, fraction (the default value used is 60%, with a margin of 50-70%;

44/12 – mass ratio of CO_2/C.

Use of Fireworks

The methodology used to estimate NO_x, CO, and SO_2 emissions from use of fireworks (SNAP 060601), is available in the EMEP/EEA Air Pollutant Emission Inventory Guidebook (2019) and uses the following equation:

$$E_{pollutant} = (AR_{product} \bullet EF_{pollutant\ technology}) / 10^3$$

Where:

$E_{pollutant}$ – emission of the specified pollutant from use of fireworks, t/yr;

$AR_{product}$ – activity rate for use of fireworks, t/yr;

$EF_{pollutant\ technology}$ – default emission factor, kg/t.

The EMEP/EEA Air Pollutant Emission Inventory Guidebook (2019) provides default emission factors (Table 4-168) for the Tier 2 approach.

Table 4-168: Tier 2 default EFs for category 2G4 'Other' (Use of Fireworks)

Source	GHGs	Emission Factor	Unit
2G4 'Other' (Use of Fireworks)	NO_x CO SO_2	0.260 7.150 3.020	kg/t of product

Source: EMEP/EEA Air Pollutant Emission Inventory Guidebook (2019), Category 2D3i, SNAP 060601, Table 3-14, p. 22.

Statistical data associated with the import and export of fireworks (code: 3604 10 000 – signalling flares, rain rockets, and other pyrotechnic articles, as well as 3604 90 000 – other fireworks) was provided by the Customs Service, from the Automated System for Customs Data ASYCUDA World, which ensures the management and processing of customs forms and documents used in customs procedures, but offered only for the period 2013-2020 (Table 4-169).

Table 4-169: AD on import of fireworks in the Republic of Moldova for 2013-2020

	2013	2014	2015	2016	2017	2018	2019	2020
Fireworks, t	107.519	214.500	72.316	98.578	80.781	195.019	234.751	206.890
Signalling flares, rain rockets, t	2.848	29.042	11.193	15.080	31.833	30.005	43.502	57.890
Total fireworks and pyrotechnic articles, t	**110.367**	**243.542**	**83.509**	**113.658**	**112.613**	**225.024**	**278.253**	**264.780**

Source: Customs Service of the RM, through Letter dated 19.02.2021, as a response to Letter 13-07/519 dated 09.02.2021, from MARDE; Letter No. 28/07-3025 dated 28.02.2020, as a response to the request from the Environment Agency No. 08-310/1 dated 11.02.2020.

4.7.3. Uncertainties and Time-Series Consistency

2G1 'Electrical Equipment'

Uncertainties associated with the emission factors used to estimate SF_6 and PFC emissions from source category 2G1 'Electrical Equipment' reach up to circa 20% (2006 IPCC Guidelines). Uncertainties associated with activity data on the use of SF_6 and PFC are considered to be low (circa 5%). Thus, combined uncertainties for this source category are estimated to be circa 20.62% (Annex 5-3.2). In view of ensuring time-series consistency of the obtained results, the same approach was used for the entire period under review, in accordance with the recommendations included in the 2006 IPCC Guidelines.

2G3 'N_2O from Product Uses'

Uncertainties associated with the emission factors used to estimate N_2O emissions from source category 2G3 'N_2O from Product Uses' are estimated to be circa 3%. Uncertainties associated with activity data on the use of N_2O in medical applications in the RM are considered to be low (circa 5%). Thus, combined uncertainties for this source category are estimated to be circa 5.83% (Annex 5-3.2). In view of ensuring time-series consistency of the obtained results, the same approach was used for the entire period under review, in accordance with the recommendations included in the 2006 IPCC Guidelines.

2G4 'Other'

Uncertainties associated with the emission factors used to estimate GHG emissions from source category 2G4 'Other' (Tobacco Combustion and Use of Shoes) reach up to circa 50%. Uncertainties associated with activity data on use of tobacco and use of shoes in the RM are considered moderate (circa 15%). Thus, combined uncertainties for this source category are estimated to be circa 52.20% (Annex 5-3.2). In view of ensuring time-series consistency of the obtained results, the same approach was used for the entire period under review, in accordance with the recommendations included in the 2006 IPCC Guidelines.

4.7.4. Quality Assurance and Quality Control

Standard verification and quality control forms and checklists were filled in for the respective category following a Tier 1 approach. Verification was focused on ensuring correct use of the default emission factors available in the 2006 IPCC Guidelines; on correct use of AD obtained from different reference sources, including official sources (i.e., National Bureau of Statistics, Ministry of Health, Labour and Social Protection, SOE 'Moldelectrica', Premier Energy Ltd., JSC 'Red-North') and the correct use of these. It should be noted that the AD and methods used for estimating GHG emissions from category 2G 'Other Product Manufacture and Use' were documented and archived both in hard copies and electronically.

4.7.5. Recalculations

2G1 'Electrical Equipment'

For the period 2015-2019, recalculations were made for SF_6 and CF_4 emissions from category 2G1 'Electrical Equipment' due to the updated total number of medium-tension electrical circuit breakers in the management of JSC 'RED-North'. In comparison with the results obtained in the BUR3 of the RM to the UNFCCC (2021), recalculations resulted in a slight upward trend in GHG emissions from category 2G1 'Electrical Equipment', varying from a minimum of 0.02% in 2015 to a maximum of 0.47% in 2018 (Table 4-170). For 2020, SF_6 and CF_4 emissions from the respective category have been estimated for the first time. The obtained results show that the respective emissions increased in the RM by circa 227.6 times between 2003 and 2020.

Table 4-170: Comparative results of SF_6 and CF_4 emissions from source category 2G1 'Electrical Equipment' included in the BUR3 and NC5 of the RM to the UNFCCC, kt CO_2 equivalent

	2003	2004	2005	2006	2007	2008	2009	2010	2011
BUR3	0.0071	0.0071	0.0427	0.3319	0.4315	0.5277	0.5710	0.7020	0.7447
NC5	0.0071	0.0071	0.0427	0.3319	0.4315	0.5277	0.5710	0.7020	0.7447
Difference, %	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2012	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**
BUR3	0.8050	1.0055	1.0943	1.0946	1.1226	1.1520	1.3687	1.4710	
NC5	0.8050	1.0055	1.0943	1.0948	1.1232	1.1549	1.3752	1.4777	1.6193
Difference, %	0.00	0.00	0.00	0.02	0.06	0.25	0.47	0.46	

Abbreviations: BUR3 – Third Biennial Update Report of the RM to the UNFCCC, NC5 – Fifth National Communication of the RM to the UNFCCC.

The table below shows SF_6 and CF_4 emissions by substance in metric tonnes and expressed in CO_2 equivalent (Table 4-171).

Table 4-171: SF_6 and CF_4 emissions from source category 2G1 'Electrical Equipment' between 2003-2020

	2003	2004	2005	2006	2007	2008	2009	2010	2011
	2G1 'Electrical Equipment'								
SF_6, t	0.0003	0.0003	0.0019	0.0135	0.0179	0.0219	0.0238	0.0290	0.0309
SF_6, kt CO_2 eq.	**0.0071**	**0.0071**	**0.0427**	**0.3088**	**0.4084**	**0.4988**	**0.5422**	**0.6616**	**0.7043**
CF_4, t	NO	NO	NO	0.0031	0.0031	0.0039	0.0039	0.0055	0.0055
CF_4, kt CO_2 eq.	NO	NO	NO	**0.0231**	**0.0231**	**0.0288**	**0.0288**	**0.0403**	**0.0403**
	2012	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**
	2G1 ,Electrical Equipment'								
SF_6, t	0.0335	0.0423	0.0462	0.0462	0.0475	0.0489	0.0585	0.0630	0.0693
SF_6, kt CO_2 eq.	**0.7646**	**0.9651**	**1.0540**	**1.0545**	**1.0829**	**1.1145**	**1.3348**	**1.4373**	**1.5790**
CF_4, t	0.0055	0.0055	0.0055	0.0055	0.0055	0.0055	0.0055	0.0055	0.0055
CF_4, kt CO_2 eq.	**0.0403**	**0.0403**	**0.0403**	**0.0403**	**0.0403**	**0.0403**	**0.0403**	**0.0403**	**0.0403**

2G3 'N_2O from Product Uses'

No recalculations were made for N_2O emissions from source category 2G3 'N_2O from Product Uses' recorded between 1990 and 2006 (Table 4-172). From 2007 through 2015, there were no records of N_2O emissions from the respective category.

Table 4-172: N_2O emissions from source category 2G3 'N_2O from Product Uses' between 1990-2006

	1990	1991	1992	1993	1994	1995	1996	1997	1998
N_2O emissions, t	0.0001	0.0001	0.0001	0.0001	0.0001	0.0000	0.0000	0.0000	0.0000
N_2O emissions, kt CO_2 equivalent	0.0197	0.0164	0.0149	0.0179	0.0149	0.0003	0.0006	0.0009	0.0015
	1999	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**%**
N_2O emissions, t	0.0000	0.0000	0.0000	0.0000	0.0000	0.0001	0.0001	0.0001	-10.6
N_2O emissions, kt CO_2 equivalent	0.0128	0.0131	0.0131	0.0131	0.0131	0.0149	0.0182	0.0176	-10.6

2G4 'Other'

Indirect CO_2 emissions from category 2G4 'Other' were recalculated for the period 2018-2019 due to updated AD regarding the use of cigars/cigarettes and shoes in the Republic of Moldova, available in the official sources of references: the Automated System for Customs Data ASYCUDA World, which ensures the management and processing of customs forms and documents used in customs procedures, respectively in the Statistical Yearbooks of the RM and the Statistical Reports PRODMOLD-A 'Total production, as a natural expression, in the Republic of Moldova, by product type', as well as in the Statistical Yearbooks of the ATULBD. In comparison with the results recorded in the BUR3 of the RM to the UNFCCC (2021), the recalculations resulted in an upward trend in indirect CO_2 emissions from source category 2G4 'Other' in the years 2018-2019 (Table 4-173). Indirect CO_2 emissions from the respective category were estimated for the first time for 2020. The obtained results show that between 1990 and 2020, the respective emissions decreased in the country by circa 72.3%.

Table 4-173: Comparative results of indirect CO_2 emissions from source category 2G4 'Other' included in the BUR3 and NC5 of the RM to the UNFCCC, kt CO_2 equivalent

	1990	1991	1992	1993	1994	1995	1996	1997
BUR3	3.4010	3.0625	2.4132	1.9809	1.4426	1.1676	1.1050	0.9982
NC5	3.4010	3.0625	2.4132	1.9809	1.4426	1.1676	1.1050	0.9982
Difference, %	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	1998	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**
BUR3	0.7460	0.6421	0.9554	0.8204	0.7843	0.9620	1.0504	1.1646
NC5	0.7460	0.6421	0.9554	0.8204	0.7843	0.9620	1.0504	1.1646
Difference, %	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	2006	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**
BUR3	1.0655	1.0652	1.1036	0.8048	1.0245	1.2291	1.1575	1.0965
NC5	1.0655	1.0652	1.1036	0.8048	1.0245	1.2291	1.1575	1.0965
Difference, %	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	2014	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**%**
BUR3	1.2062	0.9397	1.0649	1.1757	1.0114	1.1072		
NC5	1.2062	0.9397	1.0649	1.1757	1.0589	1.1299	0.9412	-72.3
Difference, %	0.0	0.0	0.0	0.0	4.7	2.1		

Abbreviations: BUR3 – Third Biennial Update Report of the RM to the UNFCCC, NC5 – Fifth National Communication of the RM to the UNFCCC.

4.7.6. Planned Improvements

Potential improvements under category 2G 'Other Product Manufacture and Use' could include specifying the activity data used to estimate GHG emissions from this category for the period 1990-2020. Likewise, activity data shall be collected for the use of fireworks (code 3604 10 000 – signalling flares, rain rockets, and other pyrotechnic articles, as well as other fireworks – code 3604 90 000), and for the period 1990-2012 (in the previous two inventory cycles, it was possible to collect data only for the period 2013-2020), in order to estimate indirect GHG emissions from the respective source (SNAP 060601) within category 2G 'Other Product Manufacture and Use'.

4.8. Other (Category 2H)

4.8.1. Source Category Description

Category 2H 'Other', covers GHG emissions generated from the following emission sources: 2H1 'Pulp and Paper Industry' and 2H2 'Food and Beverage Industry'. In the Republic of Moldova, no pulp and paper is produced, and there are no recorded emissions from category 2H1, and these are, respectively, reported as NO.

NMVOC emissions have been reported from source category 2H2 'Food and Beverage Industry'. Between 1990 and 2020, the respective emissions had decreased by circa 71%, from circa 12.08 kt in 1990 to 3.51 kt in 2020 (Table 4-174).

Table 4-174: NMVOC emissions from source category 2H2 'Food and Beverage Industry' for the period 1990-2020, kt

	1990	1991	1992	1993	1994	1995	1996	1997
2H2a 'Bread Making and Other Food'	11.0434	9.0948	7.2053	7.8286	5.0893	5.8083	5.7982	5.5868
2H2b 'Alcoholic Beverages'	1.0326	1.0178	0.8417	1.3868	2.3330	3.5273	2.7783	2.1109
2H2 'Food and Beverage Industry'	12.0760	10.1126	8.0471	9.2154	7.4223	9.3357	8.5764	7.6977
	1998	1999	2000	2001	2002	2003	2004	2005
2H2a 'Bread Making and Other Food'	4.7372	3.0748	2.9202	3.1034	3.4932	2.6133	2.9743	3.1437
2H2b 'Alcoholic Beverages'	1.5650	0.8733	0.6928	0.8859	1.0539	1.6616	2.3217	2.6349
2H2 'Food and Beverage Industry'	6.3022	3.9481	3.6129	3.9893	4.5471	4.2749	5.2960	5.7786
	2006	2007	2008	2009	2010	2011	2012	2013
2H2a 'Bread Making and Other Food'	3.1424	1.9021	3.4029	2.0758	2.8726	2.7945	2.2399	3.4545
2H2b 'Alcoholic Beverages'	1.8890	1.6852	1.4513	1.1784	1.3261	1.4815	1.7515	2.0150
2H2 'Food and Beverage Industry'	5.0313	3.5873	4.8542	3.2541	4.1987	4.2760	3.9915	5.4694
	2014	2015	2016	2017	2018	2019	2020	%
2H2a 'Bread Making and Other Food'	3.8966	2.6528	3.1529	3.6075	3.1113	3.1565	2.0902	-81.1
2H2b 'Alcoholic Beverages'	1.8188	1.5802	1.5099	1.6013	1.5791	1.5315	1.4175	37.3
2H2 'Food and Beverage Industry'	5.7153	4.2329	4.6628	5.2088	4.6903	4.6880	3.5077	-71.0

It should be noted that in the base year (1990), circa 91.4% of the total NMVOC emissions were generated from source category 2H2a 'Bread Making and Other Food'. By 2020, the share of this category in the total NMVOC emissions had decreased to circa 59.6% (Figure 4-4).

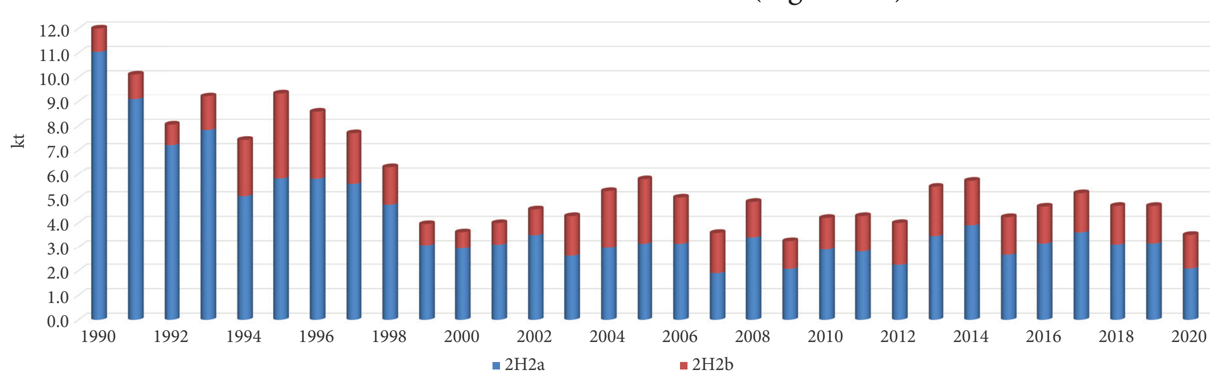


Figure 4-4: NMVOC emissions from 2H2 'Food and Beverages Industry' between 1990-2020.

4.8.2. Methodological Issues, Emission Factors and Data Sources

a) Bread Making and Other Food

Methodological issues pertaining to the calculation of NMVOC emissions from bread making and other food are addressed in the EMEP/EEA Air Pollutant Emission Inventory Guidebook (2019). The estimation method used implies multiplication of default EF values (Table 4-175) by activity data on bread making and other food available in the national statistics of the RM and of the ATULBD (Table 4-176).

Table 4-175: Default EFs used to estimate NMVOC emissions from Bread Making and Other Food

Source	Bread Making and Other Food	NMVOC, kg/t
Bread Making and Other Food	Meat processing	0.33
	Fish processing	1.0
	Grain drying in elevators	1.3
	Sugar; Margarine and solid cooking fats	10
	Cakes, biscuits and breakfast cereals; Animal Feed	1
	Bread	4.5

Source: EMEP/EEA Atmospheric Emissions Inventory Guidebook (2019), 2H2 Food and Beverages Industry, SNAP 040605 – Bread Making and Other Food, Tables 3-2, 3-3, 3-4, 3-11, 3-18, 3-19, 3-20, 3-21, 3-22. Pages 10-20.

Table 4-176: AD on bread making and other food in the Republic of Moldova for 1990-2020, kt

	1990	1991	1992	1993	1994	1995	1996	1997
Meat	257.900	218.500	136.000	114.200	85.900	58.400	52.600	50.800
Fish	9.500	5.200	6.500	9.500	2.100	0.000	0.000	0.900
Dried grains in elevators	2169.760	2539.600	1725.894	2374.223	1241.296	1581.116	1264.628	1692.411
Sugar	435.800	236.900	192.200	230.200	166.700	218.700	264.500	213.300
Margarine	NO	NO	NO	NO	NO	NO	NO	NO
Confectionery Products	24.300	23.500	12.100	10.080	5.000	5.170	5.150	5.550
Bread	601.900	528.300	468.600	431.700	325.200	268.400	252.500	221.900
Animal Feed	1037.292	946.192	867.504	440.210	309.794	333.628	350.394	231.890
	1998	1999	2000	2001	2002	2003	2004	2005
Meat	27.300	25.717	13.351	7.301	11.262	14.855	10.180	6.651
Fish	0.800	1.000	1.900	2.300	2.700	2.700	2.700	3.000
Dried grains in elevators	1339.292	985.796	899.624	860.243	876.056	618.920	849.187	814.747
Sugar	194.500	100.500	105.400	132.600	167.600	107.100	110.900	133.472
Margarine	NO	NO	0.024	1.034	2.616	3.301	3.515	3.390
Confectionery Products	9.200	8.423	8.745	12.834	15.852	18.036	17.876	20.726
Bread	180.200	147.045	138.126	133.280	130.779	144.650	145.830	142.026
Animal Feed	221.176	108.604	59.791	31.441	41.381	28.095	46.062	50.840
	2006	2007	2008	2009	2010	2011	2012	2013
Meat	10.228	16.122	12.809	16.260	24.699	28.509	31.597	35.495
Fish	2.500	2.300	4.600	3.700	1.300	7.578	7.732	8.490
Dried grains in elevators	678.433	282.590	920.742	658.146	764.898	803.125	405.366	882.522
Sugar	149.046	73.964	133.966	38.373	103.209	88.436	83.440	140.297
Margarine	2.624	2.225	1.940	1.657	1.274	1.119	0.484	0.706
Confectionery Products	21.692	22.284	22.910	23.629	27.718	29.383	31.332	34.633
Bread	144.848	154.774	169.806	161.564	160.406	162.916	161.765	165.450
Animal Feed	64.340	46.422	51.043	60.143	74.405	75.405	96.284	97.787
	2014	2015	2016	2017	2018	2019	2020	%
Meat	44.072	45.958	45.941	55.931	62.233	62.645	70.501	-72.7
Fish	8.774	9.966	8.086	7.788	10.739	10.113	10.320	8.6
Dried grains in elevators	955.221	724.699	987.553	1115.457	1161.476	1099.972	551.342	-74.6
Sugar	177.695	84.519	99.999	128.980	73.906	86.925	54.366	-87.5
Margarine	C	C	C	C	C	C	C	N/A
Confectionery Products	34.875	34.255	35.143	36.485	37.880	40.232	39.405	62.2
Bread	160.259	161.328	157.550	157.973	156.327	158.113	148.820	-75.3
Animal Feed	98.472	80.118	101.729	94.033	89.650	74.789	87.162	-91.6

Source: Statistical Yearbooks of the RM for 1994 (page 289-290), 1999 (page 304-305), 2003 (page 393-394), 2006 (page 309-310), 2010 (page 301-303), 2014 (page 299-301); Statistical Reports PROD-MOLD-A 'Total production, as a natural expression, in the Republic of Moldova, by product type, for 2005-2020'; Statistical Yearbooks of the ATULBD for 1998 (page 177), 2000 (page 100), 2002 (page 104), 2005 (page 94), 2007 (page 93), 2009 (page 93), 2011 (page 95), 2014 (page 89), 2017 (page 102), 2020 (page 103).

AD on the amount of dried grains in elevators was deduced from the information available in the national statistics of the RM and ATULBD (Table 4-177).

Table 4-177: Selective AD on agricultural crops in the Republic of Moldova for 1990-2020

	1990	1991	1992	1993	1994	1995	1996	1997
Wheat, kt	1129.0	1056.5	925.8	1392.6	658.8	1154.3	673.7	1152.6
Barley, kt	417.9	427.0	405.0	481.0	324.9	311.2	136.7	256.9
Oat, kt	3.8	5.0	6.8	10.7	7.1	9.8	4.2	10.3
Grain maize, kt	885.5	1501.2	635.6	1324.5	629.3	948.6	1006.6	1788.0
Sunflower, kt	252.2	151.4	176.2	173.7	149.2	208.1	284.0	174.3
Soy, kt	23.8	33.4	7.9	9.3	4.0	3.3	2.5	2.7
Oilseed rape, kt	NO	NO	NO	NO	NO	NO	NO	NO
Total cereals, kt	2712.2	3174.5	2157.4	3391.7	1773.3	2635.2	2107.7	3384.8
Share of cereals dried in elevators, % of total	80	80	80	70	70	60	60	50
Cereals dried in elevators, kt	2169.8	2539.6	1725.9	2374.2	1241.3	1581.1	1264.6	1692.4

	1998	1999	2000	2001	2002	2003	2004	2005
Wheat, kt	951.9	797.8	725.0	1180.8	1113.1	102.4	861.2	1048.6
Barley, kt	242.2	203.1	152.3	248.4	241.7	74.4	284.1	240.9
Oat, kt	9.5	5.9	3.5	6.4	4.7	4.0	10.3	7.6
Grain maize, kt	1272.7	1151.3	1050.4	1141.9	1206.3	1440.2	1845.1	1523.4
Sunflower, kt	196.4	291.6	305.1	278.3	340.9	421.4	354.8	368.7
Soy, kt	6.0	13.7	11.6	10.5	12.6	19.4	40.2	66.4
Oilseed rape, kt	NO	1.2	1.1	1.0	1.0	1.2	1.1	3.4
Total cereals, kt	2678.6	2464.5	2249.1	2867.5	2920.2	2063.1	3396.7	3259.0
Share of cereals dried in elevators, % of total	50	40	40	30	30	30	25	25
Cereals dried in elevators, kt	1339.3	985.8	899.6	860.2	876.1	618.9	849.2	814.7
	2006	2007	2008	2009	2010	2011	2012	2013
Wheat, kt	682.3	406.5	1286.5	738.9	749.5	797.1	496.9	1009.6
Barley, kt	214.6	125.7	362.3	290.5	240.7	218.9	139.3	241.6
Oat, kt	6.1	1.4	3.9	1.6	3.1	3.6	2.0	3.8
Grain maize, kt	1327.6	363.2	1484.1	1159.6	1462.1	1547.2	587.2	1546.5
Sunflower, kt	396.1	158.7	387.2	310.2	440.2	497.4	339.1	602.2
Soy, kt	80.2	40.0	58.8	50.1	113.0	80.6	48.9	67.6
Oilseed rape, kt	6.9	34.9	100.1	81.6	51.0	67.7	8.1	58.8
Total cereals, kt	2713.7	1130.4	3683.0	2632.6	3059.6	3212.5	1621.5	3530.1
Share of cereals dried in elevators, % of total	25	25	25	25	25	25	25	25
Cereals dried in elevators, kt	678.4	282.6	920.7	658.1	764.9	803.1	405.4	882.5
	2014	2015	2016	2017	2018	2019	2020	%
Wheat, kt	1102.6	927.4	1302.4	1258.6	1169.1	1147.6	641.7	-43.2
Barley, kt	244.7	199.1	273.9	265.0	188.2	168.0	116.2	-72.2
Oat, kt	2.9	1.6	2.8	3.6	1.5	1.5	2.0	-47.0
Grain maize, kt	1642.1	1133.6	1485.5	1871.0	2208.0	2129.9	817.1	-7.7
Sunflower, kt	627.1	562.3	789.4	925.1	898.7	811.4	539.3	113.8
Soy, kt	111.4	49.2	43.8	48.5	59.7	64.2	33.0	38.7
Oilseed rape, kt	90.2	25.6	52.4	89.9	120.8	77.3	56.1	N/A
Total cereals, kt	3820.9	2898.8	3950.2	4461.8	4645.9	4399.9	2205.4	-18.7
Share of cereals dried in elevators, % of total	25	25	25	25	25	25	25	-68.8
Cereals dried in elevators, kt	955.2	724.7	987.6	1115.5	1161.5	1100.0	551.3	-74.6

Source: National Bureau of Statistics, Statistical database, 'Sown area, average yield on agricultural crops': <http://statbank.statistica.md/pxweb/pxweb/ro/40%20Statistica%20economica/40% 20Statistica%20economica__16%20AGR__AGR020/AGR020100.px/?rxid=b2ff27d7-0b96-43c9-934b-42e1a2a9a774>; Statistical Yearbooks of the ATULBD for 1998 (page 218), 2002 (page 113), 2005 (page 101), 2009 (page 98), 2014 (page 95), 2017 (page 112), 2020 (page 113).

Only agricultural crops, the production of which is dried in elevators, were considered. The share of cereal production dried in elevators was determined by the opinion of experts, based on national practices during the period under review.

b) Alcoholic Beverages

Methodological issues related to the calculation of NMVOC emissions from the production of alcoholic beverages are addressed in the EMEP/EEA Air Pollutant Emission Inventory Guidebook (2019). The estimation method is based on multiplying default values of emission factors (Table 4-178) by activity data on the production of alcoholic beverages available in national statistics of the RM and of the ATULBD (Table 4-179).

Table 4-178: Default EFs used to calculate NMVOC emissions from alcoholic beverages

Source	Alcoholic Beverages	NMVOC, kg / hl
Alcoholic Beverages	Red Wine White Wine, Beer Spirits (unspecified) Whisky / Grain Whisky / Vodka Divin (Cognac) / Brandy	0.080 0.035 15.0 7.5 3.5

Source: EMEP/EEA Atmospheric Emissions Inventory Guidebook, (2019), 2H2 Food and Beverages Industry SNAP 040606 – Alcoholic Beverages, Tables 3-24, 3-25, 3-26, 3-27, 3-28, 3-30, 3-31. Pages 21-24.

Table 4-179: AD on the production of alcoholic beverages in the RM for 1990-2020

	1990	1991	1992	1993	1994	1995	1996	1997
Wine, thousand hl	1630.0	1430.0	920.0	1130.0	977.8	996.9	1458.0	1941.5
White wine, thousand hl	764.5	670.7	431.5	530.0	458.6	467.5	683.8	910.6
Red wine, thousand hl	865.5	759.3	488.5	600.0	519.2	529.4	774.2	1030.9
Wines of Porto, Madeira, Sherry, Tokay and other, thousand hl	0.2	0.2	0.1	0.2	0.1	0.1	0.2	0.3
Sparkling wine, thousand hl	80.4	78.3	85.4	88.8	74.2	94.8	141.9	134.5
Brandy, thousand hl	139.4	140.2	75.0	74.0	79.3	102.7	45.7	58.6
Grain Whisky and Liqueurs, thousand hl	55.9	55.6	67.6	139.4	264.7	412.7	335.8	237.0
Beer, thousand hl	760.0	660.0	430.0	360.0	285.0	302.9	256.0	262.7

	1998	1999	2000	2001	2002	2003	2004	2005
Wine, thousand hl	1239.6	690.1	1092.2	1564.2	1494.0	1921.8	3351.4	3643.5
White wine, thousand hl	581.4	323.7	512.3	733.6	700.7	901.3	1571.8	1710.2
Red wine, thousand hl	658.2	366.4	580.0	830.6	793.3	1020.5	1779.6	1933.3
Wines of Porto, Madeira, Sherry, Tokay and other, thousand hl	0.2	0.1	0.2	0.2	0.2	0.3	0.3	0.3
Sparkling wine, thousand hl	51.9	67.5	41.6	58.4	61.3	73.9	93.8	105.1
Brandy, thousand hl	49.7	48.6	71.8	95.6	103.8	136.1	142.8	171.1
Grain Whisky and Liqueurs, thousand hl	174.1	87.0	48.9	59.4	77.9	139.8	212.9	238.8
Beer, thousand hl	300.1	220.9	257.9	336.2	462.4	599.1	695.7	777.8
	2006	2007	2008	2009	2010	2011	2012	2013
Wine, thousand hl	1886.8	1258.1	1553.0	1263.1	1285.5	1260.6	1422.0	1551.7
White wine, thousand hl	983.0	717.9	814.4	600.4	591.7	664.3	679.2	694.3
Red wine, thousand hl	903.8	540.2	738.6	662.7	693.8	596.3	742.8	857.4
Wines of Porto, Madeira, Sherry, Tokay and other, thousand hl	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Sparkling wine, thousand hl	40.2	54.1	57.3	50.0	55.6	68.6	65.4	60.0
Brandy, thousand hl	79.1	82.4	103.7	69.8	74.6	91.2	109.4	118.0
Grain Whisky and Liqueurs, thousand hl	196.3	172.2	129.1	110.8	127.1	140.2	165.9	196.1
Beer, thousand hl	913.3	1014.6	866.6	781.7	952.6	1068.1	1118.4	1029.3
	2014	2015	2016	2017	2018	2019	2020	%
Wine, thousand hl	1409.5	1356.5	1345.8	1652.3	1717.3	1787.2	1746.2	7.1
White wine, thousand hl	765.1	622.5	576.2	775.7	774.9	781.5	801.4	4.8
Red wine, thousand hl	644.3	734.0	768.4	880.8	932.5	979.2	922.5	6.6
Wines of Porto, Madeira, Sherry, Tokay and other, thousand hl	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-90.8
Sparkling wine, thousand hl	52.2	50.2	63.3	65.2	67.4	67.9	66.3	-17.6
Brandy, thousand hl	93.9	70.2	50.1	84.0	87.7	91.9	73.3	-47.4
Grain Whisky and Liqueurs, thousand hl	183.4	162.3	162.8	156.9	151.9	143.0	137.0	145.1
Beer, thousand hl	984.8	994.5	847.8	866.5	819.5	839.3	832.6	9.6

Source: Statistical Yearbooks of the RM for 1994 (pages 289-290), 1999 (pages 304-305), 2003 (pages 393-394), 2006 (pages 309-310), 2010 (pages 301-303), 2014 (pages 299-301);); Statistical Reports PRODMOLD-A 'Total production, as a natural expression, in the Republic of Moldova, by product type, for 2005-2020'; Statistical Yearbooks of the ATULBD for 1998 (page 177), 2000 (page 100), 2002 (page 104), 2005 (page 94), 2007 (page 93), 2009 (page 93), 2011 (page 95), 2014 (page 89), 2017 (page 102), 2020 (page 103).

4.8.3. Uncertainties and Time-Series Consistency

The primary uncertainty-related factors pertain to methodology, EFs used to calculate GHG emissions covered by source category 2H2 'Food and Beverages Industry', and the quality of activity data available. Uncertainties associated with the default EFs used to calculate NMVOC emissions from this source category may be a factor of 2. Uncertainties associated with activity data on bread making and other food and alcoholic beverage production in the Republic of Moldova are low, estimated to be circa 5%. In view of ensuring time-series consistency of the obtained results, the same approach was used for the entire period under review, in conformity with the recommendations included in the 2006 IPCC Guidelines.

4.8.4. Quality Assurance and Quality Control

Standard verification and quality control forms and checklists were filled in for the respective category, following a Tier 1 approach. Verification was focused on comparing and correct use of emission factors including the default EFs used according to the EMEP/EEA Air Pollutant Emission Inventory Guidebook (2019); verification of AD obtained from different reference sources, including official sources and their correct application, etc. It should be noted that the AD and methods used to estimate GHG emissions from source category 2H2 'Food and Beverages Industry' were documented and archived both in hard copies and electronically.

4.8.5. Recalculations

NMVOC emissions from source category 2H2 'Food and Beverages Industry' were not recalculated for the period 1990-2019. For 2020, NMVOC emissions from the respective category have been estimated for the first time. The obtained results show that NMVOC emissions from category 2H2 'Food and Beverages Industry' decreased by 71% between 1990 and 2020.

4.8.6. Planned Improvements

Possible improvements may include updating of the activity data used to estimate NMVOC emissions from source category 2H2 'Food and Beverages Industry' for the reporting period included within the previous inventory cycles.

5. AGRICULTURE SECTOR

5.1. Overview

The main sources covered by Sector 3 'Agriculture' include methane emissions from animal breeding, particularly from categories 3A 'Enteric Fermentation' and 3B 'Manure Management', nitrous oxide emissions from 3B 'Manure Management' and 3D 'Agricultural Soils', as well as carbon dioxide emissions from category 3H 'Urea Application' to agricultural land.

As rice is not cultivated in the RM and there are no savannas, no GHG emissions were reported from categories 3C 'Rice Cultivation' and 3E 'Prescribed Burning of Savannas'.

Likewise, GHG emissions from category 3F 'Field Burning of Agricultural Residues' were reported under Sector 4 'Land Use, Land-Use Change and Forestry', source category 4B1 'Cropland Remaining Cropland'.

A brief overview, methodological issues and data sources, key categories, uncertainties and times-series consistency, QA and QC procedures, recalculations made and planned improvements are described for each source category in this sector.

5.1.1. Summary of Emission Trends

In 2020, Sector 3 'Agriculture' accounted for circa 11.3% of the total national direct GHG emissions in the Republic of Moldova (without Sector 4 'LULUCF'), being the second major source of GHG emissions after Sector 1 'Energy'. It should be noted that Sector 3 'Agriculture' was a major source of CH_4 and N_2O emissions, accounting for circa 18.1% and, respectively, 86.2% of the total emissions reported at national level.

Between 1990 and 2020, the total GHG emissions originating from Sector 3 'Agriculture' recorded a downward trend, decreasing by circa 69.5%, from 5076.73 kt recorded in 1990 to 1546.44 kt in 2020 (Table 5-1), particularly due to decreasing values of such indices as: the number of domestic livestock and poultry, the amount of synthetic and organic nitrogen fertilisers applied to soils, the quantities of agricultural crop residues returned to soil and carbon losses from land-use change and soil management practices.

Table 5-1: Evolution of direct GHG emissions from Sector 3 'Agriculture' between 1990-2020, kt CO_2 equivalent

	1990	1991	1992	1993	1994	1995	1996	1997
CO_2	0.5820	0.5226	0.3905	0.1276	0.0537	0.0607	0.0911	1.0992
CH_4	2,684.5230	2,443.9487	2,369.9032	2,147.8512	2,088.0629	1,824.3626	1,679.2333	1,434.7631
N_2O	2,391.6276	2,250.8837	1,922.0030	1,606.6271	1,395.2768	1,348.9446	1,334.3366	1,188.7040
Total	5,076.7326	4,695.3550	4,292.2967	3,754.6059	3,483.3934	3,173.3679	3,013.6610	2,624.5664
	1998	1999	2000	2001	2002	2003	2004	2005
CO_2	0.2721	0.0034	0.4397	0.1496	0.0470	0.2381	0.3669	0.1739
CH_4	1,385.6816	1,274.1632	1,181.8782	1,199.8472	1,226.0792	1,121.7722	1,049.0273	1,016.4068
N_2O	1,133.4851	1,032.7049	953.8762	1,028.1989	1,071.3299	942.2106	1,014.7057	1,046.6361
Total	2,519.4389	2,306.8715	2,136.1941	2,228.1956	2,297.4561	2,064.2209	2,064.0999	2,063.2167
	2006	2007	2008	2009	2010	2011	2012	2013
CO_2	0.1460	0.2631	0.8505	0.5864	1.7443	3.6752	5.5908	4.1840
CH_4	988.7357	788.5504	753.6957	786.5526	787.3794	741.8863	699.3920	702.7541
N_2O	1,016.5194	835.2961	942.0406	938.1032	1,014.6236	994.6744	940.3254	1,067.7368
Total	2,005.4012	1,624.1096	1,696.5868	1,725.2422	1,803.7474	1,740.2358	1,645.3082	1,774.6749
	2014	2015	2016	2017	2018	2019	2020	%
CO_2	10.2058	11.2402	12.2747	26.2081	43.3624	39.6306	42.6156	7222.8
CH_4	723.0076	698.0743	686.0592	641.2966	571.3140	492.4429	433.4064	-83.9
N_2O	1,240.7589	991.8944	1,128.3179	1,214.2443	1,222.6352	1,266.6513	1,070.4136	-55.2
Total	1,973.9724	1,701.2089	1,826.6518	1,881.7490	1,837.3116	1,798.7248	1,546.4355	-69.5

It should be noted that in 1990, CO_2, CH_4 and N_2O emissions accounted for circa 0.01%, 52.9% and 47.1%, respectively, of the total direct GHG emissions from Sector 3 'Agriculture'. By 2020, the share of CO_2 emissions increased up to 2.8%, N_2O emissions – up to 69.2%, whereas CH_4 emissions decreased to 28.0%.

During the period under review, total direct GHG emissions from Sector 3 'Agriculture' decreased by circa 69.5%, whereas CH_4 and N_2O emissions decreased by circa 83.9% and 55.2% (Figure 5-1, Table

5-2). At the same time, between 1990 and 2020, CO_2 emissions from urea application increased by circa 73 times.

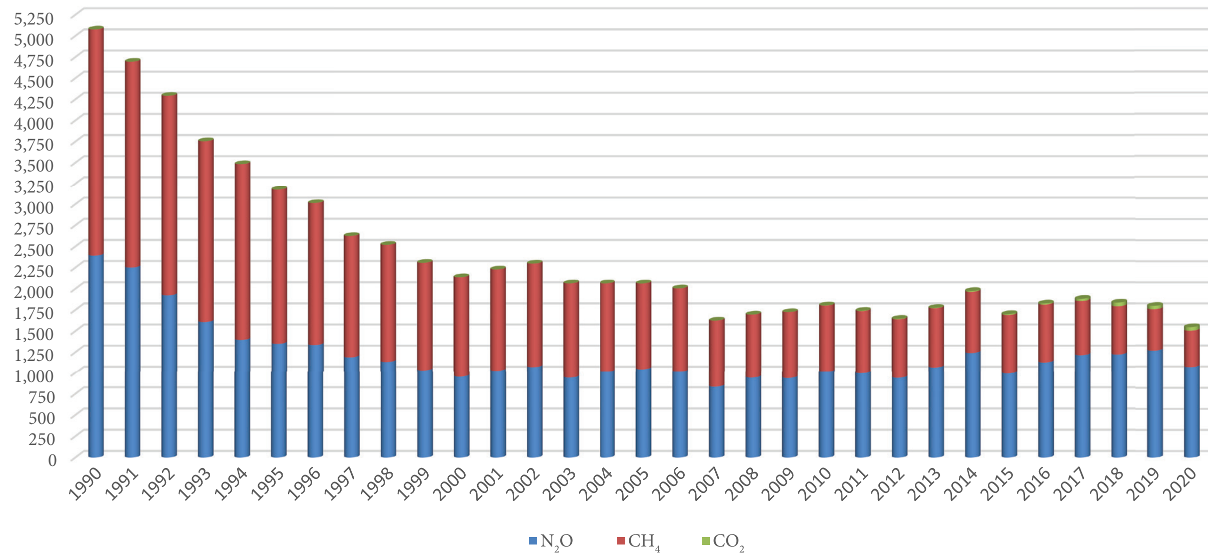


Figure 5-1: Evolution of direct GHG emissions from Sector 3 'Agriculture' in the Republic of Moldova between 1990-2020, kt CO_2 equivalent

Table 5-2: Evolution of total direct GHG emissions from Sector 3 'Agriculture' by category between 1990-2020, kt

	1990	1991	1992	1993	1994	1995	1996	1997
3H Urea Application	0.5820	0.5226	0.3905	0.1276	0.0537	0.0607	0.0911	1.0992
Total CO_2 emissions from Sector 3 'Agriculture'	**0.5820**	**0.5226**	**0.3905**	**0.1276**	**0.0537**	**0.0607**	**0.0911**	**1.0992**
3A Enteric Fermentation	87.5771	81.1547	79.8715	74.9162	72.9133	64.7235	59.6750	51.3040
3B Manure Management	19.8038	16.6032	14.9247	10.9978	10.6093	8.2510	7.4943	6.0866
Total CH_4 emissions from Sector 3 'Agriculture'	**107.3809**	**97.7579**	**94.7961**	**85.9140**	**83.5225**	**72.9745**	**67.1693**	**57.3905**
3B Manure Management	3.0192	2.7389	2.4263	2.0341	1.9658	1.8043	1.8962	1.4681
3D Agricultural Soils	5.0064	4.8144	4.0234	3.3572	2.7164	2.7223	2.5815	2.5208
Total N_2O emissions from Sector 3 'Agriculture'	**8.0256**	**7.5533**	**6.4497**	**5.3914**	**4.6821**	**4.5267**	**4.4776**	**3.9889**
	1998	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**
3H Urea Application	0.2721	0.0034	0.4397	0.1496	0.0470	0.2381	0.3669	0.1739
Total CO_2 emissions from Sector 3 'Agriculture'	**0.2721**	**0.0034**	**0.4397**	**0.1496**	**0.0470**	**0.2381**	**0.3669**	**0.1739**
3A Enteric Fermentation	49.8079	46.0727	43.4313	44.1309	45.0244	41.1415	38.4568	36.9611
3B Manure Management	5.6194	4.8938	3.8438	3.8630	4.0188	3.7294	3.5042	3.6952
Total CH_4 emissions from Sector 3 'Agriculture'	**55.4273**	**50.9665**	**47.2751**	**47.9939**	**49.0432**	**44.8709**	**41.9611**	**40.6563**
3B Manure Management	1.3749	1.2401	1.0833	1.1030	1.1134	1.0567	1.0264	1.1022
3D Agricultural Soils	2.4288	2.2253	2.1176	2.3473	2.4816	2.1051	2.3786	2.4100
Total N_2O emissions from Sector 3 'Agriculture'	**3.8036**	**3.4655**	**3.2009**	**3.4503**	**3.5951**	**3.1618**	**3.4051**	**3.5122**
	2006	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**
3H Urea Application	0.1460	0.2631	0.8505	0.5864	1.7443	3.6752	5.5908	4.1840
Total CO_2 emissions from Sector 3 'Agriculture'	**0.1460**	**0.2631**	**0.8505**	**0.5864**	**1.7443**	**3.6752**	**5.5908**	**4.1840**
3A Enteric Fermentation	35.7523	28.8838	27.5714	28.5438	28.3270	26.6765	25.2109	25.3945
3B Manure Management	3.7971	2.6582	2.5764	2.9183	3.1682	2.9990	2.7648	2.7156
Total CH_4 emissions from Sector 3 'Agriculture'	**39.5494**	**31.5420**	**30.1478**	**31.4621**	**31.4952**	**29.6755**	**27.9757**	**28.1102**
3B Manure Management	1.1361	0.8615	0.8529	0.9659	1.0080	0.9189	0.8439	0.7857
3D Agricultural Soils	2.2750	1.9415	2.3083	2.1821	2.3968	2.4190	2.3116	2.7973
Total N_2O emissions from Sector 3 'Agriculture'	**3.4111**	**2.8030**	**3.1612**	**3.1480**	**3.4048**	**3.3378**	**3.1555**	**3.5830**
	2014	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**%**
3H Urea Application	10.2058	11.2402	12.2747	26.2081	43.3624	39.6306	42.6156	7222.8
Total CO_2 emissions from Sector 3 'Agriculture'	**10.2058**	**11.2402**	**12.2747**	**26.2081**	**43.3624**	**39.6306**	**42.6156**	**7222.8**
3A Enteric Fermentation	26.1032	25.1684	24.8801	23.1354	20.6594	17.6379	15.5616	-82.2
3B Manure Management	2.8171	2.7546	2.5622	2.5165	2.1932	2.0599	1.7747	-91.0
Total CH_4 emissions from Sector 3 'Agriculture'	**28.9203**	**27.9230**	**27.4424**	**25.6519**	**22.8526**	**19.6977**	**17.3363**	**-83.9**
3B Manure Management	0.8671	0.8386	0.8631	0.8177	0.7210	0.6536	0.5584	-81.5
3D Agricultural Soils	3.2966	2.4899	2.9232	3.2570	3.3818	3.5969	3.0335	-39.4
Total N_2O emissions from Sector 3 'Agriculture'	**4.1636**	**3.3285**	**3.7863**	**4.0746**	**4.1028**	**4.2505**	**3.5920**	**-55.2**

Table 5-3 shows that category 3D 'Agricultural Soils' is the largest source of total direct GHG emissions from Sector 3 'Agriculture' (with a share varying between a minimum of 23.24% in 1994 and a maximum of 59.59% in 2019), followed by category 3A 'Enteric Fermentation' (with a share varying between a minimum of 24.51% in 2019 and a maximum of 52.33% in 1994), and category 3B 'Manure Management' (with a share varying between a minimum of 13.63% in 2020 and a maximum of 27.47% in 1990). The share of category 3H 'Urea Application' in agricultural soils was initially insignificant; however, there had been a constant upward trend, reaching 2.76% of the total emissions from the respective sector in 2020.

Table 5-3: Breakdown of total direct GHG emissions from Sector 3 'Agriculture' between 1990-2020, % of total

	1990	1991	1992	1993	1994	1995	1996	1997
3A Enteric Fermentation	43.13	43.21	46.52	49.88	52.33	50.99	49.50	48.87
3B Manure Management	27.47	26.22	25.54	23.47	24.43	23.44	24.97	22.47
3D Agricultural Soils	29.39	30.56	27.93	26.65	23.24	25.56	25.53	28.62
3H Urea Application	0.01	0.01	0.01	0.00	0.00	0.00	0.00	0.04
	1998	1999	2000	2001	2002	2003	2004	2005
3A Enteric Fermentation	49.42	49.93	50.83	49.51	48.99	49.83	46.58	44.79
3B Manure Management	21.84	21.32	19.61	19.09	18.82	19.77	19.06	20.40
3D Agricultural Soils	28.73	28.75	29.54	31.39	32.19	30.39	34.34	34.81
3H Urea Application	0.01	0.00	0.02	0.01	0.00	0.01	0.02	0.01
	2006	2007	2008	2009	2010	2011	2012	2013
3A Enteric Fermentation	44.57	44.46	40.63	41.36	39.26	38.32	38.31	35.77
3B Manure Management	21.62	19.90	18.78	20.91	21.04	20.04	19.49	17.02
3D Agricultural Soils	33.81	35.62	40.54	37.69	39.60	41.42	41.87	46.97
3H Urea Application	0.01	0.02	0.05	0.03	0.10	0.21	0.34	0.24
	2014	2015	2016	2017	2018	2019	2020	%
3A Enteric Fermentation	33.06	36.99	34.05	30.74	28.11	24.51	25.16	-41.7
3B Manure Management	16.66	18.74	17.59	16.29	14.68	13.69	13.63	-50.4
3D Agricultural Soils	49.77	43.62	47.69	51.58	54.85	59.59	58.46	98.9
3H Urea Application	0.52	0.66	0.67	1.39	2.36	2.20	2.76	23939.8

5.1.2. Key Categories

The results of key category analysis (including LULUCF), carried out following a Tier 1 approach, are provided in Chapter 1.5 of this Report, as well as in Annex 1. Table 5-4 provides information on identified key categories under Sector 3 'Agriculture'.

Table 5-4: Key categories identified under Sector 3 'Agriculture'

IPCC Category	GHG	Source Category	Without LULUCF				With LULUCF			
			T1		T2		T1		T2	
			L	T	L	T	L	T	L	T
3A	CH_4	CH_4 emissions from enteric fermentation	X	X	X	X	X	X	X	X
3B	CH_4	CH_4 emissions from manure management	X	X	X	X	X	X	X	
3B1	N_2O	Direct N_2O emissions from manure management	X		X	X	X		X	X
3B5	N_2O	Indirect N_2O emissions from manure management	X		X	X	X		X	X
3Da	N_2O	Direct N_2O emissions from agricultural soils	X	X	X	X	X	X	X	X
3Db	N_2O	Indirect N_2O emissions from agricultural soils	X	X	X	X	X		X	X
3H	CO_2	CO_2 emissions from urea application								

Abbreviations: L – Level Assessment; T – Trend Assessment; T1 – Tier 1; T2 – Tier 2.

5.1.3. Methodological Issues

Emissions from categories 3A 'Enteric Fermentation', 3B 'Manure Management', 3D 'Agricultural Soils' and 3H 'Urea Application' were estimated using both the Tier 1 methodological approach and default EF values, as well as the Tier 2 methodological approach and country-specific emission factors, particularly for the key categories. A summary description of the methods used to estimate emissions by category is provided in Table 5-5, whereas a more detailed description is available in subchapters 5.2-5.5 of this Report.

Table 5-5: Summary of methods used to estimate GHG emissions from Sector 3 'Agriculture'

IPCC Category	Source Category	CO_2		CH_4		N_2O	
		Method	EF	Method	EF	Method	EF
3A	Enteric Fermentation	NA	NA	T2, T1	CS, D	NA	NA
3B	Manure Management	NA	NA	T2, T1	CS, D	T2, T1	CS, D
3D	Agricultural Soils	NA	NA	NA	NA	T2, T1	CS, D
3H	Urea Application	T1	D	NA	NA	NA	NA

Abbreviations: T1 – Tier 1 Method; T2 – Tier 2 Method; T3 – Tier 3 Method; CS – Country-Specific; D – Default; EF – Emission Factor.

5.1.4. Uncertainties and Time-Series Consistency

Results of uncertainty analysis of GHG emissions from Sector 3 'Agriculture' (by category) are closely described in subchapters 5.2-5.5 as well as in the Annex 5-3.4 of this Report. Combined uncertainties as a percentage of the total direct GHG emissions from Sector 3 'Agriculture' were estimated to be circa 21.32%. Uncertainties in the trend of total direct GHG emissions from this sector were estimated to be circa 5.15%. In view of ensuring time-series consistency of the results, the same approach was used for the entire period under review in conformity with the recommendations included in the 2006 IPCC Guidelines.

5.1.5. Quality Assurance and Quality Control

Standard verification and quality control forms and check-lists were filled in for Sector 3 'Agriculture', following a Tier 1 methodological approach. It should be noted that the AD and methods used to estimate GHG emissions from this sector were documented and archived both in hard copies and electronically. In order to identify the data entry and emission estimation process related errors, there were applied verifications and quality control procedures. Following the recommendations in the 2006 IPCC Guidelines, GHG emissions were estimated using AD and national factors and parameters from official reference sources.

5.1.6. Recalculations

GHG emissions from Sector 3 'Agriculture' were recalculated due to the availability of an updated set of activity data (the Statistical Yearbooks of the RM and those of the ATULBD, and other relevant publications in the field), and updated country-specific emission factors. In comparison with the results recorded within the previous inventory cycle (reported in the BUR3 of the RM to the UNFCCC), recalculations resulted in a downward trend in direct GHG emissions for the period 1990-2019, varying from a minimum decrease by 4.8% in 1990, to a maximum decrease by 8.4% in 2009 (Table 5-6).

Table 5-6: Recalculated GHG emissions from Sector 3 'Agriculture' for the period 1990-2019 included in the BUR3 of the RM to the UNFCCC (2021), kt CO_2 equivalent

	1990	1991	1992	1993	1994	1995	1996	1997
BUR3	5,335.4900	4,963.3633	4,546.0699	4,006.7282	3,731.2450	3,410.3147	3,264.0934	2,825.8154
NC5	5,076.7326	4,695.3550	4,292.2967	3,754.6059	3,483.3934	3,173.3679	3,013.6610	2,624.5664
Difference, %	-4.8	-5.4	-5.6	-6.3	-6.6	-6.9	-7.7	-7.1
	1998	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**
BUR3	2,717.1126	2,492.6726	2,312.1138	2,407.9656	2,477.8471	2,234.7239	2,234.0121	2,240.3387
NC5	2,519.4389	2,306.8715	2,136.1941	2,228.1956	2,297.4561	2,064.2209	2,064.0999	2,063.2167
Difference, %	-7.3	-7.5	-7.6	-7.5	-7.3	-7.6	-7.6	-7.9
	2006	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**
BUR3	2,181.9206	1,771.3653	1,842.8018	1,884.4118	1,966.7346	1,891.4772	1,790.6000	1,914.8127
NC5	2,005.4012	1,624.1096	1,696.5868	1,725.2422	1,803.7474	1,740.2358	1,645.3082	1,774.6749
Difference, %	-8.1	-8.3	-7.9	-8.4	-8.3	-8.0	-8.1	-7.3
	2014	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**%**
BUR3	2,123.9671	1,848.4464	1,987.5167	2,037.8912	1,992.9602	1,943.4759		
NC5	1,973.9724	1,701.2089	1,826.6518	1,881.7490	1,837.3116	1,798.7248	1,546.4355	-69.5
Difference, %	-7.1	-8.0	-8.1	-7.7	-7.8	-7.4		

Abbreviations: BUR3 – Third Biennial Update Report of the RM to the UNFCCC, NC5 – Fifth National Communication of the RM to the UNFCCC.

Recalculation results at category level are shown in subchapters 5.2-5.5 of this Report.

5.1.7. Assessment of Completeness

The current inventory covers GHG emissions from 4 source categories: 3A 'Enteric Fermentation', 3B 'Manure Management', 3D 'Agricultural Soils', and 3H 'Urea Application' (Table 5-7).

Table 5-7: Assessment of completeness of GHG emissions under Sector 3 'Agriculture'

IPCC Category	Source Category	CO_2	CH_4	N_2O
3A	Enteric Fermentation	NA	X	NO
3B	Manure Management	NA	X	X
3C	Rice Cultivation	NA	NO	NA
3D	Agricultural Soils	NA	NA	X
3E	Prescribed Burning of Savannas	NA	NO	NO
3F	Field Burning of Agricultural Residues	NA	IE	IE
3G	Liming	NO	NA	NA

IPCC Category	Source Category	CO_2	CH_4	N_2O
3H	Urea Application	X	NA	NA
3I	Other Carbon-Containing Fertilizers	NO	NA	NA
3J	Other	NO	NO	NO

Abbreviations: X – source categories included in the inventory; NA – Not Applicable; NO – Not Occurring; NE – Not Estimated; IE – Included Elsewhere.

Since rice is not cultivated in the RM and there are no savannas, no GHG emissions have been recorded from categories 3C 'Rice Cultivation' and 3E 'Prescribed Burning of Savannas'. GHG emissions from source category 3F 'Field Burning of Agricultural Residues' were reported under Sector 4 'LULUCF', namely source category 4B 'Cropland'. CO_2 emissions from categories 3G 'Liming' and 3I 'Other Carbon-Containing Fertilizers' were not estimated as such activities do not occur in the RM.

5.1.8. Planned Improvements

Planned improvements at source category level within Sector 3 'Agriculture' are closely described in the respective subchapters (5.2-5.5) of this Report.

5.2. Enteric Fermentation (Category 3A)

5.2.1. Source Category Description

Ruminant livestock, due to the symbiosis between the macro-organism and the micro-organisms that inhabit the stomach consisting of four chambers (rumen, reticulum, omasum, abomasum) can be regarded as a complex biological factory, which converts feedstock into high quality food products, creating daily a protein mass of up to 2.5 kg.

Also, during the process, due to the fermentation of nutrients, significant quantities of gases are generated, containing CH_4 – up to 30-40%, and CO_2 – up to 60-70%[68].

About 5% of ingested feed gross energy is lost through gaseous emissions. The problem of reducing gas emissions within the feed fermentation process is thereby important not only in terms of environmental protection, but also from an economic point of view.

It should be noted that both ruminant (cattle, sheep and goats) and non-ruminant livestock (pigs, horses, asses and mules) are major sources of CH_4 emissions. However, ruminant livestock account for a larger share of the total CH_4 emissions from category 3A 'Enteric fermentation'. The amount of methane that is released depends on a number of factors, such as species, age, weight of the animal, quantity and quality of feed intake, etc.

5.2.2. Activity Data, Methodological Issues and Emission Factors

In order to estimate methane emissions from category 3A 'Enteric Fermentation', three basic steps were undertaken:

- division of the livestock population into subgroups and characterise each subgroup (see basic information on domestic breeds of animals bred in the RM in Annex 3-3);
- estimation of emission factors for each subgroup, as well as the average situation for the entire population, by age, kilograms of CH_4/animal/year;
- estimation of CH_4 emissions by multiplying the specific emission factors with AD on the number of animals (then summing the emissions from each category of animals, obtaining the total methane emissions from category 3A 'Enteric Fermentation').

It was possible to carry out these steps for different levels of details and complexity, following two methodological approaches: Tier 1 and Tier 2.

While following the Tier 1 methodology, CH_4 emissions from category 3A 'Enteric Fermentation' were estimated based on equations 10.19 and 10.20 in the 2006 IPCC Guidelines:

$$Total\ CH_{4\ enteric} = \Sigma_i\ E_i\ [EF_{(T)} \bullet (N_{(T)} / 10^6)]$$

Where:

[68] 'Technical Guideline for Milk Production', Babcock International Institute for Dairy Research and Development, USA, 1996 (<www.animals-feed.info>).

$Total\ CH_{4\ enteric}$ – total CH_4 emissions from enteric fermentation, kt CH_4/yr;

E_i – emissions for the *i* livestock categories and subcategories;

$EF_{(T)}$ – emission factor for the defined livestock population, kg CH_4/head/yr;

$N_{(T)}$ – number of head of livestock species/category T;

T – species/category of livestock.

The Tier 1 methodology is a simplified approach based on use of default EFs (Table 5-8) multiplied by national AD on the animal population data (Table 5-9).

Table 5-8: Default EFs for Western Europe (WE) and Eastern Europe (EE) used to estimate CH_4 emissions from category 3A 'Enteric Fermentation'

Animal by category	EF, kg CH_4/head/yr		Comments
	Western Europe	Eastern Europe	
Dairy cows	117	99	Average Milk Production: WE – 6000 kg/head/year, EE – 2550 kg/head/year WE: Average live weight – 600 kg. EE: Average live weight – 550 kg.
Other cattle	57	58	Beef cows, including young cattle. WE: Average live weight of other cattle –420 kg, including: males – 600 kg, females – 500 kg, young cattle – 230 kg. EE: Average live weight of other cattle – 391 kg, including: males – 600 kg, females – 500 kg, young cattle – 230 kg.
Sheep	8	5	Average live weight: WE – 48.5 kg, EE – 28 kg
Goats	5	5	Average live weight: WE – 38.5 kg, EE – 30 kg
Horses	18	18	Average live weight: WE – 377 kg, EE – 238 kg
Asses and mules	10	10	Average live weight: WE – 130 kg, EE – 130 kg
Swine	1.5	1	Average live weight: WE – 50 kg, breeding – 198 kg. Average live weight: EE – 50 kg, breeding – 180 kg.

The Tier 2 methodology is a more complex approach requiring country-specific data on the animal population (including distribution by species and subcategories), maintenance requirements and feeding conditions for typical livestock under each species and subcategories (particularly for cattle and sheep, which have a larger share in the total CH_4 emissions from 3A 'Enteric Fermentation').

Distribution of livestock population into subgroups. Following the 2006 IPCC Guidelines, it is *good practice* to divide the livestock population into subcategories (Table 5-9).

Table 5-9: Livestock and poultry population between 1990-2020, thousand heads

	1990	1991	1992	1993	1994	1995	1996	1997
Cattle total, including:	1060.7	1000.5	970.1	882.6	832.0	729.5	646.3	549.7
...Dairy Cows	395.2	397.1	403.2	401.8	402.6	380.8	355.4	323.7
...Other Cattle	665.5	603.4	566.9	480.7	429.4	348.7	290.9	226.0
Sheep and Goats total, including:	1281.9	1288.8	1357.2	1437.3	1501.9	1423.0	1372.4	1235.3
...Sheep	1244.8	1239.3	1294.3	1362.4	1409.8	1326.6	1271.1	1136.3
...Goats	37.1	49.5	62.9	74.9	92.2	96.4	101.3	99.0
Horses	47.2	48.4	51.4	54.5	58.2	61.6	63.3	65.4
Asses and Mules	1.7	1.8	2.1	2.2	2.9	3.2	3.1	3.0
Swine	1850.1	1753.0	1487.4	1082.3	1046.8	1016.4	950.1	797.5
Poultry total, including:	24625.0	23715.0	17128.0	12809.2	13448.3	13746.4	12364.9	12363.9
...Chickens	20234.4	19607.1	13271.0	9516.6	9957.4	10200.6	9137.4	9112.0
...Geese	1335.5	1321.8	1300.4	1378.9	1457.0	1487.4	1357.9	1372.3
...Ducks	2165.7	1914.7	1736.5	1198.9	1284.8	1293.3	1166.6	1169.5
...Turkeys	889.3	871.3	820.2	714.8	749.0	765.2	703.0	710.1
Rabbits	283.0	250.8	298.5	262.4	237.2	209.3	189.8	176.8
	1998	1999	2000	2001	2002	2003	2004	2005
Cattle total, including:	532.4	482.4	445.4	453.8	454.7	409.1	359.5	339.8
...Dairy Cows	318.4	306.9	298.5	300.1	304.8	277.7	249.0	233.1
...Other Cattle	214.0	175.5	146.9	153.7	149.9	131.5	110.5	106.7
Sheep and Goats total, including:	1147.2	1055.5	962.1	971.8	978.4	958.4	959.8	954.3
...Sheep	1046.4	948.9	846.3	851.7	843.7	829.2	832.6	827.0
...Goats	100.8	106.6	115.8	120.2	134.6	129.2	127.2	127.3
Horses	68.5	72.0	76.0	81.6	82.6	81.4	75.8	72.0
Asses and Mules	3.2	3.4	3.8	4.3	4.0	4.3	4.0	3.7
Swine	928.0	751.3	492.7	490.8	550.1	476.4	422.3	493.0
Poultry total, including:	13046.0	13730.1	13624.9	14737.4	15535.3	16195.5	17883.9	22773.6
...Chickens	9557.0	9992.5	9952.9	10952.8	11484.5	12184.2	13559.0	17195.3
...Geese	1470.0	1581.6	1550.6	1589.9	1777.4	1780.2	1828.0	2120.3
...Ducks	1264.8	1349.4	1325.3	1368.2	1423.3	1461.9	1592.6	2394.1
...Turkeys	754.2	806.6	796.2	826.6	850.1	769.3	904.4	1063.9
Rabbits	185.9	182.6	161.3	191.4	190.7	205.4	239.1	278.9

	2006	2007	2008	2009	2010	2011	2012	2013
Cattle total, including:	326.9	253.7	238.4	243.0	236.4	224.4	210.6	208.0
...Dairy Cows	222.0	181.1	171.9	173.2	165.8	155.8	145.1	141.3
...Other Cattle	104.9	72.6	66.5	69.8	70.5	68.6	65.5	66.7
Sheep and Goats total, including:	962.5	866.4	879.6	929.7	920.6	846.2	836.9	862.0
...Sheep	842.6	759.9	767.7	809.4	793.1	714.2	699.0	717.4
...Goats	119.9	106.5	111.9	120.3	127.5	132.0	137.8	144.6
Horses	69.3	60.5	57.4	56.1	53.6	50.9	47.5	46.0
Asses and Mules	3.6	3.1	3.2	2.9	2.8	2.5	2.4	2.1
Swine	568.3	320.8	302.9	403.6	511.7	471.7	438.4	444.8
Poultry total, including:	23017.2	17544.2	18830.6	22986.6	23782.5	19766.7	15897.8	11947.9
...Chickens	17320.6	14162.0	15464.0	18836.1	19456.4	16194.1	13252.8	10096.2
...Geese	2111.5	1342.2	1277.2	1497.4	1597.3	1351.6	1028.5	718.7
...Ducks	2551.0	1435.5	1501.7	1981.8	2010.8	1622.1	1166.9	822.4
...Turkeys	1034.0	604.5	587.8	671.4	718.1	599.0	449.6	310.6
Rabbits	326.0	263.4	248.5	274.5	277.0	277.4	267.0	296.2
	2014	2015	2016	2017	2018	2019	2020	%
Cattle total, including:	210.7	204.5	199.9	185.6	162.7	141.2	125.8	-88.1
...Dairy Cows	140.6	137.7	132.3	122.1	106.4	90.2	80.3	-79.7
...Other Cattle	70.1	66.9	67.7	63.5	56.3	51.0	45.5	-93.2
Sheep and Goats total, including:	887.0	880.9	882.0	854.6	809.3	689.3	629.5	-50.9
...Sheep	733.5	722.2	714.9	683.6	618.3	535.9	479.3	-61.5
...Goats	153.4	158.6	167.0	170.3	162.9	152.9	149.7	303.6
Horses	42.8	40.2	37.4	34.1	30.4	26.4	23.0	-51.3
Asses and Mules	2.2	2.0	3.1	5.0	3.8	1.4	1.2	-28.9
Swine	504.7	484.5	469.8	439.8	431.6	428.5	366.9	-80.2
Poultry total, including:	12,520.0	12,590.6	13,174.2	13,615.9	11,492.7	11,231.6	9,693.5	-60.6
...Chickens	10,438.5	10,633.3	11,155.0	11,542.6	9,666.9	9,494.4	8,176.6	-59.6
...Geese	768.0	746.1	770.6	790.7	683.8	621.3	492.7	-63.1
...Ducks	986.1	904.1	929.1	956.9	823.6	742.8	599.2	-72.3
...Turkeys	327.4	307.1	317.8	326.1	282.2	257.1	223.5	-74.9
Rabbits	326.1	350.2	366.7	376.5	351.5	329.7	319.2	12.8

Source: Statistical Annual Report No. 24-agr 'Animal Breeding Sector'. Number of livestock and poultry in all households categories as of January 1 (annual reports for 1990-2020); Statistical Yearbooks of the ATULBD for 1998 (page 224), 2002 (page 118), 2006 (page 109), 2010 (page 110), 2014 (page 104), 2017 (page 117), 2019 (page 115), 2020 (page 118), 2021 (page 118).

Average daily feed intake per day. In addition to activity data on livestock, information on average daily feed intake is required. Because data on average daily feed intake is not available in statistical sources, it was necessary to calculate this index indirectly. The following general data was collected for each representative animal category: weight of a typical animal in the respective category (kg), average weight gain per day (g), feeding situation (either confined or grazing), average daily milk production (kg), milk fat content (%), percentage of females that give birth in a year (%) average annual wool production per animal (kg), number of offspring produced per year (heads), and feed digestibility (%).

Weight (W) and Mature Weight (MW) in livestock and poultry. Information on the weight of the most prevalent breeds of livestock and poultry is provided by statistical sources (Table 5-10), as well as by the scientific literature.

Table 5-10: Livestock and poultry weight, by species and subcategories, for 1990-2020, kg

	1990	1991	1992	1993	1994	1995	1996	1997
Average weight per head at the end of the year, kg:								
Cattle, including	325	320	316	310	295	279	264	307
Dairy cows	476	443	430	415	413	412	411	452
Breeding males	580	562	550	545	540	539	537	551
Swine, including	145	143	132	140	118	109	100	55
Female sows	189	186	181	185	176	169	162	144
Sheep and goats	43	44	43	43	44	39	39	35
Horses, including	376	326	341	344	369	356	340	276
Female horses older than 3 years and stallions	433	381	396	399	414	401	382	308
Poultry of all species and ages	1.74	1.69	1.54	1.49	1.50	1.43	1.28	1.38
	1998	1999	2000	2001	2002	2003	2004	2005
Average weight per head at the end of the year, kg:								
Cattle, including	308	303	294	297	294	290	300	293
Dairy cows	443	439	435	434	434	431	435	429
Breeding males	542	539	533	535	534	532	535	531
Swine, including	51	46	56	49	47	54	51	50
Female sows	141	137	145	139	137	145	141	138
Sheep and goats	35	35	35	33	33	33	33	33
Horses, including	282	279	285	283	277	277	282	275
Female horses older than 3 years and stallions	314	311	317	315	309	309	314	307
Poultry of all species and ages	1.62	1.65	1.62	1.57	1.60	1.29	1.35	1.39

	2006	2007	2008	2009	2010	2011	2012	2013
Average weight per head at the end of the year, kg:								
Cattle, including	297	284	286	289	291	322	318	310
Dairy cows	427	425	405	409	420	421	427	430
Breeding males	529	475	480	478	480	467	474	431
Swine, including	51	51	56	56	55	57	59	54
Female sows	140	137	141	137	141	155	167	176
Sheep and goats	34	33	33	35	35	35	36	38
Horses, including	297	297	308	302	307	304	320	326
Female horses older than 3 years and stallions	322	339	342	346	345	343	342	343
Poultry of all species and ages	1.50	1.36	1.26	1.28	1.28	1.28	1.23	1.31
	2014	2015	2016	2017	2018	2019	2020	%
Average weight per head at the end of the year, kg:								
Cattle, including	344	348	344	391	400	425	383	17.8
Dairy cows	450	463	457	461	451	438	408	-14.3
Breeding males	591	595	505	456	540	495	480	-17.2
Swine, including	57	54	75	60	102	57	55	-62.1
Female sows	170	172	164	176	170	172	187	-1.1
Sheep and goats	43	41	42	41	41	41	42	-2.3
Horses, including	318	316	315	365	331	347	348	-7.4
Female horses older than 3 years and stallions	338	375	293	360	361	354	350	-19.2
Poultry of all species and ages	1.16	2.00	1.80	1.40	1.30	1.20	1.10	-36.8

Source: NBS, Statistical Annual Report No. 24-agr 'Animal Breeding Sector'. Basic indices of livestock development sector in all household categories in the Republic of Moldova (annual reports for 1990-2020).

As for cattle[69], the information on the weight of the most prevalent breeds of cattle in the RM (Steppe Red and Spotted Black), in dynamics (by age), is presented in Table 5-11. It should be noted that, currently, most animals in the RM are not purebred, but crossbred (Bucataru, Radionov, 1999). Productivity indices for crossbreeds are average values of the purebred indices. Information on the typical body weight of sheep and goats at different stages of ontogeny (birth, weaning, one year of age and slaughter) is available in the scientific literature (Bucataru, Radionov, Varban, 2003).

Table 5-11: Weight of most widespread breeds of cattle in the RM

Breed	Sex	Weight in dynamics by months, kg														
		At birth	6	7	8	9	10	12	15	18	24	30	36	48	60	72
Steppe Red	♀	30	150	170	190	205	220	250	295	340	400	425	450	490	520	520
	♂	30	170	195	220	240	260	300	375	445	525	590	650	750	800	800
Spotted Black	♀	35	165	180	200	220	240	270	320	375	430	455	480	520	550	550
	♂	35	180	205	250	255	280	330	405	480	575	640	750	820	880	880

According to the information collected, the weight of sheep and goats at birth is circa 2-4 kg, lambs are weaned at the age of 3-4 months, when they reach the mass of 18-23 kg; whereas kids at the age of 2-3 months when they reach the weight of 13-15 kg; young sheep that are not left for breeding are fed intensely until the age of 6-7 months, when they reach the weight of 30-35 kg, after which they are slaughtered. Other relevant information on the weight of sheep and goats in the RM is provided in Annex 3-3.

Average daily weight gain per day (WG)[70]*, g/day.* The information on daily actual weight gain reported in the RM between 1990 and 2020 for cattle and swine is shown in Table 5-12.

Table 5-12: Average daily weight gain for cattle and swine for the period 1990-2020

	Category	1990	1991	1992	1993	1994	1995	1996	1997
Daily weight gain, g	cattle	515.0	421.0	425.0	376.0	363.0	223.0	203.0	181.0
	swine	304.0	117.0	110.0	89.0	94.0	148.0	171.0	189.0
	Category	1998	1999	2000	2001	2002	2003	2004	2005
Daily weight gain, g	cattle	230.0	192.0	217.0	260.0	287.0	262.0	275.0	321.0
	swine	222.0	117.0	107.0	134.0	147.0	136.0	166.0	187.0
	Category	2006	2007	2008	2009	2010	2011	2012	2013
Daily weight gain, g	cattle	323.0	297.0	325.0	378.0	345.0	366.0	379.0	355.0
	swine	200.0	218.0	268.0	311.0	317.0	339.0	398.0	402.0
	Category	2014	2015	2016	2017	2018	2019	2020	%
Daily weight gain, g	cattle	383.0	342.0	437.0	398.0	456.0	415.0	482.0	-6.4
	swine	451.0	448.0	487.0	507.0	622.0	541.0	681.0	124.0

Source: NBS, Statistical Annual Report No. 24-agr 'Animal Breeding Sector'. Basic Indices of Animal Breeding Sector Development in all Households Categories in the Republic of Moldova as of January 1 (annual reports for 1990-2020).

[69] Default values used for Eastern European countries: 550 kg for dairy cows, 600 kg for males and 230 kg for young cattle (IPCC 2006 Guidelines, Volume 4, Chapter 10, Table 10A-2, Page 10.73).
[70] The default values are: WG – 0 kg per day for dairy cows and adult males (>5 years), and WG – 0.4 kg per day for young cattle (2006, IPCC Guidelines, Volume 4, Chapter 10, Table 10 A.2).

Average annual milk production per one cow. In the past 20 years, the average productivity of dairy cows in the Republic of Moldova varied between a maximum of 3735 kg of milk per year in 1990 and a minimum of 1957 kg of milk per year in 1997 (Table 5-13) albeit the potential is much higher (Annex 3-3).

Table 5-13: Average annual milk production per one cow between 1990-2020, kg/head/yr

	1990	1991	1992	1993	1994	1995	1996	1997
Total national average annual milk production per one cow	3 735	3 248	2 841	2 398	2 189	2 043	2 021	1 957
Average annual milk production per one cow at agricultural enterprises and farm households	3 975	3 394	3 026	2 413	2 245	2 207	2 051	1 687
Average annual milk production per one cow at individual farms	2 940	2 815	2 421	2 100	2 097	2 125	2 029	2 038
	1998	1999	2000	2001	2002	2003	2004	2005
Total national average annual milk production per one cow	2 040	2 030	2 039	2 072	2 111	2 126	2 480	2 800
Average annual milk production per one cow at agricultural enterprises and farm households	2 001	2 036	2 179	2 447	2 710	2 493	2 561	3 018
Average annual milk production per one cow at individual farms	2 048	2 038	2 028	2 052	2 081	2 110	2 477	2 792
	2006	2007	2008	2009	2010	2011	2012	2013
Total national average annual milk production per one cow	2 807	2 871	3 011	3 316	3 435	3 438	3 425	3 607
Average annual milk production per one cow at agricultural enterprises and farm households	2 913	2 710	2 743	3 098	2 993	3 224	3 380	3 225
Average annual milk production per one cow at individual farms	2 803	2 877	3 020	3 323	3 449	3 444	3 426	3 621
	2014	2015	2016	2017	2018	2019	2020	%
Total national average annual milk production per one cow	3,672	3,666	3,607	3,758	3,815	3,698	3,598	-3.7
Average annual milk production per one cow at agricultural enterprises and farm households	3,742	3,468	3,939	4,363	3,626	3,573	3,579	-10.0
Average annual milk production per one cow at individual farms	3,669	3,676	3,590	3,728	3,828	3,198	3,616	23.0

Source: NBS, Statistical Annual Report No. 24-agr 'Animal Breeding Sector'. Basic Indices of Animal Breeding Sector Development in all Households Categories in the Republic of Moldova as of January 1 (annual reports for 1990-2020).

Table 5-13 shows that the average milk productivity typical for the period 1993-2003 is inferior to the one recorded at the beginning of the 1990s, comparable with milk productivity recorded in the 1960s-1970s, when the cattle population in the RM mainly consisted of the Red Estonian (circa 8%), Simmental (35-37%) and Steppe Red (48-53%) (Bucataru, Cosman, Holban, 2006).

Since 1970, there has been a massive import of Spotted Black cattle in the country. A programme was developed to crossbreed all stock with this breed, considered to be one of the most productive in the world. As a consequence, over the following 30 years, absorption crossbreeding was carried out for Simmental, Estonian Red and Steppe Red breeds with Spotted Black breed. The Holstein breed was also intensely used to improve the breed, particularly in the 1980s-1990s. Developing an immense stock of half-breeds of different generations and a good organization of foddering had thereby led to a national average daily milk yield of 10-11 kg per head by 1990 (Table 5-14).

Table 5-14: Average daily milk production per one cow for the period 1990-2020, kg/head/day

	1990	1991	1992	1993	1994	1995	1996	1997
Total national average daily milk production per one cow	10.2	8.9	7.8	6.6	6.0	5.6	5.5	5.4
Average daily milk production per one cow at agricultural enterprises and farm households	10.9	9.3	8.3	6.6	6.2	6.0	5.6	4.6
Average daily milk production per one cow at individual farms	8.1	7.7	6.6	5.8	5.7	5.8	5.5	5.6
	1998	1999	2000	2001	2002	2003	2004	2005
Total national average daily milk production per one cow	5.6	5.6	5.6	5.7	5.8	5.8	6.8	7.7
Average daily milk production per one cow at agricultural enterprises and farm households	5.5	5.6	6.0	6.7	7.4	6.8	7.0	8.3
Average daily milk production per one cow at individual farms	5.6	5.6	5.5	5.6	5.7	5.8	6.8	7.6
	2006	2007	2008	2009	2010	2011	2012	2013
Total national average daily milk production per one cow	7.7	7.9	8.2	9.1	9.4	9.4	9.4	9.9
Average daily milk production per one cow at agricultural enterprises and farm households	8.0	7.4	7.5	8.5	8.2	8.8	9.2	8.8
Average daily milk production per one cow at individual farms	7.7	7.9	8.3	9.1	9.4	9.4	9.4	9.9
	2014	2015	2016	2017	2018	2019	2020	%
Total national average daily milk production per one cow	10.1	10.0	9.9	10.3	10.5	10.1	9.8	-3.9
Average daily milk production per one cow at agricultural enterprises and farm households	10.3	9.5	10.8	12.0	9.9	9.8	9.8	-10.2
Average daily milk production per one cow at individual farms	10.1	10.1	9.8	10.2	10.5	8.8	9.9	22.7

Source: NBS, Statistical Annual Report No. 24-agr 'Animal Breeding Sector'. Basic Indices of Animal Breeding Sector Development in all Households Categories in the Republic of Moldova as of January 1 (annual reports for 1990-2020).

Subsequently, once the big collective farms collapsed and livestock was concentrated in the private sector (currently, according to the NBS, circa 85% of the total cattle of the Republic of Moldova is in the private sector[71]), the average productivity of dairy cows decreased significantly, particularly as a consequence of poor organization of foddering and inappropriate animal feeding and maintenance conditions in the private sector.

[71] NBS, on-line database: < http://statbank.statistica.md/pxweb/Database/RO/16%20AGR/AGR03/AGR03.asp>.

It should be noted that milk yield greatly depends on the content of protein in the animal diet. The optimal level of protein is circa 14-18% of the dry matter in the feed intake. At a 20% deficit of protein in the feed intake, the milk yield decreases by 30%, and at a 30% deficit of protein, milk productivity drops down to 50%. For a long time, the protein deficit in the cattle diet exceeded 20% (Bucataru, Cosman, Holban, 2006), being the main reason for poor productivity indices, particularly over the period 1993-2003. Starting with 2004, the average productivity of dairy cows tended to grow.

Average annual milk production per one sheep and goat. Milk yield from sheep and goats in the RM varies in different breeds (Bucataru, Radionov, Urzica, 2002; Bucataru, Radionov, Varban, 2003). For example, the potential average milk yield of a Karakul breed sheep is 60-80 kg of milk per year with a fat content of 7-8%, and Tsigae breed reaches a productivity of 75-120 kg of milk per year with a fat content of 6.5-7.0%, whereas for local goats the milking potential is 224-324 kg of milk per year with an average fat content of 4.7% (see Annex 3-3).

Table 5-15 provides statistical data on the average milk production per sheep and goats at individual farms in the Republic of Moldova between 1990 and 2020.

Table 5-15: Average milk production per sheep and goats at individual farms between 1990-2020, kg/head/year

	1990	1991	1992	1993	1994	1995	1996	1997
Total national average annual milk production per one goat	102.0	105.0	108.0	121.0	134.0	117.0	121.0	125.0
Total national average annual milk production per one sheep	15.9	16.0	16.1	16.2	16.3	16.1	16.3	16.2
	1998	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**
Total national average annual milk production per one goat	110.0	106.0	97.0	97.0	99.0	98.0	105.0	112.0
Total national average annual milk production per one sheep	18.9	20.0	20.0	20.0	24.0	26.0	21.0	32.0
	2006	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**
Total national average annual milk production per one goat	137.0	143.0	139.0	147.0	149.0	136.9	168.8	201.3
Total national average annual milk production per one sheep	30.0	33.0	35.0	36.0	36.0	34.6	32.7	37.1
	2014	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**%**
Total national average annual milk production per one goat	167.0	178.0	179.0	188.0	191.0	171.0	154.0	51.0
Total national average annual milk production per one sheep	39.0	37.0	40.0	40.0	41.0	38.0	37.0	132.7

Source: NBS, Statistical Annual Report No. 24-agr 'Animal Breeding Sector'. Basic Indices of Animal Breeding Sector Development in all Households Categories in the Republic of Moldova as of January 1 (annual reports for 1990-2020).

Average wool production per sheep. The default value used is 4 kg/year/head (2006 IPCC Guidelines). According to statistical data, the value of this index varied in the RM over the period 1990-2019 between 1.2 and 2.3 kg of wool collected per year from one sheep (Table 5-16).

Table 5-16: Average wool production from sheep at individual farms between 1990-2020, kg/head/year

	1990	1991	1992	1993	1994	1995	1996	1997
Average annual amount of wool sheared per sheep	2.30	2.30	2.10	1.90	2.00	2.00	1.90	2.00
	1998	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**
Average annual amount of wool sheared per sheep	2.00	1.90	1.80	2.30	2.20	2.00	2.10	2.20
	2006	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**
Average annual amount of wool sheared per sheep	2.00	1.80	1.70	1.80	1.76	1.66	1.25	1.64
	2014	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**%**
Average annual amount of wool sheared per sheep	1.93	1.51	1.53	1.41	1.74	2.00	1.69	-26.5

Source: NBS, Statistical Annual Report No. 24-agr 'Animal Breeding Sector'. Basic Indices of Animal Breeding Sector Development in all Households Categories in the Republic of Moldova as of January 1 (annual reports for 1990-2020).

Climate conditions. Feeding conditions for animals are greatly dependent on climate conditions, particularly on the average annual temperature in areas where livestock is bred. In accordance with the 2006 IPCC Guidelines, data on the average annual temperature in areas with animal population have to be used as follows: areas with average annual temperatures lower than 15°C are defined as cold climate areas; areas with average annual temperatures between 15°C and 25°C are defined as temperate climate areas; and areas with average annual temperatures higher than 25°C are defined as warm climate areas. In accordance with data on the average annual temperature in the Celsius scale available in the Statistical Yearbooks, the Republic of Moldova refers to Eastern European countries with cold climate (Table 5-17).

Table 5-17: Average annual temperature in the RM between 1990-2020, °C

Geographic Areas	1990	1991	1992	1993	1994	1995	1996	1997
North	9.5	8.0	8.5	7.8	9.5	8.4	7.1	7.7
Centre	11.3	9.4	10.1	9.4	11.3	10.0	9.1	9.4
South	11.4	9.3	10.2	9.3	11.3	10.0	9.1	9.1
Geographic Areas	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**
North	8.2	9.2	9.7	8.8	9.5	8.6	9.0	8.7
Centre	10.3	11.0	11.2	10.3	10.8	9.8	10.3	10.5
South	10.1	10.9	11.2	10.4	11.0	10.3	10.9	10.8
Geographic Areas	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**
North	9.7	9.6	8.9	9.1	9.3	9.4	9.7	9.4
Centre	11.3	11.4	10.6	10.5	11.2	11.1	11.3	11.1
South	11.8	11.8	11.2	10.6	11.7	11.5	11.8	11.5
Geographic Areas	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**%**
North	9.3	10.5	9.9	9.8	9.8	10.6	10.7	12.6
Centre	10.9	12.0	11.2	11.2	11.2	12.2	12.7	12.4
South	11.3	12.1	11.8	11.5	11.7	12.6	13.1	14.9

Source: NBS, Statistical Yearbooks of the RM for 1991 (page 207), 1994 (page 31), 1999 (page 13), 2006 (page 15), 2011 (page 15), 2014 (page 15), 2016 (page 18), 2019 (page 16), 2020 (page16).

Percentage of females that give birth in a year (%)[72]. Table 5-18 provides statistical data on live products from 100 females at publicly owned agricultural enterprises between 1990 and 2020.

It should be noted, that the birth rate of some local breeds of sheep and goats is much higher than the one officially reported: circa 115 lambs per 100 Karakul breed female sheep giving birth; circa 120 lambs per 100 Tsigae breed female sheep giving birth; and circa 165 kids per 100 local female goats giving birth (see Annex 3-3).

Table 5-18: Live products from 100 females at publicly owned agricultural enterprises for 1990-2020

	1990	1991	1992	1993	1994	1995	1996	1997
Calves from cows	86	80	79	75	72	66	65	58
Pigs from sows	1466	1317	1569	1223	989	983	1019	892
Lambs from sheep giving birth	91	84	80	79	78	76	75	73
	1998	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**
Calves from cows	61	55	58	65	69	63	60	72
Pigs from sows	1187	772	434	869	967	558	689	997
Lambs from sheep giving birth	75	68	71	79	81	75	79	84
	2006	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**
Calves from cows	66	63	62	67	63	71	63	56
Pigs from sows	949	782	1015	1222	1040	1136	1106	1173
Lambs from sheep giving birth	80	73	81	83	73	82	89	89
	2014	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**%**
Calves from cows	93	71	71	67	66	73	80	-7.0
Pigs from sows	1646	2378	2403	1877	2539	2828	2450	67.1
Lambs from sheep giving birth	126	85	64	65	59	70	77	-15.4

Source: NBS, Statistical Annual Report No. 24-agr 'Animal Breeding Sector'. Basic Indices of Animal Breeding Sector Development in all Households Categories in the Republic of Moldova as of January 1 (annual reports for 1990-2020).

Digestible Energy (DE)[73]. The situation regarding the quality of animal feed and digestibility of the food consumed, which represents the percentage of energy from food which is not eliminated in the form of feces (50-60% for crop by-products and range lands, 60-75% for high quality pastures, well preserved forages, and grain supplemented forage-based diets, and 75-85% for grain-based diets fed in feedlots).

In the Republic of Moldova, DE values varied over the years. In the base year, when the livestock maintenance conditions, foddering and feeding situation were optimal, the DE value was admitted to be 69%; for 1991-1992, DE – 68%; for 1993, DE – 66%; for 1994-1996, DE – 65%; for 1997-2004, DE – 66%; for 2005-2008, DE – 67%; for 2009-2013, DE – 68%; and for 2014-2019, DE – 70%, respectively.

Gross Energy (GE). Animal performance and diet data were collected from Statistical Yearbooks and other relevant specialty publications to estimate daily feed intake, which is the amount of energy (MJ/day) an animal needs for maintenance and for activities such as growth, lactation, and pregnancy. The 2006 IPCC Guidelines provides a series of equations (Table 5-19), which were used to calculate the average amount of gross energy required for animal maintenance and other relevant vital activities.

[72] Default values used for Eastern European countries: 80% for dairy cows and 67% for other cattle, see the 2006 IPCC Guidelines, Volume 4, Chapter 10, Table 10A.1-2, page 10.73.
[73] Default values used, available in the 2006 IPCC Guidelines, Volume 4, Chapter 10, Table 10.2, Page 10.14.

Table 5-19: Equations used to estimate daily gross energy intake for cattle, sheep and goats for maintenance and other relevant vital activities

Metabolic Function	Equation in 2006 IPCC Guidelines	
	Cattle	Sheep and Goats
Maintenance (NE_m)	10.3	10.3
Activity (NE_a)	10.4	10.5
Growth (NE_g)	10.6	10.7
Lactation (NE_l)	10.8	10.9 and 10.10
Work (NE_w)	10.11	NA
Wool Production (NE_{wool})	NA	10.12
Pregnancy (NE_p)	10.13	10.13
REM {NE_{ma}/DE}	10.14	10.14
REG {NE_{ga}/DE}	10.15	10.15
Gross Energy *(GE)*	10.16	10.16

Net energy for maintenance (NE_m). Net energy required for maintenance represents the amount of energy needed to keep the animal in equilibrium where body energy is neither gained nor lost. NE_m was calculated based on Equation 10.3 in the 2006 IPCC Guidelines.

$$NE_m = Cf_i \bullet (Weight)^{0.75}$$

Where:

NE_m – net energy required by the animal for maintenance, MJ/day;

Cf_i – a coefficient which varies for each animal category[74], default values being used as follows: Cf_i – 0.386 for dairy cows in the dry period (60 days), Cf_i – 0.451 for dairy cows during the lactation period (305 days), Cf_i – 0.370 for work oxen, Cf_i – 0.426 for breeding bulls, Cf_i – 0.322 for other cattle, Cf_i – 0.236 for sheep and goats up to 1 year, Cf_i – 0.247 for breeding males and Cf_i – 0.217 for animals older than 1 year, MJ/kg day;

Weight – live-weight of animal, kg.

Net energy for animal activity (NE_a). NE_a is the net energy for activity, or the energy needed for animals to obtain their food, water and shelter. NE_a for cattle was calculated in accordance with Equation 10.4, whereas for sheep and goats in accordance with Equation 10.5 in the 2006 IPCC Guidelines.

$$NE_a = C_a \bullet NE_m$$

Where:

NE_a – net energy for animal (cattle) activity, MJ/day i;

C_a – coefficient corresponding to animal's feeding situation[75], default values used are as follows: C_a – 0, cattle is confined to a small area with the result that they expend very little or no energy to acquire feed; C_a – 0.17, cattle is confined in areas with sufficient forage requiring modest energy expense to acquire feed; C_a – 0.36, cattle graze in open range land or hilly terrain and expend significant energy to acquire feed. Taking into account that the grazing period for cattle in the RM is generally circa 210 days (April-November), and the confinement period is respectively circa 155 days (December-March) (Andries, Rusu, Donos, Constantinov, 2005), the average weighted values for C_a coefficient for conditions of the Republic of Moldova were estimated as: C_a – 0.098 for 1990-1991, and C_a – 0.207 for 1992-2020;

NE_m – net energy required by the animal for maintenance, MJ/day.

$$NE_a = C_a \bullet Weight$$

Where:

NE_a – net energy for animal (sheep and goats) activity, MJ/day;

C_a – coefficient corresponding to animal's feeding situation[76]), default values used are as follows: C_a – 0.0090, when animals are confined due to pregnancy in final trimester (50 days); C_a – 0.0107, when animals graze in open range land, walk up to 1000 meters per day and expend very little energy to acquire feed; C_a – 0.0240, graze in hilly terrain, when animals walk up to 5 km per day and expend significant energy to acquire feed; and C_a – 0.0067, when animals are housed for fattening, MJ/kg day. Taking into account that the grazing period for sheep and goats in the RM is generally circa 210 days (April-November) and the confinement period is

[74] Default values available in the 2006 IPCC Guidelines, Volume 4, Chapter 10, Table 10.4, Page 10.16.
[75] Default values available in the 2006 IPCC Guidelines, Volume 4, Chapter 10, Table 10.5, Page 10.17.
[76] Default values available in the 2006 IPCC Guidelines, Volume 4, Chapter 10, Table 10.5, Page 10.17.

respectively circa 155 days (December-March) (Andries, Rusu, Donos, Constantinov, 2005), the weighted average values for C_a coefficient for conditions of the RM is C_a – 0.0170 for sheep and lambs from one year and over, C_a – 0.0167 for mature rams, and respectively C_a – 0.0202 for growing lambs and kids up to 1 year;

Weight – live-weight of animal, kg.

Net energy for growth (*NE_g*). (NE_g) is the net energy needed for growth (i.e., weight gain). NE_a for cattle was calculated based on Equation 10.6, and for sheep and goats – Equation 10.7 in the 2006 IPCC Guidelines.

$$NE_g = 22.02 \bullet (BW / C \bullet MW)^{0.75} \bullet WG^{1.097}$$

Where:

NE_g – net energy needed for cattle growth, MJ/day;

BW – the average live body weight (BW) of cattle in the population, kg;

C – coefficient with a value of 0.8 for females, 1.0 for castrates and 1.2 for breeding bulls[77];

MW – the mature live body weight of an adult female in moderate body condition, kg;

WG – average daily weight gain of the animals in the population, kg/day.

$$NE_g = \{WG_{lamb} \bullet [a + 0.5b\,(BW_i + BW_f)]\} / (365\ days/yr)$$

Where:

NE_g – net energy needed for growth (sheep and goats), MJ/day;

WG_{lamb} – average weight gain (BW_f-BW_i), kg/year;

BW_i – average live body weight at weaning, kg;

BW_f – average live bodyweight at one year old or at slaughter (live-weight) if slaughtered prior to 1 year of age, kg;

a, b – constants, a – 2.5 and b – 0.35 for breeding males; a – 4.4 and b – 0.32 for castrates; a – 2.1 and b – 0.45 for females[78].

Net energy for lactation (*NE_l*). (NE_l) is the net energy for lactation. For cattle, the net energy for lactation was calculated in conformity with Equation 10.8, based on information on the amount of milk produced and its fat content, and for sheep it was calculated in accordance with Equation 10.9 in the 2006 IPCC Guidelines.

$$NE_l = Milk \bullet (1.47+0.40 \bullet Fat)$$

Where:

NE_l – net energy for lactation (cattle), MJ/day;

Milk – amount of milk produced by a dairy cow, kg of milk/day;

Fat – fat content of milk (cattle), % by weight.

For sheep and goats NE_l may be calculated using two possible methods. The first method, used in the current inventory cycle, is used when the amount of milk produced is known (Equation 10.9 in the 2006 IPCC Guidelines), and the second method is used when the amount of milk produced is not known (Equation 10.10 in the 2006 IPCC Guidelines).

$$NE_l = Milk \bullet EV_{milk}$$

Where:

NE_l – net energy for lactation (sheep and goats), MJ/day;

Milk – amount of milk produced, kg of milk/day;

EV_{milk} – the net energy required to produce 1 kg of milk; a default value of 4.6 MJ/kg can be used, which corresponds to a milk fat content of 7% by weight .

Net energy for work (*NE_{work}*). (NE_{work}) is the net energy for work. It is believed that one hour of typical work of draft animals (cattle) requires circa 10% of the net daily energy for maintenance (NE_m). NE_{work} is calculated in conformity with Equation 10.11 in the 2006 IPCC Guidelines.

$$NE_{work} = 0.10 \bullet NE_m \bullet Hours$$

[77] Default values available in 2006 IPCC Guidelines, Volume 4, Chapter 10, Equation 10.6, Page 10.17.
[78] Default values available in 2006 IPCC Guidelines, Volume 4, Chapter 10, Equation 10.6, Page 10.18.

Where:

NE_{work} – net energy for work (cattle), MJ/days;

NE_m – net energy required by the animal for maintenance (from Equation 10.3), MJ/day;

Hours – number of hours of work per day[79]; this inventory cycle used 2 hours of work per day for 1990-1991 and 3 hours of work per day for 1992-2020.

Net energy for wool production (NE_{wool}). (NE_{wool}) is the average daily net energy required for wool production. NE_{wool} was calculated in accordance with Equation 10.12 in the 2006 IPCC Guidelines.

$$NE_{wool} = (EV_{wool} \bullet Production_{wool}) / 365$$

Where:

NE_{wool} – net energy required to produce wool, (sheep and goats), MJ /day;

EV_{wool} – the energy value of each kg of wool produced, MJ/kg, the default value used is 24 MJ/kg;

$Production_{wool}$ – annual wool production per sheep, kg.

Net energy for pregnancy (NE_p). (NE_p) is the energy required for pregnancy[80] and is calculated in accordance with Equation 10.13 in the 2006 IPCC Guidelines. For cattle, the total energy requirement for pregnancy for a 281-day gestation period averaged over an entire year is calculated as 10% of NE_m. For sheep and goats, the NE_p requirement is similarly estimated for the 144-154-day gestation period although the percentage varies depending on the number of lambs born[81].

$$NE_p = C_{pregnancy} \bullet NE_m$$

Where:

NE_p – net energy required for pregnancy, MJ/day;

$C_{pregnancy}$ – pregnancy coefficient;

NE_m – net energy required by the animal for maintenance (Equation 10.3), MJ/day.

Ratio of net energy available in diet for maintenance to digestible energy consumed (REM). REM was calculated in accordance with Equation 10.14 in the 2006 IPCC Guidelines.

$$REM = [1.123 - (4.092 \bullet 10^{-3} \bullet DE\%) + [1.126 \bullet 10^{-5} \bullet (DE\%)^2] - (25.4/DE\%)]$$

Where:

REM – ratio of net energy available in diet for maintenance to digestible energy consumed;

DE – digestible energy expressed as a percentage of gross energy.

Ratio of net energy available for growth in a diet to digestible energy consumed (REG). REG was calculated in accordance with Equation 10.15 in the 2006 IPCC Guidelines.

$$REG = [1.164 - (5.160 \bullet 10^{-3} \bullet DE\%) + (1.308 \bullet 10^{-5} \bullet (DE\%)^2) - (37.4/DE\%)]$$

Where:

REG – ratio of net energy available for growth in a diet to digestible energy consumed;

DE – digestible energy expressed as a percentage of gross energy.

Gross Energy (GE). Gross energy (GE) was calculated in accordance with Equation 10.16 in the 2006 IPCC Guidelines.

$$GE = \{[(NE_m + NE_a + NE_l + NE_{work} + NE_p) / REM] + [(NE_g) + NE_{wool} / REG]\} / (DE\%/100)$$

Where:

GE – gross energy, MJ/day;

NE_m – net energy required by the animal for maintenance (Equation 10.3), MJ/day;

NE_a – net energy for animal activity (Equations 10.4 and 10.5), MJ/day;

NE_l – net energy for lactation (Equations 10.8, 10.9 and 10.10), MJ/day;

NE_{work} – net energy for work (Equation 10.11), MJ/day;

NE_p – net energy required for pregnancy (Equation 10.13), MJ/day;

REM – ratio of net energy available in diet for maintenance to digestible energy consumed (Equation 10.14);

[79] Default value available in 2006 IPCC Guidelines, Volume 4, Chapter 10, Table 10A-2, Page 10.73

[80] Default value available in 2006 IPCC Guidelines, Volume 4, Chapter 10, Table 10.7, Page 10.20.

[81] Cpregnancy default values were estimated taking into account average prolificacy of the local breeds in the RM: Cpregnancy – 0.087 for sheep and goats.

NE_g – net energy needed for growth (Equations 10.6 and 10.7), MJ/day;

NE_{wool} – net energy required to produce wool (Equation 10.12), MJ/day;

REG – ratio of net energy available for growth in a diet to digestible energy consumed (Equation 10.15);

DE – digestible energy expressed as a percentage of gross energy.

GE values calculated for animal categories relevant in the RM are provided in Table 5-20.

Table 5-20: Gross Energy (GE) values calculated for animal categories following a Tier 2 methodology, MJ/head/day

	1990	1991	1992	1993	1994	1995	1996	1997
Dairy cows	245.8	229.0	227.3	219.8	217.8	213.2	211.8	211.4
Other cattle (average)	118.4	116.1	116.8	122.5	125.9	123.4	129.5	124.7
…Calves and heifers up to 1 year	100.2	94.6	95.0	95.4	96.7	78.5	75.4	69.9
…Heifers between 12 and 18 months	131.0	131.0	126.7	127.2	127.4	127.4	125.7	120.8
…Heifers between 18 and 24 months	156.8	152.3	147.2	142.7	146.4	146.4	146.4	142.7
…Heifers between 24 months and more	167.2	165.0	158.8	158.8	160.2	160.2	164.4	158.7
…Breeding males	207.9	204.9	191.9	194.2	190.4	188.3	184.2	178.2
…Work bullocks	182.5	181.8	170.7	185.5	187.0	187.0	187.0	183.0
Sheep and goats (average)	16.9	16.9	16.3	16.2	16.3	15.6	15.6	15.2
…Mature females ≥ 1 year	17.4	17.3	16.7	16.7	17.0	16.0	15.9	15.6
…Breeding males	24.9	24.3	23.9	23.8	23.9	23.1	23.1	22.9
…Growing lambs and kids up to 1 year	13.2	12.9	12.4	12.4	12.7	12.4	12.3	11.4
	1998	1999	2000	2001	2002	2003	2004	2005
Dairy cows	212.1	212.5	213.5	216.2	218.9	219.4	227.1	229.8
Other cattle (average)	123.3	123.6	128.9	124.6	127.4	126.3	131.7	129.4
…Calves and heifers up to 1 year	77.4	71.6	75.5	81.5	85.0	81.7	83.5	86.7
…Heifers between 12 and 18 months	114.8	114.8	114.8	120.8	129.4	129.4	128.3	130.1
…Heifers between 18 and 24 months	136.1	136.1	136.1	142.7	147.9	147.9	151.5	149.2
…Heifers between 24 months and more	152.0	152.0	152.0	160.1	161.5	161.5	166.8	166.3
…Breeding males	178.2	178.2	178.2	178.2	180.3	180.3	182.3	178.5
…Work bullocks	180.5	177.9	175.3	177.9	180.5	183.0	185.5	184.1
Sheep and goats (average)	15.1	15.2	15.1	15.2	15.3	14.9	15.3	15.7
…Mature females ≥ 1 year	15.6	15.6	15.6	15.6	15.8	15.5	15.7	16.4
…Breeding males	22.4	22.3	22.3	21.9	21.9	21.3	22.4	21.4
…Growing lambs and kids up to 1 year	10.6	11.4	10.6	11.1	11.5	10.5	11.8	10.9
	2006	2007	2008	2009	2010	2011	2012	2013
Dairy cows	228.7	230.1	230.8	232.2	237.6	238.8	239.0	242.3
Other cattle (average)	130.2	127.7	121.7	120.7	121.8	123.7	124.3	122.0
…Calves and heifers up to 1 year	87.0	83.9	87.2	90.5	87.1	89.3	90.7	88.1
…Heifers between 12 and 18 months	132.5	130.1	119.4	114.9	120.5	122.9	123.7	121.3
…Heifers between 18 and 24 months	154.1	152.1	142.1	143.3	144.6	146.6	147.6	145.1
…Heifers between 24 months and more	170.3	166.3	151.9	150.3	153.6	154.6	155.1	154.1
…Breeding males	180.4	180.4	182.4	180.6	180.6	180.6	180.6	180.6
…Work bullocks	184.1	184.1	186.6	185.2	185.2	185.2	185.2	185.2
Sheep and goats (average)	15.5	15.6	15.5	16.2	16.2	16.0	15.7	16.7
…Mature females ≥ 1 year	16.3	16.3	16.2	16.9	16.8	16.7	16.6	17.8
…Breeding males	21.6	21.5	20.7	21.3	21.3	21.2	21.1	21.2
…Growing lambs and kids up to 1 year	10.5	11.1	10.2	10.9	11.6	10.5	10.7	10.8
	2014	2015	2016	2017	2018	2019	2020	%
Dairy cows	245.9	245.8	243.5	246.9	247.1	241.8	230.5	-6.2
Other cattle (average)	118.5	114.8	122.9	116.3	117.9	115.0	120.4	1.7
…Calves and heifers up to 1 year	86.5	82.6	91.4	89.5	93.0	89.4	95.1	-5.1
…Heifers between 12 and 18 months	118.0	113.9	122.5	118.0	124.0	122.5	126.2	-3.7
…Heifers between 18 and 24 months	140.9	138.0	140.9	140.9	142.7	140.9	142.7	-9.0
…Heifers between 24 months and more	149.4	146.6	149.4	149.4	151.3	149.4	151.3	-9.5
…Breeding males	177.4	173.6	172.7	177.4	176.5	175.6	175.6	-15.6
…Work bullocks	186.9	178.0	176.9	186.9	181.0	179.8	179.8	-1.4
Sheep and goats (average)	17.7	17.0	17.4	17.0	17.3	17.1	17.4	3.0
…Mature females ≥ 1 year	19.0	18.2	18.6	18.3	18.5	18.3	18.5	6.1
…Breeding males	20.4	20.7	20.7	20.7	20.8	20.9	20.9	-15.9
…Growing lambs and kids up to 1 year	11.9	11.7	12.0	11.7	11.8	11.9	12.1	-8.2

For animal categories 'other cattle'[82] 'sheep' and 'goats'[83], GE values are weighted averages, taking into account the specific GE values for each subcategory of animals, and the percentage distribution of their population, respectively (Table 5-21).

[82] Default values used for 'other cattle' category are: 30% of total – mature females, 22% – mature males, and 48% – young cattle (2006 IPCC Guidelines, Volume 3, Chapter 10, Table 10A-2, Page 10.73).

[83] According to the literature in the field (Bucataru et al., 2003), the reproduction structure at local sheep and goats is: breeding males – circa 3%, mature females – circa 75%, breeding youngsters – circa 22%.

Table 5-21: Distribution of animal population by subcategories for 1990-2020, %

	1990	1991	1992	1993	1994	1995	1996	1997
Other cattle, including:								
…Calves and heifers up to 1 year	62.3	58.2	53.3	40.9	37.4	31.9	22.3	27.0
…Heifers between 12 and 18 months	17.3	19.8	21.0	25.5	27.0	26.8	31.1	18.0
…Heifers between 18 and 24 months	8.7	10.2	12.4	17.3	16.2	18.5	20.1	24.2
…Heifers between 24 months and more	11.4	11.4	12.9	14.8	17.5	20.7	23.5	27.5
…Breeding males	0.2	0.3	0.4	1.1	1.4	1.4	1.9	2.3
…Work bullocks	0.0	0.0	0.1	0.4	0.5	0.7	1.0	0.9
Sheep and goats, including:								
…Mature females ≥ 1 an	79.2	83.0	82.4	80.0	74.0	81.5	82.2	82.5
…Breeding Males	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
…Growing lambs and kids up to 1 year	17.8	14.0	14.6	17.0	23.0	15.5	14.8	14.5
	1998	1999	2000	2001	2002	2003	2004	2005
Other cattle, including:								
…Calves and heifers up to 1 year	27.1	24.2	16.8	32.2	34.7	33.7	29.5	34.2
…Heifers between 12 and 18 months	14.2	13.2	13.4	15.9	14.7	16.3	17.9	15.0
…Heifers between 18 and 24 months	26.4	32.3	40.0	26.6	25.8	27.0	27.4	27.0
…Heifers between 24 months and more	28.6	26.0	25.4	21.4	21.0	19.4	21.9	20.7
…Breeding males	2.6	3.1	3.0	2.8	2.7	2.6	2.4	2.2
…Work bullocks	1.1	1.3	1.3	1.1	1.0	0.9	0.8	0.9
Sheep and goats, including:								
…Mature females ≥ 1 an	82.5	81.8	82.0	82.9	81.7	81.5	81.5	81.9
…Breeding Males	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
…Growing lambs and kids up to 1 year	14.5	15.2	15.0	14.1	15.3	15.5	15.5	15.1
	2006	2007	2008	2009	2010	2011	2012	2013
Other cattle, including:								
…Calves and heifers up to 1 year	34.2	34.8	37.0	35.9	35.5	34.6	36.2	35.7
…Heifers between 12 and 18 months	20.4	18.3	17.2	19.6	19.1	21.2	20.2	22.0
…Heifers between 18 and 24 months	25.7	26.2	25.9	25.5	26.9	26.4	25.4	24.5
…Heifers between 24 months and more	17.3	18.3	17.6	17.0	16.7	16.3	15.7	15.2
…Breeding males	1.8	1.7	1.6	1.4	1.4	0.4	0.4	0.5
…Work bullocks	0.5	0.7	0.7	0.4	0.3	1.2	2.1	2.2
Sheep and goats, including:								
…Mature females ≥ 1 an	79.6	80.7	82.5	82.1	82.7	83.0	79.7	79.2
…Breeding Males	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
…Growing lambs and kids up to 1 year	17.4	16.3	14.5	14.9	14.3	14.0	17.3	17.8
	2014	2015	2016	2017	2018	2019	2020	%
Other cattle, including:								
…Calves and heifers up to 1 year	36.9	36.8	32.6	44.0	46.8	47.0	41.5	-33.4
…Heifers between 12 and 18 months	21.0	20.6	22.2	18.4	17.6	18.6	25.3	46.2
…Heifers between 18 and 24 months	24.2	25.1	26.0	20.9	20.6	19.6	19.3	120.1
…Heifers between 24 months and more	15.4	15.4	16.9	14.5	13.5	13.3	12.6	10.0
…Breeding males	0.4	0.3	0.4	0.4	0.3	0.2	0.3	47.1
…Work bullocks	2.1	1.9	1.9	1.8	1.3	1.3	1.1	3721.8
Sheep and goats, including:								
…Mature females ≥ 1 an	78.0	77.2	77.8	76.3	77.9	77.5	78.8	-0.5
…Breeding Males	3.0	3.0	3.0	3.0	3.0	3.0	3.0	0.0
…Growing lambs and kids up to 1 year	19.0	19.8	19.2	20.7	19.1	19.5	18.2	2.1

Source: NBS, Statistical Annual Report No. 24-agr 'Animal Breeding Sector'. Basic Indices of Animal Breeding Sector Development in all Households Categories in the Republic of Moldova as of January 1 (annual reports for 1990-2020).

Methane Conversion Factor (Y_m). The extent to which feed energy is converted to CH_4 depends on several interacting feed and animal factors. As there are no CH_4 CS conversion factors, default values provided in the 2006 IPCC Guidelines were used for cattle[84]: Y_m – 0.03 for feedlot fed cattle (young animals) and Y_m – 0.065 for dairy cows and other cattle; for sheep and goats[85]: Y_m – 0.045 for lambs and kids and Y_m – 0.065 for mature animals.

Methane emission factors (EF). Based on the information above, country-specific national factors were developed for source category 3A 'Enteric Fermentation' (for cattle, sheep and goats). The emission factor for each animal category was developed following Equation 10.21 in the 2006 IPCC Guidelines.

$$EF = [GE \bullet (Y_m/100) \bullet 365 / 55.65]$$

Where:

EF – emission factor, kg CH_4/head/yr;

GE – gross energy intake, MJ/head/day;

Y_m – methane conversion factor, % of gross energy in feed converted to methane;

[84] Default values used for cattle available in 2006 IPCC Guidelines, Volume 4, Chapter 10, Table 10.12, Tables 10A-1 and 10A-2, Pages 10.30, 10.72-10.73.
[85] Default values used for sheep and goats available in 2006 IPCC Guidelines, Volume 4, Chapter 10, Table 10.13, Page 10.31.

55.65 MJ/kg CH_4 – the energy content of methane.

Table 5-22 shows country-specific emission factors for cattle bred in the RM, developed by using a Tier 2 simplified methodology.

Table 5-22: Country-Specific EFs for enteric fermentation, calculated for cattle population following a Tier 2 methodology, kg CH_4/head/year

	1990	1991	1992	1993	1994	1995	1996	1997
Dairy cows	**104.8**	**97.6**	**97.2**	**93.7**	**92.8**	**90.9**	**90.5**	**90.1**
Other cattle (average)	**50.5**	**49.5**	**49.9**	**52.2**	**53.7**	**52.6**	**55.3**	**53.2**
…Calves and heifers up to 1 year	42.7	40.3	40.6	40.7	41.2	33.5	32.2	29.8
…Heifers between 12 and 18 months	55.9	55.8	54.2	54.2	54.3	54.3	53.7	51.5
…Heifers between 18 and 24 months	66.8	64.9	62.9	60.8	62.4	62.4	62.6	60.8
…Heifers between 24 months and more	71.3	70.4	67.9	67.7	68.3	68.3	70.3	67.7
…Breeding males	88.6	87.3	82.0	82.8	81.2	80.3	78.8	76.0
…Work bullocks	77.8	77.5	73.0	79.1	79.7	79.7	79.9	78.0
	1998	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**
Dairy cows	**90.4**	**90.6**	**91.3**	**92.2**	**93.3**	**93.5**	**97.1**	**98.0**
Other cattle (average)	**52.6**	**52.7**	**55.1**	**53.1**	**54.3**	**53.9**	**56.3**	**55.2**
…Calves and heifers up to 1 year	33.0	30.5	32.3	34.8	36.3	34.8	35.7	37.0
…Heifers between 12 and 18 months	49.0	49.0	49.1	51.5	55.1	55.1	54.9	55.5
…Heifers between 18 and 24 months	58.0	58.0	58.2	60.8	63.0	63.0	64.8	63.6
…Heifers between 24 months and more	64.8	64.8	65.0	68.3	68.8	68.8	71.3	70.9
…Breeding males	76.0	76.0	76.2	76.0	76.9	76.9	77.9	76.1
…Work bullocks	76.9	75.8	75.0	75.8	76.9	78.0	79.3	78.5
	2006	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**
Dairy cows	**97.5**	**98.1**	**98.7**	**99.0**	**101.3**	**101.8**	**102.2**	**103.3**
Other cattle (average)	**55.5**	**54.4**	**52.0**	**51.4**	**51.9**	**52.7**	**53.1**	**52.0**
…Calves and heifers up to 1 year	37.1	35.8	37.3	38.6	37.1	38.1	38.8	37.6
…Heifers between 12 and 18 months	56.5	55.5	51.1	49.0	51.4	52.4	52.9	51.7
…Heifers between 18 and 24 months	65.7	64.9	60.8	61.1	61.7	62.5	63.1	61.9
…Heifers between 24 months and more	72.6	70.9	64.9	64.1	65.5	65.9	66.3	65.7
…Breeding males	76.9	76.9	78.0	77.0	77.0	77.0	77.2	77.0
…Work bullocks	78.5	78.5	79.8	79.0	79.0	79.0	79.2	79.0
	2014	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**%**
Dairy cows	**104.8**	**104.8**	**104.1**	**105.3**	**105.3**	**103.1**	**98.3**	**-6.2**
Other cattle (average)	**50.5**	**49.0**	**52.5**	**49.6**	**50.3**	**49.0**	**51.3**	**1.7**
…Calves and heifers up to 1 year	36.9	35.2	39.1	38.2	39.6	38.1	40.6	-5.1
…Heifers between 12 and 18 months	50.3	48.6	52.4	50.3	52.9	52.2	53.8	-3.7
…Heifers between 18 and 24 months	60.1	58.9	60.2	60.1	60.8	60.1	60.8	-9.0
…Heifers between 24 months and more	63.7	62.5	63.9	63.7	64.5	63.7	64.5	-9.5
…Breeding males	75.6	74.0	73.8	75.6	75.2	74.8	74.8	-15.6
…Work bullocks	79.7	75.9	75.6	79.7	77.2	76.7	76.7	-1.4

Table 5-23 shows country-specific emission factors calculated for sheep and goats. The obtained results are intermediary to default values typical of developing countries – with 5 kg CH_4/head/year for sheep and goats, and developed countries – with 8 kg CH_4/head/year, respectively (2006 IPCC Guidelines).

Table 5-23: Country-Specific EFs from enteric fermentation, calculated for sheep population following a Tier 2 methodology, kg CH_4/head/year

	1990	1991	1992	1993	1994	1995	1996	1997
Sheep (average), including:	**6.9**	**6.9**	**6.7**	**6.6**	**6.5**	**6.4**	**6.4**	**6.3**
…Mature ewes and ewe lambs ≥ 1 year	7.4	7.4	7.1	7.1	7.3	6.8	6.8	6.6
…Breeding rams	10.6	10.4	10.2	10.2	10.2	9.9	9.9	9.8
…Growing lambs up to 1 year	3.9	3.8	3.7	3.7	3.7	3.6	3.6	3.4
	1998	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**
Sheep (average), including:	**6.2**	**6.2**	**6.2**	**6.3**	**6.3**	**6.1**	**6.3**	**6.5**
…Mature ewes and ewe lambs ≥ 1 year	6.6	6.7	6.7	6.7	6.7	6.6	6.7	7.0
…Breeding rams	9.5	9.5	9.5	9.3	9.3	9.1	9.6	9.1
…Growing lambs up to 1 year	3.1	3.4	3.1	3.3	3.4	3.1	3.5	3.2
	2006	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**
Sheep (average), including:	**6.4**	**6.4**	**6.4**	**6.7**	**6.7**	**6.6**	**6.5**	**6.8**
…Mature ewes and ewe lambs ≥ 1 year	7.0	6.9	6.9	7.2	7.2	7.1	7.1	7.6
…Breeding rams	9.2	9.2	8.9	9.1	9.1	9.1	9.0	9.1
…Growing lambs up to 1 year	3.1	3.3	3.0	3.2	3.4	3.1	3.2	3.2
	2014	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**%**
Sheep (average), including:	**7.2**	**6.9**	**7.1**	**6.9**	**7.1**	**7.0**	**7.1**	**3.4**
…Mature ewes and ewe lambs ≥ 1 year	8.1	7.7	7.9	7.8	7.9	7.8	7.9	6.1
…Breeding rams	8.7	8.8	8.9	8.8	8.9	8.9	8.9	-15.9
…Growing lambs up to 1 year	3.5	3.4	3.5	3.4	3.5	3.5	3.6	-8.2

5.2.3. Uncertainties and Time-Series Consistency

Uncertainties associated with the estimation of methane emissions from enteric fermentation result from those associated with livestock estimation, and also from the emission factors used. The uncertainties associated with the domestic animal population in the RM are moderate (circa 10%). Should a Tier 1 method be used, the accuracy of the default EFs is circa 30% (2006 IPCC Guidelines). Because this methodology does not rely on country-specific values and does not take into account the country's livestock characteristics, general uncertainty of results obtained by using this approach could reach up to circa 50% (2006 IPCC Guidelines). Should a Tier 2 method be used, uncertainties will depend particularly only on how accurately the characteristics of basic categories of domestic animals will be applied and the extent to which the calculation methods and coefficients used in the different equations used to calculate the energy used correspond to national circumstances (2006 IPCC Guidelines). The accuracy CS EFs, calculated using a Tier 2 method is estimated to be circa 20% (2006 IPCC Guidelines). Thus, combined uncertainties associated with AD and EFs for source category 3A 'Enteric Fermentation' are estimated to be circa 22.36% (Annex 5-3.3).

In view of ensuring time-series consistency of the obtained results, the same approach was used for the entire period under review, in conformity with the recommendations included in the 2006 IPCC Guidelines.

5.2.4. Quality Assurance and Quality Control

Standard verification and quality control forms and check-lists were filled in for category 3A 'Enteric Fermentation', following a Tier 1 approach. It should be noted that the AD and methods used to estimate GHG emissions under this category were documented and archived both in hard copies and electronically. In order to identify the data entry and the CH_4 emission estimation process-related errors, verifications and quality control procedures were applied. Following the recommendations in the 2006 IPCC Guidelines, CH_4 emissions from source category 3A 'Enteric Fermentation' were estimated using AD from official reference sources.

5.2.5. Recalculations

CH_4 emissions from source category 3A 'Enteric fermentation' were recalculated as a result of updating the activity data used on the number of domestic livestock and the productivity of domestic livestock population for the years 2017-2019, as available in the Statistical Annual Report No. 24-agr 'Animal Breeding Sector', Number of livestock and poultry in all households categories as of January 1, and as a result of the updated DE values for the period 2017-2019 expressed as a percentage of gross energy, GE values and country-specific emission factors for cattle, and sheep and goats, calculated using a Tier 2 methodology, respectively.

In comparison with results recorded in the BUR3 of the RM to the UNFCCC (2021), the changes made in the current inventory cycle resulted in an insignificant upward trend in CH_4 emissions for 2017-2018, and an insignificant downward trend in CH_4 emissions for 2019 (Table 5-24).

Table 5-24: Comparative results of CH_4 emissions from source category 3A 'Enteric Fermentation' included in the BUR3 and NC5 of the RM to the UNFCCC, kt

	1990	1991	1992	1993	1994	1995	1996	1997
BUR3	87.5771	81.1547	79.8715	74.9162	72.9133	64.7235	59.6750	51.3040
NC5	87.5771	81.1547	79.8715	74.9162	72.9133	64.7235	59.6750	51.3040
Difference, %	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	1998	1999	2000	2001	2002	2003	2004	2005
BUR3	49.8079	46.0727	43.4313	44.1309	45.0244	41.1415	38.4568	36.9611
NC5	49.8079	46.0727	43.4313	44.1309	45.0244	41.1415	38.4568	36.9611
Difference, %	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2006	2007	2008	2009	2010	2011	2012	2013
BUR3	35.7523	28.8838	27.5714	28.5438	28.3270	26.6765	25.2109	25.3945
NC5	35.7523	28.8838	27.5714	28.5438	28.3270	26.6765	25.2109	25.3945
Difference, %	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2014	2015	2016	2017	2018	2019	2020	%
BUR3	26.1032	25.1684	24.8801	23.1182	20.6560	17.6658		
NC5	26.1032	25.1684	24.8801	23.1354	20.6594	17.6379	15.5616	-82.2
Difference, %	0.00	0.00	0.00	0.07	0.02	-0.16		

Abbreviations: BUR3 – Third Biennial Update Report of the RM to the UNFCCC, NC5 – Fifth National Communication of the RM to the UNFCCC.

The table below presents the comparative results of the inventory of methane emissions from source category 3A 'Enteric Fermentation', expressed in kt CO_2 equivalent using the GWP_{100} values available in the IPCC AR4 ($GWP_{100} = 25$) (Table 5-25).

Table 5-25: Comparative results of CH_4 emissions from source category 3A 'Enteric Fermentation' included in the BUR3 and NC5 of the RM to the UNFCCC, kt CO_2 equivalent

	1990	1991	1992	1993	1994	1995	1996	1997
BUR3	2189.4276	2028.8687	1996.7865	1872.9050	1822.8316	1618.0865	1491.8749	1282.5988
NC5	2189.4276	2028.8687	1996.7865	1872.9050	1822.8316	1618.0865	1491.8749	1282.5988
Difference, %	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	1998	1999	2000	2001	2002	2003	2004	2005
BUR3	1245.1973	1151.8178	1085.7826	1103.2722	1125.6099	1028.5383	961.4211	924.0273
NC5	1245.1973	1151.8178	1085.7826	1103.2722	1125.6099	1028.5383	961.4211	924.0273
Difference, %	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2006	2007	2008	2009	2010	2011	2012	2013
BUR3	893.8074	722.0955	689.2854	713.5953	708.1752	666.9120	630.2714	634.8631
NC5	893.8074	722.0955	689.2854	713.5953	708.1752	666.9120	630.2714	634.8631
Difference, %	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2014	2015	2016	2017	2018	2019	2020	%
BUR3	652.5791	629.2090	622.0031	577.9552	516.4012	441.6456		
NC5	652.5791	629.2090	622.0031	578.3838	516.4851	440.9463	389.0391	-82.2
Difference, %	0.00	0.00	0.00	0.07	0.02	-0.16		

Abbreviations: BUR3 – Third Biennial Update Report of the RM to the UNFCCC, NC5 – Fifth National Communication of the RM to the UNFCCC.

For 2020, CH_4 emissions resulting from category 3A 'Enteric Fermentation' were estimated for the first time. The obtained results allow us to assert that between 1990 and 2020, methane emissions from the respective category had decreased by 82.2%, particularly due to the decrease in the animal population.

Between 1990 and 2020, the share of different livestock categories in the overall methane emissions from source category 3A 'Enteric Fermentation' had changed. By 2020, the percentage of categories such as 'other cattle' had decreased compared to the level in 1990, whereas the percentage of other categories such as 'dairy cows', 'sheep', 'goats', 'horses', 'asses and mules', 'swine', and 'rabbits' recorded an upward trend (Table 5-26).

Table 5-26: Breakdown of CH_4 emissions from source category 3A 'Enteric Fermentation' by livestock category for 1990-2020, %

	1990	1991	1992	1993	1994	1995	1996	1997
Dairy cows	47.3	47.8	49.1	50.3	51.3	53.5	53.9	56.9
Other cattle	38.3	36.8	35.4	33.5	31.6	28.3	27.0	23.4
Sheep	9.8	10.6	10.9	12.0	12.7	13.1	13.7	13.9
Goats	0.2	0.3	0.4	0.5	0.6	0.7	0.8	1.0
Horses	1.0	1.1	1.2	1.3	1.4	1.7	1.9	2.3
Asses and mules	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1
Swine	3.2	3.2	2.8	2.2	2.2	2.4	2.4	2.3
Rabbits	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
	1998	1999	2000	2001	2002	2003	2004	2005
Dairy cows	57.8	60.3	62.7	62.7	63.2	63.1	62.9	61.8
Other cattle	22.6	20.1	18.6	18.5	18.1	17.2	16.2	15.9
Sheep	13.1	12.9	12.1	12.1	11.8	12.4	13.6	14.5
Goats	1.0	1.2	1.3	1.4	1.5	1.6	1.7	1.7
Horses	2.5	2.8	3.2	3.3	3.3	3.6	3.5	3.5
Asses and mules	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Swine	2.8	2.4	1.7	1.7	1.8	1.7	1.6	2.0
Rabbits	0.2	0.2	0.2	0.3	0.2	0.3	0.4	0.4
	2006	2007	2008	2009	2010	2011	2012	2013
Dairy cows	60.5	61.5	61.5	60.1	59.3	59.5	58.8	57.5
Other cattle	16.3	13.7	12.6	12.6	12.9	13.6	13.8	13.7
Sheep	15.0	16.9	17.9	18.9	18.7	17.7	17.9	19.3
Goats	1.7	1.8	2.0	2.1	2.2	2.5	2.7	2.8
Horses	3.5	3.8	3.7	3.5	3.4	3.4	3.4	3.3
Asses and mules	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Swine	2.4	1.7	1.6	2.1	2.7	2.7	2.6	2.6
Rabbits	0.5	0.5	0.5	0.6	0.6	0.6	0.6	0.7
	2014	2015	2016	2017	2018	2019	2020	%
Dairy cows	56.5	57.3	55.3	55.6	54.3	52.7	50.7	7.2
Other cattle	13.6	13.0	14.3	13.6	13.7	14.2	15.0	-60.8
Sheep	20.4	19.9	20.5	20.5	21.1	21.3	22.0	124.2
Goats	2.9	3.2	3.4	3.7	3.9	4.3	4.8	2171.6
Horses	2.9	2.9	2.7	2.7	2.7	2.7	2.7	174.0
Asses and mules	0.1	0.1	0.1	0.2	0.2	0.1	0.1	300.4
Swine	2.9	2.9	2.8	2.9	3.1	3.6	3.5	11.6
Rabbits	0.7	0.8	0.9	1.0	1.0	1.1	1.2	534.7

It should also be noted that the impact of using the Tier 2 estimation methodology, at the expense of the Tier 1 methodology, generally gave lower values of methane emissions from source category 3A 'Enteric Fermentation', this reduction varying between a minimum of 9.4% in 2014 and a maximum of 18.6% in 1999 (Table 5-27).

Table 5-27: Comparative results of CH_4 emissions from category 3A 'Enteric Fermentation', calculated using Tier 1 and Tier 2 methodologies, kt

	1990	1991	1992	1993	1994	1995	1996	1997
Tier 1	98.1242	94.6819	93.5080	88.4700	86.1070	78.3118	71.5496	62.8516
Tier 2	87.5771	81.1547	79.8715	74.9162	72.9133	64.7235	59.6750	51.3040
Difference, %	-10.7	-14.3	-14.6	-15.3	-15.3	-17.4	-16.6	-18.4
	1998	1999	2000	2001	2002	2003	2004	2005
Tier 1	61.0890	56.6017	52.8901	53.6474	54.0904	49.6052	44.9070	42.8450
Tier 2	49.8079	46.0727	43.4313	44.1309	45.0244	41.1415	38.4568	36.9611
Difference, %	-18.5	-18.6	-17.9	-17.7	-16.8	-17.1	-14.4	-13.7
	2006	2007	2008	2009	2010	2011	2012	2013
Tier 1	41.6227	33.6952	32.2693	33.1232	32.3301	30.3247	28.6838	28.4903
Tier 2	35.7523	28.8838	27.5714	28.5438	28.3270	26.6765	25.2109	25.3945
Difference, %	-14.1	-14.3	-14.6	-13.8	-12.4	-12.0	-12.1	-10.9
	2014	2015	2016	2017	2018	2019	2020	%
Tier 1	28.8193	28.1627	27.5135	25.7706	22.8584	19.8373	17.7355	-81.9
Tier 2	26.1032	25.1684	24.8801	23.1354	20.6594	17.6379	15.5616	-82.2
Difference, %	-9.4	-10.6	-9.6	-10.2	-9.6	-11.1	-12.3	

Planned improvements could include updating AD and productivity indices used to estimate GHG emissions from this source category following a Tier 2 methodology, particularly for cattle and sheep.

5.3. Manure Management (Category 3B)

Category 3B 'Manure Management' includes both methane and nitrous oxide emissions. The emissions level depends on the amount of manure treated and handled within manure management systems, properties of manure and type of manure management systems. Usually, poorly aerated manure management systems generate larger amounts of CH_4 and smaller amounts of N_2O; whereas well aerated systems generate less CH_4 emissions and more N_2O emissions.

5.3.1. Methane Emissions

5.3.1.1. Source Category Description

When manure decomposes anaerobically (in the absence of oxygen), methanogenic bacteria produce methane. The main factors affecting the production of CH_4 emissions from manure are the amount of manure produced and the share (or percentage) of manure decomposed anaerobically. The first category of these factors depends on the production rate of animal manure during a calendar year, as well as on livestock; and the second group of factors – the way in which animal manure is collected, stored and, used. The share of manure that decomposes anaerobically depends on how the manure is managed. When manure is stored or treated as a liquid (e.g., in lagoons, ponds, etc.), it decomposes anaerobically and can produce a significant quantity of CH_4, and when manure is stored or handled as a solid (e.g., in stacks or piles) or when it is excreted in the grazing process or applied on agricultural soils as organic fertilizer, it tends to decompose under more aerobic conditions and produces insignificant amounts of methane.

In order to estimate methane emissions from manure management, the total animal population was divided into subgroups to better reflect the average amount of waste produced per animal or poultry per year, as well as the way in which manure is managed. Average emission rates were calculated for existent animal and poultry categories, based on typical manure management systems and country-specific emission factors for cattle and swine, as well as based on default emission factors for other livestock and poultry categories.

5.3.1.2. Activity Data, Estimation Methodologies and Emission Factors

When using the Tier 1 methodology, emissions may be calculated by multiplying the activity data on livestock (identical to those used to estimate CH_4 emissions from 3A 'Enteric Fermentation') by default emission factors in countries with cold climate (average annual temperature being less than 15°C), for each category of animals (see Equation 10.22 in the 2006 IPCC Guidelines).

$$CH_4\ Emissions = \Sigma_{(T)}\ [(EF_{(T)} \bullet N_{(T)})/10^6]$$

Where:

CH_4 Emissions – CH_4 from manure management, for a defined population, kt CH_4/yr;

$EF_{(T)}$ – emission factor for the defined livestock population, kg CH_4/head/yr;

$N_{(T)}$ – number of head of livestock species/category *T* in the country;

T – species/category of livestock.

Since source category 3B 'Manure Management' has a significant share in the country's emissions and default values used do not correspond to the specific conditions of animal growth and manure management practices used in the Republic of Moldova, following the 2006 IPCC Guidelines, in order to estimate CH_4 emissions, the Tier 2 methodology was used (for cattle and swine).

Methane Emission Factors (EFs). In the Republic of Moldova, country-specific EFs (for cattle and swine) were calculated based on information collected from statistical publications and various scientific research publications. To calculate these coefficients, it was necessary to determine the range in manure volatile solid content per animal (VS, in kg) and the maximum methane producing capacity typical to certain type of manure (B_0 in m^3 per kg of VS). Additionally, methane conversion factors (MCF) which also account for the influence of climate conditions on methane formation process were identified for each type of manure management system. CH_4 emission factors under category 3B 'Manure Management' were calculated by using Equation 10.23 in the 2006 IPCC Guidelines.

$$EF_{(T)} = (VS_{(T)} \bullet 365) \bullet [B_{0(T)} \bullet 0.67\ kg/m^3 \bullet \Sigma_{(S,k)}\ (MCF_{(S,k)}/100) \bullet MS_{(T,S,k)}]$$

Where:

$EF_{(T)}$ – annual CH_4 emission factor for livestock category *T*, kg CH_4/animal/yr;

$VS_{(T)}$ – daily volatile solid excreted for livestock category *T*, kg dm/animal/day (Table 5-28);

$B_{0(T)}$ – maximum methane producing capacity for manure produced by livestock category *T*, m^3 CH_4/kg of VS excreted;

0.67 – conversion factor (CF) of m^3 CH_4 to kilograms CH_4;

$MCF_{(S,k)}$ – methane conversion factors for each manure management system *S* by climate region *k*, %;

$MS_{(T,S,k)}$ – fraction of livestock category *T*'s manure handled using management system *S* in climate region *k*, dimensionless.

Table 5-28: Daily volatile solid excreted (VS) calculated for the period 1990-2020, kg dry matter/day

	1990	1991	1992	1993	1994	1995	1996	1997
Dairy cows	4.15	3.98	3.95	4.03	4.10	4.01	3.98	3.87
Other cattle	1.99	2.00	2.02	2.23	2.36	2.31	2.42	2.27
Market swine	0.54	0.54	0.52	0.53	0.51	0.49	0.47	0.42
Fattening swine	0.34	0.34	0.33	0.34	0.32	0.31	0.29	0.26
	1998	1999	2000	2001	2002	2003	2004	2005
Dairy cows	3.89	3.89	3.91	3.96	4.01	4.02	4.16	4.10
Other cattle	2.25	2.25	2.35	2.27	2.32	2.30	2.40	2.30
Market swine	0.41	0.40	0.42	0.40	0.40	0.42	0.41	0.40
Fattening swine	0.26	0.25	0.26	0.25	0.25	0.26	0.26	0.25
	2006	2007	2008	2009	2010	2011	2012	2013
Dairy cows	4.08	4.11	4.12	4.03	4.13	4.15	4.15	4.21
Other cattle	2.31	2.27	2.16	2.08	2.10	2.14	2.15	2.11
Market swine	0.40	0.40	0.41	0.40	0.41	0.45	0.48	0.51
Fattening swine	0.25	0.25	0.26	0.25	0.26	0.28	0.30	0.32
	2014	2015	2016	2017	2018	2019	2020	%
Dairy cows	4.03	4.03	3.99	4.05	4.05	3.97	3.78	-8.9
Other cattle	1.93	1.87	2.00	1.90	1.92	1.88	1.96	-1.2
Market swine	0.49	0.50	0.47	0.51	0.49	0.50	0.54	-1.1
Fattening swine	0.31	0.31	0.30	0.32	0.31	0.31	0.34	-1.1

Volatile Solids Excretion Rate (VS) was calculated following Equation 10.24 in the 2006 IPCC Guidelines.

$$VS = [GE \bullet (1 - DE\%/100)+(UE \bullet GE)] \bullet [(1 - ASH/18.45)]$$

Where:

VS – volatile solid excretion per day on a dry-organic matter basis, kg VS/day[86] (see country-specific values in Table 5-28);

GE – gross energy intake, MJ/day; the same values as those used for Enteric Fermentation;

DE – digestibility of the feed in %; for cattle the same values were used as under 3A 'Enteric Fermentation'; for fattening swine, DE – 85%, while for market swine DE – 75%;

(UE • GE) – urinary energy expressed as fraction of gross energy (GE); typically, this value is 0.04 GE for cattle and 0.02 GE for swine;

ASH – the ash content of manure calculated as a fraction of the dry matter feed intake; values used by Austria into its NIR for 1990-2018 were used, 11% for dairy cows, 11.5% for other cattle, the default value of 2% was used for swine (2006 IPCC Guidelines);

18.45 – conversion factor (CF) for dietary GE in MJ per kg of dry matter; this value is relatively constant across a wide range of forage and grain-based feeds commonly consumed by livestock.

The maximum *methane-producing capacity of the manure* (B_0) varies by species and diet. As it was not possible to identify country-specific values of B_0 expressed in m^3 per kg of VS in the specialty literature, default values typical of EE countries were used (Tables 5-29 and 5-30).

Table 5-29: Coefficients and default EFs used for 3B 'Manure Management' for cattle and swine

Categories	Weight, kg	Digestibility, %	Energy, MJ/day	Daily feed intake, kg	Manure, kg/ dry (dry basis)	VS, kg/day	B_0, m^3 CH_4 / kg VS	EF, kg CH_4/ year
Dairy cows	550	60	207.2	11.2	4.49	4.5	0.24	11
Other cattle	391	60	134.4	7.3	2.91	2.7	0.17	6
Fattening swine	50	75	38.0	2.1	0.51	0.3	0.45	3
Market swine	180	60	38.0	2.1	0.51	0.5	0.45	4

Source: 2006 IPCC Guidelines, Volume 4, Chapter 10, Table 10.14, page 10.38; Table 10A-4, page 10.77; Table 10A-5, page 10.78; Table 10A-7, page 10.80 and Table 10A-8, page 10.81.

Table 5-30: Coefficients and default emission factors used in category 3B 'Manure Management' (for developed countries)

Categories	Weight, kg	Digestibility, %	Daily feed intake, kg	% Ash, dry basis.	VS per day, kg VS	B_0, m^3/kg VS	CF CH_4, %	EF, kg CH_4/ year
Sheep	48.5	60	1.08	8	0.40	0.19	1	0.19
Goats	38.5	60	0.76	8	0.30	0.18	1	0.13
Horses	377	70	5.96	4	2.13	0.30	1	1.56
Asses and Mules	130	70	3.25	4	0.94	0.33	1	0.76
Rabbits	1.6	-	-	-	0.10	0.32	1	0.08
Chickens	1.8	63	-	5	0.02	0.39	1	0.03
Turkeys	6.8	68	-	3	0.07	0.36	1	0.09
Broilers	0.9	68	-	2	0.01	0.36	1	0.02
Ducks	2.7	66	-	2	0.02	0.36	1	0.02

Source: 2006 IPCC Guidelines, Volume 4, Chapter 10, Table 10.15, page 10.41; Table 10A-9, pages 10.82-10.83.

Methane Conversion Factor (MCF) values vary depending on the manure management systems and annual average temperatures. Because of the unavailability of country-specific methane conversion factors (MCF), default values provided in the 2006 IPCC Guidelines were used (Table 5-31).

Table 5-31: Default values of MCF for Manure Management Systems, %

Manure Management System		MCF, %
Pasture/Range/Paddock: the manure from pasture and range grazing animals is allowed to lie as deposited, and is not managed		1
Daily Spread: animal manure is collected in solid form, being then immediately applied to cropland or pastures with a certain regularity. Manure is not stored or treated, so emissions are considered zero.		0.1
Solid storage: manure is collected and stored in solid form for a long time (by default – a few months) before use.		2
Dry lot: in countries with dry climates, animals can be kept in confinement areas, the manure formed is allowed to dry, being periodically evacuated in a dry state and used accordingly.		1
Liquid/Slurry: manure is stored as excreted or with minimal addition of water in either tanks or earthen ponds for six months or more, later applied to land; in order to facilitate manure management, water is added to it.	with natural crust cover	10
	without natural crust cover	17

[86] Default values used as follows: for dairy cows – 4.5 kg dm/day, other cattle – 2.7 kg dm/day (2006 IPCC Guidelines , Volume 4, Chapter 10, Table 10A-4, Page 10.77, and Table 10A-5, Page 10.78); for swine: market swine – 0.5 kg dm/day, fattening swine – 0.3 kg dm/day (2006 IPCC Guidelines , Volume 4, Chapter 10, Table 10A-8, Page 10.81 and Table 10A-7, Page 10.80).

Manure Management System		MCF, %
Uncovered anaerobic lagoon: systems that use water to transport animal manure to lagoons/ponds, where they are kept for 30 to 200 days; the water can be recycled or then used to irrigate and fertilize agricultural land.		66
Pit Storage below animal confinements: solid and liquid animal manure is excreted on the floor, under which there are deep pits, from where manure is discharged after a certain period, which also varies for this analysis, was divided into two categories.	< 30 days	3
	> 30 days	17
Anaerobic Digester: manure, usually in liquid form, is subjected to anaerobic digestion in fermenters in order to produce methane or energy. Emissions, in this case, come from leaks and vary depending on the type of fermenter.		0-100
Burned for Fuel: manure is collected, dried and burned for fuel. Methane emissions associated with burned manure are not included in the Agriculture Sector but were considered in the Energy Sector , category 'Biomass Burning'.		10
Composting – Intensive windrow: solid and liquid manure is collected and stored in tanks or pits, with forced aeration of manure		0.5
Composting – Passive windrow: solid and liquid animal manure is collected and stored in piles, with regular turning for aeration.		0.5
Poultry manure with litter: poultry manure is excreted on the floor with bedding; birds do tread on the manure.		1.5
Poultry manure without litter: poultry manure is excreted on the floor without bedding; birds do not tread on the manure.		1.5
Aerobic treatment: animal manure (dung and urine) is collected in a liquid state, subjected to forced aeration, or treated in aerobic lagoons or ponds or in moist soil systems to ensure the nitrification or denitrification process.		0

Source: 2006 IPCC Guidelines, Volume 4, Chapter 10, Table 10.17, pages 10.44-10.47.

MCF represents the extent to which maximum methane producing capacity (B_0) is attained. Thus, measurement of MCF values should include the following factors: length of storage; manure characteristics; determination of the amount of manure left in the storage facility; time and temperature distribution between indoor and outdoor storage; daily temperature fluctuation; seasonal temperature variation, etc.

The default values of the methane conversion factor for cattle and swine are presented in Table 5-32, while the percentage of using different manure management systems in Eastern European countries – in Table 5-33 below.

Table 5-32: MCFs for different animal categories and manure management systems

Manure Management Systems	MCF, %	
	Cattle	Swine
Anaerobic Lagoon	66	66
Liquid/Slurry	17	17
Solid Storage	2	2
Dry lot	1	1
Pasture/Range/Paddock	1	0
Pit Storage below animal confinements < 1 month	0	3
Pit Storage below animal confinements > 1 month	0	17
Daily Spread	0.1	0.1
Anaerobic Digester	10	10
Burning for fuel	10	0
Other Systems	1	1

Source: 2006 IPCC Guidelines, Volume 4, Chapter 10, Table 10A-4 page 10.77, Table 10A-5 page 10.78, Table 10A-7 page 10.80 and Table 10A-8 page 10.88.

Table 5-33: Default manure management systems used in Eastern European countries (MS%)

	Anaerobic Lagoon	Liquid / Slurry	Solid Storage	Pasture	Daily Spread	Other
Dairy cows	0	17.5	60	18	2.5	2
Other cattle	0	22.5	44	20	0	13.5
	Anaerobic Lagoon	Liquid / Slurry	Solid Storage	Pasture	Daily Spread	Other
Fattening swine	3	0	42	24.7	24.7	5.7
Market swine	3	0	42	24.7	24.7	5.7

Source: 2006 IPCC Guidelines, Volume 4, Chapter 10, Table 10A-4 page 10.77, Table 10A-5 page 10.78, Table 10A-7 page 10.80 and Table 10A-8 page 10.88.

Based on country-specific AD (identical to that used for enteric fermentation), as well as on default EFs and coefficients, country-specific CH_4 EFs for 3B 'Manure Management' were calculated (for animal categories 'cattle' and 'swine'). Following good practices, the same estimation methodology was used for the entire period under review.

As significant changes occurred in the livestock breeding sector of the RM in terms of manure management practices (large scale feedlots for cattle and swine were closed down, most animal population being concentrated currently in the private sector; the share of liquid manure management systems, contributing to a greater extent to the generation of CH_4 emissions, decreased; while the share of solid manure management systems, less responsible for the generation of CH_4 emissions, increased), as well as a consequence of non-compliance to actual manure management systems in the RM with the ones described in the 2006 IPCC Guidelines (for Eastern European countries), it was not deemed necessary to use default values in terms of the share of different manure management systems typical of Eastern European countries.

Thus, in order to estimate CH_4 emissions from category 3B ‘Manure Management’ (for cattle and swine), country-specific values were used (Table 5-34), available from a study developed in May-June 2015 by specialists from the Scientific-Practical Institute of Biotechnology in Animal Breeding and Veterinary Medicine, as well as from a second study developed in June 2021 by specialists from the National Agency for Food Safety, whose results were presented to the Environment Agency by Letter No. 016/1722 dated 30.06.2021, as a response to request No. 08/136/2021 dated 09.06.2021.

Table 5-34: Share of Manure Management Systems (MS%) for the period 1989-2020

Animal Categories (T) and Manure Management Systems (MS)	1989 / 1990	1991 / 1992	1993 / 1994	1995 / 1997	1998 / 1999	2000 / 2001	2002 / 2003	2004 / 2005	2006 / 2007	2008 / 2009	2010 / 2011	2012 / 2015	2016 / 2017	2018 / 2019	2020 / 2021
	valorile $MS_{(T,S)}$														
Dairy cows	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**
Pasture/Range/Paddock	6.0	10.0	16.0	20.0	23.0	24.0	24.0	24.5	24.5	24.5	24.5	25.0	25.0	24.9	24.9
Liquid/Slurry	24.0	20.0	12.0	7.0	3.0	1.0	1.0	1.5	1.5	1.5	1.5	1.5	1.4	1.4	1.3
Aerobic digestion	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.2	0.3
Solid Storage	70.0	70.0	72.0	73.0	74.0	75.0	75.0	74.0	74.0	74.0	74.0	73.5	73.5	73.5	73.5
Other cattle	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**
Pasture/Range/Paddock	4.0	8.0	12.0	16.0	20.0	22.0	22.0	22.0	22.0	22.0	22.0	21.5	20.0	18.0	17.0
Liquid/Slurry	34.0	26.0	18.0	10.0	4.0	4.0	4.0	6.0	6.0	6.0	6.0	6.1	6.4	6.8	7.1
Solid Storage	62.0	66.0	70.0	74.0	76.0	74.0	74.0	72.0	72.0	72.0	72.0	72.4	73.6	75.2	75.9
Swine	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**
Liquid Systems	73.0	65.0	60.0	55.0	52.0	49.0	47.0	45.0	43.0	41.0	39.0	37.0	31.0	25.0	19.0
Aerobic digestion	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.0	6.0	9.0
Litter, pit storage <1 month	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	10.0	20.0	30.0
Solid Storage	27.0	35.0	40.0	45.0	48.0	51.0	53.0	55.0	57.0	59.0	61.0	63.0	56.0	49.0	42.0
Sheep and Goats	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**
Pasture/Range/Paddock	18.0	18.0	20.0	20.0	22.0	22.0	24.0	24.0	24.0	26.0	26.0	26.0	27.0	27.0	27.0
Solid Storage	82.0	82.0	80.0	80.0	78.0	78.0	76.0	76.0	76.0	74.0	74.0	74.0	73.0	73.0	73.0
Horses, Asses and Mules	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**
Pasture/Range/Paddock	18.0	18.0	20.0	20.0	22.0	22.0	24.0	24.0	24.0	26.0	26.0	26.0	27.0	27.0	27.0
Solid Storage	82.0	82.0	80.0	80.0	78.0	78.0	76.0	76.0	76.0	74.0	74.0	74.0	73.0	73.0	73.0
Rabbits	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**
Solid Storage	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Poultry	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**
Pasture/Range/Paddock	7.0	7.0	7.0	8.0	8.0	8.0	9.0	9.0	9.0	10.0	10.0	10.0	9.9	9.8	9.7
Aerobic digestion	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.7	1.3	1.9
Solid Storage	93.0	93.0	93.0	92.0	92.0	92.0	91.0	91.0	91.0	90.0	90.0	90.0	89.4	88.9	88.4

The goal of the study was to determine the share of manure management systems in the RM in order to enhance the accuracy of GHG inventory results from category 3B ‘Manure Management’. In the process of carrying out this study, dairy cow and other cattle farms with a livestock of more than 5 heads were inspected, as well as pig farms with more than 30 heads and the largest poultry farms in the country. In total, manure management systems from 593 farms were inspected: of which 188 dairy cow farms, 17 other cattle farms, 114 pig farms, 188 sheep farms, 6 horse farms, 13 rabbit farms and 67 poultry farms (Table 5-35).

Table 5-35: Share of different manure management systems in agricultural enterprises and individual farms in 2021

Animal Categories (T) and Manure Management Systems (MS)	Farms, units	Share, % of total	Livestock, heads	Share, % of total
Dairy cows	**188**	**100.0**	**12,222**	**100.0**
Solid storage, including:	170	90.4	9,700	79.4
On concrete platforms	37	19.7	2,000	16.4
Directly on the ground	133	70.7	7,700	63.0
Liquid/slurry, including:	17	9.0	2,522	20.6
Special tanks	0	0.0	0	0.0
Ponds and lakes	16	8.5	2,100	17.2
Anaerobic digestion of manure in digesters	1	0.5	422	3.5
Other cattle	**17**	**100.0**	**16,483**	**100.0**
Solid storage, including:	12	70.6	13,100	79.5
On concrete platforms	0	0.0	0	0.0
Directly on the ground	12	70.6	13,100	79.5
Liquid/slurry, including:	5	29.4	3,383	20.5
Special tanks	1	5.9	2,400	14.6
Ponds and lakes	4	23.5	983	6.0
Anaerobic digestion of manure in digesters	0	0.0	0	0.0

Animal Categories (T) and Manure Management Systems (MS)	Farms, units	Share, % of total	Livestock, heads	Share, % of total
Swine	**114**	**100.0**	**236,774**	**100.0**
Solid storage, including:	0	0.0	0	0.0
On concrete platforms	0	0.0	0	0.0
Directly on the ground	0	0.0	0	0.0
Storage in pits bellow the floor of the animal confinement room	4	3.5	120,000	50.7
<30 days	4	3.5	120,000	50.7
>30 days	0	0.0	0	0.0
Liquid/slurry, including:	110	96.5	116,774	49.3
Special tanks	20	17.5	35,774	15.1
Ponds and lakes	89	78.1	43,000	18.2
Anaerobic digestion of manure in digesters	1	0.9	38,000	16.0
Sheep and Goats	188	100.0	64,822	100.0
Solid storage, including:	188	100.0	64,822	100.0
On concrete platforms	0	0.0	0	0.0
Directly on the ground	188	100.0	64,822	100.0
Horses and Asses	6	100.0	253	100.0
Solid storage, including:	6	100.0	253	100.0
On concrete platforms	0	0.0	0	0.0
Directly on the ground	6	100.0	253	100.0
Rabbits	13	100.0	16,600	100.0
Solid storage, including:	13	100.0	16,600	100.0
On concrete platforms	0	0.0	0	0.0
Directly on the ground	13	100.0	16,600	100.0
Poultry	67	100.0	2,832,475	100.0
Solid storage, including:	67	100.0	2,832,475	100.0
On concrete platforms	0	0.0	0	0.0
Directly on the ground	65	97.0	2,682,475	94.7
Liquid/slurry, including:	2	3.0	150,000	5.3
Special tanks	0	0.0	0	0.0
Ponds and lakes	0	0.0	0	0.0
Anaerobic digestion of manure in digesters	2	3.0	150,000	5.3

In order to estimate the share of manure management systems (MS%) (Table 5-34) for the period 1990-2020, the information on livestock and poultry population was considered (Table 5-9), and their share in agricultural enterprises and farms with livestock in stocks, and households of the population, respectively (Table 5-36).

Table 5-36: Livestock and poultry population for the period 1990-2020, % of the total livestock and poultry population in all categories of producers in the RM

	1990	1991	1992	1993	1994	1995	1996	1997
Agricultural enterprises and farms								
Cattle, including:	81.8	77.2	71.3	59.0	50.7	43.8	37.0	26.8
cows	74.9	69.5	62.0	49.9	40.0	33.1	26.7	18.6
other cattle	86.0	82.2	78.0	66.8	61.0	55.8	50.1	39.0
Swine	81.0	77.4	71.1	60.3	54.0	55.1	52.0	40.2
Sheep and goats, including:	35.9	31.3	27.3	20.3	16.5	14.6	11.7	9.4
sheep	37.0	32.6	28.7	21.5	17.6	15.6	12.6	10.2
goats	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Horses	84.7	76.4	66.2	53.6	46.3	41.9	35.8	28.0
Poultry	53.5	51.9	36.4	21.9	20.5	19.4	16.9	14.9
Households								
Cattle, including:	18.1	22.9	28.8	41.1	49.3	56.3	63.0	73.3
cows	25.0	30.5	37.9	50.2	59.9	66.7	73.5	81.5
other Cattle	14.0	17.9	22.2	33.3	39.1	44.6	49.7	61.1
Swine	19.0	22.5	29.0	40.0	46.1	44.9	47.9	59.8
Sheep and Goats, including:	64.1	68.7	72.6	79.6	83.5	85.4	88.3	90.5
sheep	63.1	67.5	71.3	78.5	82.4	84.4	87.4	89.7
goats	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Horses	14.8	24.8	35.0	45.9	53.4	57.7	64.8	70.8
Poultry	46.5	48.1	63.6	78.1	79.5	80.6	83.1	85.1

	1998	1999	2000	2001	2002	2003	2004	2005
Agricultural enterprises and farms								
Cattle, including:	20.9	13.0	9.4	7.9	7.8	6.7	6.0	6.4
cows	14.3	8.4	5.6	4.8	4.3	3.9	3.5	3.7
other cattle	31.2	21.6	17.6	14.3	15.3	12.9	12.0	12.9
Swine	36.9	19.6	9.2	11.1	14.6	9.2	8.5	10.0
Sheep and goats, including:	8.1	5.9	5.0	4.9	5.0	4.5	4.0	3.9
sheep	8.9	6.6	5.7	5.5	5.7	5.1	4.6	4.5
goats	0.0	0.0	0.0	0.0	0.8	0.0	0.0	0.0
Horses	21.9	11.9	8.4	6.5	6.4	5.2	4.1	4.3
Poultry	12.9	9.8	9.6	12.6	10.9	9.5	11.3	11.7
Households								
Cattle, including:	79.1	87.0	90.6	92.1	92.3	93.3	94.1	93.4
cows	85.6	91.7	94.4	94.9	95.6	96.4	96.6	96.3
other cattle	68.9	78.4	82.5	86.4	85.1	86.6	88.2	86.7
Swine	63.2	80.4	90.8	88.9	85.4	90.8	91.5	90.1
Sheep and Goats, including:	91.9	94.1	95.0	95.2	94.7	95.5	96.0	96.0
sheep	91.1	93.4	94.4	94.5	94.2	94.8	95.4	95.4
goats	100.0	100.0	100.0	100.0	97.6	100.0	100.0	100.0
Horses	78.2	87.8	91.4	94.0	94.6	95.6	95.2	96.9
Poultry	87.1	90.2	90.4	87.4	89.1	90.5	88.7	88.3
	2006	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**
Agricultural enterprises and farms								
Cattle, including:	6.4	6.6	6.1	6.0	5.4	5.9	6.1	6.5
cows	3.4	3.6	3.2	3.0	2.9	3.0	3.5	3.9
other cattle	13.0	14.8	14.1	13.7	11.5	12.9	12.2	12.4
Swine	12.6	20.6	23.3	25.1	29.1	27.5	34.6	37.8
Sheep and goats, including:	3.8	3.7	3.0	2.6	2.2	2.5	2.1	2.3
sheep	4.3	4.1	3.3	2.9	2.5	2.9	2.5	2.6
goats	0.0	0.3	0.4	0.4	0.3	0.4	0.4	0.7
Horses	3.0	2.9	2.7	2.2	2.1	1.8	1.7	1.3
Poultry	11.3	13.0	17.4	14.9	13.8	14.7	22.4	30.3
Households								
Cattle, including:	93.6	93.4	93.9	94.0	94.7	94.1	93.9	93.5
cows	96.8	96.5	96.8	97.0	97.1	96.9	96.5	96.1
other cattle	86.5	85.2	85.8	86.2	88.5	87.2	87.9	87.6
Swine	87.4	79.4	76.7	74.9	70.9	72.5	65.4	62.2
Sheep and Goats, including:	96.2	96.3	97.0	97.4	97.8	97.5	97.9	97.7
sheep	95.7	95.9	96.7	97.1	97.5	97.1	97.5	97.4
goats	100.1	99.7	99.6	99.7	99.8	99.6	99.6	99.3
Horses	97.4	97.2	97.3	97.8	98.0	98.1	98.3	98.6
Poultry	88.7	87.0	82.6	85.1	86.2	85.3	77.6	69.7
	2014	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**%**
Agricultural enterprises and farms								
Cattle, including:	7.2	8.1	10.0	11.4	12.6	14.9	17.1	-79.1
cows	4.5	4.6	4.7	4.8	5.2	6.3	7.7	-89.7
other cattle	13.0	15.7	20.9	25.1	27.6	31.3	34.9	-59.5
Swine	41.6	41.0	43.6	45.4	51.9	57.8	57.9	-28.5
Sheep and goats, including:	2.7	3.2	2.9	3.0	2.7	2.8	2.9	-92.0
sheep	3.1	3.7	3.3	3.5	3.1	3.3	3.5	-90.5
goats	0.8	0.7	0.8	0.9	0.8	1.0	0.8	N/A
Horses	1.2	1.0	1.0	0.8	0.8	0.7	0.8	-99.1
Poultry	29.6	33.4	34.4	34.4	32.8	38.1	35.3	-34.0
Households								
Cattle, including:	92.8	91.9	90.0	88.6	87.4	85.1	82.9	358.0
cows	95.6	95.4	95.3	95.2	94.8	93.7	92.3	268.4
other cattle	87.0	84.2	79.1	74.9	72.4	68.7	65.1	366.2
Swine	58.4	59.0	56.4	54.6	48.1	42.2	42.1	121.2
Sheep and Goats, including:	97.3	96.8	97.1	97.0	97.3	97.2	97.1	51.5
sheep	96.9	96.3	96.6	96.5	96.9	96.7	96.5	53.0
goats	99.2	99.2	99.2	99.1	99.2	99.0	99.2	-0.6
Horses	98.7	98.9	99.0	99.2	99.2	99.3	99.2	569.8
Poultry	70.4	66.6	65.6	65.6	67.2	61.9	64.7	39.0

Country-specific EFs, calculated following the simplified Tier 2 approach (Equation 10.23 in the 2006 IPCC Guidelines) are shown in Table 5-37.

Table 5-37: Country-specific CH_4 emission factors for source category 3B 'Manure Management', calculated following a Tier 2 Methodology for cattle and swine population

	1990	1991	1992	1993	1994	1995	1996	1997
Dairy cows	13.5	11.4	11.4	8.6	8.8	6.7	6.7	6.5
Other cattle (average)	5.8	4.9	4.9	4.3	4.5	3.2	3.4	3.2
Swine (average)	5.1	4.6	4.5	4.4	4.2	3.7	3.6	3.2
Market swine	7.8	6.9	6.7	6.5	6.1	5.5	5.3	4.7
Fattening piglets	4.9	4.4	4.2	4.1	3.9	3.5	3.3	2.9
	1998	1999	2000	2001	2002	2003	2004	2005
Dairy cows	5.1	5.1	4.4	4.4	4.5	4.5	4.8	4.8
Other cattle (average)	2.2	2.2	2.3	2.2	2.3	2.3	2.7	2.6
Swine (average)	3.0	2.9	3.0	2.8	2.7	2.8	2.7	2.6
Market swine	4.4	4.3	4.3	4.1	3.9	4.2	3.9	3.8
Fattening piglets	2.8	2.7	2.7	2.6	2.5	2.6	2.5	2.4
	2006	2007	2008	2009	2010	2011	2012	2013
Dairy cows	4.7	4.8	4.8	4.7	4.8	4.8	4.8	4.9
Other cattle (average)	2.6	2.5	2.4	2.3	2.3	2.4	2.4	2.4
Swine (average)	2.6	2.5	2.5	2.4	2.4	2.6	2.7	2.8
Market swine	3.8	3.7	3.6	3.5	3.5	3.9	4.0	4.2
Fattening piglets	2.4	2.3	2.3	2.2	2.2	2.4	2.5	2.7
	2014	2015	2016	2017	2018	2019	2020	%
Dairy cows	4.7	4.7	4.6	4.7	4.7	4.6	4.4	-67.6
Other cattle (average)	2.2	2.1	2.3	2.2	2.3	2.2	2.4	-59.5
Swine (average)	2.7	2.8	2.5	2.6	2.3	2.3	2.3	-54.5
Market swine	4.1	4.1	3.6	3.9	3.5	3.5	3.5	-55.2
Fattening piglets	2.6	2.6	2.3	2.5	2.2	2.2	2.2	-55.2

Regarding other cattle and swine population, the share of animal population by subcategory was taken into account to estimate average national EFs (see Table 5-21 for 'Other Cattle' and Table 5-38 for 'Swine').

Table 5-38: Swine population distribution by subcategory for 1990-2020, %

	1990	1991	1992	1993	1994	1995	1996	1997
Swine, total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
…Market swine	8.4	9.1	9.9	12.3	12.5	12.1	12.8	13.6
…Piglets over 4 months	7.4	8.7	9.4	11.5	12.4	12.7	12.9	12.7
...Other swine	84.2	82.2	80.7	76.3	75.1	75.1	74.4	73.7
	1998	1999	2000	2001	2002	2003	2004	2005
Swine, total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
…Market swine	14.6	14.5	15.3	16.6	16.3	14.7	14.9	15.5
…Piglets over 4 months	16.0	28.6	37.8	56.3	56.5	65.0	66.4	64.4
...Other swine	69.4	56.9	46.9	27.1	27.1	20.3	18.8	20.1
	2006	2007	2008	2009	2010	2011	2012	2013
Swine, total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
…Market swine	14.2	13.2	13.0	12.9	12.1	12.2	11.0	10.6
…Piglets over 4 months	65.2	66.3	60.7	65.8	64.9	64.5	65.0	57.6
...Other swine	20.6	20.5	26.2	21.3	23.0	23.2	23.9	31.8
	2014	2015	2016	2017	2018	2019	2020	%
Swine, total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	N/A
…Market swine	10.8	11.4	12.0	12.3	11.0	10.7	10.8	29.2
…Piglets over 4 months	62.1	54.1	54.0	58.5	57.3	59.0	55.6	651.1
...Other swine	27.1	34.5	34.0	29.1	31.7	30.3	33.5	-60.2

Source: NBS, Statistical Annual Report No. 24-agr 'Animal Breeding Sector', the Number of Livestock and Poultry in all Households Categories as of January 1 (annually for 1990-2020).

5.3.1.3. Uncertainties and Time-Series Consistency

Uncertainties associated with the estimation of methane emissions from category 3B 'Manure Management', result from uncertainties associated with the estimation of livestock, and also on the default emission factors used. The uncertainties associated with the total animal population in the Republic of Moldova are moderate (circa 10%).

It should be noted that the uncertainty range for the default emission factors calculated using the Tier 1 method is estimated to be circa 30% (2006 IPCC Guidelines). Since this approach is not based on the country-specific data and the characteristics of livestock from the particular country are not taken into account, the general uncertainty related to the use of this methodology can reach circa 50% (2006 IPCC Guidelines).

Should the Tier 2 methodology be used, uncertainties associated with manure management systems will depend on the accuracy of characteristic features of the livestock breeding sector and how information on manure management systems is collected and used in the RM. Because the RM lately uses mainly three manure management systems (pasture/range/paddock, solid storage and, to a lesser extent, liquid/slurry), uncertainties associated with manure management systems can be considered relatively low; however, because the share of manure management systems used varied considerably in the period under review, uncertainties may reach circa 30%. Thus, combined uncertainties of AD and EFs for source category 3B 'Manure Management' account for circa 31.62% (Annex 5-3.3).

In view of ensuring time-series consistency of the obtained results, the same approach was used for the entire period under review, in conformity with the recommendations included in the 2006 IPCC Guidelines.

5.3.1.4. Quality Assurance and Quality Control

Standard verification and quality control forms and check-lists were filled in for the respective category, following a Tier 1 approach. It should be noted that the AD and methods used to estimate CH_4 emissions under this category were documented and archived both in hard copies and electronically. In order to identify the data entry and GHG emission estimation process-related errors, AD and EF verifications and quality control procedures were applied.

5.3.1.5. Recalculations

CH_4 emissions from category 3B 'Manure Management' for the period 1998-2019 were recalculated as a result of updating the share manure management systems (MS%) in the RM for livestock and poultry, based on a study developed in 2015, as well as in 2021 by specialists from the National Agency for Food Safety. The most relevant updates were related to the change over time in the share of 'liquid systems', 'solid storage', as well as considering such management systems as 'anaerobic digestion of animal manure in digesters' and 'pit storage < 1 month' for the first time. In comparison with the results recorded in the BUR3 of the RM to the UNFCCC, the changes made in the current inventory cycle resulted in an upward trend in CH_4 emissions from the respective category during for 1998-2011 and 2014-2015, respectively in a downward trend in CH_4 emissions for 2012-2013 and 2016-2019 (Table 5-39).

Table 5-39: Comparative results of CH_4 emissions from source category 3B 'Manure Management' included in the BUR3 and NC5 of the RM to the UNFCCC, kt

	1990	1991	1992	1993	1994	1995	1996	1997
BUR3	19.8038	16.6032	14.9247	10.9978	10.6093	8.2510	7.4943	6.0866
NC5	19.8038	16.6032	14.9247	10.9978	10.6093	8.2510	7.4943	6.0866
Difference, %	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	1998	1999	2000	2001	2002	2003	2004	2005
BUR3	5.1085	4.4921	3.4005	3.4366	3.5979	3.3469	3.2519	3.4059
NC5	5.6194	4.8938	3.8438	3.8630	4.0188	3.7294	3.5042	3.6952
Difference, %	10.00	8.94	13.04	12.41	11.70	11.43	7.76	8.49
	2006	2007	2008	2009	2010	2011	2012	2013
BUR3	3.5129	2.5021	2.4937	2.8113	3.0755	2.9050	2.7652	2.7160
NC5	3.7971	2.6582	2.5764	2.9183	3.1682	2.9990	2.7648	2.7156
Difference, %	8.09	6.24	3.32	3.80	3.01	3.23	-0.02	-0.01
	2014	2015	2016	2017	2018	2019	2020	%
BUR3	2.8169	2.7544	2.8363	2.7862	2.7933	2.6639		
NC5	2.8171	2.7546	2.5622	2.5165	2.1932	2.0599	1.7747	-91.0
Difference, %	0.01	0.01	-9.66	-9.68	-21.49	-22.68		

Abbreviations: BUR3 – Third Biennial Update Report of the RM to the UNFCCC, NC5 – Fifth National Communication of the RM to the UNFCCC.

The table below presents comparative results of methane emissions from source category 3B 'Manure Management', expressed in kt CO_2 equivalent using the GWP_{100} values available in the IPCC AR4 (GWP_{100} = 25) (Table 5-40).

Table 5-40: Comparative results of CH_4 emissions from source category 3B 'Manure Management' included in the BUR3 and NC5 of the RM to the UNFCCC, kt CO_2 equivalent

	1990	1991	1992	1993	1994	1995	1996	1997
BUR3	495.0955	415.0799	373.1167	274.9462	265.2313	206.2761	187.3584	152.1643
NC5	495.0955	415.0799	373.1167	274.9462	265.2313	206.2761	187.3584	152.1643
Difference, %	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

	1998	1999	2000	2001	2002	2003	2004	2005
BUR3	127.7113	112.3024	85.0121	85.9160	89.9480	83.6736	81.2980	85.1477
NC5	140.4844	122.3454	96.0956	96.5750	100.4693	93.2338	87.6062	92.3795
Difference, %	10.00	8.94	13.04	12.41	11.70	11.43	7.76	8.49
	2006	2007	2008	2009	2010	2011	2012	2013
BUR3	87.8226	62.5516	62.3432	70.2833	76.8879	72.6254	69.1310	67.9012
NC5	94.9283	66.4548	64.4103	72.9573	79.2042	74.9743	69.1206	67.8911
Difference, %	8.09	6.24	3.32	3.80	3.01	3.23	-0.02	-0.01
	2014	2015	2016	2017	2018	2019	2020	%
BUR3	70.4215	68.8589	70.9073	69.6553	69.8333	66.5982		
NC5	70.4285	68.8654	64.0561	62.9128	54.8289	51.4965	44.3673	-91.0
Difference, %	0.01	0.01	-9.66	-9.68	-21.49	-22.68		

Abbreviations: BUR3 – Third Biennial Update Report of the RM to the UNFCCC, NC5 – Fifth National Communication of the RM to the UNFCCC.

For 2020, CH_4 emissions resulting from category 3B 'Manure Management' were estimated for the first time. The obtained results allow us to assert that, over the period 1990-2020, methane emissions from the respective category decreased by 91%, as a result of the decrease in livestock population, and changes in the share of manure management systems (overall, there had been a significant downward trend in the share of liquid-based systems and a concomitant increase in the share of pasture and solid storage of animal manure).

Between 1990 and 2020, the share of different livestock categories in the overall methane emissions from category 3B 'Manure Management' had changed significantly'. By 2020, the share of 'Cattle' had decreased considerably compared to the level in 1990, whereas the share of categories such as 'Sheep', 'Goats', 'Horses', 'Asses and Mules', 'Rabbits', 'Poultry' and 'Swine' recorded an upward trend (Table 5-41).

Table 5-41: Share of different animal categories in the structure of CH_4 emissions from source category 3B 'Manure Management' for the period 1990-2020, %

	1990	1991	1992	1993	1994	1995	1996	1997
Cattle	46.5	45.0	49.2	50.0	51.4	44.5	44.7	46.2
Sheep	1.2	1.4	1.6	2.4	2.5	3.1	3.2	3.5
Goats	0.0	0.0	0.1	0.1	0.1	0.2	0.2	0.2
Horses	0.4	0.5	0.5	0.8	0.9	1.2	1.3	1.7
Asses and Mules	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Swine	47.9	48.6	44.8	42.9	41.0	45.7	45.2	41.7
Poultry	3.8	4.4	3.6	3.6	4.0	5.2	5.2	6.4
Rabbits	0.1	0.1	0.2	0.2	0.2	0.2	0.2	0.2
	1998	1999	2000	2001	2002	2003	2004	2005
Cattle	37.2	39.9	43.0	43.5	42.7	41.6	42.8	37.5
Sheep	3.5	3.7	4.2	4.2	4.0	4.2	4.5	4.3
Goats	0.2	0.3	0.4	0.4	0.4	0.5	0.5	0.4
Horses	1.9	2.3	3.1	3.3	3.2	3.4	3.4	3.0
Asses and Mules	0.0	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Swine	49.5	44.7	37.8	36.2	37.2	36.4	32.3	35.1
Poultry	7.3	8.8	11.1	12.0	12.1	13.4	15.9	19.0
Rabbits	0.3	0.3	0.3	0.4	0.4	0.4	0.5	0.6
	2006	2007	2008	2009	2010	2011	2012	2013
Cattle	34.8	39.4	38.2	33.4	30.3	30.5	31.0	31.2
Sheep	4.2	5.4	5.7	5.3	4.8	4.5	4.8	5.0
Goats	0.4	0.5	0.6	0.5	0.5	0.6	0.6	0.7
Horses	2.8	3.6	3.5	3.0	2.6	2.6	2.7	2.6
Asses and Mules	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Swine	38.3	30.1	29.1	33.2	38.3	41.0	42.6	46.2
Poultry	18.6	20.1	22.2	23.8	22.7	20.0	17.4	13.3
Rabbits	0.7	0.8	0.8	0.8	0.7	0.7	0.8	0.9
	2014	2015	2016	2017	2018	2019	2020	%
Cattle	28.7	28.5	29.9	28.2	28.6	25.6	25.8	-44.5
Sheep	4.9	5.0	5.3	5.2	5.4	4.9	5.1	329.7
Goats	0.7	0.7	0.8	0.9	1.0	1.0	1.1	4404.3
Horses	2.4	2.3	2.3	2.1	2.2	2.0	2.0	443.2
Asses and Mules	0.1	0.1	0.1	0.2	0.1	0.1	0.1	693.9
Swine	48.9	48.7	44.9	46.0	45.7	48.9	48.2	0.6
Poultry	13.4	13.8	15.5	16.3	15.8	16.3	16.2	323.4
Rabbits	0.9	1.0	1.1	1.2	1.3	1.3	1.4	1158.6

It should be mentioned that for animal categories 'dairy cows', 'other cattle' and 'swine', the Tier 2 methodology impact is much greater compared to the Tier 1 methodology.

The use of the Tier 2 method, an approach that reflects country-specific conditions, particularly related to manure management systems (MS%), has contributed to much lower CH_4 emission values for 1993-2020, varying between a minimum of 2.9% in 1993 to a maximum of 40.4% in 2001; except for the years 1990-1992, in which the results obtained using the Tier 2 method show increased values compared to those obtained after using the Tier 1 method (Table 5-42); this is explained by the fact that the productivity indices of livestock and poultry during the soviet period and in the following few years immediately after independence, respectively the application of manure management systems was close to similar indices typical of Western European countries; also, during that period, the overwhelming majority of livestock and poultry was under collective management, and large agricultural enterprises, respectively, whereas currently it is the opposite (Table 5-36), the majority of the livestock and poultry being owned by individual farmers with much more limited opportunities, including financial ones, for the use of modern manure management systems.

Table 5-42: Comparative results of CH_4 emissions from source category 3B 'Manure Management', estimated using Tier 1 and Tier 2 methodologies, kt

	1990	1991	1992	1993	1994	1995	1996	1997
Tier 1	14.9864	14.3176	13.1911	11.3291	10.9584	10.1404	9.2643	8.0449
Tier 2	19.8038	16.6032	14.9247	10.9978	10.6093	8.2510	7.4943	6.0866
Difference, %	32.1	16.0	13.1	-2.9	-3.2	-18.6	-19.1	-24.3
	1998	1999	2000	2001	2002	2003	2004	2005
Tier 1	8.3155	7.4377	6.3811	6.4811	6.7124	6.0931	5.5407	5.6963
Tier 2	5.6194	4.8938	3.8438	3.8630	4.0188	3.7294	3.5042	3.6952
Difference, %	-32.4	-34.2	-39.8	-40.4	-40.1	-38.8	-36.8	-35.1
	2006	2007	2008	2009	2010	2011	2012	2013
Tier 1	5.7948	4.2009	4.0433	4.5108	4.7781	4.3961	4.0340	3.9031
Tier 2	3.7971	2.6582	2.5764	2.9183	3.1682	2.9990	2.7648	2.7156
Difference, %	-34.5	-36.7	-36.3	-35.3	-33.7	-31.8	-31.5	-30.4
	2014	2015	2016	2017	2018	2019	2020	%
Tier 1	4.1125	3.9983	3.9153	3.6933	3.3656	3.1090	2.7171	-81.9
Tier 2	2.8171	2.7546	2.5622	2.5165	2.1932	2.0599	1.7747	-91.0
Difference, %	-31.5	-31.1	-34.6	-31.9	-34.8	-33.7	-34.7	

5.3.1.6. Planned Improvements

Planned improvements may include activities focused on obtaining more precise AD and productivity indices used to estimate CH_4 emissions from category 3B 'Manure Management', particularly for 'cattle' and 'swine', which are livestock categories accounting for the largest share in the structure of total CH_4 emissions originating from this source; as well as updating the values for the main coefficients used to calculate country-specific emission factors for the respective animal categories following the Tier 2 methodology; likewise, there are planned activities focused on regular updating (every 3 years) AD regarding the share of manure management systems in the livestock breeding sector.

5.3.2. Nitrous Oxide Emissions

5.3.2.1. Source Category Description

During the storage and treatment of manure (dung and urine) before it is applied to land, direct N_2O emissions occur via combined nitrification and denitrification of nitrogen contained in the manure. It should be noted that nitrification is the aerobic oxidation of ammonia (NH_4^+) into nitrate (NO_3^-), whereas denitrification consists of the reduction under anaerobic conditions of nitrates into nitrogen oxides or molecular nitrogen: $NO_3^- \rightarrow NO_2^- \rightarrow NO \rightarrow N_2O \rightarrow N_2$.

The direct emission of N_2O vary depending on the nitrogen and carbon content of manure, as well as on the duration of the storage and type of treatment within the animal waste management systems.

It is considered that the aeration increase in animal waste contributes to direct N_2O emissions. There is general agreement in the scientific literature that the ratio of N_2O/N_2 increases when acidity, nitrate concentration, and reduced moisture increases. Generally, the production and emission of N_2O from managed manures requires the presence of either nitrites or nitrates in an anaerobic environment preceded by aerobic conditions necessary for the formation of these oxidized forms of nitrogen. In addition, it is necessary to have conditions, such as a low pH or limited moisture, which would prevent the reduction of nitrogen oxide (N_2O) to dinitrogen (N_2).

Indirect emissions result from volatile nitrogen losses that occur primarily in the forms of ammonia (NH_3) and (NO_x). The fraction of excreted organic nitrogen that is mineralized to ammonia nitrogen during manure collection and storage depends primarily on time, and to a lesser degree on temperature. Simple forms of organic nitrogen such as urea (mammals) and uric acid (poultry) are rapidly mineralized to ammonia nitrogen, which is highly volatile and easily diffused into the surrounding air. Nitrogen losses begin at the point of excretion in houses and other animal production areas and continue through on-site management in storage and treatment systems. Nitrogen is also lost through runoff and leaching[87] processes.

Due to significant direct and indirect losses of manure nitrogen in management systems it is important to estimate the remaining amount of animal manure nitrogen available for application to soils or for other purposes.

5.3.2.2. Activity Data, Estimation Methodologies and Emission Factors

N_2O emissions from category 3B 'Manure Management' were estimated based on the Tier 2 methodology (2006 IPCC Guidelines). In order to estimate direct N_2O emissions from manure management, it was necessary to collect information on the total livestock population (identical to the one used for 3A 'Enteric Fermentation'), information on the amount of produced manure per head in a year, as well as information on manure management systems usage in the Republic of Moldova. The following five steps were used to estimate direct N_2O emissions from category 3B 'Manure Management':

(i) collect data on the livestock population;

(ii) develop the annual average nitrogen excretion rate per head ($N_{ex(T)}$) for each defined livestock species/category *T*;

(iii) determine the fraction of total annual nitrogen excretion for each livestock species/category *T* that is managed in each manure management system *S* ($MS_{(T, S)}$);

(iv) develop N_2O EFs for each manure management system *S* ($FE_{3\ (S)}$);

(v) calculate N_2O emissions for each manure management system type S, multiplying the emission factor ($FE_{3(S)}$) by the total amount of nitrogen managed (from all livestock species/categories) in that system.

The obtained results for each manure management system were summed, resulting in the total N_2O emissions from the respective source category.

The calculation of direct N_2O emissions is based on Equation 10.25 in the 2006 IPCC Guidelines.

$$N_2O_{D(mm)} = [\ \Sigma_{(S)} [\Sigma_{(T)} (N_{(T)} \bullet Nex_{(T)} \bullet MS_{(T,S)})] \bullet FE_{3(S)}] \bullet 44/28$$

Where:

$N_2O_{D\ (mm)}$ – direct N_2O emissions from Manure Management in the country (kg N_2O/yr);

$N_{(T)}$ – number of head of livestock species/category T in the country;

$N_{ex\ (T)}$ – annual average N excretion per head of species/category T in the country (kg N/animal/yr);

$MS_{(T,S)}$ – fraction of total annual nitrogen excretion for each livestock species/category T that is managed in manure management system S in the country;

$FE_{3\ (S)}$ – emission factor for direct N_2O emissions from manure management system S in the country, (kg N_2O-N/kg N in manure management system S);

S – manure management system;

[87] Leaching – the loss of mineral and organic solutes due to water or other liquids percolation from soil.

T – species/category of livestock;

44/28 – conversion of $(N_2O\text{-}N)_{(mm)}$ emissions to $N_2O_{(mm)}$ emissions.

The calculation of the average N excretion rates $N_{ex(T)}$ is based on Equation 10.30 available in the 2006 IPCC Guidelines.

$$Nex_{(T)} = N_{rate(T)} \bullet (TAM/1000) \bullet 365$$

Where:

$N_{ex\ (T)}$ – annual N excretion for livestock category T, (kg N/animal/yr);

$N_{rate\ (T)}$ – default N excretion rate, kg N (1000 kg animal mass)/day;

$TAM_{(T)}$ – typical animal mass for livestock category T, kg animal.

The annual amount of N excreted by each livestock species/category depends on the total annual N intake and total annual N retention of the animal.

Annual N intake (the amount of N consumed by the animal annually) depends on the annual amount of feed digested by the animal, and the protein content of that feed.

Total feed intake depends on the production level of the animal (growth rate, milk production, wool production, egg production, etc.).

Annual N retention (the fraction of N intake that is retained by the animal for the production of meat, milk, wool, eggs, etc.) is a measure of the animal's efficiency to produce animal protein from feed protein.

Default N retention values are provided in Table 10.20 (2006 IPCC Guidelines, Volume 4, Chapter 10, Page 10.60).

Rates of annual N excretion for each livestock species/category $N_{ex\ (T)}$ were estimated using Equation 10.31 available in the 2006 IPCC Guidelines.

$$Nex_{(T)} = N_{intake\ (T)} \bullet (1 - N_{retention\ (T)})$$

Where:

$N_{intake\ (T)}$ – the annual N intake per head of animal of species/category T, (kg N/animal/yr);

$N_{retention\ (T)}$ – fraction of annual N intake that is retained by animal of species/category T, dimensionless).

Based on information on the average weight of livestock and poultry in Eastern European countries and default values of nitrogen excretion rate (kg N/1000 kg of animal mass/yr) typical of the same region, country-specific $N_{ex(T)}$ values were calculated (Table 5-43).

Table 5-43: Average annual N excretion by main livestock and poultry categories in Eastern European countries

Livestock Category	$N_{rate\ (T)}$, kg N/1000 kg/day	TAM, average weight in kg	$N_{ex\ (T)\ ANIMAL}$, kg N/head/yr	$N_{ex(T)\ ANIMAL}$	$N_{retention\ (T)}$, kg N retained / animal / yr	$N_{ex(T)\ ANIMAL\ ADJUSTED}$	$N_{bedding\ MS}$	$N_{ex(T)\ ANIMAL\ FINAL}$
Dairy cows	0.35	550	0.5500	70.3	0.20	56.2	14.0	70.2
Other cattle	0.35	391	0.3910	50.0	0.07	46.5	8.0	54.5
Sheep	0.90	28	0.0280	9.2	0.10	8.3	1.0	9.3
Goats	1.28	30	0.0300	14.0	0.10	12.6	1.0	13.6
Horses	0.30	238	0.2380	26.1	0.07	24.2	14.0	38.2
Asses and mules	0.30	130	0.1300	14.2	0.07	13.2	6.0	19.2
Swine	0.74	70	0.0695	18.8	0.30	13.1	2.0	15.1
Fattening swine	0.55	50	0.0500	10.0	0.30	7.0	2.0	9.0
Market swine	0.46	180	0.1800	30.2	0.30	21.2	2.0	23.2
Rabbits	8.10	1.6	0.0016	4.7	0.10	4.3	2.0	6.3
Chicken	0.82	1.8	0.0018	0.5	0.30	0.4	0.1	0.5
Geese	0.83	3.8	0.0038	1.2	0.30	0.8	0.1	0.9
Ducks	0.83	2.7	0.0027	0.8	0.30	0.6	0.1	0.7
Turkeys	0.74	6.8	0.0068	1.8	0.30	1.3	0.1	1.4

Source: 2006 IPCC Guidelines, Volume 4, Chapter 10, Table 10.19, page 10.59, Table 10A-9, pages 10.82-10.83.

The amount of N fed to animals stored in straw bedding together with manure ($N_{bedding\ MS}$) was taken into consideration. It is known from the literature in the field that this amount can reach circa 7 kg N/head/yr for dairy cows; circa 4 kg N/head/yr for other cattle; circa 0.8 kg N/head/yr for market swine; and circa 5.5 kg N/head/yr for fattening swine; at the same time, should a large straw bedding be applied, as it is practised in the RM, these quantities may be doubled (Webb, 2001; Döhler et al., 2002; quoted in the 2006 IPCC Guidelines).

Applying the above methodological approach, the default values used for the N excretion rate characteristic to Eastern Europe, as well as country-specific data on the typical animal mass (TAM) in the RM during the period under review (see Table 5-10), country-specific values for $N_{ex(T)}$ were also calculated (Table 5-44).

Table 5-44: Average annual $N_{ex(t)}$ excretion by main livestock and poultry categories between 1990-2020, kg N/head/year

	1990	1991	1992	1993	1994	1995	1996	1997
Dairy cows	62.6	59.3	58.1	56.4	56.2	56.1	56.1	60.2
Other cattle	54.4	51.5	48.6	47.0	45.5	45.8	47.1	45.8
Sheep	13.7	14.0	13.7	13.7	14.0	12.5	12.6	11.3
Goats	17.0	17.4	17.0	17.0	17.4	15.3	15.3	13.6
Horses	53.8	46.2	48.8	49.0	51.6	50.3	48.7	45.2
Asses and mules	19.3	18.8	18.7	18.8	18.6	18.1	17.6	17.5
Swine	20.5	19.1	17.7	16.9	16.2	17.7	20.2	18.1
Rabbits	6.3	6.2	6.2	6.1	6.2	6.2	42.7	6.2
Chicken	0.5	0.5	0.5	0.5	0.4	0.4	0.4	0.4
Geese	0.9	0.9	0.9	0.9	0.8	0.8	0.8	0.8
Ducks	0.7	0.7	0.7	0.6	0.6	0.6	0.6	0.6
Turkeys	1.4	1.4	1.3	1.3	1.2	1.2	1.2	1.2
	1998	1999	2000	2001	2002	2003	2004	2005
Dairy cows	59.3	58.9	58.6	58.4	58.4	58.0	58.6	57.8
Other cattle	44.6	44.0	43.0	43.3	42.9	42.5	43.7	42.8
Sheep	11.3	11.3	11.4	10.8	10.8	10.8	10.8	10.8
Goats	13.6	13.6	13.6	12.8	12.8	12.8	12.8	12.8
Horses	45.0	42.6	43.1	42.8	43.0	43.5	42.8	44.1
Asses and mules	17.4	16.6	16.8	16.7	16.7	16.9	16.7	17.1
Swine	13.7	12.8	11.9	11.4	10.9	11.3	11.7	11.5
Rabbits	6.2	6.1	6.1	6.2	6.2	6.0	6.2	6.2
Chicken	0.4	0.4	0.4	0.5	0.4	0.4	0.5	0.5
Geese	0.8	0.8	0.8	0.9	0.8	0.8	0.9	0.9
Ducks	0.6	0.6	0.6	0.6	0.6	0.6	0.7	0.7
Turkeys	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.3
	2006	2007	2008	2009	2010	2011	2012	2013
Dairy cows	57.6	57.4	55.5	55.8	56.9	57.0	57.8	57.9
Other cattle	43.3	41.7	42.1	42.3	42.6	46.3	45.9	44.8
Sheep	11.1	10.8	10.8	11.3	11.3	11.3	11.7	12.2
Goats	13.2	12.8	12.8	13.6	13.6	13.6	14.1	14.9
Horses	47.8	44.2	45.5	44.8	45.3	45.0	46.7	47.2
Asses and mules	17.3	17.3	17.6	17.3	17.5	17.7	17.9	18.1
Swine	11.6	11.6	12.6	12.6	12.4	12.8	13.2	12.2
Rabbits	6.2	6.0	6.2	6.2	6.3	6.2	6.0	6.0
Chicken	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Geese	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9
Ducks	0.7	0.7	0.7	0.7	0.7	0.7	0.6	0.6
Turkeys	1.3	1.3	1.4	1.4	1.4	1.4	1.4	1.4
	2014	2015	2016	2017	2018	2019	2020	%
Dairy cows	60.0	61.3	60.7	61.1	60.1	58.8	55.8	-10.9
Other cattle	48.9	49.3	48.9	54.5	55.5	58.5	53.6	-1.4
Sheep	13.7	13.1	13.4	13.1	13.1	13.1	13.5	-1.9
Goats	17.0	16.1	16.6	16.1	16.1	16.1	16.2	-4.7
Horses	46.4	46.2	46.1	51.2	47.7	49.3	49.5	-8.0
Asses and mules	17.7	17.5	17.4	19.2	18.0	18.3	18.5	-4.6
Swine	12.8	12.2	16.2	13.3	13.7	12.8	12.4	-39.5
Rabbits	6.2	6.2	6.2	6.3	6.2	6.2	6.2	-1.1
Chicken	0.5	0.5	0.5	0.5	0.5	0.5	0.5	-5.6
Geese	0.9	0.9	0.9	0.9	0.9	0.9	0.9	-4.5
Ducks	0.7	0.7	0.6	0.6	0.6	0.6	0.6	-6.1
Turkeys	1.4	1.4	1.4	1.4	1.4	1.4	1.4	-2.5

Based on information from the scientific literature, CS values on average annual N excretion ($N_{ex(T)}$) from manure were calculated following an alternative methodological approach (Table 5-45), which does not consider the amount of N retained annually by livestock and poultry. Albeit the average annual N excretion values $N_{ex(T)}$ were calculated by different methods, the obtained results are still comparable.

As values featured in Table 5-45 are not available for all animal categories, country-specific values related to N retained were not identified, respectively (the fraction of N intake retained for the production of meat, milk, wool, eggs, etc.); $N_{ex(T)}$ values set forth in Table 5-44 were used to calculate the direct N_2O emissions from manure management in the RM.

Table 5-45: Average annual nitrogen excretion for a typical animal $N_{ex(T)}$ calculated based on country-specific information

Livestock Category	Solid Manure, kg/head/day	Liquid Manure, kg/ head/day	Straw Bedding, kg/head/day	Total Manure with/ without bedding, kg/ head/day	N content with/ without bedding, kg/t	$N_{ex(T)}$ with/ without bedding kg N/ head/day
Cattle	25.0	12.0	5.0	42.0 / 37.0	5.6 / 4.6	85.8 / 62.1
Sheep	2.5	1.0	0.8	4.3 / 3.5	9.5 / 9.2	14.9 / 11.8
Horses	18.0	5.0	4.0	27.0 / 23.0	6.0 / 5.0	59.1 / 42.0
Swine	2.0	3.5	1.5	7.0 / 5.5	8.2 / 5.7	21.0 / 11.4
Poultry	0.1	0.0	0.1	0.2 / 0.1	16.3 / 22.3	1.2 / 0.8

Source: Ungureanu, Cerbari et al., 2006; Bucataru, Cosman, Holban, 2006; Raileanu, Jolondcovschi et al., 2006; Andries, Rusu et al., 2005; Bucataru, Maciuc, 2005; Toncea, 2004.

Activity data on manure management systems usage is identical to that previously used in subchapter 5.3.1. It should be noted that the actual distribution of manure management systems in the RM does not comply with the default values for Eastern European countries (MS%) available in the 2006 IPCC Guidelines, so their use was deemed to be inappropriate. In order to estimate direct N_2O emissions, country-specific information on manure management system usage in the Republic of Moldova were used (Table 5-34). It is considered a good practice to estimate emissions from manure management systems keeping account of storage duration and treatment type. In order to determine the types of treatment of animal manure, temperature and aeration conditions are taken into account. Should the use of country-specific EFs not be possible, default values provided in the 2006 IPCC Guidelines are used (Table 5-46).

Table 5-46: Default EFs for N_2O emissions from Manure Management Systems

Manure Management System		FE_3, kg N_2O-N/kg N excreted	Uncertainty ranges of EF_3	Reference
Pasture/Range/Paddock: The manure from pasture and range grazing animals is allowed to lie as is, and is not managed. It should be noted N_2O emissions from pasture, range and paddock are monitored in category 3D 'Agricultural soils'	cattle, swine, poultry	0.020	0.007-0.06	2006 IPCC Guidelines, Table 11.1
	sheep, goats, horses, asses and mules	0.010	0.003-0.03	
Solid Storage: animal manure is collected and stored in solid form for a long time (by default – a few months), before being used.		0.005	Factor of 2	2006 IPCC Guidelines, Table 10.21
Dry lot: A paved or unpaved open confinement area without any significant vegetative cover where accumulating manure and may be removed periodically, when dry, to be used accordingly.		0.020	Factor of 2	2006 IPCC Guidelines, Table 10.21
Liquid/Slurry: manure is stored as excreted or with minimal addition of water in either tanks or earthen ponds for six months or more, later applied to land; in order to facilitate manure management, water is added to it; emissions are considered to be insignificant due to the absence of oxidized forms of N, combined with the low nitrification and denitrification potential in this manure management system.	With natural crust cover	0.005	Factor of 2	2006 IPCC Guidelines, Table 10.21
	Without natural crust cover	0.000	Not Applicable	
Pit storage below animal confinements: Collection and storage of liquid manure usually with little or no added water typically below a slatted floor in an enclosed animal confinement facility.		0.002	Factor of 2	2006 IPCC Guidelines, Table 10.21
Cattle and swine deep bedding: As manure accumulates, bedding is continually added to absorb moisture over a production cycle and possibly for as long as 6 to 12 months. The layers formed of mixed manure with the straw bedding is not mixed or cannot be actively mixed.	No mixing	0.010	Factor of 2	2006 IPCC Guidelines, Table 10.21
	Active mixing	0.070	Factor of 2	
Composting – In-Vessel: Composting, typically in an enclosed channel, with forced aeration and continuous mixing.		0.006	Factor of 2	2006 IPCC Guidelines, Table 10.21
Composting – Static Pile: Composting in piles with forced aeration but no mixing.		0.006	Factor of 2	2006 IPCC Guidelines, Table 10.21
Composting – Intensive Windrow: Composting in windrows with regular turning for mixing and aeration.		0.100	Factor of 2	2006 IPCC Guidelines, Table 10.21
Composting – Passive Windrow: Composting in windrows with infrequent turning for mixing and aeration.		0.010	Factor of 2	2006 IPCC Guidelines, Table 10.21
Poultry manure with litter: Manure is excreted on floor with bedding, birds walk on manure.		0.001	Factor of 2	2006 IPCC Guidelines, Table 10.21
Poultry manure without bedding: Manure is excreted on floor without bedding, manure is collected and dried		0.001	Factor of 2	2006 IPCC Guidelines, Table 10.21

Manure Management System		FE_3, kg N_2O-N/kg N excreted	Uncertainty ranges of EF_3	Reference
Aerobic treatment: The biological oxidation of manure collected as a liquid with either forced or natural aeration. Natural aeration is limited to aerobic and facultative ponds and wetland systems and is due primarily to photosynthesis. Hence, these systems typically become anoxic during periods without sunlight. Nitrification-denitrification is used widely for the removal of nitrogen in the biological treatment of municipal and industrial wastewaters with negligible N_2O emissions. Limited oxidation may increase emissions compared to forced aeration systems.	Natural aeration systems	0.010	Factor of 2	2006 IPCC Guidelines, Table 10.21
	Forced aeration systems	0.005	Factor of 2	

A significant share of the total amount of nitrogen excreted by livestock in different manure management systems (except pasture, range and paddock), is lost before being applied to agricultural lands. Therefore, in order to estimate the amount of nitrogen in manure which is applied to managed soils, it is necessary to omit the total nitrogen amount excreted by animals in different management systems, nitrogen losses occurring through volatilization (NH_3, NO_x), as well as runoff and leaching.

Indirect N_2O emissions from source category 3B 'Manure Management' were estimated using a Tier 1 methodology (2006 IPCC Guidelines). Indirect N_2O emissions from volatilization of N in forms of NH_3 and NO_x were estimated by using Equations 10.26 and 10.27 in the 2006 IPCC Guidelines.

$$N_2O_{G(mm)} = \Sigma_{(S)} [\Sigma_{(T)} (N_{(T)} \bullet Nex_{(T)} \bullet MS_{(T,S)}) \bullet (Frac_{GasMS}/100)_{(T,S)}] \bullet FE_4 \bullet 44/28$$

Where:

$N_2O_{G(mm)}$ – indirect N_2O emissions due to volatilization of N from Manure Management in the country (kg N_2O/yr);

$N_{(T)}$ – number of head of livestock species/category T in the country;

$N_{ex(T)}$ – annual average N excretion per head of species/category T in the country (kg N/animal/yr);

$MS_{(T,S)}$ – fraction of total annual nitrogen excretion for each livestock species/category T that is managed in manure management system S in the country;

$Frac_{GasMS}$ –% of managed manure nitrogen for livestock category T that volatilizes as NH_3 and NO_x in the manure management system S,% (see in Table 5-47);

FE_4 – emission factor for N_2O emissions from atmospheric deposition of nitrogen on soils and water surfaces, the default value is 0.01 kg N_2O-N/kg NH_3-N+NO_x-N volatilized;

S – manure management system;

T – species/category of livestock;

44/28 – conversion of $(N_2O\text{-}N)_{(mm)}$ emissions to $N_2O_{(mm)}$ emissions.

Table 5-47: Default values for nitrogen loss, which volatilizes in NH_3 and NO_x in different Manure Management Systems *S*, %

Livestock Category	Manure Management System (MMS)	Total N loss from MMS due to volatilization of N-NH_3 and N-NO_x (%), $Frac_{Gas MS}$ (Range)
Dairy cows	Anaerobic lagoon	35% (20-80)
	Liquid/slurry	40% (15-45)
	Pit storage	28% (10-40)
	Dry lot	20% (10-35)
	Solid storage	30% (10-40)
	Daily spread	7% (5-60)
Other cattle	Dry lot	30% (20-50)
	Solid storage	45% (10-65)
	Deep bedding	30% (20-40)
Swine	Anaerobic lagoon	40% (25-75)
	Pit storage	25% (15-30)
	Deep bedding	40% (10-60)
	Liquid/slurry	48% (15-60)
	Solid storage	45% (10-65)
Sheep, Goats, Horses, Asses and Mules	Solid storage	25% (10-30)
	Deep bedding	12% (5-20)
Poultry	Poultry without litter	55% (40-70)
	Anaerobic lagoon	40% (25-75)
	Poultry with litter	40% (10-60)

Source: 2006 IPCC Guidelines, Volume 4, Chapter 10, Table 10.22.

Indirect N_2O emissions from leaching and runoff were estimated using Equations 10.28 and 10.29 from the 2006 IPCC Guidelines.

$$N_2O_{L(mm)} = \Sigma_{(S)} [\Sigma_{(T)} (N_{(T)} \bullet Nex_{(T)} \bullet MS_{(T, S)}) \bullet (Frac_{leach\ MS} / 100)_{(T, S)}] \bullet FE_5 \bullet 44/28$$

Where:

$N_2O_{L(mm)}$ – indirect N_2O emissions due to N leaching and runoff (kg N_2O/yr);

$N_{(T)}$ – number of head of livestock species/category T in the country;

$N_{ex\ (T)}$ – annual average N excretion per head of species/category T in the country (kg N/animal/yr);

$MS_{(T, S)}$ – fraction of total annual nitrogen excretion for each livestock species/category T that is managed in manure management system S in the country;

$Frac_{leach\ MS}$ – % of managed manure nitrogen losses for livestock category T due to runoff and leaching during solid and liquid storage of manure (typical range 1-20%);

FE_5 – emission factor for N_2O emissions from nitrogen leaching and runoff, kg N_2O-N/kg N leaching/runoff (default: 0.0075 kg N_2O-N/kg N leaching/runoff);

S – manure management system;

T – species/category of livestock;

44/28 – conversion of (N_2O-N)(mm) emissions to N_2L(mm) emissions.

The scientific literature show that runoff losses are smaller in drier climates (circa 3-6% of N excreted) than in areas with high humidity (5-19%, respectively). Leaching losses of nitrogen depend on weather conditions, varying between 5 and 16% (2006 IPCC Guidelines).

Table 5-48 shows default values for total nitrogen losses from manure management systems. These default values include losses that occur from the point of excretion, including manure storage losses, and losses from leaching and runoff at the manure storage system.

Table 5-48: Default values for total nitrogen loss in different manure management systems *S*, %

Livestock Category	Manure Management System (MMS)	Total N loss from MMS (%), $Frac_{Loss\ MS}$ (Range)
Dairy cows	Anaerobic lagoon	77% (55-99)
	Liquid/slurry	40% (15-45)
	Pit storage	28% (10-40)
	Dry lot	30% (10-35)
	Solid storage	40% (10-65)
	Daily spread	22% (15-60)
Other cattle	Dry lot	40% (20-50)
	Solid storage	50% (20-70)
	Deep bedding	40% (10-50)
Swine	Anaerobic lagoon	78% (55-99)
	Pit storage	25% (15-30)
	Deep bedding	50% (10-60)
	Liquid/slurry	48% (15-60)
	Solid storage	50% (20-70)
Sheep, Goats, Horses, Asses and Mules	Solid storage	35% (15-40)
	Deep bedding	15% (5-20)
Poultry	Poultry without litter	55% (40-70)
	Anaerobic lagoon	77% (50-99)
	Poultry with litter	50% (20-80)

Source: 2006 IPCC Guidelines, Volume 4, Chapter 10, Table 10.23.

It should be noted that there is a high level of variability in the range of total nitrogen losses from manure management systems, the majority of which are due to volatilization losses, primarily ammonia losses that occur rapidly following the excretion of the manure. Losses also occur in the form of NO_3, N_2O, and N_2, particularly from leaching and runoff, which occur where manure is stored. The values included in the table reflect average values for typical management/storage combinations for each animal category.

Following storage in any system of manure management, nearly all the manure is applied to land. The N_2O emissions that subsequently arise from manure application to soil shall not be reported under category 3B 'Manure Management', but under 3D 'Agricultural Soils'. The estimated amount of N from managed manure available for application to managed soils was based on Equation 10.34 in the 2006 IPCC Guidelines.

$$N_{MMS\_Avb} = \Sigma_{(S)} \{\Sigma_{(T)} [(N_{(T)} \bullet Nex_{(T)} \bullet MS_{(T,S)}) \bullet (1\text{-}Frac_{Loss\,MS}/100)] + [N_{(T)} \bullet Nex_{(T)} \bullet N_{bending\,MS}]\}$$

Where:

N_{MMS_Avb} – amount of managed manure nitrogen available for application to managed soils or for feed, fuel, or construction purposes, kg N/yr;

$N_{(T)}$ – number of head of livestock species/category T in the country;

$N_{ex\,(T)}$ – annual average N excretion per animal of species/category T in the country, kg N/animal/yr;

$MS_{(T,S)}$ – fraction of total annual nitrogen excretion for each livestock species/category T that is managed in manure management system S in the country;

$Frac_{Loss\,MS}$ – amount of managed manure nitrogen for livestock category T that is lost in the manure management system S,%;

$N_{bedding\,MS}$ – amount of nitrogen from bedding (to be applied for solid storage and deep bedding MMS if known organic bedding usage), kg N/animal/year;

S – manure management system;

T – species/category of livestock.

5.3.2.3. Uncertainties and Time-Series Consistency

Uncertainties associated with the estimation of N_2O emissions from source category 3B 'Manure Management' result, particularly, from uncertainties regarding the estimation of livestock (±10%), and also those associated with different coefficients and emission factors.

With respect to N_2O emissions, uncertainty ranges for the default N excretion rates ($N_{ex(T)}$) are estimated at circa 50% and they can be reduced to circa 30% should country-specific values be used. It should be noted that the uncertainties associated with FE_3 emission factors are usually very high, from -50% to +100%. For indirect N_2O emissions, uncertainties associated with default values for nitrogen loss due to volatilization of NH_3 and NO_x and total nitrogen loss from manure management are also somewhat high. Uncertainties associated with default emission factors for nitrogen volatilization and re-deposition (EF_4), as well as for leaching and runoff (EF_5), are also somewhat high, from -100% to +200%. Thus, combined uncertainties associated with AD and EFs for 3B 'Manure Management' constitute circa 104.40% for direct N_2O missions, and circa 152.97% for indirect N_2O emissions, respectively (Annex 5-3.3).

In view of ensuring time-series consistency of the obtained results, the same approach was used for the entire period under review, in conformity with the recommendations included in the 2006 IPCC Guidelines.

5.3.2.4. Quality Assurance and Quality Control

Standard verification and quality control forms and checklists were filled in for the respective category under Sector 4 'Agriculture', following a Tier 1 approach. It should be mentioned that the AD and methods used to estimate direct and indirect N_2O emissions from category 3B 'Manure Management' were documented and archived both in hard copies and electronically. In order to identify the data entry and N_2O emission estimation process related errors, verifications and quality control procedures were carried out periodically, including for emission factors applied and the emission calculation process.

5.3.2.5. Recalculations

N_2O emissions from category 3B 'Manure Management' for the period 1990-2019, were estimated as a result of updating the values of shares of manure management systems (MS%) applied in the RM, based on results of the study conducted in 2015 and 2021 by specialists from the National Agency for Food Safety, and as a result of the correction of the default emission factor value used (FE_3, kg N_2O-N/kg N excreted) for the manure management system 'Solid storage' (the value '0.02 kg N_2O-N/kg N excreted' was used in the previous inventory cycle, typical of the manure management system 'Dry lot'), whereas in the current inventory cycle the value 0.01 kg N_2O-N/kg N excreted was used, characteristic to the manure management system 'Solid storage with deep bedding, without active mixing'. Additionally, for specific animal categories, the default values used regarding the losses of N, which volatilize into NH_3 and NO_x, were corrected/adjusted for some Manure Management S,% ($_{GasMS}$ and $_{LossMS}$), because in the previous inventory cycle for certain categories of animals such as dairy cows, other cattle and swine, values were incorrectly used for lower N losses than those used by default according to the 2006 IPCC Guidelines.

In comparison with the results recorded in the BUR3, the changes made in the current inventory cycle resulted in a downward trend in total N_2O emissions from category 3B 'Manure Management', varying between a minimum of 19.4% in 1990 and a maximum of 31.1% in 2001 (Table 5-49).

Table 5-49: Comparative results of $N_2O_{TOTAL(mm)}$ emissions from source category 3B 'Manure Management' included in the BUR3 and NC5 of the RM to the UNFCCC, kt

	1990	1991	1992	1993	1994	1995	1996	1997
BUR3	3.7470	3.4991	3.1392	2.7360	2.6585	2.4596	2.5974	2.0035
NC5	3.0192	2.7389	2.4263	2.0341	1.9658	1.8043	1.8962	1.4681
Difference, %	-19.4	-21.7	-22.7	-25.7	-26.1	-26.6	-27.0	-26.7
	1998	1999	2000	2001	2002	2003	2004	2005
BUR3	1.9398	1.7608	1.5712	1.5998	1.6116	1.5302	1.4804	1.5820
NC5	1.3749	1.2401	1.0833	1.1030	1.1134	1.0567	1.0264	1.1022
Difference, %	-29.1	-29.6	-31.0	-31.1	-30.9	-30.9	-30.7	-30.3
	2006	2007	2008	2009	2010	2011	2012	2013
BUR3	1.6257	1.2423	1.2244	1.3794	1.4304	1.3045	1.1973	1.1202
NC5	1.1361	0.8615	0.8529	0.9659	1.0080	0.9189	0.8439	0.7857
Difference, %	-30.1	-30.7	-30.3	-30.0	-29.5	-29.6	-29.5	-29.9
	2014	2015	2016	2017	2018	2019	2020	%
BUR3	1.2335	1.1952	1.2328	1.1730	1.0372	0.9345		
NC5	0.8671	0.8386	0.8631	0.8177	0.7210	0.6536	0.5584	-81.5
Difference, %	-29.7	-29.8	-30.0	-30.3	-30.5	-30.1		

Abbreviations: BUR3 – Third Biennial Update Report of the RM to the UNFCCC, NC5 – Fifth National Communication of the RM to the UNFCCC.

Table 5-50 shows comparative results of the inventory of NO_2 emissions from source category 3B 'Manure Management', expressed in kt CO_2 using the GWP_{100} values available in the IPCC AR4 ($GWP_{100} = 298$).

Table 5-50: Comparative results of $N_2O_{TOTAL(mm)}$ emissions from source category 3B 'Manure Management' included in the BUR3 and NC5 of the RM to the UNFCCC, kt CO_2 equivalent

	1990	1991	1992	1993	1994	1995	1996	1997
BUR3	1,116.6179	1,042.7426	935.4783	815.3185	792.2223	732.9723	774.0215	597.0533
NC5	899.7142	816.1992	723.0274	606.1705	585.7993	537.6941	565.0636	437.4938
Difference, %	-19.4	-21.7	-22.7	-25.7	-26.1	-26.6	-27.0	-26.7
	1998	1999	2000	2001	2002	2003	2004	2005
BUR3	578.0598	524.7140	468.2084	476.7359	480.2456	456.0074	441.1540	471.4376
NC5	409.7130	369.5596	322.8297	328.7069	331.8054	314.8850	305.8807	328.4623
Difference, %	-29.1	-29.6	-31.0	-31.1	-30.9	-30.9	-30.7	-30.3
	2006	2007	2008	2009	2010	2011	2012	2013
BUR3	484.4637	370.1945	364.8654	411.0664	426.2558	388.7320	356.7848	333.8296
NC5	338.5550	256.7282	254.1676	287.8301	300.3879	273.8235	251.4705	234.1272
Difference, %	-30.1	-30.7	-30.3	-30.0	-29.5	-29.6	-29.5	-29.9
	2014	2015	2016	2017	2018	2019	2020	%
BUR3	367.5888	356.1825	367.3776	349.5395	309.0862	278.4665		
NC5	258.3833	249.8959	257.2030	243.6701	214.8667	194.7808	166.4175	-81.5
Difference, %	-29.7	-29.8	-30.0	-30.3	-30.5	-30.1		

Abbreviations: BUR3 – Third Biennial Update Report of the RM to the UNFCCC, NC5 – Fifth National Communication of the RM to the UNFCCC.

For 2020, total N_2O emissions resulting from 3B 'Manure Management' were estimated for the first time. The results allow us to assert that between 1990 and 2020 nitrous oxide emissions from the respective category decreased by 81.5%, due to the decrease in animal population, productivity of livestock and poultry, and changes in the share of manure management systems (the share of liquid/slurry systems decreased significantly whereas the share of pasture and solid storage increased).

Direct $N_2O_{D(mm)}$ (Table 5-51) and indirect $N_2O_{IND(mm)}$ (Table 5-52) emissions from category 3B 'Manure Management' were recalculated.

Table 5-51: Comparative results of direct $N_2O_{D(mm)}$ emissions from source category 3B 'Manure Management' included in the BUR3 and NC5 of the RM to the UNFCCC, kt, kt

	1990	1991	1992	1993	1994	1995	1996	1997
BUR3	2.9259	2.7696	2.5012	2.2182	2.1606	2.0047	2.1230	1.6333
NC5	1.6437	1.5205	1.3643	1.1789	1.1447	1.0533	1.1138	0.8572
Difference, %	-43.8	-45.1	-45.5	-46.9	-47.0	-47.5	-47.5	-47.5
	1998	1999	2000	2001	2002	2003	2004	2005
BUR3	1.5979	1.4543	1.3081	1.3317	1.3406	1.2731	1.2299	1.3103
NC5	0.8107	0.7365	0.6539	0.6659	0.6711	0.6372	0.6181	0.6583
Difference, %	-49.3	-49.4	-50.0	-50.0	-49.9	-49.9	-49.7	-49.8
	2006	2007	2008	2009	2010	2011	2012	2013
BUR3	1.3452	1.0317	1.0152	1.1408	1.1800	1.0769	0.9894	0.9289
NC5	0.6770	0.5186	0.5123	0.5763	0.5980	0.5461	0.5039	0.4731
Difference, %	-49.7	-49.7	-49.5	-49.5	-49.3	-49.3	-49.1	-49.1
	2014	2015	2016	2017	2018	2019	2020	%
BUR3	1.0222	0.9911	1.0160	0.9695	0.8530	0.7680		
NC5	0.5214	0.5050	0.5179	0.4932	0.4359	0.3943	0.3397	-79.3
Difference, %	-49.0	-49.0	-49.0	-49.1	-48.9	-48.7		

Abbreviations: BUR3 – Third Biennial Update Report of the RM to the UNFCCC, NC5 – Fifth National Communication of the RM to the UNFCCC.

Table 5-52: Comparative results of indirect $N_2O_{IND(mm)}$ emissions from source category 3B 'Manure Management' included in the BUR3 and NC5 of the RM to the UNFCCC, kt

	1990	1991	1992	1993	1994	1995	1996	1997
BUR3	0.8212	0.7295	0.6380	0.5178	0.4978	0.4550	0.4744	0.3702
NC5	1.3755	1.2184	1.0620	0.8552	0.8210	0.7510	0.7824	0.6109
Difference, %	67.5	67.0	66.5	65.2	64.9	65.1	64.9	65.0
	1998	1999	2000	2001	2002	2003	2004	2005
BUR3	0.3419	0.3065	0.2631	0.2680	0.2710	0.2572	0.2505	0.2717
NC5	0.5642	0.5036	0.4294	0.4372	0.4424	0.4195	0.4083	0.4439
Difference, %	65.0	64.3	63.2	63.1	63.2	63.1	63.0	63.4
	2006	2007	2008	2009	2010	2011	2012	2013
BUR3	0.2806	0.2106	0.2092	0.2386	0.2504	0.2275	0.2079	0.1914
NC5	0.4591	0.3429	0.3406	0.3896	0.4100	0.3727	0.3400	0.3125
Difference, %	63.6	62.8	62.9	63.3	63.8	63.8	63.6	63.3
	2014	2015	2016	2017	2018	2019	2020	%
BUR3	0.2114	0.2042	0.2168	0.2035	0.1842	0.1664		
NC5	0.3457	0.3335	0.3452	0.3245	0.2851	0.2593	0.2188	-84.1
Difference, %	63.6	63.4	59.2	59.5	54.8	55.8		

For 2020, direct $N_2O_{D(mm)}$ and indirect $N_2O_{IND(mm)}$ emissions resulting from 3B 'Manure Management' were estimated for the first time. The results allow us to assert that, over the period 1990-2020, direct $N_2O_{D(mm)}$ emissions from the respective category decreased by 79.3%, whereas indirect $N_2O_{IND(mm)}$ emissions decreased by circa 84.1%.

It should be noted that indirect $N_2O_{G(mm)}$ emissions from volatilization of ammonia (NH_3) and nitrogen oxides (NO_x) decreased in the respective period by 85.1%, whereas $N_2O_{L(mm)}$ emissions from leaching and runoff of nitrogen decreased by 82.9%, respectively (Table 5-53).

Table 5-53: Indirect $N_2O_{IND(mm)}$ emissions from volatilization of ammonia (NH_3) and nitrogen oxides (NO_x), as well as from leaching and runoff of nitrogen, under source category 3B 'Manure Management' between 1990-2020, kt

	1990	1991	1992	1993	1994	1995	1996	1997
Indirect $N_2O_{(G)}$	0.7311	0.6427	0.5581	0.4442	0.4256	0.3884	0.4038	0.3158
Indirect $N_2O_{(L)}$	0.6445	0.5757	0.5039	0.4111	0.3954	0.3626	0.3785	0.2951
$N_2O_{IND(mm)}$	1.3755	1.2184	1.0620	0.8552	0.8210	0.7510	0.7824	0.6109
	1998	1999	2000	2001	2002	2003	2004	2005
Indirect $N_2O_{(G)}$	0.2902	0.2582	0.2185	0.2224	0.2251	0.2134	0.2078	0.2264
Indirect $N_2O_{(L)}$	0.2740	0.2454	0.2110	0.2148	0.2173	0.2061	0.2006	0.2174
$N_2O_{IND(mm)}$	0.5642	0.5036	0.4294	0.4372	0.4424	0.4195	0.4083	0.4439
	2006	2007	2008	2009	2010	2011	2012	2013
Indirect $N_2O_{(G)}$	0.2344	0.1743	0.1733	0.1987	0.2096	0.1905	0.1735	0.1591
Indirect $N_2O_{(L)}$	0.2247	0.1685	0.1673	0.1909	0.2004	0.1823	0.1665	0.1534
$N_2O_{IND(mm)}$	0.4591	0.3429	0.3406	0.3896	0.4100	0.3727	0.3400	0.3125

	2014	2015	2016	2017	2018	2019	2020	%
Indirect $N_2O_{(G)}$	0.1761	0.1698	0.1748	0.1641	0.1430	0.1301	0.1087	-85.1
Indirect $N_2O_{(L)}$	0.1696	0.1637	0.1704	0.1604	0.1421	0.1292	0.1101	-82.9
$N_2O_{IND(mm)}$	0.3457	0.3335	0.3452	0.3245	0.2851	0.2593	0.2188	-84.1

This evolution was possible due to the drastic decrease in animal population, as well as a significant change in livestock and poultry farming practices and in the share of manure management systems.

Table 5-54 below shows the total amount of nitrogen generated from all manure management systems, as well as the amounts of nitrogen from animal waste available for application to agricultural soils, estimated in accordance with the methodology in the IPCC 2006 Guidelines.

Table 5-54: Total amount of nitrogen excreted ($N_{ex(T)}$) in all manure management systems and amount of nitrogen available (N_{MMS_Avb}) to be introduced into agricultural soils in the RM for the period 1990-2020, kt N

	1990	1991	1992	1993	1994	1995	1996	1997
$N_{ex\ (T)}$	135.1713	123.4886	110.3797	95.2995	92.4152	85.1856	88.3974	69.2488
N_{MMS_Avb}	85.3474	77.5640	70.2188	59.9481	58.2225	52.9686	54.7989	43.1256
Share, % from $N_{ex\ (T)}$	63.1	62.8	63.6	62.9	63.0	62.2	62.0	62.3
	1998	1999	2000	2001	2002	2003	2004	2005
$N_{ex\ (T)}$	65.7947	59.4772	52.6415	53.4215	54.2313	51.2960	49.5581	52.1850
N_{MMS_Avb}	40.6662	37.0445	32.9376	33.5994	33.8845	32.1125	30.9263	32.5562
Share, % from $N_{ex\ (T)}$	61.8	62.3	62.6	62.9	62.5	62.6	62.4	62.4
	2006	2007	2008	2009	2010	2011	2012	2013
$N_{ex\ (T)}$	53.4875	41.0368	40.7807	45.6589	47.2092	43.2692	40.1457	38.0213
N_{MMS_Avb}	33.3299	25.7049	25.2450	28.1581	29.0164	26.5946	24.5663	23.3267
Share, % from $N_{ex\ (T)}$	62.3	62.6	61.9	61.7	61.5	61.5	61.2	61.4
	2014	2015	2016	2017	2018	2019	2020	%
$N_{ex\ (T)}$	41.8910	40.5144	41.3243	39.2943	34.4683	31.0589	26.6182	-80.3
N_{MMS_Avb}	25.4006	24.7047	25.0049	23.8697	21.0244	19.0072	16.4221	-80.8
Share, % from $N_{ex\ (T)}$	60.6	61.0	60.5	60.7	61.0	61.2	61.7	-2.3

5.3.2.6. Planned Improvements

Regarding N_2O emissions from source category 3B 'Manure Management', possible improvements could include activities on periodical collection of updated information on the share of manure management systems at national level during the reference period, and for the more recent period (once every 3 years), as well as information associated with specifying country-specific values of $N_{ex(T)}$ nitrogen excretion rates for different categories of animals (kg N/head/year).

5.4. Agricultural Soils (Category 3D)

Direct and indirect N_2O emissions are monitored under source category 3D 'Agricultural Soils'. The following nitrogen sources are included in the methodology for estimating direct N_2O emissions from managed soils: synthetic N fertilizers; organic N applied as fertilizer; urine and dung N deposited on pasture, range and paddock by grazing animals, N in crop residues; N mineralization associated with loss of soil organic matter resulting from change of land use or management of mineral soils; and drainage/management of organic soils.

Direct N_2O emissions were estimated following the methodology available in the 2006 IPCC Guidelines.

$$N_2O_{direct} = N_2O_{SN} + N_2O_{ON} + N_2O_{PRP} + N_2O_{CR} + N_2O_{SOM}$$

Where:

- N_2O_{SN} – N_2O emissions from the amount of synthetic fertilizer N applied to soils, kt/yr;
- N_2O_{ON} – N_2O emissions from the use of organic fertilizers in soil;
- N_2O_{PRP} – N_2O emissions from urine and dung inputs to grazed soils;
- N_2O_{CR} – N_2O emissions from the amount of N in crop residues;
- N_2O_{SOM} – N_2O emissions from the amount of N in mineral soils that is mineralized, in association with loss of soil organic matter resulting from change of land use or management of mineral soils (dehumification).

It should be noted, that during the reference period 1990-2020, direct N_2O emissions from source category 3D 'Agricultural Soils' decreased by circa 38.6%, from 3.8207 kt in 1990 to 2.3471 kt in 2020 (Figure 5-2).

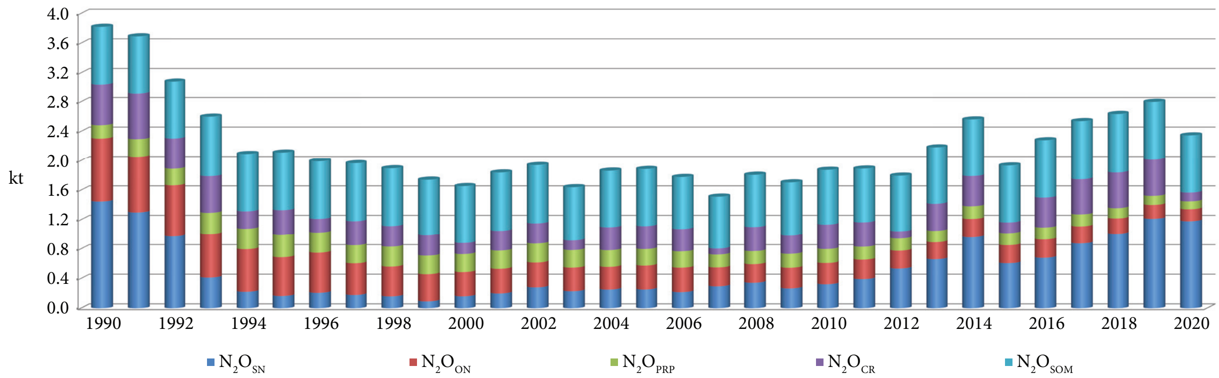


Figure 5-2: Evolution of direct N_2O emissions from source category 3D 'Agricultural Soils' between 1990-2020, kt.

The contribution of different emission sources in the structure of total direct N_2O emissions had also changed. The share of N_2O_{ON}, N_2O_{CR}, and N_2O_{PRP} had decreased by 69.1%, 64.4% and 4.5%, respectively; whereas the share of N_2O_{SN} and N_2O_{SOM} had increased by circa 32.8% and 60.6%, respectively (Table 5-55).

Table 5-55: Breakdown of direct N_2O emissions from source category 3D 'Agricultural Soils' by source for the period 1990-2020, % of total

	1990	1991	1992	1993	1994	1995	1996	1997
N_2O_{SN}	37.9	35.2	31.5	15.9	10.6	7.8	10.4	9.1
N_2O_{ON}	22.4	20.5	22.5	22.8	27.5	24.8	27.2	21.7
N_2O_{PRP}	4.7	6.5	7.3	11.0	13.4	14.2	13.9	12.5
N_2O_{CR}	14.3	16.7	13.4	19.1	11.2	16.1	9.3	16.7
N_2O_{SOM}	20.6	21.2	25.3	31.1	37.3	37.1	39.2	40.0
	1998	1999	2000	2001	2002	2003	2004	2005
N_2O_{SN}	8.4	5.3	9.7	10.8	14.5	14.0	13.5	13.4
N_2O_{ON}	21.2	21.0	19.7	18.1	17.3	19.4	16.4	17.1
N_2O_{PRP}	14.3	14.4	14.8	13.5	13.2	14.5	12.1	11.9
N_2O_{CR}	14.8	15.7	9.1	14.7	14.2	7.9	16.8	16.7
N_2O_{SOM}	41.2	43.5	46.8	42.9	40.7	44.2	41.1	40.9
	2006	2007	2008	2009	2010	2011	2012	2013
N_2O_{SN}	12.2	19.6	19.1	15.6	17.2	20.8	29.8	30.3
N_2O_{ON}	18.6	16.8	13.8	16.3	15.3	13.9	13.5	10.6
N_2O_{PRP}	12.4	11.6	9.8	11.1	10.1	9.3	9.2	7.3
N_2O_{CR}	17.2	5.3	18.3	14.4	17.8	17.6	5.6	16.7
N_2O_{SOM}	39.6	46.7	39.1	42.5	39.5	38.4	41.9	35.1
	2014	2015	2016	2017	2018	2019	2020	%
N_2O_{SN}	37.5	31.4	29.9	34.5	38.3	43.3	50.3	32.8
N_2O_{ON}	9.8	12.6	10.9	9.3	7.9	6.7	6.9	-69.1
N_2O_{PRP}	6.7	8.6	7.3	6.3	5.3	4.4	4.5	-4.5
N_2O_{CR}	16.0	7.5	17.8	18.8	18.3	17.5	5.1	-64.4
N_2O_{SOM}	30.1	39.8	34.2	31.1	30.2	28.0	33.2	60.6

N_2O emission can also take place indirectly through several pathways: the volatilization of N as NH_3 and oxides of nitrogen (NO_x), and the deposition of these gases and their products NH_4^+ and NO_3^- onto soils and the surface of lakes and other waters; while the second pathway is the volatilization of N from synthetic and organic fertilizer additions, urine and dung deposition from grazing animals, as well as from leaching and runoff of N from synthetic and organic fertilizer additions, urine and dung deposition from grazing animals, crop residue, mineralization of N associated with loss of carbon in mineral soils as a result of land-use change and management practices.

Indirect N_2O emissions from managed soils were calculated by using the following equation from the 2006 IPCC Guidelines.

$$N_2O_{INDIRECT} = N_2O_{ATD} + N_2O_{L}$$

Where:

N_2O_{ATD} – indirect N_2O emissions, produced from atmospheric deposition of nitrogen as ammonia (NH_3), oxides of N (NO_x), and their products NH_4^+ and NH_3^- into soils and the surface of lakes and other waters; deposition of agriculturally derived NH_3 and NO_x, following the application of synthetic and organic N fertilizers and/or urine and dung deposition from grazing animals;

N_2O_L – from leaching and runoff from land of N from synthetic and organic fertilizer additions, crop residues returned to soils, mineralization of N associated with loss of soil C in mineral and drained/managed organic soils through land-use change or management practices and urine and dung deposition from grazing animals.

Between 1990 and 2020, indirect N_2O emissions from source category 3D 'Agricultural Soils' had decreased by circa 42.1%, from 1.1857 kt in 1990 to 0.6864 kt in 2020 (Figure 5-3).

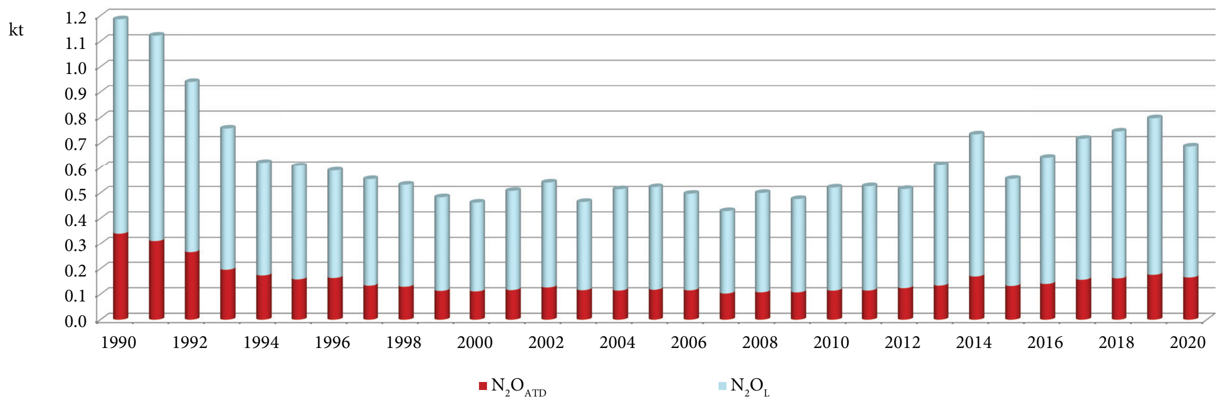


Figure 5-3: Evolution of indirect N_2O emissions from source category 3D 'Agricultural Soils' between 1990-2020, kt

The share of emission sources in the structure of total indirect N_2O emissions had also changed. Thus, the share of N_2O_{ATD} emissions from atmospheric deposition of nitrogen decreased by 15.9%, whereas the share of N_2O_L emissions from leaching and runoff of nitrogen from land increased by 6.4% (Table 5-56).

Table 5-56: Breakdown of indirect N_2O emissions from source category 3D 'Agricultural Soils' for the period 1990-2020, %

	1990	1991	1992	1993	1994	1995	1996	1997
N_2O_{ATD}	28.7	27.7	28.2	25.9	27.9	26.0	27.8	24.1
N_2O_L	71.3	72.3	71.8	74.1	72.1	74.0	72.2	75.9
	1998	1999	2000	2001	2002	2003	2004	2005
N_2O_{ATD}	24.3	23.4	24.0	22.9	23.4	24.9	22.2	22.5
N_2O_L	75.7	76.6	76.0	77.1	76.6	75.1	77.8	77.5
	2006	2007	2008	2009	2010	2011	2012	2013
N_2O_{ATD}	23.2	24.0	21.4	22.5	21.9	21.8	24.0	21.8
N_2O_L	76.8	76.0	78.6	77.5	78.1	78.2	76.0	78.2
	2014	2015	2016	2017	2018	2019	2020	%
N_2O_{ATD}	23.1	23.8	21.9	21.9	21.7	22.1	24.1	-15.9
N_2O_L	76.9	76.2	78.1	78.1	78.3	77.9	75.9	6.4

5.4.1. Direct N_2O Emissions from Managed Soils

5.4.1.1. Inorganic Nitrogen Fertilizers

Source Category Description

Considerable amounts of nitrogen are applied to soils with inorganic nitrogen fertilizers. This nitrogen undergoes transformations such as nitrification and denitrification processes and releases N_2O emissions. The amount of emissions from fertilizer consumption depends on a number of factors, such as: the amount and type of N fertilizers applied, crop type, soil type, climate and other environment-related conditions. N_2O emissions from synthetic N fertilizers vary a lot over the year.

Methodological Issues, Emission Factors and Data Sources

Direct N_2O_{SN} emissions from applied inorganic nitrogen fertilizers were estimated using a Tier 1 methodology, and Equation 10.6 in the 2006 IPCC Guidelines.

$$N_2O_{SN} = F_{SN} \bullet EF_1 \bullet 44/28$$

Where:

N_2O_{SN} – N_2O emissions from applied inorganic nitrogen fertilizers (kt/yr);

F_{SN} – annual amount of inorganic nitrogen fertilizers applied to soils (kg N/yr);

EF_1 – emission factor for 0.01 kg N_2O-N/kg from N inputs, range: 0.003-0.03 kg N_2O-N/kg N;

[44/28] – mass ratio of nitrogen content in N_2O-N and N_2O.

Table 5-57 provides a short overview of inorganic N fertilizers, including complex fertilizers most commonly used in the Republic of Moldova.

Table 5-57: Brief overview of inorganic nitrogen fertilizers most commonly used in the RM

Type of Fertilizer	Chemical Formula	Active substance, %	Form	Features
Ammonium nitrate	NH_4NO_3	34.5	White macro crystals or pellets	Physiologically it is faintly acid, may be applied to all crops and all soils. Highly hygroscopic.
Urea (carbamide)	$CO(NH_2)_2$	46	White crystals or pellets	Has a physiologically faintly acid/neutral, low hygroscopic. Highly volatile. Applied to soils, may be used in solutions for foliar fertilization.
Ammophos	$NH_4H_2PO_4$	N: 11-12, P_2O_5: 42-50	Grey pellets	Efficient on chernozems, brown soils, and phosphor deficient soils.
Diammophos	$(NH_4)_2HPO_4$	N: 21, P_2O_5: 53	Grey pellets	Efficient on chernozems, and phosphor deficient soils.
Nitroammophos	Complex formula	N: P: K 13-19 each one	Pellets of different colours	Efficient on all soils and used for all crops.
Diammophos	Complex formula	N: P: K 10:26:26	Pellets of different colours	Efficient on all soils and used for all crops.

Information on the amounts of applied inorganic N fertilizers (active substance – a.s.) on managed soils is available in the Statistical Yearbooks of the RM (for the period until 1992 – for the whole territory of the country, and for the period after 1993 – only for the right bank of the Dniester river), and in the Statistical Yearbooks of the ATULBD (for the period 1993-2020).

Table 5-58 indicates that between 1990 and 2020, there was a significant decrease by circa 50.7% in the amounts of inorganic N fertilizers used in the agriculture sector of the RM, including a decrease by circa 18.4% in inorganic N fertilizers; a decrease by circa 67.7% in inorganic P fertilizers; and a decrease by circa 78.1% in inorganic K fertilizers. The amounts of inorganic fertilizers used per one hectare decreased by circa 50%, from 134.1 kg a.s./ha in 1990, to 67.1 kg a.s./ha in 2020.

Table 5-58: Applied inorganic fertilizers between 1990-2020, kt of active substance

	1990	1991	1992	1993	1994	1995	1996	1997
Applied inorganic fertilizer – total, kt a.s.	232.4	191.4	127.6	44.9	20.0	12.5	14.3	12.1
N fertilizer	92.1	82.7	61.8	26.4	14.1	10.5	13.2	11.4
P fertilizer	85.7	75.2	43.4	12.7	8.0	1.4	0.7	0.5
K fertilizer	54.6	33.5	22.4	5.8	1.6	0.6	0.3	0.2
average per 1 sown ha, kg	134.1	111.5	74.6	25.2	11.7	7.2	8.3	7.0
	1998	1999	2000	2001	2002	2003	2004	2005
Applied inorganic fertilizer – total, kt a.s.	10.3	6.1	10.3	12.8	18.4	15.4	17.5	18.0
N fertilizer	10.2	5.9	10.2	12.7	18.0	14.6	16.1	16.1
P fertilizer	0.1	0.1	0.1	0.1	0.3	0.6	1.0	1.5
K fertilizer	0.0	0.0	0.0	0.0	0.1	0.2	0.4	0.5
average per 1 sown ha, kg	6.0	3.6	6.1	7.4	10.6	9.7	10.4	10.6
	2006	2007	2008	2009	2010	2011	2012	2013
Applied inorganic fertilizer – total, kt a.s.	16.6	22.4	24.7	19.9	25.5	30.9	44.0	54.8
N fertilizer	13.8	18.8	21.9	17.0	20.6	25.0	34.1	42.1
P fertilizer	2.0	2.4	1.7	2.0	3.3	4.1	7.1	9.6
K fertilizer	0.8	1.1	1.1	0.9	1.6	1.8	2.8	3.1
average per 1 sown ha, kg	10.7	14.4	15.9	12.5	15.6	19.3	26.6	32.5
	2014	2015	2016	2017	2018	2019	2020	%
Applied inorganic fertilizer – total, kt a.s.	84.5	52.4	58.8	81.4	94.2	113.8	114.7	-50.7
N fertilizer	61.1	38.7	43.4	55.7	64.3	77.2	75.2	-18.4
P fertilizer	19.4	10.8	11.6	19.2	22.2	25.6	27.7	-67.7
K fertilizer	4.0	2.9	3.8	6.4	7.8	10.3	12.0	-78.1
average per 1 sown ha, kg	49.9	30.9	34.3	46.9	53.9	66.0	67.1	-50.0

Source: Statistical Yearbooks of the RM for 1988 (page 280), 1994 (page 239), 1999 (page 330), 2003 (page 442), 2006 (page 352), 2011 (page 345), 2014 (page 345), 2019 (page 296), and 2020 (page 296). Statistical Yearbooks of the ATULBD for 1998 (page 230), 2000 (page 107), 2002 (page 111), 2006 (page 108), 2009 (page 107), 2012 (page 114), 2017 (page 110), 2019 (page 108), 2020 (page 111), 2021 (page 111).

It should be noted that the average consumption of nutrients, in kg of nitrogen per 1 ton of basic yield in most crops is 30-35 kg, and the yield capacity of crops grown in the RM, according to the National Complex Soil Fertility Enhancing Program for 2001-2020, vary between 3.5-4.8 t/ha for winter wheat, 4.5-6.4 t/ha for grain maize, 2.1-3.5 t/ha for sunflower, 26.8-37.0 t/ha for sugar beet, etc. The sharp reduction in fertilizer consumption occurred due to a number of reasons, such as: a drop in the import of synthetic fertilizer into the country, the farmers' lack of financial resources in certain periods of the year, particularly in the context of the disorganization of the country's agriculture during the transition to market economy. Additionally, in accordance with the National Complex Soil Fertility Enhancing Program for 2001-2020, the annual amount of synthetic N fertilizer in the RM was envisioned to increase to 120-130 thousand tonnes of nitrogen by 2020, but didn't.

Uncertainties and Time-Series Consistency

Uncertainties associated with activity data on applied inorganic N fertilizers in the RM are considered to be low (circa 5%). Uncertainties associated with the default emission factor (EF_1 for F_{SN}) may reach up to circa 6%. Thus, combined uncertainties associated with activity data and emission factors for source category 3D.a.1 'Inorganic Nitrogen Fertilizers' are considered to be low (circa 7.81%) (Annex 5-3.3). In view of ensuring time-series consistency of the obtained results, the same approach was used for the entire period under review, in accordance with the recommendations included in the 2006 IPCC Guidelines.

Quality Assurance and Quality Control

Standard verification and quality control forms and check-lists were filled in for category 3D 'Agricultural Soils', following a Tier 1 approach. The AD and methods used to estimate N_2O emissions originating from this source category were documented and archived both in hard copies and electronically. In order to identify the data entry and the N_2O emission estimation process-related errors, AD and EF verifications and quality control procedures were periodically applied. Following the recommendations included in the 2006 IPCC Guidelines, N_2O emissions from applied inorganic N fertilizers were estimated using AD from official reference sources.

Recalculations

No recalculations were made for direct N_2O_{SN} emissions from applied inorganic N fertilizers in the country over the period 1990-2019 (Table 5-59). For 2020, direct N_2O_{SN} emissions from applied inorganic N fertilizers to agricultural soils were estimated for the first time. The obtained results show that between 1990 and 2020, the respective emissions had decreased by circa 18.4%.

Table 5-59: Results of N_2O_{SN} emission inventory from the use of inorganic N fertilizer included in the BUR2 and BUR3 of the RM to the UNFCCC, kt

	1990	1991	1992	1993	1994	1995	1996	1997
N_2O_{SN}, kt	1.4473	1.2996	0.9711	0.4145	0.2217	0.1652	0.2077	0.1795
N_2O_{SN}, kt CO_2 equivalent	431.2911	387.2723	289.4006	123.5197	66.0704	49.2215	61.8980	53.4876
	1998	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**
N_2O_{SN}, kt	0.1600	0.0929	0.1609	0.1994	0.2823	0.2298	0.2524	0.2530
N_2O_{SN}, kt CO_2 equivalent	47.6855	27.6851	47.9571	59.4114	84.1182	68.4681	75.2161	75.4034
	2006	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**
N_2O_{SN}, kt	0.2170	0.2959	0.3446	0.2670	0.3234	0.3928	0.5355	0.6617
N_2O_{SN}, kt CO_2 equivalent	64.6623	88.1735	102.6997	79.5613	96.3774	117.0677	159.5721	197.1895
	2014	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**%**
N_2O_{SN}, kt	0.9603	0.6078	0.6821	0.8754	1.0105	1.2134	1.1810	-18.4
N_2O_{SN}, kt CO_2 equivalent	286.1680	181.1301	203.2777	260.8773	301.1419	361.6060	351.9420	-18.4

Planned Improvements

No activities to improve the estimation process regarding direct N_2O emissions from applied inorganic N fertilizers are planned for the next inventory cycle.

5.4.1.2. Organic Nitrogen Fertilizers

Source Category Description

Applied organic nitrogen fertilizers may enhance the processes of nitrification and denitrification, thus contributing to the increase in N_2O emissions from managed soils. While calculating emissions covered by this source category, activity data on the generation of various organic waste obtained in the national economy should be taken into account.

In the Republic of Moldova, processing plants and the animal breeding sector are the major providers of organic fertilizer. However, the latter is still the most important supplier of organic fertilizer: animal manure; composts based on manure and crop residue, diluvial soil, sludge from water basins, manure slurry, household sludge, poultry manure, etc.; sludge from livestock complexes, poultry litter, urine and manure.

Another important source is the sludge from the treatment of domestic wastewater and waste from sugar beet processing plants (sludge), as well as from wineries (vinasse, solid wine yeasts, etc.).

Methodological Issues, Emission Factors and Data Sources

N_2O emissions from applied organic N fertilizers were estimated using a Tier 1 methodology and Equation 11.2 from the 2006 IPCC Guidelines.

$$N_2O_{ON} = F_{ON} \bullet EF_1 \bullet 44/28$$

Where:

- N_2O_{ON} – N_2O emissions from applied organic N fertilizers (kt/yr);
- $F_{ON} = (F_{AM} + F_{SEW} + F_{COMP} + F_{OOA})$, total annual amount of organic N fertilizers applied to soils (kg N/yr);
- F_{AM} – annual amount of animal manure N applied to soils (kg N/yr);
- F_{SEW} – annual amount of total sewage N from household waste treatment that is applied to soils (kg N/yr);
- F_{COMP} – annual amount of total compost N applied to soils (kg N/yr);
- F_{OOA} – annual amount of other organic amendments used as fertilizer (kg N/yr);
- EF_1 – default EF: 0.01 kg N_2O-N/kg N applied (range: 0.003-0.03 kg N_2O-N/kg N);
- [44/28] – mass ratio of nitrogen content in N_2O-N and N_2O.

Data on total amount of organic fertilizers (preponderantly, manure with bedding[88]) applied on managed lands are available in the Statistical Yearbooks of the RM and those of the ATULBD (Table 5-60).

Table 5-60: Applied organic fertilizers in the RM between 1990-2020

	1990	1991	1992	1993	1994	1995	1996	1997
Total applied organic N fertilizers, kt	9740.0	8600.0	5300.0	4200.0	1620.0	1779.2	905.7	352.9
tonnes applied to 1 ha of sown field	5.60	5.10	3.40	2.40	1.10	1.20	0.60	0.20
	1998	1999	2000	2001	2002	2003	2004	2005
Total applied organic N fertilizers, kt	227.3	122.1	83.3	98.2	54.2	47.3	42.2	44.2
tonnes applied to 1 ha of sown field	0.10	0.10	0.03	0.10	0.02	0.06	0.04	0.04
	2006	2007	2008	2009	2010	2011	2012	2013
Total applied organic N fertilizers, kt	10.5	7.9	8.0	6.9	17.7	31.5	22.9	42.6
tonnes applied to 1 ha of sown field	0.01	0.00	0.00	0.01	0.02	0.04	0.03	0.05
	2014	2015	2016	2017	2018	2019	2020	%
Total applied organic N fertilizers, kt	33.8	61.2	74.6	45.5	103.4	84.0	105.5	-98.9
tonnes applied to 1 ha of sown field	0.03	0.07	0.08	0.05	0.11	0.08	0.11	-98.0

Source: Statistical Yearbooks of the RM for 1988 (page 280), 1994 (page 239), 1999 (page 330), 2003 (page 442), 2006 (page 352), 2011 (page 345), 2014 (page 345), 2019 (page 296) and 2020 (page 296). Statistical Yearbooks of the ATULBD for 1998 (page 230), 2000 (page 107), 2002 (page 111), 2006 (page 108), 2009 (page 107), 2012 (page 114), 2017 (page 110), 2019 (page 108), 2020 (page 111), 2021 (page 111).

As the table indicates, between 1990 and 2020, according to the NBS and the State Statistical Service of the ATULBD, there was a significant reduction, by circa 51 times, in the amounts of organic N fertilizers applied per hectare of sown fields, from circa 5.6 tonnes per sown hectare in 1990, to circa 0.11 tonnes per sown hectare in 2020.

[88] In the early 1990s, the share of animal bedding manure (4-6 kg bedding/animal/day) in Moldova was circa 37.6% of the total amount of animal manure generated in the livestock breeding sector; the share of manure with semi-bedding (1-3 kg bedding/animal/day) constituted circa 26.7%; and the share of manure without bedding – circa 35.4%, respectively (Turcan et al., 1984; Balteanskyi, 1986).

It should be mentioned that the statistical data on the amount of organic N fertilizers applied to soils is collected through Questionnaire no. 9-agr 'The use of phytosanitary products and the introduction of synthetic and organic fertilizers into the crop yield of year...' . This questionnaire is submitted annually to the territorial statistical institution, by December 5, by agricultural enterprises and organizations irrespective of the organizational-legal and property forms (including individual farms with a total area of 50 or more ha) depending on the location of the land.

As it can be seen, individual farms with an area less than 50 ha are not required to report data related to the type of fertilizers applied to soil. Considering that most of the livestock and poultry population is included in individual farms (Table 5-36), who also do not report to the territorial statistical institution, it is obvious that the statistical data presented above (Table 5-60) is by far underestimated.

Within the past two inventory cycles, the amount of organic N fertilizers applied to soils was estimated based on the information on the total amount of excreted nitrogen ($N_{ex(T)}$) in all manure management systems and the amount of nitrogen available (N_{MMS_Avb}) for application to managed soils (Table 5-54).

As it can be seen in Table 5-61, the current statistical system fails to monitor the amounts of organic N fertilizers actually applied to soils in the RM, as it does not statistically include all producers and individual farmers.

Table 5-61: Amount of organic fertilizers generated and available to be applied to soils in the Republic of Moldova over the period 1990-2020, in comparison to the official statistical data within the same reporting period, kt

	1990	1991	1992	1993	1994	1995	1996	1997
Organic fertilizers available to be applied to soils (calculated AD), kt	15240.6	13850.7	12539.1	10705.0	10396.9	9458.7	9785.5	7701.0
Applied organic fertilizers (statistical data), kt	9740.0	8600.0	5300.0	4200.0	1620.0	1779.2	905.7	352.9
Applied organic fertilizers (statistical data), % of the amount available to be applied to soils	63.9	62.1	42.3	39.2	15.6	18.8	9.3	4.6
	1998	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**
Organic fertilizers available to be applied to soils (calculated AD), kt	7261.8	6615.1	5881.7	5999.9	6050.8	5734.4	5522.6	5813.6
Applied organic fertilizers (statistical data), kt	227.3	122.1	83.3	98.2	54.2	47.3	42.2	44.2
Applied organic fertilizers (statistical data), % of the amount available to be applied to soils	3.1	1.8	1.4	1.6	0.9	0.8	0.8	0.8
	2006	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**
Organic fertilizers available to be applied to soils (calculated AD), kt	5951.8	4590.2	4508.0	5028.2	5181.5	4749.0	4386.8	4165.5
Applied organic fertilizers (statistical data), kt	10.5	7.9	8.0	6.9	17.7	31.5	22.9	42.6
Applied organic fertilizers (statistical data), % of the amount available to be applied to soils	0.2	0.2	0.2	0.1	0.3	0.7	0.5	1.0
	2014	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**%**
Organic fertilizers available to be applied to soils (calculated AD), kt	4535.8	4411.6	4465.2	4262.5	3754.4	3394.1	2932.5	-80.8
Applied organic fertilizers (statistical data), kt	33.8	61.2	74.6	45.5	103.4	84.0	105.5	-98.9
Applied organic fertilizers (statistical data), % of the amount available to be applied to soils	0.7	1.4	1.7	1.1	2.8	2.5	3.6	-94.4

The scientific literature [89] shows that 1 ton of cattle manure with bedding contains circa 5.6 kg of nitrogen. In order to estimate the F_{ON} values (Table 5-62), the applied amount of organic fertilizer (the values for the period 1990-1991 were taken from official statistics; and for 1992-2020 it was inferred that 63% of the available amount is actually applied to soil, this value represents an arithmetic mean between the value 63.9%, typical of year 1990, and the value 62.1%, typical of year 1991) was multiplied by the conversion factor from bedding manure to nitrogen.

Table 5-62: Amount of nitrogen applied to soils with organic fertilizers between 1990-2020, kt

	1990	1991	1992	1993	1994	1995	1996	1997
Organic fertilizers available to be applied to soils, kt	15240.6	13850.7	12539.1	10705.0	10396.9	9458.7	9785.5	7701.0
Applied organic fertilizers (63% of the available amounts), kt	9740.0	8600.0	7899.6	6744.2	6550.0	5959.0	6164.9	4851.6
Applied organic fertilizers (F_{ON}), kt of a.s. (N)	54.5440	48.1600	44.2378	37.7673	36.6802	33.3702	34.5233	27.1691
	1998	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**
Organic fertilizers available to be applied to soils, kt	7261.8	6615.1	5881.7	5999.9	6050.8	5734.4	5522.6	5813.6
Applied organic fertilizers (63% of the available amounts), kt	4574.9	4167.5	3705.5	3779.9	3812.0	3612.7	3479.2	3662.6
Applied organic fertilizers (F_{ON}), kt of a.s. (N)	25.6197	23.3381	20.7507	21.1676	21.3472	20.2309	19.4836	20.5104
	2006	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**
Organic fertilizers available to be applied to soils, kt	5951.8	4590.2	4508.0	5028.2	5181.5	4749.0	4386.8	4165.5
Applied organic fertilizers (63% of the available amounts), kt	3749.6	2891.8	2840.1	3167.8	3264.3	2991.9	2763.7	2624.2
Applied organic fertilizers (F_{ON}), kt of a.s. (N)	20.9978	16.1941	15.9044	17.7396	18.2803	16.7546	15.4768	14.6958

[89] Ungureanu, Cerbari et al., 2006; Bucataru et al., 2006; Raileanu, Jolondcovschi et al., 2006; Andries, Rusu, et al., 2005; Bucataru, Maciuc, 2005; Toncea, 2004; Banaru, 2003.

	2014	2015	2016	2017	2018	2019	2020	%
Organic fertilizers available to be applied to soils, kt	4535.8	4411.6	4465.2	4262.5	3754.4	3394.1	2932.5	-80.8
Applied organic fertilizers (63% of the available amounts), kt	2857.6	2779.3	2813.0	2685.3	2365.2	2138.3	1847.5	-81.0
Applied organic fertilizers (F_{ON}), kt of a.s. (N)	16.0024	15.5640	15.7531	15.0379	13.2453	11.9746	10.3459	-81.0

It should be noted that in accordance with the crop rotation structure, the need for organic fertilizer is circa 10-15 t/ha for a neutral humus balance, and circa 20-30 t/ha for a positive balance (to fully compensate for the humus losses, an average amount of organic fertilizer of 10 t/ha is needed). According to experts in agriculture, the stabilization of the humus content in soil on arable lands and horticultural plantations requires the annual application of circa 20-22 million tonnes of organic fertilizers, whereas current resources of organic matter can ensure application of as much as 3.5-4.5 million tonnes of organic fertilizer.

It is considered that the only way to eliminate the deficit of organic fertilizer is to radically change the structure of crops by changing the land-use categories, improving crop rotations, and a more comprehensive use of all local sources of organic matter.

In this context, specialists recommend that the green mass of the leguminous crops with highly developed semi-fascicular root system be used as an organic fertilizer applied to soil. The best suited cultures are the vetch, and winter and spring peas.

The use of these crops as a green fertilizer can be achieved in two ways: (1) the vetch or the winter peas sown in September as an intermediate crop and incorporated into the soil by early spring in the following year, at the end of April, before sowing the main crop; the crop rotation would be: winter cereals → vetch or winter peas as an intermediate crop → maize or sunflower, etc.; or (2) in a five field crop rotation, in which the first field is used during the first year for vetch or winter and spring peas, two crop yields incorporated into the soil as green fertilizers; the crop rotation for the field used in the first year for vetch would be: winter cereals → maize → sunflower → winter cereals.

It should be noted that a vetch yield (mixed with a cereal crop of circa 20%) or a peas yield, could return to soil annually circa 8 t/ha of dry matter of organic mass, aerial and roots, with an average N content of circa 3.4%; which provides for synthesis about 2.0 t/ha/year of humus or circa 1.2 t/ha/year of carbon. The systemic use of vetch or peas as green fertilizer, intermediate crop, or in a five field crop rotation, where a field is occupied with vetch or peas, provides a balance of organic matter and nitrogen in the soil (Wiesmeier et. al, 2015[90]; Leah, Cerbari, 2015[91]; Cerbari, Leah, 2016[92]; Leah, 2018[93]; Leah, Cerbari, 2019[94], 2020[95]).

Uncertainties and Time-series Consistency

Uncertainties associated with activity data on applied organic N fertilizers to agricultural soils in the RM reach circa 30%. Uncertainties associated with the default emission factor used (EF_1 for F_{ON}) may reach circa 6%. Thus, combined uncertainties associated with activity data and emission factors for source category 3D.a.2 'Organic N Fertilizers' are considered average (circa 30.59%) (Annex 5-3.3). In view of ensuring time-series consistency of the obtained results, the same approach was used for the entire period under review, in conformity with the recommendations included in the 2006 IPCC Guidelines.

Quality Assurance and Quality Control

Standard verification and quality control forms and check-lists were filled in for Sector 3 'Agriculture', following a Tier 1 approach. Activity Data and methods used to estimate N_2O emissions originating from applied organic fertilizers were documented and archived both in hard copies and electronically. In order to identify the data entry and GHG emission estimation process-related errors, AD and EF verifications and quality control procedures were applied.

[90] Wiesmeier M., Lungu M., Hübner R. & Cerbari V. (2015), Remediation of Degraded Arable Steppe Soils in Moldova using Vetch as Green Manure. Solid Earth, 6: pages 609-620.
[91] Leah, T. & Cerbari V. (2015), Cover crops – Key to Storing Organic Matter and Remediation of Degraded Properties of Soils in Moldova. Series Agronomy. USAMV, Bucharest, pages 73-76.
[92] Cerbari V. & Leah C. (2016), Green Manure – the only Possibility to save Moldova's Arable Soils from Degradation. USAMV 'Ion Ionescu de la Brad', Iasi. Romania. Scientific Papers. Agronomy. Vol. 59(2), pages 155-158.
[93] Leah T. (2018), The Importance of Crop Rotation and the Role of Legumes in the Agriculture of Moldova. Researches on the Field Crops in the Republic of Moldova. Balti, Indigou Color, pages 66-71 (Rom).
[94] Leah T.& Cerbari V. (2019), Effects of Green Fertilizers on the Quality Status and Production Capacity of the Cambic Chernozem from Moldova. International Journal AGROFOR, Volume 5 (3), 2020, pages 28-38.
[95] Leah T. & Cerbari V. (2020), Evaluation of the Conservative Agriculture Benefits on Soil Properties and Harvests in Crop Rotation with Legumes. Scientific Paper. Series Agronomy. Volume 63, No. 2. UASVM 'Ion I. de la Brad', Iasi. 2020, pages 9-14.

Recalculations

Direct N_2O_{ON} emissions from source category 3D.a.2 'Organic N Fertilizers' were recalculated for the period 1998-2019, as a result of the updated share of manure management systems (MS%) applied in RM, based on the results of studies conducted in 2015 and 2021 by specialists of the National Agency for Food Safety. As a result, the values associated with the total amount of nitrogen excreted in all manure management systems and the amount of N available for application to agricultural soils in the Republic of Moldova have also been changed. In comparison with results recorded in the BUR3 of the RM to the UNFCCC (2021), the changes made in the current inventory cycle resulted in a downward trend in direct N_2O_{ON} emissions from applied organic fertilizers for the period 1998-2019, varying between a minimum of 0.1% and a maximum of 3.3% (Table 5-63).

Table 5-63: Comparative results of direct N_2O_{ON} emissions from category 3D.a.2 'Organic N Fertilizers' included in the BUR3 and NC5 of the RM to the UNFCCC, kt

	1990	1991	1992	1993	1994	1995	1996	1997
BUR3	0.8571	0.7568	0.6952	0.5935	0.5764	0.5244	0.5425	0.4269
NC5	0.8571	0.7568	0.6952	0.5935	0.5764	0.5244	0.5425	0.4269
Difference, %	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	1998	1999	2000	2001	2002	2003	2004	2005
BUR3	0.4041	0.3679	0.3273	0.3339	0.3367	0.3190	0.3069	0.3232
NC5	0.4026	0.3667	0.3261	0.3326	0.3355	0.3179	0.3062	0.3223
Difference, %	-0.4	-0.3	-0.4	-0.4	-0.4	-0.3	-0.2	-0.3
	2006	2007	2008	2009	2010	2011	2012	2013
BUR3	0.3308	0.2550	0.2502	0.2791	0.2875	0.2635	0.2434	0.2312
NC5	0.3300	0.2545	0.2499	0.2788	0.2873	0.2633	0.2432	0.2309
Difference, %	-0.3	-0.2	-0.1	-0.1	-0.1	-0.1	-0.1	-0.1
	2014	2015	2016	2017	2018	2019	2020	%
BUR3	0.2517	0.2448	0.2523	0.2399	0.2152	0.1939		
NC5	0.2515	0.2446	0.2475	0.2363	0.2081	0.1882	0.1626	-81.0
Difference, %	-0.1	-0.1	-1.9	-1.5	-3.3	-2.9		

Abbreviations: BUR3 – Third Biennial Update Report of the RM to the UNFCCC, NC5 – Fifth National Communication of the RM to the UNFCCC..

For 2020, direct N_2O_{ON} emissions from category 3D.a.2 'Organic N Fertilizers' were estimated for the first time. The obtained results allow us to assert that the respective emissions decreased by circa 81% for 1990-2020, particularly due to the reduction of the animal population.

Table 5-65 below shows comparative results of nitrous oxide emissions from applied organic N fertilizers on managed lands in the Republic of Moldova for the period 1990-2020, expressed in kt CO_2 equivalent using the GWP_{100} values available in the IPCC AR4 (GWP_{100} = 298).

Table 5-64: Comparative results of direct N_2O_{ON} emissions from category 3D.a.2 'Organic N Fertilizers' included in the BUR3 and NC5 of the RM to the UNFCCC, kt CO_2 equivalent

	1990	1991	1992	1993	1994	1995	1996	1997
BUR3	255.4218	225.5264	207.1594	176.8587	171.7681	156.2680	161.6677	127.2290
NC5	255.4218	225.5264	207.1594	176.8587	171.7681	156.2680	161.6677	127.2290
Difference, %	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	1998	1999	2000	2001	2002	2003	2004	2005
BUR3	120.4089	109.6464	97.5490	99.5026	100.3474	95.0667	91.4602	96.3065
NC5	119.9734	109.2888	97.1726	99.1249	99.9660	94.7383	91.2389	96.0473
Difference, %	-0.4	-0.3	-0.4	-0.4	-0.4	-0.3	-0.2	-0.3
	2006	2007	2008	2009	2010	2011	2012	2013
BUR3	98.5819	75.9769	74.5502	83.1683	85.6858	78.5343	72.5454	68.8856
NC5	98.3298	75.8346	74.4779	83.0720	85.6042	78.4594	72.4756	68.8183
Difference, %	-0.3	-0.2	-0.1	-0.1	-0.1	-0.1	-0.1	-0.1
	2014	2015	2016	2017	2018	2019	2020	%
BUR3	75.0019	72.9498	75.1846	71.4945	64.1245	57.7742		
NC5	74.9368	72.8838	73.7694	70.4205	62.0261	56.0752	48.4486	-81.0
Difference, %	-0.1	-0.1	-1.9	-1.5	-3.3	-2.9		

Abbreviations: BUR3 – Third Biennial Update Report of the RM to the UNFCCC, NC5 – Fifth National Communication of the RM to the UNFCCC..

Planned Improvements

No activities to improve the estimation process regarding direct N_2O emissions from applied organic fertilizers in the RM are planned for the next inventory cycle.

5.4.1.3. Urine and Dung Deposited by Grazing Animals

Source Category Description

By 2020, hayfields and pastures occupied circa 339.9 thousand ha (10.1% of the country's area). Worldwide, permanent grasslands, hayfields and pastures generally occupy a surface twice as big as arable lands. However, this surface is 5 times smaller in the RM. Generally, the surface of land occupied by pastures varies between 0.3 and 300 ha, these being pastures on steep slopes, where agricultural machinery cannot be used, as well as lowlands with excessive amount of water due to flooding or superficial level of surface waters. In the RM, grazing takes place from March through November, involving a large number of cattle, regardless of weather. Nitrous oxide is produced naturally in soils through the processes of ammonification, nitrification and denitrification of N inputs from urine and dung N deposited on pasture by grazing animals. In these process, direct N_2O emissions are produced.

Methodological Issues, Emission Factors and Data Sources

Direct N_2O emissions from urine and dung deposited by grazing animals were estimated using a Tier 1 methodology applying Equations 11.1 and 11.2 from the 2006 IPCC Guidelines:

$$N_2O_{PRP} = F_{PRP} \bullet EF_{3\ PRP} \bullet 44/28$$

Where:

N_2O_{PRP} – N_2O emissions from urine and dung deposited by grazing animals;

F_{PRP} – annual amount of urine and dung N deposited by grazing animals on pasture, range and paddock (kg N/yr):

$$F_{PRP} = \Sigma_{(s)} [(N_{(T)} \bullet N_{ex\ (T)}) \bullet MS_{(T,\ PRP)}]$$

Where:

$N_{(T)}$ – number of head of livestock species/category T in the country (see source category 3A);

$N_{ex\ (T)}$ – annual average N excretion per animal of species/category T in the country (kg N/animal/yr) (see source category 3B);

$MS_{(T,\ PRP)}$ – fraction of annual amount of urine and dung N deposited by grazing animals on pasture, range and paddock/number of head of livestock species/category T (see source category 3B);

$EF_{3\ PRP}$ – default emission factor values are: 0.02 kg N_2O-N/kg N for cattle, swine and poultry; 0.01 kg N_2O-N/kg N for other animal categories;

[44/28] – mass ratio of nitrogen content in N_2O-N and N_2O.

In order to estimate the amount of nitrogen from urine and dung deposited by grazing animals (Table 5-65), activity data were used on the total population of livestock and poultry from the Statistical Annual Report No. 24-agr 'Animal Breeding Sector': 'The Number of Livestock and Poultry in all Households Categories as of January 1' (annually for the period 1990-2020), Statistical Yearbooks of the ATULBD (identical AD to those used under categories 3A 'Enteric Fermentation' and 3B 'Manure Management'), country-specific data on nitrogen excretion rate $N_{ex(T)}$ (in kg N/head/yr), and country-specific values of the different manure management systems used (identical to those used under 3B 'Manure Management').

Table 5-65: Annual amount of urine and dung nitrogen deposited by grazing animals on pasture, range and paddock between 1990-2020, kt

	1990	1991	1992	1993	1994	1995	1996	1997
F_{PRP}	7.5735	9.4632	9.0904	11.3944	11.3683	11.6633	10.8571	9.5347
	1998	1999	2000	2001	2002	2003	2004	2005
F_{PRP}	10.4221	9.6861	9.3852	9.4625	9.9027	9.2932	8.8609	8.7819
	2006	2007	2008	2009	2010	2011	2012	2013
F_{PRP}	8.7505	7.0606	7.2414	7.7838	7.7559	7.1786	6.8555	6.7558
	2014	2015	2016	2017	2018	2019	2020	%
F_{PRP}	7.3516	7.1180	7.1803	6.9519	6.0737	5.3624	4.7258	-37.6

Uncertainties and Time-Series Consistency

There is a high degree of uncertainty related to N_2O emission estimations from this source category due to high uncertainties associated with the estimation of the amount of N excreted with urine and dung deposited by grazing animals (circa 30%), and uncertainties associated with the default emission factor (EF_3) specific to this process (circa 50%). Combined uncertainties associated with activity data and emission factors for source category 3D.a.3 'Urine and Dung Deposited by Grazing Animals' are considered to be average (circa 58.31%) (Annex 5-3.3).

In view of ensuring time-series consistency of the obtained results, the same approach was used for the entire period under review, in conformity with the recommendations included in the 2006 IPCC Guidelines.

Quality Assurance and Quality Control

Standard verification and quality control forms and check-list were filled in for this source category within Sector 3 'Agriculture', following a Tier 1 approach. The AD and methods used to estimate N_2O emissions from N urine and dung deposited by grazing animals under this category were documented and archived both in hard copies and electronically. In order to identify the data entry and GHG emission estimation process-related errors, AD and EF verifications and quality control procedures were applied. Following the recommendations included in the 2006 IPCC Guidelines, N_2O emissions from urine and dung deposited by grazing animals were estimated using AD from official reference sources.

Recalculations

Direct N_2O_{PRP} emissions from source category 3D.a.3 'Urine and Dung Deposited by Grazing Animals' were recalculated for the period 2012-2019, particularly due to the use of updated shares of manure management systems (MS%) applied based on a study developed in 2015 and 2021 by specialists of the National Agency for Food Safety. In comparison with the results recorded in the BUR3 of the RM to the UNFCCC, the changes made in the current inventory cycle resulted in a downward trend in direct N_2O_{PRP} emissions from urine and dung deposited by grazing animals for 2012-2016, varying between a minimum of 0.3% and a maximum of 3.4% (Table 5-66).

Table 5-66: Comparative results of direct N_2O_{PRP} emissions from 3D.a.3 'Urine and Dung Deposited by Grazing Animals' included in the BUR3 and NC5 of the RM to the UNFCCCF, kt

	1990	1991	1992	1993	1994	1995	1996	1997
BUR3	0.1807	0.2395	0.2251	0.2869	0.2806	0.2998	0.2763	0.2455
NC5	0.1807	0.2395	0.2251	0.2869	0.2806	0.2998	0.2763	0.2455
Difference, %	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	1998	1999	2000	2001	2002	2003	2004	2005
BUR3	0.2709	0.2514	0.2447	0.2481	0.2569	0.2386	0.2260	0.2241
NC5	0.2709	0.2514	0.2447	0.2481	0.2569	0.2386	0.2260	0.2241
Difference, %	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	2006	2007	2008	2009	2010	2011	2012	2013
BUR3	0.2212	0.1756	0.1770	0.1900	0.1898	0.1756	0.1654	0.1591
NC5	0.2212	0.1756	0.1770	0.1900	0.1898	0.1756	0.1650	0.1586
Difference, %	0.0	0.0	0.0	0.0	0.0	0.0	-0.3	-0.3
	2014	2015	2016	2017	2018	2019	2020	%
BUR3	0.1716	0.1673	0.1680	0.1634	0.1434	0.1269		
NC5	0.1710	0.1668	0.1657	0.1610	0.1389	0.1226	0.1060	-41.4
Difference, %	-0.3	-0.3	-1.4	-1.5	-3.2	-3.4		

Abbreviations: BUR3 – Third Biennial Update Report of the RM to the UNFCCC, NC5 – Fifth National Communication of the RM to the UNFCCC.

For 2020, direct N_2O_{PRP} emissions from urine and dung deposited by grazing animals were estimated for the first time. The results allow us to assert that over the period 1990-2020, the respective emissions decreased by circa 41.4%, due to the reduction of the total livestock and poultry population and changes in the share of manure management systems.

Table 5-67 below shows the comparative results of direct N_2O_{PRP} emissions from urine and dung deposited by grazing animals for the period 1990-2020, expressed in kt CO_2 equivalent using the GWP_{100} values available in the IPCC AR4 ($GWP_{100} = 298$).

Table 5-67: Comparative results of direct N_2O_{PRP} emissions from source category 3D.a.3 'Urine and Dung Deposited by Grazing Animals' included in the BUR3 and NC5 of the RM to the UNFCCC, kt CO_2 equivalent

	1990	1991	1992	1993	1994	1995	1996	1997
BUR3	53.8411	71.3567	67.0890	85.4882	83.6134	89.3328	82.3343	73.1452
NC5	53.8411	71.3567	67.0890	85.4882	83.6134	89.3328	82.3343	73.1452
Difference, %	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	1998	1999	2000	2001	2002	2003	2004	2005
BUR3	80.7339	74.9079	72.9094	73.9328	76.5423	71.0935	67.3462	66.7788
NC5	80.7339	74.9079	72.9094	73.9328	76.5423	71.0935	67.3462	66.7788
Difference, %	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	2006	2007	2008	2009	2010	2011	2012	2013
BUR3	65.9181	52.3419	52.7535	56.6075	56.5567	52.3378	49.3006	47.4177
NC5	65.9181	52.3419	52.7535	56.6075	56.5567	52.3378	49.1599	47.2776
Difference, %	0.0	0.0	0.0	0.0	0.0	0.0	-0.3	-0.3
	2014	2015	2016	2017	2018	2019	2020	%
BUR3	51.1317	49.8657	50.0634	48.6822	42.7271	37.8123		
NC5	50.9713	49.7112	49.3783	47.9652	41.3807	36.5306	31.5771	-41.4
Difference, %	-0.3	-0.3	-1.4	-1.5	-3.2	-3.4		

Abbreviations: BUR3 – Third Biennial Update Report of the RM to the UNFCCC, NC5 – Fifth National Communication of the RM to the UNFCCC.

Planned Improvements

No activities to improve the estimation process regarding direct N_2O emissions from urine and dung deposited by grazing animals are planned for the next inventory cycle.

5.4.1.4. Crop Residues

Source Categories Description

During crop harvesting, a part of the crop, as agricultural residues (above-ground and below-ground), is left in the field to decompose. The nitrogen in crop residues is a relevant source for nitrification and denitrification, contributing to N_2O emissions.

Emission calculation requires taking into account both the amount of crop residues burnt in fields to clean the stubble fields for the next agricultural cycle, as well as the amount of crop residues to be removed annually for purposes such as feed, bedding, burnt for heating and cooking, etc.

Methodological Issues, Emission Factors and Data Sources

N_2O emissions from this source category were estimated using the *'Methodology of determining the carbon balance in agricultural soils to assess GHG emissions'* (see Annex A3-4.2)[96].

In order to calculate emissions, Equation 11.2 in the 2006 IPCC Guidelines was applied:

$$N_2O_{CR} = F_{CR} \bullet EF_1 \bullet 44/28$$

Where:

F_{CR} – annual amount of N in crop residues returned to soils annually, t N/yr;

EF_1 – default value of emission factor is 0.01 kg N_2O-N/kg N;

[44/28] – mass ratio of nitrogen content in N_2O-N and N_2O.

The total amount of N in crop residues returned to soils was estimated using the following equation:

$$F_{CR} = (Crop_{(T)} \bullet R_{AG(T)} \bullet (1\text{-}Frac_{Remove(T)}) + Crop_{(T)} \bullet R_{BG(T)}) \bullet (P_{CR}/10^2) \bullet (k_6/10^2)$$

Where:

$Crop_{(T)}$ – harvested annual dry matter yield for crop T t.d.m./ha;

$$Crop_{(T)} = Yield\ Fresh_{(T)} \bullet DRY$$

$Yield\ Fresh_{(T)}$ – harvested fresh yield for crop T, t/ha;

DRY – dry matter fraction of harvested crop T, kg dm/t of yield[97] (see Table 6-62);

$R_{AG(T)}$ – ratio of above-ground residues dry matter to harvested yield for crop T (Crop(T)), $t.d.m_{AG}$/t.d.m[98] (see Table 5-68);

[96] Banaru, Anatol (2000), *Methodology to Calculate CO_2 Emissions from Agricultural Soils,* In the collection of papers 'Climate Change: Research, Studies, Solutions', Ministry of Environment / UNDP Moldova. 'Bons Offices' Ltd. Chisinau, 2000, pages 115-123

[97] 2006 IPCC Guidelines, Volume 4, Chapter 11, Table 11.2, Page 11.17.

[98] Nicolaev N., Boincean B., Sidorov M., Vanicovici Gh., Coltun V. (2006), *Agrotechnics.* Ministry of Education and Youth of the RM – Balti: Balti University Press, 2006, page 298.

$R_{BG(T)}$ – ratio of below-ground residues to harvested yield for crop T, t.d.m$_{BG}$/t dm[99] (see Table 5-70);
$Frac_{Remove(T)}$ – fraction of above-ground residues of crop T removed and used for other purposes[100] (see Table 5-70) (it should be noted that in dry years, the fraction of crop residues reaches up to 90%);
P_{CR} – amount of nitrogen in crop residues (% a.s.) (Table 5-69);
k_6 – coefficient reflecting the N in crop residues (Banaru, 2002)[101] (Table 5-69).

Coefficients used to estimate N_2O emissions from crop residues returned to soils come from different official reference sources, including the 2006 IPCC Guidelines.

Table 5-68: Coefficients used to estimate the amount of carbon in crop residues returned to soils

Crop	DRY	$R_{AG\,(T)}$	$R_{BG\,(T)}$	$Frac_{Remove\,(T)}$
Winter wheat	0.89	1.40	0.23	0.75
Winter rye	0.88	1.30	0.22	0.75
Barley	0.89	1.17	0.22	0.75
Oat	0.89	1.17	0.25	0.75
Buckwheat	0.88	1.17	0.25	0.75
Millet	0.88	1.17	0.22	0.40
Grain maize	0.87	1.17	0.22	0.70
Sorghum	0.89	1.17	0.22	0.50
Pea, bean, vetch	0.90	1.30	0.19	0.40
Soybeans	0.91	1.30	0.19	0.00
Sugar beet	0.22	0.29	0.20	0.00
Sunflower	0.90	3.80	0.22	0.40
Tobacco	0.90	5.77	0.19	0.00
Grain rapeseed	0.88	1.17	0.22	0.00
Potatoes	0.22	0.17	0.20	0.00
Vegetables	0.22	0.17	0.20	0.00
Melons and gourds	0.22	0.17	0.20	0.00
Fodder beet	0.22	0.14	0.20	0.00
Maize for silo and green fodder	0.23	0.25	0.22	0.77
Perennial grasses for green fodder, silo and fodder	0.26	0.25	0.40	0.74
Annual grasses (oat and vetch) for green fodder	0.22	0.25	0.40	0.78

Table 5-69: Amount of N in crop residues (average values from the literature in the field)

Crop	P_{CR}, % (a.s.)	k_6
Winter wheat	0.50	Use of N from vegetal residues represents 25% of the total contents
Winter rye	1.05	
Winter barley	0.80	
Oat	0.60	
Millet	1.25	
Buckwheat	0.60	
Leguminous crops	2.08	
Grain maize	1.08	
Grain sorghum	1.00	
Other cereal crops	0.60	
Sugar beet	1.65	
Sunflower	0.95	
Soybeans	2.08	
Tobacco	1.30	
Grain Rapeseed	1.05	
Potatoes	0.40	
Vegetables	2.09	
Melons and gourds	1.19	
Root crops for fodder	1.65	
Maize for silo and green fodder	1.08	
Perennial grasses for green fodder, silo and fodder	2.48	
Annual grasses for green fodder	1.60	

Activity data on areas sown with crops and average yield per ha for the main crops is available in the Statistical Yearbooks of the RM and those of the ATULBD (Tables 5-70, 5-71 and 5-72).

[99] 2006 IPCC Guidelines, Volume 4, Chapter 11, Table 11.2, Page 11.17.
[100] Expert opinion, Prof. Valerian Cerbari, 'Nicolae Dimo' Institute of Pedology, Agrochemistry and Soil Protection.
[101] Banaru A. (2002), Methodological Guidelines to Determine Humus Balance in Arable Soils, Ministry of Agriculture and Food Industry of the RM, 'Nicolae Dimo' Institute of Pedology, Agrochemistry and Soil Protection and TACIS FDMOL 9901 Project 'Support to Developing Education, Research and Extension Services in Agriculture', Chisinau, 2002, 23 pages.

Table 5-70: Areas sown with crops between 1990-2020, thousand hectares

	1990	1991	1992	1993	1994	1995	1996	1997
Sown areas – total	**1,733.1**	**1,717.0**	**1,711.1**	**1,779.5**	**1,715.5**	**1,725.4**	**1,717.4**	**1,726.3**
Cereals and leguminous crops – total	**745.7**	**837.0**	**746.6**	**910.7**	**830.1**	**920.5**	**902.4**	**1,055.5**
…wheat (winter and spring)	286.7	303.0	281.7	345.9	300.4	393.9	380.9	410.3
…winter rye	0.9	0.8	0.7	1.1	1.7	2.7	4.7	3.9
…barley (winter and spring)	120.4	134.0	123.0	139.0	147.0	135.0	108.7	129.5
…oat	2.1	3.0	3.0	4.0	5.0	5.8	3.7	6.5
…millet	0.1	0.1	0.1	0.1	0.1	0.2	0.3	0.3
…buckwheat	3.6	6.0	7.0	7.0	8.0	5.5	7.4	7.3
…leguminous crops	72.6	77.0	71.2	70.7	65.5	54.0	44.6	46.2
…grain maize	258.0	310.0	259.4	342.6	283.4	321.3	350.0	450.7
…grain sorghum	1.2	3.1	0.5	0.3	1.2	1.1	0.3	0.3
…other cereal crops	0.1	0.0	0.0	0.0	17.8	1.0	1.8	0.5
Industrial crops – total	**295.3**	**277.0**	**275.3**	**262.7**	**263.5**	**284.0**	**333.7**	**300.0**
…sugar beet	81.5	79.9	82.6	83.0	83.0	90.3	83.9	76.3
…sunflower	134.1	126.9	130.9	125.5	139.5	163.2	225.1	199.0
…soybeans	26.5	24.1	16.6	9.3	5.6	3.6	2.3	2.3
…tobacco	32.1	32.5	28.1	31.2	28.4	20.1	16.4	17.3
…grain rapeseed	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
…other industrial crops	21.1	13.6	17.1	13.7	7.0	6.6	6.0	5.1
Potatoes, vegetables and melons & gourds – total	**131.8**	**141.0**	**143.1**	**156.9**	**140.4**	**142.0**	**130.3**	**135.4**
…potatoes	41.2	46.9	55.3	71.1	62.8	57.1	59.6	62.3
…vegetables	71.1	78.0	73.7	73.2	68.1	74.0	61.4	63.5
…melons gourds	9.2	8.0	7.0	6.0	5.0	7.6	6.7	7.9
…other	10.3	8.1	7.1	6.6	4.5	3.3	2.6	1.7
Forage crops – total	**560.3**	**462.0**	**546.1**	**449.2**	**481.5**	**379.0**	**351.0**	**235.4**
…forage roots	26.4	30.0	29.0	28.0	24.0	24.5	17.6	16.3
…maize for silo and green fodder	292.3	200.0	299.3	215.8	265.5	179.0	181.0	98.7
…perennial grasses for green fodder, silo and fodder	206.3	205.2	182.9	174.9	157.3	144.7	124.0	102.6
…annual grasses for green fodder	31.4	26.8	35.0	30.5	34.7	29.3	27.0	16.8
…other	3.9	0.0	0.0	0.0	0.0	1.3	1.4	1.0
	1998	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**
Sown areas – total	**1,717.6**	**1,663.8**	**1,701.4**	**1,733.4**	**1,736.2**	**1,593.1**	**1,682.5**	**1,698.1**
Cereals and leguminous crops – total	**1,039.0**	**1,024.7**	**1,077.4**	**1,172.1**	**1,165.7**	**940.6**	**1,144.6**	**1,131.7**
…wheat (winter and spring)	405.8	392.1	423.8	490.0	502.8	213.2	342.4	456.1
…winter rye	3.7	3.9	3.8	5.5	3.6	1.3	2.6	3.2
…barley (winter and spring)	134.0	128.5	125.0	115.4	133.7	96.1	140.8	147.8
…oat	6.1	4.9	4.2	4.8	4.3	4.6	5.9	6.4
…millet	0.3	0.2	0.4	0.0	0.1	0.2	0.5	0.2
…buckwheat	11.1	16.8	12.1	13.7	5.1	4.9	4.1	3.1
…leguminous crops	58.8	64.7	53.6	52.2	59.9	48.3	37.9	43.3
…grain maize	416.7	411.7	454.1	488.7	454.7	567.9	604.1	469.1
…grain sorghum	0.2	0.1	0.4	1.0	0.5	3.1	3.8	0.7
…other cereal crops	2.2	1.7	0.0	0.8	0.7	0.8	2.5	1.8
Industrial crops – total	**344.7**	**355.1**	**364.9**	**336.6**	**358.6**	**447.9**	**367.2**	**392.6**
…sugar beet	76.4	65.5	66.6	63.3	52.0	39.7	34.9	34.4
…sunflower	234.5	246.0	256.9	237.8	280.7	381.3	293.0	309.2
…soybeans	6.3	17.0	11.6	11.5	10.2	18.3	28.5	36.9
…tobacco	22.0	18.8	23.7	17.2	9.3	5.6	5.8	4.8
…grain rapeseed	0.0	1.0	1.0	1.0	1.0	1.0	0.9	2.4
…other industrial crops	5.2	5.9	3.9	5.8	4.2	2.0	4.1	4.9
Potatoes, vegetables and melons & gourds – total	**127.9**	**131.0**	**132.3**	**122.5**	**112.6**	**92.5**	**81.4**	**84.0**
…potatoes	62.0	66.6	65.4	43.0	45.1	38.6	34.8	36.7
…vegetables	58.6	56.3	56.8	69.6	58.7	43.7	38.2	39.8
…melons gourds	5.2	6.0	7.9	7.5	6.5	8.7	7.3	5.2
…other	2.1	2.1	2.2	2.4	2.3	1.5	1.1	2.2
Forage crops – total	**206.0**	**153.0**	**126.8**	**102.3**	**99.3**	**112.1**	**89.3**	**89.9**
…forage roots	15.5	14.3	11.5	4.5	4.1	4.5	3.7	2.5
…maize for silo and green fodder	97.1	62.8	49.7	40.3	35.1	44.5	24.6	18.2
…perennial grasses for green fodder, silo and fodder	75.2	58.3	53.1	48.4	49.8	50.9	53.6	60.2
…annual grasses for green fodder	17.3	16.9	11.3	8.1	8.9	11.3	6.1	8.1
…other	0.9	0.7	1.1	0.6	1.1	0.9	1.2	0.9

	2006	2007	2008	2009	2010	2011	2012	2013
Sown areas – total	**1,546.9**	**1,552.4**	**1,552.0**	**1,593.0**	**1,628.2**	**1,597.3**	**1,653.5**	**1,686.3**
Cereals and leguminous crops – total	**953.9**	**989.2**	**1,034.8**	**1,033.8**	**1,020.3**	**991.6**	**1,037.3**	**1,080.0**
…wheat (winter and spring)	316.1	333.6	429.6	395.8	380.8	353.2	374.2	432.7
…winter rye	0.7	0.8	1.0	1.9	1.6	0.6	1.3	2.0
…barley (winter and spring)	123.2	138.1	139.4	184.7	164.9	128.4	114.1	126.9
…oat	4.5	4.4	2.8	2.4	3.0	2.2	2.3	2.6
…millet	0.1	0.4	0.3	0.3	0.5	0.2	0.2	0.1
…buckwheat	3.8	1.3	0.8	1.0	0.2	0.6	0.9	0.3
…leguminous crops	42.2	40.1	28.3	36.1	39.5	30.2	25.2	23.5
…grain maize	461.4	469.2	429.5	407.3	425.7	473.8	516.9	488.9
…grain sorghum	0.4	0.2	0.2	0.2	0.2	0.1	0.1	0.1
…other cereal crops	1.4	1.3	2.8	3.8	3.5	2.3	1.6	2.0
Industrial crops – total	**413.3**	**376.7**	**355.9**	**401.0**	**440.5**	**477.2**	**462.7**	**463.3**
…sugar beet	42.4	34.3	24.7	23.4	26.5	25.4	31.2	28.7
…sunflower	299.7	241.1	239.1	249.5	288.1	320.9	348.4	348.3
…soybeans	55.9	50.9	31.0	51.0	61.5	61.0	62.5	42.8
…tobacco	3.5	3.1	2.7	2.5	4.4	3.8	2.4	1.5
…grain rapeseed	7.1	41.3	53.5	67.4	48.9	53.8	8.2	36.0
…other industrial crops	4.7	6.0	4.9	7.2	10.4	12.2	10.0	5.9
Potatoes, vegetables and melons & gourds – total	**90.1**	**84.0**	**83.2**	**78.7**	**80.5**	**76.4**	**68.4**	**69.9**
…potatoes	34.8	35.8	31.3	28.5	28.0	29.7	25.1	24.1
…vegetables	44.4	39.7	41.7	37.0	40.6	37.4	34.9	37.0
…melons gourds	9.1	7.1	8.8	11.9	10.6	8.2	7.3	7.8
…other	1.8	1.4	1.4	1.3	1.4	1.1	1.1	1.0
Forage crops – total	**89.6**	**102.4**	**78.1**	**79.5**	**86.8**	**79.7**	**85.1**	**73.2**
…forage roots	3.0	1.9	1.9	1.5	1.7	1.2	1.4	1.2
…maize for silo and green fodder	16.1	24.9	10.3	11.3	10.1	10.4	22.4	8.8
…perennial grasses for green fodder, silo and fodder	63.5	68.4	60.2	61.5	66.9	61.8	56.7	57.7
…annual grasses for green fodder	5.8	5.6	4.6	3.5	6.5	4.8	3.9	4.4
…other	1.1	1.6	1.1	1.7	1.6	1.4	0.7	1.1

	2014	2015	2016	2017	2018	2019	2020	%
Sown areas – total	**1,694.3**	**1,693.8**	**1,715.1**	**1,735.8**	**1,749.2**	**1,724.0**	**1,709.7**	-1.3
Cereals and leguminous crops – total	**1,055.1**	**1,065.3**	**1,074.2**	**1,050.7**	**1,095.4**	**1,074.7**	**1,050.9**	40.9
…wheat (winter and spring)	415.0	416.9	454.8	410.5	455.2	438.4	362.7	26.5
…winter rye	0.5	0.4	0.6	0.6	0.5	0.6	1.5	69.9
…barley (winter and spring)	120.9	104.8	101.4	96.9	77.9	63.3	63.2	-47.5
…oat	2.1	1.7	1.4	1.7	1.3	1.0	1.6	-22.8
…millet	0.1	0.1	0.9	0.1	0.1	0.1	0.1	15.0
…buckwheat	0.3	0.3	0.5	0.4	0.3	0.3	0.4	-89.4
…leguminous crops	22.5	24.9	26.3	37.1	46.1	42.9	34.9	-51.9
…grain maize	490.3	515.1	485.6	500.9	512.0	519.9	575.9	123.2
…grain sorghum	0.1	0.2	1.4	1.3	1.1	7.3	10.1	741.7
…other cereal crops	2.8	0.8	1.3	0.9	0.7	0.7	0.6	N/A
Industrial crops – total	**501.9**	**499.0**	**510.6**	**558.4**	**538.9**	**530.5**	**531.5**	80.0
…sugar beet	28.0	21.9	20.9	23.6	19.8	15.3	13.5	-83.4
…sunflower	371.0	380.6	416.2	451.0	419.3	410.0	447.0	233.3
…soybeans	56.5	69.7	41.4	35.5	29.4	38.1	29.3	10.5
…tobacco	0.9	0.8	0.6	0.5	0.4	0.3	0.4	-98.8
…grain rapeseed	38.2	13.3	22.4	36.1	58.2	53.6	29.9	N/A
…other industrial crops	7.2	12.5	9.0	11.8	11.8	12.9	11.1	-47.2
Potatoes, vegetables and melons & gourds – total	**67.1**	**59.6**	**61.5**	**59.9**	**55.6**	**66.2**	**72.4**	-45.1
…potatoes	23.1	22.5	20.9	19.9	19.2	18.7	23.2	-43.8
…vegetables	35.5	29.4	30.5	31.0	30.4	39.4	42.2	-40.6
…melons gourds	7.3	6.7	7.9	7.8	5.5	7.4	6.3	-31.5
…other	1.2	1.1	2.2	1.1	0.5	0.7	0.7	-93.2
Forage crops – total	**70.0**	**69.9**	**68.6**	**66.7**	**59.3**	**52.5**	**54.8**	-90.2
…forage roots	1.3	1.3	1.5	1.2	1.0	0.6	0.7	-97.3
…maize for silo and green fodder	9.3	11.2	8.0	6.8	6.3	5.7	11.8	-95.9
…perennial grasses for green fodder, silo and fodder	54.6	51.6	55.0	54.4	47.9	42.5	39.2	-81.0
…annual grasses for green fodder	3.9	4.4	2.2	2.6	2.6	2.1	2.0	-93.7
…other	0.9	1.4	1.8	1.7	1.6	1.6	1.0	-74.4

Source: NBS on-line database, Section 'Sown Area, crops average yield and harvest within 1980-2020: <http://statbank.statistica.md/pxweb/Database/RO/16%20AGR/AGR02/AGR02.asp>; Statistical Yearbooks of the ATULBD for: 1998 (page 218), 2002 (page 113), 2005 (page 101), 2009 (page 97), 2011 (page 100), 2014 (page 94), 2019 (page 109), 2020 (page 112), 2021 (page 112).

Table 5-71: Average yield for main agricultural crops for the period 1990-2020, kt

	1990	1991	1992	1993	1994	1995	1996	1997
Cereals and leguminous crops – total	**2538.6**	**3105.9**	**2099.8**	**3340.2**	**1753.8**	**2638.6**	**1981.2**	**3512.3**
…wheat (winter and spring)	1129.0	1056.5	925.8	1392.6	658.8	1154.3	673.7	1152.6
…winter rye	1.9	1.6	1.4	2.8	2.7	5.9	9.9	10.9
…barley (winter and spring)	417.9	427.0	405.0	481.0	324.9	311.2	136.7	256.9
…oat	3.8	5.0	6.8	10.7	7.1	9.8	4.2	10.3
…millet	0.1	0.1	0.0	0.1	0.1	0.3	0.2	0.5
…buckwheat	1.8	5.0	2.3	5.5	3.5	2.2	3.0	4.8
…leguminous crops	97.1	105.7	121.8	121.6	70.2	55.4	31.6	63.2
…grain maize	885.5	1501.2	635.6	1324.5	629.3	948.6	1006.6	1788.0
…grain sorghum	1.2	3.1	1.1	1.4	1.1	0.8	0.1	0.5
…other cereal crops	0.3	0.7	0.0	0.0	56.1	0.3	0.2	0.0
Industrial crops								
…sugar beet	2374.5	1988.6	1783.4	2048.3	1526.7	1877.9	1682.1	1674.8
…sunflower	252.2	151.4	176.2	173.7	149.2	208.1	284.0	174.3
…soybeans	23.8	33.4	7.9	9.3	4.0	3.3	2.5	2.7
…tobacco	66.2	62.8	42.4	50.2	41.5	27.1	19.8	23.9
…grain rapeseed	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Potatoes, vegetables and melons & gourds								
…potatoes	295.3	290.6	310.8	726.0	474.7	385.3	344.3	392.6
…vegetables	1177.3	989.2	787.5	777.2	598.5	568.8	362.4	393.6
…melons gourds	34.4	35.6	9.3	18.6	12.6	23.3	23.3	30.4
Forage crops								
…forage roots	1171.8	1416.4	922.5	988.6	547.0	597.0	336.5	310.2
…maize for silo and green fodder	4509.0	4979.1	3025.9	3358.7	2285.7	2136.2	1212.0	1065.0
…perennial grasses for green fodder, silo and fodder	4456.1	6053.5	3401.4	3514.6	2013.8	1704.7	1027.2	855.6
…annual grasses for green fodder	288.9	420.7	339.0	339.1	190.7	222.3	143.4	96.7
	1998	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**
Cereals and leguminous crops – total	**2751.9**	**2375.0**	**2070.2**	**2847.5**	**2791.2**	**1654.4**	**3178.0**	**3059.9**
…wheat (winter and spring)	951.9	797.8	725.0	1180.8	1113.1	102.4	861.2	1048.6
…winter rye	7.0	6.3	5.0	9.3	5.9	0.8	5.1	6.1
…barley (winter and spring)	242.2	203.1	152.3	248.4	241.7	74.4	284.1	240.9
…oat	9.5	5.9	3.5	6.4	4.7	4.0	10.3	7.6
…millet	0.1	0.0	0.1	0.0	0.1	0.1	0.3	0.2
…buckwheat	4.3	6.1	8.0	6.4	1.4	1.6	1.2	1.1
…leguminous crops	76.9	61.6	30.8	79.1	50.2	30.2	51.0	67.1
…grain maize	1272.7	1151.3	1050.4	1141.9	1206.3	1440.2	1845.1	1523.4
…grain sorghum	0.2	0.3	0.5	1.1	0.5	4.4	3.4	0.3
…other cereal crops	4.7	6.0	3.2	5.7	4.2	0.7	3.7	12.3
Industrial crops								
…sugar beet	1356.8	956.4	982.5	1120.6	1157.4	660.3	911.3	996.2
…sunflower	196.4	291.6	305.1	278.3	340.9	421.4	354.8	368.7
…soybeans	6.0	13.7	11.6	10.5	12.6	19.4	40.2	66.4
…tobacco	24.6	22.6	26.3	16.3	12.4	7.2	7.9	6.7
…grain rapeseed	0.0	1.2	1.1	1.0	1.0	1.2	1.1	3.4
Potatoes, vegetables and melons & gourds								
…potatoes	372.5	330.6	330.4	388.6	326.0	303.2	321.8	391.1
…vegetables	570.8	535.8	396.1	487.4	408.4	371.7	328.7	410.3
…melons gourds	25.9	33.9	31.7	39.3	29.0	72.7	57.3	49.3
Forage crops								
…forage roots	286.4	170.1	125.0	63.5	67.9	55.7	52.7	41.6
…maize for silo and green fodder	856.5	428.6	350.7	316.4	322.8	327.9	219.4	199.6
…perennial grasses for green fodder, silo and fodder	498.5	506.8	317.4	201.5	173.4	145.4	206.7	183.8
…annual grasses for green fodder	106.6	53.7	28.8	19.3	16.0	12.6	12.6	16.3
	2006	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**
Cereals and leguminous crops – total	**2371.2**	**932.5**	**3261.6**	**2375.5**	**2674.3**	**2794.6**	**1359.0**	**3130.0**
…wheat (winter and spring)	682.3	406.5	1286.5	738.9	749.5	797.1	496.9	1009.6
…winter rye	1.1	0.8	2.0	3.4	2.4	1.0	2.6	5.7
…barley (winter and spring)	214.6	125.7	362.3	290.5	240.7	218.9	139.3	241.6
…oat	6.1	1.4	3.9	1.6	3.1	3.6	2.0	3.8
…millet	0.0	0.1	0.5	0.7	0.3	0.1	0.1	0.1
…buckwheat	0.5	0.4	0.5	0.6	0.5	0.5	0.3	0.4
…leguminous crops	68.4	14.4	38.0	32.0	40.1	33.1	17.3	24.1
…grain maize	1327.6	363.2	1484.1	1159.6	1462.1	1547.2	587.2	1546.5
…grain sorghum	0.5	0.1	0.1	0.2	0.2	0.1	0.1	0.4
…other cereal crops	15.2	1.1	8.1	5.3	7.7	4.8	2.1	5.4
Industrial crops								
…sugar beet	1177.3	612.3	960.7	337.4	837.6	588.6	587.0	1009.0
…sunflower	396.1	158.7	387.2	310.2	440.2	497.4	339.1	602.2
…soybeans	80.2	40.0	58.8	50.1	113.0	80.6	48.9	67.6
…tobacco	4.9	3.6	3.9	4.4	7.6	5.4	2.9	2.2

	2006	2007	2008	2009	2010	2011	2012	2013
…grain rapeseed	6.9	34.9	100.1	81.6	51.0	67.7	8.1	58.8
Potatoes, vegetables and melons & gourds								
…potatoes	384.1	200.9	273.7	264.8	286.7	362.9	191.5	244.0
…vegetables	490.6	226.6	389.4	322.8	365.8	396.0	251.9	319.1
…melons gourds	92.6	41.2	69.9	102.4	104.9	85.2	52.6	56.6
Forage crops								
…forage roots	34.9	13.8	26.4	20.0	31.7	23.2	10.6	22.2
…maize for silo and green fodder	153.3	104.6	113.0	106.4	143.8	125.2	110.8	166.6
…perennial grasses for green fodder, silo and fodder	194.9	177.0	364.2	213.4	323.9	238.5	116.6	239.3
…annual grasses for green fodder	13.6	7.4	15.3	7.9	10.9	11.3	8.1	15.5
	2014	2015	2016	2017	2018	2019	2020	%
Cereals and leguminous crops – total	**3341.0**	**2587.0**	**3531.7**	**3813.4**	**3946.8**	**4020.6**	**1638.9**	-35.4
…wheat (winter and spring)	1102.6	927.4	1302.4	1258.6	1169.1	1152.3	655.3	-42.0
…winter rye	1.4	1.0	1.8	2.3	1.7	1.9	3.0	56.9
…barley (winter and spring)	244.7	199.1	273.9	265.0	188.2	178.2	118.4	-71.7
…oat	2.9	1.6	2.8	3.6	1.5	1.6	1.7	-55.0
…millet	0.2	0.2	1.1	0.1	0.1	0.2	0.0	-56.7
…buckwheat	0.4	0.2	0.9	0.7	0.3	0.4	0.6	-66.9
…leguminous crops	32.9	25.1	45.1	75.2	51.5	56.6	29.3	-69.9
…grain maize	1642.1	1133.6	1485.5	1871.0	2208.0	2263.7	821.2	-7.3
…grain sorghum	0.3	0.2	5.1	4.5	4.6	48.9	12.5	941.7
…other cereal crops	8.3	2.8	4.4	4.5	2.2	1.7	0.7	133.3
Industrial crops								
…sugar beet	1356.2	537.5	664.8	876.3	707.2	607.0	423.2	-82.2
…sunflower	627.1	562.3	789.4	925.1	898.7	915.3	547.3	117.0
…soybeans	111.4	49.2	43.8	48.5	59.7	64.8	33.4	40.4
…tobacco	1.4	1.2	0.9	1.0	0.7	0.5	0.4	-99.4
…grain rapeseed	90.2	25.6	52.4	89.9	120.8	110.2	56.3	N/A
Potatoes, vegetables and melons & gourds								
…potatoes	275.7	163.8	220.3	201.7	177.7	181.8	179.5	-39.2
…vegetables	352.3	266.9	320.6	340.9	301.2	339.4	259.8	-77.9
…melons gourds	48.3	56.7	69.3	59.6	49.1	47.0	30.3	-11.9
Forage crops								
…forage roots	26.1	14.6	21.0	21.4	19.8	18.2	3.5	-99.7
…maize for silo and green fodder	135.7	91.7	139.6	111.7	133.8	116.2	116.6	-97.4
…perennial grasses for green fodder, silo and fodder	304.7	136.0	209.6	199.2	203.8	177.3	137.1	-96.9
…annual grasses for green fodder	16.9	12.4	13.3	13.2	12.0	16.8	21.7	-92.5

Source: NBS on-line database, Section 'Sown Area, crop average yield and harvest within 1980-2020', <http://statbank.statistica.md/pxweb/Database/RO/16%20AGR/AGR02/AGR02.asp>; Statistical Yearbooks of the ATULBD for 1998 (page 218), 2002 (page 113), 2005 (page 101), 2009 (page 98), 2011 (page 101), 2014 (page 95), 2019 (page 110), 2020 (page 113), 2021 (page 113).

Table 5-72: Average yield per hectare for agricultural crops over the period 1990-2020, t/ha

	1990	1991	1992	1993	1994	1995	1996	1997
Cereals and leguminous crops – total	**3.4**	**3.7**	**2.8**	**3.7**	**2.1**	**2.9**	**2.2**	**3.3**
…wheat (winter and spring)	3.9	3.5	3.3	4.0	2.2	2.9	1.8	2.8
…winter rye	2.1	2.0	2.0	2.6	1.6	2.2	2.1	2.8
…barley (winter and spring)	3.5	3.2	3.3	3.5	2.2	2.3	1.3	2.0
…oat	1.8	1.7	2.3	2.7	1.4	1.7	1.1	1.6
…millet	1.0	1.0	0.4	1.0	0.6	1.4	0.7	1.6
…buckwheat	0.5	0.8	0.3	0.8	0.4	0.4	0.4	0.7
…leguminous crops	1.3	1.4	1.7	1.7	1.1	1.0	0.7	1.4
…grain maize	3.4	4.8	2.5	3.9	2.2	3.0	2.9	4.0
…grain sorghum	1.9	2.6	0.9	1.1	0.9	0.7	0.4	1.2
…other cereal crops	1.7	1.6	1.3	1.8	2.8	1.7	1.3	2.0
Industrial crops								
…sugar beet	29.1	24.9	21.6	24.7	18.4	20.8	20.0	22.0
…sunflower	1.9	1.2	1.3	1.4	1.1	1.3	1.3	0.9
…soybeans	0.9	1.4	0.5	1.0	0.7	0.9	1.1	1.2
…tobacco	2.1	1.9	1.5	1.6	1.5	1.3	1.2	1.4
…grain rapeseed	2.0	2.0	1.6	1.2	1.0	0.8	0.7	1.0
Potatoes, vegetables and melons & gourds								
…potatoes	7.2	6.2	5.6	10.2	7.6	6.8	5.8	6.3
…vegetables	16.6	12.7	10.7	10.6	8.8	7.7	5.9	6.2
…melons gourds	3.7	4.5	1.3	3.1	2.5	3.1	3.5	3.8
Forage crops								
…forage roots	44.4	47.2	31.8	35.3	22.8	24.4	19.1	19.0
…maize for silo and green fodder	15.4	24.9	10.1	15.6	8.6	11.9	6.7	10.8
…perennial grasses for green fodder, silo and fodder	21.6	29.5	18.6	20.1	12.8	11.8	8.3	8.3
…annual grasses for green fodder	9.2	15.7	9.7	11.1	5.5	9.0	6.5	7.2

	1998	1999	2000	2001	2002	2003	2004	2005
Cereals and leguminous crops – total	**2.6**	**2.3**	**1.9**	**2.4**	**2.4**	**1.8**	**2.8**	**2.7**
…wheat (winter and spring)	2.3	2.0	1.7	2.4	2.2	0.5	2.5	2.3
…winter rye	1.9	1.6	1.3	1.7	1.6	0.6	2.0	1.9
…barley (winter and spring)	1.8	1.6	1.2	2.2	1.8	0.8	2.0	1.6
…oat	1.6	1.2	0.8	1.3	1.1	0.9	1.7	1.2
…millet	0.4	0.1	0.2	0.8	0.5	0.5	0.7	0.9
…buckwheat	0.4	0.4	0.7	0.5	0.3	0.3	0.3	0.4
…leguminous crops	1.3	1.0	0.6	1.5	0.8	0.6	1.3	1.6
…grain maize	3.1	2.8	2.3	2.3	2.7	2.5	3.1	3.2
…grain sorghum	0.8	2.6	1.2	1.1	1.0	1.4	0.9	0.4
…other cereal crops	1.7	1.9	1.2	1.6	1.5	1.3	1.3	1.4
Industrial crops								
…sugar beet	17.8	14.6	14.8	17.7	22.3	16.6	26.1	29.0
…sunflower	0.8	1.2	1.2	1.2	1.2	1.1	1.2	1.2
…soybeans	0.9	0.8	1.0	0.9	1.2	1.1	1.4	1.8
…tobacco	1.1	1.2	1.1	0.9	1.3	1.3	1.4	1.4
…grain rapeseed	0.9	1.2	1.0	1.0	1.0	1.0	1.2	1.4
Potatoes, vegetables and melons & gourds								
…potatoes	6.0	5.0	5.1	9.0	7.2	7.9	9.2	10.6
…vegetables	9.7	9.5	7.0	7.0	7.0	8.5	8.6	10.3
…melons gourds	5.0	5.7	4.0	5.2	4.5	8.4	7.8	9.4
Forage crops								
…forage roots	18.5	11.9	10.9	14.0	16.6	12.3	14.2	16.4
…maize for silo and green fodder	8.8	6.8	7.1	7.8	9.2	7.4	8.9	11.0
…perennial grasses for green fodder, silo and fodder	6.6	8.7	6.0	4.2	3.5	2.9	3.9	3.1
…annual grasses for green fodder	7.8	5.4	5.0	9.5	6.4	3.3	5.8	6.5
	2006	2007	2008	2009	2010	2011	2012	2013
Cereals and leguminous crops – total	**2.5**	**0.9**	**3.2**	**2.3**	**2.6**	**2.8**	**1.3**	**2.9**
…wheat (winter and spring)	2.2	1.2	3.0	1.9	2.0	2.3	1.3	2.3
…winter rye	1.6	1.1	1.9	1.8	1.5	1.8	2.0	2.8
…barley (winter and spring)	1.7	0.9	2.6	1.6	1.5	1.7	1.2	1.9
…oat	1.3	0.3	1.4	0.7	1.0	1.6	0.9	1.5
…millet	0.5	0.1	1.7	2.4	0.5	0.7	0.6	1.8
…buckwheat	0.1	0.3	0.6	0.6	3.2	0.8	0.3	1.3
…leguminous crops	1.6	0.4	1.3	0.9	1.0	1.1	0.7	1.0
…grain maize	2.9	0.8	3.5	2.8	3.4	3.3	1.1	3.2
…grain sorghum	1.3	0.4	0.5	0.9	0.9	0.7	0.5	3.0
…other cereal crops	1.3	0.7	2.5	1.5	1.6	1.9	1.3	2.1
Industrial crops								
…sugar beet	27.8	17.9	38.9	14.4	31.6	23.2	18.8	35.2
…sunflower	1.3	0.7	1.6	1.2	1.5	1.6	1.0	1.7
…soybeans	1.4	0.8	1.9	1.0	1.8	1.3	0.8	1.6
…tobacco	1.4	1.2	1.4	1.8	1.7	1.4	1.2	1.5
…grain rapeseed	1.0	0.8	1.9	1.2	1.0	1.3	1.0	1.6
Potatoes, vegetables and melons & gourds								
…potatoes	11.0	5.6	8.7	9.3	10.2	12.2	7.6	10.1
…vegetables	11.0	5.7	9.3	8.7	9.0	10.6	7.2	8.6
…melons gourds	10.2	5.8	7.9	8.6	9.9	10.4	7.2	7.3
Forage crops								
…forage roots	11.6	7.4	14.1	13.7	18.5	19.0	7.4	18.5
…maize for silo and green fodder	9.6	4.2	11.0	9.4	14.2	12.0	5.0	19.0
…perennial grasses for green fodder, silo and fodder	3.1	2.6	6.0	3.5	4.8	3.9	1.7	3.4
…annual grasses for green fodder	6.4	3.1	8.6	6.9	5.4	6.5	4.5	5.3
	2014	2015	2016	2017	2018	2019	2020	%
Cereals and leguminous crops – total	**3.2**	**2.4**	**3.3**	**3.6**	**3.6**	**3.7**	**1.6**	-54.2
…wheat (winter and spring)	2.7	2.8	3.7	3.8	3.2	3.3	1.8	-54.1
…winter rye	2.8	2.3	2.9	3.6	3.3	3.1	1.9	-7.6
…barley (winter and spring)	2.0	2.3	3.2	3.1	2.7	3.1	1.9	-46.0
…oat	1.4	1.0	2.3	2.2	1.2	1.7	1.1	-41.8
…millet	2.4	1.3	1.2	1.0	1.5	2.0	0.4	-62.3
…buckwheat	1.5	0.9	1.9	1.6	1.0	1.3	1.6	213.1
…leguminous crops	1.5	1.0	1.7	2.0	1.1	1.3	0.8	-37.3
…grain maize	3.3	2.2	3.1	3.7	4.3	4.4	1.4	-58.4
…grain sorghum	2.8	0.9	3.7	3.8	4.0	4.0	4.0	117.2
…other cereal crops	1.1	1.5	2.0	2.7	3.3	3.3	3.3	94.7
Industrial crops								
…sugar beet	48.4	24.5	31.8	37.1	35.7	39.7	31.3	7.6
…sunflower	1.7	1.5	1.9	2.1	2.1	2.2	1.2	-34.9
…soybeans	2.0	0.7	1.1	1.4	2.0	1.7	1.1	27.1
…tobacco	1.6	1.5	1.5	2.0	1.8	1.7	1.0	-51.5
…grain rapeseed	2.4	1.9	2.3	2.5	2.1	2.1	1.9	-5.8

	2014	2015	2016	2017	2018	2019	2020	%
Potatoes, vegetables and melons & gourds								
…potatoes	11.9	7.3	10.5	10.1	9.3	9.7	7.8	8.1
…vegetables	9.9	9.1	10.5	11.0	9.9	8.6	6.2	-62.9
…melons gourds	6.6	8.5	8.8	7.6	8.9	6.3	4.8	28.6
Forage crops								
…forage roots	20.1	11.2	14.0	17.8	19.8	30.2	5.0	-88.8
…maize for silo and green fodder	14.5	8.2	17.4	16.4	21.3	20.3	9.8	-36.2
…perennial grasses for green fodder, silo and fodder	5.0	2.6	3.8	3.7	4.3	4.2	3.5	-83.8
…annual grasses for green fodder	8.2	4.9	4.7	4.3	3.3	5.3	3.5	-61.5

Source: NBS on-line database, Section 'Sown Area, crop average yield and harvest, 1980-2020': <http://statbank.statistica.md/pxweb/Database/RO/16%20AGR/AGR02/AGR02.asp>; Statistical Yearbooks of the ATULBD for 1998 (page 218), 2002 (page 113), 2005 (page 101), 2009 (page 99), 2011 (page 102), 2014 (page 96), 2019 (page 112), 2020 (page 115), 2021 (page 115).

Based on the coefficients provided in Tables 5-68 and 5-69, and based on the activity data in Tables 5-70, 5-71 and 5-72, respectively, the total amount of nitrogen in crop residues returned to soils was calculated. The results allow us to assert that the total amount of nitrogen in crop residues returned to soils decreased by 78.2% in the Republic of Moldova between 1990 and 2020 (Table 5-73).

Table 5-73: Amount of nitrogen in crop residues returned to soils between 1990-2020, kt

	1990	1991	1992	1993	1994	1995	1996	1997
F_{CR}	34.7994	39.1741	26.2975	31.5452	14.9767	21.6408	11.7862	20.9379
	1998	1999	2000	2001	2002	2003	2004	2005
F_{CR}	17.9185	17.4528	9.5485	17.2165	17.5917	8.2521	19.9839	20.0496
	2006	2007	2008	2009	2010	2011	2012	2013
F_{CR}	19.4949	5.1190	21.0310	15.6403	21.2771	21.2544	6.3843	23.2515
	2014	2015	2016	2017	2018	2019	2020	%
F_{CR}	26.0313	9.2134	25.8074	30.3983	30.7315	31.2410	7.5999	-78.2

Very modest results from 1992, 1996, 2000, 2003, 2007, 2012, 2015 and 2020 are explained by the severe droughts that were recorded in the Republic of Moldova and which induced a drastic reduction of agricultural crops.

It should be noted that implementation of activities aimed at reasonable distribution of soil resources depending on the volume and nature of agricultural production, the recommended crop structure (Figure 5-4) will permit the production of the necessary amount of cereal required to ensure food security for the population, fodder for the animal breeding sector, industrial and leguminous crops to meet the needs of the population and processing industry. At the same time, this structure will permit the use of soil protective crop rotation, contributing to stabilizing the humus balance in soil and soil fertility conservation.

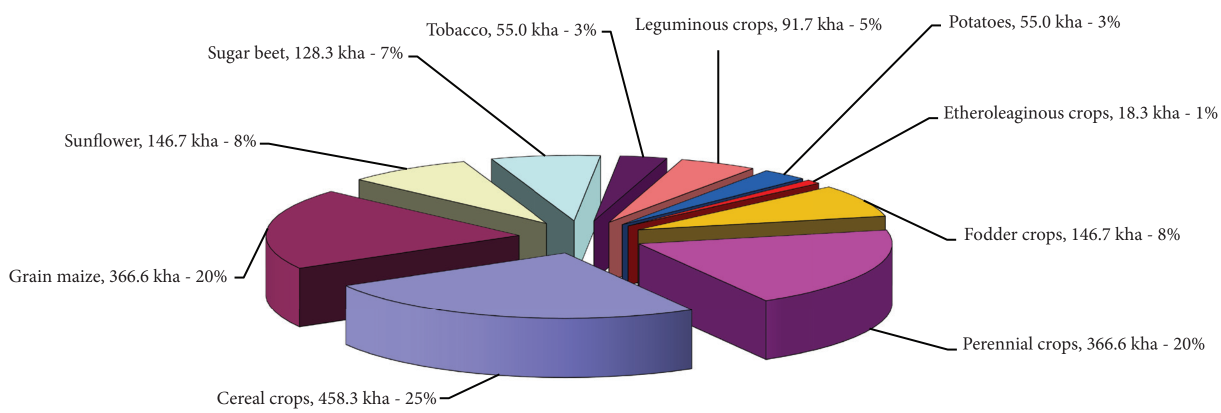


Figure 5-4: Recommended crop structure on agricultural lands[102].

Uncertainties and Time-Series Consistency

Uncertainties associated with activity data on areas sown with crops and average yield per hectare for the main crops in the Republic of Moldova are considered to have decreased to circa 5%. Uncertainties associated with coefficients used to calculate the amount of nitrogen in agricultural crop residues returned to soils are moderate and were estimated to be circa 25%. Uncertainties associated with the default emission factor (EF_1 for F_{CR}) may reach circa 6%. Combined uncertainties associated with N_2O

[102] Buza, Vasile et al. (2007), Disaster Risks Management in the Republic of Moldova, National Agency for Rural Development in the RM, FAO, Chisinau, 2007, page 104.

emissions from crop residues may reach circa 25.50%. In view of ensuring time-series consistency of the obtained results, the same approach was used for the entire period under review, in conformity with the recommendations included in the 2006 IPCC Guidelines.

Quality Assurance and Quality Control

Standard verification and quality control forms and check-lists were filled in for Sector 3 'Agriculture' following a Tier 1 approach. It should be noted that the AD and methods used to estimate N_2O emissions from crop residues returned to soil under this category were documented and archived both in hard copies and electronically. In order to identify the data entry and GHG emission estimation process-related errors, AD and EF verifications and quality control procedures were applied. Following the recommendations included in the 2006 IPCC Guidelines, N_2O emissions from crop residues returned to soil were estimated using AD from official reference sources.

Recalculations

Direct N_2O_{CR} emissions from source category 3D.a.4 'Crop Residues Returned to Soil' were recalculated for the years 2012-2019 as a result of updated statistical activity data for the ATULBD, based on Press Releases 'Sown area, crop average yield and harvest in 2012-2020' (excluding households)[103]. In comparison with the results recorded in the previous inventory cycle, the changes made resulted in an insignificant increase in direct N_2O_{CR} emissions from source category 3D.a.3 'Crop Residues Returned to Soils' in the years 2012-2019 (Table 5-74).

Table 5-74: Comparative results of direct N_2O_{CR} emissions from source category 3D.a.3 'Crop Residues Returned to Soils', included in the BUR3 and NC5 of the RM to the UNFCCC, kt

	1990	1991	1992	1993	1994	1995	1996	1997
BUR3	0.5468	0.6156	0.4132	0.4957	0.2353	0.3401	0.1852	0.3290
NC5	0.5468	0.6156	0.4132	0.4957	0.2353	0.3401	0.1852	0.3290
Difference, %	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	1998	1999	2000	2001	2002	2003	2004	2005
BUR3	0.2816	0.2743	0.1500	0.2705	0.2764	0.1297	0.3140	0.3151
NC5	0.2816	0.2743	0.1500	0.2705	0.2764	0.1297	0.3140	0.3151
Difference, %	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	2006	2007	2008	2009	2010	2011	2012	2013
BUR3	0.3063	0.0804	0.3305	0.2458	0.3344	0.3340	0.0997	0.3638
NC5	0.3063	0.0804	0.3305	0.2458	0.3344	0.3340	0.1003	0.3654
Difference, %	0.0	0.0	0.0	0.0	0.0	0.0	0.6	0.4
	2014	2015	2016	2017	2018	2019	2020	%
BUR3	0.4079	0.1442	0.4044	0.4767	0.4819	0.4900		
NC5	0.4091	0.1448	0.4055	0.4777	0.4829	0.4909	0.1194	-78.2
Difference, %	0.3	0.4	0.3	0.2	0.2	0.2		

Abbreviations: BUR3 – Third Biennial Update Report of the RM to the UNFCCC, NC5 – Fifth National Communication of the RM to the UNFCCC.

Table 5-75 below shows comparative results of direct N_2O emissions from crop residues returned to soil in the RM for the period 1990-2020, expressed in kt CO_2 equivalent using the GWP_{100} values available in the IPCC AR4 ($GWP_{100} = 298$).

Table 5-75: Comparative results of N_2O_{CR} emissions from source category 3D.a.4 'Crop Residues Returned to Soils', included in the BUR3 and NC5 of the RM to the UNFCCC, kt CO_2 equivalent

	1990	1991	1992	1993	1994	1995	1996	1997
BUR3	162.9604	183.4465	123.1477	147.7215	70.1338	101.3406	55.1933	98.0491
NC5	162.9604	183.4465	123.1477	147.7215	70.1338	101.3406	55.1933	98.0491
Difference, %	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	1998	1999	2000	2001	2002	2003	2004	2005
BUR3	83.9100	81.7291	44.7142	80.6222	82.3792	38.6432	93.5817	93.8892
NC5	83.9100	81.7291	44.7142	80.6222	82.3792	38.6432	93.5817	93.8892
Difference, %	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	2006	2007	2008	2009	2010	2011	2012	2013
BUR3	91.2919	23.9715	98.4850	73.2411	99.6376	99.5312	29.7048	108.4229
NC5	91.2919	23.9715	98.4850	73.2411	99.6376	99.5312	29.8968	108.8834
Difference, %	0.0	0.0	0.0	0.0	0.0	0.0	0.6	0.4

[103] Press Release 'Sown area, crop average yield and harvest in 2012-2020.' (excluding households). Tiraspol, 2013-2021. P. 15.

	2014	2015	2016	2017	2018	2019	2020	%
BUR3	121.5686	42.9576	120.5046	142.0573	143.6204	146.0197		
NC5	121.9010	43.1448	120.8526	142.3507	143.9112	146.2970	35.5893	-78.2
Difference, %	0.3	0.4	0.3	0.2	0.2	0.2		

Abbreviations: BUR3 – Third Biennial Update Report of the RM to the UNFCCC, NC5 – Fifth National Communication of the RM to the UNFCCC.

For 2020, direct N_2O_{CR} emissions from source category 3D.a.4 'Crop Residues Returned to Soils' were estimated for the first time. The obtained results show that direct N_2O_{CR} emissions from crop residues returned to soils decreased by circa 78.2% in the Republic of Moldova between 1990 and 2020. Very low emissions in 1992, 1996, 2000, 2003, 2007, 2012, 2015 and 2020 are explained by the severe droughts that were recorded in the Republic of Moldova and which induced a drastic reduction of yields in the respective years.

Planned Improvements

Planned improvements could include activities focused on specifying country specific coefficients used to estimate direct N_2O emissions from crop residues returned to soils in the RM.

5.4.1.5. Nitrogen Mineralization Associated with Loss of Soil Organic Matter

Source Category Description

The change in land-use and management practices may have a significant impact on soil organic carbon storage. Organic carbon and nitrogen are closely linked in soil organic matter (humus). Where soil carbon is lost through oxidation as a result of land-use or management practice change, this loss will be accompanied by a simultaneous mineralization of nitrogen (biochemical decomposition). Where a loss of soil carbon occurs, this mineralized nitrogen is regarded as an additional source of nitrogen available for conversion into N_2O emissions.

Methodological Issues, Emission Factors and Data Sources

The N_2O emissions from nitrogen mineralization associated with loss of soil organic matter as a result of land-use or management change were estimated by using a Tier 1 methodology (2006 IPCC Guidelines).

In order to calculate emissions from nitrogen mineralization associated with loss of soil organic matter (N_2O_{SOM}), a simplified version of Equation 11.2 available in the 2006 IPCC Guidelines was used:

$$N_2O_{SOM} = F_{SOM} \bullet EF_1 \bullet 44/28$$

Where:

EF_1 – emission factor, 0.01 kg N_2O-N/kg N applied (range: 0.003-0.03 kg N_2O-N/kg N);

[44/28] – mass ratio between the content of nitrogen in N_2O-N and N_2O;

F_{SOM} – the net annual amount of N mineralized in mineral soils as a result of loss of soil carbon through change in land-use or management (t N/yr).

$F_{(SOM)}$ values were estimated using Equation 11.8 in the 2006 IPCC Guidelines:

$$F_{SOM} = \Sigma\, [(\Delta C_{mineral} \bullet 1/R)]$$

Where:

R – carbon and nitrogen ratio in the soil organic matter (C : N); according to the 2006 IPCC Guidelines, the default value of 10 (range: 8-15) is used for arable soils; according to the national scientific sources (Krupenikov, Ganenko, 1984), the C : N ratio in the soil organic matter in the Republic of Moldova is around 10.7 (range: 10.1-11.3);

$\Delta C_{Mineral}$ – annual change in carbon stocks in mineral soils, (t C/yr) (see Table 5-76) was estimated using a Tier 2 methodology available in the 2006 IPCC Guidelines.

In order to calculate the annual changes in carbon stocks in mineral soils, equation 2.25 in the 2006 IPCC Guidelines was used (Volume 4, Chapter 2, page 2.30):

$$\Delta C_{Mineral} = (SOC_0 - SOC_{(0-T)}) / D$$

Where:

$\Delta C_{mineral}$ – annual change in carbon stocks in mineral soils, tonnes C/yr;

SOC_0 – soil organic carbon stock in the last year of an inventory time period, tonnes C;

$SOC_{(0-T)}$ – soil organic carbon stock at the beginning of the inventory time period, tonnes C;

D – The interval of years corresponding to the change in carbon reserves in mineral soils (T is used in this equation if T ≥ 20 years, where T is the number of years in an inventory cycle).

The following aspects were taken into consideration in the process of assessing annual change in organic carbon stocks in mineral soils in the RM:

- the agricultural practices applied on arable lands of the RM and the pedo-climatic conditions allow the highlighting of a single agricultural area of land-use (mineral soils are quite homogeneous in the country, represented mainly by chernozems); significant changes in tillage technologies over the period 1990-2020 had not occurred: the entire arable area of the country is dominated by autumn ploughing; since 1990, the amounts of carbon sequestered in arable soils decreased significantly, particularly due to the gradual reduction in both the amounts of organic fertilizers applied to soil and the amounts of crop residues returned to soil (including as a result of the significant decrease in main crop yields);
- information on the evolution of organic carbon stocks in arable land has been identified in the national scientific literature; according to the reference sources consulted, soils in the RM, mostly used for circa 150 years, have meanwhile lost circa 45-50% of the accumulated carbon: the content of humus in arable land in 1877 (layer – 0-30 cm, apparent density – 1.19 g/cm^3) in the northern part of the country (Napadova commune, Floresti district) constituted 5.72% (204.2 tonnes of humus/ha or 118.4 tonnes of C/ha); in 1960, the content of humus in the same soil constituted 3.6% (152.3 tonnes of humus/ha or 88.3 tonnes of C/ha); and in 2007 – 3.18% (134.5 tonnes of humus/ha or 78.0 tonnes C/ha);
- in the same context, according to other publications in the scientific literature, by direct measurements performed on leached chernozem located in the northern part of the country, it was established that in circa 60 years of exploitation, the soil lost circa 37% of accumulated carbon, and the average annual rates constituted 300 kg C/ha/year (Moldavian Soils, Volume 1, 1989); according to the 'Nicolae Dimo' Institute of Pedology, Agrochemistry and Soil Protection, in their long-term experiences (circa 40 years) in the main pedo-climatic areas of the country, located on subtypes of chernozems that dominate in the soil cover, it was established that the annual rates of carbon loss are very close to the area and subtype of chernozem, constituting circa 325 kg C/ha/year (Bulletin of Ecopedological Monitoring, 7th Edition, 2000); rates with very close values were established in the oldest long-term experiences in the RM on carbonated chernozem organised by the State Agrarian University of Moldova in Chetrosu commune, Anenii Noi district (Zagorcha, 1990); values between 300-330 kg C/ha/year regarding carbon losses from soils in agricultural soils have been established by other researchers (Ungureanu et al., 1997; Andries, 1999; Banaru, 2001;
- organic carbon stocks in soil in the first year of inventory ($SOC_{(0-T)}$) were identified in the 'Soil Quality Monitoring of the Republic of Moldova (database, conclusions, forecasts, recommendations)' (2010); according to this publication, the humus content in arable soils in 1990 (layer 0-30 cm, apparent density – 1.41 g/cm^3) in the northern part of the country constituted circa 3.46% (146.1 tonnes of humus/ha or 84.8 tonnes of C/ha); at the same time, in the southern part of the RM (Lebedenco commune, Cahul district), the humus content in arable soils (layer – 0-30 cm, apparent density – 1.37 g/cm^3) constituted circa 3.25% (133.6 tonnes of humus/ha or 77.5 tonnes of C/ha); in these circumstances, the national average ($SOC/_{(0-T)}$) constituted 139.8 tonnes of humus/ha or circa 81.1 tonnes C/ha;
- organic carbon stocks in soils in the last year of the inventory cycle (SOC_0) were identified in the scientific literature; according to specialists from the 'Nicolae Dimo' Institute of Pedology, Agrochemistry and Soil Protection, the humus content in arable soils in 2021 (layer – 0-30 cm, apparent density – 1.41 g/cm^3) in the northern part of the country (Napadova commune, Floresti

district) constituted circa 3.02% (127.8 tonnes of humus/ha or 74.1 tonnes of C/ha); at the same time, in the southern part of the country (Lebedenco commune, Cahul district), the humus content in arable soils (layer – 0-30 cm, apparent density – 1.37 g/cm^3) constituted in that year circa 2.89% (118.8 tonnes of humus/ha or 68.9 tonnes of C/ha), the national average (SOC_0) being circa123.2 tonnes of humus/ha or circa 71.5 tonnes of C/ha, which corresponds to average annual losses per country of circa 310 kg C/ha/year between 1990 and 2021.

The annual changes in the carbon stocks in mineral soils were calculated based on the respective activity data (Table 5-76).

Table 5-76: Annual loss of soil carbon in the RM between 1990-2020, kt C

	1990	1991	1992	1993	1994	1995	1996	1997
$\Delta C_{Mineral}$, kt C	-537.0723	-532.0831	-530.2547	-551.4513	-531.6183	-534.6970	-532.2070	-534.9651
	1998	1999	2000	2001	2002	2003	2004	2005
$\Delta C_{Mineral}$, kt C	-532.2690	-515.5969	-527.2488	-537.1755	-538.0330	-493.6876	-521.3918	-526.2351
	2006	2007	2008	2009	2010	2011	2012	2013
$\Delta C_{Mineral}$, kt C	-479.3706	-481.0747	-480.9644	-493.6523	-504.5514	-495.0015	-512.4152	-522.5720
	2014	2015	2016	2017	2018	2019	2020	%
$\Delta C_{Mineral}$, kt C	-525.0431	-524.9027	-531.4795	-537.9043	-542.0572	-534.2420	-529.8319	-1.3

The obtained results show the rates in which changes of carbon stocks in mineral soils occur over the period 1990-2020, equal to circa 309.9 kg C/ha/year. This value is close to the results previously obtained by different authors from the Republic of Moldova in long-term experiences (Zagorcha, 1990; Ungureanu et al., 1997; Andries, 1999; Banaru, 2001; Cerbari, 2010, 2012).

The obtained results on the calculation of the total amount of mineralized nitrogen (F_{SOM}) as a result of the loss of carbon stocks in mineral soils are provided in Table 5-77.

Table 5-77: Amount of mineralized nitrogen in mineral soils as a result of loss of soil carbon in the Republic of Moldova between 1990-2020, kt

	1990	1991	1992	1993	1994	1995	1996	1997
F_{SOM}	50.1937	49.7274	49.5565	51.5375	49.6839	49.9717	49.7390	49.9967
	1998	1999	2000	2001	2002	2003	2004	2005
F_{SOM}	49.7448	48.1866	49.2756	50.2033	50.2835	46.1390	48.7282	49.1809
	2006	2007	2008	2009	2010	2011	2012	2013
F_{SOM}	44.8010	44.9603	44.9499	46.1357	47.1543	46.2618	47.8893	48.8385
	2014	2015	2016	2017	2018	2019	2020	%
F_{SOM}	49.0694	49.0563	49.6710	50.2714	50.6596	49.9292	49.5170	-1.3

Uncertainties and Time-Series Consistency

Uncertainties associated with activity data on areas of arable lands in the Republic of Moldova are considered to be low, up to circa 5%. Uncertainties associated with coefficients used to estimate N_2O emissions from nitrogen mineralization as a result of loss of soil carbon resulting from land-use or management change were estimated at circa 25%, whereas uncertainties associated with the default emission factor (EF_1 for F_{SOM}) may reach circa 6%. Combined uncertainties associated with direct N_2O emissions from this emission source are considered to be average (circa 25.50%). In view of ensuring time-series consistency of the obtained results, the same approach was used for the entire period under review, in conformity with the recommendations included in the 2006 IPCC Guidelines.

Quality Assurance and Quality Control

Standard verification and quality control forms and checklists were filled in for the respective source category in Sector 3 'Agriculture' following a Tier 1 approach. It should be noted that the AD and methods used to estimate N_2O emissions from nitrogen mineralization associated with loss of soil carbon as a result of land-use or management change in the Republic of Moldova were documented and archived both in hard copies and electronically. In order to identify the data entry and GHG emission estimation process related errors, AD and EF verifications and quality control procedures were applied. Following the recommendations included in 2006 IPCC Guidelines, N_2O emissions from nitrogen mineralization associated with loss of soil carbon as a result of land-use or management change in the Republic of Moldova were estimated based on AD from official reference sources.

Recalculations

Direct N_2O_{SOM} emissions from source category 3D.a.5 'Nitrogen Mineralization Associated with Loss of Soil Organic Matter' as a result of land-use or management change in the RM were recalculated for the period 1990-2021, using a Tier 2 methodology from the 2006 IPCC Guidelines (Equation 2.25, Volume 4, Chapter 2, page 2.30), based on country-specific values, measured in July-August 2021, offered by professor Valerian Cerbari, Head of the Pedology Laboratory of the 'Nicolae Dimo' Institute of Pedology, Agrochemistry and Soil Protection, having carried out research in order to determine and describe the evolution of organic carbon stocks in arable soils in 3 geographical areas of the Republic of Moldova (North – Napadova commune, Floresti district; Centre – Ivancea commune, Orhei district; and South – Lebedenco commune, Cahul district). In comparison with the results recorded in the previous inventory cycle, the updated country-specific values associated with annual carbon losses in mineral soils resulted in a 12.7% reduction of direct N_2O_{SOM} emissions from category 3D.a.5 'Nitrogen Mineralization Associated with Loss of Soil Organic Matter' from agricultural soils between 1990 and 2020 (Table 5-78).

Table 5-78 Comparative results of direct N_2O_{SOM} emissions from category 3D.a.5 'Nitrogen Mineralization Associated with Loss of Soil Organic Matter', included in the BUR3 and NC5 of the RM to the UNFCCC, kt

	1990	1991	1992	1993	1994	1995	1996	1997
BUR3	0.9034	0.8950	0.8919	0.9276	0.8942	0.8994	0.8952	0.8999
NC5	0.7888	0.7814	0.7787	0.8099	0.7807	0.7853	0.7816	0.7857
Difference, %	-12.7	-12.7	-12.7	-12.7	-12.7	-12.7	-12.7	-12.7
	1998	1999	2000	2001	2002	2003	2004	2005
BUR3	0.8673	0.8869	0.9036	0.9050	0.8304	0.8770	0.8852	0.8673
NC5	0.7572	0.7743	0.7889	0.7902	0.7250	0.7657	0.7728	0.7572
Difference, %	-12.7	-12.7	-12.7	-12.7	-12.7	-12.7	-12.7	-12.7
	2006	2007	2008	2009	2010	2011	2012	2013
BUR3	0.8063	0.8092	0.8090	0.8304	0.8487	0.8326	0.8619	0.8790
NC5	0.7040	0.7065	0.7064	0.7250	0.7410	0.7270	0.7525	0.7675
Difference, %	-12.7	-12.7	-12.7	-12.7	-12.7	-12.7	-12.7	-12.7
	2014	2015	2016	2017	2018	2019	2020	%
BUR3	0.8832	0.8829	0.8940	0.9048	0.9118	0.8986		
NC5	0.7711	0.7709	0.7805	0.7900	0.7961	0.7846	0.7781	-1.3
Difference, %	-12.7	-12.7	-12.7	-12.7	-12.7	-12.7		

Abbreviations: BUR3 – Third Biennial Update Report of the RM to the UNFCCC, NC5 – Fifth National Communication of the RM to the UNFCCC.

For 2020, direct N_2O_{SOM} emissions were estimated for the first time. The obtained results show that direct N_2O_{SOM} emissions from nitrogen mineralization associated with loss of soil organic matter decreased by circa 1.3% between 1990 and 2020.

Table 5-79 shows comparative results of direct N_2O_{SOM} emissions from nitrogen mineralization as a result of loss of soil organic matter between 1990 and 2020, expressed in kt CO_2 equivalent using the GWP_{100} values available in the IPCC AR4 ($GWP_{100} = 298$).

Table 5-79: Comparative results of direct N_2O_{SOM} emissions from source category 3D.a.5 'Nitrogen Mineralization Associated with Loss of Soil Organic Matter', included in the BUR3 and NC5 of the RM to the UNFCCC, kt CO_2 equivalent

	1990	1991	1992	1993	1994	1995	1996	1997
BUR3	269.2161	266.7152	265.7987	276.4238	266.4822	268.0254	266.7773	268.1598
NC5	235.0498	232.8663	232.0661	241.3428	232.6628	234.0103	232.9205	234.1276
Difference, %	-12.7	-12.7	-12.7	-12.7	-12.7	-12.7	-12.7	-12.7
	1998	1999	2000	2001	2002	2003	2004	2005
BUR3	266.8084	258.4512	264.2919	269.2678	269.6977	247.4688	261.3560	263.7838
NC5	232.9476	225.6511	230.7505	235.0950	235.4703	216.0625	228.1872	230.3069
Difference, %	-12.7	-12.7	-12.7	-12.7	-12.7	-12.7	-12.7	-12.7
	2006	2007	2008	2009	2010	2011	2012	2013
BUR3	240.2922	241.1464	241.0911	247.4511	252.9145	248.1274	256.8563	261.9476
NC5	209.7966	210.5424	210.4942	216.0470	220.8170	216.6375	224.2586	228.7038
Difference, %	-12.7	-12.7	-12.7	-12.7	-12.7	-12.7	-12.7	-12.7
	2014	2015	2016	2017	2018	2019	2020	%
BUR3	263.1862	263.1159	266.4126	269.6331	271.7149	267.7973		
NC5	229.7852	229.7238	232.6021	235.4139	237.2314	233.8111	231.8810	-1.3
Difference, %	-12.7	-12.7	-12.7	-12.7	-12.7	-12.7		

Abbreviations: BUR3 – Third Biennial Update Report of the RM to the UNFCCC, NC5 – Fifth National Communication of the RM to the UNFCCC.

Planned Improvements

Planned improvements could include activities focused on updating country-specific coefficients used to estimate direct N_2O emissions from nitrogen mineralization associated with loss of soil carbon as a result of land-use or management change in the RM. It is thereby necessary to establish the values of humus content in arable soils at least once every three years (layer – 0-30 cm) in the northern part of the country (Napadova commune, Floresti district), and in the southern part of the country, respectively (Lebedenco commune, Cahul district) in order to identify the national average (SOC_0) and the average annual losses in the Republic of Moldova during the reporting period to the UNFCCC.

5.4.2. Indirect N_2O Emissions from Managed Soils

In addition to direct N_2O emissions from managed soils which occur through a direct pathway (i.e., directly from the soils to which nitrogen is applied), N_2O emissions also take place through two indirect pathways.

The first is the volatilization of nitrogen as NH_3 or nitrogen oxides (NO_x), and the deposition of these gases and their products (NH_4^+ and NO_3^-) into soils and the surface of lakes, rivers and other waters. Sources of nitrogen in the form of ammonia (NH_3) and nitrogen oxides (NO_x) come not only from the application of organic and synthetic fertilizers to soil, but also from other activities of anthropogenic origin, such as: fossil fuel combustion, biomass burning, and some industrial processes. These processes thereby cause N_2O emissions analogous to those resulting from the deposition of agriculturally derived NH_3 and NO_x, following the application of synthetic and organic nitrogen fertilizers and/or urine and dung deposition from grazing animals.

The second pathway is nitrogen leaching and runoff in soil (from the application of synthetic and organic fertilizer, animal dung and urine, crop residues, mineralization of nitrogen associated with loss of soil carbon in mineral soils through land-use or management change). Some of the inorganic nitrogen in or on the soil, mainly in the form of NO_3^-, may bypass biological retention mechanisms in the soil/vegetation system by transport in overland water flow (runoff) and/or flow through soil macropores or pipe drains. Should NO_3^- be present in the soil in excess of biological demand, e.g., under cattle urine patches, the excess leaches through the soil. The nitrification and denitrification microbial processes transform some of the NH_4^+ and NO_3^- into N_2O. This may take place in the groundwater where nitrogen ends up, or in riverside areas receiving drain or runoff water, or in ditches, streams, rivers and estuaries (and their sediments) into which the land drainage water eventually flows.

5.4.2.1. Atmospheric Deposition of Nitrogen Volatilized from Managed Soils (NO_x and NH_4)

Source Category Description

Atmospheric deposition of nitrogen oxides (NO_x^-) and ammonia (NH_4^+) induce soil and surface water fertilization, entailing biogenic formation of N_2O.

When synthetic or organic (manure) nitrogen fertilizers are applied to managed soils, a portion of nitrogen is lost through volatilization as ammonia and nitrogen oxides. The volatilized nitrogen is then re-deposited in soils and waters may incur further changes through nitrification and denitrification entailing N_2O emissions. The amount of volatilized nitrogen depends on a series of factors, such as the type of fertilizer, technology and time of application, type of soil, atmospheric precipitations, temperature, soil pH, etc.

Methodological Issues, Emission Factors and Data Sources

N_2O emissions were estimated using a Tier 1 methodology (Equation 11.9 in the 2006 IPCC Guidelines).

$$N_2O_{ATD} = \{(F_{SN} \bullet Frac_{GASF}) + ((F_{ON} + F_{PRP}) \bullet Frac_{GASM})\} \bullet EF_4 \bullet 44/28$$

Where:

F_{SN} – annual amount of inorganic N fertilizers applied to soils (t N/yr);

$Frac_{GASF}$ – fraction of inorganic fertilizers N that volatilizes as NH_3 and NO_x, t N volatilized (the default value is 0.1 t NH_3-N + NO_x-N/t N in inorganic N fertilizers applied to soils) (range from 0.03-0.3 t NH_3-N + NO_x-N/t N in inorganic N fertilizers applied to soils);

F_{ON} – annual amount of managed animal manure, compost, sewage sludge and other organic N additions applied to soils (t N/yr);

F_{PRP} – annual amount of urine and dung N deposited by grazing animals on pasture, range and paddock (t N/yr);

$Frac_{GASM}$ – fraction of applied organic N fertilizers materials (F_{ON}) and of urine and dung N deposited by grazing animals (F_{PRP}) that volatilizes as NH_3 and NO_x, (the default value is 0.2 t NH_3-N + NO_x-N/t N in manure) (range from 0.05 to 0.5 t NH_3-N + NO_x-N/t N in manure);

EF_4 – emission factor for N_2O emissions from atmospheric deposition of N on soils and water surfaces (the default value is 0.01 t N_2O-N/t per t NH_4-N and NO_x-N emitted) (range from 0.002 to 0.05 t N_2O-N/t per t NH_4-N and NO_x-N emitted);

[44/28] – mass ratio of nitrogen content in N_2O-N and N_2O.

Activity data on the amount of nitrogen in synthetic and organic fertilizers, urine and dung of grazing animals applied to soils is available in Tables 5-58, 5-61 and in Table 5-65, respectively.

Uncertainties and Time-Series Consistency

Uncertainties associated with the estimation of indirect N_2O emissions from this source are very high. Uncertainties mostly include: estimating the amount of volatilized fertilizer, amount of nitrogen in manure and emission factors, for which it is extremely difficult to verify to what extent they reflect the specific conditions of Republic of Moldova. Likewise, uncertainties associated with the estimation of the amount of nitrogen lost through volatilization of NO_x and NH_4 are high. The nitrogen volatilization fraction varies significantly, from negligible to very high, depending on environmental conditions, soil properties, climate conditions, etc. According to the 2006 IPCC Guidelines, uncertainties associated with the estimation of indirect N_2O emissions from this source may vary up to the factor of 2. In the Republic of Moldova, combined uncertainties associated with indirect N_2O emissions from this source category are considered to be very high (circa 165.53%).

In view of ensuring time-series consistency of the obtained results, the same approach to estimate indirect N_2O emissions from the atmospheric deposition of nitrogen oxides (NO_x) and ammonia (NH_4) was used for the entire period under review.

Quality Assurance and Quality Control

For this source category under Sector 3 'Agriculture', standard verification and quality control forms and checklists were filled in for the respective source category, following a Tier 1 approach. The AD and methods used were documented and archived both in hard copies and electronically.

In order to identify the data entry and GHG emission estimation process-related errors, AD and EF verifications and quality control procedures were applied.

Recalculations

Indirect N_2O_{ATD} emissions from source category 3D.b.1 'Atmospheric Deposition of Nitrogen Oxides (NO_x) and Ammonia (NH_4)' were recalculated for the period 1998-2019, as a result of updated shares of manure management systems (MS%) applied based on studies developed in 2015 and 2021 by specialists of the National Agency for Food Safety, respectively of the values associated with the total amount of excreted N within all manure management systems and the amount of nitrogen available to be applied to agricultural soils in the Republic of Moldova. In comparison with the results recorded in previous inventory cycle, the changes made in the current inventory cycle resulted in an insignificant downward trend in indirect N_2O_{ATD} emissions from source category 3D.b.1 'Atmospheric Deposition of Nitrogen Oxides (NO_x) and Ammonia (NH_4)' for the period 1998-2019 (Table 5-80).

Table 5-80: Comparative results of indirect N_2O_{ATD} emissions from source category 3D.b.1 'Atmospheric Deposition of Nitrogen Oxides (NO_x) and Ammonia (NH_4)', included in the BUR3 and NC5 of the RM to the UNFCCC, kt

	1990	1991	1992	1993	1994	1995	1996	1997
BUR3	0.3400	0.3111	0.2647	0.1960	0.1732	0.1581	0.1634	0.1333
NC5	0.3400	0.3111	0.2647	0.1960	0.1732	0.1581	0.1634	0.1333
Difference, %	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	1998	1999	2000	2001	2002	2003	2004	2005
BUR3	0.1296	0.1133	0.1111	0.1165	0.1267	0.1160	0.1145	0.1175
NC5	0.1293	0.1131	0.1108	0.1162	0.1264	0.1158	0.1143	0.1174
Difference, %	-0.2	-0.2	-0.2	-0.2	-0.2	-0.2	-0.1	-0.1
	2006	2007	2008	2009	2010	2011	2012	2013
BUR3	0.1154	0.1028	0.1073	0.1070	0.1142	0.1146	0.1238	0.1337
NC5	0.1152	0.1027	0.1072	0.1069	0.1142	0.1145	0.1237	0.1336
Difference, %	-0.1	-0.1	0.0	-0.1	0.0	0.0	-0.1	-0.1
	2014	2015	2016	2017	2018	2019	2020	%
BUR3	0.1695	0.1322	0.1415	0.1576	0.1636	0.1774		
NC5	0.1694	0.1321	0.1403	0.1567	0.1618	0.1758	0.1655	-51.3
Difference, %	-0.1	-0.1	-0.8	-0.6	-1.1	-0.9		

Abbreviations: BUR3 – Third Biennial Update Report of the RM to the UNFCCC, NC5 – Fifth National Communication of the RM to the UNFCCC.

Table 5-81 below shows comparative results of indirect N_2O_{ATD} emissions from source category 3D.b.1 'Atmospheric Deposition of Nitrogen Oxides (NO_x) and Ammonia (NH_4)' for the period 1990-2020, expressed in kt CO_2 equivalent using the GWP_{100} values available in the IPCC AR4 (GWP_{100} = 298).

Table 5-81: Comparative results of indirect N_2O_{ATD} emissions from source category 3D.b.1 'Atmospheric Deposition of Nitrogen Oxides (NO_x) and Ammonia (NH_4)', included in the BUR3 and NC5 of the RM to the UNFCCC, kt CO_2 equivalent

	1990	1991	1992	1993	1994	1995	1996	1997
BUR3	101.3066	92.6955	78.8857	58.3954	51.6079	47.0993	48.6918	39.7245
NC5	101.3066	92.6955	78.8857	58.3954	51.6079	47.0993	48.6918	39.7245
Difference, %	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	1998	1999	2000	2001	2002	2003	2004	2005
BUR3	38.6114	33.7695	33.0954	34.7040	37.7559	34.5639	34.1125	35.0265
NC5	38.5243	33.6980	33.0201	34.6285	37.6796	34.4982	34.0682	34.9747
Difference, %	-0.2	-0.2	-0.2	-0.2	-0.2	-0.2	-0.1	-0.1
	2006	2007	2008	2009	2010	2011	2012	2013
BUR3	34.3781	30.6255	31.9621	31.8799	34.0389	34.1369	36.9010	39.8373
NC5	34.3277	30.5970	31.9476	31.8606	34.0226	34.1220	36.8730	39.8099
Difference, %	-0.1	-0.1	0.0	-0.1	0.0	0.0	-0.1	-0.1
	2014	2015	2016	2017	2018	2019	2020	%
BUR3	50.5185	39.3850	42.1581	46.9693	48.7621	52.8662		
NC5	50.4894	39.3563	41.8065	46.6828	48.2078	52.3979	49.3100	-51.3
Difference, %	-0.1	-0.1	-0.8	-0.6	-1.1	-0.9		

Abbreviations: BUR3 – Third Biennial Update Report of the RM to the UNFCCC, NC5 – Fifth National Communication of the RM to the UNFCCC.

For 2020, indirect N_2O_{ATD} emissions from source category 3D.b.1 'Atmospheric Deposition of Nitrogen Oxides (NO_x) and Ammonia (NH_4)' were estimated for the first time. The obtained results show that indirect N_2O_{ATD} emissions from source category 3D.b.1 had decreased by 51.3% between 1990 and 2020.

This significant decrease in indirect N_2O_{ATD} emissions from atmospheric deposition of nitrogen oxides (NO_x) and ammonia (NH_4) is due to the significant decrease in the amounts of organic and inorganic fertilizer applied to soils over this period, and the significant reduction of the total livestock population and changes in the share of manure management systems in the RM.

Planned Improvements

No activities to improve the estimation process regarding indirect N_2O_{ATD} emissions from atmospheric deposition of nitrogen oxides (NO_x) and ammonia (NH_4) in the RM are planned for the next inventory cycle.

5.4.2.2. Nitrogen Leaching and Run-off

Source Category Description

A big part of nitrogen applied to soil through synthetic and organic fertilizer addition, through urine and dung deposition from grazing animals, crop residues and mineralization of nitrogen associated with loss of soil carbon in mineral soils as a result of land-use or management change is lost through leaching and run-off. Some of the inorganic nitrogen in or on the soil, mainly in the form of NO_3^-, may bypass biological retention mechanisms in the soil/vegetation system and by being transported in water flow (run-off) through soil macropores. Therefore, if N is present in the soil in excess of biological demand, this excess leaches through the soil profile. This nitrogen may reach groundwater, riverside areas, lakes, rivers and eventually seas and oceans, where it intensifies the biogenic production of N_2O emissions.

Methodological Issues, Emission Factors and Data Sources

Indirect N_2O emissions from leaching and run-off were estimated using a Tier 1 methodology (Equation 11.10 in the 2006 IPCC Guidelines).

$$N_2O_L = \{(F_{SN} + F_{ON} + F_{PRP} + F_{CR} + F_{SOM}) \bullet Frac_{LEACH-(H)})\} \bullet EF_5 \bullet 44/28$$

Where:

F_{SN} – annual amount of inorganic nitrogen fertilizers applied to soils (t N/yr);

F_{ON} – annual amount of managed animal manure, compost, sewage sludge and other organic nitrogen applied to soils (t N/yr);

F_{PRP} – annual amount of urine and dung nitrogen deposited by grazing animals on pasture, range and paddock (t N/yr);

F_{CR} – nitrogen in crop residues (above- and below-ground) returned to soils (t N/yr);

F_{SOM} – annual amount of nitrogen mineralized in mineral soils associated with loss of soil carbon from soil organic matter as a result of changes to land use or management (t N/yr);

$Frac_{LEACH}$ – fraction of all nitrogen added to/mineralized in managed soils that is lost through leaching and run-off, kg N: the default value is 0.3 kg N/kg N applied (range: 0.1-0.8 t N/t N applied with synthetic nitrogen and organic fertilizer);

EF_5 – emission factor for N_2O emissions from nitrogen leaching and run-off (the default value is 0.0075 t N_2O-N/t N), (range: 0.0005-0.025 t N_2O-N/t N leached and run-off).

[44/28] – mass ratio of nitrogen content in N_2O-N and N_2O.

Activity data on the amount of nitrogen in synthetic and organic fertilizers, urine and dung of grazing animals applied to soils, crop residues, mineralization of nitrogen associated with loss of soil carbon in mineral soils through land-use change is available in Tables 5-58, 5-61, 5-65, 5-73 and 5-77.

Uncertainties and Time-Series Consistency

Uncertainties associated with the estimation of indirect N_2O emissions from leaching and run-off are very high, which are caused by the estimation of the amount of nitrogen applied to soil lost through leaching and run-off, as well as by the emission factors, for which it is extremely difficult to verify to what extent they reflect the specific conditions of the Republic of Moldova.

It should be noted that according to the 2006 IPCC Guidelines, uncertainties associated with the estimation of indirect N_2O emissions from leaching and run-off may vary up to a factor of 2. In the RM, combined uncertainties associated with indirect N_2O emissions from leaching and run-off are considered to be very high (circa 167.71%).

In view of ensuring time-series consistency of the obtained results, the same approach and emission factors were used for the entire period under review when assessing indirect N_2O emissions from leaching and run-off through the application of synthetic and organic fertilizers, urine and dung, crop residues, mineralization of nitrogen associated with loss of soil carbon in mineral soils as a result of land-use and soil management change.

Quality Assurance and Quality Control

Standard verification and QC forms and checklists were filled in for Sector 3 'Agriculture', following a Tier 1 approach. It should be noted that the AD and methods used were documented and archived both in hard copies and electronically.

In order to identify the data entry and GHG emission estimation process-related errors, AD and EF verifications and QC procedures were periodically applied.

Recalculations

Indirect N_2O_L emissions from source category 3D.b.2 'Nitrogen Leaching and Run-off' were recalculated for the period 1990-2019, as a result of updated statistical activity data for the ATULBD, based on the Press Releases 'Sown area, crop average yield and harvest in 2012-2020' (excluding households); as a result of the updated shares of manure management systems (MS%) applied in the RM, based on the studies carried out in 2015 and 2021 by specialists of the National Agency for Food Safety; and as a result of changing the values associated with the total quantity of excreted N within all manure management systems and the amount of nitrogen available to be applied to agricultural soils; respectively, as a result of updated country-specific values of annual mineral soil carbon loss between 1990-2020, based on research conducted by the 'Nicolae Dimo' Institute of Pedology, Agrochemistry and Soil Protection between July-August 2021 in order to determine and describe the evolution of organic carbon stocks in arable soils in 3 geographical areas of the Republic of Moldova (North – Napadova commune, Floresti district; Centre – Ivancea commune, Orhei district; and South – Lebedenco commune, Cahul district).

In comparison with the results recorded in previous inventory cycle, the changes made resulted in a downward trend in indirect N_2O_L emissions from source category 3D.b.2 'Nitrogen Leaching and Run-off' for the years 1990-2019 (Table 5-82).

Table 5-82: Comparative results of indirect $N_2O_{(L)}$ emissions from source category 3D.b.2 'Nitrogen Leaching and Run-off', included in the BUR3 and NC5 of the RM to the UNFCCC, kt

	1990	1991	1992	1993	1994	1995	1996	1997
BUR3	0.8716	0.8360	0.7007	0.5873	0.4739	0.4753	0.4503	0.4467
NC5	0.8458	0.8105	0.6753	0.5608	0.4484	0.4496	0.4247	0.4210
Difference, %	-3.0	-3.1	-3.6	-4.5	-5.4	-5.4	-5.7	-5.8
	1998	1999	2000	2001	2002	2003	2004	2005
BUR3	0.4286	0.3948	0.3764	0.4176	0.4401	0.3724	0.4252	0.4308
NC5	0.4027	0.3697	0.3507	0.3915	0.4140	0.3484	0.4000	0.4053
Difference, %	-6.0	-6.3	-6.8	-6.2	-5.9	-6.4	-5.9	-5.9
	2006	2007	2008	2009	2010	2011	2012	2013
BUR3	0.4046	0.3491	0.4158	0.3925	0.4311	0.4356	0.4159	0.5045
NC5	0.3813	0.3259	0.3927	0.3687	0.4068	0.4117	0.3913	0.4796
Difference, %	-5.7	-6.7	-5.6	-6.1	-5.6	-5.5	-5.9	-4.9
	2014	2015	2016	2017	2018	2019	2020	%
BUR3	0.5893	0.4482	0.5280	0.5866	0.6114	0.6485		
NC5	0.5642	0.4230	0.5014	0.5599	0.5835	0.6213	0.5210	-38.4
Difference, %	-4.3	-5.6	-5.0	-4.6	-4.6	-4.2		

Abbreviations: BUR3 – Third Biennial Update Report of the RM to the UNFCCC, NC5 – Fifth National Communication of the RM to the UNFCCC.

Table 5-83 below shows indirect N_2O_L emissions from source category 3D.b.2 'Nitrogen Leaching and Run-off', expressed in kt CO_2 equivalent using the GWP_{100} values available in the IPCC AR4 (GWP_{100} = 298)

For 2020, indirect N_2O_L emissions from source category 3D.b.2 'Nitrogen Leaching and Run-off' were estimated for the first time. The obtained results show that indirect N_2O_L emissions from source category 3D.b.2 'Nitrogen Leaching and Run-off' had decreased by circa 38.4% between 1990-2020.

Table 5-83: Comparative results of indirect $N_2O_{(L)}$ emissions from source category 3D.b.2 'Nitrogen Leaching and Run-off', included in the BUR3 and NC5 of the RM to the UNFCCC, kt CO_2 equivalent

	1990	1991	1992	1993	1994	1995	1996	1997
BUR3	259.7299	249.1370	208.8169	175.0235	141.2304	141.6315	134.1852	133.1044
NC5	252.0425	241.5209	201.2271	167.1302	133.6211	133.9781	126.5674	125.4471
Difference, %	-3.0	-3.1	-3.6	-4.5	-5.4	-5.4	-5.7	-5.8
	1998	1999	2000	2001	2002	2003	2004	2005
BUR3	127.7140	117.6458	112.1539	124.4510	131.1560	110.9622	126.6994	128.3641
NC5	119.9974	110.1853	104.5224	116.6772	123.3690	103.8219	119.1866	120.7735
Difference, %	-6.0	-6.3	-6.8	-6.2	-5.9	-6.4	-5.9	-5.9
	2006	2007	2008	2009	2010	2011	2012	2013
BUR3	120.5563	104.0247	123.9157	116.9713	128.4604	129.7974	123.9418	150.3342
NC5	113.6381	97.1068	117.0151	109.8837	121.2201	122.6953	116.6189	142.9270
Difference, %	-5.7	-6.7	-5.6	-6.1	-5.6	-5.5	-5.9	-4.9
	2014	2015	2016	2017	2018	2019	2020	%
BUR3	175.5970	133.5518	157.3529	174.8195	182.1863	193.2639		
NC5	168.1239	126.0484	149.4284	166.8639	173.8693	185.1526	155.2480	-38.4
Difference, %	-4.3	-5.6	-5.0	-4.6	-4.6	-4.2		

Abbreviations: BUR3 – Third Biennial Update Report of the RM to the UNFCCC, NC5 – Fifth National Communication of the RM to the UNFCCC.

This decrease in indirect emissions is due to the reduction of the amounts of organic and inorganic fertilizer applied to soils, the reduction of the total livestock population in the period under review, and changes in the share of manure management systems in the RM; likewise, due to the decrease in the amount of crop residues returned to soil (including due to the irrational distribution of soil resources and non-compliance with the recommended crop structure, with a profoundly negative impact on stabilizing humus balance in the soil), as well as the increase in carbon loss in soil as a result of inefficient agricultural land management practices.

Planned Improvements

No activities to improve the estimation process regarding indirect $N_2O_{(L)}$ emissions from nitrogen leaching and run-off in the RM are planned for the next inventory cycle.

5.5. Urea Application (Category 3H)

5.5.1. Source Category Description

Adding urea ($CO(NH_2)_2$) to agricultural soils for fertilization purposes leads to CO_2 losses (previously in the industrial production process). Urea is converted into ammonium (NH_4^+), hydroxyl ion (OH^-) and bicarbonate (HCO_3^-) in the presence of water and urease enzymes. Bicarbonate that is formed evolves into CO_2 and water.

5.5.2. Methodological Issues, Emission Factors and Data Sources

CO_2 emissions from urea application were estimated using a Tier 1 methodology and Equation 11.13 from the 2006 IPCC Guidelines.

$$CO_2 = M \bullet EF \bullet 44/12$$

Where:

CO_2 – annual CO_2 emissions from urea application (kt/yr);

M – annual amount of urea fertilization (kt urea/yr);

EF – emission factor, tonnes C/tonnes urea (default value: 0.2 t C/t urea);

[44/12] – mass ratio of carbon content in CO_2-C and CO_2.

No urea is produced in the RM. Activity data on urea application to soils as a fertilizer were generated indirectly based on the information provided by the Customs Service of the RM on urea imports and exports (Table 5-84).

Table 5-84: Urea consumption as a fertilizer in the RM between 1990-2020, t

	1990	1991	1992	1993	1994	1995	1996	1997
Urea import into the RM, t	793.6	712.6	532.5	174.1	73.2	82.7	124.3	1,499.0
Urea export from the RM, t	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Annual urea consumption in the RM, t	793.6	712.6	532.5	174.1	73.2	82.7	124.3	1,499.0
	1998	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**
Urea import into the RM, t	371.1	4.6	599.7	204.0	64.2	324.8	500.7	237.2
Urea export from the RM, t	0.0	0.0	0.0	0.0	0.0	0.1	0.4	0.0
Annual urea consumption in the RM, t	371.1	4.6	599.7	204.0	64.1	324.7	500.3	237.2
	2006	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**
Urea import into the RM, t	199.1	358.7	1,159.8	799.6	2,385.5	5,022.2	7,634.2	5,705.4
Urea export from the RM, t	0.0	0.0	0.0	0.0	6.9	10.6	10.4	0.0
Annual urea consumption in the RM, t	199.1	358.7	1,159.8	799.6	2,378.6	5,011.6	7,623.8	5,705.4
	2014	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**%**
Urea import into the RM, t	13,917.0	15,327.6	16,738.2	35,738.3	59,130.6	54,041.7	58,112.1	7,222.8
Urea export from the RM, t	0.0	0.0	0.0	0.0	0.0	0.0	0.0	N/A
Annual urea consumption in the RM, t	13,917.0	15,327.6	16,738.2	35,738.3	59,130.6	54,041.7	58,112.1	7,222.8

Source: Customs Service of the RM, through Letter dated 19.02.2021, as a response to Letter No. 13-07/519 dated 09.02.2021, from the MARDE; Letter No. 28/07-3025 dated 28.02.2020, as a response to Letter No. 08-310/1 from the Environment Agency dated 11.02.2020; Letter No. 28/07-612 dated 12.01.2018, as a response to Letter No. 601/2017-12-03 from the Climate Change Office of MARDE dated 14.12.2017; Letter No. 28/07-8785 dated 26.05.2016, as a response to Letter No. 512/2016-05-01 from the Climate Change Office of the Ministry of Environment dated 10.05.2016.

It was considered that the annual consumption of urea is equal to the total urea imports minus exports.

As the database of the Customs Service does not cover the period 1990-1994, information regarding urea consumption during the respective period was generated based on the trend of using synthetic N fertilizers between 1990 and 1995.

As it can be seen in Table 5-84, an obvious upward trend in urea consumption was recorded in the Republic of Moldova in the last decade, albeit the annual consumption varies significantly from year to year.

5.5.3. Uncertainties and Time-Series Consistency

Uncertainties associated with activity data on urea application as a fertilizer in agricultural soils in the RM reach up to circa 30%. According to the 2006 IPCC Guidelines, uncertainties associated with default EFs are circa 50%. Combined uncertainties from source category 3H 'Urea Application' are thereby considered moderate (circa 58.31%) (Annex 5-3.3).

In view of ensuring time-series consistency of the obtained results, the same approach and emission factors were used for the entire period under review, in conformity with the recommendations included in the 2006 IPCC Guidance.

5.5.4. Quality Assurance and Quality Control

Standard verification and quality control forms and checklists were filled in for the respective source category, following a Tier 1 approach. The AD and methods used to estimate CO_2 emissions from urea application were documented and archived both in hard copies and electronically. In order to identify the data entry and GHG emission estimation process-related errors, AD and EF verifications and quality control procedures were applied.

5.5.5. Recalculations

CO_2 emissions from category 3H 'Urea Application' were not recalculated. For 2020, the respective emissions were calculated for the first time. The obtained results show that CO_2 emissions from source category 3H 'Urea Application' increased in the Republic of Moldova by circa 73 times between 1990 and 2020 (Table 5-85).

Table 5-85: CO_2 emissions from urea application to agricultural soils between 1990-2020, kt

	1990	1991	1992	1993	1994	1995	1996	1997
3H 'Urea Application', kt	0.5820	0.5226	0.3905	0.1276	0.0537	0.0607	0.0911	1.0992
	1998	1999	2000	2001	2002	2003	2004	2005
3H 'Urea Application', kt	0.2721	0.0034	0.4397	0.1496	0.0470	0.2381	0.3669	0.1739
	2006	2007	2008	2009	2010	2011	2012	2013
3H 'Urea Application', kt	0.1460	0.2631	0.8505	0.5864	1.7443	3.6752	5.5908	4.1840
	2014	2015	2016	2017	2018	2019	2020	%
3H 'Urea Application', kt	10.2058	11.2402	12.2747	26.2081	43.3624	39.6306	42.6156	7,222.8

5.5.6. Planned Improvements

No activities to improve the process of estimating CO_2 emissions from urea application as a fertilizer in agricultural soils in the RM are planned for the next inventory cycle.

6. LAND USE, LAND-USE CHANGE AND FORESTRY SECTOR

6.1. Overview

This chapter envisages the estimation of GHG removals/emissions from Sector 4 'Land Use, Land-Use Change and Forestry'. GHG removals/emissions within this sector were estimated following methodologies in the 2006 IPCC Guidelines for National Greenhouse Gas Inventories.

The evolution of removals/emissions recorded between 1990-2020 at sectoral level was greatly affected, apart from the state of forests and other vegetation types, by the socio-political and economic changes that occurred over the respective period in the RM (transition to market economy, land parceling as result of land reform, a sharp decrease in agricultural production, etc.).

Following the implementation of land reforms in the 1990s, land-use in the Republic of Moldova was relatively stable in the past 10-15 years. The forest area is growing steadily. According to data provided by the General Land Cadastre, by 01.01.2021, forest land constitutes 370.7 thousand ha or 11.2% of the country's territory or +13.9% compared to the level in the base year (1990).

6.1.1. Evolution of CO_2 Removal Trends

Over the period 1990-2020, especially since 2009, the evolution of CO_2 removals from Sector 4 'LULUCF' tended to decrease significantly (Figure 6-1); and the volume of removals in 2020 is only 9.4% of the value recorded in 1990.

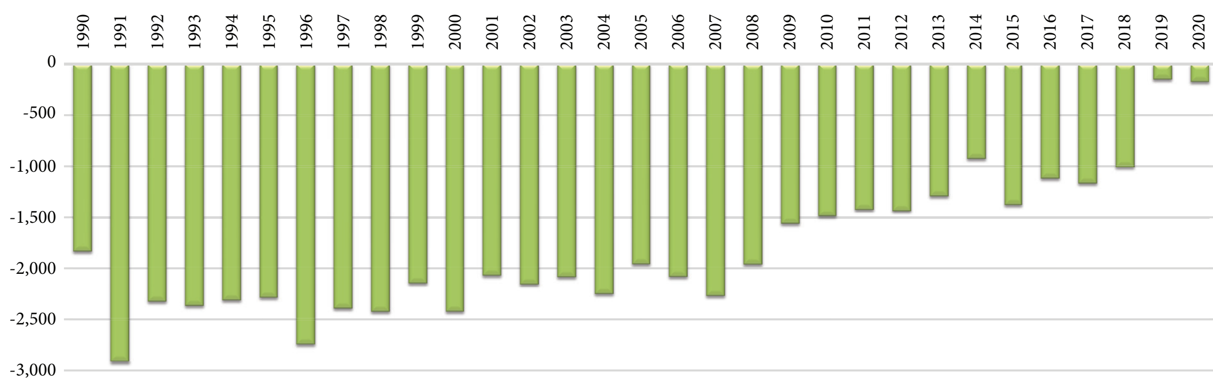


Figure 6-1: CO_2 removals/emissions from Sector 4 'LULUCF' between 1990-2020, kt.

The main sources of emission reduction in Sector 4 'LULUCF' are forest lands, grasslands and lands with wood vegetation from croplands, particularly subcategories: 4A1 'Forest Land Remaining Forest Land', 4A2 'Land Converted to Forest Land', 4C2 'Land Converted to Grassland', and 4B2 'Land Converted to Cropland' (Table 6-1; Figure 6-2). Subcategories 4B1 'Cropland Remaining Cropland', 4E2 'Land Converted to Settlements', and 4F2 'Land Converted to Other Land' remain a constant source of CO_2 emissions due to a profoundly negative balance as a result of the conversion of land with different categories of vegetation types, and a significant decrease in areas with perennial plantations (circa 39.4%).

Table 6-1: Emissions/removals from Sector 4 'LULUCF' in the RM, by subcategory between 1990-2020, kt

Year	Forest Land		Cropland		Grassland		Wetlands		Settlements		Other Land		HWP	LULUCF total	Compared to 1990, %
	4A1	4A2	4B1	4B2	4C1	4C2	4D1	4D2	4E1	4E2	4F1	4F2	4G		
1990	-1579.04	-984.39	2333.34	45.75	0.00	-1205.69	0.00	-555.38	0.00	84.75	0.00	152.36	-122.18	-1830.49	100.0
1991	-1352.65	-990.66	1221.40	27.39	0.00	-1414.32	0.00	-526.46	0.00	88.71	0.00	152.36	-113.61	-2907.84	158.9
1992	-1290.42	-893.82	1301.63	-127.44	0.00	-1428.48	0.00	-595.55	0.00	386.62	0.00	418.78	-94.30	-2322.98	126.9
1993	-1367.44	-826.08	1437.81	5.19	0.00	-1303.52	0.00	-525.84	0.00	114.62	0.00	164.02	-63.45	-2364.70	129.2
1994	-1355.18	-752.83	1209.79	-3.40	0.00	-1577.33	0.00	-497.64	0.00	130.49	0.00	549.46	-14.65	-2311.29	126.3
1995	-1350.20	-694.87	1383.08	-66.35	0.00	-1601.10	0.00	-469.44	0.00	106.92	0.00	401.13	5.97	-2284.87	124.8
1996	-1559.05	-631.39	1219.68	-101.15	0.00	-1548.08	0.00	-441.24	0.00	101.59	0.00	217.33	1.78	-2740.53	149.7
1997	-1639.49	-592.79	1531.81	-146.02	0.00	-1400.86	0.00	-413.03	0.00	100.80	0.00	188.24	-19.24	-2390.60	130.6
1998	-1732.32	-556.17	1566.68	-154.62	0.00	-1436.27	0.00	-384.83	0.00	99.04	0.00	185.01	-9.13	-2422.61	132.3
1999	-1840.91	-495.94	1543.24	-112.44	0.00	-1433.29	0.00	-356.63	0.00	111.83	0.00	425.16	18.54	-2140.44	116.9
2000	-1881.45	-425.98	1349.37	-126.64	0.00	-1291.95	0.00	-328.42	0.00	100.18	0.00	178.52	5.81	-2420.58	132.2
2001	-1873.56	-400.15	1731.69	-171.25	0.00	-1290.65	0.00	-300.22	0.00	67.09	0.00	178.52	-6.26	-2064.79	112.8

Year	Forest Land		Cropland		Grassland		Wetlands		Settlements		Other Land		HWP	LULUCF total	Compared to 1990, %
	4A1	4A2	4B1	4B2	4C1	4C2	4D1	4D2	4E1	4E2	4F1	4F2	4G		
2002	-1913.58	-354.04	1300.69	-144.11	0.00	-1235.14	0.00	-272.02	0.00	67.09	0.00	456.24	-56.69	-2151.54	117.5
2003	-1863.87	-406.25	1376.95	-139.40	0.00	-1007.18	0.00	-243.82	0.00	67.86	0.00	201.66	-65.11	-2079.15	113.6
2004	-1904.34	-430.44	1321.99	-123.40	0.00	-1120.48	0.00	-215.61	0.00	53.67	0.00	223.82	-53.47	-2248.26	122.8
2005	-1966.00	-443.52	1359.37	-87.69	0.00	-1058.12	0.00	-187.41	0.00	53.67	0.00	416.50	-41.11	-1954.31	106.8
2006	-1882.93	-483.58	1391.96	-88.69	0.00	-1056.37	0.00	-159.21	0.00	53.67	0.00	189.50	-40.59	-2076.24	113.4
2007	-1985.96	-474.43	1346.90	-80.78	0.00	-1031.24	0.00	-131.00	0.00	49.27	0.00	83.11	-44.59	-2268.71	123.9
2008	-1985.38	-477.41	1329.19	-92.51	0.00	-932.15	0.00	-102.80	0.00	49.27	0.00	291.00	-35.61	-1956.39	106.9
2009	-2008.95	-517.12	1469.75	-79.07	0.00	-447.69	0.00	-74.60	0.00	45.57	0.00	79.94	-28.47	-1560.64	85.3
2010	-1964.09	-520.08	1344.75	-72.97	0.00	-691.99	0.00	-46.40	0.00	45.57	0.00	441.48	-22.80	-1486.52	81.2
2011	-1871.43	-519.14	1336.69	-106.00	0.00	-638.17	0.00	-75.31	0.00	62.04	0.00	393.73	-4.38	-1421.98	77.7
2012	-1702.27	-592.56	1321.32	-84.81	0.00	-562.75	0.00	-15.47	0.00	11.89	0.00	114.14	76.84	-1433.66	78.3
2013	-1531.88	-609.99	1416.02	-276.10	0.00	-360.17	0.00	-106.10	0.00	13.75	0.00	103.45	61.88	-1289.15	70.4
2014	-1484.67	-650.06	1420.30	-245.69	0.00	-341.11	0.00	-139.75	0.00	18.98	0.00	436.65	58.02	-927.33	50.7
2015	-1496.39	-663.05	1421.96	-309.33	0.00	-418.46	0.00	-82.79	0.00	39.16	0.00	86.82	49.24	-1372.85	75.0
2016	-1433.25	-682.52	1495.48	-383.49	0.00	-402.37	0.00	-82.79	0.00	19.31	0.00	351.63	0.88	-1117.11	61.0
2017	-1324.56	-691.87	1502.19	-412.63	0.00	-384.04	0.00	-82.82	0.00	77.31	0.00	218.21	-67.45	-1165.66	63.7
2018	-1281.36	-687.99	1505.41	-299.01	0.00	-440.15	0.00	-82.83	0.00	21.62	0.00	321.21	-63.50	-1006.61	55.0
2019	-1231.10	-719.55	1516.68	-9.28	0.00	-293.29	0.00	-82.81	0.00	116.50	0.00	611.79	-57.56	-148.62	8.1
2020	-1159.88	-727.44	1558.08	71.82	0.00	-223.15	0.00	-82.81	0.00	27.21	0.00	329.14	34.69	-172.34	9.4

This trend is mainly due to changes in land-use and land management practices (Category 4B), which contributed to the significant decrease in organic carbon stocks in cropland[104], thereby changing the humus balance, from a positive one into a negative and/or profoundly negative one. The respective process was also influenced by some changes in forest management and forest-use (Category 4A), such as the increase in authorized harvesting of wood, significant increase in illegal logging, increased conversion of cropland to forest land, etc.

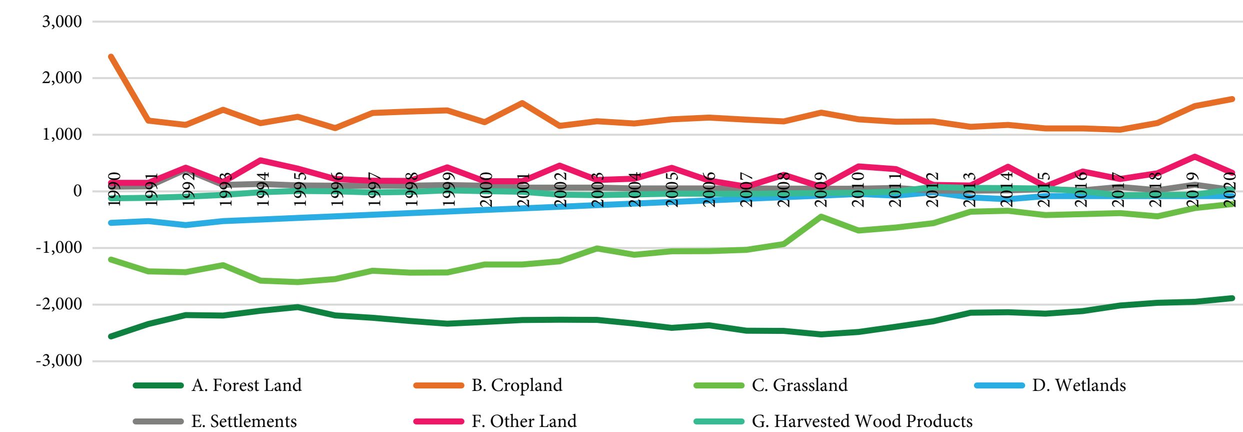


Figure 6-2: Evolution of CO_2 emissions/removals by category within Sector 4 'LULUCF', kt.

Table 6-2 shows net CO_2 emissions/removals within Sector 4 'LULUCF' between 1990-2020.

Table 6-2: Net direct GHG emissions/removals within Sector 4 'LULUCF' in the RM between 1990-2020, kt CO_2 equivalent

	1990	1991	1992	1993	1994	1995	1996	1997
CO_2	-1,830.49	-2,907.84	-2,322.98	-2,364.70	-2,311.29	-2,284.87	-2,740.53	-2,390.60
CH_4	2.65	2.40	2.20	2.95	1.66	2.24	1.54	2.69
N_2O	170.37	183.88	204.65	222.57	236.54	251.52	262.26	272.18
Net total	**-1,657.46**	**-2,721.56**	**-2,116.13**	**-2,139.18**	**-2,073.10**	**-2,031.11**	**-2,476.73**	**-2,115.73**
	1998	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**
CO_2	-2,422.61	-2,140.44	-2,420.58	-2,064.79	-2,151.54	-2,079.16	-2,248.26	-1,954.31
CH_4	2.47	2.39	0.91	1.27	0.27	0.06	0.20	0.25
N_2O	284.36	293.86	296.32	296.55	296.95	294.34	290.12	286.54
Net total	**-2,135.78**	**-1,844.19**	**-2,123.34**	**-1,766.97**	**-1,854.32**	**-1,784.76**	**-1,957.94**	**-1,667.52**
	2006	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**
CO_2	-2,076.24	-2,268.71	-1,956.39	-1,560.64	-1,486.52	-1,421.98	-1,433.66	-1,289.15
CH_4	0.25	1.52	0.77	0.31	0.14	0.16	1.17	0.87
N_2O	282.60	278.02	272.03	265.33	258.21	251.96	233.42	217.25
Net total	**-1,793.38**	**-1,989.17**	**-1,683.60**	**-1,294.99**	**-1,228.17**	**-1,169.86**	**-1,199.07**	**-1,071.02**

[104] Organic carbon and nitrogen in soil are closely related to the humus content in soil; carbon loss through oxidation due to changes in soil management and cropland use are accompanied by the simultaneous nitrogen mineralization (biochemical decomposition).

	2014	2015	2016	2017	2018	2019	2020	2021
CO_2	-927.34	-1,372.85	-1,117.11	-1,165.67	-1,006.61	-148.62	-172.34	N/A
CH_4	0.12	0.65	0.36	0.50	0.17	0.39	0.80	N/A
N_2O	202.47	190.26	179.27	171.85	165.39	161.53	168.00	N/A
Net total	**-724.75**	**-1,181.93**	**-937.48**	**-993.32**	**-841.05**	**13.30**	**-3.54**	**N/A**

6.1.2. Key Categories

The results of key category analysis under Sector 4 'LULUCF' (by level and trend), carried out following a Tier 1 approach, are provided in Table 6-3.

Table 6-3: Key Categories in sector 4 'LULUCF'

IPCC Category	GHG	Source and Sink Categories	T1		T2	
			L	T	L	T
4A1	CO_2	Forest Land Remaining Forest Land	X	X	X	X
4A1	non-CO_2	Forest Land Remaining Forest Land				
4A2	CO_2	Land Converted to Forest Land	X	X	X	X
4A2	non-CO_2	Land Converted to Forest Land				
4B1	CO_2	Cropland Remaining Cropland	X	X	X	X
4B1	non-CO_2	Cropland Remaining Cropland				
4B2	CO_2	Land Converted to Cropland				
4B2	non-CO_2	Land Converted to Cropland				
4C1	CO_2	Grassland Remaining Grassland				
4C2	CO_2	Land Converted to Grassland	X	X	X	X
4D1	CO_2	Wetlands Remaining Wetlands				
4D2	CO_2	Land Converted to Wetlands	X	X		X
4E1	CO_2	Settlements Remaining Settlements				
4E2	CO_2	Land Converted to Settlements				
4E2	N_2O	Land Converted to Settlements	X	X	X	
4F1	CO_2	Other Land Remaining Other Land				
4F2	CO_2	Land Converted to Other Land	X	X	X	X
4G	CO_2	Harvested Wood Products		X		X

Abbreviations: L – Level Assessment; T – Trend Assessment; T1 –Tier 1; T2 –Tier 2.

6.1.3. Methodological Issues and Data Sources

Tier 1 and Tier 2 methodologies (2006 IPCC Guidelines), as well as default and country-specific emission/removal factors (e.g.: current growth factors, basic wood density; carbon fraction of dry matter, biomass and/or soil carbon decrease/increase due to conversion, etc.) were employed to estimate emissions/removals from Sector 4 'LULUCF'. At the same time, in order to estimate the emission reduction achieved in the implementation of afforestation projects through the CDM of the Kyoto Protocol: 'Moldova Soil Conservation Project' (MSCP) and 'Moldova Community Forestry Development Project' (MCFDP) a Tier 3 methodology AR-AM0002 'Restoration of degraded land through afforestation/reforestation" (Version 01 and 03) was used.

The summary of estimation methods used to calculate emissions by source and sink categories are presented in Table 6-4, and a more detailed description is provided in subchapters 6.2-6.8 of this Report).

The main reference sources for the activity data used under Sector 4 'LULUCF' were: data from State Records on Forestry Resources – areas occupied by forests, distribution by species, volume of standing wood, etc.; forest planning materials – areas occupied and dendrometrical features of forests and other types of forest vegetation; data from the General Land Cadastre of the RM, drafted by the Agency for Land Relations and Cadastre (ALRC) – forest areas, areas occupied by forest vegetation not included in forestry resources, grassland, perennial plantations, cropland, settlements, other land, etc.; Statistical Reports from Agency 'Moldsilva' – the volume of wood harvested during forest clearings (by category and species); illegal felling detected in forest fund managed by the Agency, as well as in the forests and forest vegetation managed by other owners; Reports of the Environmental Protection Inspectorate: illegal felling revealed by its forestry institutions; the volume of wood mass subject to authorized harvesting (1990-2018) in forests and forest vegetation managed by local and central public authorities: areas on which crop residue was burnt; Reports from the Environment Agency – volume of wood mass subject to authorized harvesting in forests and forest vegetation managed by local and central public authorities, etc. (2019-2020); Statistical Yearbooks of the Republic of Moldova and those of the ATULBD – harvesting of wood products, forestlands that suffered from fires, cropping, the total production and the production per hectare on main crops, etc.

Table 6-4: CO_2 emission/removal methodological approach applied within Sector 4 'LULUCF'

IPCC Category	Subcategories	Methodology Used	EF	Notes
4A Forest Land	A1 Forest Land Remaining Forest Land	T2	D, CS	Above-ground biomass (biomass increment in forests; losses due to authorized commercial felling and illegal logging)
	A2 Land Converted to Forest Land	T1, T2, T3	D, CS	Above-ground and below-ground biomass (biomass increment in new forests; losses / gains of biomass due to conversion; forest fires, CH_4, N_2O, NOx, CO emissions); carbon losses (carbon losses / gains due to conversion)
4B Cropland	B1 Cropland Remaining Cropland, including:	T1, T2	D, CS	
	B1.1 Cropland Covered with Woody Vegetation	T1, T2	CS	Above-ground and below-ground biomass (forest strips, other types of forest vegetation, orchards, vineyards, trees in individual gardens.)
	B1.2 Annual Change in Carbon Stocks in Mineral Soils	T2	D, CS	Annual change in carbon stocks in mineral soils (losses/gains of biomass and/or carbon in soil due to agricultural activities)
	B.1.3 Burning of Crop Residue	T1, T2	D, CS	CH_4, N_2O, NOx, CO emissions
	B2 Land Converted to Cropland	T1, T2	D, CS	Above-ground and below-ground biomass (losses/gains of biomass due to conversion), carbon stocks in mineral soils (carbon losses/gains due to conversion); N_2O emissions due to conversion to Cropland
4C Grassland	C1 Grassland Remaining Grassland	T2	CS	Neutral balance
	C2 Land Converted to Grassland	T2	CS	Above-ground and below-ground biomass (forest strips, other types of forest vegetation and degraded arable lands converted to grassland; losses/gains of biomass due to conversion), carbon stocks in mineral soils (carbon losses/gains due to conversion)
4D Wetlands	D1 Wetlands Remaining Wetlands	T1	D	Neutral balance
	D2 Land Converted to Wetlands	T1, T2	D, CS	Above-ground and below-ground biomass (losses/gains of biomass due to conversion), carbon stocks in mineral soils (carbon losses/gains due to conversion)
4E Settlements	E1 Settlements Remaining Settlements	T1	D	Neutral balance
	E2 Land Converted to Settlements	T1, T2	D, CS	Above-ground and below-ground biomass (losses/gains of biomass due to conversion), carbon stocks in mineral soils (carbon losses/gains due to conversion), N_2O emissions due to conversion to Settlements
4F Other Land	F1 Other Land Remaining Other Land	T1	D	Neutral balance
	F2 Land Converted to Other Land	T1, T2	D, CS	Above-ground and below-ground biomass (losses/gains of biomass due to conversion), carbon stocks in mineral soils (carbon losses/gains due to conversion)
4G HWP	Harvested Wood Products	T1	D	Harvested wood products/processed, imported or exported (raw roundwood; timber, wooden panels, etc.)

Abbreviations: T1, T2, T3 – Tier 1, 2 and 3; CS – country specific emission/removal factors; D – default emission/removal factors.

6.1.4. Uncertainties and Time-Series Consistency

The uncertainty analysis of CO_2 emissions/removals from Sector 4 'LULUCF' (by source and sink category) is described in detail in subchapters 6.2-6.8 of this Report, as well as in Annex 5-3.4. Combined uncertainties as a percentage of total direct GHG emissions/removals from this sector were estimated at circa 7.30%. Uncertainties introduced in the trend of total direct GHG emissions from this sector were estimated at circa ±5.22%. In view of ensuring time-series consistency of the results, the same approach was used for the entire period under review, in conformity with the recommendations included in the 2006 IPCC Guidelines.

6.1.5. Quality Assurance and Quality Control

Standard verification and quality control forms and checklists by individual source and sink category were filled in for each category under Sector 4 'LULUCF', following a Tier 1 approach. It should be noted that AD and methods used to estimate CO_2 emissions/removals from this sector were documented and archived both in hard copies and electronically. In order to identify the data entry, as well as GHG emission estimation-related errors, AD and EFs verifications and quality control procedures were applied.

Following the sustainable practices, GHG emissions/removals were estimated based on AD and CS EFs from official reference sources. Also, an important factor that positively influenced the quality of the GHG inventory was the development of a Land Use and Land-Use Change Matrix for the period 1970-2020. Quality control (QC) measures consisted of self-monitoring own protocols and data processing procedures. QC is based on using a specific checklist by each compiler, e.g.: re-checking AD or EFs entered into the tables, verifying whether the sum of the land category matches the total area of the country for the entire time series, checking the formulas implemented in the spreadsheets or calculating some parameters (i.e. at disaggregated level or through the IEF values implemented in the spreadsheets), the re-verification of measurement units for all the parameters involved in the inventory estimation.

Quality assurance activities included verifications by a person not involved in the data collection or processing operation, based on the same checklist as for QC, including troubleshouting inconsistencies between the spreadsheets and those set out in the NIR.

6.1.6. Recalculations

Net GHG emissions/removals from Sector 4 'LULUCF' were recalculated in the current inventory cycle as a result of updating activity data on country-specific emission factors utilised in source category 4B1 (4B1.2. 'Annual Change in Carbon Stocks in Mineral Soils'). Details and arguments for the recalculations are presented in subchapters 6.2-6.8 of this Report. These may include the modification of the coefficient regarding carbon loss (organic matter) as a result of mineralization of agricultural soils. Compared to the results recorded in the BUR3 of the RM to the UNFCCC (2021), the changes made in the current inventory cycle resulted in an upward trend in net CO_2 removals between 1990 and 2019, varying from a minimum of +10.2% in 1991 to a maximum of +211.0% in 2019 (Table 6-5).

Table 6-5: Recalculated net CO_2 emissions/removals from Sector 4 'LULUCF' included in the BUR3 and NC5 of the RM to the UNFCCC, kt

	1990	1991	1992	1993	1994	1995	1996	1997
BUR3	-1 560.8442	-2 639.3787	-2 053.2024	-2 094.6617	-2 041.3832	-2 015.3244	-2 470.8404	-2 119.5658
NC5	-1 830.4863	-2 907.8407	-2 322.9822	-2 364.6959	-2 311.2923	-2 284.8659	-2 740.5286	-2 390.6002
Difference, %	+17.3	+10.2	+13.1	+12.9	+13.2	+13.4	+10.9	+12.8
	1998	1999	2000	2001	2002	2003	2004	2005
BUR3	-2 150.7175	-1 869.0627	-2 151.1356	-1 796.6576	-1 883.4274	-1 810.9497	-1 980.5023	-1 682.7486
NC5	-2 422.6056	-2 140.4389	-2 420.5755	-2 064.7883	-2 151.5395	-2 079.1549	-2 248.2613	-1 954.3081
Difference, %	+12.6	+14.5	+12.5	+14.9	+14.2	+14.8	+13.5	+16.1
	2006	2007	2008	2009	2010	2011	2012	2013
BUR3	-1 801.8890	-1 994.4386	-1 682.2257	-1 286.3366	-1 212.2817	-1 148.0863	-1 161.4016	-1 015.6837
NC5	-2 076.2371	-2 268.7122	-1 956.3934	-1 560.6386	-1 486.5202	-1 421.9811	-1 433.6639	-1 289.1465
Difference, %	+15.2	+13.8	+16.3	+21.3	+22.6	+23.9	+23.4	+26.9
	2014	2015	2016	2017	2018	2019	2020	2021
BUR3	-651.4692	-1 094.4097	-837.1816	-886.1457	-725.6453	133.8653	NA	N/A
NC5	-927.3346	-1 372.8484	-1 117.1054	-1 165.6648	-1 006.6081	-148.6229	-172.34092	N/A
Difference, %	+42.3	+25.4	+33.4	+31.5	+38.7	+211.0	N/A	N/A

Abbreviations: BUR3 – Third Biennial Update Report of the RM to the UNFCCC, NC5 – Fifth National Communication of the RM to the UNFCCC. N/A – not applicable

The results of recalculations performed at category level are presented in subchapters 6.2-6.8 of this Report.

6.1.7. Assessment of Completeness

The current inventory covers CO_2 emissions/removals from 13 source and sink categories under Sector 4 'LULUCF' (Table 6-6).

Table 6-6: Assessment of completeness under Sector 4 'LULUCF'

IPCC Category	Source Category	CO_2	CH_4	N_2O	NO_x	CO
4A1	Forest Land Remaining Forest Land	X	NE	NE	NE	NE
4A2	Land Converted to Forest Land	X	X	X	X	X
4B1	Cropland Remaining Cropland	X	X	X	X	X
4B2	Land Converted to Cropland	X	NE	X	NE	NE
4C1	Grassland Remaining Grassland	X	NE	NE	NE	NE
4C2	Land Converted to Grasslands	X	NE	NE	NE	NE
4D1	Wetlands Remaining Wetlands	X	NE	NE	NE	NE
4D2	Land Converted to Wetlands	X	NE	NE	NE	NE
4E1	Settlements Remaining Settlements	X	NE	NE	NE	NE
4E2	Land Converted to Settlements	X	NE	X	NE	NE
4F1	Other Land Remaining Other Land	X	NE	NE	NE	NE
4F2	Land Converted to Other Land	X	NE	NE	NE	NE
4G	Harvested Wood Products	X	NE	NE	NE	NE

Abbreviations: X – source and sink categories included in the inventory; NE – Not Estimated.

Non-CO_2 emissions from forest fires and burning of crop residues (CH_4; N_2O) were estimated for subcategories 4A2 'Land Converted to Forest Land' and 4B1 'Cropland Remaining Cropland'; these emissions, however, are quite insignificant from a quantitative point of view. At the same time, non-CO_2 emissions were estimated partially (N_2O) for 4B2 'Land Converted to Cropland' and 4E2 'Land Converted to Settlements'.

6.1.8. Definitions regarding land-use, classification systems used and their correspondence to land-use categories, land-use change and forestry

In the context of the information presented in Table 6-6, the ways to represent land use within the cadastre evidence system are also defined in the estimation process of sectoral emission reduction within Sector 4 'LULUCF'. Data on land areas and use categories are provided by land cadastral reports issued by the Agency for Land Relations and Cadastre, subsequently approved by Government decisions. Additionally, information on forest land is available at Agency 'Moldsilva', the institution responsible to present sectoral statistical reports to the NBS.

The time series begin with 1970 and include circa 25 national categories of aggregated use within 11 major categories which are highlighted in Table 6-7, including correspondence with IPCC categories. According to the table, national circumstances were considered, including the national statistical system and land cadastral records in force, regarding land-use categories applied in the RM, as well as their correspondence with the categories in the 2006 IPCC Guidelines.

Table 6-7: Correspondence of land categories in the National Classification and in the 2006 IPCC Guidelines

IPCC Category	National classification according to land Cadastre (aggregated in 11 categories)
(1) Forest Land (4A)	**(1) forests** (land covered with forests, forest land in a regeneration process (parks, grooves, forest stands affected by fires, degraded stands, forest crops planted in the Forest Fund and not achieved the canopy closure stage etc.) and **(2) afforestation**
(2) Cropland (4B)	**(3) vineyards**, **(4) orchards** (including fruit orchards, woody vegetation in individual gardens etc.), **(5) other forest vegetation** (including forest protection strips, green areas etc.), **(6) arable land**
(3) Grassland (4C)	**(7) pastures and meadows** (including landslides, land undergoing improvement and fertility restoration)
(4) Wetlands (4D)	**(8) water basins (9) standing waters, flowing waters**
(5) Settlements (4E)	**(10) constructions**, streets, yards, markets, roads
(6) Other Land (4F)	**(11) ravines,** other land categories not included in previous categories

The current inventory covers the entire area of the Republic of Moldova (3384.63 thousand ha). Data in Table 6-8 confirms that the inventory aggregated all the land for the period 1990-2020.

Table 6-8: Evolution of land area included in the National Inventory System according to the 2006 IPCC Guidelines Use Categories

IPCC Category	Area, thousand ha						
	1990	1995	2000	2005	2010	2015	2020
I. Forest Land (4A), total	371.40	369.80	372.30	392.82	411.07	414.10	417.05
1.1. Forests	368.57	369.24	371.95	388.45	410.63	413.48	416.41
1.2. Afforested Land (conversions)	2.83	0.56	0.35	4.38	0.44	0.62	0.64
II. Cropland (4B), total	2258.40	2241.80	2212.50	2198.52	2197.76	2203.59	2204.86
2.1. Forest Vegetation	47.00	55.20	50.50	50.47	52.03	51.15	50.78
2.2. Vineyards	218.80	195.90	162.20	157.34	149.58	136.17	126.23
2.3. Orchards	251.80	216.70	172.70	141.68	149.21	152.73	151.83
2.4. Cropland	1740.80	1774.00	1827.10	1849.03	1846.95	1863.53	1876.02
III. Grassland (4C), total	390.70	400.60	412.80	399.14	380.92	373.87	362.89
IV. Wetlands (4D), total	89.40	92.40	96.60	96.08	99.64	96.66	95.54
V. Settlements (4E), total	218.43	234.10	236.10	235.78	233.64	236.48	244.70
VI. Other Land (4F), total	56.30	45.93	54.33	62.28	61.60	59.93	58.60
Total	**3384.63**	**3384.63**	**3384.63**	**3384.63**	**3384.63**	**3384.63**	**3384.63**

Source: Land Cadastre of the Republic of Moldova for the period 1990-2020. Land Use and Land-Use Change Matrix in the RM for the period 1970-2020.

According to current research and pedological records, no organic soils are registered in the Republic of Moldova.

6.1.9. Information on approaches used to represent lands and on land-use databases used for the inventory preparation

In accordance with the provisions of the 2006 IPCC Guidelines, Chapter 3 'Consistent Representation of Lands', Approach 3 is used for Forest Land and Conversions of Forest Land with respect to the cadastral database (the time series starts in 1970). Approach 1 is used for Forest Land Conversion, to the extent that there are no explicit statistics and tracking of land that was converted from Forest Land (thereby resulting in the difference from the net area of the national forest reported at the end of the year and taking into account the conversions to Forest Land). Also, Approach 1 is applied to all other categories of Non-Forest Land (due to a combination of cadastral and non-cadastral data).

The Representation of Land Approach may be assessed cumulatively: Approach 3 of the IPCC (considering the cadastral basis of land-use representation and information for net area at the end of the year, as well as conversions to Forest Land through artificial plantations) and Approach 1 (considering that conversion from Forest Land to non-Forest Land and among other classifications of land are estimated based on assumptions). Conversion parts are generated based on records prior to 1994 regarding explicit conversion among Non-Forest Land categories. Conversion from Forest Land is derived from the net change in the total forest area and the annual afforestation rate.

The Republic of Moldova has developed the Land Use and Land-Use Change Matrix since 1970 based on the annual data reported by the General Land Cadastre. The Land Use and Land-Use Change Matrix has 11 entries which are then grouped into the six major IPCC categories (the national classification is highlighted in bold in Table 6-7). The matrix implements the 20-year transition period for conversions for mineral soils in all types of conversions, as well as litter and dead wood for conversions to Forest Land. Likewise, a one-year transition period is implemented in the matrix for the loss of biomass, litter and dead wood in conversions from a large stock to a low one or to land-uses where C in biomass, litter, or dead wood is missing.

6.1.10. Planned Improvements

Planned improvements at source and sink category level within the Sector 4 'LULUCF' are described in detail in subchapters 6.2-6.8 of this Report. UNFCCC independent reviews and technical reviews are inspiration sources for the development of the inventory.

6.2. Forest Land (Category 4A)

6.2.1. Source Category Description

Category 4A 'Forest Land' covers estimations of CO_2 emissions/removals from the Republic of Moldova's forests, including above-ground and below-ground biomass (biomass increments in forests, losses from authorized and illegal harvesting etc.), soil carbon losses (carbon losses/gains due to conversion). The respective estimations were made separately for two categories: 4A1 'Forest Land Remaining Forest Land' and 4A2 'Land Converted to Forest Land'.

According to the national definition, '*forest*' is an element of geographical landscape, a functional unit of the biosphere, composed of the totality of forest vegetation (dominated by trees and shrubbery), live layers, animals and microorganisms which are interdependent in their biological development and affect their habitat. Lands covered with forest vegetation occupying areas over 0.25 ha are regarded as forests. The minimal consistency of trees and shrubbery for the lands with forest vegetation to be considered forests should reach an operational level of 30%. The consistency requirement should apply only to trees and shrubbery with a natural potential to reach a minimum height of 5 meters at maturity, which is in accordance with the definition in the national legislation (Forestry Code, art. 3), and the CDM projects of the Republic of Moldova.

In the Republic of Moldova, the areas covered with forests varied considerably over time, from 366.2 thousand ha in 1848 to 222.0 thousand ha in 1945[105], recovering to 370.7 thousand ha in 2020 or circa 11.2% of the country's territory (Figure 6-3).

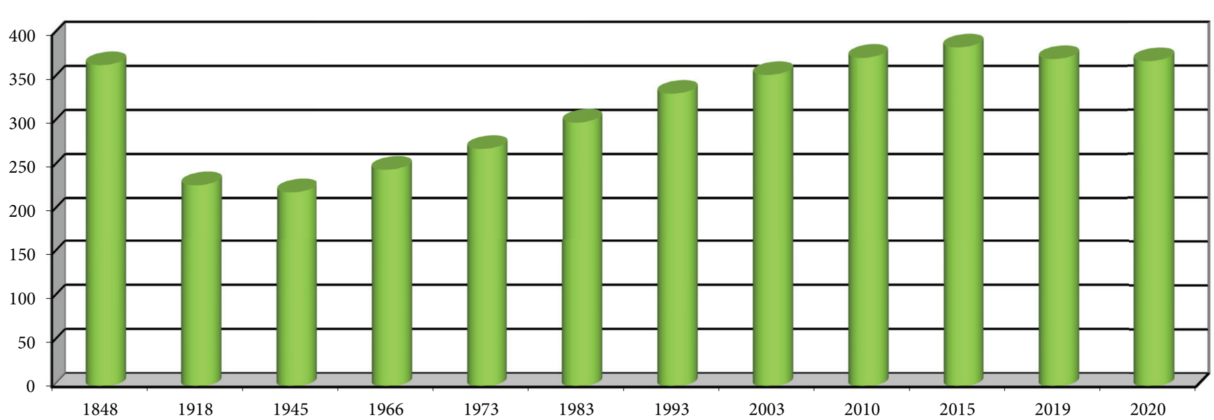


Figure 6-3: Evolution of areas covered with forests in the RM over the period 1848-2020, kha.

[105] Vdovii, Gh., Galupa, D. et al. (1997), National Report on the State of the Forest Fund of the Republic of Moldova; Galupa D., Talmaci I., Spitoc L. (2006), Forestry Sector of the Republic of Moldova – Issues, Accomplishments, Perspectives; Galupa, D., Platon, I. et al. (2011), Report on the Conditions of the Forest Resources in the Republic of Moldova: 2006-2010. Agency 'Moldsilva'; Ch., 48 p.; Government Decision No. 52 dated 29.04.2021 on approving the Land Cadastre as of January 1, 2021.

The total volume of standing wood mass in the forests of the Republic of Moldova is circa 45.4 million m^3, on average 118 m^3 per hectare. The average forest increment is 3.8 m^3/year/ha, and the total average increment is circa 1408.7 thousand m^3/year. The average production class is 3.9 (Annex 3-4.1). The structure by age in all forest species is misbalanced, particularly in those of low productivity.

6.2.2. Methodological Issues, Emission Factors and Data Sources

Living Biomass

To estimate CO_2 emissions/removals from sink category 4A1 'Forest Land Remaining Forest Land', current biomass increments in forest were used (in accordance with production tables and forest planning materials on annual growth of species in forests of the Republic of Moldova) as well as from losses from authorized and illegal harvesting of wood. This approach allows the implementation of Tier 1 (Gain-Loss) method and Tier 2 method for all data used. The calculation process took place in two stages, using equation 2.9 in Volume 4, Chapter 2 of the 2006 IPCC Guidelines:

1. Annual changes in carbon stocks due to biomass increments in forest land remaining forest land (in stem, branches, leaves, roots), using the following equation:

$$\Delta C_G = \Sigma(A \bullet G_{total} \bullet CF)$$

Where:

ΔC_G – annual increase in biomass carbon stocks due to biomass growth in land remaining forest land, tonnes C/yr;

A – area of forest land remaining forest land, ha;

CF – carbon fraction;

G_{total} – average annual biomass growth above and below-ground (t CM[106]/yr/ha), calculated using equation 2.10 in Vol. 4, Chapter 2 of the 2006 IPCC Guidelines:

$$G_{total} = \Sigma\{Iv \bullet BCEF_I \bullet (1 + R)\}$$

Where:

Iv – average annual biomass growth, m^3/yr/ha;

R – root-shoot ratio;

$BCEF_I$ – biomass conversion and expansion factor for conversion of net annual increment in volume (including bark) to above-ground biomass growth for specific vegetation type, tonnes above-ground biomass growth (m^3 net annual increment), which can be calculated following the following formula:

$$BCEF_I = BEF_I \bullet D$$

Where:

BEF_I – biomass expansion factor for annual net tree biomass increase;

D – basic wood density, t CM/m^3 volume for standing wood.

2. Annual decrease in carbon mass through biomass removals (from authorized felling and illegal logging, natural and technogenic disturbances), estimated by the following formula:

$$\Delta C_L = L_{fellings} + L_{fuelwood} + L_{perturbations}$$

Where:

ΔC_L – annual decrease in carbon stocks due to biomass loss (felling and other losses), t C/yr;

$L_{fellings}$ – annual carbon loss due to commercial felling, t C/yr;

$L_{fuelwood}$ – annual carbon loss due to fuelwood removals, t C/yr;

$L_{perturbations}$ – annual carbon loss due to loss of biomass affected by disturbances (diseases and pests, natural calamities, mass droughts, etc.), t C/yr.

The respective indicators were estimated by the following formula:

$$L_{fellings} = \{H \bullet BCEF_R \bullet (1+R)\} \bullet CF$$

[106] Constant mass.

Where:

H – annual wood removals m^3;

$BCEF_R$ – biomass conversion and expansion factors for extracted roundwood conversion (including tree bark), (t of biomass extracted/m^3 extractions), which can be estimated by the following formula:

$$BCEF_R = D \bullet BEF_R$$

Where:

D – basic wood density (t CM/m^3 volume for standing wood);

BEF_R – biomass expansion factor for extracted roundwood.

$$L_{fuelwood} = [\{FG_{trees} \bullet BCEF_R \bullet (1+R)\} + FG_{parts\ of\ trees} \bullet D] \bullet CF$$

Where:

FG_{trees} – annual volume of fuelwood removal of whole trees, m^3;

$FG_{parts\ of\ trees}$ – annual volume of fuelwood removal as parts of trees, m^3 (= 0 to the extent that this method is not used in forestry practice in the Republic of Moldova);

$BCEF_R$ – biomass conversion and expansion factors for extracted fuelwood conversion (including tree bark), (t of biomass extracted/m^3 extractions), which can be estimated by the following formula:

$$BCEF_R = D \bullet BEF_R$$

Where:

D – basic wood density (t CM/m^3 volume for standing wood);

BEF_R – biomass expansion factor for fuelwood removals.

The volumes from $L_{perturbations}$ were included in $L_{felling}$ and $L_{fuelwood}$, as forests in the Republic of Moldova are intensively managed, being regularly drawn in cleaning cuttings (including selective sanitation treatments), final harvesting (including sanitation cuttings) and various cuttings (including sanitation cuttings).

In principle, for both stages, the methodologies described in the 2006 IPCC Guidelines are applicable under the conditions of the Republic of Moldova for both estimation stages previously described.

At the same time, country-specific emission/removal factors were used, regarding annual biomass increment, carbon fraction etc., as well as sectoral activity data (forest land areas by species/category of species, afforestation, wood harvesting, etc.).

Eleven groups of species were formed for the inventory process so as to reflect all diversity of forest species growing in the forests of the RM (Table 6-9).

Table 6-9: Groups of forest species and their structure in the RM for GHG inventory

No	Groups of species by name		Species included in categories	Abbreviations
	Scientific	Common		
	Quercus spp.	Oak tree	English Oak, durmast, downy oak, red oak	QU
	Carpinus ssp.	Hornbeam	Hornbeam (*Carpinus betulus*), beech (*Fagus sylvatica L.*)	CA
	Fraxinus spp.	Ash tree	Ash tree, flowering ash etc.	FR
	Acer spp.	Sycamore maple	Field maple, Common maple, Mountain maple, Silver maple	AC
	Ulmus spp.	Elm	Field elm, Elm tree, Turkestan elm, etc.	UL
	Tilia spp.	Linden tree	Foul lime, Silver lime, big leaf linden tree, etc.	TI
	Salix spp.	Willow	Willow, Osier, etc.	SA
	Pinus spp.	Pine	Sylvester pine, Black pine, Spruce fir, Fir tree, etc.	PI
	Populus spp.	Poplar	White poplar, Black poplar, Aspen tree	PO
	Robinia spp.	Acacia	Acacia, Honey locust, Sophora	RB
	Other species	Other species	Apple tree, pear tree, cherry tree, mahaleb cherry tree, appricot tree, Tatar maple tree, silver berry tree, ash-leaved maple, etc.	OS

In order to estimate biomass increments in forests and CO_2 removals, data from a series of national/sectoral reports on forestry resources regarding the evolution of forest land in the RM were used, for the period 1990-2020 (Table 6-10).

At the same time, beginning with 2013, information on the distribution of predominant forest species were taken from the Forestry Research and Management Institute database.

Table 6-10: Areas of forest land in the RM between 1990-2020, kha

Year	Total	Forest Land Areas by Species										
		QU	CA	FR	AC	UL	TI	SA	PI	PO	RB	OS
1990	325.4	140.6	9.4	16.6	2.9	3.1	2.9	1.9	6.9	5.7	124.0	11.4
1991	328.2	141.3	9.4	16.7	2.9	3.1	2.9	2.0	6.9	5.9	125.7	11.4
1992	331.0	142.0	9.4	16.8	3.0	3.1	2.9	2.1	6.9	6.0	127.4	11.4
1993	333.9	142.7	9.5	16.9	3.0	3.1	2.9	2.2	6.9	6.1	129.1	11.5
1994	335.4	143.1	9.9	17.2	3.0	3.1	2.9	2.2	6.9	6.2	130.0	10.9
1995	336.9	143.5	10.2	17.6	3.0	3.1	2.9	2.3	6.9	6.2	130.9	10.4
1996	338.4	143.8	10.6	17.9	3.0	3.1	2.9	2.3	6.9	6.3	131.7	9.8
1997	339.9	144.2	11.0	18.2	3.0	3.1	2.9	2.4	6.9	6.3	132.6	9.3
1998	341.4	144.6	11.3	18.6	3.0	3.1	2.9	2.4	6.9	6.4	133.5	8.7
1999	342.9	145.0	11.7	18.9	3.0	3.1	2.9	2.5	6.9	6.5	134.4	8.1
2000	344.4	145.3	12.1	19.2	3.0	3.1	2.9	2.5	6.9	6.5	135.3	7.6
2001	345.9	145.7	12.4	19.6	3.0	3.1	2.9	2.6	6.9	6.6	136.1	7.0
2002	347.3	146.0	12.8	19.9	3.0	3.1	2.9	2.6	6.9	6.6	137.0	6.4
2003	352.4	148.4	12.6	20.1	3.2	3.2	3.1	2.5	6.9	6.7	137.9	7.8
2004	357.6	151.7	12.4	20.2	3.4	3.4	3.2	2.4	6.9	6.8	138.8	8.4
2005	362.7	153.6	12.1	20.3	3.7	3.8	3.4	2.4	7.0	6.9	139.7	9.8
2006	366.0	153.9	12.1	20.5	4.0	3.8	3.4	2.4	7.0	7.0	141.9	10.0
2007	369.0	154.2	11.8	20.7	4.1	3.9	3.5	2.4	7.0	7.0	144.4	10.0
2008	372.0	154.7	11.9	20.8	4.1	3.9	3.5	2.4	6.9	7.1	146.7	10.0
2009	372.9	155.1	12.1	20.9	4.1	3.9	3.5	2.4	6.9	7.1	146.9	10.0
2010	374.5	155.4	12.1	21.0	4.1	3.9	3.5	2.4	6.9	7.1	148.0	10.1
2011	374.8	155.6	12.1	21.0	4.1	3.9	3.5	2.4	6.9	7.1	148.1	10.1
2012	375.3	155.8	12.1	21.0	4.1	3.9	3.5	2.4	6.9	7.1	148.3	10.1
2013	372.8	154.7	12.0	20.9	4.1	3.9	3.5	2.4	6.8	7.1	147.3	10.1
2014	379.3	167.1	16.4	21.8	5.7	4.1	5.7	3.9	6.3	7.5	125.6	15.1
2015	386.4	170.3	16.7	22.2	5.8	4.2	5.8	4.0	6.4	7.7	128.0	15.4
2016	386.5	170.3	16.7	22.2	5.8	4.2	5.8	4.0	6.4	7.7	128.1	15.4
2017	374.3	164.9	16.1	21.5	5.6	4.1	5.6	3.9	6.2	7.4	124.1	14.9
2018	378.7	166.8	16.3	21.7	5.7	4.1	5.7	3.9	6.3	7.5	125.5	15.1
2019	373.2	164.4	16.1	21.4	5.6	4.1	5.6	3.8	6.2	7.4	123.7	14.9
2020	370.7	163.3	16.0	21.3	5.6	4.1	5.6	3.8	6.2	7.4	122.9	14.8

Source: Galupa, D., Platon, I. et al. (2011), National Report on Forestry Resources of the RM (2011); OSC Report on updating basic indicators for forest and other types of forest vegetation in the RM (2016), Land Cadastre of the RM for 1990-2020; Land Use and Land-Use Change Matrix for 1970-2020.

Forest Land Remaining Forest Land. Final data on species distribution over the period under review was obtained by modelling using the primary data set obtained from the Statistical Records and Reports of Agency 'Moldsilva', according to which the total area of forest species planted over the reference period consisted of: *Robinia species* – circa 80%, *Juglans spp.* (*Regia and Nigra*) – 8%, *Quercus species* – 3%, *Populus* and *Salix species* – 3%, *other species* – 6%. The respective species distribution (Table 6-10) was applied for the area included in the sink category 4A1 'Forest Land Remaining Forest Land' according to the Land Use and Land-Use Change Matrix of the RM for 1970-2020. As a result, relevant data were gathered for the GHG inventory in subcategory 4A1 'Forest Land Remaining Forest Land' (Table 6-11).

Table 6-11: Forest land areas remaining forest land in the RM between 1990-2020, kha

Species	1990	1991	1992	1993	1994	1995	1996	1997
Quercus spp.	97.76	99.33	103.72	107.53	110.63	113.35	116.52	118.55
Carpinus spp.	6.54	6.61	6.87	7.16	7.63	8.08	8.59	9.01
Fraxinus spp.	11.54	11.74	12.27	12.74	13.33	13.88	14.50	14.99
Acer spp.	2.02	2.04	2.19	2.26	2.32	2.37	2.43	2.47
Ulmus spp.	2.16	2.20	2.26	2.34	2.40	2.45	2.51	2.55
Tilia spp.	2.02	2.04	2.12	2.19	2.24	2.29	2.35	2.38
Salix spp.	1.32	1.41	1.53	1.66	1.74	1.81	1.89	1.96
Pinus spp.	4.80	4.85	5.04	5.20	5.34	5.45	5.59	5.67
Populus spp.	3.96	4.15	4.38	4.60	4.76	4.91	5.09	5.21
Robinia spp.	86.22	88.37	93.06	97.28	100.51	103.40	106.73	109.03
Other Species	7.93	8.01	8.33	8.67	8.43	8.22	7.94	7.65
Groove [107]	31.99	32.11	30.53	29.99	27.64	25.98	25.54	25.87
Total	**258.25**	**262.85**	**272.30**	**281.60**	**286.95**	**292.20**	**299.67**	**305.34**

[107] It includes forest lands with consistency below the average index of 0.3, which are part of the forest management (regenerating patches, forest crops up to the state of massif, forest nurseries, different types of forest plantations, etc.)

Species	1998	1999	2000	2001	2002	2003	2004	2005
Quercus spp.	120.54	123.36	126.75	128.28	128.06	128.32	130.51	131.76
Carpinus spp.	9.45	9.95	10.52	10.94	11.23	10.90	10.67	10.38
Fraxinus spp.	15.48	16.08	16.77	17.23	17.45	17.38	17.38	17.41
Acer spp.	2.50	2.55	2.62	2.64	2.63	2.77	2.93	3.17
Ulmus spp.	2.58	2.64	2.70	2.73	2.72	2.77	2.93	3.26
Tilia spp.	2.42	2.47	2.53	2.55	2.54	2.68	2.75	2.92
Salix spp.	2.02	2.10	2.19	2.25	2.28	2.16	2.06	2.06
Pinus spp.	5.75	5.87	6.02	6.08	6.05	5.97	5.94	6.00
Populus spp.	5.34	5.50	5.69	5.79	5.82	5.79	5.85	5.92
Robinia spp.	111.31	114.36	117.97	119.87	120.18	119.24	119.39	119.81
Other Species	7.25	6.89	6.63	6.16	5.61	6.74	7.23	8.41
Grooves	26.77	24.63	24.32	24.48	24.97	27.76	27.79	25.84
Total	**311.41**	**316.42**	**324.71**	**329.01**	**329.57**	**332.48**	**335.43**	**336.94**
Species	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**
Quercus spp.	130.54	131.44	131.78	131.96	132.60	131.93	127.64	122.80
Carpinus spp.	10.26	10.06	10.14	10.29	10.32	10.27	9.93	9.55
Fraxinus spp.	17.39	17.64	17.72	17.78	17.92	17.82	17.24	16.59
Acer spp.	3.39	3.49	3.49	3.49	3.50	3.48	3.37	3.24
Ulmus spp.	3.22	3.32	3.32	3.32	3.33	3.31	3.20	3.09
Tilia spp.	2.88	2.98	2.98	2.98	2.99	2.97	2.88	2.76
Salix spp.	2.04	2.05	2.04	2.04	2.05	2.04	1.97	1.90
Pinus spp.	5.94	5.97	5.88	5.87	5.89	5.85	5.66	5.40
Populus spp.	5.94	5.97	6.05	6.04	6.06	6.02	5.83	5.64
Robinia spp.	120.37	123.09	124.96	124.98	126.29	125.60	121.51	116.89
Other Species	8.48	8.52	8.52	8.51	8.62	8.57	8.29	7.98
Grooves	28.69	30.43	30.42	34.73	33.39	30.49	30.27	33.54
Total	**339.15**	**344.96**	**347.30**	**352.00**	**352.95**	**348.34**	**337.79**	**329.39**
Species	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**
Quercus spp.	129.17	128.69	125.80	118.55	117.16	111.24	107.16	N/A
Carpinus spp.	12.64	12.59	12.31	11.60	11.46	10.88	10.49	N/A
Fraxinus spp.	16.81	16.75	16.37	15.43	15.25	14.48	13.94	N/A
Acer spp.	4.42	4.41	4.31	4.06	4.01	3.81	3.67	N/A
Ulmus spp.	3.20	3.19	3.12	2.94	2.90	2.76	2.66	N/A
Tilia spp.	4.41	4.39	4.29	4.04	4.00	3.79	3.66	N/A
Salix spp.	3.02	3.01	2.94	2.77	2.74	2.60	2.51	N/A
Pinus spp.	4.88	4.86	4.75	4.48	4.42	4.20	4.05	N/A
Populus spp.	5.81	5.79	5.66	5.33	5.27	5.01	4.82	N/A
Robinia spp.	97.10	96.73	94.65	89.19	88.15	83.69	80.63	N/A
Other Species	11.82	11.65	11.39	10.73	10.61	10.07	9.69	N/A
Grooves	26.26	20.94	20.03	29.08	26.44	29.42	30.39	N/A
Total	**319.53**	**312.99**	**305.62**	**298.19**	**292.40**	**281.95**	**273.66**	**N/A**

Source: Land Cadastre of the RM for 1990-2020; Land Use and Land-Use Change Matrix for 1970-2020.

Harvested Wood Products. The volume of harvested timber includes commercial timber (without bark), as well as the quantity of fuelwood gathered in the RM (round fuelwood, branches and tips, bark, illegally harvested wood). In national statistical reports, commercial timber is identified as 'working timber'. BEF_R (Table 6-15) is applied only to the volume of commercial timber and it only comprises bark. Data is provided by Agency 'Moldsilva' and environmental protection organisations (Environmental Protection Inspectorate and the Environment Agency) on authorized felling and illegal logging in forests and other woody vegetation areas managed by the State Forestry Authorities and by the Environmental Protection Inspectorate (Environment Agency) for areas managed by local public authorities, and by the Statistical Yearbooks of the ATULBD on wood harvests in forests on the left bank of the Dniester river (Table 6-12).

Table 6-12: Evolution of wood harvests in the RM between 1990-2020, thousand m^3

Sort categories	1990	1991	1992	1993	1994	1995	1996	1997
Commercial timber	39.42	27.00	27.39	31.50	39.80	68.49	51.69	52.70
Fuelwood	184.80	376.50	490.29	489.18	538.70	531.42	450.43	423.85
Total	**224.22**	**403.50**	**517.68**	**520.68**	**578.50**	**599.91**	**502.12**	**476.55**
Sort categories	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**
Commercial timber	38.00	38.79	39.68	37.28	50.41	46.99	43.47	39.01
Fuelwood	398.55	368.62	393.34	432.47	381.98	420.20	415.37	394.79
Total	**436.55**	**407.41**	**433.02**	**469.75**	**432.39**	**467.19**	**458.84**	**433.80**
Sort categories	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**
Commercial timber	46.51	44.44	42.79	37.34	40.63	33.91	31.69	29.92
Fuelwood	430.10	390.92	401.84	396.82	429.89	485.45	541.47	587.20
Total	**476.61**	**435.36**	**444.63**	**434.16**	**470.52**	**519.36**	**573.16**	**617.12**

Sort categories	2014	2015	2016	2017	2018	2019	2020	2021
Commercial timber	25.60	28.00	50.16	46.20	47.30	44.40	44.58	N/A
Fuelwood	624.33	607.32	567.42	589.71	596.71	561.29	546.79	N/A
Total	**649.93**	**635.32**	**617.57**	**635.91**	**644.01**	**605.69**	**591.36**	**N/A**

Source: Statistical Records, Agency 'Moldsilva' Reports, Environmental Protection Inspectorate and the Environment Agency for the period 1990-2020; Study for the Republic of Moldova 'Ensuring Sustainability of Forests and Livelihoods through Improving Governance and Control of Illegal Logging'. Chisinau, Editorial Centre of UASM, 2005, 116 pages; Statistical Yearbooks of the ATULBD (2000-2020); Galupa Dumitru, Ciobanu Anatol, Scobioala Marian et al. (2011), Illegal Logging of Forest Vegetation in the Republic of Moldova. Analytical Study, Chisinau, Agency 'Moldsilva', 38 pages.

Since the Statistical Yearbooks provide a national aggregated value of harvested wood, division by species is made based on records from Agency 'Moldsilva' (except for some species suitable for industrial processing): (1) hardwood – oak, durmast oak, hornbeam, ash tree, sycamore maple, elm, acacia, honey locust, etc.; (2) softwood – poplar, willow, linden tree, etc. The ratio of the estimated volume by species to total volume harvested per year provides data of acceptable quality (the difference between the estimated volume and harvested volume is on average 5-10%). Distribution by species of wood suitable for industrial processing and fuelwood, harvested between 1990-2020, is presented in Tables 6-13 and 6-14.

Table 6-13: Trends in commercial timber harvest in the RM between 1990-2020, thousand m^3

Species	1990	1991	1992	1993	1994	1995	1996	1997
Quercus spp.	7.16	4.32	4.09	4.41	6.88	9.59	10.05	10.26
Carpinus spp.	1.05	0.71	0.72	0.83	1.04	1.79	1.35	1.39
Fraxinus spp.	3.65	2.99	3.24	3.94	4.03	8.56	4.47	4.47
Acer spp.	0.31	0.23	0.23	0.27	0.34	0.58	0.45	0.44
Ulmus spp.	0.17	0.1	0.1	0.12	0.15	0.26	0.19	0.21
Tilia spp.	3.78	2.48	2.52	2.9	3.66	6.31	4.70	4.91
Salix spp.	0.26	0.19	0.19	0.22	0.28	0.48	0.37	0.36
Pinus spp.	0.28	0.17	0.18	0.2	0.26	0.44	0.32	0.35
Populus spp.	4.87	3.2	3.26	3.74	4.73	8.14	6.07	6.33
Robinia spp.	16.74	12.02	12.26	14.18	17.54	30.83	22.66	22.70
Other species	1.15	0.59	0.6	0.69	0.89	1.51	1.06	1.28
Total	**39.42**	**27.00**	**27.39**	**31.50**	**39.80**	**68.49**	**51.69**	**52.70**
Species	1998	1999	2000	2001	2002	2003	2004	2005
Quercus spp.	7.40	7.51	7.77	5.18	10.12	10.31	9.34	7.63
Carpinus spp.	1.00	0.99	1.07	1.09	1.85	1.00	0.92	1.05
Fraxinus spp.	3.23	3.49	3.17	2.96	4.45	3.41	3.03	3.12
Acer spp.	0.32	0.37	0.28	0.30	0.42	0.26	0.19	0.28
Ulmus spp.	0.15	0.13	0.18	0.19	0.24	0.22	0.22	0.18
Tilia spp.	3.54	3.34	3.97	4.86	4.82	4.22	4.47	3.90
Salix spp.	0.26	0.30	0.24	0.32	0.29	0.20	0.21	0.24
Pinus spp.	0.25	0.22	0.30	0.33	0.00	0.00	1.10	0.30
Populus spp.	4.56	4.32	5.11	2.89	5.82	8.28	6.62	5.02
Robinia spp.	16.37	17.67	16.13	18.19	19.94	16.43	15.93	15.85
Other species	0.92	0.45	1.46	0.97	2.46	2.66	1.44	1.44
Total	**38.00**	**38.79**	**39.68**	**37.28**	**50.41**	**46.99**	**43.47**	**39.01**
Species	2006	2007	2008	2009	2010	2011	2012	2013
Quercus spp.	9.26	7.49	7.17	5.84	7.16	5.68	4.77	6.28
Carpinus spp.	1.28	0.92	1.13	0.77	0.87	0.74	0.49	0.52
Fraxinus spp.	5.57	5.94	6.02	5.70	5.83	4.03	4.52	4.76
Acer spp.	0.28	0.28	0.25	0.15	0.20	0.14	0.11	0.15
Ulmus spp.	0.27	0.31	0.20	0.17	0.19	0.24	0.12	0.17
Tilia spp.	4.06	3.45	3.84	3.24	3.42	3.17	2.67	2.21
Salix spp.	0.31	0.42	0.38	0.38	0.14	0.19	0.24	0.25
Pinus spp.	0.79	1.60	0.60	0.89	1.19	1.95	1.35	0.73
Populus spp.	7.81	6.44	6.09	4.87	6.32	5.61	5.26	5.06
Robinia spp.	15.68	16.58	16.01	14.34	14.41	11.47	11.69	9.43
Other species	1.22	1.01	1.10	0.98	0.89	0.69	0.47	0.36
Total	**46.51**	**44.44**	**42.79**	**37.34**	**40.63**	**33.91**	**31.69**	**29.92**
Species	2014	2015	2016	2017	2018	2019	2020	2021
Quercus spp.	6.05	6.62	12.15	8.56	8.76	8.22	10.39	N/A
Carpinus spp.	0.33	0.36	0.40	1.10	1.12	1.05	0.34	N/A
Fraxinus spp.	4.26	4.66	7.49	5.16	5.29	4.96	9.57	N/A
Acer spp.	0.06	0.06	0.14	0.30	0.31	0.29	0.12	N/A
Ulmus spp.	0.06	0.06	0.07	0.20	0.20	0.19	0.11	N/A
Tilia spp.	2.00	2.19	5.46	4.27	4.37	4.10	3.57	N/A
Salix spp.	0.07	0.08	0.37	0.31	0.32	0.30	0.83	N/A
Pinus spp.	0.62	0.68	0.49	0.67	0.68	0.64	0.61	N/A
Populus spp.	4.69	5.13	9.52	6.39	6.54	6.14	9.96	N/A
Robinia spp.	7.09	7.76	13.50	18.07	18.50	17.37	8.92	N/A
Other species	0.37	0.40	0.56	1.18	1.21	1.13	0.16	N/A
Total	**25.60**	**28.00**	**50.16**	**46.20**	**47.30**	**44.40**	**44.58**	**N/A**

Source: Statistical Records, Reports of Agency 'Moldsilva', Environmental Protection Inspectorate and the Environment Agency for the period 1990-2020.

Data on the volume of fuelwood gathered also include the volume of twigs, boughs, branches, etc., which are also used for heating and cooking. Considering that most illegal loggings occur in forests managed by local public authorities, situated near settlements and composed preponderantly of acacia, the respective volumes were attributed to category 'RB' (*Robinia spp.*).

Table 6-14: Trends in fuelwood harvest (by group of species) in the RM between 1990-2020, thousand m^3

Species	1990	1991	1992	1993	1994	1995	1996	1997
Quercus spp.	30.10	50.35	49.29	51.15	39.07	63.60	58.99	49.12
Carpinus spp.	12.50	17.96	13.24	13.15	10.05	11.30	15.45	20.41
Fraxinus spp.	15.80	38.99	56.52	73.07	55.81	71.97	73.74	25.80
Acer spp.	8.70	11.39	6.65	6.19	4.73	5.30	5.00	14.12
Ulmus spp.	3.50	6.19	6.54	10.23	7.81	8.76	2.26	5.72
Tilia spp.	10.60	18.97	20.40	29.23	22.32	20.10	19.50	17.29
Salix spp.	3.40	6.68	7.95	12.42	9.49	10.64	4.14	5.57
Pinus spp.	0.40	2.10	4.09	6.58	5.02	5.63	3.80	0.70
Populus spp.	11.80	34.34	55.04	73.07	55.81	74.35	70.09	19.21
Robinia spp.	76.80	172.62	256.75	198.01	316.31	246.00	184.48	247.59
Other species	11.20	16.91	13.82	16.08	12.28	13.77	12.98	18.32
Total	**184.80**	**376.50**	**490.29**	**489.18**	**538.70**	**531.42**	**450.43**	**423.85**
Species	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**
Quercus spp.	64.60	55.32	53.71	48.34	56.93	65.45	64.16	56.64
Carpinus spp.	26.84	24.10	23.40	22.46	23.41	23.07	25.30	24.68
Fraxinus spp.	33.93	30.09	29.22	28.35	28.91	32.38	30.63	30.81
Acer spp.	18.57	16.64	16.16	14.17	17.49	16.50	17.13	17.04
Ulmus spp.	7.52	6.38	6.19	5.78	6.36	8.32	7.07	6.53
Tilia spp.	22.73	19.59	19.02	18.93	18.35	21.63	23.40	20.06
Salix spp.	7.33	6.32	6.13	5.48	6.55	6.28	8.22	6.47
Pinus spp.	0.92	0.74	0.72	1.41	0.00	0.00	2.09	0.76
Populus spp.	25.26	20.32	19.73	17.37	21.29	28.96	28.19	20.80
Robinia spp.	166.76	168.74	199.28	252.20	181.90	190.09	187.09	190.14
Other species	24.09	20.38	19.78	17.98	20.79	27.52	22.09	20.86
Total	**398.55**	**368.62**	**393.34**	**432.47**	**381.98**	**420.20**	**415.37**	**394.79**
Species	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**
Quercus spp.	71.56	57.00	59.84	59.35	65.69	79.64	83.02	98.39
Carpinus spp.	27.49	23.70	27.73	26.27	30.17	34.86	40.26	43.26
Fraxinus spp.	48.42	47.74	49.05	52.75	62.33	51.55	63.35	71.66
Acer spp.	23.05	21.44	23.48	23.33	23.79	22.06	12.98	21.90
Ulmus spp.	10.45	10.47	8.55	9.90	12.74	20.56	21.48	20.25
Tilia spp.	27.66	24.71	25.19	22.43	22.98	22.18	28.72	29.86
Salix spp.	9.95	8.43	7.85	4.75	5.42	7.79	9.24	10.71
Pinus spp.	3.06	2.80	2.74	3.91	4.78	10.27	8.92	10.87
Populus spp.	27.11	23.26	25.04	23.82	26.00	30.91	33.72	39.37
Robinia spp.	164.27	155.19	153.64	148.00	156.80	182.12	200.93	208.77
Other species	17.08	16.17	18.74	22.32	19.20	23.51	38.85	32.16
Total	**430.10**	**390.92**	**401.84**	**396.83**	**429.89**	**485.45**	**541.47**	**587.20**
Species	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**
Quercus spp.	106.84	100.82	103.58	84.55	85.56	80.48	104,37	N/A
Carpinus spp.	45.93	44.15	44.61	33.76	34.16	32.13	42,44	N/A
Fraxinus spp.	76.71	74.44	73.67	64.42	65.19	61.32	91,65	N/A
Acer spp.	17.27	31.63	30.81	21.72	21.97	20.67	26,41	N/A
Ulmus spp.	19.15	15.12	17.29	13.15	13.31	12.52	12,81	N/A
Tilia spp.	30.30	31.28	38.27	30.36	30.72	28.90	36,52	N/A
Salix spp.	10.90	12.82	11.92	10.33	10.45	9.83	9,64	N/A
Pinus spp.	17.02	5.59	4.91	5.33	5.39	5.07	3,85	N/A
Populus spp.	42.69	40.88	41.78	45.14	45.67	42.96	40,67	N/A
Robinia spp.	208.91	222.77	164.35	252.34	255.34	240.18	138,82	N/A
Other species	48.61	27.82	36.23	28.61	28.95	27.23	25,81	N/A
Total	**624.33**	**607.32**	**567.42**	**589.71**	**596.71**	**561.29**	**532.99**	**N/A**

Source: Statistical Records, Reports of Agency 'Moldsilva', Environmental Protection Inspectorate and the Environment Agency for the period 1990-2020; Arcadie Capcelea, Aurel Lozan, Ion Lupu et al. (2011), Analytical Study on Wood Mass Consumption in the RM. Agency 'Moldsilva', Chisinau, 48 pages; Statistical Yearbooks of the ATULBD for 2000-2021.

In order to estimate annual biomass increments and losses, country-specific emission factors were calculated/developed (Tables 6-15 and 6-16). To estimate/develop these, production tables were used, as well as data on actual productivity of stands, according to the forest planning records.

BEF_1 is generated from country-specific data (Table 6-15) so as to consider the increase in above-ground biomass. BEF_R (Table 6-15) is generated from country-specific data for commercial timber, as it only reflects the contribution of bark, whereas fuelwood includes bark in the amount of fuelwood recorded in national statistics. Thus, BEF does not include the entire amount of biomass lost when harvesting both commercial wood and fuelwood (for instance, small branches) which is left in the forest and represents an additional 5% (Agency 'Moldsilva', 1990-2020).

Table 6-15: Coefficients used to estimate CO_2 emissions/removals from sink category 4A1 'Forest Land Remaining Forest Land'

Species	Average annual net increments, $m^3/ha/year$	Basic wood density, t CM/m^3 fresh volume	Biomass expansion factor for current increments, BEF_I	Biomass expansion factor for Commercial Felling Harvest, BEF_R
Quercus spp.	3.9	0.835	1.20	1.20
Carpinus spp.	5.0	0.85	1.20	1.10
Fraxinus spp.	4.4	0.72	1.20	1.20
Acer spp.	2.3	0.75	1.20	1.15
Ulmus spp.	2.9	0.70	1.20	1.15
Tilia spp.	6.4	0.55	1.20	1.15
Salix spp.	6.5	0.38	1.20	1.20
Pinus spp.	4.7	0.535	1.15	1.10
Populus spp.	5.2	0.51	1.20	1.20
Robinia spp.	3.2	0.78	1.20	1.20
Other species	3.0	0.70	1.20	1.15

Source: Ukrainian Forest Management Service: Forestry Resources of the Moldavian Soviet Socialist Republic, as of 1.01.1988, Irpeni, 1988 (in Russian); Vdovii, Gh., Galupa, D. et al., National Report on Forestry Resources of the Republic of Moldova, 1997; **Osadcev** V.G., Ivankov P.T., Sergovskii P.S. et al., Guidebook on Woodworking (for forest farms consumer goods manufacturing workshops). Moscow, 1955 (in Russian); Wood Samples Trial Report, Furniture and Wooden Goods Trial and Certification Centre, 2003 (in Russian); Trial Report of Wood Samples; Giurgiu V., Decei I., Armasescu S. Biometry of Trees and Stands in Romania, 1972; Shvidenko A.Z., Savich J.N., Reference Materials for Evaluation of forests in Ukraine and Moldova. Kiev, Urozhai, 1987 (in Russian); Kapp G., Velsen-Zerweck M., Horst A., Horn L., Galupa D. Talmaci I. et al., The Baseline Study for the Soil Conservation Project in Moldova, 2003; Talmaci I., Prosii E., Varzari A., Mardari A., Galupa A., Report on updating basic indicators for forest and other types of forest vegetation in the Republic of Moldova, 2016.

Table 6-16: Coefficients used to estimate CO_2 removals from sink category 4A1 'Forest Land Remaining Forest Land'

Species	Root-shoot ratio appropriate to increments	Carbon fraction of biomass	Fraction of biomass left to decay in forest,%
Quercus spp.	0.40	0.50	0.05
Carpinus ssp.	0.35	0.50	0.05
Fraxinus spp.	0.28	0.49	0.05
Acer spp.	0.28	0.49	0.05
Ulmus spp.	0.28	0.49	0.05
Tilia spp.	0.21	0.50	0.05
Salix spp.	0.21	0.49	0.05
Pinus spp.	0.46	0.51	0.05
Populus spp.	0.21	0.50	0.05
Robinia spp.	0.28	0.49	0.05
Other species	0.28	0.50	0.05

Source: Osadcev.G., Ivankov P.T., Sergovskii P.S. et al., Guidebook on Woodworking (for Forest Farms Consumer Goods Manufacturing Workshops). Moscow, 1955 (in Russian); Giurgiu V., Decei I., Armasescu S. Biometry of Trees and Stands in Romania, 1972; Shvidenko A.Z., Savich J.N. (1987), Reference Materials for Evaluation of Forests in Ukraine and Moldova. Kiev, Urozhai, 1987 (in Russian); Kapp G., Velsen-Zerweck M., Horst A., Horn L., Galupa D., Talmaci I. et al.: The Baseline Study for the Soil Conservation Project in Moldova, 2003; Vanin S. I., Wood Science, Moscow, 1949 (in Russian).

Carbon stock change in mineral soils, litter and dead wood

Since there have been no significant changes in forests at national level, reporting changes in soil carbon stocks is neutral. In similar circumstances, litter and dead wood pools are also considered neutral.

4A2 'Land Converted to Forest Land'

In order to estimate CO_2 removals from category 4A2 'Land Converted to Forest Land', the same principles were applied as for category 4A1 'Forest Land Remaining Forest Land' – establishing current biomass increments (according to the results obtained in the international monitoring and certification of MSCP and MCFDP). Calculations were made following Equation 2.15 in the 2006 IPCC Guidelines (Volume 4, Chapter 2, Page 2.20):

$$\Delta C_B = \Delta C_G + \Delta C_{Conversion} - \Delta C_L$$

Where:

ΔC_B – annual change in carbon stocks in biomass on land converted to forest land, t C/yr;

ΔC_G – annual increase in carbon stocks in biomass due to growth on land converted to forest land, t C/yr;

$\Delta C_{Conversion}$ – initial change in carbon stocks in biomass resulting from the land-use conversion, t C/yr;

ΔC_L – annual decrease in biomass carbon stocks due to losses from harvesting, fuelwood gathering and disturbances on land converted to forest land, t C/yr.

Initial changes in carbon stocks in biomass on land converted to forest land ($\Delta C_{Conversion}$) were calculated using Equation 2.16 from the 2006 IPCC Guidelines (Volume 4, Chapter 2, Page 2.20):

$$\Delta C_{Conversion} = \Sigma\{(B_{After} - B_{Before}) \bullet \Delta A_{TO\ OTHERS}\} \bullet CF$$

Where:

B_{After} – biomass stocks on land immediately after the conversion, t CM/ha;

B_{Before} – biomass stocks on land before the conversion, t CM/ha;

$\Delta A_{TO\ OTHERS}$ – area of land-use converted to forest land in a certain year, ha/yr;

CF – carbon fraction of dry matter.

At the same time, the estimation process considered increases in dead organic matter (litter) and in soil organic carbon since afforestation is primarily done on degraded land with low fertility, forest vegetation contributing substantially to carbon gain.

AD for category 4A2 'Land Converted to Forest Land' were taken from the Land Use and Land-Use Change Matrix for 1970-2020 (Table 6-17). The definition of 'afforestation' used in CDM projects is in accordance with 'conversion to forest land'.

Table 6-17: Annual successful afforestation in forest land included in cadastral records between 1970-2020, ha

Land Converted to Forest Land	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982
Arable lands	0.0	296.8	307.8	335.3	288.0	399.9	417.2	433.1	464.3	543.2	633.9	244.3	227.2
Orchards, vineyards	0.0	155.5	161.3	175.7	150.9	209.6	218.6	227.0	243.3	284.6	332.2	128.0	119.1
Grassland	0.0	3428.8	3555.9	3874.3	3327.9	4620.6	4820.8	5004.4	5364.2	6276.1	7324.6	2822.2	2625.1
Other land	0.0	719.0	7675.0	4915.0	4833.0	1870.0	2243.0	0.0	0.0	0.0	0.0	1106.0	0.0
Total	**0.0**	**4600.1**	**11699.9**	**9300.4**	**8599.9**	**7100.0**	**7699.7**	**5664.5**	**6071.7**	**7104.0**	**8290.7**	**4300.5**	**2971.3**
Land Converted to Forest Land	**1983**	**1984**	**1985**	**1986**	**1987**	**1988**	**1989**	**1990**	**1991**	**1992**	**1993**	**1994**	**1995**
Arable lands	222.4	225.4	227.7	168.4	197.7	298.9	280.0	216.1	80.8	87.5	43.0	49.5	42.5
Orchards, vineyards	116.5	118.1	119.3	88.3	103.6	156.6	146.7	113.2	42.4	45.9	22.5	25.9	22.3
Grassland	2569.7	2604.7	2630.3	1945.8	2284.1	3453.4	3234.8	2496.4	933.9	1011.3	496.3	572.1	491.0
Other land	0.0	0.0	0.0	0.0	3229.6	291.0	1038.5	1174.0	1443.0	0.0	338.5	0.0	0.0
Total	**2909.0**	**2948.0**	**2977.0**	**2202.0**	**5815.0**	**4199.9**	**4700.0**	**3999.7**	**2500.1**	**1145.0**	**900.3**	**647.5**	**555.8**
Land Converted to Forest Land	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**
Arable lands	24.9	29.6	33.1	30.3	27.1	23.5	344.3	347.4	336.8	334.7	352.4	355.7	372.3
Orchards, vineyards	13.0	15.5	17.3	15.9	14.2	12.3	180.4	182.0	176.5	175.4	184.7	186.4	195.1
Grassland	287.6	341.5	382.3	349.8	312.7	271.9	3978.5	4013.9	3891.4	3866.6	4071.4	4110.1	4302.0
Other land	1.2	1113.0	1667.9	0.0	146.0	1067.2	0.0	4193.4	996.0	0.8	2383.6	223.0	0.0
Total	**326.7**	**1499.5**	**2100.6**	**396.0**	**500.0**	**1375.0**	**4503.3**	**8736.7**	**5400.6**	**4377.4**	**6992.1**	**4875.2**	**4869.0**
Land Converted to Forest Land	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**
Arable lands	221.7	33.3	23.4	19.4	19.6	22.0	47.2	121.0	48.8	51.0	60.1	48.7	N/A
Orchards, vineyards	116.2	17.5	12.3	10.1	10.3	11.5	24.7	63.4	25.6	26.7	31.5	25.5	N/A
Grassland	2561.9	384.8	270.3	223.7	226.3	253.7	544.9	1397.5	563.7	588.8	694.4	562.7	N/A
Other land	3076.3	0.0	1886.4	8916.1	2573.0	4833.0	1894.1	2417.4	405.0	1050.0	3283.0	500.0	N/A
Total	**5976.1**	**436.0**	**2191.4**	**9169.3**	**2829.2**	**5120.2**	**2510.9**	**3999.3**	**1043.1**	**1716.5**	**4069.0**	**1136.9**	**N/A**

Source: General Land Cadastre of the RM for the period 1970-2020; Land Use and Land-Use Change Matrix for 1970-2020.

CDM projects implemented in the Republic of Moldova

The conversion to forest land during the reference period included afforestation under the Moldova Soil Conservation Project (MSCP) and Moldova Community Forestry Development Project (MCF-DP). Both projects are implemented under the CDM of the Kyoto Protocol, and have completed all national and international validation and registration procedures. The total afforested area within MSCP and MCFDP constitutes circa 28.8 thousand ha (Table 6-18).

Table 6-18: Annual afforestation under CDM Projects in the RM between 2002-2015, ha

Afforested Area	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	Total
MSC Project	4894.7	4736.6	4219.6	4029.6	891.2	71.9	475.8	152.8	211.3	276.7	98.8	116.5	45.7	68.8	20289.9
MCFD Project	0.0	0.0	0.0	0.0	2009.6	2959.3	2190.4	1224.4	10.0	12.0	8.0	52.6	2.5	0.0	8468.8
Total	**4894.7**	**4736.6**	**4219.6**	**4029.6**	**2900.8**	**3031.2**	**2666.2**	**1377.2**	**221.3**	**288.7**	**106.8**	**169.1**	**48.2**	**68.8**	**28758.7**

Source: Agency 'Moldsilva' (2009), MSCP for MCFDP, available at: https://cdm.unfccc.int/Projects/DB/SGS-UKL1216031019.22/view. Agency 'Moldsilva' (2012), MSCP for MCFDP, available at: https://cdm.unfccc.int/Projects/DB/TUEV-SUED1352989843.61. Agency 'Moldsilva' (2004-2015), Annual Reports to the World Bank for the period 2004-2016 regarding emission reductions within MSCP and MCFDP. Agency 'Moldsilva' (2012-2013 and 2017-2018) Monitoring Reports for the MSCP and MCFDP, available at: https://cdm.unfccc.int/Projects/DB/SGS-UKL1216031019.22/view and https://cdm.unfccc.int/Projects/DB/TUEV-SUED1352989843.61.

In addition to harvested wood products, the net CO_2 emissions reduction into the atmosphere will account for circa 4.8 million tonnes (MSCP – 3.6 million tonnes; MCFDP – 1.2 million tonnes). The main participants in the implementation process of these projects are Agency 'Moldsilva' and its forestry institutions, the World Bank, the Forestry Research and Management Institute, as well as local public authorities that have allocated land for afforestation (over 500).

The changes in carbon stock from biomass, soil, litter and dead wood for subcategory 4A2 are reported using a Tier 2 methodology. In order to establish annual biomass gains/losses in forest land for subcategory 4A2, national EFs were calculated/developed based on results from MSCP and MCFDP projects (Table 6-19).

Table 6-19: Coefficients used to estimate CO_2 emissions/removals from subcategory 4A2 'Land Converted to Forest Land'

Indicators	Units	Value
Annual average carbon increments of biomass (trees and shrubs)	Mg C/ha/yr	1.74
Annual average carbon increments of dead organic matter (litter)	Mg C/ha/yr	0.41
Annual average carbon increments of dead organic matter (dead wood)	Mg C/ha/yr	0.00
Annual average organic carbon increments of mineral soils	Mg C/ha/yr	0.32
Conversion period	years	20

Source: PDD for MSCP and MCFDP; Agency 'Moldsilva' Monitoring Reports for MSCP and MCFDP (2012; 2013; 2017; 2018).

Non-CO_2 Emissions on Forest Land

According to national statistics, there are no records of wildfires and controlled burning of biomass in forests remaining forests, thereby no non-CO_2 emissions are estimated for category 4A1.

The methodology used to estimate non-CO_2 emissions from subcategory 4A2 'Land Converted to Forest Land' is a Tier 1 method (2006 IPCC Guidelines). Calculations were made according to equation 2.27 2006 IPCC Guidelines (Volume 4, Chapter 2, Page 2.42):

$$L_{fire} = A \bullet M_B \bullet C_f \bullet G_{ef} \bullet 10^{-3}$$

Where:

L_{fire} – amount of GHG emissions (including non-CO_2) from fires, t/yr;

A – area burnt annually, ha/yr;

M_B – mass of fuel available for combustion, t/ha;

C_f – combustion factor, the default value used is 0.45 (2006 IPCC Guidelines, Volume 4, Chapter 2, Table 2.6, Page 2.48);

$M_B \bullet C_f$ – the amount of fuel actually burnt, its value, according to MSCP and MCFDP estimates is 32,632.6 kg CM/ha;

G_{ef} – default emission factor, kg/t CM burnt.

Table 6-20: EFs for different categories of vegetation, kg GHG/t CM

	CO	CH_4	N_2O	NO_x
Temperate Forests	107	4.7	0.26	3.0

Source: 2006 IPCC Guidelines, Volume 4, Chapter 2, Table 2.5, page 2.47.

Most fires are located in young forests or stands, particularly in the vicinity of croplands. Activity data on forest land affected by fires is available in the Statistical Yearbooks of the RM and those of the ATULBD (Table 6-21).

Table 6-21: Forest land areas affected by fires in the RM between 1990-2020, ha

	1990	1991	1992	1993	1994	1995	1996	1997
RBDR	120.10	20.10	22.00	1.50	33.50	1.40	0.00	0.00
LBDR	IE	IE	IE	IE	IE	0.53	11.20	3.40
RM - total	**120.10**	**20.10**	**22.00**	**1.50**	**33.50**	**1.93**	**11.20**	**3.40**
	1998	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**
RBDR	9.70	0.00	0.00	41.60	12.50	10.50	42.00	5.50
LBDR	24.00	25.20	0.90	15.40	18.10	23.00	46.00	2.90
RM - total	**33.70**	**25.20**	**0.90**	**57.00**	**30.60**	**33.50**	**88.00**	**8.40**
	2006	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**
RBDR	32.60	683.30	31.00	126.00	20.00	25.90	636.60	460.00
LBDR	58.20	108.00	24.00	8.20	26.90	36.90	35.80	7.10
RM - total	**90.80**	**791.30**	**55.00**	**134.20**	**46.90**	**62.80**	**672.40**	**467.10**

	2014	2015	2016	2017	2018	2019	2020	2021
RBDR	9.50	338.20	119.00	173.00	79.00	169.68	402.0	N/A
LBDR	28.90	18.00	59.8	73.80	5.90	34.40	17.2	N/A
RM - total	**38.40**	**356.20**	**178.8**	**246.80**	**84.90**	**204.08**	**419.2**	**N/A**

Source: Statistical Yearbooks of the RM for 1994 (page 38), 1999 (page 20), 2007 (page 22), 2011 (page 22), 2014 (page 22), 2015 (page 22); National Bureau of Statistics, Statistics for Geography and Environment (Forest Fires, as of November 1 (2010-2020); Statistical Yearbooks of the ATULBD for 2000 (page 88), 2002 (page 91), 2007 (page 81), 2009 (page 80), 2011 (page 82), 2014 (page 78), 2015 (page 88), 2016 (page 88), 2017 (page 91), 2020 (page 92), 2021 (page 90).

6.2.3. Uncertainties and Time-Series Consistency

4A1 'Forest Land Remaining Forest Land'

Uncertainties associated with CO_2 removals from sink category 4A1 'Forest Land Remaining Forest Land' at the beginning of the reference period (1990), were rather low, circa 5%. Since 1991, due to socio-political developments, the level of uncertainties increased significantly. For 2020, the level of activity data precision related to the production processes reached circa 15%. Uncertainties related to removal factors in both cases are circa 5%. Combined uncertainties within 4A1 constitute circa 15.81% (Annex 5-3.4).

The above-mentioned situation is influenced by several factors because part of the data needed to estimate GHG removals by forests in the Republic of Moldova require updating. Uncertainties by section are also determined by the volumes of wood mass actually harvested by local public authorities and other forests owners. There is no accurate statistics on the amount of wood mass harvested during authorized felling and/or illegal logging. General information in this field is available to the Environmental Protection Inspectorate only, as institution exercising state control in the field of environment (Article 22 of the Forestry Code on state control and state control data), and the Environment Agency, which authorizes (based on Article 40 of the Law on Environment Protection) felling of any type of forest vegetation. According to some estimative studies, the annual volume of wood mass from unidentified sources is circa 400-800 thousand m^3.[108] At the same time, the amount of illegal logging recorded annually is only circa 3-4 thousand m^3. The current system of monitoring and control of production processes in the forestry sector is applied only for forests managed by Agency 'Moldsilva'. The forestry resources managed by local public authorities practically do not regulate these activities. A considerable share of illicit logging is not even reported.

4A2 'Land Converted to Forest Land'

Uncertainties associated with the process of estimating the CO_2 removals/emissions from category 4A2 'Land Converted to Forest Land' constitute circa 15%, whereas uncertainties associated with removal/emission factors – circa 5%. Combined uncertainties for this source category reach circa 15.81%. (Annex 5-3.4). Uncertainties related to the estimation of non-CO_2 emissions from forest land affected by fires result from uncertainties related to the available biomass, as well as those related to emission factors. Uncertainties related to annual activity data on forest land affected by fires are considered to be relatively low, up to circa 10%. Uncertainties related to default emission factors for different types of burnings (dry matter burnt) are moderate for CH_4 (circa 30%) and N_2O (circa 30%). Thus, combined uncertainties related to non-CO_2 emissions (CH_4 and N_2O) from the respective sink category are considered relatively high and constitute circa 31.62% for both CH_4 and N_2O (Annex 5-3.4).

6.2.4. Quality Assurance and Quality Control

The quality of estimations for both subcategories 4A1 'Forest Land Remaining Forest Land' and 4A2 'Land Converted to Forest Land' was assured by the fact that most of the AD used were taken from official records. Thus, total forest area, as well as areas converted to forest land were taken from the General Land Cadastre of the Republic of Moldova, annual forest land balance drafted annually by the state forest authorities, periodical records of forests (once every 5 years), forest planning materials, etc. At the same time, data quality is ensured through the creation for Sector 4 'LULUCF' of the Land Use and Land-Use Change Matrix for the period 1970-2020.

Annual biomass increments were taken from production tables, periodical state records (once every 5 years) of forests, forest planning materials, by-laws and technical regulations in forestry, as well as

[108] Galupa, D., Ciobanu, A., Scobioala, M. et al. Illegal logging of forest vegetation in the Republic of Moldova. Analytical study. 2011. Chisinau, Agency 'Moldsilva', 38 pages.

from the international monitoring and certification procedures for Moldova Soil Conservation Project (MSCP) and Moldova Community Forestry Development Project (MCFDP).

Data on the volume of wood mass was obtained from the following sectoral statistical reports: Form 3 G.S. 'Statistical Report on volumes of standing wood withdrawn from forests'; Statistical Form 5 G.S. 'Statistical Report on volumes of illegal logging' and Form 2 G.S. 'Statistical Report on attaining production indicators in forestry' (Section 'Wood mass movement"). At the same time, data on illicit logging detected according to official records were taken from the study *'Illegal logging of forest vegetation in the Republic of Moldova'*[109], annual reports by Agency 'Moldsilva', and the Environmental Protection Inspectorate. Standard verification and quality control forms and checklists were filled in for category 4A 'Forest Land', following a Tier 1 approach. Verification was focused on various aspects such as: ensuring correct use of estimation methodologies following the 2006 IPCC Guidelines, correct use of national coefficients, their accuracy, as well as comparing them to the values used by other countries in the region.

6.2.5. Recalculations

No recalculations were performed for subcategories 4A1 'Forest Land Remaining Forest Land' and 4A2 'Land Converted to Forest Land' as well as for non-CO_2 emissions from 4A2 'Land Converted to Forest Land'. Between 1990 and 2020, CO_2 removals from category 4A 'Forest Land' had fallen continuously (Figure 6-4).

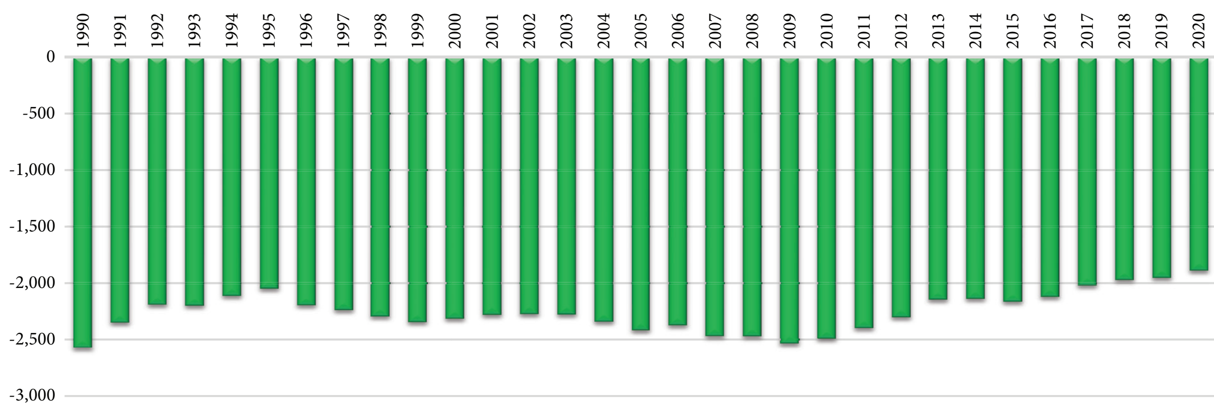


Figure 6-4: Net CO_2 removals from category 4A 'Forest Land' between 1990-2020, kt.

Thus, compared to the base year (1990), a decrease by 26.4% in GHG reduction was recorded in 2020, or a difference of circa 676 kt CO_2 (Table 6-22). This also is due to the increase in the amount of wood officially harvested from forests.

Table 6-22: Evolution of net CO_2 removals from category 4A 'Forest Land' in the RM between 1990-2020, kt

	1990	1991	1992	1993	1994	1995	1996	1997
4A1	-1 579.0396	-1 352.6491	-1 290.4237	-1 367.4361	-1 355.1762	-1 350.1974	-1 559.0470	-1 639.4910
4A2	-984.3932	-990.6641	-893.8167	-826.0754	-752.8259	-694.8696	-631.3866	-592.7944
Total 4A	**-2 563.4328**	**-2 343.3131**	**-2 184.2404**	**-2 193.5115**	**-2 108.0022**	**-2 045.0670**	**-2 190.4337**	**-2 232.2854**
	1998	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**
4A1	-1 732.3177	-1 840.9058	-1 881.4545	-1 873.5555	-1 913.5787	-1 863.8705	-1 904.3372	-1 965.9956
4A2	-556.1680	-495.9410	-425.9839	-400.1473	-354.0371	-406.2471	-430.4396	-443.5229
Total 4A	**-2 288.4857**	**-2 336.8468**	**-2 307.4384**	**-2 273.7027**	**-2 267.6159**	**-2 270.1176**	**-2 334.7768**	**-2 409.5185**
	2006	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**
4A1	-1 882.9327	-1 985.9585	-1 985.3822	-2 008.9453	-1 964.0859	-1 871.4295	-1 702.2662	-1 531.8805
4A2	-483.5841	-474.4270	-477.4052	-517.1206	-520.0768	-519.1417	-592.5559	-609.9898
Total 4A	**-2 366.5168**	**-2 460.3855**	**-2 462.7874**	**-2 526.0659**	**-2 484.1627**	**-2 390.5712**	**-2 294.8221**	**-2 141.8702**
	2014	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**
4A1	-1 484.6747	-1 496.3946	-1433.2460	-1324.5630	-1281.3639	-1231.1003	-1159.8803	N/A
4A2	-650.0643	-663.0493	-682.5162	-691.8743	-687.9943	-719.5474	-727.4426	N/A
Total 4A	**-2 134.7390**	**-2 159.4439**	**-2115.7622**	**-2016.4373**	**-1969.3582**	**-1950.6476**	**-1887.3228**	**N/A**

As for the individual contribution of the two categories (4A1 and 4A2), it should be noted that the share of subcategory 4A1 'Forest Land Remaining Forest Land' is dominant, accounting for circa 61.6% in 1990, and circa 61.5% in 2020, respectively (Figure 6-5).

[109] Dumitru Galupa, Anatol Ciobanu, Marian Scobioala et al. (2011), Illegal logging of forest vegetation in the Republic of Moldova. Analytical study, Chisinau, Agency 'Moldsilva', 38 pages.

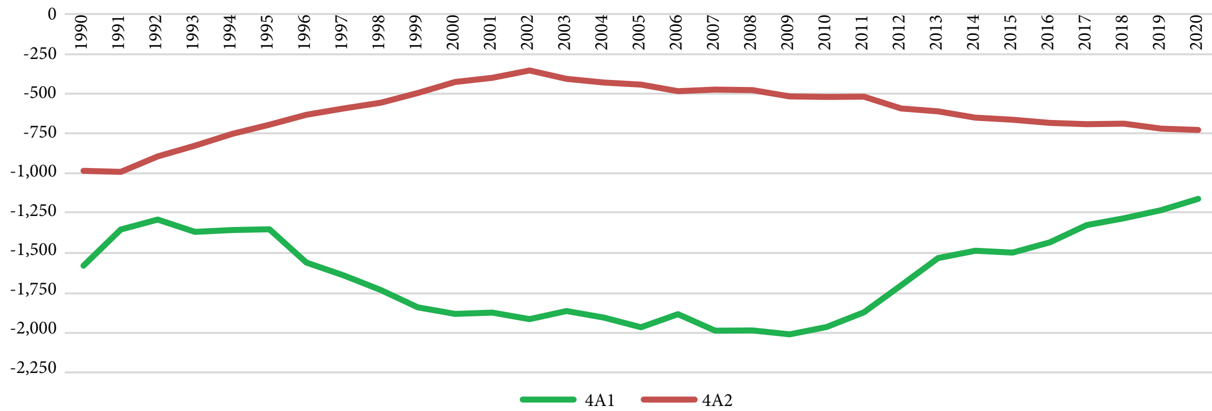


Figure 6-5: CO_2 removals by subcategory from category 4A 'Forest land' between 1990-2020, kt.

In the reference period, non-CO_2 emissions (CH_4 and N_2O) from category 4A 'Forest Land' were relatively constant, except for the years 2007 and 2012, when due to severe droughts the forest areas affected by fires recorded a historical maximum of 791.0 ha and 672.4 ha, or a 7-time increase compared to the level in the base year. Compared 1990, non-CO_2 emissions from forest areas affected annually by fires within category 4A 'Forest Land' increased by circa 3.5 times by 2020 (Table 6-23).

Table 6-23: Non-CO_2 emissions from forest areas annually affected by fires between 1990-2020

	1990	1991	1992	1993	1994	1995	1996	1997
CH_4 emissions, kt	0.0083	0.0014	0.0015	0.0001	0.0023	0.0001	0.0008	0.0002
N_2O emissions, kt	0.0005	0.0001	0.0001	0.0000	0.0001	0.0000	0.0000	0.0000
Total, kt CO_2 equivalent	**0.3438**	**0.0575**	**0.0630**	**0.0043**	**0.0959**	**0.0055**	**0.0321**	**0.0097**
NO_x emissions, kt	0.0053	0.0009	0.0010	0.0001	0.0015	0.0001	0.0005	0.0001
CO emissions, kt	0.1887	0.0316	0.0346	0.0024	0.0526	0.0030	0.0176	0.0053
	1998	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**
CH_4 emissions, kt	0.0023	0.0017	0.0001	0.0039	0.0021	0.0023	0.0061	0.0006
N_2O emissions, kt	0.0001	0.0001	0.0000	0.0002	0.0001	0.0001	0.0003	0.0000
Total, kt CO_2 equivalent	**0.0965**	**0.0721**	**0.0026**	**0.1632**	**0.0876**	**0.0959**	**0.2519**	**0.0240**
NO_x emissions, kt	0.0015	0.0011	0.0000	0.0025	0.0013	0.0015	0.0039	0.0004
CO emissions, kt	0.0529	0.0396	0.0014	0.0896	0.0481	0.0526	0.1383	0.0132
	2006	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**
CH_4 emissions, kt	0.0063	0.0546	0.0038	0.0093	0.0032	0.0043	0.0464	0.0322
N_2O emissions, kt	0.0003	0.0030	0.0002	0.0005	0.0002	0.0002	0.0026	0.0018
Total, kt CO_2 equivalent	**0.2600**	**2.2655**	**0.1575**	**0.3842**	**0.1343**	**0.1798**	**1.9251**	**1.3373**
NO_x emissions, kt	0.0040	0.0349	0.0024	0.0059	0.0021	0.0028	0.0296	0.0206
CO emissions, kt	0.1427	1.2432	0.0864	0.2108	0.0737	0.0987	1.0564	0.7339
	2014	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**
CH_4 emissions, kt	0.0027	0.0246	0.0123	0.0170	0.0059	0.0141	0.0289	N/A
N_2O emissions, kt	0.0001	0.0014	0.0007	0.0009	0.0003	0.0008	0.0016	N/A
Total, kt CO_2 equivalent	**0.1099**	**1.0198**	**0.5119**	**0.7066**	**0.2431**	**0.5843**	**1.2002**	**N/A**
NO_x emissions, kt	0.0017	0.0157	0.0079	0.0109	0.0037	0.0090	0.0185	N/A
CO emissions, kt	0.0603	0.5596	0.2809	0.3878	0.1334	0.3206	0.6586	N/A

In the context of the attributed competencies, 'Moldsilva' Agency produces regular reports on CO_2 emission reduction following the implementation of CDM Afforestation Projects (MSCP and MCFDP). These calculations are based on the AR-AM0002 Methodology 'Restoration of Degraded Lands through Afforestation/Reforestation' (Version 01 and Version 03), based on the initial modules and documentation of the MSCP and MCFDP, reports submitted by the forestry entities participating in the projects (successful forest plantation, repairs, etc.), monitoring events with measurements on sample plots and international certification, etc. Thus, according to these reports, between 2004 and 2017, a decrease in emissions by circa 2.45 Mt of CO_2 equivalent was reported, having implemented the MSCP and MCFDP (Table 6-24).

Table 6-24: CO_2 emission reductions within the CDM Projects (MSCP and MCFDP) between 2004-2020, kt

	2004	2005	2006	2007	2008	2009
Net removals in MSCP	-31.39	-37.36	-86.53	-93.32	-123.30	-138.40
Net removals in MCFDP	0.00	0.00	0.00	0.00	0.00	0.00
Total	**-31.39**	**-37.36**	**-86.53**	**-93.32**	**-123.30**	**-138.40**

	2010	2011	2012	2013	2014	2015
Net removals in MSCP	-151.06	-190.60	-191.85	-216.49	-214.77	-221.90
Net removals in MCFDP	0.00	0.00	-328.81	-58.15	-39.00	-36.00
Total	**-151.06**	**-190.60**	**-520.66**	**-274.64**	**-253.78**	**-257.90**
	2016	**2017**	**2018**	**2019**	**2020**	**2021**
Net removals in MSCP	-203.047	0.000	0.000	0.000	0.000	N/A
Net removals in MCFDP	-41.000	-47.034	0.000	0.000	0.000	N/A
Total	**-244.047**	**-47.034**	**0.000**	**0.000**	**0.000**	**N/A**

Source: Agency 'Moldsilva' (2009), PDD for MSCP, Available at: https://cdm.unfccc.int/Projects/DB/SGS-UKL1216031019.22/view. Agency 'Moldsilva' (2012), PDD for MCFDP, available at: https://cdm.unfccc.int/Projects/DB/TUEV-SUED1352989843.61. Agency 'Moldsilva' (2004-2015), Annual Reports to the World Bank for the period 2004-2016 on emissions reduction within MSCP and MCFDP. Agency 'Moldsilva' (2012-2013 and 2017-2018) Monitoring Reports for MSCP and MCFDP, available at: https://cdm.unfccc.int/Projects/DB/SGS-UKL1216031019.22/view and https://cdm.unfccc.int/Projects/DB/TUEV-SUED1352989843.61.

6.2.6. Planned Improvements

For the next inventory cycle, the possibility to improve records on actual wood consumption from forests in the RM will be envisaged, primary data on land categories converted to forest land, as well as updating national emission/removal factors (wood density, biomass expansion factor, emission factors from forest fires, etc.).

6.3. Cropland (Category 4B)

6.3.1. Source Category Description

Category 4B 'Cropland' includes a wide range of land whose primary purpose is the cultivation of different types of agricultural crops and/or their protection against unfavorable weather conditions. Thus, category 4B 'Cropland' comprises the following lands: perennial plantations (vineyards and orchards, including fruit nurseries, woody vegetation in individual gardens, etc.); other forest vegetation, including windbreaks and green spaces; arable soils.

CO_2 emission/removal estimates originating from two subcategories are reported under this category: 4B1 'Cropland Remaining Cropland' and 4B2 'Land Converted to Cropland', including non-CO_2 emissions from post-harvest field burning of agricultural residues.

4B1 'Cropland Remaining Cropland'

For a clearer explanation of the calculation exercise carried out for subcategory 4B1 'Cropland Remaining Cropland', the results are presented separately for three sections: 4B1.1 'Cropland Covered with Woody Vegetation', 4B1.2 'Annual Change in Carbon Stocks in Mineral Soils' and 4B1.3 'Non-CO_2 Emissions from Post-Harvest Field Burning of Agricultural Residues' (stubble field burning). The basic calculations include separate categories in estimating GHGs: a) orchards, b) vineyards, c) woody vegetation, and d) conversions.

4B1.1 'Cropland Covered with Woody Vegetation'

Category 4B1.1 'Cropland Covered with Woody Vegetation' comprises CO_2 removals/emissions from cropland covered with woody vegetation, including above-ground and below-ground biomass in windbreaks, tree and shrub plantations, other types of forest vegetation, as well as from perennial plantations: orchards, vineyards, trees from private gardens, etc.

Though having a smaller share in CO_2 removals in comparison with forests, the respective category is still somewhat important in the total balance per sector, as the quantitative share in the general land structure per country of these sources reaches up to 10%, thus having an essential contribution to maintaining environmental balance.

In conformity with records available in the Republic of Moldova, forest vegetation not regarded as forest resources includes the following categories:

- windbreaks along agricultural fields;
- windbreaks, and tree and shrub plantations along communication ways;
- windbreaks as protection against erosion;
- groups of trees and separately standing trees within urban and settlement areas.

According to the general definition, windbreaks represent formations of forest vegetation, located at a particular distance from each other or toward an object in order to protect it against the effects of various harmful factors and/or for climatic, economic and aesthetic-sanitary land improvement.

4B1.2 'Annual Change in Carbon Stocks in Mineral Soils'

CO_2 emissions from mineral soils are reported under category 4B1.2 'Annual Change in Carbon Stocks in Mineral Soils'. This source has a significant share in the total national emissions, as this source includes arable lands with a share of over 54.7% of the country's territory, or 1852.19 thousand ha (according to the General Land Cadastre of the Republic of Moldova as of 01.01.2021). It should be mentioned that the areas of arable land remained relatively constant, increasing only by 5% between 1990 and 2020.

Changes in land-use of cropland and soil management practices can considerably affect the organic carbon stocks in mineral soils[110]. Thus, for example, conversion of natural 'Grassland' and 'Forest Land' to 'Cropland' could determine the loss of 20-40% of the original soil carbon stocks (2006 IPCC Guidelines). Soil organic carbon stocks can change with management or disturbance if the net balance between carbon inputs (such as organic fertilizers, agricultural residues) and carbon losses (e.g., carbon loss due to mineralization of organic substances in soil). Carbon stocks also depend on the intensity of the humification process, which is directly influenced by the climatic conditions, particularly humidity and temperature regime.

4B1.3 'Non-CO_2 Emissions from Post-Harvest Field Burning of Crop Residues'

'Post-Harvest Field Burning of Agricultural Residues' is a rather frequent practice. According to more recent estimations, in some developing countries, up to 40% of crop residues are burnt in fields (in developed countries this percentage is much smaller, less than 10%). It should be noted that in cases in which crop residues are removed from fields to be used as fuel for heating and/or cooking, these emissions from burning are estimated under the Energy sector.

Only non-CO_2 emissions: CH_4, N_2O, NO_x and CO are monitored under this category (CO_2 emissions are not regarded as a source of emissions, as the carbon emitted into atmosphere is considered to be re-absorbed in the following agricultural cycle).

The amount of crop residues varies year-over-year, and depends on crops and management technologies. It should be noted that though burning of stubble fields is prohibited by law, this practice still persists. Crop residues are burnt in fields to clear the stubble fields from the straw left after reaping (in the RM, stubble fields are most often burnt after wheat and barley reaping) and to prepare the fields for the next agricultural cycle.

4B2 'Land Converted to Cropland'

Subcategory 4B2 'Land Converted to Cropland' includes lands subject to conversion which previously had a certain volume of biomass (forests, grasslands, perennial plantations, windbreaks, etc.) or lacked vegetation (settlements, wetlands, etc.).

6.3.2. Methodological Issues, Emission Factors and Data Sources

4B1 'Cropland Remaining Cropland'

The calculation methods used to estimate CO_2 removals/emissions from category 4B1 'Cropland Remaining Cropland' are those available in the 2006 IPCC Guidelines. At the same time, country-specific emission/removal factors were used regarding the annual biomass increments, as well as AD by sector (windbreaks, tree and shrub plantations, orchards, vineyards, wood harvesting, area of mineral soils used for agriculture, etc.).

4B1.1 'Cropland Covered with Woody Vegetation'

To estimate CO_2 removals/emissions within subcategory 4B1.1 'Cropland Covered with Woody Vegetation', current biomass increments were established in woody vegetation not included in forestry re-

[110] According the FAO classification: mineral soils are soils with moderate content of organic matter; unlike organic soils which contain 12-20% of organic matter from total mass; it should be noted that there are no such types of soils in the Republic of Moldova.

sources and perennial plantations: according to production tables, forest planning, scientific sources, data from 'Moldova – Agricultural Competitiveness Project' (MACP), etc.

The calculation was done based on annual change in carbon stocks as a result of current increments of perennial woody crops (stem, shoots, leaves and roots) by using Equations 2.9-2.14 from the 2006 IPCC Guidelines (pages 2.14-2.18). The estimation of these indicators was performed according to the algorithm and intermediate equations described in the paragraph dedicated to subcategory 4A1 'Forest Land Remaining Forest Land' in the current Report, the difference being in the removal/emission factors used in the calculation process.

Annual wood harvesting from orchards and vineyards occurs during technological cleaning processes. For wood harvesting from windbreaks and other types of forest vegetation, 90% of which are managed by local public authorities, the volume of wood harvested was included in the total volume authorized annually by the Environmental Protection Inspectorate and/or the Environment Agency (Article 40 of the Environmental Protection Law; Article 22 of the Forestry Code on state control and its data), since other national records for this type of vegetation are not available. Based on data obtained from the Environmental Protection Inspectorate and/or the Environment Agency on the amount of wood authorized for harvesting by local authorities and other public institutions (except Agency 'Moldsilva'), the annual harvested amounts were calculated (Table 6-25).

Table 6-25: Wood harvested from other types of woody vegetation between 1990-2020, thousand m^3

	1990	1991	1992	1993	1994	1995	1996	1997
Volume of wood harvested	0.00	24.98	37.80	58.52	36.90	36.18	32.47	2.95
	1998	1999	2000	2001	2002	2003	2004	2005
Volume of wood harvested	10.75	3.08	1.37	0.48	0.30	0.40	2.74	2.11
	2006	2007	2008	2009	2010	2011	2012	2013
Volume of wood harvested	3.11	1.78	2.36	2.48	5.20	2.10	2.91	3.49
	2014	2015	2016	2017	2018	2019	2020	2021
Volume of wood harvested	8.57	9.51	43.49	38.01	33.37	28.18	39.16	n/a

Source: Reports of the Environmental Protection Inspectorate and/or the Environment Agency for the period 1990-2020.

In order to estimate biomass increments of perennial woody crops on croplands, and, implicitly, the resulting CO_2 removals, activity data available in the General Land Cadastre of the RM was used on areas occupied by such crops between 1990 and 2020 (Table 6-26).

Table 6-26: Areas of land covered with woody vegetation in subcategory 4B1 'Cropland Remaining Cropland' between 1990-2020, ha

Land Category	1990	1991	1992	1993	1994	1995	1996	1997
Perennial plantations	288955.4	299617.5	290817.5	278922.5	279873.4	267483.4	278702.1	265402.1
Other forest vegetation	23950.0	23950.0	23950.0	22450.0	22450.0	22450.0	21850.0	18750.0
Total woody vegetation	**312905.4**	**323567.5**	**314767.5**	**301372.5**	**302323.4**	**289933.4**	**300552.1**	**284152.1**
Land Category	1998	1999	2000	2001	2002	2003	2004	2005
Perennial plantations	250302.1	231902.1	226234.3	197070.3	203977.4	211223.7	219946.8	219771.4
Other forest vegetation	16650.0	22600.0	22300.0	23084.0	23384.0	21615.0	21615.0	30615.0
Total woody vegetation	**266952.1**	**254502.1**	**248534.3**	**220154.3**	**227361.4**	**232838.7**	**241561.8**	**250386.4**
Land Category	2006	2007	2008	2009	2010	2011	2012	2013
Perennial plantations	219586.8	219400.3	228261.4	226224.1	288530.4	281941.6	278612.7	272655.4
Other forest vegetation	34315.0	34315.0	35415.0	34115.1	34115.1	34856.0	35532.4	33705.8
Total woody vegetation	**253901.8**	**253715.3**	**263676.4**	**260339.3**	**322645.5**	**316797.6**	**314145.1**	**306361.2**
Land Category	2014	2015	2016	2017	2018	2019	2020	%
Perennial plantations	250631.5	242116.3	217331.4	217305.7	213811.6	210573.5	193404.8	-33.1
Other forest vegetation	39839.8	40939.8	40939.8	40880.8	40134.6	35684.6	35463.4	48.1
Total woody vegetation	**290471.3**	**283056.1**	**258271.2**	**258186.5**	**253946.2**	**246258.1**	**228868.2**	**-26.9**

According to recorded data, the evolution of areas of other types of woody vegetation had a positive trend between 1990 and 2020, increasing by 7.4%. The area of perennial woody crops decreased continuously over the same period (Table 6-8), the titak area of perennial plantations decreasing by 41.0%: the area of orchards decreased by 39.7%, and vineyards – by 42.3%. At the same time, it should be mentioned that category 4B1.1 'Cropland Covered with Woody Vegetation' also includes lands that are subject to internal conversions, which generate certain changes in carbon stocks (Table 6-27).

Table 6-27: Evolution of lands subject to internal conversion within category 4B1.1 'Cropland Covered with Woody Vegetation' between 1970-2020, ha

Land Category	1970	1971	1972	1973	1974	1975	1976	1977	1978
Perennial plantations to cropland	0.0	391.8	19923.5	3269.4	0.0	0.0	0.0	5178.6	5948.0
Forest vegetation to cropland	0.0	72.4	72.0	72.4	72.0	181.0	145.0	36.0	778.0
Cropland to forest vegetation	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Cropland to perennial plantations	0.0	10511.8	0.0	5798.7	18118.8	5607.2	24273.7	0.0	0.0
Total	**0.0**	**10975.9**	**19995.5**	**9140.5**	**18190.8**	**5788.2**	**24418.7**	**5214.6**	**6726.0**
Land Category	**1979**	**1980**	**1981**	**1982**	**1983**	**1984**	**1985**	**1986**	**1987**
Perennial plantations to cropland	3255.2	0.0	1347.6	0.0	0.0	0.0	23450.9	19160.3	1076.3
Forest vegetation to cropland	0.0	0.0	0.0	0.0	0.0	72.4	0.0	0.0	1157.9
Cropland to forest vegetation	2153.0	36.0	434.0	109.0	0.0	0.0	3257.0	1338.8	0.0
Cropland to perennial plantations	0.0	11521.0	0.0	11606.3	9934.5	8757.6	0.0	0.0	0.0
Total	**5408.2**	**11557.0**	**1781.6**	**11715.3**	**9934.5**	**8830.0**	**26707.9**	**20499.1**	**2234.2**
Land Category	**1988**	**1989**	**1990**	**1991**	**1992**	**1993**	**1994**	**1995**	**1996**
Perennial plantations to cropland	0.0	1034.5	0.0	0.0	8596.6	17457.5	17159.5	17752.3	13244.2
Forest vegetation to cropland	0.0	0.0	470.0	0.0	0.0	542.8	0.0	0.0	217.1
Cropland to forest vegetation	398.0	615.0	0.0	289.0	253.0	0.0	2569.1	398.0	0.0
Cropland to perennial plantations	8893.1	0.2	63352.0	4166.0	0.0	0.0	0.0	0.0	0.0
Total	**9291.2**	**1649.7**	**63822.0**	**4455.0**	**8849.6**	**18000.3**	**19728.7**	**18150.4**	**13461.3**
Land Category	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**
Perennial plantations to cropland	13045.4	14811.2	18053.2	17072.9	28626.9	4646.4	2639.8	18.2	0.0
Forest vegetation to cropland	1121.7	759.9	0.0	144.7	150.5	0.0	640.1	0.0	0.0
Cropland to forest vegetation	0.0	0.0	542.8	0.0	0.0	258.7	0.0	103.0	417.0
Cropland to perennial plantations	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1415.4
Total	**14167.1**	**15571.1**	**18596.0**	**17217.6**	**28777.5**	**4905.1**	**3279.9**	**121.2**	**1832.4**
Land Category	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**
Perennial plantations to cropland	0.0	0.0	0.0	1886.7	2150.1	112.4	3259.0	41.2	3497.4
Forest vegetation to cropland	0.0	0.0	0.0	1085.5	0.0	21.4	8.5	660.9	349.5
Cropland to forest vegetation	244.2	116.9	223.0	0.0	1066.3	0.0	0.0	0.0	0.0
Cropland to perennial plantations	2929.0	1107.1	453.7	0.0	0.0	0.0	0.0	0.0	0.0
Total	**3173.2**	**1224.0**	**676.7**	**2972.2**	**3216.4**	**133.8**	**3267.6**	**702.2**	**3846.9**
Land Category	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**	**2023**
Perennial plantations to cropland	2730.5	2.9	0.0	3405.0	3031.1	5313.5	n/a	n/a	n/a
Forest vegetation to cropland	0.0	0.0	21.3	270.0	0.0	43.9	n/a	n/a	n/a
Cropland to forest vegetation	724.0	178.9	0.0	0.0	20.0	0.0	n/a	n/a	n/a
Cropland to perennial plantations	0.0	0.0	1275.8	0.0	0.0	0,0	n/a	n/a	n/a
Total	**3454.5**	**181.7**	**1297.1**	**3675.1**	**3051.2**	**5357.4**	**n/a**	**n/a**	**n/a**

Source: General Land Cadastre of the RM for the period 1970-2020; Land Use and Land-Use Change Matrix in the RM for the period 1970-2020.

To establish annual biomass increments and losses for other type of forest vegetation on cropland, country-specific emission/carbon stock change factors were used, based on data in Hungary's 2014 NIR, as well as data from the literature in the field regarding perennial plantation management (Table 6-28). Production tables, activity data on windbreak productivity, according to records and forestry management practices (Table 6-28) were used for the calculation of the carbon stock change factors for other types of forest vegetation on cropland. In order to estimate carbon stock change factors in perennial plantations (orchards and vineyards), a 15-year production cycle was used, including 14 years with a constant annual biomass increment (represented as a net annual biomass increment), the fifteenth year being the year in which vegetation was cut, thereby assuming the total carbon emitted into the atmosphere.

Table 6-28: Emission/removal factors used in the estimation process for 4B1.1 'Cropland Covered with Woody Vegetation'

Land Category	Annual Biomass Increments, t C/yr/ha	Biomass Losses due to Conversion, t C/yr/ha
Other types of forest vegetation	1.42	-24.8
Perennial plantations	0.32	-4.43

Source: Ukrainian Forest Management Service: Forestry Resources of the Moldavian Soviet Socialist Republic, standing as of 1.01.1988, Irpeni, 1988; Gh. Vdovii, D. Galupa et al. (1997), National Report on Forestry Resources of the Republic of Moldova, Giurgiu V., Decei I., Armasescu S. Biometry of Trees and Stands in Romania, 1972; Kapp G., Velsen-Zerweck M., Horst A., Horn L., Galupa D. Talmaci I. et al.: The Baseline Study for the Moldova Soils Conservation Project, 2003; National GHG Inventory Report for Hungary, 2014.

Country-specific emission factors were developed for lands subject to internal conversion within category 4B1.1, depending on the particularities of the land categories subject to the respective processes (Table 6-29).

Table 6-29: Emission/removal factors used for internal conversion under category 4B1.1 'Cropland Covered with Woody Vegetation'

Internal Conversion	Indicators	Period, years	Units	Indicator Value[111]
Perennial plantations to cropland	Annual average carbon increments of biomass	year 1	Mg C/ha/yr	0.57
	Annual average carbon increments of DOM and SOC	years 1-20	Mg C/ha/yr	0.00
Forest vegetation to cropland	Annual average carbon increments/losses of biomass	year 1	Mg C/ha/yr	-24.80
	Annual average carbon increments/losses of dead organic matter (litter/DOM)	year 1	Mg C/ha/yr	-1.15
	Annual average increments/losses of soil organic carbon (SOC/SOM)	years 1-20	Mg C/ha/yr	-1.1988
Cropland to forest vegetation	Annual average carbon increments/losses of biomass (trees and shrubs)	year 1	Mg C/ha/yr	-3.26
	Annual average carbon increments of biomass (trees and shrubs)	years 2-20	Mg C/ha/yr	1.74
	Annual average carbon increments of dead organic matter (litter/DOM)	years 1-20	Mg C/ha/yr	0.41
	Annual average increments of soil organic carbon (SOC/SOM)	years 1-20	Mg C/ha/yr	0.32
Cropland to perennial plantations	Annual average carbon increments/losses of biomass (trees and shrubs)	year 1	Mg C/ha/yr	-4.68
	Annual average carbon increments of biomass (trees and shrubs)	years 2-20	Mg C/ha/yr	0.32
	Annual average carbon increments of dead organic matter (litter/DOM)	years 1-20	Mg C/ha/yr	0.00
	Annual average increments of soil organic carbon (SOC/SOM)	years 1-20	Mg C/ha/yr	0.00

Source: Ukrainian Forest Management Service: Forestry Resources of the Moldavian Soviet Socialist Republic, standing as of 1.01.1988, Irpeni, 1988; Gh. Vdovii, D. Galupa et al. (1997), National Report on Forestry Resources of the Republic of Moldova, Giurgiu V., Decei I., Armasescu S. Biometry of Trees and Stands in Romania, 1972; Kapp G., Velsen-Zerweck M., Horst A., Horn L., Galupa D. Talmaci I. et al.: The Baseline Study for the Moldova Soils Conservation Project, 2003; National GHG Inventory Report for Hungary, 2014.

4B1.2 'Annual Change in Carbon Stocks in Mineral Soils'

In order to estimate emissions from subcategory 4B1.2 'Annual Change in Carbon Stocks in Mineral Soils', a Tier 2 approach was used. For the calculation of annual changes in carbon stocks in mineral soils, Equation 2.25 from the 2006 IPCC Guidelines was used (Volume 4, Chapter 2, Page 2.30):

$$\Delta C_{mineral} = (SOC_0 - SOC_{(0-T)}) / T$$

Where:

$\Delta C_{mineral}$ – annual change in carbon stocks in mineral soils, t C/yr;

SOC_0 – soil organic carbon stock in the last year of an inventory period, t C;

$SOC_{(0-T)}$ – soil organic carbon stock at the beginning of the inventory time period, t C;

T – time dependence of stock change factors which is the default time period for transition from equilibrium SOC values, yr (T is used in this equation if T ≥ 20 years, where T represents number of years over a single inventory time period).

In order to estimate CO_2 emissions from annual change in carbon stocks in mineral soils the following equation was used:

$$CO_2 = \Delta C_{mineral} \bullet 44/12$$

Where:

CO_2 – emissions from carbon losses in mineral soils due to land-use change for cropland and soil management practices, Gg/yr;

[44/12] – mass ratio between carbon content in CO_2 and C.

The following aspects were taken into consideration in the process of assessing the annual change in carbon stocks in mineral soils in the RM:

- The agricultural practices applied on the arable land of the RM and the pedo-climatic conditions allow the highlighting of a single agricultural land use (in the country, the mineral soils cover is quite homogeneous, mainly represented by chernozems); significant changes in soil management technologies between 1990 and 2020 did not occur: autumn plowing is dominant on the entire arable land of the country; since 1990, the amount of carbon stocks in mineral soils had decreased substantially, particularly due to the fact that the amount of organic fertilizers applied to soil have been gradually reduced, as well as the amount of crop residues returned to soil (including as a result of significant reduction of harvests for basic crops);
- Information on the evolution of organic carbon stocks in arable soils were identified in the national scientific literature; according to the reference sources consulted, the soils in the RM, used for the most part for about 150 years, in the meantime lost circa 45-50% of the accumulated carbon: in 1877, the content of humus in arable soils (a layer of 0-30 cm, bulk density – 1.17 g/cm^3) in the northern area of the country (Napadova commune, Floresti district) acounted for 5.72%

[111] The 'minus' sign indicates losses.

(200.7 t humus/ha or 116.4 t C/ha); in 1960, the content of humus in the same area acounted for 3.68% (129.0 t humus/ha or 74.8 t C/ha); by 2003 – 3.36% (117.9 t humus/ha or 68.4 t C/ha), whereas in 2010 – 3.11% (109.2 t humus/ha or 63.3 t C/ha);

- In the same context, according to other sources published in the field literature, through direct measurements made on leaching chernozems in the northern part of the country, it was established that in 60 years of exploitation, the soils lost about 37% of the accumulated carbon, and the annual average was 300 kg C/ha/yr (Soils of Moldova, Volume 1, 1989); within the long-term experiments (circa 40 years) of the 'Nicolae Dimo' Institute of Pedology, Agrochemistry and Soil Protection, in the main pedo-climatic areas of the country, located on the chernozems subtypes dominant in soil cover, it was established that annual rates of carbon losses are very similar at area and chernozem subtype level – circa 325 kg C/ha/yr (Ecopedological Monitoring Bulletin, 7th Edition, 2000); very similar rates were established through the oldest long-term experiments in the country organized by the Agrarian State University of Moldova in Chetrosu village, Anenii Noi district, on carbonate chernozem (Zagorcea, 1990); values between 300-330 kg C/ha/yr for carbon losses in cropland were established by other researchers as well (Ungureanu et al., 1997; Banaru et al., 2002, Andries, 2017);
- Organic carbon stocks in soil in the first year of inventory ($SOC_{(0-T)}$) were identified in 'Soil Quality Monitoring in the Republic of Moldova (database, conclusions, forecasts, recommendations)' (2010); according to the respective publication, in 1990, the content of humus in arable soils (a layer of 0-30 cm, apparent density – 1.17 g/cm^3) in the northern area of the country accounted for circa 3.46% (121.3 t humus/ha or 70.3 t C/ha); at the same time, in the southern part of the country (Lebedenco commune, Cahul district), the content of humus in arable soils (a layer of 0-30 cm, apparent density – 1.30 g/cm^3) accounted for circa 3.27% (127.3 t humus/ha or 73.9 t C/ha); under these circumstances, the country average ($SOC_{(0-T)}$) accounted for circa 124.3 t humus/ha or circa 72.1 t C/ha;
- Carbon stock change in mineral soils for the period until 1990 was estimated at -0.15 t C/ha/yr;
- Soil organic carbon stocks in the last year of the inventory cycle (SOC_0) were identified in the scientific literature; according to specialists from the 'Nicolae Dimo' Institute of Pedology, Agrochemistry and Soil Protection, the content of humus in arable soils in 2021 (a layer of 0-30 cm, bulk density – 1.41 g/cm^3) in the northern area of the country (Napadova commune, Floresti district) accounted for circa 3.0% (127.3 t humus/ha or 74.0 t C/ha); at the same time, in the southern part of the country (Lebedenco commune, Cahul district), the content of humus in arable soils (a layer of 0-30 cm, apparent density – 1.37 g/cm^3) accounted for circa 2.89% (118.8 t humus/ha or 68.9 t C/ha), the country average (SOC_0) represented circa 123.5 t humus/ha or circa 71.5 t C/ha, which corresponds to annual average losses of 309.9 kg C/ha/yr between 1990 and 2020.

In order to estimate CO_2 emissions from category 4B1.2 'Annual Change in Carbon Stocks in Mineral Soils', based on General Land Cadastre of the RM, the areas of cropland remaining cropland in the period under review were identified (Table 6-30).

Table 6-30: Areas of cropland remaining cropland in the RM between 1990-2020

Land Category	1990	1991	1992	1993	1994	1995	1996	1997
Cropland Remaining Cropland, thousand ha	1631.79	1624.65	1632.63	1634.17	1633.41	1631.19	1632.07	1640.22
Land Category	1998	1999	2000	2001	2002	2003	2004	2005
Cropland Remaining Cropland, thousand ha	1645.39	1642.29	1630.57	1622.65	1622.53	1623.10	1620.40	1643.40
Land Category	2006	2007	2008	2009	2010	2011	2012	2013
Cropland Remaining Cropland, thousand ha	1660.27	1659.82	1659.18	1659.99	1659.61	1657.53	1647.65	1654.92
Land Category	2014	2015	2016	2017	2018	2019	2020	
Cropland Remaining Cropland, thousand ha	1669.46	1685.03	1694.02	1691.57	1700.30	1709.54	1716.88	5.2

Based on the respective AD, annual change in carbon stocks in mineral soils were estimated (Table 6-31). The results show average annual rates for carbon stocks in mineral soils between 1990 and 2020, equal to circa 309.9 kg C/ha/yr[112]. This value is close to the previous results recorded by various specialists in the RM in their long-term experiments (Zagorcea, 1990; Ungureanu et al., 1997; Banaru et al., 2002; Cerbari, 2010, 2012, 2021; Andries, 2017).

[112] V. Cerbari (2021), Expert report for the determination and description of the evolution of organic carbon stocks in arable soils in 3 geographical areas of the Republic of Moldova (North – Napadova commune, Floresti district; Center – Ivancea commune, Orhei district; South – Lebedenco commune, Cahul district), PI 'EPIU', 16 P.

Table 6-31: Annual change in carbon stocks in mineral soils in the RM between 1990-2020

	1990	1991	1992	1993	1994	1995	1996	1997
$\Delta C_{mineral}$, t C/yr	-505644.07	-503431.14	-505902.39	-506379.26	-506144.79	-505455.33	-505730.54	-508254.88
	1998	1999	2000	2001	2002	2003	2004	2005
$\Delta C_{mineral}$, t C/yr	-509855.83	-508895.84	-505264.90	-502809.88	-502774.89	-502949.57	-502112.79	-509239.58
	2006	2007	2008	2009	2010	2011	2012	2013
$\Delta C_{mineral}$, t C/yr	-514468.95	-514329.13	-514130.63	-514382.49	-514263.33	-513618.90	-510557.67	-512808.79
	2014	2015	2016	2017	2018	2019	2020	2021
$\Delta C_{mineral}$, t C/yr	-517314.10	-522139.83	-524924.75	-524165.73	-526873.23	-529733.71	-532010.29	N/A

4B1.3 'Non-CO_2 Emissions from Post-Harvest Field Burning of Crop Residues (stubble field burning)'

Non-CO_2 emissions from post-harvest field burning of crop residues (stubble field burning) within 4B 'Cropland' were estimated using a Tier 1 methodology (2006 IPCC Guidelines, Volume 4, Chapter 2.4, pages 2.40-2.49).

$$L_{fire} = A \bullet M_B \bullet C_f \bullet G_{ef} \bullet 10^{-3}$$

Where:

L_{fire} – amount of non-CO_2 greenhouse gas emissions from field burning of crop residues, t/yr;

A – area burned annually in the case of crops for which stubble burning is practiced, ha/yr;

M_B – mass of fuel available for combustion varies from year to year, based on the harvest recorded, t/ha;

C_f – combustion factor; IPCC default value is 0.90 (2006 IPCC Guidelines), used to consider aspects regarding incomplete combustion;

G_{ef} – default EF for non-CO_2 GHG (g/kg CM) (Table 6-32) according to the 2006 IPCC Guidelines: Table 2.5. EFs (g/kg CM burnt) for different types of combustion, and Table 2.6. Combustion factor values (proportion of fuel before fire) for fires depending on the type of vegetation.

Table 6-32: EFs for field burning of crop residues, g/kg CM

Category	CO	CH_4	N_2O	NO_x
Field Burning of Crop Residues	92	2.7	0.07	2.5

In order to determine the amount of non-CO_2 emissions from field burning of crop residues, activity data is required on areas sown with grain crops (wheat and barley), which is available in the Statistical Yearbooks of the Republic of Moldova. Information regarding cases recorded annually by environmental inspectors in connection with the phenomenon of burning stubble in the Republic of Moldova is presented in Table 6-33.

Table 6-33: Stubble field burning in the Republic of Moldova between 1990-2020

	1990	1991	1992	1993	1994	1995	1996	1997
Burnt stubble fields, thousand ha	12.213	13.11	12.141	14.547	13.422	15.8	18.6	20.7
Burnt stubble fields, % of total	3.00	3.00	3.00	3.00	3.00	2.99	3.8	3.83
	1998	1999	2000	2001	2002	2003	2004	2005
Burnt stubble fields, thousand ha	21.5	24.00	11.5	9.5	1.96	0.1	0.4	2.2
Burnt stubble fields, % of total	3.98	4.61	2.1	1.57	0.31	0.03	0.08	0.36
	2006	2007	2008	2009	2010	2011	2012	2013
Burnt stubble fields, thousand ha	0.89	2.65	4.465	0.892	0.627	0.475	0.106	0.575
Burnt stubble fields, % of total	0.2	0.56	0.78	0.15	0.11	0.1	0.02	0.1
	2014	2015	2016	2017	2018	2019	2020	%
Burnt stubble fields, thousand ha	0.4	0.346	0.321	0.395	0.15	0.237	0.456	-96.3
Burnt stubble fields, % of total	0.07	0.08	0.06	0.09	0.003	0.06	0.12	-96.0

Source: Ministry of Ecology, Construction and Territorial Development / National Institute of Ecology (2003), State of the Environment Report of the Republic of Moldova in 2002 (National Report). Chisinau, Mediul Ambiant, 2003, 144 p. (page 60, Figure 2.19, information covering the period 1995-2002); State Ecological Inspectorate (2014), SEI Yearbook-2013 'Environment Protection in the Republic of Moldova'/ State Ecological Inspectorate; editorial board: V. Curari [et al.]. – Ch.: Pontos, 2014 (Publishing house 'Europres'). – 300 p. (page 107, Figure 5, data regarding 2000-2013 time series); SEI Yearbook-2014 'Environment Protection in the Republic of Moldova' State Ecological Inspectorate; editorial board: V. Stangaci, red.: D. Osipov – Chisinau: 'Pontos', 2015, Publishing house 'Europres', 336 p. (page 79, Figure 4, data regarding 2000-2014 time series); SEI Yearbook-2015 'Environment Protection in the Republic of Moldova'/ Ministry of Environment, SEI; editorial board: Igor Talmazan [et al.]; coord.: Dumitru Osipov. Chisinau: Pontos, 2016. Publishing House 'Europres', 348 p. (page 87, Figure 4. data regarding 2000-2015 time series). SEI Yearbook-2016 'Environment Protection in the Republic of Moldova' State Ecological Inspectorate/ Ministry of Environment; editorial board: Valeriu Nani [et. al.]; coord.: Dumitru Osipov [et al.]. Chisinau: 'Pontos', 2017, Publishing house 'Europres', 356 p.; SEI Yearbook-2017 'Environment Protection in the Republic of Moldova' State Ecological Inspectorate/ MARDE, editorial board.: Vadim Stangaci, Dumitru Osipov [et. al.]; coord.: Dumitru Osipov. Chisinau 'Pontos', 2018, Publishing house 'Europres', 392 p.; SEI Yearbook-2018 'Environment Protection in the Republic of Moldova' State Ecological Inspectorate/ MARDE, editorial board.: Gheorghe Manjeru [et. al.]; coord.: Dumitru Osipov Chisinau 'Pontos', 2019, Publishing house 'Europres' 348 p.; SEI Yearbook-2019 'Environment Protection in the Republic of Moldova' State Ecological Inspectorate/ MARDE, editorial board.: Gheorghe Manjeru [et. al.]; coord.: Dumitru Osipov Chisinau: 2020, 500 p.

As activity data was not available for the period of time between 1990 and 1994, this data was extrapolated based on the assumption that the areas of stubble fields combusted annually account for circa 3 percent of the total areas under the respective cereals (wheat and barley). Between 1995 and 2020, data on fires (biomass) were presented by the Environmental Protection Inspectorate and the General Inspectorate for Emergency Situations.

The activity data on the amount of crop residues available to be combusted on field (Table 6-34) were inferred from information on average crop yield per hectare, by multiplying it to the dry matter fraction in the basic yield of the respective crop (default value is 0.89). In order to estimate the amount of agricultural residues available for combustion on site, a mean arithmetic value between wheat and barley was used, which is closely related to the average yield per hectare recorded actually in the Republic of Moldova over the reference period.

Table 6-34: Amount of crop residues available for combustion on field between 1990-2020, t CM/ha

	1990	1991	1992	1993	1994	1995	1996	1997
Winter wheat	3.5047	3.1033	2.9248	3.5832	1.9518	2.6079	1.5741	2.5002
Barley	3.0891	2.836	2.9305	3.0798	1.9671	2.0518	1.1193	1.7656
Average	**3.2969**	**2.9696**	**2.9277**	**3.3315**	**1.9594**	**2.3298**	**1.3467**	**2.1329**
	1998	1999	2000	2001	2002	2003	2004	2005
Winter wheat	2.0877	1.8109	1.5225	2.1448	1.9703	0.4274	2.2386	2.0463
Barley	1.6085	1.4064	1.0846	1.9163	1.6088	0.6894	1.7958	1.4511
Average	**1.8481**	**1.6086**	**1.3036**	**2.0305**	**1.7895**	**0.5584**	**2.0172**	**1.7487**
	2006	2007	2008	2009	2010	2011	2012	2013
Winter wheat	1.9211	1.0847	2.6653	1.6617	1.7518	2.0084	1.1817	2.0765
Barley	1.5503	0.8103	2.3134	1.3993	1.2991	1.518	1.0862	1.6944
Average	**1.7357**	**0.9475**	**2.4893**	**1.5305**	**1.5254**	**1.7632**	**1.134**	**1.8855**
	2014	2015	2016	2017	2018	2019	2020	%
Winter wheat	2.3645	1.9798	2.5489	3.2930	2.7590	2.9370	1.6910	-51.75
Barley	1.8011	1.691	2.4043	2.7590	2.4030	2.8480	1.8690	-39.50
Average	**2.0828**	**1.8354**	**2.4766**	**3.0260**	**2.5810**	**2.8925**	**1.7800**	-46.00

4B2 'Land Converted to Cropland'

In the process of estimating CO_2 removals/emissions from category 4B2 'Land Converted to Cropland', increments and losses of biomass and carbon in soil were identified as a result of the conversion of different land categories on which there was a certain increase in biomass (forest land, grassland, perennial plantations, etc.). At the same time, estimations in this subcategory included N_2O emissions resulting from Grassland Converted to Cropland (arable land).

In the process of calculating the annual change in carbon stocks due to the conversion of different types of land to cropland, Equation 2.15 from the 2006 IPCC Guidelines (Volume 4, Chapter 2, page 2.20) was used:

$$\Delta C_B = \Delta C_G + \Delta C_{Conversion} - \Delta C_L$$

Where:

ΔC_B – annual change in carbon stocks in biomass on land converted to cropland, t C/yr;

ΔC_G – annual increase in carbon stocks in biomass due to growth on land converted to cropland, t C/yr;

$\Delta C_{Conversion}$ – initial change in carbon stocks in biomass resulting from land conversion to cropland, t C/yr;

ΔC_L – annual decrease in biomass carbon stocks due to the conversion to cropland, t C/yr.

Initial changes in carbon stocks in biomass on land converted to cropland ($\Delta C_{Conversion}$) were estimated using Equation 2.16 from the 2006 IPCC Guidelines (Volume 4, Chapter 2, page 2.20):

$$\Delta C_{Conversion} = \Sigma\{(B_{After} - B_{Before}) \bullet \Delta A_{TO\ OTHERS}\} \bullet CF$$

Where:

B_{After} – biomass stocks on land immediately after the conversion to cropland, t CM//ha;

B_{Before} – biomass stocks on land before the conversion to cropland, t CM/ha;

$\Delta A_{TO\ OTHERS}$ – area of land-use converted to cropland in a certain year, ha/yr;

CF – carbon fraction of dry matter.

The estimation process considered increments of dead wood (litter) and in organic soil carbon, since the change in land-use category has a major impact on the respective stocks.

Non-CO_2 emissions (N_2O) resulting from the conversion of grassland to cropland were estimated using Equation 11.8 from the 2006 IPCC Guidelines (Volume 4, Chapter 11, page 11.16):

$$F_{SOM} = \Sigma_{LU}\{(\Delta C_{Mineral,LU} \bullet 1/R) \bullet 100\}$$

Where:

F_{SOM} – the net annual amount of N mineralized in mineral soils as a result of loss of soil carbon through change in land-use or management, kg N;

$\Delta C_{Mineral,LU}$ – average annual loss of soil carbon for each land-use type (*LU*), tonnes C;

R – *C : N* ratio of the soil organic matter. A default value of 15 for the *C : N* ratio (R) may be used for situations involving land-use change from Forest Land or Grassland to Cropland. A default value of 10 may be used in case of internal croplands conversions;

LU – land-use and/or management system type.

AD on areas subject to conversion to category 4B2 'Land Converted to Cropland' are available in the General Land Cadastre of the RM, and are included in the Land Use and Land-Use Change Matrix for 1970-2020. The main types of land converted to cropland are grassland and settlements (Table 6-35).

Table 6-35: Areas of land converted to cropland in the RM between 1970-2020, ha

Conversion	1970	1971	1972	1973	1974	1975	1976	1977	1978
Grassland to Cropland	0.0	212.7	737.0	0.0	2749.0	0.0	3967.8	5699.0	238.3
Grassland to Forest Vegetation	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Grassland to Perennial Plantations	0.0	192.7	0.0	106.3	332.1	102.8	444.9	0.0	0.0
Wetlands to Cropland	0.0	600.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Settlements to Cropland	0.0	81.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Other Land to Cropland	0.0	0.0	0.0	0.0	0.0	0.0	1757.0	1757.0	1757.0
Total	**0.0**	**1087.1**	**737.0**	**106.3**	**3081.1**	**102.8**	**6169.8**	**7456.0**	**1995.3**
Conversion	**1979**	**1980**	**1981**	**1982**	**1983**	**1984**	**1985**	**1986**	**1987**
Grassland to Cropland	0.0	0.0	935.1	0.0	1324.5	489.5	0.0	476.6	0.0
Grassland to Forest Vegetation	3797.0	64.0	766.0	191.0	0.0	0.0	5743.0	2361.2	0.0
Grassland to Perennial Plantations	0.0	211.2	0.0	212.7	182.1	160.5	0.0	0.0	0.0
Wetlands to Cropland	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Settlements to Cropland	0.0	0.0	0.0	490.1	0.0	0.0	1715.5	1470.4	0.0
Other Land to Cropland	3583.9	10181.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total	**7380.9**	**10457.1**	**1701.1**	**893.9**	**1506.6**	**650.1**	**7458.5**	**4308.1**	**0.0**
Conversion	**1988**	**1989**	**1990**	**1991**	**1992**	**1993**	**1994**	**1995**	**1996**
Grassland to Cropland	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Grassland to Forest Vegetation	702.0	1085.0	0.0	511.0	447.0	0.0	4530.9	702.0	0.0
Grassland to Perennial Plantations	163.0	0.0	1161.2	76.4	0.0	0.0	0.0	0.0	0.0
Wetlands to Cropland	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Settlements to Cropland	408.5	0.0	245.1	0.0	0.0	163.4	0.0	571.8	163.4
Other Land to Cropland	0.0	0.0	0.0	0.0	7460.9	0.0	618.2	0.0	0.0
Total	**1273.4**	**1085.0**	**1406.3**	**587.4**	**7907.9**	**163.4**	**5149.0**	**1273.8**	**163.4**
Conversion	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**
Grassland to Cropland	0.0	0.0	0.0	0.0	0.0	0.0	1039.4	0.0	496.2
Grassland to Forest Vegetation	0.0	0.0	957.2	0.0	0.0	456.3	0.0	181.0	735.0
Grassland to Perennial Plantations	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	25.9
Wetlands to Cropland	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Settlements to Cropland	0.0	326.8	0.0	0.0	58.0	35.1	0.0	236.1	343.9
Other Land to Cropland	0.0	0.0	0.0	0.0	2231.0	1126.5	0.5	0.6	0.6
Total	**0.0**	**326.8**	**957.2**	**0.0**	**2289.0**	**1617.9**	**1039.9**	**417.6**	**1601.6**
Conversion	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**
Grassland to Cropland	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Grassland to Forest Vegetation	430.8	206.1	394.0	0.0	1880.5	0.0	0.0	0.0	0.0
Grassland to Perennial Plantations	53.7	20.3	8.3	0.0	0.0	0.0	0.0	0.0	0.0
Wetlands to Cropland	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Settlements to Cropland	1016.2	283.5	113.8	314.3	19.8	0.0	30.6	0.0	0.0
Other Land to Cropland	0.6	0.6	1004.5	318.7	330.1	926.6	0.0	10036.4	10591.3
Total	**1501.2**	**510.4**	**1520.6**	**633.0**	**2230.4**	**926.6**	**30.6**	**10036.4**	**10591.3**
Conversion	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**	**2023**
Grassland to Cropland	0.0	0.0	2110.0	5349.0	904.0	11757.6	n/a	n/a	n/a
Grassland to Forest Vegetation	1277.0	315.5	0.0	0.0	35.3	0.0	n/a	n/a	n/a
Grassland to Perennial Plantations	0.0	0.0	23.4	0.0	0.0	0.0	n/a	n/a	n/a
Wetlands to Cropland	0.0	0.0	0.0	0.0	0.0	0.0	n/a	n/a	n/a
Settlements to Cropland	0.0	0.0	0.0	27.1	0.0	94.2	n/a	n/a	n/a
Other Land to Cropland	14595.4	17633.0	19376.0	14970.8	1768.0	0.0	n/a	n/a	n/a
Total	**15872.4**	**17948.5**	**21509.4**	**20346.9**	**2707.3**	**11851.8**	**n/a**	**n/a**	**n/a**

Source: General Land Cadastre of the RM for the period 1970-2020; Land Use and Land-Use Change Matrix for the period 1970-2020.

Country specific EFs were calculated/developed in order to establish the annual increments/losses of biomass and carbon stocks in soil on lands subject to conversion to cropland. The calculation and development of such factors was based on data on productivity of grasslands according to accounting data and forest planning records, 'Moldsilva' Agency Monitoring Reports for MSCP and MCFDP (2012; 2013; 2017; 2018), as well as data in the scientific literature regarding biomass increments and the clearing process of perennial plantations (Table 6-36).

Table 6-36: Removal/emission factors used in the calculation process for category 4B2 'Land Converted to Cropland'

Conversion	Indicators	Period, years	Unit	Indicator Value
Grassland to Cropland	Annual average carbon increments of biomass	year 1	Mg C/ha/yr	1.22
	Annual average carbon increments of dead organic matter (litter/DOM)	year 1	Mg C/ha/yr	0.00
	Annual average increments/losses of soil organic carbon (SOC/SOM)	years 1-20	Mg C/ha/yr	-2.2650
Grassland to Forest Vegetation	Annual average carbon increments/losses of biomass (trees and shrubs)	year 1	Mg C/ha/yr	-2.69
	Annual average carbon increments of biomass (trees and shrubs)	years 2-20	Mg C/ha/yr	1.74
	Annual average carbon increments of dead organic matter (litter/DOM)	years 1-20	Mg C/ha/yr	0.41
	Annual average increments of soil organic carbon (SOC/SOM)	years 1-20	Mg C/ha/yr	0.32
Grassland to Perennial Plantations	Annual average carbon increments/losses of biomass (trees and shrubs)	year 1	Mg C/ha/yr	-3.46
	Annual average carbon increments of biomass (trees and shrubs)	years 2-14, 16-20	Mg C/ha/yr	0.32
	Annual average carbon increments of biomass (trees and shrubs)	year 15	Mg C/yr	-4.43
	Annual average carbon increments of dead organic matter (litter/DOM)	years 1-20	Mg C/ha/yr	0.00
	Annual average increments/losses of soil organic carbon (SOC/SOM)	years 1-20	Mg C/ha/yr	-2.2650
Wetlands to Cropland	Annual average carbon increments of biomass (trees and shrubs)	year 1	Mg C/ha/yr	0,8
	Annual average carbon increments of dead organic matter (litter/DOM)	year 1	Mg C/ha/yr	0.0
	Annual average increments/losses of soil organic carbon (SOC/SOM)	year 1	Mg C/ha/yr	-2.2650
Settlements to Cropland	Annual average carbon increments of biomass	year 1	Mg C/ha/yr	5.00
	Annual average carbon increments of dead organic matter (litter/DOM)	year 1	Mg C/ha/yr	0.00
	Annual average increments of soil organic carbon (SOC/SOM)	years 1-20	Mg C/ha/yr	0.2168
Other Land to Cropland	Annual average carbon increments of biomass	year 1	Mg C/ha/yr	5.00
	Annual average carbon increments of dead organic matter (litter/DOM)	year 1	Mg C/ha/yr	0.00
	Annual average increments of soil organic carbon (SOC/SOM)	year 1	Mg C/ha/yr	0.0108

Source: 'Soil Quality Monitoring in the RM (database, conclusions, forecasts, recommendations), 2010; Miron A., Vedutenco D. et al., Report on Drafting Management Plans for Grasslands in Orhei National Park, 2014; National GHG Inventory Report for Hungary, 2014; Agency 'Moldsilva' Reports on MSCP and MCFDP monitoring (2012; 2013; 2017; 2018).

6.3.3. Uncertainties and Time-Series Consistency

4B1 'Cropland Remaining Cropland'

Uncertainties related to CO_2 emissions/removals from subcategory 4.B1.1 'Cropland Remaining Cropland' may be considered somewhat acceptable, falling within the values reported for other categories under Sector 4 'LULUCF'. Thus, for production processes and emission/removal factors, these uncertainties account for circa 10%. The main uncertainty is associated with the actual volume of wood mass harvested from woody vegetation managed by local public authorities and other owners since there is no accurate official statistics on the volume of wood mass harvested during forest clearings for this category. The situation was overcome after having made additional calculations based on the experience of the MACP Project and data from the Environmental Protection Inspectorate (EPI). Consequently, for subcategory 4B1.1 'Cropland Covered with Woody Vegetation', wood harvests were provided as part of the total volume authorized annually by the EPI and/or the Environment Agency for local authorities and other public institutions (except for Agency 'Moldsilva').

Uncertainties related to activity data used to estimate CO_2 emissions/removals from category 4B1.2 'Annual Change in Carbon Stocks in Mineral Soils' are considered to be low (circa 10%). Uncertainties related to factors used to estimate CO_2 emissions from carbon loss in mineral soils due to land-use change and soil management practices are considered to be circa 10%.

Thus, cumulatively for category 4B1 'Cropland Remaining Cropland', uncertainties for production processes and emission/removal factors account for circa 10%, and combined uncertainties were estimated to be circa 14.14% (Annex 5-3.4).

In view of ensuring time-series consistency of the obtained results, the same approach and the same EFs were used for the entire period under review for estimating emissions/removals within this category.

4B1 'Non-CO_2 Emissions from Post-Harvest Field Burning of Crop Residues (stubble field burning)'

Uncertainties associated with the non-CO_2 emissions from post-harvest field burning of crop residues result from uncertainties related to activity data on the amounts of crop residues available to be burnt on field, as well as those related to emission factors for various types of burning.

Uncertainties related to activity data on land under cereal production and average yield per hectare reported for these crops are considered relatively low, up to circa 10%. At the same time, uncertainties related to the estimation of stubble fields actually burnt are considered to be moderate, up to circa 30%. Uncertainties associated with the default emission factors for various types of burning are moderate for CH_4 (circa 30%) and N_2O (circa 50%); however, in agricultural seasons with high humidity, these uncertainties can increase to higher levels. Thus, combined uncertainties related to direct non-CO_2 (CH_4 and N_2O) emissions from this source category are regarded to be relatively high: ±31.62% for CH_4 and ±50.99% for N_2O (Annex 5-3.4).

In view of ensuring time-series consistency of the obtained results, the same approach and the same EFs were used for the entire period under review for estimating emissions within this category.

4B2 'Land Converted to Cropland'

Uncertainties related to CO_2 emissions/removals from category 4B2 'Land Converted to Cropland' at the beginning and at the end of the reference period (1990 and 2020) are relatively low, estimated to be circa 10%. Uncertainties related to emission/removal factors are in both cases circa 10%, whereas combined uncertainties in category 4B2 'Land Converted to Cropland' related to CO_2 emissions/removals constitute circa 14.14%. As for non-CO_2 emissions from category 4B2, uncertainties related to activity data are estimated to be circa 10%, whereas uncertainties related to emission factors account for circa 30%. Combined uncertainties for non-CO_2 emissions from category 4B2 are estimated to be circa 31.62% (Annex 5-3.4).

In view of ensuring time-series consistency of the obtained results, the same approach and the same EFs were used for the entire period under review for estimating emissions within this category.

6.3.4. Quality Assurance and Quality Control

4B1.1 'Cropland Covered with Woody Vegetation'

Quality assessment for category 4B1.1 'Cropland Covered with Woody Vegetation' is ensured by the fact that most of the AD used is taken from official records[113]. At the same time, the quality of estimates increased due to the development of the Land Use and Land-Use Change Matrix for the period 1970-2020. Standard verification and quality control forms and checklists were filled in for this category, following a Tier 1 approach. Verification was focused on various aspects such as: ensuring correct use of estimation methodologies according to the 2006 IPCC Guidelines, correct use of country-specific coefficients and indices, their accuracy, as well as comparing them to the values used by other countries in the region.

4B1.2 'Annual Change in Carbon Stocks in Mineral Soils'

Standard verification and quality control forms and checklists were filled in for this category, following a Tier 1 approach. Verification was focused on various aspects such as: identifying data entry and CO_2 emission estimation-related errors, on AD and EF verifications and quality control procedures, etc. Activity data and methods used to estimate CO_2 emissions from annual change in carbon stocks in mineral soils due to land-use change and management practices were documented and archived both in hard copies and electronically. Following the recommendations of the 2006 IPCC Guidelines, CO_2 emissions from carbon loss in mineral soils as a result of land-use change and management practices were estimated based on AD from official reference sources (General Land Cadastre of the Republic of Moldova, Statistical Yearbooks, etc.), and the results of multiannual research from scientific institutions in the country, respectively.

[113] E.g., the total area of windbreaks and other types of forest vegetation, perennial plantations, is provided annually by the General Land Cadastre, while data on annual biomass increments are provided by the Production Tables, Forest State Records – once every 5 years for forests, Forest Planning Materials, Normative and Technical Forestry Regulations Acts.

4B1.3 'Non-CO_2 Emissions from Post-Harvest Field Burning of Crop Residues (stubble field burning)'

Standard verification and quality control forms and checklists were filled in for this category, following a Tier 1 approach. Verification was focused on various aspects such as: identifying data entry and CO_2 emission estimation-related errors, on AD and EF verifications and quality control procedures, etc. Activity data and methods used to estimating non-CO_2 emissions from field burning of crop residues were documented and archived both in hard copies and electronically.

6.3.5. Recalculations

For the period 1990-2020, recalculations were only made for subcategory 4B1.2 'Annual Change in Carbon Stocks in Mineral Soils'. The recalculations for the respective category are due to the updated activity data that emerged from the improvement of the Land Use and Land-Use Change Matrix for the period 1970-2020.

4B1 'Cropland Remaining Cropland'

4B1.1 'Cropland Covered with Woody Vegetation'

For 1990-2020, no recalculations were performed for subcategory 4B1.1 'Cropland Covered with Woody Vegetation'.

4B1.2 'Annual Change in Carbon Stocks in Mineral Soils'

The comparative analysis of CO_2 removals/emissions from category 4B1.2 'Annual Change in Carbon Stocks in Mineral Soils' for the period 1990-2020 is presented in Table 6-37. According to data in the table, there has been a decrease in emissions within the respective subcategory for the entire time series. The respective change is due to the update of some coefficients, particularly – organic carbon losses in soils (from 0.355 t C/ha/yr to 0.310 t C/ha/yr)[114].

Table 6-37: Recalculation of CO_2 removals/emissions from subcategory 4B1.2 'Annual Change in Carbon Stocks in Mineral Soils', included in the BUR3 and NC5 of the RM to the UNFCCC, kt

	1990	1991	1992	1993	1994	1995	1996	1997
BUR3	2123.6703	2114.3762	2124.7553	2126.7581	2125.7733	2122.8777	2124.0335	2134.6356
NC5	1857.9955	1849.2242	1857.6721	1861.4884	1857.2977	1853.5070	1854.8331	1868.8615
Difference, %	-12.5	-12.5	-12.6	-12.5	-12.6	-12.7	-12.7	-12.5
	1998	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**
BUR3	2141.3595	2137.3276	2122.0779	2111.7670	2111.6200	2112.3536	2108.8392	2138.7712
NC5	1874.6520	1873.0213	1860.3864	1852.5555	1852.2515	1855.7057	1852.1985	1881.6624
Difference, %	-12.5	-12.4	-12.3	-12.3	-12.3	-12.1	-12.2	-12.0
	2006	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**
BUR3	2160.7343	2160.1470	2159.3133	2160.3711	2159.8707	2157.1641	2144.3071	2153.7617
NC5	1902.1211	1896.3815	1895.8591	1902.2756	1898.5216	1896.5919	1885.7017	1894.4752
Difference, %	-12.0	-12.2	-12.2	-11.9	-12.1	-12.1	-12.1	-12.0
	2014	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**
BUR3	2172.6837	2192.9514	2204.6479	2201.4601	2212.8314	2224.8452	N/A	N/A
NC5	1915.5456	1932.8575	1941.9047	1934.2847	1942.0590	1953.1608	1961.0648	N/A
Difference, %	-11.8	-11.9	-11.9	-12.1	-12.2	-12.2	N/A	N/A

Abbreviations: BUR3 – Third Biennial Update Report of the RM to the UNFCCC, NC5 – Fifth National Communication of the RM to the UNFCCC.

4B1.3 'Non-CO_2 Emissions from Post-Harvest Field Burning of Crop Residues (stubble field burning)'

No recalculations were performed for subcategory 4B1.3 'Non-CO_2 Emissions from Post-Harvest Field Burning of Crop Residues'.

4B2 'Land Converted to Cropland'

For 1990-2020, no recalculations were performed for subcategory 4B2 'Land Converted to Cropland'.

4B 'Cropland'

The comparative analysis of CO_2 removals/emissions from category 4B 'Cropland' for the period 1990-2020 is presented in Table 6-38. According to data in the table, we may observe an insignificant decrease in values for category 4B (on average 17.6%).

[114] V. Cerbari (2021), Expert report for the determination and description of the evolution of organic carbon stocks in arable soils in 3 geographical areas of the Republic of Moldova (North – Napadova commune, Floresti district; Center – Ivancea commune, Orhei district; South – Lebedenco commune, Cahul district), PI 'EPIU', 16 P.

Table 6-38: Recalculation of CO_2 removals/emissions from category 4B 'Cropland' included in the BUR3 and NC5 of the RM to the UNFCCC, kt

	1990	1991	1992	1993	1994	1995	1996	1997
BUR3	2648.7307	1517.2470	1443.9675	1713.0301	1476.2941	1586.2644	1388.2124	1656.8247
NC5	2379.0886	1248.7850	1174.1876	1442.9960	1206.3850	1316.7230	1118.5241	1385.7903
Difference, %	-10.18	-17.69	-18.68	-15.76	-18.28	-16.99	-19.43	-16.36
	1998	1999	2000	2001	2002	2003	2004	2005
BUR3	1683.9458	1702.1754	1492.1681	1828.5659	1424.6996	1505.7575	1466.3473	1543.2389
NC5	1412.0577	1430.7993	1222.7282	1560.4352	1156.5876	1237.5523	1198.5883	1271.6794
Difference, %	-16.15	-15.94	-18.06	-14.66	-18.82	-17.81	-18.26	-17.60
	2006	2007	2008	2009	2010	2011	2012	2013
BUR3	1577.6205	1540.3986	1510.8422	1664.9870	1546.0139	1504.5789	1508.7640	1413.3777
NC5	1303.2724	1266.1250	1236.6745	1390.6850	1271.7754	1230.6841	1236.5016	1139.9149
Difference, %	-17.39	-17.81	-18.15	-16.47	-17.74	-18.20	-18.05	-19.35
	2014	2015	2016	2017	2018	2019	2020	2021
BUR3	1450.4798	1391.0666	1391.9179	1369.0793	1487.3577	1789.8845	N/A	N/A
NC5	1174.6145	1112.6279	1111.9941	1089.5602	1206.3949	1507.3962	1629.9020	N/A
Difference, %	-19.02	-20.02	-20.11	-20.42	-18.89	-15.78	N/A	N/A

Abbreviations: BUR3 – Third Biennial Update Report of the RM to the UNFCCC, NC5 – Fifth National Communication of the RM to the UNFCCC.

Next, CO_2 removals/emissions within category 4B 'Cropland' are shown for the period 1990-2020. Thus, during the period under review, CO_2 removals from subcategory 4B1.1 'Cropland Covered with Woody Vegetation' were relatively constant, significant fluctuations being recorded over the period 1990-2002 as a result of internal conversions.

Towards the end of the period, an increase by circa 182.7% (compared to 1990) of total CO_2 removals from subcategory 4B1.1 'Cropland Covered with Woody Vegetation' was recorded. The evolution of CO_2 removals within subcategory 4B1.1 'Cropland Covered with Woody Vegetation' between 1990 and 2020 is presented in Table 6-39.

Table 6-39: Evolution of CO_2 removals from subcategory 4B1.1 'Cropland Covered with Woody Vegetation' in the RM between 1990-2020, kt

	1990	1991	1992	1993	1994	1995	1996	1997
Perennial Plantations	621.0776	-470.8458	-412.0377	-359.7555	-532.4280	-311.5310	-488.2169	-256.3340
Woody Vegetation	-135.1775	-144.0052	-130.6496	-52.8625	-97.8655	-141.0862	-130.0409	-67.6328
Total	485.9001	-614.8510	-542.6873	-412.6180	-630.2934	-452.6172	-618.2578	-323.9667
	1998	1999	2000	2001	2002	2003	2004	2005
Perennial Plantations	-213.2668	-145.0914	-329.9127	61.4331	-356.7158	-349.4031	-343.8840	-316.4868
Woody Vegetation	-80.0922	-169.2948	-166.3777	-168.2494	-179.9304	-117.1359	-171.2571	-195.0093
Total	-293.3590	-314.3862	-496.2904	-106.8163	-536.6462	-466.5391	-515.1412	-511.4961
	2006	2007	2008	2009	2010	2011	2012	2013
Perennial Plantations	-291.7716	-326.2119	-341.7083	-318.5139	-350.9427	-334.2057	-336.9199	-323.2828
Woody Vegetation	-209.2384	-213.9407	-215.8986	-110.4438	-193.0869	-216.4818	-218.5733	-149.0324
Total	-501.0100	-540.1526	-557.6069	-428.9577	-544.0296	-550.6875	-555.4931	-472.3152
	2014	2015	2016	2017	2018	2019	2020	%
Perennial Plantations	-304.9532	-293.4707	-259.0135	-237.0690	-263.5206	-258.9820	-243.8326	-139.26
Woody Vegetation	-186.7005	-211.8723	-181.5837	-189.2942	-168.4468	-172.4600	-158.0793	16.94
Total	-491.6537	-505.3430	-440.5973	-426.3631	-431.9674	-431.4420	-401.9119	-182.71

The graphical illustration of the evolution of CO_2 removals within subcategory 4B1.1 'Cropland Covered with Woody Vegetation' is provided in Figure 6-6.

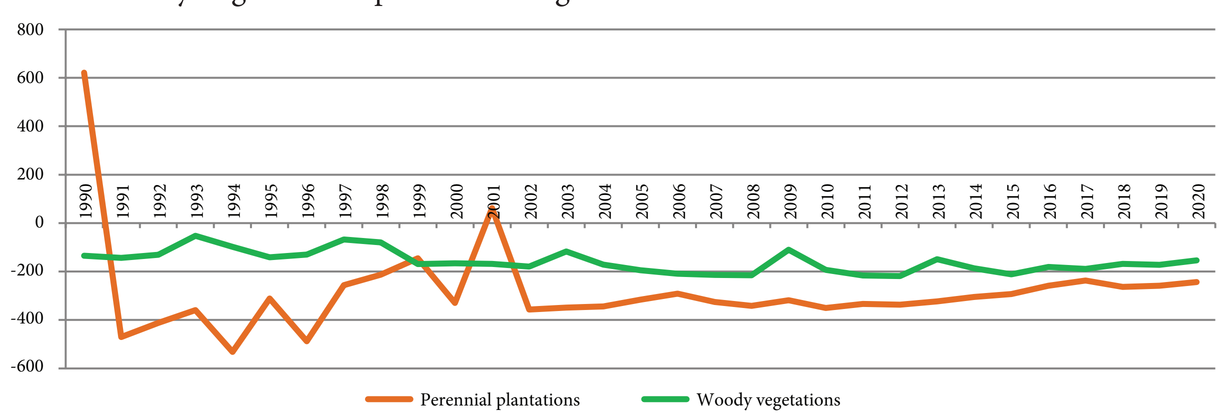


Figure 6-6: Evolution of CO_2 emissions/removals from cropland covered with woody vegetation in subcategory 4B1 'Cropland Remaining Cropland' in the RM between 1990-2020, kt.

CO_2 emissions from subcategory 4B1.2 'Annual Change in Carbon Stocks in Mineral Soils' were relatively constant between 1990 and 2020, with insignificant fluctuations in certain years (Table 6-40). At the same time, due to the above-mentioned factors, CO_2 emissions from 4B1.2 category had increased by 2020 by circa 5.5%, in comparison with the base year.

Table 6-40: CO_2 removals from subcategory 4B1.2 'Annual Change in Carbon Stocks in Mineral Soils' in the RM between 1990-2020, kt

	1990	1991	1992	1993	1994	1995	1996	1997
Emissions from mineral soils	1857.9955	1849.2242	1857.6721	1861.4884	1857.2977	1853.5070	1854.8331	1868.8615
	1998	1999	2000	2001	2002	2003	2004	2005
Emissions from mineral soils	1874.6520	1873.0213	1860.3864	1852.5555	1852.2515	1855.7057	1852.1985	1881.6624
	2006	2007	2008	2009	2010	2011	2012	2013
Emissions from mineral soils	1902.1211	1896.3815	1895.8591	1902.2756	1898.5216	1896.5919	1885.7017	1894.4752
	2014	2015	2016	2017	2018	2019	2020	%
Emissions from mineral soils	1915.5456	1932.8575	1941.9047	1934.2847	1942.0590	1953.1608	1961.0648	5.55

The graphical illustration of the evolution of CO_2 emissions from subcategory 4B1.2 'Annual Change in Carbon Stocks in Mineral Soils' is provided in Figure 6-7.

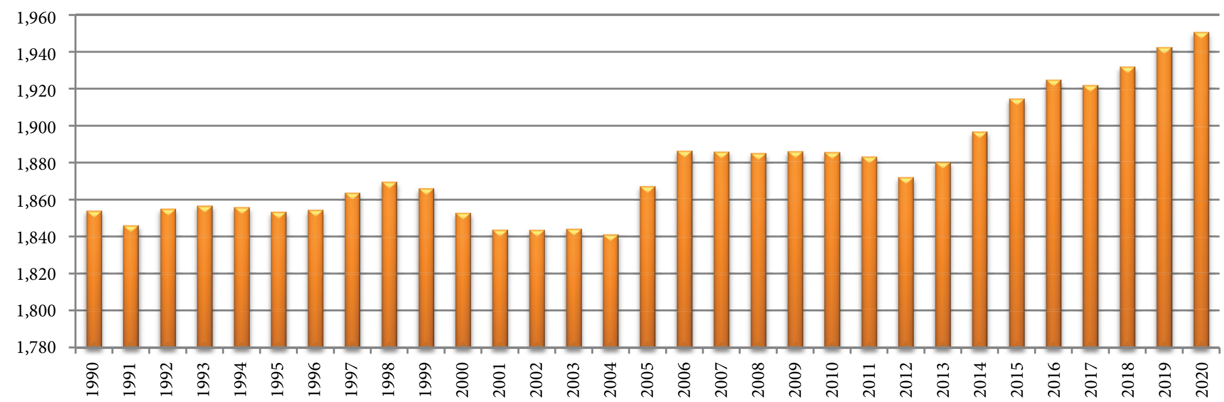


Figure 6-7: CO_2 emissions from subcategory 4B1.2 'Annual Change in Carbon Stocks in Mineral Soils' between 1990-2020, kt.

Non-CO_2 emissions from field burning of crop residues (stubble field burning) for the period 1990-2020 is shown in Table 6-41. By the end of the period under review, the volume had decreased significantly, constituting only circa 3.3% compared to 1990. At the same time, it should be noted that the volume fluctuates significantly year-over-year due to adverse weather conditions and anthropogenic factors.

Table 6-41: Non-CO_2 emissions from stubble field burning in the RM between 1990-2020

	1990	1991	1992	1993	1994	1995	1996	1997
CH_4 emissions, kt	0.09785	0.09460	0.08637	0.11777	0.06391	0.08945	0.06087	0.10729
N_2O emissions, kt	0.00254	0.00245	0.00224	0.00305	0.00166	0.00232	0.00158	0.00278
Total, kt CO_2 equivalent	**3.20207**	**3.09603**	**2.82667**	**3.85398**	**2.09144**	**2.92740**	**1.99197**	**3.51100**
NO_x emissions, kt	0.09060	0.08760	0.07998	0.10904	0.05917	0.08283	0.05636	0.09934
CO emissions, kt	3.33398	3.22358	2.94311	4.01274	2.17760	3.04799	2.07403	3.65564
	1998	1999	2000	2001	2002	2003	2004	2005
CH_4 emissions, kt	0.09655	0.09382	0.03643	0.04687	0.00852	0.00014	0.00196	0.00935
N_2O emissions, kt	0.00250	0.00243	0.00094	0.00122	0.00022	0.00000	0.00005	0.00024
Total, kt CO_2 equivalent	**3.15984**	**3.07020**	**1.19214**	**1.53403**	**0.27893**	**0.00444**	**0.06417**	**0.30594**
NO_x emissions, kt	0.08940	0.08687	0.03373	0.04340	0.00789	0.00013	0.00182	0.00866
CO emissions, kt	3.29001	3.19668	1.24126	1.59722	0.29042	0.00462	0.06681	0.31854
	2006	2007	2008	2009	2010	2011	2012	2013
CH_4 emissions, kt	0.00375	0.00610	0.02701	0.00332	0.00232	0.00208	0.00030	0.00263
N_2O emissions, kt	0.00010	0.00016	0.00070	0.00009	0.00006	0.00005	0.00001	0.00007
Total, kt CO_2 equivalent	**0.12285**	**0.19967**	**0.88390**	**0.10857**	**0.07606**	**0.06793**	**0.00970**	**0.08621**
NO_x emissions, kt	0.00348	0.00565	0.02501	0.00307	0.00215	0.00192	0.00027	0.00244
CO emissions, kt	0.12791	0.20790	0.92031	0.11304	0.07919	0.07073	0.01010	0.08977
	2014	2015	2016	2017	2018	2019	2020	%
CH_4 emissions, kt	0.00202	0.00154	0.00193	0.00290	0.00094	0.00167	0.00321	-96.7
N_2O emissions, kt	0.00005	0.00004	0.00005	0.00008	0.00002	0.00004	0.00008	-96.7
Total, kt CO_2 equivalent	**0.06625**	**0.05050**	**0.06322**	**0.09505**	**0.03079**	**0.05452**	**0.10489**	**-96.7**
NO_x emissions, kt	0.00187	0.00143	0.00179	0.00269	0.00087	0.00154	0.00297	-96.7
CO emissions, kt	0.06898	0.05258	0.06583	0.09897	0.03206	0.05676	0.10921	-96.7

Between 1990 and 2020, CO_2 removals/emissions from subcategory 4B2 'Land Converted to Cropland' fluctuated (Table 6-42), this fluctuation being influenced by various land conversions to the respective category, including in the period prior to 1990 (see Table 6-35). At the start of the period, subcategory 4B2 was a source of CO_2 emissions, but since 1994 it has been a constant source of CO_2 removals, although with fluctuating values. In 2020, it becomes a source of CO_2 emissions once again.

Table 6-42: CO_2 removals/emissions from category 4B2 'Land Converted to Cropland' in the RM between 1990-2020, kt

	1990	1991	1992	1993	1994	1995	1996	1997
4B2 CO_2 removals/emissions	45.75	27.39	-127.44	5.19	-3.40	-66.35	-101.15	-146.02
	1998	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**
4B2 CO_2 removals/emissions	-154.62	-112.44	-126.64	-171.25	-144.11	-139.40	-123.40	-87.69
	2006	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**
4B2 CO_2 removals/emissions	-88.69	-80.78	-92.51	-79.07	-72.97	-106.00	-84.81	-276.10
	2014	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**%**
4B2 CO_2 removals/emissions	-245.69	-309.33	-383.49	-412.63	-299.01	-9.28	71.82	57.0

The graphical illustration of the evolution of CO_2 emissions/removals from subcategory 4B2 'Land Converted to Cropland' is provided in Figure 6-8.

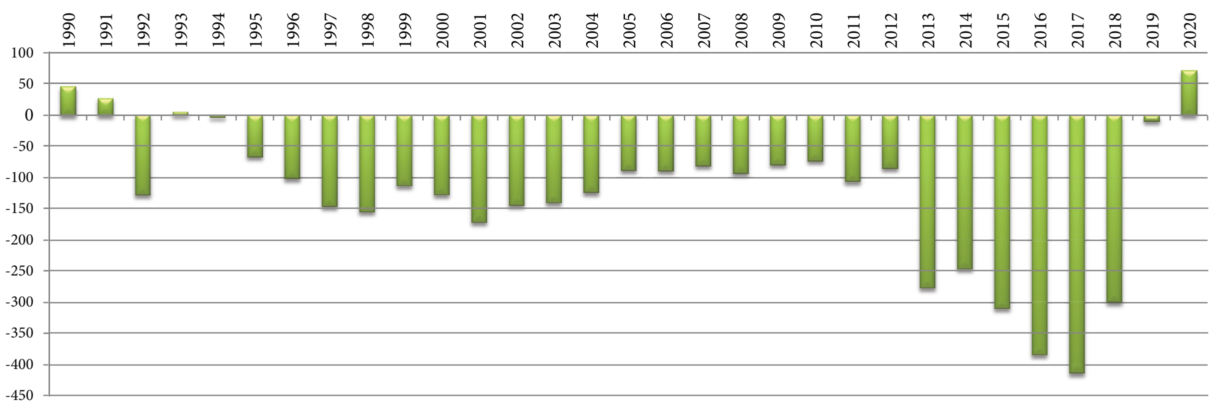


Figure 6-8: CO_2 removals/emissions from category 4B2 'Land Converted to Cropland' in the RM between 1990-2020, kt.

N_2O emissions resulting from the conversion of grassland to cropland included in category 4B2 'Land Converted to Cropland' fluctuated between 1990 and 2020, except for 1990-1995, when significant values were recorded (Table 6-43). By the end of the period under review, the volume increased by 5% compared to 1990.

Table 6-43: N_2O emissions resulting from the conversion of grassland to subcategory 4B2 'Land Converted to Cropland' between 1990-2020

	1990	1991	1992	1993	1994	1995	1996	1997
N_2O Emissions, kt	0.0325	0.0310	0.0299	0.0297	0.0249	0.0247	0.0178	0.0088
Total, kt CO_2 equivalent	**9.6848**	**9.2497**	**8.9048**	**8.8551**	**7.4135**	**7.3655**	**5.3009**	**2.6346**
	1998	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**
N_2O Emissions, kt	0.0085	0.0085	0.0081	0.0067	0.0063	0.0056	0.0046	0.0054
Total, kt CO_2 equivalent	**2.5231**	**2.5231**	**2.4243**	**1.9868**	**1.8873**	**1.6691**	**1.3645**	**1.6090**
	2006	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**
N_2O Emissions, kt	0.0047	0.0048	0.0045	0.0045	0.0027	0.0026	0.0026	0.0026
Total, kt CO_2 equivalent	**1.4110**	**1.4205**	**1.3481**	**1.3481**	**0.8048**	**0.7691**	**0.7691**	**0.7691**
	2014	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**%**
N_2O Emissions, kt	0.0026	0.0026	0.0026	0.0059	0.0143	0.0157	0.0342	5.3
Total, kt CO_2 equivalent	**0.7691**	**0.7691**	**0.7691**	**1.7681**	**4.2721**	**4.6931**	**10.1986**	**5.3**

According to the results obtained, it can be seen that category 4B represented a source of CO_2 emissions during the entire period under review (Table 6-44).

Table 6-44: CO_2 removals/emissions from category 4B 'Cropland' between 1990-2020, kt

	1990	1991	1992	1993	1994	1995	1996	1997
4B1	2333.3383	1221.3997	1301.6309	1437.8052	1209.7880	1383.0753	1219.6762	1531.8101
4B2	45.7503	27.3853	-127.4433	5.1908	-3.4030	-66.3523	-101.1521	-146.0198
Total	**2379.0886**	**1248.7850**	**1174.1876**	**1442.9960**	**1206.3850**	**1316.7230**	**1118.5241**	**1385.7903**

	1998	1999	2000	2001	2002	2003	2004	2005
4B1	1566.6826	1543.2413	1349.3665	1731.6866	1300.6929	1376.9534	1321.9902	1359.3685
4B2	-154.6249	-112.4420	-126.6383	-171.2515	-144.1054	-139.4011	-123.4019	-87.6890
Total	**1412.0577**	**1430.7993**	**1222.7282**	**1560.4352**	**1156.5876**	**1237.5523**	**1198.5883**	**1271.6794**
	2006	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**
4B1	1391.9588	1346.9010	1329.1873	1469.7549	1344.7488	1336.6859	1321.3161	1416.0186
4B2	-88.6864	-80.7760	-92.5128	-79.0698	-72.9734	-106.0017	-84.8145	-276.1037
Total	**1303.2724**	**1266.1250**	**1236.6745**	**1390.6850**	**1271.7754**	**1230.6841**	**1236.5016**	**1139.9149**
	2014	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**%**
4B1	1420.2997	1421.9583	1495.4822	1502.1864	1505.4051	1516.6795	1558.0806	-33.2
4B2	-245.6852	-309.3304	-383.4881	-412.6261	-299.0102	-9.2832	71.8214	57.0
Total	**1174.6145**	**1112.6279**	**1111.9941**	**1089.5602**	**1206.3949**	**1507.3962**	**1629.9020**	**-31.5**

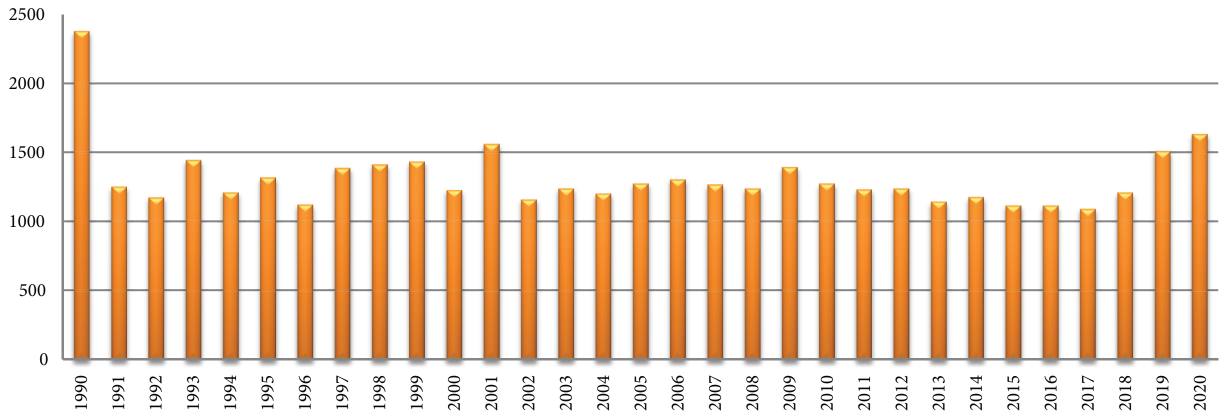


Figure 6-9: CO_2 emissions from source category 4B 'Cropland' between 1990-2020, kt.

Figure 6-10 shows the individual contribution of the two subcategories (4B1 and 4B2) to CO_2 removals/emissions. As it can be seen, due to land-use change and management practices, as well as conversions processes, subcategory 4B1 is a permanent source of CO_2 emissions, whereas subcategory 4B2 – a source of removals and/or emissions.

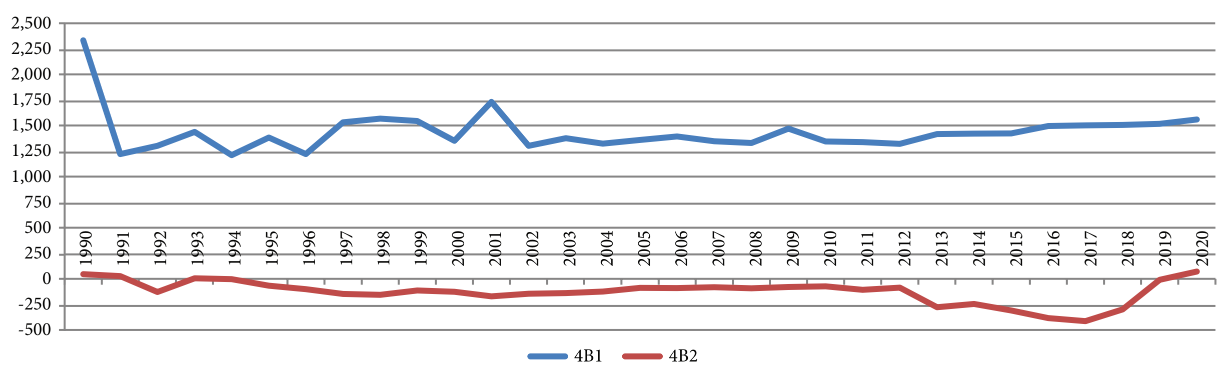


Figure 6-10: CO_2 removals/emissions from category 4B 'Cropland' between 1990-2020, kt.

6.3.6. Planned Improvements

For the next inventory cycle, for subcategory 4B1.1 'Cropland Covered with Woody Vegetation', the possibility to improve records pertaining to the actual volume of wood mass from windbreak management and other types of woody vegetation shall be considered, as well as activities aimed at the verification of emission/removal factors specific to perennial plantations (current biomass increments, biomass harvesting during clearings, etc.).

For subcategory 4B1.2 'Annual Change in Carbon Stocks in Mineral Soils', activities regarding the reduction of obtained uncertainty results are planned, including by improving the country-specific methodology (Banaru, 2000) and improving the quality of activity data used to estimate CO_2 emissions/removals.

There are no planned improvements for subcategory 4B1.3. 'Non-CO_2 Emissions from Post-Harvest Field Burning of Crop Residues' (stubble field burning).

There are no planned improvements for subcategory 4B2 'Land Converted to Cropland'.

6.4. Grassland (Category 4C)

6.4.1. Source Category Description

Category 4C 'Grassland' comprises CO_2 emissions/removals originating from two subcategories, 4C1 'Grassland Remaining Grassland' and 4C2 'Land Converted to Grassland'. Grassland is an area of land covered with perennial herbaceous vegetation used for grazing animals (pastures and hayfields).

Under Sector 4 'LULUCF', in 1990, grassland accounted for 27.4% of the total CO_2 removals (analysis of sectoral GHG flows). In 2020, the share of grassland in this process decreased to 10.7%, remaining a significant source in total share recorded within this sector.

Subcategory 4C1 'Grassland Remaining Grassland' includes: a) land which has always been covered with perennial herbaceous vegetation used as pastures or hayfields (reported together as a single input in the Land Use and Land-Use Change Matrix), and land covered with perennial herbaceous vegetation from other categories of use, such as b) land under improvement and fertility restoration, and c) land affected by landslides. Subcategory 4C1 also includes all land converted to grassland more than 20 years ago (taking into account that the time series commences in 1970).

Within subcategory 4C2 'Land Converted to Grassland', CO_2 emissions/removals are estimated, which result from: a) restoration of natural vegetation on land excluded from agricultural use and converted to grassland; b) conversions of wetlands to grassland; c) conversions of settlements to grassland; d) conversions of land covered with woody vegetation to grassland.

The main sources of activity data utilized in the inventory for the period 1970-2020 were: the General Land Cadastre of the Republic of Moldova (all cadastral categories have been converted into IPCC Land-Use categories), reports from Agency 'Moldsilva' and the Environmental Protection Inspectorate (Forest Land Converted to Grassland).

6.4.2. Methodological Issues, Emission Factors and Data Sources

4C1 'Grassland Remaining Grassland'

Within subcategory 4C1 'Grassland Remaining Grassland', CO_2 emissions/removals resulting from the following categories of national use were estimated (according to land cadastral records): 'pastures', 'hayfields', 'land under improvement and fertility restoration', 'landslides', as well as various categories of land converted to grassland more than 20 years ago.

Activity data, particularly the areas included in subcategory 4C1 'Grassland Remaining Grassland' between 1990 and 2020, are provided in Table 6-45.

Table 6-45: Areas of land included in subcategory 4C1 'Grassland Remaining Grassland' in the Republic of Moldova between 1990-2020, thousand ha

Land Category	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
4C1 'Grassland Remaining Grassland'	243.30	241.90	237.35	244.19	237.60	236.73	236.30	235.79	236.49	242.07	247.80
Land Category	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
4C1 'Grassland Remaining Grassland'	258.02	266.51	265.20	261.04	264.06	259.07	259.99	269.66	300.88	304.84	310.26
Land Category	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
4C1 'Grassland Remaining Grassland'	309.63	305.92	308.06	305.45	305.92	305.34	297.16	287.02	277.21	N/A	N/A

Source: Land Use and Land-Use Change Matrix in the RM for the period 1970-2020; General Land Cadastre of the RM for the period 1970-2020.

In order to estimate the change of carbon stock in biomass for subcategory 4C1 'Grassland Remaining Grassland', the Tier 1 approach from the 2006 IPCC Guidelines is used, which assumes that there are no fluctuations in this subcategory, the stock thereby does not change in time and space on a national scale. A country-specific approach is used in order to estimate CO_2 emissions/removals from mineral soils. The humus content is available in recurrent measurements in 1990 vs. 1980 in land categories converted to grassland (annual herbaceous vegetation) in national reference sources (Table 17.16 in Donos A., 2004). The estimated emission factor is -0.0028 tonnes C/ha/yr.

4C2 'Land Converted to Grassland'

Subcategory 4C2 'Land Converted to Grassland' includes land with woody vegetation, arable land, perennial plantations (vineyards and orchards), as well as wetlands (marshes, wetlands saturated by water), settlements converted to grassland in the last 20 years. GHG emissions/removals from this category result from land-use change and changes in land management, thereby eliminating the existing vegetation and its replacement with grassland vegetation. There are no conversions of forest land to grassland. The areas currently subject to conversion are provided in Table 6-46.

Table 6-46: Area of lands converted to grassland in the RM between 1970-2020 (annual areas initiating the conversion), ha

Category of Use	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982
I. Cropland Converted to Grassland, total	0.0	134.8	493.2	8238.6	128.0	319.0	255.0	158.9	1481.0	59.7	0.0	24.7	13719.0
- arable land	*0.0*	*0.0*	*0.0*	*8051.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*13719.0*
- forest vegetation	*0.0*	*127.6*	*128.0*	*127.6*	*128.0*	*319.0*	*255.0*	*64.0*	*1372.0*	*0.0*	*0.0*	*0.0*	*0.0*
- vineyards and orchards	*0.0*	*7.2*	*365.2*	*59.9*	*0.0*	*0.0*	*0.0*	*94.9*	*109.0*	*59.7*	*0.0*	*24.7*	*0.0*
II. Wetlands Converted to Grassland	0.0	0.0	0.0	0.0	800.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
III. Settlements Converted to Grassland	0.0	18.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	109.8
IV. Other Land Converted to Grassland	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	9027.1	16419.7	26895.7	26895.7
Total	**0.0**	**153.1**	**493.2**	**8238.6**	**928.0**	**319.0**	**255.0**	**158.9**	**1481.0**	**9086.8**	**16419.7**	**26920.4**	**40724.5**

Category of Use	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995
I. Cropland Converted to Grassland, total	0.0	127.6	7211.5	351.2	7046.2	15818.4	36651.3	21077.0	3800.8	157.6	3037.1	314.5	2290.9
- arable land	*0.0*	*0.0*	*6781.7*	*0.0*	*4984.4*	*15818.4*	*36632.3*	*20247.0*	*3800.8*	*0.0*	*1759.9*	*0.0*	*1965.5*
- forest vegetation	*0.0*	*127.6*	*0.0*	*0.0*	*2042.1*	*0.0*	*0.0*	*830.0*	*0.0*	*0.0*	*957.2*	*0.0*	*0.0*
- vineyards and orchards	*0.0*	*0.0*	*429.9*	*351.2*	*19.7*	*0.0*	*19.0*	*0.0*	*0.0*	*157.6*	*320.0*	*314.5*	*325.4*
II. Wetlands Converted to Grassland	500.0	0.0	0.0	0.0	0.0	0.0	0.0	200.0	700.0	0.0	0.0	0.0	200.0
III. Settlements Converted to Grassland	0.0	0.0	384.5	329.5	0.0	91.5	0.0	54.9	0.0	0.0	36.6	0.0	100.0
IV. Other Land Converted to Grassland	33104.2	34252.4	43629.7	49532.5	47818.2	46326.6	43488.1	31613.8	33171.0	33154.5	34877.1	46680.4	47554.4
Total	**33604.2**	**34380.0**	**51225.7**	**50213.2**	**54864.4**	**62236.6**	**80139.4**	**52945.8**	**37671.8**	**33312.1**	**37950.8**	**46995.0**	**50145.3**

Category of Use	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
I. Cropland Converted to Grassland, total	5582.4	4873.3	3376.3	7039.4	17713.1	790.2	85.2	1177.3	0.3	0.0	0.0	407.7	0.0
- arable land	*4956.8*	*2655.9*	*1764.7*	*6708.5*	*17144.9*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*407.7*	*0.0*
- forest vegetation	*382.9*	*1978.3*	*1340.1*	*0.0*	*255.3*	*265.5*	*0.0*	*1128.9*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*
- vineyards and orchards	*242.8*	*239.1*	*271.5*	*330.9*	*312.9*	*524.7*	*85.2*	*48.4*	*0.3*	*0.0*	*0.0*	*0.0*	*0.0*
II. Wetlands Converted to Grassland	0.0	0.0	0.0	0.0	0.0	43.0	0.0	1121.0	0.0	731.0	0.0	0.0	0.0
III. Settlements Converted to Grassland	36.6	0.0	73.2	0.0	0.0	13.0	7.9	0.0	52.9	77.1	227.8	63.5	25.5
IV. Other Land Converted to Grassland	44423.0	42409.5	38942.2	26984.1	11947.5	6222.2	8402.9	0.0	0.0	0.0	0.0	1714.6	3921.3
Total	**50042.0**	**47282.7**	**42391.7**	**34023.5**	**29660.6**	**7068.4**	**8496.0**	**2298.3**	**53.2**	**808.1**	**227.8**	**2185.8**	**3946.8**

Category of Use	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
I. Cropland Converted to Grassland, total	1949.0	39.4	39.8	5259.4	1166.4	680.6	50.1	0.1	1818.6	538.6	55.6	174,8	N/A
- arable land	*0.0*	*0.0*	*0.0*	*5184.6*	*0.0*	*0.0*	*0.0*	*0.0*	*1781.0*	*0.0*	*0.0*	*0.0*	N/A
- forest vegetation	*1914.4*	*0.0*	*37.8*	*15.0*	*1165.6*	*616.5*	*0.0*	*0.0*	*37.6*	*476.2*	*0.0*	*77.4*	N/A
- vineyards and orchards	*34.6*	*39.4*	*2.1*	*59.7*	*0.8*	*64.1*	*50.1*	*0.1*	*0.0*	*62.4*	*55.6*	*97,4*	N/A
II. Wetlands Converted to Grassland	0.0	0.0	175.4	234.0	2405.0	79.0	131.0	526.0	86.0	322.0	60.0	40.7	N/A
III. Settlements Converted to Grassland	70.4	4.4	0.0	6.9	0.0	0.0	0.0	0.0	0.0	6.1	0.0	21.1	N/A
IV. Other Land Converted to Grassland	4039.2	19829.4	18524.4	11761.2	5166.2	0.0	2474.6	4486.8	5201.0	13044.7	3528.0	9260.0	N/A
Total	**6058.6**	**19873.3**	**18739.7**	**17261.5**	**8737.5**	**759.6**	**2655.6**	**5012.8**	**7105.6**	**13911.4**	**3643.6**	**9496.4**	**N/A**

Source: General Land Cadastre of the RM for the period 1990-2020, Reports of Agency 'Moldsilva' and Reports of the State Ecological Inspectorate on the area of forest land and other types of forest vegetation cleared through illegal logging for the period 1990-2020; Land Use and Land-Use Change Matrix for the period 1970-2020.

GHG inventory for land categories converted to grassland includes the assessment of changes in carbon stocks for the following carbon pools: biomass, litter, soil.

In order to estimate the annual change in carbon stock in biomass of land converted to grassland from country-specific data, and the national scientific literature, respectively, national EFs were calculated/

developed. The biomass stock was thereby estimated taking into account the distribution of grassland by landscape and productivity (meadows and grassland located on slopes of high, medium, and low productivity), and by consulting national sources in the scientific literature, respectively (Table 6-47).

Table 6-47: Annual biomass increment rates used to estimate emissions/removals from subcategory 4C2 'Land Converted to Grassland'

Categories	Productivity	Annual Biomass Stock, t CM/ha/yr
Meadows	high	3.2
	medium	2.0
	low	1.2
Grasslands on slopes	high	2.8
	medium	1.8
	low	1.2
Landslides	low	1.2

Source: Forest Research and Management Institute Reports (2014-2016) on Grassland Inventory within Orhei National Park.

The amount reported in Table 6-47 represents the maximum harvestable biomass resulting from the collection of hay in two successive stages (harvesting in the first stage represented 93% of the total estimated biomass). To this harvestable above-ground biomass, a percentage of 110% is added (to include the lower part of above-ground biomass and below-ground biomass), inferred from the data provided in Table 2.3, in Donos A. (2001).

Based on the inventory surveys of the grasslands in Orhei National Park (EU/UNDP 'Clima East' Project, 2014-2016), Soroca and Stefan Voda districts ('Integration of Biodiversity Conservation Priorities into Territorial Planning Policies and Land-Use Practices in Moldova, 2015-2016' Project) it can be observed that grasslands (pastures and hayfields) in these areas, as most in the RM, are managed traditionally in an extensive and unsystematic way. The practiced system is characterized by minimal tending activities, or even inexistent, and by the inexistent correlation between the production capacity of grasslands and their loading with animals. For this reason, grasslands cannot be fully used due to under-exploitation/under-loading with animals (which is why the invasion of grassland with spontaneous shrubby vegetation occurs), or they can be overloaded, failing to provide sufficient food for the entire livestock.

In order to estimate CO_2 removals in biomass on land converted to grassland, the annual increments of perennial herbaceous vegetation on newly-formed grasslands, as well as the differences of initial biomass for land previously covered with forest vegetation were established, according to the available data at national level. The calculation process is based on the annual increments in carbon pools due to current biomass increments in new grasslands and uses Equation 2.15 from the 2006 IPCC Guidelines (Volume 4, Chapter 2, Page 2.20). Emission factors used in the assessment process, including for litter and soil are provided in Table 6-48.

Table 6-48: EFs used to estimate emissions/removals from subcategory 4C2 'Land Converted to Grassland'

Conversion	Indicator	Period, years	Unit	Indicator Value
Cropland Converted to Grassland	Annual average carbon increments/losses of biomass	year 1	Mg C/ha/yr	-1.22
	Annual average carbon increments of dead organic matter (litter/DOM)	year 1	Mg C/ha/yr	0.00
	Annual average increments of soil organic carbon (SOC/SOM)	years 1-20	Mg C/ha/yr	2.2650
Forest Vegetation (in Cropland) Converted to Grassland	Annual average carbon increments/losses of biomass	year 1	Mg C/ha/yr	-26.02
	Annual average carbon increments/losses of dead organic matter (litter/DOM)	year 1	Mg C/ha/yr	-1.15
	Annual average increments of soil organic carbon (SOC/SOM)	years 1-20	Mg C/ha/yr	1.0662
Perennial Plantations (in Cropland) Converted to Grassland	Annual average carbon increments/losses of biomass	year 1	Mg C/ha/yr	-0.65
	Annual average carbon increments of dead organic matter (litter/DOM)	year 1	Mg C/ha/yr	0.00
	Annual average increments of soil organic carbon (SOC/SOM)	years 1-20	Mg C/ha/yr	2.2650
Wetlands Converted to Grassland	Annual average carbon increments of biomass	year 1	Mg C/ha/yr	0.00
	Annual average carbon increments of dead organic matter (litter/DOM)	year 1	Mg C/ha/yr	0.00
	Annual average increments of soil organic carbon (SOC/SOM)	years 1-20	Mg C/ha/yr	2.4818
Settlements Converted to Grassland	Annual average carbon increments of biomass	year 1	Mg C/ha/yr	3.78
	Annual average carbon increments of dead organic matter (litter/DOM)	year 1	Mg C/ha/yr	0.00
	Annual average increments of soil organic carbon (SOC/SOM)	year 1	Mg C/ha/yr	0.1241

Source: Giurgiu V., Decei I., Armasescu S. Biometry of Trees and Rammels in Romania, 1972; Kapp G., Velsen-Zerweck M., Horst A., Horn L., Galupa D. Talmaci I. et al.: The baseline study for the 'Soils Conservation Project in Moldova', 2003; Official Monitor No. 46-49, Government Decision No. 367 dated 13.04.2000, 'On approving the National Program to Combat Desertification 2000'; National GHG Inventory Report for Hungary, 2014; 'Soil Quality Monitoring in the Republic of Moldova (database, conclusions, forecasts, recommendations)', 2010.

6.4.3. Uncertainties and Time-Series Consistency

4C1 'Grassland Remaining Grassland'

Uncertainties associated with CO_2 emissions/removals from subcategory 4C1 'Grassland Remaining Grassland' are not estimated since there is a neutral balance in the main carbon pools (biomass, litter, soil).

4C2 'Land Converted to Grassland'

Uncertainties associated with the CO_2 emissions/removals resulting from subcategory 4C2 'Land Converted to Grassland' are within acceptable limits. Land conversion (cropland, forest vegetation, etc.) to grassland is a usual process in the Republic of Moldova, having different magnitudes between 1970 and 2020. In the base year (1990), the accuracy degree represented circa 5% for 'production processes', which is explained by the fact that state institutions ensured a rigorous control of processes and accounts. Cadastral records thereby recorded systematic changes in land-use categories, etc. By the end of the reference period (2020), the accuracy degree of activity data decreased to circa 15%, which is explained by the lack of veridical records on the evolution of land-use of forest land damaged by illegal logging (grazing, growing crops, etc.). Emission/removal factors have an uncertainty level of circa 10%.

In accordance with current practices, most land with forest vegetation subject to conversion is continuously used primarily for grazing because most of it is degraded, or situated on slopes over 7°, where cultivation of agricultural crops (including through tillage) is economically inefficient. Exclusion of cropland from the agricultural production cycle is a contradictory process, as surface fluctuations for grassland were conditioned both by exclusion of cropland from the cycle and planting forest vegetation and perennial plantation on it (orchards, vineyards).

The General Land Cadastre of the Republic of Moldova after 1994 contains only general information in this sense, without specifying to which categories cropland excluded the from the agricultural production cycle were transferred (arable lands, perennial plantations, etc.). One part of them were converted to forest land, while the other (depending on condition) were transferred to other categories (grassland, ravines, landslides, etc.). Practically, only the land-use category (in many cases determined by local traditions) reflects, to some extent, the condition of such land after conversion from cropland.

Thus, combined uncertainties related to CO_2 emissions/removals from subcategory 4C2 'Land Converted to Grassland' can be regarded as moderate, and are estimated to be circa 18.03%.

6.4.4. Quality Assurance and Quality Control

Quality of assessment for category 4C 'Grassland' is provided by the fact that most of the AD used is taken from official records. The total area of grassland is thereby provided by the General Land Cadastre of the Republic of Moldova for each year. Data regarding the area of forest land converted to grassland is available in the sectoral records of the state forestry institutions (Statistical Form 5 G.S. 'Statistical Report on volumes of illegal logging'), as well as in the reports of state institutions for environmental protection.

Data on annual biomass increment for forest land converted to grassland is provided by Production Tables and specific records/measurements. For grassland, data is taken from the scientific literature in the field, from normative and technical regulation acts, as well as from the grassland inventory reports of the Forest Research and Management Institute within Orhei National Park.

Verification of the GHG inventory quality within category 4C 'Grassland' includes, in addition to complying with the recommendations included in the 2006 IPCC Guidelines, ensuring correct use of national factors, their accuracy, as well as comparing them to the values used by other Eastern and Central European countries. At the same time, the quality of AD increased due to the development of the Land Use and Land-Use Change Matrix for the period 1970-2020.

Quality assurance and quality control measures of the GHG inventory are described in section 4A 'Forest Land'. Standard verification and quality control forms and checklists were filled in for this category, following a Tier 1 approach. It should be noted that according to the recommendations included in the 2006 IPCC Guidelines, CO_2 emissions/removals from grassland use processes within this sector were estimated based on AD from official reference sources (General Land Cadastre of the Republic of Moldova and Statistical Yearbooks, etc.).

6.4.5. Recalculations

4C1 'Grassland Remaining Grassland'

No recalculations were performed in the current inventory cycle for category 4C1 'Grassland Remaining Grassland'.

4C2 'Land Converted to Grassland'

No recalculations were performed in the current inventory cycle for category 4C2 'Land Converted to Grassland'.

Between 1990 and 2020, CO_2 removals from category 4C 'Grassland' had continuously decreased. Results regarding CO_2 removal rates from this subcategory are provided in Table 6-49.

Table 6-49: CO_2 removals from category 4C 'Grassland' between 1990-2020, kt

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
4C1	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
4C2	-1205.6938	-1414.3167	-1428.4835	-1303.5202	-1577.3332	-1601.1004	-1548.0826	-1400.8607	-1436.2698	-1433.2865	-1291.9495
4C	**-1205.6938**	**-1414.3167**	**-1428.4835**	**-1303.5202**	**-1577.3332**	**-1601.1004**	**-1548.0826**	**-1400.8607**	**-1436.2698**	**-1433.2865**	**-1291.9495**
	2001	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**
4C1	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
4C2	-1290.6541	-1235.1380	-1007.1842	-1120.4767	-1058.1239	-1056.3692	-1031.2350	-932.1498	-447.6932	-691.9874	-638.1726
4C	**-1290.6541**	**-1235.1380**	**-1007.1842**	**-1120.4767**	**-1058.1239**	**-1056.3692**	**-1031.2350**	**-932.1498**	**-447.6932**	**-691.9874**	**-638.1726**
	2012	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**
4C1	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	N/A	N/A
4C2	-562.7510	-360.1740	-341.1085	-418.4569	-402.3693	-384.0392	-440.1513	-293.2923	-223.1528	N/A	N/A
4C	**-562.7510**	**-360.1740**	**-341.1085**	**-418.4569**	**-402.3693**	**-384.0392**	**-440.1513**	**-293.2923**	**-223.1528**	**N/A**	**N/A**

At the start of the reporting period (1990), removals from subcategory 4C2 are somewhat significant at sectoral level, due to massive conversion of different lands into grasslands (Table 6-46). Towards the end of the reporting period, removals from subcategory 4C2 had decreased significantly. In 2020, the lowest rate recorded is only 18.5% compared to the base year. Thus, compared to 1990, a decrease by 81.5%, or a difference by circa 983 kt CO_2 was thereby recorded in 2020.

The evolution of CO_2 removals from subcategory 4C2 'Land Converted to Grassland' is provided in Figure 6-11.

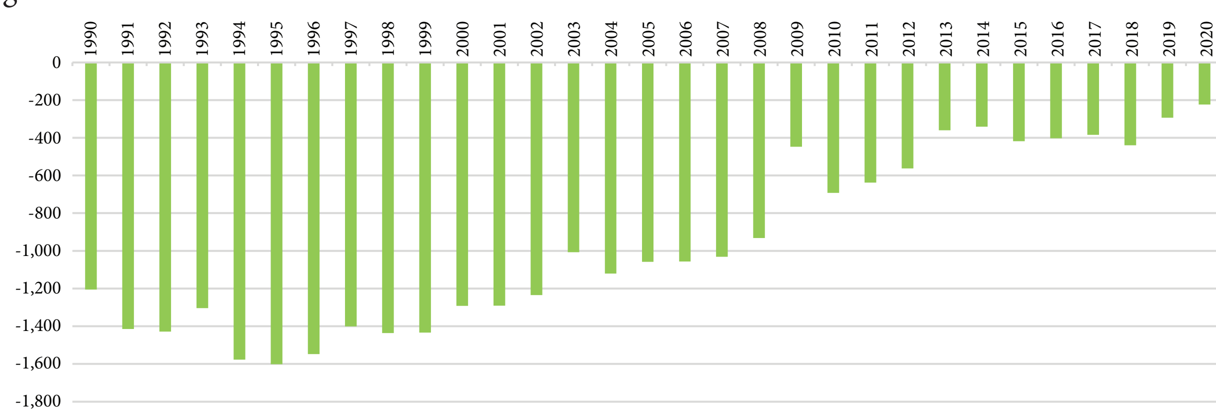


Figure 6-11: Evolution of CO_2 removals from subcategory 4C2 'Land Converted to Grassland' in the RM between 1990-2020, kt.

6.4.6. Planned Improvements

The possibility to improve activity data on specifying the land-use categories to which land excluded from agricultural production cycle was transferred will be considered in the next inventory cycles.

6.5. Wetlands (Category 4D)

6.5.1. Source Category Description

Category 4D ‘Wetlands’ includes any land that is covered or saturated by water for the entire or only for a part of the year (for example, marshes), and does not fall into categories ‘Forest Land’, ‘Cropland’, ‘Grassland’ or ‘Settlements’. It also includes storage water reservoirs (including managed ponds), as well as unmanaged natural lakes and rivers. 4D ‘Wetlands’ comprises two subcategories: 4D1 ‘Wetlands Remaining Wetlands’ and 4D2 ‘Land Converted to Wetlands’.

6.5.2. Methodological Issues, Emission Factors and Data Sources

4D1 ‘Wetlands Remaining Wetlands’

Due to the particularities of lands in the RM included in subcategory 4D1 ‘Wetlands Remaining Wetlands’ (land without forest/herbaceous vegetation and/or no management activities contributing to essential changes in carbon pools), following the Tier 1 approach in the 2006 IPCC Guidelines, a neutral balance was established in the main carbon pools (above-ground and below-ground biomass, dead organic matter, soil). AD on areas within this category are available in the General Land Cadastre of the Republic of Moldova and are also included in the Land Use and Land-Use Change Matrix for the period 1970-2020. Subcategory 4D1 ‘Wetlands Remaining Wetlands’ also includes lands subject to internal conversion, which do not generate essential changes in carbon pools, maintaining a steady balance (Table 6-50).

Table 6-50: Area of land included in subcategory 4D1 ‘Wetlands Remaining Wetlands’ in the RM between 1990-2020, ha

Land Category	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
Wetlands with vegetation (marshes)	9200.0	9300.0	9000.0	10000.0	10000.0	9900.0	10200.0	10200.0	10200.0	10400.0	10400.0
Wetlands saturated by water	54600.0	55500.0	53800.0	56399.7	57400.0	59500.0	61100.0	62100.0	62100.0	64900.0	65600.0
Wetlands with vegetation (marshes) converted to wetlands saturated by water	4100.0	4100.0	4200.0	4300.0	3300.0	2500.0	2500.0	2200.0	2200.0	2200.0	1800.0
Wetlands saturated by water converted to wetlands with vegetation (marshes)	200.0	200.0	200.0	200.0	200.0	200.0	200.0	200.0	200.0	200.0	200.0
Total	**68100.0**	**69100.0**	**67200.0**	**70899.7**	**70900.0**	**72100.0**	**74000.0**	**74700.0**	**74700.0**	**77700.0**	**78000.0**
Land Category	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**
Wetlands with vegetation (marshes)	11800.0	12400.0	10911.0	11911.0	11617.0	12017.0	11833.0	12833.0	13126.4	12910.4	12910.4
Wetlands saturated by water	65425.0	67325.0	67325.0	67925.0	68488.0	68688.0	68688.0	70788.0	70888.0	71988.0	70112.6
Wetlands with vegetation (marshes) converted to wetlands saturated by water	1800.0	1800.0	2168.0	2168.0	1768.0	1768.0	2152.0	2152.0	2158.6	1274.6	1274.6
Wetlands saturated by water converted to wetlands with vegetation (marshes)	532.0	532.0	532.0	532.0	532.0	532.0	432.0	432.0	432.0	432.0	432.0
Total	**79557.0**	**82057.0**	**80936.0**	**82536.0**	**82405.0**	**83005.0**	**83105.0**	**86205.0**	**86605.0**	**86605.0**	**84729.6**
Land Category	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**
Wetlands with vegetation (marshes)	13262.7	12162.7	13053.7	12902.7	12510.7	12652.7	12730.7	14382.7	15342.0	N/A	N/A
Wetlands saturated by water	71585.8	67581.6	67780.8	65580.8	63946.8	63018.8	63018.8	60305.8	59705.8	N/A	N/A
Wetlands with vegetation (marshes) converted to wetlands saturated by water	1220.6	1120.6	2150.6	2970.6	2970.6	3270.6	3270.6	3270.6	3670.6	N/A	N/A
Wetlands saturated by water converted to wetlands with vegetation (marshes)	432.0	432.0	432.0	432.0	432.0	432.0	432.0	432.0	432.0	N/A	N/A
Total	**86501.1**	**81296.9**	**83417.1**	**81886.1**	**79860.1**	**79374.1**	**79452.1**	**78391.1**	**79150.4**	**N/A**	**N/A**

Source: General Land Cadastre of the RM for the period 1970-2020; Land Use and Land-Use Change Matrix for the period 1970-2020.

4D2 ‘Land Converted to Wetlands’

In order to estimate CO_2 removals/emissions from subcategory 4D2 ‘Land Converted to Wetlands’, a Tier 2 approach was utilized for biomass. Losses in biomass are determined by the conversion of land-use categories which were previously covered with a certain amount of biomass (forest vegetation, grassland, perennial plantations, etc.). At the same time, biomass increments were estimated due to the conversion of land-use categories without initial vegetation (Other Land).

The calculation process of CO_2 removals/emissions is based on the annual increments in carbon stocks due to current biomass growth, and uses Equation 2.15 from the 2006 IPCC Guidelines (Volume 4, Chapter 2, Page 2.20). According to Table 6-51, the main land categories converted to wetlands are grasslands and other land.

Table 6-51: Area of land converted to Wetlands in the RM between 1970-2020 (annual areas that initiate conversion), ha

Conversion	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982
Grassland to Wetlands	0.0	0.0	400.0	0.0	0.8	1400.0	1900.0	700.0	0.0	3000.0	300.0	1600.0	2500.0
Other Land to Wetlands	0.0	1700.0	0.0	1399.2	3099.2	3099.2	3099.2	3099.2	3099.2	3099.2	3099.2	3099.2	3099.2
Total	**0.0**	**1700.0**	**400.0**	**1399.2**	**3100.0**	**4499.2**	**4999.2**	**3799.2**	**3099.2**	**6099.2**	**3399.2**	**4699.2**	**5599.2**
Conversion	**1983**	**1984**	**1985**	**1986**	**1987**	**1988**	**1989**	**1990**	**1991**	**1992**	**1993**	**1994**	**1995**
Grassland to Wetlands	0.0	1600.0	600.0	600.0	100.0	3100.0	400.0	0.0	0.0	800.0	900.0	2200.0	0.0
Other Land to Wetlands	3099.2	3099.2	3099.2	3099.2	3099.2	3099.2	3099.2	3099.2	1399.2	3699.2	0.0	0.0	0.0
Total	**3099.2**	**4699.2**	**3699.2**	**3699.2**	**3199.2**	**6199.2**	**3499.2**	**3099.2**	**1399.2**	**4499.2**	**900.0**	**2200.0**	**0.0**
Conversion	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**
Grassland to Wetlands	400.0	300.0	400.0	2000.0	1100.0	0.0	905.0	0.0	472.0	0.0	178.0	80.0	40.5
Other Land to Wetlands	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total	**400.0**	**300.0**	**400.0**	**2000.0**	**1100.0**	**0.0**	**905.0**	**0.0**	**472.0**	**0.0**	**178.0**	**80.0**	**40.5**
Conversion	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**
Grassland to Wetlands	28.8	3231.0	63.0	47.2	32.0	0.0	3698.9	0.0	0.0	742.0	0.0	165.8	N/A
Other Land to Wetlands	0.0	0.0	1700.0	0.0	3699.2	3698.8	0.0	0.0	1.0	1.0	0.0	0.0	N/A
Total	**28.8**	**3231.0**	**1763.0**	**47.2**	**3731.2**	**3698.8**	**3698.9**	**0.0**	**1.0**	**743.0**	**0.0**	**165.8**	**N/A**

Source: General Land Cadastre of the RM for the period 1970-2020; Land Use and Land-Use Change Matrix for the period 1970-2020.

Carbon stocks in mineral soils within subcategory 4D2 'Land Converted to Wetlands' is estimated based on country-specific data (Soil Quality Monitoring in the Republic of Moldova, 2010). In order to estimate annual biomass increments/losses in land converted to wetlands, national emission factors were calculated/developed (Table 6-52).

Table 6-52: EFs used to estimate CO_2 emissions/removals from subcategory 4D2 'Land Converted to Wetlands'

Conversion	Indicators	Period, years	Unit	Indicator Value
Grassland Converted to Wetlands[115]	Annual average carbon increments of biomass (herbaceous cover)	year 1	Mg C/ha/yr	0.0
	Annual average carbon increments of dead organic matter (litter)	year 1	Mg C/ha/yr	0.0
	Annual average increments of soil organic carbon	years 1-20	Mg C/ha/yr	0.0
Other Land Converted to Wetlands	Annual average carbon increments of biomass (herbaceous cover)	year 1	Mg C/ha/yr	4.2
	Annual average carbon increments of dead organic matter (litter)	year 1	Mg C/ha/yr	0.0
	Annual average increments of soil organic carbon	years 1-20	Mg C/ha/yr	2.4818

6.5.3. Uncertainties and Time-Series Consistency

4D1 'Wetlands Remaining Wetlands'

Uncertainties for subcategory 4D1 'Wetlands Remaining Wetlands' are not estimated since a neutral balance was established in the main carbon pools (above-ground and below-ground biomass, dead organic matter, soil).

4D2 'Land Converted to Wetlands'

Uncertainties associated with CO_2 emissions/removals from subcategory 4D2 'Land Converted to Wetlands' at the beginning and the end of the reference period (1990 and 2020) are somewhat low, estimated at circa 10%. In both cases, emission/removal factors have an uncertainty level of circa 10%. Combined uncertainties in subcategory 4D2 'Land Converted to Wetlands' constitute circa 14.14%. (see Annex 5-3.4).

6.5.4. Quality Assurance and Quality Control

The quality of assessment for category 4D 'Wetlands' is ensured by the fact that most of the AD used is taken from official records (the General Land Cadastre of the Republic of Moldova). Annual biomass increments/losses for lands converted to wetlands were estimated using country-specific EFs developed within EU/UNDP 'Clima East' Project, and based on CDM Projects: MSCP and MCFDP. At the same time, the quality of AD increased due to the development of the Land Use and Land-Use Change Matrix for the period 1970-2020. Standard verification and quality control forms and checklists were filled in for this category, following a Tier 1 approach.

Verification was focused on following the recommendations included in the 2006 IPCC Guidelines (Volume 4 'AFOLU'), time-series consistency for activity data, ensuring correct use of country-spe-

[115] The indicator value is equal to zero, because wetlands (marshes) are associated with grasslands, thereby after conversion there are no significant changes in carbon pools.

cific coefficients, their accuracy, validation of the assumptions and calculations used in estimating the parameters inferred from other data available at national level, as well as their comparison with values used in inventories compiled by countries in the region. Also, QA/QC also included monitoring the way in which data is compiled from spreadsheets and conversion among units of measurement.

6.5.5. Recalculations

4D1 'Wetlands Remaining Wetlands'

No recalculations were performed in the current inventory cycle for subcategory 4D1 'Wetlands Remaining Wetlands'.

4D2 'Land Converted to Wetlands'

No recalculations were performed in the current inventory cycle for subcategory 4D2 'Land Converted to Wetlands'. Between 1990 and 2020, CO_2 removals from the respective subcategory had continuously decreased, becoming constant in recent years (2015-2020). Results on CO_2 removal rates from this subcategory are provided in Table 6-53.

Table 6-53: CO_2 removals from category 4D 'Wetlands' between 1990-2020, kt

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
4D1	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
4D2	-555.3798	-526.4627	-595.5455	-525.8447	-497.6418	-469.4389	-441.2360	-413.0332	-384.8303	-356.6274	-328.4245
4D	**-555.3798**	**-526.4627**	**-595.5455**	**-525.8447**	**-497.6418**	**-469.4389**	**-441.2360**	**-413.0332**	**-384.8303**	**-356.6274**	**-328.4245**
	2001	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**
4D1	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
4D2	-300.2217	-272.0188	-243.8159	-215.6130	-187.4101	-159.2073	-131.0044	-102.8015	-74.5986	-46.3958	-75.3129
4D	**-555.3798**	**-526.4627**	**-595.5455**	**-525.8447**	**-497.6418**	**-469.4389**	**-441.2360**	**-413.0332**	**-384.8303**	**-356.6274**	**-328.4245**
	2012	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**
4D1	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	N/A	N/A
4D2	-15.4700	-106.0998	-139.7535	-82.7917	-82.7917	-82.8162	-82.8253	-82.8099	-82.8099	N/A	N/A
4D	**-555.3798**	**-526.4627**	**-595.5455**	**-525.8447**	**-497.6418**	**-469.4389**	**-441.2360**	**-413.0332**	**-384.8303**	N/A	N/A

At the start of the reporting period (1990), removals from subcategory 4D2 'Land Converted to Wetlands' are somewhat significant at sectoral level, due to massive conversion of different lands to wetlands (see Table 6-51). By the end of the period (2020), removals from subcategory 4D2 'Land Converted to Wetlands' had decreased significantly, constituting only 14.9% compared to the base year. Thus, compared to 1990, a decrease by 85% or a difference by circa 473 kt CO_2 was recorded in 2020 (Figure 6-12).

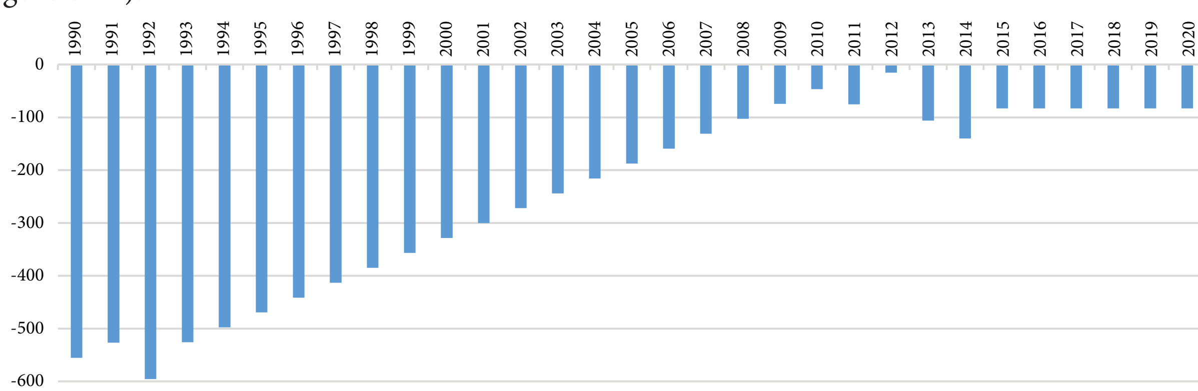


Figure 6-12: CO_2 removals from category 4D 'Wetlands' between 1990-2020, kt.

6.5.6. Planned Improvements

The possibility to improve cadastral records (as main reference sources for AD) regarding a more detailed specification in explanatory notes of initial land-use categories converted to category 4D 'Wetlands' will be considered for the next inventory cycle.

6.6. Settlements (Category 4E)

6.6.1. Source Category Description

Category 4E 'Settlements' includes all developed land (constructions, streets, yards, squares, roads, etc.), including transportation infrastructure and all size settlements if they are not accounted for in another land-use category. Depending on the type of vegetation with which they are covered, a part of land inside settlements was included in categories 4B 'Cropland' (parks, public gardens, green areas, perennial plantations, etc.), and 4C 'Grassland' (pastures and hayfields). 4E 'Settlements' comprises two subcategories: 4E1 'Settlements Remaining Settlements' and 4E2 'Land Converted to Settlements'. Activity data on land in this category are provided by the General Land Cadastre of the Republic of Moldova.

6.6.2. Methodological Issues, Emission Factors and Data Sources

4E1 'Settlements Remaining Settlements'

Category 4E1 'Settlements Remaining Settlements' includes lands without forest/herbaceous vegetation and/or no management activities which would contribute to essential changes in carbon pools; thus, a neutral balance was established in the main carbon pools (above-ground and below-ground biomass, dead organic matter, soil). Areas considered in subcategory 4E1 'Settlements Remaining Settlements' for 1970-2020 are shown in Table 6-54.

Table 6-54: Area of land included in subcategory 4E1 'Settlements Remaining Settlements' in the RM between 1990-2020, ha

Land Category	1990	1991	1992	1993	1994	1995	1996	1997
Settlements	181826.1	181826.1	181826.1	184126.1	187326.0	187926.0	190025.9	191225.9
Land Category	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**
Settlements	190825.9	194725.9	203425.7	207055.1	207012.1	211012.1	213023.1	212602.1
Land Category	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**
Settlements	211358.1	212911.1	212771.8	213987.1	213962.9	214162.9	229325.5	226824.6
Land Category	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**%**
Settlements	224798.7	223498.7	221199.7	220099.7	220066.1	217266.2	209851.5	15.4

Source: General Land Cadastre of the RM for the period 1970-2020; Land Use and Land-Use Change Matrix for the period 1970-2020.

4E2 'Land Converted to Settlements'

In order to estimate CO_2 removals/emissions from subcategory 4E2 'Land Converted to Settlements', a loss of carbon in biomass and in mineral soils was established due to conversion of different land types which were previously covered by a certain amount of biomass (forests, grassland, perennial plantations, etc.). At the same time, non-CO_2 (N_2O) emissions from the conversion of grassland to settlements were also estimated. The calculation process of CO_2 removals/emissions is based on the annual increments in carbon stocks due to current biomass growth, and uses Equation 2.15 from the 2006 IPCC Guidelines (Volume 4, Chapter 2, Page 2.20). Non-CO_2 (N_2O) emissions resulting from the conversion of grassland to settlements were estimated using Equation 11.8 from the 2006 IPCC Guidelines (Volume 4, Chapter 11, page 11.16).

The main land categories converted to settlements are croplands and grasslands (Table 6-55).

Table 6-55: Area of lands converted to settlements in the RM between 1970-2020, ha

Conversion	1970	1971	1972	1973	1974	1975	1976	1977	1978
Cropland Converted to Settlements	0.0	0.0	0.0	2042.3	2614.1	1062.0	1878.9	980.3	0.0
Grassland Converted to Settlements	0.0	0.0	0.0	457.7	585.9	238.0	421.1	219.7	0.0
Other Land Converted to Settlements	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total	**0.0**	**0.0**	**0.0**	**2500.0**	**3199.9**	**1300.0**	**2300.0**	**1200.0**	**0.0**
Conversion	**1979**	**1980**	**1981**	**1982**	**1983**	**1984**	**1985**	**1986**	**1987**
Cropland Converted to Settlements	3185.9	7107.0	3022.5	0.0	3267.6	1878.9	0.0	0.0	1552.1
Grassland Converted to Settlements	714.0	1592.8	677.4	0.0	732.3	421.1	0.0	0.0	347.9
Other Land Converted to Settlements	0.0	0.0	0.5	0.5	0.6	0.6	0.6	0.6	0.6
Total	**3899.9**	**8699.8**	**3700.5**	**0.5**	**4000.5**	**2300.6**	**0.6**	**0.6**	**1900.6**

Conversion	1988	1989	1990	1991	1992	1993	1994	1995	1996
Cropland Converted to Settlements	0.0	1307.0	0.0	163.4	12416.9	0.0	959.0	0.0	0.0
Grassland Converted to Settlements	0.0	292.9	0.0	36.6	2782.8	0.0	214.9	0.0	0.0
Other Land Converted to Settlements	0.6	0.6	0.6	0.6	0.9	0.0	0.0	0.0	0.9
Total	**0.6**	**1600.6**	**0.6**	**200.6**	**15200.6**	**0.0**	**1174.0**	**0.0**	**0.9**
Conversion	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**
Cropland Converted to Settlements	81.7	0.0	898.6	1143.7	0.0	0.0	413.4	0.0	0.0
Grassland Converted to Settlements	18.3	0.0	201.4	256.3	0.0	0.0	92.6	0.0	0.0
Other Land Converted to Settlements	0.9	0.5	0.5	1.0	0.0	0.0	0.0	0.0	0.0
Total	**100.9**	**0.5**	**1100.5**	**1400.9**	**0.0**	**0.0**	**506.0**	**0.0**	**0.0**
Conversion	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**
Cropland Converted to Settlements	0.0	0.0	0.0	0.0	0.0	697.8	0.0	76.7	395.4
Grassland Converted to Settlements	0.0	0.0	0.0	0.0	0.0	156.4	0.0	17.2	88.6
Other Land Converted to Settlements	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.9	1.0
Total	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**854.1**	**0.0**	**94.9**	**485.0**
Conversion	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**	**2023**
Cropland Converted to Settlements	1180.4	224.6	2597.4	0.0	4013.7	0.0	N/A	N/A	N/A
Grassland Converted to Settlements	264.6	50.3	582.1	0.0	899.5	0.0	N/A	N/A	N/A
Other Land Converted to Settlements	1.2	0.7	1.0	1.0	0.0	0.0	N/A	N/A	N/A
Total	**1446.1**	**275.7**	**3180.6**	**1.0**	**4913.2**	**0.0**	**N/A**	**N/A**	**N/A**

Source: General Land Cadastre of the RM for the period 1970-2020; Land Use and Land-Use Change Matrix for the period 1970-2020.

Country-specific emission factors were developed within EU/UNDP 'Clima East' Project, and based on two other CDM Projects of the Kyoto Protocol: MSCP and MCFDP, respectively, as well as from other relevant information in order to estimate annual biomass increments/losses on land converted to settlements (Table 6-56).

Table 6-56: EFs used to estimate CO_2 emissions/removals from subcategory 4E2 'Land Converted to Settlements'

Conversion	Indicator	Period, years	Unit	Indicator Value
Cropland Converted to Settlements	Annual average carbon increments/losses of biomass (crops)	year 1	Mg C/ha/yr	-5.0
	Annual average carbon increments of dead organic matter (litter)	year 1	Mg C/ha/yr	0.0
	Annual average increments/losses of soil organic carbon	years 1-20	Mg C/ha/yr	-0.2168
Grassland Converted to Settlements	Annual average carbon increments/losses of biomass (herbaceous cover)	year 1	Mg C/ha/yr	-3.78
	Annual average carbon increments of dead organic matter (litter)	year 1	Mg C/ha/yr	0.0
	Annual average increments/losses of soil organic carbon	years 1-20	Mg C/ha/yr	-2.4818
Other Land Converted to Settlements	Annual average carbon increments of biomass (herbaceous cover)	year 1	Mg C/ha/yr	0.0
	Annual average carbon increments of dead organic matter (litter)	year 1	Mg C/ha/yr	0.0
	Annual average increments of soil organic carbon	years 1-20	Mg C/ha/yr	0.0

6.6.3. Uncertainties and Time-Series Consistency

4E1 'Settlements Remaining Settlements'

Uncertainties associated with CO_2 emissions/removals from subcategory 4E1 'Settlements Remaining Settlements' are not estimated since a neutral balance was established in the main carbon pools (above-ground and below-ground biomass, dead organic matter, soil).

4E2 'Land Converted to Settlements'

Uncertainties associated with the CO_2 emissions/removals from subcategory 4E2 'Land Converted to Settlements' at the beginning and the end of the reference period (1990 and 2020) are somewhat low, and are estimated to be circa 10%. Uncertainties associated with emission/removal factors in both cases are also estimated to be circa 10%. Combined uncertainties from subcategory 4E2 'Land Converted to Settlements' account for circa 14.14%. For non-CO_2 emissions, uncertainties related to activity data account for circa 10%, whereas emission/removal factors have an uncertainty level of circa 30%. Combined uncertainties are estimated to be circa 31.62% (see Annex 5-3.4).

6.6.4. Quality Assurance and Quality Control

The quality of assessment for category 4E 'Settlements' is ensured by the fact that most of the AD used is taken from official records (the General Land Cadastre of the Republic of Moldova). Annual biomass increments/losses for lands converted to settlements were estimated using country-specific

EFs developed within EU/UNDP 'Clima East' Project, respectively based on two other CDM Projects: MSCP and MCFDP. At the same time, the quality of AD increased due to the development of the Land Use and Land-Use Change Matrix for the period 1970-2020 for the entire Sector 4 'LULUCF'.

Standard verification and quality control forms and checklists were filled in for this category, following a Tier 1 approach. Verification was focused on following the recommendations included in the 2006 IPCC Guidelines (Volume 4 'AFOLU'), on various aspects such as: verification of correct application of calculation methods set out in the Guidelines, ensuring correct use of country-specific coefficients, their accuracy, as well as comparing them to the values used by other Eastern and Central European countries. The description of the general and specific verification process of the GHG inventory is presented in the chapter dedicated to category 4A 'Forest Land'.

6.6.5. Recalculations

4E1 'Settlements Remaining Settlements'

No recalculations on CO_2 emissions/removals were performed for subcategory 'Settlements Remaining Settlements' in the current inventory cycle.

4E2 'Land Converted to Settlements'

No recalculations on CO_2 emissions/removals were performed for subcategory 'Land Converted to Settlements' in the current inventory cycle. Between 1990-2020, CO_2 emissions/removals from category 4E 'Settlements' fluctuated, being influenced particularly by the temporary conversion of different lands to this category (Table 6-55). The evolution of CO_2 emissions from category 4E 'Settlements' in the RM between in 1990 and 2020 is presented in Table 6-57.

Table 6-57: CO_2 emissions from category 4E 'Settlements' between 1990 and 2020, kt

	1990	1991	1992	1993	1994	1995	1996	1997
4E1 'Settlements Remaining Settlements'	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
4E2 'Land Converted to Settlements'	84.7480	88.7139	386.6196	114.6181	130.4883	106.9167	101.5910	100.7954
4E 'Settlements'	**84.7480**	**88.7139**	**386.6196**	**114.6181**	**130.4883**	**106.9167**	**101.5910**	**100.7954**
	1998	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**
4E1 'Settlements Remaining Settlements'	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
4E2 'Land Converted to Settlements'	99.0440	111.8259	100.1768	67.0898	67.0898	67.8615	53.6737	53.6737
4E 'Settlements'	**99.0440**	**111.8259**	**100.1768**	**67.0898**	**67.0898**	**67.8615**	**53.6737**	**53.6737**
	2006	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**
4E1 'Settlements Remaining Settlements'	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
4E2 'Land Converted to Settlements'	53.6737	49.2742	49.2742	45.5694	45.5694	62.0438	11.8882	13.7512
4E 'Settlements'	**53.6737**	**49.2742**	**49.2742**	**45.5694**	**45.5694**	**62.0438**	**11.8882**	**13.7512**
	2014	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**%**
4E1 'Settlements Remaining Settlements'	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0
4E2 'Land Converted to Settlements'	18.9848	39.1617	19.3071	77.3098	21.6217	116.5030	27.2098	-67.9
4E 'Settlements'	**18.9848**	**39.1617**	**19.3071**	**77.3098**	**21.6217**	**116.5030**	**27.2098**	**-67.9**

Only emissions were recorded during the reference period – the highest volume recorded was in 1992 (circa 386.6 kt CO_2) and can be explained by large areas subject to conversion to settlements in that year, and the lowest – in 2012 and 2013 (Figure 6-13).

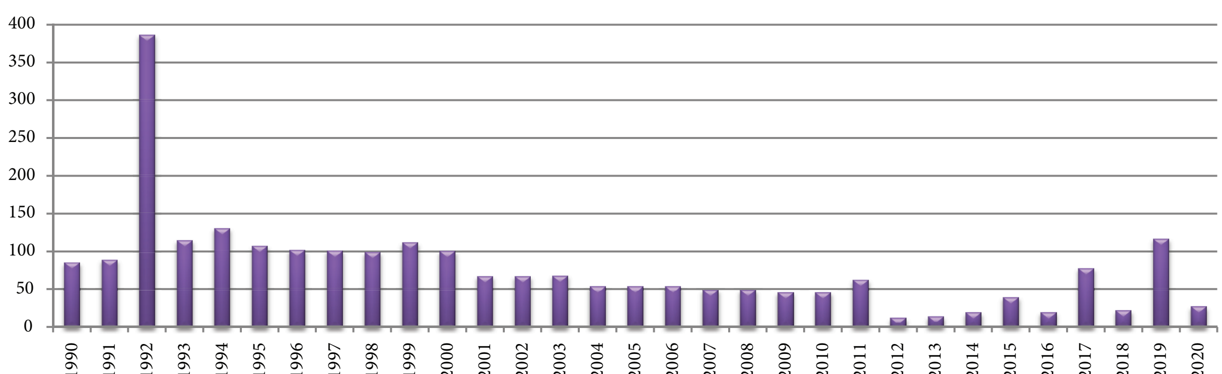


Figure 6-13: CO_2 emissions from category 4E 'Settlements' between 1990-2020, kt.

N_2O emissions from subcategory 4E2 'Land Converted to Settlements' are shown in Table 6-58.

Table 6-58: N_2O emissions from subcategory 4E2 'Land Converted to Settlements' between 1990-2020

	1990	1991	1992	1993	1994	1995	1996	1997
4E.2.1 Cropland to Settlements, kt N_2O	0.5257	0.5729	0.6396	0.6999	0.7535	0.8037	0.8480	0.8894
4E.2.2 Grassland to Settlements, kt N_2O	0.0105	0.0106	0.0149	0.0142	0.0136	0.0133	0.0126	0.0123
4E.2 Conversions to Settlements, kt N_2O	0.5362	0.5835	0.6545	0.7141	0.7671	0.8170	0.8606	0.9017
4E2, Total, kt CO_2 equivalent	**159.7967**	**173.8786**	**195.0547**	**212.8037**	**228.5960**	**243.4567**	**256.4737**	**268.7144**
	1998	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**
4E.2.1 Cropland to Settlements, kt N_2O	0.9308	0.9636	0.9759	0.9787	0.9815	0.9747	0.9619	0.9492
4E.2.2 Grassland to Settlements, kt N_2O	0.0123	0.0115	0.0094	0.0083	0.0083	0.0073	0.0067	0.0067
4E.2 Conversions to Settlements, kt N_2O	0.9431	0.9751	0.9853	0.9870	0.9898	0.9820	0.9686	0.9559
4E2, Total, kt CO_2 equivalent	**281.0494**	**290.5838**	**293.6176**	**294.1316**	**294.9625**	**292.6299**	**288.6416**	**284.8502**
	2006	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**
4E.2.1 Cropland to Settlements, kt N_2O	0.9365	0.9189	0.9013	0.8796	0.8579	0.8368	0.7767	0.7231
4E.2.2 Grassland to Settlements, kt N_2O	0.0067	0.0061	0.0061	0.0057	0.0057	0.0058	0.0015	0.0015
4E.2 Conversions to Settlements, kt N_2O	0.9432	0.9250	0.9074	0.8853	0.8636	0.8426	0.7781	0.7246
4E2, Total, kt CO_2 equivalent	**281.0588**	**275.6524**	**270.4086**	**263.8049**	**257.3381**	**251.1010**	**231.8871**	**215.9302**
	2014	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**%**
4E.2.1 Cropland to Settlements, kt N_2O	0.6753	0.6328	0.5965	0.5670	0.5376	0.5217	0.5245	-0.2
4E.2.2 Grassland to Settlements, kt N_2O	0.0013	0.0017	0.0018	0.0027	0.0027	0.0038	0.0034	-67.9
4E.2 Conversions to Settlements, kt N_2O	0.6766	0.6345	0.5983	0.5697	0.5403	0.5255	0.5279	-1.6
4E2, Total, kt CO_2 equivalent	**201.6397**	**189.0781**	**178.2795**	**169.7771**	**161.0110**	**156.5897**	**157.3018**	**-1.6**

6.6.6. Planned Improvements

The possibility to improve cadastral records (as the main reference sources for AD) regarding a more detailed specification in their explanatory notes on initial land-use categories converted to settlements will be considered for the next inventory cycle.

6.7. Other Land (Category 4F)

6.7.1. Source Category Description

Category 4F 'Other Land' includes, as a priority, bare soil (ravines, pits, rocks, etc.), as well as all lands that do not fall into any of the other categories – 4A-4E (for example, river banks, rocks). This category is also used to sum up all areas of the country's total official surface. 4F 'Other Land' comprises two categories: 4F1 'Other Land Remaining Other Land' and 4F2 'Land Converted to Other Land'.

6.7.2. Methodological Issues, Emission Factors and Data Sources

4F1 'Other Land Remaining Other Land'

Due to the particularities of lands in the Republic of Moldova included in subcategory 4F1 'Other Land Remaining Other Land' (land without forest/herbaceous vegetation and/or no management activities contributing to essential changes in carbon pools) a neutral balance was established in the main carbon pools (above-ground and below-ground biomass, dead organic matter, soil). AD on areas within this category are available in the General Land Cadastre of the Republic of Moldova and are also included in the Land Use and Land-Use Change Matrix for the period 1970-2020 (Table 6-59).

Table 6-59: Area of land included in category 4F1 'Other Land Remaining Other Land' between 1990-2020, ha

Land category	1990	1991	1992	1993	1994	1995	1996	1997
Other Land	56300.0	53300.0	45855.0	51255.5	41078.0	40822.0	45444.0	48200.3
Land category	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**
Other Land	50226.0	51330.0	52230.0	56459.0	55383.0	54510.1	57649.4	51984.3
Land category	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**
Other Land	52532.2	61311.9	60290.5	60620.4	58553.4	55818.4	57268.9	60198.0
Land category	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**%**
Other Land	52389.0	58031.5	57836.3	55874.0	55426.4	48943.4	39921.4	-29.1

Source: General Land Cadastre of the RM for the period 1970-2020; Land Use and Land-Use Change Matrix for the period 1970-2020.

4F2 'Land Converted to Other Land'

In order to estimate CO_2 removals/emissions from subcategory 4F2 'Land Converted to Other Land', a biomass loss was established due to conversion of different land categories which were previously covered by a certain amount of biomass (forests, grassland, perennial plantations, etc.). Activity data on areas subject to conversion within this category are available in the General Land Cadastre of the Republic of Moldova and are also included in the Land Use and Land-Use Change Matrix for the period 1970-2020. The main land categories subject to conversion to other land are forest lands, grasslands, and croplands – arable soils (Table 6-60).

Table 6-60: Area of lands converted to other land between 1970-2020, ha

Conversions	1970	1971	1972	1973	1974	1975	1976	1977	1978
Forest Land to Other Land	0.0	0.0	0.0	0.0	0.0	0.0	0.0	664.0	622.0
Cropland to Other Land	0.0	0.0	6275.0	4614.4	0.0	1112.0	0.0	0.0	0.0
Grassland to Other Land	0.0	0.0	0.0	0.0	8433.0	1557.8	0.0	3436.0	3078.0
Wetlands to Other Land	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Perennial plantations to Other Land	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total	**0.0**	**0.0**	**6275.0**	**4614.4**	**8433.0**	**2669.8**	**0.0**	**4100.0**	**3700.0**
	1979	**1980**	**1981**	**1982**	**1983**	**1984**	**1985**	**1986**	**1987**
Forest Land to Other Land	1654.0	1691.0	0.0	1571.7	4308.3	248.5	8177.0	8802.0	1615.0
Cropland to Other Land	0.0	0.0	0.0	228.6	0.0	0.0	0.0	0.0	0.0
Grassland to Other Land	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Wetlands to Other Land	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Perennial plantations to Other Land	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total	**1654.0**	**1691.0**	**0.0**	**1800.4**	**4308.3**	**248.5**	**8177.0**	**8802.0**	**1615.0**
Conversions	**1988**	**1989**	**1990**	**1991**	**1992**	**1993**	**1994**	**1995**	**1996**
Forest Land to Other Land	0.0	0.0	0.0	0.0	2245.0	0.0	3248.0	1856.0	226.0
Cropland to Other Land	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Grassland to Other Land	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Wetlands to Other Land	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Perennial plantations to Other Land	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total	**0.0**	**0.0**	**0.0**	**0.0**	**2245.0**	**0.0**	**3248.0**	**1856.0**	**226.0**
Conversions	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**
Forest Land to Other Land	0.0	0.0	2096.0	0.0	0.0	2409.0	0.0	0.0	1460.0
Cropland to Other Land	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2822.5	0.0
Grassland to Other Land	0.0	0.0	0.0	0.0	0.0	0.0	2874.9	890.1	8834.7
Wetlands to Other Land	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Perennial plantations to Other Land	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total	**0.0**	**0.0**	**2096.0**	**0.0**	**0.0**	**2409.0**	**2874.9**	**3712.6**	**10294.7**
Conversions	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**
Forest Land to Other Land	0.0	0.0	1860.0	0.0	3046.6	2511.0	0.0	0.0	1900.0
Cropland to Other Land	705.6	698.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Grassland to Other Land	6836.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	8702.9
Wetlands to Other Land	0.0	0.0	0.0	0.0	0.0	0.0	694.5	0.0	0.0
Perennial plantations to Other Land	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total	**7542.4**	**698.1**	**1860.0**	**0.0**	**3046.6**	**2511.0**	**694.5**	**0.0**	**10602.9**
Conversions	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**	**2023**
Forest Land to Other Land	0.0	2241.4	1019.0	1820.0	3740.0	237.0	N/A	N/A	N/A
Cropland to Other Land	0.0	0.0	0.0	145.0	1473.0	9822.0	N/A	N/A	N/A
Grassland to Other Land	0.0	0.0	0.0	0.0	2633.0	0.0	N/A	N/A	N/A
Wetlands to Other Land	0.0	0.0	0.0	0.0	1.0	0.0	N/A	N/A	N/A
Perennial plantations to Other Land	0.0	0.0	0.0	0.0	120.0	0.0	N/A	N/A	N/A
Total	**0.0**	**2241.4**	**1019.0**	**1965.0**	**7967.0**	**10059.0**	**N/A**	**N/A**	**N/A**

Source: General Land Cadastre of the RM for the period 1970-2020; Land Use and Land-Use Change Matrix for the period 1970-2020.

The calculation process of CO_2 removals/emissions from subcategory 4F2 'Land Converted to Other Land' is based on the annual increments in carbon stocks due to current biomass increments, and uses Equation 2.15 from the 2006 IPCC Guidelines (Volume 4, Chapter 2, page 2.20).

Country-specific emission factors were developed within CDM Projects: MSCP and MCFDP, as well as from other relevant information in order to estimate annual biomass increments/losses on land converted to other land (Table 6-61).

Table 6-61: EFs used to estimate CO_2 emissions/removals from subcategory 4F2 'Land Converted to Other Land'

Conversions	Indicator	Period, year	Unit	Indicator Value
Forest Land to Other Land	Annual average carbon increments/losses of biomass (trees and shrubs)	year 1	Mg C/ha/yr	-29.8
	Annual average carbon increments/losses of dead organic matter (litter)	year 1	Mg C/ha/yr	-1.15
	Annual average increments/losses of soil organic carbon	years 1-20	Mg C/ha/yr	-1.4156
Cropland to Other Land	Annual average carbon increments/losses of biomass (crops)	year 1	Mg C/ha/yr	-5.0
	Annual average carbon increments of dead organic matter (litter)	year 1	Mg C/ha/yr	0.0
	Annual average increments/losses of soil organic carbon	years 1-20	Mg C/ha/yr	-0.2168

Conversions	Indicator	Period, year	Unit	Indicator Value
Grassland to Other Land	Annual average carbon increments/losses of biomass (crops)	year 1	Mg C/ha/yr	-3.78
	Annual average carbon increments of dead organic matter (litter)	year 1	Mg C/ha/yr	0.0
	Annual average increments/losses of soil organic carbon	years 1-20	Mg C/ha/yr	-0.1241
Wetlands to Other Land	Annual average carbon increments/losses of biomass (crops)	year 1	Mg C/ha/yr	-4.2
	Annual average carbon increments of dead organic matter (litter)	year 1	Mg C/ha/yr	0.0
	Annual average increments/losses of soil organic carbon	years 1-20	Mg C/ha/yr	-2.4818

6.7.3. Uncertainties and Time-Series Consistency

4F1 'Other Land Remaining Other Land'

Uncertainties associated with the CO_2 emissions from 4F1 'Other Land Remaining Other Land' are not estimated, since a neutral balance was established in the main carbon pools (above-ground and below-ground biomass, dead organic matter, soils).

4F2 'Land Converted to Other Land'

Uncertainties associated with the CO_2 emissions/removals from 4F2 'Land Converted to Other Land' at the beginning and the end of the reference period (1990 and 2020) are somewhat low, and are estimated to be circa 10%. In both cases, emission/removal factors have an uncertainty level of circa 10%. Combined uncertainties within subcategory 4F2 'Land Converted to Other Land' constitute circa 14.14%. (Annex 5-3.4).

6.7.4. Quality Assurance and Quality Control

The quality of assessment for category 4F 'Other Land' is ensured by the fact that most of the AD used is taken from official records (the General Land Cadastre of the Republic of Moldova). Annual biomass increments/losses for lands converted to settlements were estimated using country-specific EFs developed within two CDM Projects: MSCP and MCFDP. At the same time, the quality of AD increased due to the development of the Land Use and Land-Use Change Matrix for the period 1970-2020. Within this category, verification was focused on following the recommendations included in the 2006 IPCC Guidelines (Volume 4 'AFOLU'), on various aspects such as: verification of correct application of calculation methods set out in the Guidelines, ensuring correct use of country-specific coefficients and indices, their accuracy, as well as comparing them to values used by other countries in the region.

6.7.5. Recalculations

No recalculations were performed to estimate CO_2 emissions/removals from category 4F 'Other Land'. Between 1990 and 2020, CO_2 emissions from category 4F 'Other Land' fluctuated (Table 6-62), being influenced particularly by the conversion of different lands to this category.

Table 6-62: CO_2 emissions from category 4F 'Other Land' between 1990-2020, kt

	1990	1991	1992	1993	1994	1995	1996	1997
4F1 'Other Land Remaining Other Land'	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
4F2 'Land Converted to Other Land'	152.3638	152.3638	418.7786	164.0168	549.4579	401.1281	217.3293	188.2363
4F 'Other Land'	**152.3638**	**152.3638**	**418.7786**	**164.0168**	**549.4579**	**401.1281**	**217.3293**	**188.2363**
	1998	1999	2000	2001	2002	2003	2004	2005
4F1 'Other Land Remaining Other Land'	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
4F2 'Land Converted to Other Land'	185.0077	425.1554	178.5246	178.5246	456.2431	201.6619	223.8177	416.5012
4F 'Other Land'	**185.0077**	**425.1554**	**178.5246**	**178.5246**	**456.2431**	**201.6619**	**223.8177**	**416.5012**
	2006	2007	2008	2009	2010	2011	2012	2013
4F1 'Other Land Remaining Other Land'	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
4F2 'Land Converted to Other Land'	189.4964	83.1072	291.0044	79.9357	441.4824	393.7285	114.1449	103.4500
4F 'Other Land'	**185.0077**	**425.1554**	**178.5246**	**178.5246**	**456.2431**	**201.6619**	**223.8177**	**416.5012**
	2014	2015	2016	2017	2018	2019	2020	%
4F1 'Other Land Remaining Other Land'	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0
4F2 'Land Converted to Other Land'	436.6463	86.8192	351.6349	218.2055	321.2138	611.7881	329.1445	116.0
4F 'Other Land'	**436.6463**	**86.8192**	**351.6349**	**218.2055**	**321.2138**	**611.7881**	**329.1445**	**116.0**

The graphical illustration of the evolution of CO_2 emissions from category 4F 'Other Land' in the Republic of Moldova between 1990-2020 is shown in Figure 6-14.

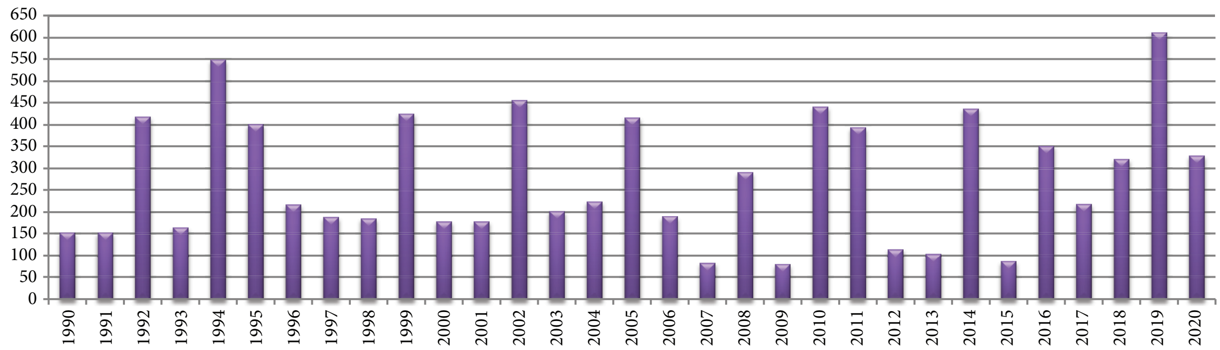


Figure 6-14: CO_2 emissions from category 4F 'Other Land' between 1990-2020, kt.

6.7.6. Planned Improvements

The possibility to improve cadastral records (as the main reference sources for activity data) regarding a more detailed specification in their explanatory notes on initial land-use categories converted to other land will be considered for the next inventory cycle in the RM. At the same time, it is necessary to analyze the input and output process of land within category 4F 'Other Land', including in terms of establishing the average conversion period.

6.8. Harvested Wood Products (Category 4G)

6.8.1. Source Category Description

Category 4G 'Harvested Wood Products' includes CO_2 removals/emissions from wood products harvested/processed, imported or exported (rough roundwood; saw logs, timber, wood panels, etc.) used in the national economy. In the Republic of Moldova, wood harvesting from forests takes place during the process of cutting secondary products (spacing, cleaning, thinning and sanitary cutting), and main products (regeneration cuts, preservation, sanitation cutting) and ecological reconstruction. Due to the classification of the Republic of Moldova's forests in functional Group I, the harvesting in exploitable forests is made depending on their state, in order to ensure the regeneration/continuity of the stands. In this context, the low quality of the harvested wood products is noticeable, including the share of commercial timber in the total volume of the harvested wood. Thus, according to official records, between 1990 and 2020, the share of commercial wood in the total volume of the harvested wood was the highest in 1990 (17.6%), whereas the lowest – in 2014 (3.9%).

6.8.2. Methodological Issues, Emission Factors and Data Sources

For category 4G 'Harvested Wood Products', a Tier 1 approach was used (2006 IPCC Guidelines), and default emission/removal factors, respectively. The IPCC 'HWP Calculator' module was used for calculations ('Production Approach'). AD for the period 1961-2020 on wood products included in 4G 'Harvested Wood Products' are partly available in the official statistics of the Republic of Moldova, particularly for the period 1961-1993. For 1994-2020, AD from the FAOSTAT database was used. The evolution of wood product volumes included in category 4G 'Harvested Wood Product' between 1961 and 2020 is presented in Table 6-63.

Table 6-63: Evolution of wood product volume considered in source category 4G 'Harvested Wood Products' between 1961-2020

Wood Products by Category	Source	1961	1962	1963	1964	1965	1966	1967	1968	1969	1970	1971	1972
Rough roundwood, m^3	Produced	26960	26960	26960	26960	26960	24920	22880	20840	18800	16750	15100	13450
	Imported	73040	73040	73040	73040	73040	71480	69920	68360	66800	65240	63680	62120
	Exported	5620	5850	6080	6310	6540	6770	7000	7230	7460	7690	7920	8150
Other types of roundwood, m^3	Produced	32300	32300	32300	32300	32300	29860	27420	24980	22540	20100	18110	16120
	Imported	67700	67700	67700	67700	67700	66730	65760	64790	63820	62850	61880	60910
	Exported	0	0	0	0	0	0	0	0	0	0	0	0
Paper and cardboard, t	Produced	0	0	0	0	0	0	0	0	63150	64460	65770	67080
	Imported	37270	38760	40250	41740	43230	44720	46210	47700	49190	50680	52170	53660
	Exported	0	0	0	0	0	0	0	0	0	0	90	130

Wood Products by Category	Source	1961	1962	1963	1964	1965	1966	1967	1968	1969	1970	1971	1972
	Produced	42370	55720	69070	82420	95770	107700	119650	131550	142060	154070	154070	152920
Timber, m^3	Imported	59240	60080	60920	61760	62600	62370	62140	61910	61680	61450	61220	60990
	Exported	1930	1990	2050	2110	2170	2230	2290	2350	2410	2470	2530	2590
	Produced	660	1320	1980	2640	3300	4540	5780	7020	8260	9500	18540	27580
Wood panels, m^3	Imported	2580	2690	2800	2910	3020	3130	3240	3350	3460	3570	3680	3790
	Exported	2580	2690	2800	2910	3020	3130	3240	3350	3460	3570	3680	3790
Wood Products by Category	**Source**	**1973**	**1974**	**1975**	**1976**	**1977**	**1978**	**1979**	**1980**	**1981**	**1982**	**1983**	**1984**
	Produced	11800	10150	8480	8620	8760	8900	9040	9200	11750	8160	21080	26170
Rough roundwood, m^3	Imported	60560	59000	57440	55880	54320	52760	51200	49640	48080	46520	44960	43400
	Exported	8380	8610	8840	9070	9300	9530	9760	9990	10220	10450	10680	10910
	Produced	14130	12140	10160	10340	10520	10700	10880	11050	14080	9780	25260	27160
Other types of roundwood, m^3	Imported	59940	58970	58000	57030	56060	55090	54120	53150	52180	51210	50240	49270
	Exported	0	0	0	0	0	0	0	0	0	0	0	0
	Produced	68390	69700	71010	72320	73630	74940	76250	77560	78870	80180	81490	84000
Paper and cardboard, t	Imported	55150	56640	58130	59620	61110	62600	64090	65580	67070	68560	70050	71560
	Exported	170	210	250	290	330	370	410	450	490	530	570	610
	Produced	151780	150730	149700	136260	122820	109400	95970	82530	80180	79380	86440	87610
Timber, m^3	Imported	60760	60530	60300	60070	59840	59610	59380	59150	58920	58690	58460	58230
	Exported	2650	2710	2770	2830	2890	2950	3010	3070	3130	3190	3250	3310
	Produced	36620	45660	54700	56260	57820	59380	60940	62500	64800	67100	71600	86000
Wood panels, m^3	Imported	3900	4010	4120	4230	4340	4450	4560	4670	4780	4890	5000	5110
	Exported	3900	4010	4120	4230	4340	4450	4560	4670	4780	4890	5000	5110
Wood Products by Category	**Source**	**1985**	**1986**	**1987**	**1988**	**1989**	**1990**	**1991**	**1992**	**1993**	**1994**	**1995**	**1996**
	Produced	31260	36350	41440	46530	51620	56710	61800	66890	71980	77070	82200	71800
Rough roundwood, m^3	Imported	41840	40280	38720	37160	35600	34040	32480	30920	29360	26200	28300	28300
	Exported	11140	11370	11600	11830	12060	12290	12520	12824	6910	1000	200	200
	Produced	29060	30960	32860	34760	36660	38560	40460	42360	44260	46160	48100	41700
Other types of roundwood, m^3	Imported	48300	47330	46360	45390	44420	43450	42480	41510	40540	39570	38600	37630
	Exported	0	0	0	0	0	0	0	0	0	0	0	0
	Produced	82690	81380	80070	78760	77450	74140	68830	54470	40110	25750	11360	11010
Paper and cardboard, t	Imported	71560	71560	71560	71560	71560	71560	71560	5005	10114	20000	18400	18400
	Exported	650	690	730	770	810	850	890	993	993	6900	5200	5200
	Produced	86080	83860	81640	79320	77190	74970	72740	70520	68300	63480	59100	59300
Timber, m^3	Imported	58000	57770	57540	57310	57080	56850	56620	55970	60000	74260	68190	65790
	Exported	3370	3430	3490	3550	3610	3670	3730	3821	2711	5600	900	600
	Produced	81670	77340	73010	68680	64350	60020	55690	51360	47000	14000	10000	10000
Wood panels, m^3	Imported	5220	5330	5440	5550	5660	5770	5880	44	6400	10600	37400	37400
	Exported	5220	5330	5440	5550	5660	5770	5880	44	6400	10600	37400	37400
Wood Products by Category	**Source**	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**
	Produced	82600	67400	74500	80800	71000	92500	94000	86600	83800	45000	43000	43000
Rough roundwood, m^3	Imported	28300	28300	28300	28300	28300	28300	28300	28300	28300	43400	39000	39000
	Exported	200	800	900	300	300	300	300	300	300	370	2548	2548
	Produced	46900	37600	41300	47100	39200	49400	53800	49500	49500	17900	17000	17000
Other types of roundwood, m^3	Imported	36660	35690	34720	33750	32780	31810	30840	29870	28900	27930	26960	25990
	Exported	0	0	0	0	0	0	0	0	0	0	0	0
	Produced	13640	12220	5930	12220	14460	19220	31040	30530	26530	84200	97500	97500
Paper and cardboard, t	Imported	18400	27106	27106	27106	27106	27106	27106	27106	27106	48682	80001	80001
	Exported	5200	9970	9970	9970	9970	9970	9970	9970	9970	27880	6100	6100
	Produced	65300	59700	39000	39100	46800	74100	71200	68100	65300	58040	60480	60480
Timber, m^3	Imported	56090	118190	118190	118190	118190	118190	118190	118190	118190	147020	155100	155100
	Exported	300	300	0	16	16	16	16	16	16	3900	4000	4000
	Produced	10000	10000	10000	10000	10000	10000	10000	10000	10000	18000	2800	2800
Wood panels, m^3	Imported	37400	25962	25962	25962	25962	25962	25962	25962	25962	91	122	122
	Exported	37400	25962	25962	25962	25962	25962	25962	25962	25962	91	122	122
Wood Products by Category	**Source**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**
	Produced	43000	43000	43000	32600	29900	25600	25600	52000	46000	46000	46000	31000
Rough roundwood, m^3	Imported	39000	39000	45448	49980	36252	29100	29100	29100	394	364	364	82
	Exported	2548	2548	134	150	56	56	56	56	0	0	0	0
	Produced	17000	17000	17000	12800	8600	8800	8800	15000	12000	12000	12000	14000
Other types of roundwood, m^3	Imported	25020	24050	23080	22110	21140	20170	18900	29652	9510	4688	4688	0
	Exported	0	0	0	0	0	0	0	56	0	22	22	0
	Produced	97500	97500	97500	4410	14100	11800	11700	26000	39800	40328	40328	31172
Paper and cardboard, t	Imported	80001	80001	40066	35840	34929	36066	36066	101456	97957	102837	102837	69147
	Exported	6100	6100	19898	17860	16406	14833	14833	17621	29648	31314	31314	22200
	Produced	60480	60480	60480	50834	37580	31700	33317	53000	51689	52735	52735	12724
Timber, m^3	Imported	155100	155100	151113	132290	137595	150517	150517	153900	230697	232141	232141	223000
	Exported	4000	4000	1678	1980	1378	2081	2081	2081	256	224	224	432
	Produced	2800	2800	2800	15055	15270	15000	15000	0	2487	2787	2787	425
Wood panels, m^3	Imported	122	122	161514	167030	169818	212560	212560	145001	329594	334958	334958	187077
	Exported	122	122	161514	167030	169818	212560	212560	3164	4264	4813	4813	3155

Source: Statistical Yearbooks of the RM for 1961-2020; FAOSTAT database for 1994-2020.

In order to estimate annual carbon increments/losses from use of wood products included in source category 4G 'Harvested Wood Products', emission/removal factors were used according to the 2006 IPCC Guidelines (Table 6-64).

Table 6-64: EFs used to estimate CO_2 emissions/removals from category 4G 'Harvested Wood Products' in the RM

Category	Indicator	Unit	Indicator Value
Period of use	Solidwood products (timber, wood chips and veneer, rough roundwood, wood panels, etc.)	years	30.0
	Paper products	years	3.0
Conversion factor	Timber, other types of roundwood (wood chips and veneer, rafter, etc.)	t C/m³	0.5
	Wood panels	t C/m³	0.295
	Paper and cardboards	t C/t	0.45

Source: IPCC Guidelines 2006 (Volume 4, Chapter 12, Table 12.2, page 12.17 and Table 12.4, page 12.19).

6.8.3. Uncertainties and Time-Series Consistency

Uncertainties associated with the CO_2 emissions/removals from category 4G 'Harvested Wood Products' at the beginning and the end of the reference period (1990 and 2020) are somewhat high, and are estimated to be circa 30%. In both cases, emission/removal factors have an uncertainty level of circa 10%. Combined uncertainties from 4G 'Harvested Wood Products' constitute circa 31.62%. (see Annex 5-3.4).

6.8.4. Quality Assurance and Quality Control

The quality of assessment for 4G 'Harvested Wood Products' is ensured by the fact that most of the AD used is taken from official records (Statistical Yearbooks of the RM; FAOSTAT database). At the same time, it should be noted that the export and import data for the period 1961-1993 (while the RM was part of the USSR and in the first years after independence) was calculated indirectly, considering the estimated needs of wood products of the national economy, as well as the local production capacities. Standard verification and quality control forms and checklists were filled in for this category, following a Tier 1 approach. Within this category, verification was focused on following the recommendations included in the 2006 IPCC Guidelines (Volume 4 'AFOLU'), on various aspects such as: verification of correct application of estimation methods set out in the Guidelines, ensuring correct use of country-specific coefficients and indices, their accuracy, as well as comparing them to the values used by other countries in the region.

6.8.5. Recalculations

No recalculations were performed to estimate CO_2 emissions/removals from category 4G 'Harvested Wood Products' in the current inventory cycle for the period 1990-2020. Between 1990 and 2020, CO_2 emissions/removals from category 4G 'Harvested Wood Products' fluctuated significantly (Figure 6-15), being influenced particularly by the temporary harvesting/production of wood with a long period of use.

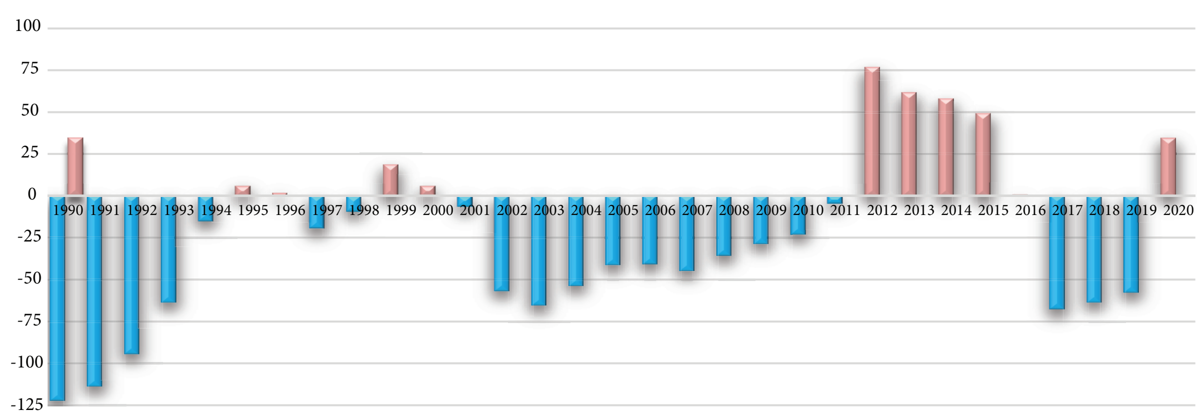


Figure 6-15: Evolution of CO_2 removals/emissions from category 4G 'Harvested Wood Products' between 1990-2020, kt.

The largest removal volumes were recorded in 1990 (-122.2 kt), whereas the most reduced – in 2011 (4.4 kt) (Table 6-65). At the same time, CO_2 emissions were recorded for 10 years (1995-1996, 1999-2000, 2012-2016; 2020) – with a minimum of 0.9 kt in 2016, and a maximum of 76.8 kt in 2012.

Table 6-65: CO_2 removals/emissions from category 4G 'Harvested Wood Products' in the RM between 1990-2020, kt

	1990	1991	1992	1993	1994	1995	1996	1997
4G. CO_2 removals/emissions	-122.1804	-113.6108	-94.2986	-63.4504	-14.6464	5.9727	1.7792	-19.2429
	1998	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**
4G. CO_2 removals/emissions	-9.1293	18.5414	5.8073	-6.2594	-56.6873	-65.1129	-53.4745	-41.1098
	2006	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**
4G. CO_2 removals/emissions	-40.5864	-44.5936	-35.6078	-28.4708	-22.8014	-4.3808	76.8444	61.8814
	2014	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**
4G. CO_2 removals/emissions	58.0208	49.2353	0.8816	-67.4476	-63.5037	-57.5604	34.6883	N/A

6.8.6 Planned Improvements

The possibility to improve statistical records (as the main reference sources for activity data) regarding wood product production/export/import within category 4G 'Harvested Wood Products' will be considered for the next inventory cycle.

7. WASTE SECTOR

7.1. Overview

Sector 5 'Waste' covers direct GHG emissions (CO_2, CH_4 and N_2O) from managing municipal and industrial waste, incineration and open burning of waste, as well as from wastewater treatment and discharge, estimated based on methodologies in the 2006 IPCC Guidelines. The source categories covered by this sector are: 5A 'Solid Waste Disposal', 5B 'Biological Treatment of Solid Waste', 5C 'Incineration and Open Burning of Waste' and 5D 'Wastewater Treatment and Discharge'. A brief overview, methodological issues and data sources, key categories, uncertainties and times-series consistency, quality assurance and quality control verification, recalculations made and planned improvements are described for each source category within this sector.

7.1.1. Summary of Emission Trends

In 2020, Sector 5 'Waste' accounted for circa 11.5% of total national direct GHG emissions (without Sector 4 'LULUCF'), being the third major source of GHG emissions in the Republic of Moldova, following Sector 1 'Energy' and Sector 3 'Agriculture'. It should be noted that Sector 5 'Waste' is a major source of CH_4 emissions, accounting for circa 62.4%% of the total methane emissions reported at national level.

The evolution of total GHG emissions originating from Sector 5 'Waste' recorded a slight downward trend between 1990 and 2020, decreasing from 1573.5 kt CO_2 equivalent in 1990 to 1566.6 kt CO_2 equivalent in 2020 (Table 7-1). The economic growth recorded in the last 20 years resulted in a higher level of welfare and industrial production, and increased consumption also results in a greater capacity to generate waste.

Table 7-1: Evolution of total direct GHG emissions from Sector 5 'Waste' between 1990-2020

Year	CO_2, kt	CH_4, kt CO_2 equivalent	N_2O, kt CO_2 equivalent	Total, kt CO_2 equivalent	CO_2, % of total	CH_4, % of total	N_2O, % of total
1990	14.9667	1,468.0088	90.5302	1,573.5058	1.0	93.3	5.8
1991	14.9994	1,505.6591	83.7658	1,604.4244	0.9	93.8	5.2
1992	15.0476	1,512.3344	77.0182	1,604.4001	0.9	94.3	4.8
1993	15.0447	1,574.9573	71.8949	1,661.8969	0.9	94.8	4.3
1994	15.0947	1,556.8668	69.8180	1,641.7795	0.9	94.8	4.3
1995	15.0979	1,551.5871	70.6313	1,637.3163	0.9	94.8	4.3
1996	15.0960	1,553.4688	69.6101	1,638.1749	0.9	94.8	4.2
1997	15.0456	1,544.6267	70.8125	1,630.4848	0.9	94.7	4.3
1998	15.0794	1,517.7256	71.8643	1,604.6693	0.9	94.6	4.5
1999	15.0071	1,513.4962	70.3233	1,598.8266	0.9	94.7	4.4
2000	14.9965	1,486.9842	71.9066	1,573.8873	1.0	94.5	4.6
2001	14.9689	1,458.3147	72.6511	1,545.9346	1.0	94.3	4.7
2002	14.9402	1,444.4133	74.5114	1,533.8650	1.0	94.2	4.9
2003	14.9100	1,412.2243	72.0468	1,499.1811	1.0	94.2	4.8
2004	14.8621	1,397.2687	68.6927	1,480.8235	1.0	94.4	4.6
2005	14.4670	1,400.9198	63.1072	1,478.4941	1.0	94.8	4.3
2006	14.1260	1,385.7969	64.9690	1,464.8920	1.0	94.6	4.4
2007	13.7672	1,378.2161	60.5129	1,452.4962	0.9	94.9	4.2
2008	13.4533	1,397.7393	55.7607	1,466.9534	0.9	95.3	3.8
2009	13.1613	1,408.7682	56.8951	1,478.8246	0.9	95.3	3.8
2010	12.8663	1,433.5155	55.0736	1,501.4555	0.9	95.5	3.7
2011	12.5793	1,442.5387	55.3120	1,510.4300	0.8	95.5	3.7
2012	12.2708	1,426.1858	55.7250	1,494.1816	0.8	95.4	3.7
2013	11.9033	1,367.5480	56.0012	1,435.4525	0.8	95.3	3.9
2014	11.5371	1,356.7809	55.4310	1,423.7490	0.8	95.3	3.9
2015	13.3135	1,353.3989	56.5261	1,423.2385	0.9	95.1	4.0
2016	13.0346	1,379.6683	57.1517	1,449.8546	0.9	95.2	3.9
2017	14.6448	1,465.6365	59.1497	1,539.4310	1.0	95.2	3.8
2018	14.2880	1,480.2001	60.7231	1,555.2113	0.9	95.2	3.9
2019	13.9352	1,485.5909	60.9402	1,560.4663	0.9	95.2	3.9
2020	13.7583	1,491.8574	60.9751	1,566.5908	0.9	95.2	3.9
1990-2020, %	-8.1	1.6	-32.6	-0.4	-7.7	2.1	-32.3

In 1990, CO_2, CH_4 and N_2O emissions accounted for circa 1.0%, 93.3% and 5.8% respectively, of the total GHG emissions from Sector 5 'Waste'. By 2020, the share of pollutants had not changed significantly, constituting circa 0.9%, 95.2%, and 3.9% respectively, of the total sectoral emissions. At the same time, between 1990 and 2020, total direct GHG emissions originating from Sector 5 'Waste' increased by circa 2.1%, CH_4 emissions decreased by 0.4%, whereas CO_2 and N_2O emissions decreased by 7.0%, and 32.3% respectively (Figure 7-1).

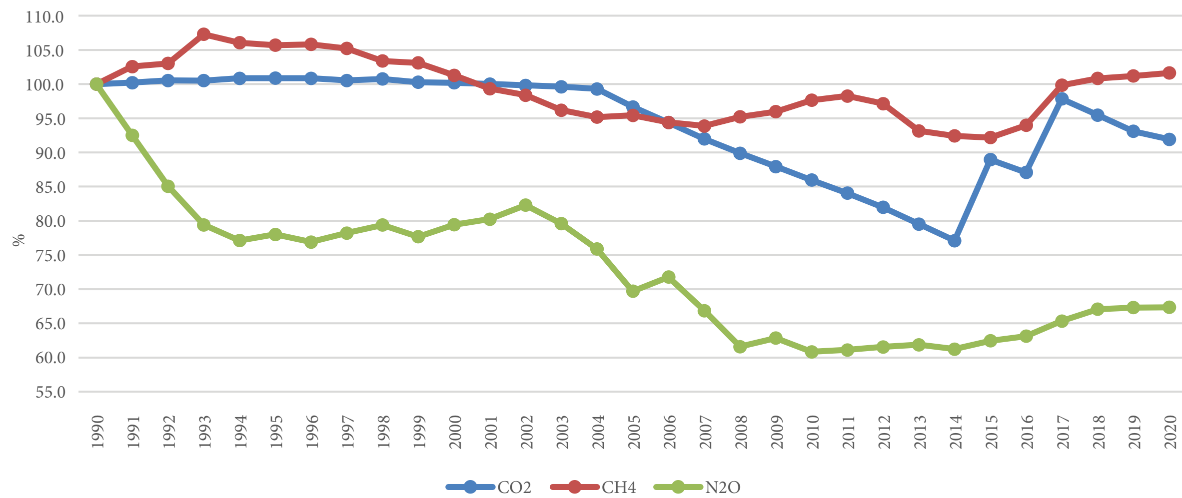


Figure 7-1: Direct GHG emissions from Sector 5 'Waste' by gas in the RM between 1990-2020, where 1990 represents 100%

Source category 5A 'Solid Waste Disposal' was the largest source of direct GHG emissions between 1990 and 2020, with a share varying between a minimum of 70.3% of the total in 1990, and a maximum of 79.5% of the total in 2020; followed by source category 5D 'Wastewater Treatment and Discharge', with a share varying between a minimum of 18.9% of the total in 2020 and a maximum of 28.0% of the total in 1990; source category 5C 'Incineration and Open Burning of Waste', with a share varying between 1.6% and 1.4% of the total sectoral emissions between 1990 and 2020, and source category 5B 'Biological Treatment of Solid Waste', which constituted 0.2% in 2020.

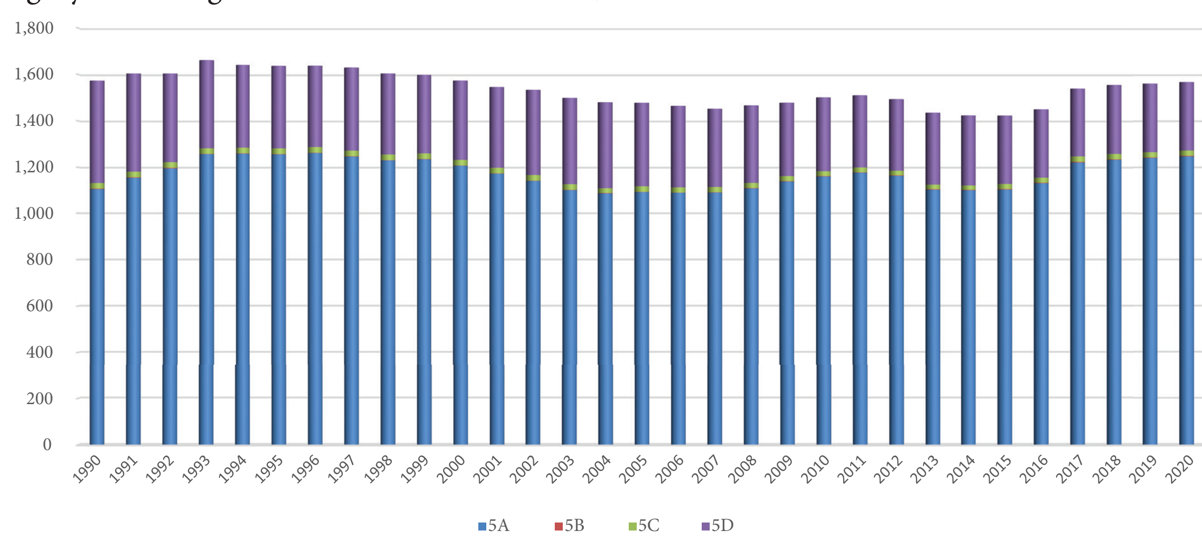


Figure 7-2: Breakdown of direct GHG emissions from Sector 5 'Waste' by category between 1990-2020, kt CO_2 equivalent.

Within the reference period, direct GHG emissions from source category 5A 'Solid Waste Disposal' increased by circa 12.7%; from source category 5B 'Biological Treatment of Solid Waste' – by 4.3%; from source category 5C 'Incineration and Open Burning of Waste', emissions decreased by circa 8.1%, whereas emissions from source category 5D 'Wastewater Treatment and Discharge' decreased by circa 32.9% (Figure 7-2, Table 7-2).

Table 7-2: Evolution of direct GHG emissions by category and their share in the total sectoral emissions in the RM between 1990-2020

Year	5A, kt CO_2 eq.	5B, kt CO_2 eq.	5C, kt CO_2 eq.	5D, kt CO_2 eq.	5, kt CO_2 eq.	5A, % of total	5A, % of total	5C, % of total	5D, % of total
1990	1,105.9965	2.3322	24.2621	440.9149	1,573.5058	70.3	0.1	1.5	28.0
1991	1,154.9967	2.3633	24.3113	422.7530	1,604.4244	72.0	0.1	1.5	26.3
1992	1,195.5847	2.4656	24.3859	381.9639	1,604.4001	74.5	0.2	1.5	23.8
1993	1,256.5473	1.2339	24.3780	379.7377	1,661.8969	75.6	0.1	1.5	22.8
1994	1,259.1024	1.1501	24.4557	357.0713	1,641.7795	76.7	0.1	1.5	21.7
1995	1,256.0725	1.0843	24.4574	355.7021	1,637.3163	76.7	0.1	1.5	21.7
1996	1,261.8303	1.1178	24.4511	350.7757	1,638.1749	77.0	0.1	1.5	21.4
1997	1,246.6523	1.0514	24.3673	358.4138	1,630.4848	76.5	0.1	1.5	22.0
1998	1,230.1150	1.0616	24.4200	349.0727	1,604.6693	76.7	0.1	1.5	21.8
1999	1,234.6535	0.9961	24.3095	338.8674	1,598.8266	77.2	0.1	1.5	21.2
2000	1,207.0370	0.8984	24.2867	341.6652	1,573.8873	76.7	0.1	1.5	21.7
2001	1,172.9240	0.8156	24.2427	347.9523	1,545.9346	75.9	0.1	1.6	22.5
2002	1,141.7814	0.8954	24.1900	366.9981	1,533.8650	74.4	0.1	1.6	23.9
2003	1,101.9715	0.9401	24.1339	372.1356	1,499.1811	73.5	0.1	1.6	24.8
2004	1,085.3420	0.9870	24.0505	370.4440	1,480.8235	73.3	0.1	1.6	25.0
2005	1,093.6111	1.0334	23.4100	360.4395	1,478.4941	74.0	0.1	1.6	24.4
2006	1,089.7168	1.1210	22.8582	351.1959	1,464.8920	74.4	0.1	1.6	24.0
2007	1,091.3363	1.4534	22.2776	337.4289	1,452.4962	75.1	0.1	1.5	23.2
2008	1,109.4186	1.7211	21.7640	334.0498	1,466.9534	75.6	0.1	1.5	22.8
2009	1,139.0402	1.9112	21.2853	316.5880	1,478.8246	77.0	0.1	1.4	21.4
2010	1,160.6703	1.8439	20.8019	318.1393	1,501.4555	77.3	0.1	1.4	21.2
2011	1,176.7888	1.8723	20.3296	311.4394	1,510.4300	77.9	0.1	1.3	20.6
2012	1,163.7460	1.9175	19.8260	308.6921	1,494.1816	77.9	0.1	1.3	20.7
2013	1,103.9166	2.0826	19.2357	310.2176	1,435.4525	76.9	0.1	1.3	21.6
2014	1,101.2941	2.1785	18.6487	301.6276	1,423.7490	77.4	0.2	1.3	21.2
2015	1,104.4973	2.1795	21.5422	295.0195	1,423.2385	77.6	0.2	1.5	20.7
2016	1,131.9612	2.1665	21.0986	294.6284	1,449.8546	78.1	0.1	1.5	20.3
2017	1,220.9072	2.4799	23.7193	292.3246	1,539.4310	79.3	0.2	1.5	19.0
2018	1,232.4760	2.2360	23.1496	297.3497	1,555.2113	79.2	0.1	1.5	19.1
2019	1,239.2098	2.2366	22.5896	296.4302	1,560.4663	79.4	0.1	1.4	19.0
2020	1,246.1821	2.4322	22.2913	295.6853	1,566.5908	79.5	0.2	1.4	18.9
1990-2020, %	12.7	4.3	-8.1	-32.9	-0.4	13.2	4.7	-7.7	-32.6

The table below shows the evolution of direct GHG emissions from Sector 5 'Waste' in the Republic of Moldova by source and gas (Table 7-3).

Table 7-3: Evolution of direct GHG emissions from Sector 5 'Waste', by source and gas, in the RM between 1990-2020, kt CO_2 equivalent

Year	5A	5B		5C			5D		5. Waste
	CH_4, kt CO_2 equivalent	CH_4, kt CO_2 equivalent	N_2O, kt CO_2 equivalent	CO_2, kt	CH_4, kt CO_2 equivalent	N_2O, kt CO_2 equivalent	CH_4, kt CO_2 equivalent	N_2O, kt CO_2 equivalent	Total, kt CO_2 equivalent
1990	1,105.9965	1.3597	0.9725	14.9667	7.6876	1.6078	352.9650	87.9499	1,573.5058
1991	1,154.9967	1.3779	0.9855	14.9994	7.7010	1.6109	341.5835	81.1694	1,604.4244
1992	1,195.5847	1.4375	1.0281	15.0476	7.7226	1.6157	307.5895	74.3744	1,604.4001
1993	1,256.5473	0.7194	0.5145	15.0447	7.7182	1.6150	309.9724	69.7653	1,661.8969
1994	1,259.1024	0.6705	0.4796	15.0947	7.7410	1.6200	289.3528	67.7185	1,641.7795
1995	1,256.0725	0.6322	0.4521	15.0979	7.7395	1.6200	287.1429	68.5592	1,637.3163
1996	1,261.8303	0.6517	0.4661	15.0960	7.7356	1.6194	283.2511	67.5246	1,638.1749
1997	1,246.6523	0.6130	0.4384	15.0456	7.7079	1.6138	289.6535	68.7603	1,630.4848
1998	1,230.1150	0.6189	0.4427	15.0794	7.7234	1.6172	279.2682	69.8045	1,604.6693
1999	1,234.6535	0.5807	0.4154	15.0071	7.6922	1.6101	270.5697	68.2978	1,598.8266
2000	1,207.0370	0.5238	0.3746	14.9965	7.6818	1.6084	271.7416	69.9236	1,573.8873
2001	1,172.9240	0.4755	0.3401	14.9689	7.6683	1.6055	277.2468	70.7055	1,545.9346
2002	1,141.7814	0.5221	0.3734	14.9402	7.6480	1.6017	294.4618	72.5363	1,533.8650
2003	1,101.9715	0.5481	0.3920	14.9100	7.6262	1.5977	302.0785	70.0571	1,499.1811
2004	1,085.3420	0.5754	0.4116	14.8621	7.5964	1.5919	303.7548	66.6893	1,480.8235
2005	1,093.6111	0.6025	0.4309	14.4670	7.3936	1.5495	299.3127	61.1268	1,478.4941
2006	1,089.7168	0.6536	0.4674	14.1260	7.2192	1.5130	288.2073	62.9886	1,464.8920
2007	1,091.3363	0.8474	0.6060	13.7672	7.0358	1.4745	278.9966	58.4323	1,452.4962
2008	1,109.4186	1.0034	0.7176	13.4533	6.8704	1.4403	280.4470	53.6028	1,466.9534
2009	1,139.0402	1.1143	0.7969	13.1613	6.7157	1.4083	261.8981	54.6899	1,478.8246
2010	1,160.6703	1.0751	0.7689	12.8663	6.5595	1.3761	265.2106	52.9287	1,501.4555
2011	1,176.7888	1.0916	0.7807	12.5793	6.4058	1.3445	258.2525	53.1868	1,510.4300
2012	1,163.7460	1.1179	0.7996	12.2708	6.2443	1.3109	255.0776	53.6146	1,494.1816
2013	1,103.9166	1.2142	0.8684	11.9033	6.0604	1.2720	256.3568	53.8608	1,435.4525
2014	1,101.2941	1.2701	0.9084	11.5371	5.8782	1.2334	248.3385	53.2891	1,423.7490
2015	1,104.4973	1.2707	0.9088	13.3135	6.8029	1.4258	240.8280	54.1915	1,423.2385
2016	1,131.9612	1.2631	0.9034	13.0346	6.6672	1.3968	239.7768	54.8516	1,449.8546
2017	1,220.9072	1.4458	1.0341	14.6448	7.5036	1.5709	235.7799	56.5448	1,539.4310

Year	5A	5B		5C			5D		5. Waste
	CH_4, kt CO_2 equivalent	CH_4, kt CO_2 equivalent	N_2O, kt CO_2 equivalent	CO_2, kt	CH_4, kt CO_2 equivalent	N_2O, kt CO_2 equivalent	CH_4, kt CO_2 equivalent	N_2O, kt CO_2 equivalent	Total, kt CO_2 equivalent
2018	1,232.4760	1.3036	0.9324	14.2880	7.3280	1.5335	239.0924	58.2573	1,555.2113
2019	1,239.2098	1.3040	0.9326	13.9352	7.1574	1.4970	237.9196	58.5106	1,560.4663
2020	1,246.1821	1.4180	1.0142	13.7583	7.0563	1.4767	237.2010	58.4843	1,566.5908
1990-2020, %	12.7	4.3	4.3	-8.1	-8.2	-8.2	-32.8	-33.5	-0.4

Indirect GHG emissions, ozone and aerosol precursors (NO_x, CO, NMVOC and SO_2), from Sector 5 'Waste' were also recorded within the current inventory cycle (Table 7-4), in accordance with the methodologies available in the EMEP/EEA Air Pollutant Emission Inventory Guidebook (2019).

Table 7-4: Indirect GHG emissions from Sector 5 'Waste' in the RM between 1990-2020

	1990	1991	1992	1993	1994	1995	1996	1997
NOx	0.1503	0.1506	0.1510	0.1508	0.1512	0.1512	0.1511	0.1505
CO	2.6430	2.6451	2.6506	2.6428	2.6482	2.6451	2.6417	2.6305
NMVOC	3.1194	3.2557	3.0827	2.9041	2.7991	1.7494	1.5880	1.4614
SO_2	0.0052	0.0053	0.0053	0.0053	0.0054	0.0054	0.0054	0.0054
	1998	1999	2000	2001	2002	2003	2004	2005
NOx	0.1508	0.1502	0.1500	0.1497	0.1493	0.1488	0.1481	0.1442
CO	2.6344	2.6281	2.6204	2.6161	2.6051	2.5930	2.5791	2.5098
NMVOC	1.4245	1.3300	1.3258	1.2028	1.1999	1.0868	1.1456	1.2975
SO_2	0.0054	0.0053	0.0054	0.0054	0.0054	0.0054	0.0054	0.0053
	2006	2007	2008	2009	2010	2011	2012	2013
NOx	0.1408	0.1372	0.1339	0.1308	0.1277	0.1246	0.1214	0.1179
CO	2.4509	2.3898	2.3308	2.2748	2.2175	2.1602	2.1026	2.0438
NMVOC	1.3840	1.5403	1.6676	2.0892	2.3831	2.1659	1.9934	2.0204
SO_2	0.0051	0.0050	0.0049	0.0048	0.0048	0.0047	0.0046	0.0045
	2014	2015	2016	2017	2018	2019	2020	%
NOx	0.1144	0.1326	0.1301	0.1465	0.1432	0.1400	0.1379	-8.3
CO	1.9861	2.3124	2.2716	2.5663	2.5112	2.4607	2.4190	-8.5
NMVOC	1.9951	2.1675	2.2928	2.3021	2.0943	2.4008	2.1869	-29.9
SO_2	0.0043	0.0049	0.0047	0.0052	0.0051	0.0049	0.0049	-7.0

7.1.2. Key Categories

The results of key category analysis under Sector 5 'Waste' (Table 7-5), carried out following a Tier 1 approach, are presented in Annex 1 of this Report.

Table 7-5: Key Categories identified under Sector 5 'Waste'

IPCC Category	GHG	Source Category	Without LULUCF				With LULUCF			
			T1		T2		T1		T2	
			L	T	L	T	L	T	L	T
5A	CH_4	Solid Waste Disposal	X	X	X	X	X	X	X	X
5B	CH_4	Biological Treatment of Solid Waste								
5B	N_2O	Biological Treatment of Solid Waste								
5C	CO_2	Incineration and Open Burning of Waste								
5C	CH_4	Incineration and Open Burning of Waste								
5C	N_2O	Incineration and Open Burning of Waste								
5D	CH_4	Wastewater Treatment and Discharge	X	X	X	X	X	X	X	X
5D	N_2O	Wastewater Treatment and Discharge (Human Sewage)								

Abbreviations: L – Level Assessment; T – Trend Assessment; T1 – Tier 1; T2 – Tier 2.

7.1.3. Methodological Issues

In order to estimate GHG emissions from source categories 5A 'Solid Waste Disposal', 5B 'Biological Treatment of Solid Waste', 5C 'Incineration and Open Burning of Waste', and 5D 'Wastewater Treatment and Discharge', Tier 1 and a Tier 3 methodologies were applied, and default EFs respectively, provided by the 2006 IPCC Guidebook, as well as country-specific emission factors (Table 7-6). A detailed description of methods and EFs used to estimate emissions is available in the respective subchapters of the NIR (7.2-7.5).

Table 7-6: Estimation methods used to estimate GHG emissions from Sector 5 'Waste'

IPCC Category	Source Category	CO_2		CH_4		N_2O	
		Method	EF	Method	FE	Method	Method
5A	Solid Waste Disposal	NA	NA	T3	D, CS	NA	NA
5B	Biological Treatment of Solid Waste	NA	NA	T1	D	T1	D
5C	Incineration and Open Burning of Waste	T1	D, CS	T1	D, CS	T1	D
5D	Wastewater Treatment and Discharge	NA	NA	T1	D, CS	T1	D

Abbreviations: T1 – Tier 1; T2 – Tier 2; CS – country-specific; D – default; NA –Not Applicable; NO – Not Occurring.

7.1.4. Uncertainties and Time-Series Consistency

The uncertainty analysis of GHG emissions from the Sector 5 'Waste' (including by source category) is described in detail in subchapters 7.2-7.5, as well as in the Annex 5-3.5 of this Report. Combined uncertainties as a percentage of total direct sectoral emissions were estimated to be circa 40.67%. Uncertainties introduced in trend of total direct sectoral emissions were estimated to be circa 35.06%. In view of ensuring time-series consistency of the results, the same approach was used for the entire period under review, in conformity with the recommendations included in the 2006 IPCC Guidelines.

7.1.5. Quality Assurance and Quality Control

Standard verification and quality control forms and checklists by individual source categories were filled in for each source category under Sector 5 'Waste', following a Tier 1 approach. It should be noted that AD and methods used for the estimation of GHG emissions from Sector 5 'Waste' were documented and archived both in hard copies and electronically. In order to identify the data entry, as well GHG emission estimation-related errors, AD and EF verifications and QC procedures are constantly applied. Following the recommendations included in the 2006 IPCC Guidelines, GHG emissions from Sector 5 'Waste' were estimated based on AD and EFs from official reference sources.

7.1.6. Recalculations

GHG emissions from Sector 5 'Waste' were recalculated as a result of updating activity data utilised, particularly the population number, and due to the correction of an error identified for source categories 5A 'Solid Waste Disposal', 5C 'Incineration and Open Burning of Waste', and 5D 'Wastewater Treatment and Discharge'

In comparison with the results recorded in the previous inventory cycle, the recalculations resulted in a slight upward trend trend in direct GHG emissions for the period 1990-2019, varying between a minimum of 0.5% and a maximum of 3.9% (Table 7-7). Recalculation results are provided in the subchapters 7.2-7.5 of this Report.

Table 7-7: Recalculation results of direct GHG emissions for the period 1990-2019, included in the BUR3 of the RM to the UNFCCC (Sector 5 'Waste'), kt CO_2 equivalent

	1990	1991	1992	1993	1994	1995	1996	1997
BUR3	1,514.2369	1,548.0461	1,550.7715	1,610.0679	1,592.4783	1,590.4195	1,593.1275	1,587.6344
NC5	1,573.5058	1,604.4244	1,604.4001	1,661.8969	1,641.7795	1,637.3163	1,638.1749	1,630.4848
Difference, %	3.9	3.6	3.5	3.2	3.1	2.9	2.8	2.7
	1998	1999	2000	2001	2002	2003	2004	2005
BUR3	1,563.9087	1,559.3997	1,536.3833	1,510.4849	1,500.1442	1,467.4426	1,450.6328	1,449.1911
NC5	1,604.6693	1,598.8266	1,573.8873	1,545.9346	1,533.8650	1,499.1811	1,480.8235	1,478.4941
Difference, %	2.6	2.5	2.4	2.3	2.2	2.2	2.1	2.0
	2006	2007	2008	2009	2010	2011	2012	2013
BUR3	1,437.0182	1,425.9818	1,441.7321	1,454.8334	1,478.6343	1,488.7218	1,474.0519	1,416.3044
NC5	1,464.8920	1,452.4962	1,466.9534	1,478.8246	1,501.4555	1,510.4300	1,494.1816	1,435.4525
Difference, %	1.9	1.9	1.7	1.6	1.5	1.5	1.4	1.4
	2014	2015	2016	2017	2018	2019	2020	%
BUR3	1,405.5348	1,405.9127	1,433.0666	1,530.2502	1,546.2913	1,552.6426		
NC5	1,423.7490	1,423.2385	1,449.8546	1,539.4310	1,555.2113	1,560.4663	1,566.5908	-0.4
Difference, %	1.3	1.2	1.2	0.6	0.6	0.5		

Abbreviations: BUR3 – Third Biennial Update Report of the RM to the UNFCCC, NC5 – Fifth National Communication of the RM to the UNFCCC.

7.1.7. Assessment of Completeness

The current inventory covers direct GHG emissions from four source categories (Table 7-8).

Table 7-8: Assessment of Completeness under Sector 5 'Waste'

IPCC Category	Source Category	CO_2	CH_4	N_2O
5A	Solid Waste Disposal	NE	X	NE
5B	Biological Treatment of Solid Waste	NO	X	X
5C	Incineration and Open Burning of Waste	X	X	X
5D	Wastewater Treatment and Discharge	NE	X	X
5E	Other	NO, NE	NO, NE	NO, NE

Abbreviations: X – source categories included into the inventory; NO – Not Occurring; NE – Not Estimated; NA – Not Applicable.

7.1.8. Planned Improvements

Planned improvements at source category level within Sector 5 'Waste' are described in detail in subchapters 7.2-7.5 of this Report.

7.2. Solid Waste Disposal (Category 5A)

7.2.1. Source Category Description

The current situation regarding the management of 'Municipal Solid Waste' (MSW) in the Republic of Moldova is similar to that of other developing countries, still being under development and includes two basic elements: MSW generating sources and MSW landfills. The generating process of municipal solid waste is influenced by multiple factors, the most relevant being the population's income, consumer behaviour, the use of new packaged products, as well as the demographic evolution. The recent increase in the wellbeing of the population and the evolution of the urbanization process resulted in an increased waste generation rate per capita, varying, according to a study conducted by the World Bank, between 0.3 and 0.4 kg/per capita/day in rural areas, and 0.9 kg/per capita/per day in urban areas, respectively. This data was taken into consideration during the development of the Republic of Moldova's Waste Management Strategy for 2013-2027[116]. Food consumption currently generates more and more waste. The introduction of new packages, particularly plastic, produces a significant negative impact on the environment. The polyethylene terephthalate (PET) packaging have replaced glass packaging in recent years; whereas polyethylene (PE) sacks, bags or boxes have replaced paper packaging, thereby influencing the amount and composition of generated waste. The increasing number of markets, shops and supermarkets, along with an increase in welfare, respectively, in the purchasing power of packaged products led to a greater capacity to generate waste, particularly in urban areas. Waste generation indicators were revised in the Republic of Moldova during the feasibility studies for the development of integrated waste management systems at regional level, and the following values were proposed – for rural areas: 0.5-0.7 kg/per capita/day, and 0.9 kg/per capita/day, respectively, for small urban areas and district towns, and 1.3-1.5 kg/per capita/day for Balti and Chisinau municipalities. It should be mentioned that these calculations use AD on waste disposed provided by MSW collection services.

Currently, the most used method of treating waste is waste disposal on sites, which is often a major source of soil pollution and groundwater contamination. In this context, sanitation and waste management services are an important goal for local and governmental structures.

According to the 'State Ecological Inspectorate Yearbook for 2020", there are currently 1136 SWDS with a total area of 1220.55 ha. These sites were established in each locality by local public authorities, and are exploited according to the decision of local councils – 989 landfills with an area of 1052.60 ha.

Most of the SWDS landfills, circa ¾, do not correspond to the sanitary and ecological requirements, and the volume of domestic waste, accumulated since their establishment, is unknown. Currently, activities regarding sanitation problems of localities and separate waste collection are organised at a satisfactory level in most town halls. Thus, specialized services in waste collection and disposal exist in municipalities, all district towns, their management being carried out in an organised way through these service providers, who operate on a contract basis with individual generators. Thus, 187 service providers specialized in waste collection and disposal operated in 2020 (53 service providers in the urban sector, and 134 – in the rural sector), and 296 rural localities benefited from municipal waste-collection services.

The coverage rate of waste collection systems in urban areas is circa 75-90%, and in some district towns, urban waste collection services are provided for neighbouring rural localities: Anenii Noi (5), Chisinau (3), Cimislia (13), Floresti (14), Otaci (3), Orhei (3), Rezina (3), Sangerei (3), Soldanesti (11), Telenesti (5), Ungheni (9).

[116] <http://lex.justice.md/index.php?action=view&view=doc&lang=1&id=347341>

In rural areas, approximately 15-20% of the population is provided with waste collection services, and a part of the service providers extend their activity to neighbouring localities. They also extend their service from urban areas to rural areas, and the volume of waste collected is thereby increasing. Consequently, the waste generation rate per capita will have a marginal upward trend, an annual average growth by 2.5% between 2021 and 2030 being anticipated, and by 1% between 2031 and 2035 for rural and urban areas.

There is no statistical evidence carried out on the volumes of previously accumulated waste in landfills, there are only visual estimates of environmental inspectors, who estimate the total volume of MSW accumulated in landfills at about 30-35 million tonnes. In most district towns, the landfills are overfilled, the disposed waste layer being circa 10-15 metres (e.g., in Ungheni, Cahul, Ocnita, etc.); the layer may reach circa 10-20 metres at some landfills (e.g., in Briceni, Balti, Ialoveni, etc.); and even circa 25-30 metres (Cretoaia and Orhei municipality). Circa ¾ of the landfills of district towns have been used for circa 30-40 years, being at over 80% of their capacity.

There have been changes in waste management in Chisinau municipality in recent years. The landfill situated in Tintareni commune, which serves Chisinau municipality, became operational by the end of 1990 (the de facto exploitation began in 1991); this landfill has an area of about 24.95 ha, the net area being 20.89 ha.

According to the project, it was designed to store circa 44 million m^3 of MSW until the end of 2010.

By 2011, when its operation was discontinued, only 19 million m^3 of solid waste were stored, which is less than half the capacity of the landfill.

From 2011 to 2017, Chisinau municipality stored its waste near the waste trans-shipment station, located in Bubuieci village. The new location, treated as a temporary solution, became a serious environmental problem since waste was disposed on an unmanaged land, lacking environmental protection measures such as sealed foundation, collection and treatment of leachate, rainwater deviation, etc.

Since summer 2017, Chisinau municipality has recommenced storing its waste at the Tintareni landfill, after negotiating the conditions for reusing the landfill with the local public authorities, including the solutions for environmental protection problems.

Between 2018 and 2019, measures were taken to recultivate and remedy the environmental pollution caused by the landfill, located near the waste trans-shipment station in Bubuieci village.

Also, the leachate treatment station at the Tantareni landfill was recently established (November 2020), together with the protection dam of the landfill.

Figure 7-3: Landfill in Tantareni commune and the leachate treatment facility.

The impact of waste on the environment has alarmingly increased in recent years, and its mismanagement leads to contamination of soil and groundwater, as well as CH_4, CO_2, and toxic gas emissions with direct effects on public health and the environment.

Between 1990 and 2020, methane emissions from source category 5A 'Solid Waste Disposal' increased by circa 12.7%, from circa 44.23 kt in 1990, to circa 49.84 kt in 2020 (Figure 7-4).

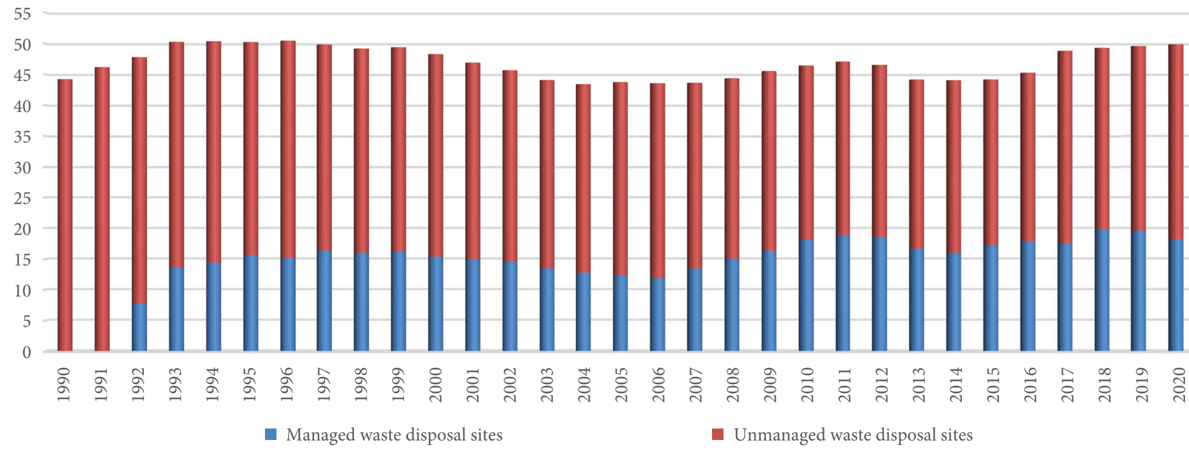


Figure 7-4: Evolution of CH_4 emissions from source category 5A 'Solid Waste Disposal' between 1990-2020.

7.2.2. Methodological Issues, Emission Factors and Data Sources

In order to estimate methane emissions from solid waste disposal, the 2006 IPCC Guidelines recommends using the First Order Decay Method, with three alternative methodological approaches – Tier 1, 2 and 3; the Tier 1 method mainly uses activity data and default EFs; the Tier 2 method implies the partial application of default emission factors, requiring country-specific activity data on waste disposal at SWDS for historical periods longer than 10 years; the Tier 3 method uses national statistical data on solid waste disposal for more relevant periods (e.g., longer than 25 years), with country-specific emission factors and relevant parameters resulting from measurements and research conducted periodically at national level (e.g., DOC fraction or degradable organic carbon in year x; DOC_f fraction or DOC fraction dissimilated; L_o – methane generation potential, etc.).

Estimation Method

In the Republic of Moldova, methane emissions from 5A 'Solid Waste Disposal' were estimated using the First Order Decay Method (IPCC FOD), with a Tier 3 approach.

Methane emissions were estimated using Equation 3.1 from the 2006 IPCC Guidelines (Volume 5, Chapter. 3, page 3.8):

$$CH_4\ Emissions = [\Sigma_x\ CH_4\ generated_{x,T} - R_T] \bullet (1 - OX_T)$$

Where:

- CH_4 Emissions – amount of methane generated in year T, kt;
- T – inventory year;
- x – waste category or type/material;
- R_T – recovered methane in year T, kt;
- OX_T – oxidation factor in year T (fraction).

One key input in the IPCC FOD model is the amount of degradable organic matter (DOCm) in waste disposed into SWDS (Solid Waste Disposal Sites). This value is estimated using data on disposal of different waste categories (MSW – Municipal Solid Waste, sludge, industrial and other waste) and the different waste types/material (food, paper, wood, textiles, etc.) included in these categories, or alternatively as mean DOC in bulk waste disposed.

The basis for the estimation of methane emissions is the amount of Decomposable Degradable Organic Carbon – DDOCm). DDOCm is the part of the organic carbon that will degrade under anaerobic conditions in SWDS.

The amount of DDOCm (where the index m is used for mass) is calculated using Equation 3.2 provided by the 2006 IPCC Guidelines (Volume 5, Chapter 3, page 3.9):

$$DDOCm = W \bullet DOC \bullet DOCf \bullet MCF$$

Where:

DDOCm – mass of decomposable DOC deposited, kt;

W – mass of waste deposited, kt;

DOC – degradable organic carbon in the year of deposition, fraction, kt C / kt waste;

DOCf – fraction of DOC that can decompose (fraction);

MCF – CH_4 correction factor for aerobic decomposition in the year of deposition (fraction).

Using DDOCm, the methane generation potential (L_o) can be estimated by applying Equation 3.3 provided by the 2006 IPCC Guidelines (Volume 5, Chapter 3, Page 3.9):

$$L_o = DDOCm \bullet F \bullet 12/16$$

Where:

Lo – CH_4 generation potential, kt CH_4;

DDOCm – mass of decomposable DOC, kt;

F – fraction of CH_4 in generated landfill gas (volume fraction);

16/12 – molecular weight ratio CH_4/C (ratio), used for the conversion of C to CH_4.

DDOCm accumulated in SWDS at the end of year T can be estimated using Equation 3.4 provided by the 2006 IPCC Guidelines (Vol. 5, Chapter. 3, Page 3.9), while DDOCm decomposed at the end of year T, by using Equation 3.5 respectively, provided by the 2006 IPCC Guidelines (Volume 5, Chapter 3, Page 3.9).

$$DDOCma_T = DDOCmd_T + (DDOCma_{T-1} \bullet e^{-k})$$

$$DDOCm\ decomp_T = DDOCma_{T-1} \bullet (1- e^{-k})$$

Where:

T – inventory year;

$DDOCma_T$ – DDOCm accumulated in the SWDS at the end of year T, kt;

$DDOCma_{T-1}$ – DDOCm accumulated in the SWDS at the end of year T-1, kt;

$DDOCmd_T$ – DDOCm deposited into the SWDS in year T, kt;

DDOCm decomp $_T$ – DDOCm decomposed in the SWDS in year T, kt;

k – constant, $k = \ln(2)/t_{1/2}$ (y^{-1});

$t_{1/2}$ – half-life time (y).

The amount of methane formed from decomposable material can be found by using Equation 3.6 provided by the 2006 IPCC Guidelines (Volume 5, Chapter 3, Page 3.10):

$$CH_4\ generated_T = DDOCm\ decomp_T \bullet F \bullet 16/12$$

Where:

CH_4 generated in year $_T$ – amount of CH_4 generated from decomposable material;

DDOCm decomp $_T$ – DDOCm decomposed in year T, kt;

F – fraction of CH_4, by volume, in generated landfill gas (fraction);

16/12 – molecular weight ratio CH_4/C, used for the conversion of C to CH_4.

Emission Factors

Degradable organic carbon (DOC) is the organic carbon in waste that is accessible to biochemical decomposition and can be calculated using Equation 3.7 provided by the 2006 IPCC Guidelines (Volume 5, Chapter 3, page 3.13):

$$DOC = \Sigma_i (DOC_i \bullet W_i)$$

Where:

DOC – fraction of degradable organic carbon in bulk waste, kt C/kt solid waste;

DOC_i – fraction of degradable organic carbon in waste type *i* (e.g., the default value for paper is 0.4 (wet weight basis);

DOC_i – fraction of degradable organic carbon in waste type *i* (e.g., the default value for paper is 0.4 (wet weight basis);

W_i – fraction of waste type *i* by waste category (e.g., the default value for paper in MSW in Eastern Europe is 0.218 (wet weight basis).

The default DOC values for these fractions for MSW can be found in Table 2.4 in the 2006 IPCC Guidelines (Volume 5, Chapter 2, Page 2.14), whereas for industrial waste by industry in Table 2.5 in the 2006 IPCC Guidelines (Volume 5, Chapter 2, Page 2.16). A similar approach can be used to estimate the DOC content in total waste disposed in the country annually. In the IPCC FOD model, the estimation of the DOC in MSW is needed only for the bulk waste option, and constitutes the average DOC for the MSW disposed in the SWDS, including inert materials.

The inert part of the waste (glass, plastics, metals and other non-degradable waste (see default values in Table 2.3 in the 2006 IPCC Guidelines (Vol. 5, Chapter. 2, Pages 2.12-2.13) is relevant when estimating the total amount of DOC in MSW. It is thereby good practice in this exercise to consider country-specific values of the share of inert waste in MSW to the detriment of default values, which probably do not entirely consider the country's cational circumstances.

Country-specific values can be obtained by performing waste generation studies, sampling at SWDS to identify solid waste generation rates combined with the analysis of the degradable carbon content solid waste generated.

Methane Correction Factor (MCF)

The Methane Correction Factor (MCF) refers to the effect of solid waste management practices on the generation of methane emissions. Unmanaged SWDS produce less CH_4 from a given amount of waste than anaerobic managed SWDS since a larger fraction of waste decomposes aerobically in the top layer in the respective disposal sites. Table 7-9 presents the default values of the MCF for different types of SWDS.

Table 7-9: MCF values used to estimate CH_4 emissions from Solid Waste Disposal Sites

Type of sites	MCF	MCF used in the Republic of Moldova
Managed – anaerobic[1]	1.0	Chisinau municipality, for the period 1991-2020
Managed – semi-aerobic[2]	0.5	NA
Unmanaged – deep (> 5 m)[3]	0.8	Chisinau municipality, until 1990. Balti Municipality and district towns
Unmanaged – shallow (< 5 m)[4]	0.4	Rural Areas in the Republic of Moldova
Uncategorised SWDS[5]	0.6	NA

Notes: [1]1Anaerobic managed solid waste disposal sites include the following: cover material, mechanical compacting or levelling of solid waste; [2]Semi-aerobic managed solid waste disposal sites include the following: permeable cover material, leachate drainage system, regulating pondage and gas ventilation system; [3]Unmanaged solid waste disposal sites – deep include all SWDS not meeting the criteria of managed SWDS and which have depths of greater than or equal to 5 metres and/or high water table at near ground level; [4]Unmanaged solid waste disposal sites – shallow include all SWDS not meeting the criteria of managed SWDS and which have depths of less than 5 metres; [5]Uncategorised solid waste disposal sites – only if countries cannot categorise their SWDS into above four categories of managed and unmanaged SWDS, the MCF for this category can be used.

Degradable Organic Carbon (DOC)

Degradable organic carbon (*DOC*) is the organic carbon that is accessible to biochemical decomposition. It is based on the composition of waste and can be calculated from a weighted average of the carbon content of various components of the waste stream – cardboard, textiles, waste from gardens, parks and other non-food waste, food waste and wood waste.

Based on waste morphological composition studies performed between 1986 and 2016, country-specific DOC values were calculated. Figure 7-5 illustrates the share of biodegradable fractions in the waste stream in the RM, indicating a decrease from circa 77.0% in 1986 to circa 54.0% in 2001, with a further increase to circa 72.4% in 2005, and a subsequent decrease to circa 58.9% in 2016.

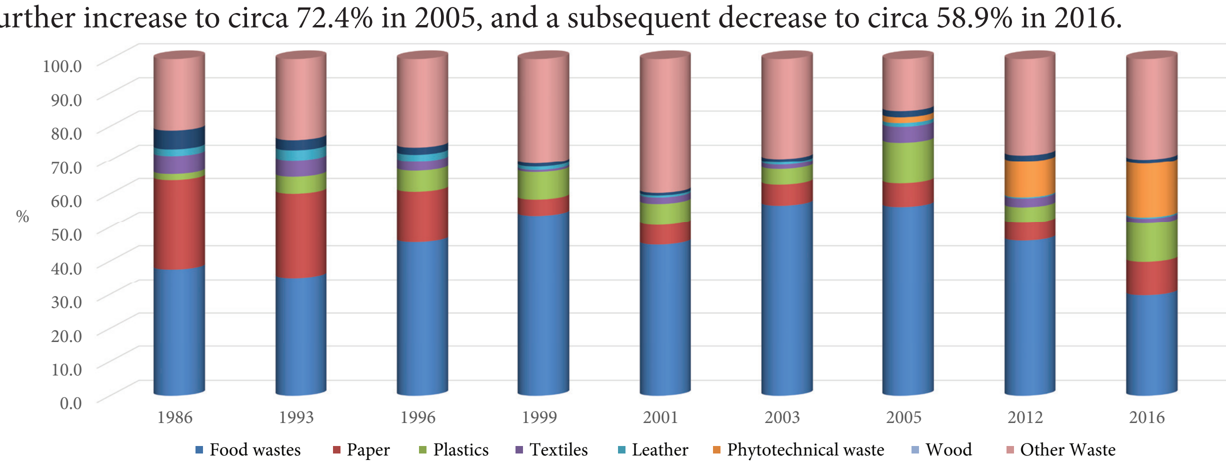


Figure 7-5: Biodegradable waste in the Major Waste Streams in the RM between 1986-2016.

No new studies on the solid waste morphological composition were conducted in the current inventory cycle. A new study for 2020 and 2021 is envisaged so as to determine the morphological composition of municipal waste in the next inventory cycle.

Fraction of Degradable Organic Carbon Which Decomposes (DOC_f)

DOC_f is the fraction of Degradable Organic Carbon, which is then converted to biogas and reflects the fact that part of the carbon either decomposes or decomposes extremely slowly in SWDS. It is considered that the DOC_f value is dependent of the temperature in the anaerobic area of the site, revealed by the following relation: 0.014T + 0.28 (Tabasaran, 1981). The recommended default value in the 2006 IPCC Guidelines (Volume 5, Chapter 3, page 3.13) is 0.5. In the RM, the country-specific values for DOC and DOC_f fractions (Table 7-10) were calculated using the 'MSW Learning Tool' developed by the University of Florida (1996) based on the laboratory experiments conducted by Dr Morton Barlaz (1987, 1997) and further investigations by Chandler, Van Soest (1980).

Table 7-10: Country-specific values for DOC and DOC_f fractions used to estimate CH_4 emissions from SWDS for 1986-2016

	1986	1993	1996	1999	2001	2003	2005	2012	2016
DOC_f	0.5178	0.5258	0.5667	0.6353	0.6207	0.6277	0.5935	0.4985	0.4204
DOC	0.2069	0.1891	0.1522	0.1091	0.1009	0.1201	0.1410	0.1405	0.1475

Fraction of CH_4 in Generated Landfill Gas (F)

The 2006 IPCC Guidelines (Volume 5, Chapter 3, page 3.15) recommends the use of a default 0.5 value for the fraction of CH_4 in landfill gas (*F*). Still, it is known that the *F* value can vary between 0.4 and 0.6, depending on several factors which can influence the process of decomposition of solid household waste, including the morphological composition of MSW (Bingemer, Crutzen, 1987).

In the Republic of Moldova, the biogas composition was estimated based on the Buswell extended equation (Table 7-11 and Figure 7-6), using AD on the MSW morphological composition eliminated by storage, which also served as the basis to estimate *DOC* and DOC_f values.

Table 7-11: Country-specific values on biogas composition in landfill gas in the RM for 1986-2016, based on extended Buswell equation, %

	1986	1993	1996	1999	2001	2003	2005	2012	2016
$C \rightarrow CH_4$	53.1	54.0	54.5	55.4	55.1	54.5	55.6	54.2	55.2
$C \rightarrow CO_2$	46.9	46.0	45.5	44.6	44.9	45.5	44.4	45.8	44.8

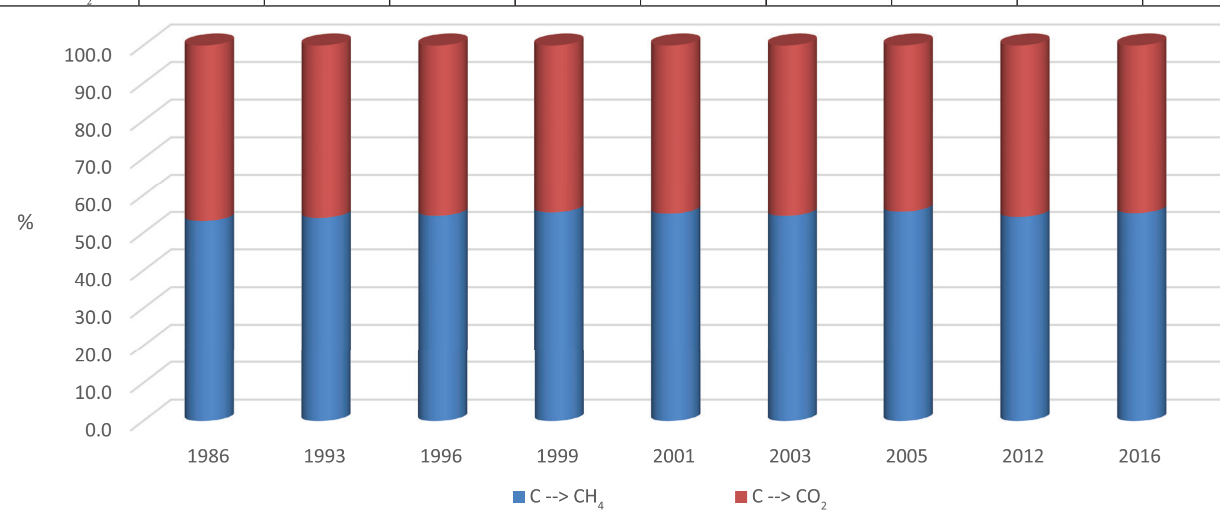


Figure 7-6: Biogas composition in landfill gas in the Republic of Moldova between 1986-2016 periods, based on Extended Buswell equation.

At the same time, between 2000 and 2005, several studies were conducted in the RM on biogas composition emitted at landfills in the country, including those in Cretoaia commune, Anenii Noi district. Table 7-12 presents the results of the studies.

Table 7-12: Fractions of gases in the landfill gas composition in different SWDS in the Republic of Moldova, compared to similar values in SWDS in developed and developing countries

Gas	Landfill gas composition in developed countries, %	Landfill gas composition in developing countries, %	Landfill gas composition in Cretoaia, %	Landfill gas composition in Balti, %	Landfill gas composition in Straseni, %
CH_4	40-60	33-88	60-70[1]/ 63-65[2]	75-85	23-43
CO_2	40-60	35-89	15-18[1]/ 32-34[2]	14-19	20-22
N_2	2.4-5.0	87	7-19	11-38	38-69
O_2	0.16	20.9	1-8[1]/ 0.5-1[2]	0.5-16	0.5-19

Note: [1]results obtained by national experts; [2]results obtained by DEPA (Danish Environment Protection Agency) experts.

Methane Recovery (R)

CH_4 generated at SWDS can be recovered and combusted (with or without energy recovery). The amount of methane recovered is expressed as *R* in Equation 3.1 from the 2006 IPCC Guidelines (Volume 5, Chapter 3, Page. 3.8). The default value for CH_4 recovery is zero. CH_4 recovery should be reported only when references documenting the amount of CH_4 recovery are available for SWDS in country.

As for Republic of Moldova, AD on methane recovered and combusted at the SWDS in Tintareni (2.5199 kt of biogas in 2013, 2.9058 kt biogas in 2014, 3.1665 kt biogas in 2015 and 3.3898 kt biogas in 2016) were provided by the project document CDM 'PDD Landfill Gas Recovery and Energy Production at the Tintareni Landfill Site, Chisinau, Moldova'. Indirectly, the information can also be deduced from the Annual Reports on the activity of the National Agency for Energy Regulation[117] (which contains activity data on the amount of electricity generated annually from the biogas recovered at the SWDS in Tintareni by 'Tevas Grup' Ltd., which managed the respective site).

After the reopening of the landfill in 2017, new amounts of waste were deposited on its territory, requiring maintenance and management of the landfill. At the same time, the biogas recovery activity was interrupted, which led to the decommissioning of the biogas recovery system, previously installed on the landfill. Since 2017, the data on the amount of electricity generated annually from the biogas recovered at the SWDS landfill in Tantareni by the company 'Tevas Grup' Ltd. is no longer found in the reports of the National Agency for Energy Regulation.

Oxidation Factor (OX)

The oxidation factor (OX) reflects the amount of methane from SWDS that is oxidised in the soil or other material covering the waste. If the OX is zero, methane oxidation does not occur but should the value of the oxidation factor be 1, methane oxidation represents 100%. Well-managed SWDS tend to have higher oxidation rates, whereas unmanaged landfills have a lower oxidation factor. The default value for the oxidation factor is zero, according to the 2006 IPCC Guidelines (Volume 5, Chapter 3, page 3.15) (Table 7-13).

Table 7-13: Oxidation factor

Type of SDWS	Oxidation Factor (OX)
Managed[1], unmanaged and uncategorised SWDS	0.0
Unmanaged, covered with CH_4 oxidising material[2]	0.1

Note: [1]Managed but not covered with aerated material; [2]e.g: soil or compost.

Constant k and half-life $t_{1/2}$

The half-life value $t_{1/2}$ is the time taken for the DOC_m in waste to decay to half its initial mass. The relationship between the constant k and $t_{1/2}$ is the following: $k = \ln(2)/t_{1/2.}$ The half-life is affected by a wide variety of factors related with the composition of waste, climatic conditions at the site where the SWDS is located, characteristics of the SWDS, waste disposal practices and others, etc. The most rapid rates (k = 0.2 or $t_{1/2}$ = 3 years are associated with food waste in high moisture conditions, respectively the slower decay rate (k = 0.02 or $t_{1/2}$ = 35 years) for wood or paper waste slowly degradable associated with dry site conditions. There are two alternative approaches to select the half-life (or K value) for the calculations: calculate a weighted average for $t_{1/2}$ for mixed MSW or divide the waste stream into categories of waste according to their degradation speed. The default values used for the constant *k* as well as the half-life value $t_{1/2}$ are available in Tables 3.3 and 3.4 in the 2006 IPCC Guidelines (Volume 5, Chapter 3, Pages 3.17 and 3.18).

[117] <http://anre.md/ro/reports/8>

NMVOC Emissions

NMVOC emissions from SWDS were estimated using the methodological approach available in the EMEP/EEA Air Pollutant Emission Inventory Guidebook (2019):

$$NMVOC\ Emissions = W \bullet EF \bullet 10^{-6}$$

Where:

NMVOC Emissions – NMVOC emissions in inventory year, kt/yr;

W – amount of solid waste disposed, kt/yr;

EF – emission factor, kg NMVOC / kt of waste (default value used, 1.56 kg NMVOC/t of solid waste, available in the EMEP/EEA Air Pollutant Emission Inventory Guidebook (2019), Category 5A 'Biological treatment of waste – solid waste disposal on land', Table 3-1, p. 5);

10^{-6} – conversion factor, from kg to kt.

Data Sources

In the previous inventory cycle, multiple statistical sources on solid waste management records were examined, such as, Statistical Forms: F-1 'Toxic Waste' and F-2 'Waste' and Statistical Form 'Special Road Transport'; whereas since 2003, also the Statistical Form No. 2-gc 'Urban Settlement Sanitation' approved by the Order of the Department of Statistics and Sociology, No. 83, dated 01.08.2003, which reflects the amount of MSW disposed.

The performed analyses revealed that only municipal solid waste is being transported to dumps by means of waste collection services, while other organic types of waste such as waste from food processing industry, from animal breeding and phytotechnical waste disposed are not included in Statistical Form Nr. 2-gc 'Urban Settlements Sanitation', because they are disposed by the beneficiary's own transport. Under these circumstances, data on the amount of waste from the food processing industry, from animal breeding and phytotechnical waste disposed were collected through Statistical Form F-2 'Waste'. Considering the trends in the activity data collected through the statistical form F-2 'Waste' between 2007 and 2012, it was decided to infer a conversion coefficient from municipal waste into industrial waste for the period 1990-2020. The downward trend of the coefficient from 0.8 to 0.4 is justified by the economic decline that the country experienced between 1990 and 1999, as well as the increase in the amount of municipal waste. In the current inventory cycle, the same approach was used in the collection of activity data, for municipal and industrial waste, using the information on the disposal of MSW reported through Statistical Form no. 2-gc 'Sanitation of urban localities'.

Table 7-14 refers only to the urban landfills where there are waste collection services operate and provides activity data to the National Bureau of Statistics of the Republic of Moldova. Historical AD for the period 1959-1984 were deduced based on the population number, the socio-economic development conditions as well as waste generation trends. At the same time, the average value of the MCF was estimated considering SWDS characteristics, such as managed or unmanaged SWDS and the depth of the disposed waste layer. By the end of 1990, the landfill in Cretoaia commune had become operational for Chisinau municipality (de facto use of this landfill started in 1991), while GHG emissions generated by this landfill began in 1992, using the MCF = 1.

Table 7-14: AD on the amount of MSW and industrial waste disposed at SWDS in the RM between 1959-2020

	Total	MSW			D_{ind}, kt	SWDS			Average MCF F
	MSW + D_{ind}, kt	Total, kt	Inert waste, kt	Without inert waste, kt		Managed, MCF=1.0	Unmanaged, >5 m, MCF=0.8	Unmanaged, <5 m, MCF=0.4	
1959	595.26	357.16	103.56	253.60	238.11	0.0	10.0	90.0	23.4
1960	626.59	375.96	109.01	266.95	250.64	0.0	10.0	90.0	23.6
1961	659.57	395.74	114.75	280.99	263.83	0.0	15.0	85.0	23.8
1962	694.29	416.57	120.79	295.79	277.71	0.0	15.0	85.0	24.1
1963	730.83	438.50	127.17	311.33	292.33	0.0	15.0	85.0	24.3
1964	769.29	461.58	133.84	327.74	307.72	0.0	15.0	85.0	24.6
1965	809.78	485.87	140.88	344.99	323.91	0.0	15.0	85.0	24.8
1966	852.40	511.44	148.31	363.13	340.96	0.0	20.0	80.0	25.1
1967	897.26	538.36	156.11	382.25	358.91	0.0	20.0	80.0	25.4
1968	944.49	566.69	164.31	402.38	377.80	0.0	20.0	80.0	25.7
1969	994.20	596.52	172.90	423.62	397.68	0.0	20.0	80.0	26.1

	Total	MSW			D_{ind}, kt	SWDS			Average MCF F
	MSW + D_{ind}, kt	Total, kt	Inert waste, kt	Without inert waste, kt		Managed, MCF=1.0	Unmanaged, >5 m, MCF=0.8	Unmanaged, <5 m, MCF=0.4	
1970	1046.53	627.92	182.09	445.82	418.61	0.0	20.0	80.0	26.4
1971	1162.81	697.68	202.30	495.38	465.12	0.0	25.0	75.0	27.2
1972	1224.01	734.40	212.98	521.43	489.60	0.0	25.0	75.0	27.6
1973	1288.43	773.06	224.19	548.87	515.37	0.0	25.0	75.0	28.0
1974	1356.24	813.74	235.97	577.77	542.50	0.0	25.0	75.0	28.4
1975	1427.62	856.57	248.44	608.13	571.05	0.0	25.0	75.0	28.9
1976	1502.76	901.66	261.46	640.19	601.10	0.0	30.0	70.0	29.4
1977	1581.85	949.11	275.24	673.87	632.74	0.0	30.0	70.0	29.9
1978	1665.11	999.06	289.73	709.34	666.04	0.0	30.0	70.0	30.4
1979	1752.74	1051.65	306.12	745.52	701.10	0.0	30.0	70.0	31.0
1980	1844.99	1014.75	294.26	720.48	830.25	0.0	35.0	65.0	31.2
1981	1892.30	1040.77	301.80	738.96	851.54	0.0	35.0	65.0	31.5
1982	1940.82	1067.45	309.55	757.91	873.37	0.0	35.0	65.0	31.9
1983	1990.59	1094.82	317.49	777.33	895.76	0.0	35.0	65.0	32.2
1984	2041.63	1122.89	325.64	797.25	918.73	0.0	35.0	65.0	32.5
1985	2093.98	1163.32	337.36	825.96	930.66	0.0	40.0	60.0	32.9
1986	2236.52	1242.51	360.33	882.18	994.01	0.0	40.0	60.0	33.8
1987	2217.94	1232.19	357.34	874.85	985.75	0.0	40.0	60.0	33.7
1988	2307.89	1282.16	371.83	910.33	1025.73	0.0	45.0	55.0	34.2
1989	2414.81	1341.56	389.04	952.53	1073.25	0.0	45.0	55.0	34.9
1990	2311.52	1359.72	394.31	965.41	951.80	0.0	45.0	55.0	34.6
1991	2204.61	1377.88	399.56	978.32	826.73	0.0	45.0	55.0	34.2
1992	2156.28	1437.52	416.88	1020.65	718.76	16.3	30.0	53.7	34.3
1993	1279.31	719.41	208.63	510.78	559.90	27.2	30.0	42.8	27.9
1994	1161.65	670.52	194.45	476.07	491.14	28.6	30.0	41.4	27.3
1995	1070.97	632.19	183.34	448.85	438.78	31.1	30.0	38.9	26.8
1996	1074.35	651.73	208.42	443.31	422.62	30.0	30.0	40.0	26.9
1997	1003.87	613.00	196.16	416.84	390.87	32.8	30.0	37.2	26.4
1998	1003.69	618.92	198.05	420.87	384.77	32.5	30.0	37.5	26.5
1999	947.81	580.75	220.67	360.08	367.06	32.9	30.0	37.1	26.1
2000	924.55	523.80	199.04	324.76	400.74	31.8	30.0	38.2	25.8
2001	867.26	475.49	213.98	261.52	391.77	31.9	30.0	38.1	25.4
2002	926.28	522.07	235.22	286.85	404.22	32.0	30.0	38.0	25.8
2003	975.80	548.08	186.35	361.73	427.72	30.6	30.0	39.4	26.1
2004	1041.40	575.44	195.64	379.80	465.96	29.4	30.0	40.6	26.5
2005	1109.58	602.50	162.68	439.83	507.08	28.3	30.0	41.7	26.9
2006	1205.78	653.59	176.47	477.12	552.18	27.2	35.0	37.8	27.5
2007	1529.12	847.37	228.77	618.60	681.74	30.8	35.0	34.2	29.6
2008	1760.41	1003.42	270.92	732.50	756.99	33.8	35.0	31.2	31.1
2009	1651.91	1114.28	300.86	813.42	537.63	35.8	35.0	29.2	31.2
2010	1531.58	1075.06	290.27	784.80	456.52	39.0	35.0	26.0	30.5
2011	1554.28	1091.58	294.73	796.84	462.70	40.1	35.0	24.9	30.7
2012	1590.83	1117.94	346.55	771.39	472.89	40.0	35.0	25.0	31.0
2013	1726.60	1214.21	376.40	837.81	512.39	37.8	35.0	27.2	31.9
2014	1824.88	1270.13	393.73	876.40	554.75	36.3	35.0	28.7	32.5
2015	1826.90	1270.69	393.92	876.78	556.21	39.1	35.0	25.9	32.5
2016	1818.37	1263.09	517.87	884.16	555.28	39.5	35.0	25.5	32.5
2017	2090.53	1445.83	592.79	1012.08	644.71	35.8	35.0	29.2	34.3
2018	1895.71	1303.63	534.49	912.54	592.08	40.1	35.0	24.9	33.0
2019	1913.57	1304.11	534.69	977.53	609.46	39.6	35.0	25.4	33.8
2020	2075.53	1417.93	581.35	836,58	657,6	36.5	35.0	28.48	33.3

Since 2001, trends in waste generation per capita are steadily growing, and this level even exceeded the level recorded in the early 1990s in Chisinau municipality. Thus, in 1990, only 20% of the waste was generated in Chisinau city; whereas in the last four or five years, the share of Chisinau city in the total share of waste disposed at SWDS already constitutes circa 30%.

7.2.3. Uncertainties and Time-Series Consistency

For countries with efficient statistical systems, the 2006 IPCC Guidelines recommends the use of a value of circa 10-30% of uncertainties associated with AD, whereas for countries with poor quality data, uncertainties can be of a factor of two. In the Republic of Moldova, it was deemed rational to use the value of ±30% for uncertainties associated with managed and unmanaged MSW. It was taken into consideration that some types of waste (e.g., waste from the food processing industry, which account for approximately 10% of the total amount of MSW generated in the country) were not completely taken into account while estimating methane emissions from category 5A 'Solid Waste Disposal'. Considering the results of the studies undertaken in the Republic of Moldova to identify the MSW morphological composition, (*DOC and* DOC_f), and the study of biogas composition (CH_4 fraction in biogas), it was deemed appropriate to use the value of ±40% for the uncertainties associated with the emission factors. Therefore, combined uncertainties for category 5A 'Solid Waste Disposal' constitute circa 50% (Annex 5-3.5).

In view of ensuring time series consistency of results, the same approach was used for the entire period under review, in conformity with good practices applied in the GHG emissions inventory.

7.2.4. Quality Assurance and Quality Control

Standard verification and quality control forms and checklists were filled in for the category 5A 'Solid Waste Disposal' following a Tier 1 approach. Verification was focused on various aspects such as: ensuring correct use of the default emission factors available in the 2006 IPCC Guidelines; use of country-specific factors; correct use of AD obtained from different reference sources, etc. It should be noted that the AD and methods used for the estimation of GHG emissions from the category 5A 'Solid Waste Disposal' were documented and archived both in hard copies and electronically.

7.2.5. Recalculations

GHG emissions from category 5A 'Solid Waste Disposal' were recalculated in the current inventory cycle for the entire period 1990-2020 as a result of an error identified in the calculation model for CH_4 emissions (in the calculation formula, the link to a calculation parameter was incorrectly indicated, which caused a consecutive error for the entire time series). Concomitantly, the value of inert waste was updated for the period 2016-2019, from 31% to 41%, according to the morphological composition of waste).

Table 7-15: Comparative results of CH_4 emissions from category 5A 'Solid Waste Disposal' included in the BUR3 and NC5 of the RM to the UNFCCC, kt CO_2 equivalent

	1990	1991	1992	1993	1994	1995	1996	1997
BUR3	1046.728	1098.618	1141.956	1204.718	1209.801	1209.176	1216.783	1203.802
NC5	1105.997	1154.997	1195.585	1256.547	1259.102	1256.072	1261.830	1246.652
Difference, %	5.7	5.1	4.7	4.3	4.1	3.9	3.7	3.6
	1998	1999	2000	2001	2002	2003	2004	2005
BUR3	1189.354	1195.227	1169.533	1137.474	1108.061	1070.233	1055.151	1064.308
NC5	1230.115	1234.654	1207.037	1172.924	1141.781	1101.972	1085.342	1093.611
Difference, %	3.4	3.3	3.2	3.1	3.0	3.0	2.9	2.8
	2006	2007	2008	2009	2010	2011	2012	2013
BUR3	1061.843	1064.822	1084.197	1115.049	1137.849	1155.081	1143.616	1084.769
NC5	1089.717	1091.336	1109.419	1139.040	1160.670	1176.789	1163.746	1103.917
Difference, %	2.6	2.5	2.3	2.2	2.0	1.9	1.8	1.8
	2014	2015	2016	2017	2018	2019	2020	%
BUR3	1083.080	1087.171	1115.173	1211.726	1223.556	1231.588		
NC5	1101.294	1104.497	1131.961	1220.907	1232.476	1239.210	1246.182	12.7
Difference, %	1.7	1.6	1.5	0.8	0.7	0.6		

Abbreviations: BUR3 – Third Biennial Update Report of the RM to the UNFCCC, NC5 – Fifth National Communication of the RM to the UNFCCC.

7.2.6. Planned Improvements

From the sustainable development perspective as well as from the European Union integration perspective, a new approach is needed to address environmental issues, in accordance with the commitments under the ratified international conventions and agreements.

Among the main priorities of the EU strategy on waste management is the need to promote statistical evidence on the generated waste, the main criterion being relevance and comparability among member states. Thus, between 2018 and 2020, several legislative acts were adopted for the coherent application of Law No. 209/2016 on waste, and it was deemed appropriate to adopt the Resolution of the EU Commission 2000/532/EC on the waste list, including hazardous waste through Government Decision regarding the approval of the Waste List No. 99/2018.

At the same time, the approach to records in the field of waste management was reviewed by approving Government Decision No. 501/2018 on the Instruction on keeping records and transmitting data on waste and its management, Government Decision No. 682/2018 on the approval of the Concept of the Automated Waste Management Information System, through which the reporting system www.siamd.gov.md was developed.

It must be acknowledged, however, that 2020 was the first reporting year in the new system and the information collected does not reflect the actual situation in the field of waste management. Thus, for example, the volumes of MSW generated in rural localities are not subject to statistical records, as there are usually no waste collection services. Likewise, albeit there are waste processing companies operating in the Republic of Moldova, the information on the amounts of recycled waste is not subject to strict statistical records. Considering the tendency of the Republic of Moldova to align with EU standards, the sector is to be essentially restructured. In this context, most MSW sites are to be recultivated, and their number – drastically reduced.

Transformation coefficient of the volume of MSW into quantity

With respect to the development of the Biennial Transparency Report of the Republic of Moldova to the UNFCCC, activity data will be updated in the next inventory cycle, particularly the revison of the transformation coefficient of the volume of MSW into quantity needs. Upward trends have been recorded in recent years in the share of packaging in the total amount of waste generated per capita, and the Sanitation Service in Chisinau shows that 1 m^3 of MSW constitutes 180-200 kg, which means that the MSW coefficient 0.4 kg/1 m^3 will be revised.

In the next period, we shall analyse the AD reported in the Automated Information System, in the National Register of Emissions and Transfer of Pollutants, and in the Automated Waste Management Information System, by the waste collection systems in the country.

Morphological Composition of MSW

It is also proposed, with the involvement of the Environmental Reference Laboratory of the Environment Agency, to update the study on the morphological composition of solid waste, solid waste generated in Chisinau, and in the cities of Causeni and Straseni, respectively.

It will also be necessary to include the weighing of waste trucks in order to infer the transformation coefficient of the volume of MSW into quantity.

Another aspect that needs to be mentioned is the fact that recently, June 2020, Law No. 89 was approved on the ratification of the Financing Agreement between the Republic of Moldova and the European Investment Bank regarding the implementation of the project 'Solid Waste in the Republic of Moldova'. Through this agreement, signed on October 18, 2019 between the European Investment Bank and the Government of the Republic of Moldova, a loan of 100 million euros will be granted for the improvement of solid waste management services in the country. The loan will be offered in several instalments, the first instalment being 25 million euros. This Agreement aims to implement the Waste Management Strategy 2013-2027 in the Republic of Moldova, involving projects aimed at modernizing and developing Solid Waste Management Systems and facilities in eight regions of our country. The projects will provide localities with new collection systems, mechanical-biological waste treatment facilities and new regional sanitary landfills for the entire country. The projects will aim to reduce the negative impact on the environment and human health, by modernizing waste collection systems and separate collection of recyclable materials and bio-waste, as well as rehabilitating or closing landfills. Regional landfills will be equipped with biogas recovery systems, which will contribute to the reduction of GHG emissions and therefore to the achievement of the updated NDC, in accordance with the provisions of the Paris Agreement.

7.3. Biological Treatment of Solid Waste (Category 5B)

7.3.1. Source Category Description

Composting and anaerobic digestion of organic waste, such as food waste, garden and park waste, and sludge from wastewater treatment plants are common practices in both developed and developing countries. The advantages of biological treatment include: low waste, stabilization of waste, destruction of pathogens in the residual material and biogas production for energy consumption. The final products of the biological treatment, depending on its quality, can be used as fertilizer and to improve the quality of the soil or can be disposed in SWDS.

Anaerobic treatment is usually associated with the recovery of CH_4 and its combustion for energy, and thereby greenhouse gas emissions from this process should be reported under Sector 1 'Energy'. Anaerobic treatment of sludge at wastewater treatment plants should be addressed in Chapter 5D 'Wastewater Treatment and Discharge', and emissions should be reported in the respective category. However, when sludge from wastewater treatment is transferred into an anaerobic plant that co-digests sludge with MSW or other waste, any related CH_4 and N_2O emissions should be reported within this category – 5B 'Biological Treatment of Solid Waste'. Should these gases be used to generate energy, then the associated emissions should be reported under Sector 1 'Energy'.

Composting is an aerobic process and much of the degradable organic carbon (DOC) in the waste material is converted to CO_2. Methane is formed in the anaerobic sections of the compost, but is largely oxidized in the aerobic sections of the compost, so less than 1% of the initial carbon content of the composted material is emitted into the atmosphere.

Anaerobic digestion of organic waste accelerates the natural decomposition of oxygen-free organic material by keeping the temperature, moisture content and pH close to their optimum values. The generated CH_4 can be used for the production of heat and/or electricity, which is why emissions are usually reported under Sector 1 'Energy'. CO_2 emissions are of biogenic origin, and are reported only in Sector 1 'Energy'. CH_4 emissions from such installations are between 0 and 10% of the amount of CH_4 generated, being motivated by accidental leaks during process disturbances or other unexpected events. In the absence of additional information, it is recommended to use a default value of 5% for CH_4 emissions. If the technical standards for biogas plants ensure the avoidance of CH_4 emissions, they are considered to be close to zero. N_2O emissions from the process are assumed to be negligible, but data on these emissions are extremely rare.

Mechanical-biological treatment (MB) of waste is becoming more and more often practised in Europe, being expected in the RM as well. In MB treatment, waste undergoes a series of mechanical and biological operations, which aim to reduce the volume of waste and stabilize it to reduce emissions from final disposal. Mechanical operations separate the residual material into fractions that will be subject to additional treatment (composting, anaerobic decomposition, combustion, recycling). These may include separating and crushing the material. Biological operations include composting and anaerobic decomposition. Composting can take place in piles or in composting facilities for optimized conditions, as well as filtration of gas produced, which allows the quantitative reduction of the organic fraction to be disposed in landfills (which is 40-60%). Due to the small amount of material subject to biological treatment, including its organic content and biological activity, waste subject to mechanical-biological treatment will produce up to 95% less CH_4 than untreated waste when disposed in SWDS. CH_4 and N_2O emissions in the different phases of MB treatment depend on the specific operations and the duration of the process.

7.3.2. Methodological Issues, Emission Factors and Data Sources

The assessment of CH_4 and N_2O emissions from source category 5B 'Biological Treatment of Solid Waste' can be done using First Order Decay Model (IPCC FOD).

Methane emissions were estimated using Equation 4.1 available in the 2006 IPCC Guidelines (Volume 5, Chapter 4, page 4.5):

$$CH_4\ Emissions = \Sigma(M_i \bullet EF_i) \bullet 10^{-3} - R$$

Where:

CH_4 Emission – total CH_4 Emissions in inventory year, kt CH_4;

M_i – mass of organic waste treated by biological treatment type *i*, kt;

EF – emission factor for treatment *i*, g CH_4/kg waste treated;

i – composting or anaerobic digestion;

R – total amount of CH_4 recovered in inventory year, kt CH_4.

When CH_4 emissions from anaerobic digestion are reported, the amount of recovered gas should be subtracted from the amount CH_4 generated. The recovered gas can be combusted in a flare or energy device. The amount of CH which is recovered is expressed as *R* in Equation 4.1. If the recovered gas is used for energy, the resulting greenhouse gas emissions from the combustion of the gas should also be reported under the Energy Sector. Emissions from combustion of the recovered gas are insignificant, however, as CO_2 emissions are of biogenic origin, and CH_4 and N_2O emissions are very small so good practice in the Waste Sector does not require their estimation. N_2O emissions from source category 5B 'Biological Treatment of Solid Waste' are estimated using the First Order Decay Model (IPCC FOD), according to equation 4.2 in the 2006 IPCC Guidelines (Volume 5, Chapter 4, page 4.5):

$$N_2O\ Emissions = \Sigma(M_i \bullet EF_i) \bullet 10^{-3}$$

Where:

N_2O Emissions – total N_2O emissions in inventory year, kt N_2O

M_i – mass of organic waste treated by biological treatment type *i*, kt;

EF – emission factor for treatment *i*, g N_2O/kg waste treated;

i – composting or anaerobic digestion.

In the current inventory cycle, a Tier 1 methodology was used with IPCC default emission factors.

Emission Factors

Emissions from composting and anaerobic digestion in biogas plants will depend on factors such as the type of composting of waste, the amount and type of support material (such as wood chips and peat), temperature, moisture content and aeration during the process.

First and foremost, a request for activity data from the 'Purcel' Mine (which would be a source of GHG emissions from composting organic waste) was sent to Chisinau City Hall – General Directorate of Housing and Communal Planning regarding the total amount of construction waste and vegetation waste collected from parks, including from Municipal Housing Services. Between 2000 and 2016, Chisinau City Hall managed the land of the 'Purcel' mine (JSC 'Macon' mining perimeter for clay extraction), in order to store leaves, branches, construction material waste, sand and garbage resulting from the city's sanitation. Upon request for activity data, the project team was informed about the lack of such data. Since 2018-2019, a new land is allocated for the storage of foliage, branches, construction material waste in the vicinity of 'Pruncul' quarry.

At the same time, recently, in 2020, a platform for composting vegetable waste accumulated from the green spaces of the city was established on the territory of the Wastewater Treatment Plant. Thus, vegetable remains are separated from the waste thrown at random by Green Space workers. The vegetable mass and the dehydrated sludge are then arranged in several layers, and organic fertilizers are obtained after fermentation. The technological process of obtaining organic mass consists of mixing vegetable waste with dehydrated sludge, obtained after wastewater treatment. The compost can be used to arrange flowerbeds, vases in public spaces, as well as to plant trees in parks and squares.

For the next inventory cycle, information shall be requested on the amount of biodegradable waste to be composted.

Table 7-16: CH_4 and N_2O default emission factors from biological treatment of waste

Type of Biological Treatment	CH_4 Emission Factor (g CH_4/kg waste treated)		N_2O Emission Factor (g N_2O/kg waste treated)		Comments
	dry weight basis	wet weight basis	dry weight basis	wet weight basis	
Composting	10 (0.08-20)	4 (0.03-8)	0.6 (0.2-1.6)	0.24 (0.06-0.6)	Assumptions on the waste treated: 25-50% DOC in dry matter, 2% N in dry matter, moisture content 60%. The emission factors for dry waste are estimated from those for wet waste assuming a moisture content of 60% in wet waste.
Anaerobic digestion at biogas facilities	2 (0-20)	0.8 (0-8)	Assumed negligible		

CO Emissions

The calculation of CO emissions from biological waste treatment (Table 7-17) was done according to the methodological approach available in the EMEP/EEA Air Pollutant Emission Inventory Guidebook (2019):

$$CO\ Emissions = W \bullet EF \bullet 10^{-6}$$

Where:

CO Emissions – CO emissions in inventory year, kt/year;

W – amount of solid waste composted, kt/year;

EF – emission factor, kg CO/kt waste (the default value used, 0.56 kg CO/tonne solid waste, is available in the EMEP/EEA Air Pollutant Emission Inventory Guidebook (2019), Source Category 5.B1; 'Biological Treatment of Solid Waste – composting', Table 3-2, page 6);

10^{-6} – conversion factor, from kg to kt.

Table 7-17: Evolution of CO emissions from source category 5B 'Biological Treatment of Solid Waste' between 1990-2020

	1990	1991	1992	1993	1994	1995	1996	1997
CO emissions, kt	0.0076	0.0077	0.0081	0.0040	0.0038	0.0035	0.0036	0.0034
	1998	1999	2000	2001	2002	2003	2004	2005
CO emissions, kt	0.0035	0.0033	0.0029	0.0027	0.0029	0.0031	0.0032	0.0034
	2006	2007	2008	2009	2010	2011	2012	2013
CO emissions, kt	0.0037	0.0047	0.0056	0.0062	0.0060	0.0061	0.0063	0.0068
	2014	2015	2016	2017	2018	2019	2020	2021
CO emissions, kt	0.0071	0.0071	0.0071	0.0081	0.0073	0.0073	0.0079	N/A

Activity Data

Between 2000 and 2016, Chisinau City Hall managed the land of the 'Purcel' quarry (JSC 'Macon' mining perimeter for clay extraction) to store leaves, branches, construction material waste, sand and garbage accumulated as a result of city sanitation. Upon request for activity data, the project team was informed about the lack of such data. Since 2018-2019, a new land is allocated for the storage of foliage, branches, construction material waste in the vicinity of 'Pruncul' quarry.

In the absence of activity data for the test model, an assumption will be made that the amount of waste subject to composting has gradually increased from 1 to 3% between 1990 and 2020 depending on the total amount of municipal waste stored.

Table 7-18: AD used to estimate direct and indirect GHG emissions from source category 5B 'Biological Treatment of Solid Waste'

	1990	1991	1992	1993	1994	1995	1996	1997
Amount of waste composted, kt	13.60	13.78	14.38	7.19	6.71	6.32	6,52	6.13
	1998	1999	2000	2001	2002	2003	2004	2005
Amount of waste composted, kt	6.19	5.81	5.24	4.75	5.22	5.48	5.75	6.03
	2006	2007	2008	2009	2010	2011	2012	2013
Amount of waste composted, kt	6.54	8.47	10.03	11.14	10.75	10.92	11.18	12.14
	2014	2015	2016	2017	2018	2019	2020	%
Amount of waste composted, kt	12.70	12.71	12.63	14.46	13.03	13.04	14.10	4.2

The energy potential of biodegradable waste produced annually in the agricultural and industrial sectors could play a key role in solving the energy problem, and the use of this waste as fuel contributes to reducing GHG emissions. Thus, in 2020, there were 48 producers of pellets and briquettes who used cereal straw, wood sawdust, sunflower seed husks, walnut shells and other vegetable waste in the production process.

Animal manure is a dangerous source of environmental pollution. At the same time, the sources of biodegradable waste in the livestock sector represents the highest potential for the production of organic fertilizers and biogas through anaerobic fermentation, which is not used enough in domestic practice. Plants that produce biogas from waste from the animal breeding sector operate in Firladeni village, Hancesti district ('Garma Grup' Ltd.), Tarnova village, Donduseni district ('Rom-Cris' Ltd.), and at Zabriceni Monastery, Zabriceni village, Edinet district.

The sugar factory in Drochia town, JSC 'Sudzucher Moldova', uses waste resulting from sugar extraction from beets to obtain biogas, producing electricity for the energy needs of the company.

Table 7-19 contains activity data on biogas plants (emissions from biogas are reported under Sector 1 'Energy').

Table 7-19: AD on biogas plants

No.	Enterprise, Legal address	Est.	Raw Material Used, 2018		Plant Capacity	Energy Use
			Name	Amount, t		
1.	'Garma Grup' Ltd. Firladeni vilage, Hincesti district	2014	Manure Vinasse from alcohol production Molasses	29000.0 6200.0 6500.0	25-30 thousand m^3/day	Boiler, Electricity production
2.	'Rom-Cris' Ltd., Tirnova vilage, Donduseni district	2017	Manure Maize stalk	9125.0 3000.0	627 kW/hour	Delivery in the electrical network
3.	'Sudzucker Moldova' JSC, Drochia	2012	Vinasse from sugar production	83000	11,000,000 m^3/year	Own consumption
4.	Zabriceni Monastery, Zabriceni village, Edinet district	2016	Animal manure	280.0	15 m^3/day	Own consumption
5.	'Biogaz Inter' Ltd.	2008	Buried MSW	Circa 20.0 million	Not operational	Electricity production

The Environmental Strategy for the years 2014-2023 and the Action Plan for its implementation, approved by Government Decision No. 301/2014 provides the creation of integrated waste and chemical management systems, which would contribute to a 30% decrease in the amount of waste deposited and a 20% increase in the recycling rate by 2023.

7.3.3. Uncertainties and Time-Series Consistency

The quality of data on the amount of waste subject to biological decomposition by composting is considered uncertain for category 5B 'Biological Treatment of Solid Waste', inferred by expert assumption, and we thereby consider an uncertainty of circa 50%. Default emission factors recommended by the 2006 IPCC Guidelines were used for the calculation, so we consider it appropriate to use the value of circa 50%. Thus, uncertainties associated with combined uncertainties of activity data and emission factors for category 5B 'Biological Treatment of Solid Waste" are considered to be circa 70.71% (Annex 5-3.5).

In view of ensuring time-series consistency of the results, the same approach was used for the entire period under review, in conformity with the recommendations included in the 2006 IPCC Guidelines.

7.3.4. Quality Assurance and Quality Control

Verification was focused on various aspects such as: ensuring correct use of the default emission factors available in the 2006 IPCC Guidelines; use of country-specific factors; verification and correct use of AD obtained from different reference sources, etc. It should be noted that the AD and methods used for the estimation of GHG emissions under category 5A 'Solid Waste Disposal' were documented and archived both in hard copies and electronically. For category 5B 'Biological Treatment of Solid Waste', standard verification and quality control forms and checklists were also filled in following a Tier 1 approach. The quality of this activity data will be verified and adjusted in the next inventory cycle, through additional studies.

7.2.5. Recalculations

No recalculations were made in the current inventory cycle for GHG emissions from category 5B 'Biological Treatment of Solid Waste'.

7.3.6. Planned Improvements

Organic waste composting practices are to be specified at national level in order to determine the existence of these platforms in urban and rural localities, especially where there are waste collection services. Together with the implementation of a new integrated waste management system, waste composting facilities will be developed, which would significantly reduce the impact on the environment and take control of biogas emissions from the new systems.

7.4. Incineration and Open Burning of Waste (Category 5C)

7.4.1. Source Category Description

Waste incineration is defined as the combustion of solid and liquid waste in controlled incineration facilities. Types of waste incinerated include municipal solid waste, industrial waste, hazardous waste, clinical waste and sewage sludge. The practice of MSW incineration is currently more common in developed countries, while it is common for developing countries to mostly incinerate clinical waste.

Emissions from waste incineration without energy recovery are reported within the Waste Sector, while emissions from waste incineration with energy recovery are reported in the Energy Sector. The methodology described in this chapter is applicable for both incineration with and without energy recovery. Co-firing of specific waste fractions as alternative fuels is reported only within the Energy Sector (e.g., emissions from the incineration of tires in cement plant kilns will be reported only in the Energy Sector). Simultaneously, emissions from agricultural residue burning are considered in the Agriculture Sector or in category 4B 'Cropland' within Sector 4 'LULUCF'.

Figure 7-7: Open burning of waste at Balti and Tintareni landfills

Open burning of waste can be defined as the unintentional combustion of combustible materials such as paper, wood, plastics, textiles, rubber, waste oils and other debris in nature (open-air) or in open dumps, where smoke and other emissions are released directly into the air without passing through a chimney or stack. Open burning can also include incineration devices that do not control the combustion air to maintain an adequate temperature and do not provide sufficient residence time for complete combustion. This waste management practice is used in many developing countries whereas in developed countries open burning of waste may either be strictly regulated, or otherwise occur more frequently in rural areas than in urban areas.

Incineration and open burning of waste are sources of direct (CO_2, CH_4, and N_2O) and indirect (NO_x, CO, NMVOC, and SO_2) GHG emissions. Intentional burning of waste on solid waste disposal sites is a waste management practice sometimes used in some developing countries. Emissions resulting from this practice and those from unintentional fires on SWDS will be estimated and reported according to the methodology and guidance provided for open burning of waste.

7.4.2. Methodological Issues, Emission Factors and Data Sources

CO_2, CH_4 and N_2O emissions from the open burning of MSW and clinical waste were estimated within category 5C 'Incineration and open Burning of Waste'.

The amount of waste open-burned each year was estimated using Equation 5.7 from the 2006 IPCC Guidelines (Volume 5, Chapter 5.3.2, page 5.16):

$$MSW_B = P \bullet P_{frac} \bullet MSW_P \bullet B_{frac} \bullet 365 \bullet 10^{-6}$$

Where:

MSW_B – total amount of municipal solid waste open-burned, kt/yr;

P – population, capita;

P_{frac} – fraction of population burning waste (fraction);

MSW_P – per capita waste generation, kg waste/capita/day;

B_{frac} – fraction of the waste amount that is burned relative to the total amount of waste treated (fraction);

365 – number of days by year;

10^{-6} – conversion factor from kg to kt.

The total population of the Republic of Moldova (as well as separately for the right and left bank of the Dniester River) is presented below in Table 7-20.

Table 7-20: Total population of the Republic of Moldova between 1990-2020, million people

	1990	1991	1992	1993	1994	1995	1996	1997
LBDR	0.7310	0.7307	0.7303	0.7296	0.7025	0.7017	0.6916	0.6791
RBDR	3.6306	3.6356	3.6288	3.6182	3.6502	3.6462	3.6428	3.6409
RM – Total	**4.3616**	**4.3663**	**4.3591**	**4.3478**	**4.3527**	**4.3479**	**4.3344**	**4.3200**
	1998	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**
LBDR	0.6708	0.6657	0.6600	0.6518	0.6425	0.6336	0.6238	0.5544
RBDR	3.655	3.6493	3.6435	3.6345	3.6272	3.6177	3.6068	3.53304
RM – Total	**4.3258**	**4.315**	**4.3035**	**4.2863**	**4.2697**	**4.2513**	**4.2306**	**4.0874**
	2006	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**
LBDR	0.5475	0.5406	0.5335	0.5275	0.5225	0.5180	0.5134	0.5094
RBDR	3.4593	3.3855	3.3118	3.2380	3.1643	3.0905	3.0167	2.9430
RM – Total	**4.0068**	**3.9261**	**3.8453**	**3.7655**	**3.6868**	**3.6085**	**3.5301**	**3.4524**
	2014	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**%**
LBDR	0.5052	0.5007	0.4745	0.4706	0.4690	0.4651	0.4658	-36.28
RBDR	2.8692	2.8447	2.8244	2.7800	2.7304	2.6861	2.6439	-27.18
RM – Total	**3.3744**	**3.3454**	**3.2989**	**3.2506**	**3.1994**	**3.1512**	**3.1097**	**-28.70**

According to the 2006 IPCC Guidelines, open burning includes regular burning and sporadic burning of solid household waste. Regular burning means that this is the only practice used to eliminate solid waste. Sporadic burning means that this practice is used in addition to other practices and therefore open burning is not the only practice used to eliminate waste. For countries that have well-functioning waste collection systems in place, it is good practice to investigate the type of fossil carbon which is open-burned.

In developed countries, P_{frac} can be assumed to be the rural population for a rough estimate. In a region where the urban population exceeds 80% of total population, it can be assumed that no open burning of waste occurs. In developing countries, mainly in urban areas, P_{frac} can be roughly estimated as being the sum of population whose waste is not collected by waste collection services and population whose waste is collected and disposed in open dumps that are open burned at solid waste landfills.

In the RM, the share of urban population varied over the period 1990-2020 between 47.4 and 45.8%, whereas the rural population between 52.6 and 54.2%, respectively (Table 7-21).

Table 7-21: Urban and rural population of the RM between 1990-2020, million people

	1990	1991	1992	1993	1994	1995	1996	1997
Urban population	2.0693	2.0736	2.0522	2.0392	2.0366	2.033	2.0041	1.9953
Rural population	2.2923	2.2927	2.3069	2.3086	2.3161	2.3149	2.3303	2.3247
Share of urban population, %	47.4	47.5	47.1	46.9	46.8	46.8	46.2	46.2
Share of rural population, %	52.6	52.5	52.9	53.1	53.2	53.2	53.8	53.8
	1998	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**
Urban population	2.0016	1.9907	1.9834	1.9488	1.9401	1.9325	1.9192	1.7427
Rural population	2.3242	2.3243	2.3201	2.3375	2.3296	2.3188	2.3115	2.3447
Share of urban population, %	46.3	46.1	46.1	45.5	45.4	45.5	45.4	42.6
Share of rural population, %	53.7	53.9	53.9	54.5	54.6	54.5	54.6	57.4
	2006	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**
Urban population	1.7200	1.7102	1.6778	1.6460	1.6186	1.5915	1.5628	1.5389
Rural population	2.2868	2.2160	2.1675	2.1196	2.0682	2.0169	1.9673	1.9135
Share of urban population, %	42.9	43.6	43.6	43.7	43.9	44.1	44.3	44.6
Share of rural population, %	57.1	56.4	56.4	56.3	56.1	55.9	55.7	55.4
	2014	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**%**
Urban population	1.5121	1.5062	1.4884	1.4722	1.4576	1.4401	1.4249	-31.14
Rural population	1.8623	1.8392	1.8105	1.7783	1.7417	1.7111	1.6848	-26.50
Share of urban population, %	44.8	45.0	45.1	45.3	45.6	45.7	45.8	-3.42
Share of rural population, %	55.2	55.0	54.9	54.7	54.4	54.3	54.2	3.09

The incineration of waste is predominantly characteristic to rural areas, both in households and on landfills in order to reduce the volume of solid waste disposed, mainly by burning organic waste (paper, cardboard, plastics and vegetable waste). In the case of the RM, the share of population that burns waste in open-air (P_{frac}) is estimated based on the share of the rural population ($P_{frac\ rural}$) plus the urban population ($P_{frac\ urban}$) that does not benefit from waste collection services ($P_{frac} = P_{frac\ rural} + P_{frac\ urban}$).

Approximately 75% to 90% of the urban population are provided waste collection services, and in some district centers the town waste collection systems serve neghbouring rural localities, and in rural areas – approximately 15 to 20% of the population are provided with waste collection services.

Municipal waste generation indicators indicate that the level of well-being of the population, by increased consumption in the last decade, but also the increased urbanization rate, which resulted in a capacity to generate a higher amount of waste per capita. Based on the Waste Management Strategy in the Republic of Moldova 2013-2027[118], the generation of municipal waste per capita varied in rural areas between 0.3-0.4 kg/capita/day, and for urban areas – 0.9 kg/capita/day (2010-2012). Between 2016 and 2020, at the feasibility study phase for the development of waste management systems at regional level, the waste generation indicators were revised, and the following values were proposed for rural localities: 0.5-0.7 kg/capita/day, and 0.9 kg/capita/day for small urban areas and district centres, and 1.3-1.5 kg/capita/day for Balti and Chisinau municipalities, respecitvely.

Regarding the waste generation rate per capita for the period 1990-2015, the value of 0.5 kg/capita/day for the rural population was used, and the value of 0.9 kg/capita/day, respectively, for the urban population. Based on the latest available data and information mentioned above, the following values were used for the period 2016-2020:

- for 2016-2017 – 0.6 kg/capita/day for rural population and 1.0 kg/capita/day for urban population;
- for 2018-2020 – 0.7 kg/capita/day for rural population and 1.1 kg/capita/day for urban population.

Considering the morphological composition of municipal solid waste, the fractions of organogenic waste that can be burned by the rural and urban population were identified (paper, cardboard, plastics, phytotechnical waste, textiles, furniture, wood waste). In fact, the share of combustible waste varies in large municipalities, such as Chisinau and Balti, and in the district centres, such as Leova and Causeni, respectively, usually varying depending on the population's purchasing power. In order to estimate emissions, the results obtained from the most recent analysis of the morphological composition of solid waste in the Republic of Moldova were used (Figure 7-4).

It was considered that circa 20% of the urban population that does not benefit from waste disposal services burns the organogenic solid waste in open-air, and the fraction for solid waste burned (B_{frac}) from the total amount of treated waste in urban areas is 0.15 (15% of the total). It should be noted that the population of Chisinau was excluded from the urban population, as it is considered that open burning of waste is not practiced, as waste disposal platforms are available in the city. In rural areas, it was considered that 40% of the population burns organogenic solid waste in open-air, and B_{frac} is 0.2 (20% of the total).

The total amount of MSW burned in open-air by the population was estimated using the following equation:

$$MSW_B = MSW_{B\ rural} + MSW_{B\ urban}$$

Where:

$$MSW_{B\ rural\ RM}\ (kt) = P_{\ rural}\ (inhabitants) \bullet MSW_{P\ rural}\ (kg/capita/day) \bullet 0.20 \bullet 365 \bullet 10^{-6}$$

$$MSW_{B\ urban\ RM}\ (kt) = P_{\ urban}\ (inhabitants) \bullet MSW_{P\ urban}\ (kg/capita/day) \bullet 0.15 \bullet 365 \bullet 10^{-6}$$

Although there are no authorized incinerators in the Republic of Moldova for the incineration of clinical waste, a certain category of plastic clinical waste generated by several medical institutions in the country is treated through the pyrolysis or autoclaving method ('UISPAC' Ltd.[119], 'Trisumg' Ltd.[120] and 'Ecostat' Ltd.[121]). Medical institutions in the RM practise three different methods of open burning of clinical waste: 1) open burning; 2) closed burning in heating boilers or metal barrels; and 3) transport for pyrolysis treatment.

As a response, the Ministry of Health, Labour and Social Protection[122] mentioned that in 2018, according to data reported from 26 territories (70.3%) in the structure of waste generated, non-hazardous waste prevails by 77.13%, followed by hazardous waste – 21.74% (986,057 kg), anatomopathological waste – 0.61% (27813.9 kg), stinging-cutting waste – 0.27% (11972.3 kg), and other hazardous waste

[118] https://www.legis.md/cautare/getResults?doc_id=67104&lang=ro
[119] Authorization issued by the Environment Agency, Series 005, AM 20091601 dated 02.10.2020 on the collection, transport and processing (the pyrolysis method) of plastic waste and of waste from clinical or veterinary care activities and/or related research.
[120] Authorization issued by the Environment Agency, Series 005, AM 20090802 dated 30.09.2020 on the transport and processing of clinical waste by autoclaving.
[121] Authorization No. 071/2016 dated 27.05.2016 issued by the Ministry of Environment.
[122] Letter from the Ministry of Health, Labor and Social Protection No. 04/677 dated 04.02.2019 as an official response to the Letter from the MARDE No. 14-0//16 dated 03.01.2019.

– 0.25% (chemical, etc.). Outsourcing of waste treatment services, including infectious and stinging, was reported in 32 territories (86.5%). At the same time, the method of treating infectious waste by immersion in chlorine solutions and their incineration in open-air or improvised installations persists in medical institutions in rural areas (Chisinau municipality, Basarabeasca, Briceni, Cahul, Cimislia, Donduseni, Falesti, Floresti, Glodeni, Hincesti, Ialoveni, Nisporeni, Ocnita, Orhei, Soroca, Straseni, Soldanesti, Stefan Voda, Taraclia, Ungheni, Comrat, Ceadir-Lunga, Vulcanesti).

In order to determine AD for the estimation of direct GHG emissions (CO_2, CH_4, and N_2O) and indirect emissions (NO_x, CO, NMVOC, and SO_2) from open burning of clinical waste, as a first step, the amount of clinical waste generated annually was estimated based on the rate of waste generation reported per hospital bed. The second step was to estimate the share of waste burned in open-air in the total clinical waste generated. Thus, the data received from the National Centre of Public Health[123] on clinical waste burned by medical institutions across the country, who practise the three above-mentioned methods, was used for the years 2010-2014. Additionally, for the years 2015-2019, similar data was received from several medical institutions in the country, being requested through the Circular of the Ministry of Health, Labour and Social Protection[124]. Although the data received did not cover all medical institutions in all districts of the country, they allowed the deduction of a rate of clinical waste generated per hospital bed. The share of waste burned in open-air was estimated based on the data received. The historical data for the years 1990-2009 was inferred by correlating the generation rate per hospital bed with the number of beds (available in the database of the National Bureau of Statistics on www.statistica.gov.md), and the burning coefficient was estimated based on expert opinion, considering that in the 1990s the burning rate was somewhat low.

The tables below shows activity data used to estimate GHG emissions from open burning of clinical waste.

Table 7-22: Amount of total clinical waste burned in open-air between 1990-2020

	1990	1991	1992	1993	1994	1995	1996	1997
Number of hospital beds, units	57334	56992	55653	54275	53140	52986	52457	50101
Generation per hospital bed, kg/day	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05
Total country, tonnes	1046.3	1040.1	1015.7	990.5	969.8	967.0	957.3	914.3
Burning rate, %	10.0	14.5	19.0	23.5	28.0	32.5	37.0	41.5
Total open burning amount, tonnes	104.63	150.82	192.98	232.77	271.55	314.27	354.22	379.45
	1998	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**
Number of hospital beds, units	48261	35089	32423	25044	24443	24097	23113	22961
Generation per hospital bed, kg/day	0.05	0.05	0.06	0.07	0.08	0.09	0.1	0.1
Total country, tonnes	880.8	640.4	710.1	639.9	713.7	791.6	843.6	838.1
Burning rate, %	46.0	50.5	55.0	59.5	64.0	68.5	72.5	72.5
Total open burning amount, tonnes	405.15	323.39	390.54	380.73	456.79	542.24	611.59	607.57
	2006	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**
Number of hospital beds, units	22471	21892	21798	21938	22021	22031	22162	20760
Generation per hospital bed, kg/day	0.1	0.1	0.11	0.12	0.13	0.14	0.15	0.15
Total country, tonnes	820.2	799.1	875.2	960.9	1044.9	1125.8	1213.4	1136.6
Burning rate, %	72.5	72.5	72.5	72.5	72.5	74.6	72.6	71.4
Total open burning amount, tonnes	594.60	579.28	634.47	696.60	757.50	840.26	880.87	811.83
	2014	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**%**
Number of hospital beds, units	20131	18803	18805	18398	18138	18042	20524*	-64.20
Generation per hospital bed, kg/day	0.15	0.15	0.15	0.15	0.15	0.15	0.28	460.00
Total country, tonnes	1102.2	1029.5	1029.6	1007.3	993.1	987.8	2097.5	100.46
Burning rate, %	66.2	55.9	45.6	35.3	25	10.3	11.39605	-6.30
Total open burning amount, tonnes	729.29	575.23	469.32	355.49	248.26	101.67	239.037	87.83

Note: *The number of beds has been increased, due to the COVID 19 pandemic, when the allocation coefficient for the number of beds per 10.000 inhabitants was increased from 57 to 66.1 (based on the information on the NBS web page: https://statistica.gov.md/category.php?l=ro&idc=198). At the same time, the generation rate of waste per bed has been increased, from 0.15 to 0.28 kg/bed (based on the deductions of the expert, including on the basis of the reports submitted on www.siamd.gov.md by economic agents authorized in the collection and treatment of medical waste).

CO_2 emissions from open burning of waste were estimated using Equation 5.1 from the 2006 IPCC Guidelines (Volume 5, Chapter 5, page 5.7):

$$CO_2\ Emissions = \Sigma_i\ (SW_i \bullet dm_i \bullet CF_i \bullet FCF_i \bullet OF_i) \bullet 44/12$$

Where:

[123] Letter from the Ministry of Health No. 06t-3/2521 dated 30.10.2015 as an official response to the Letter from the Ministry of Environment No. 05-07/1425 dated 13.08.2015.

[124] Circular of the Ministry of Health, Labor and Social Protection No.06/2218 dated 23.04.2020 addressed to Health Carters/Family Medical Centers/ Territorial Medical Associations, District/ Municipal/ Republican Hospitals, prepared as a response to the interpellation of the MARDE No. 14-07/1356 dated 16.03.2020.

CO_2 Emissions – CO_2 emissions in inventory year, kt/yr;

SW_i – total amount of solid waste of type *i* (wet weight) incinerated or open-burned, kt/yr;

dm_i – dry matter content in the waste (wet weight) incinerated or open-burned (fraction) (default values used – 76% for MSW and 90% for clinical waste are available in Table 2.4 in the 2006 IPCC Guidelines, Volume 5, Chapter 2, page 2.14);

CF_i – fraction of carbon in the dry matter (total carbon content) (default values used – 47% for MSW and 60% for clinical waste are available in Table 2.4 in the 2006 IPCC Guidelines, Volume 5, Chapter 2, page 2.14, and in Table 5.2 in the 2006 IPCC Guidelines, Volume 5, Chapter 5, page 5.18, respectively);

FCF_i – fraction of fossil carbon in the total carbon (default values used – 90% for industrial waste, 42% for MSW and 40% for clinical waste are available in Table 2.4 in the 2006 IPCC Guidelines, Volume 5, Chapter 2, page 2.14, and in Table 5.2 in the 2006 IPCC Guidelines, Volume 5, Chapter 5, page 5.18, respectively);

OF_i – oxidation factor (default value used – 58% is available in Table 5.2 in the 2006 IPCC Guidelines, Volume 5, Chapter 5, page 5.18);

44/12 – conversion factor from C to CO_2.

i – type of waste incinerated/open-burned specified as follows: MSW – municipal solid waste (if not estimated using Equation 5.2 in the 2006 IPCC Guidelines, Volume 5, Chapter 5, page 5.7); ISW: industrial solid waste; SS: sewage sludge; HW: hazardous waste; CW: clinical waste, others (to be specified).

Methane emissions from incineration and open burning of waste are a result of incomplete combustion. Important factors affecting the emissions are temperature, residence time, and air ratio (air volume in relation to the waste amount incinerated or open-burned).

In large and well-functioning industrial incinerators, CH_4 emissions are usually very small. Methane can also be generated in the waste bunker of incinerators if there are low oxygen levels and subsequent anaerobic processes in the waste bunker, particularly where waste is wet, stored for long periods and not well agitated. Where the storage gases are fed into the air supply of the incineration chamber, they will be incinerated and emissions will be reduced to significant levels.

The calculation of methane emissions is based on Equation 5.4 from the 2006 IPCC Guidelines, Volume 5, Chapter 5, page 5.12):

$$CH_4\ Emissions = \Sigma_i\ (IW_i \bullet EF_i) \bullet 10^{-6}$$

Where:

CH_4 Emissions – CH_4 emissions in inventory year, kt/yr;

IW_i – amount of solid waste of type *i* incinerated or open-burned, kt/yr;

EF_i – aggregate CH_4 emission factor, kg CH_4/kt waste type *i* (default value used – 6.5 kg CH_4/t MSW is available in the 2006 IPCC Guidelines, Volume. 5, Chapter 5, page 5.20);

10^{-6} – conversion factor, from kg to kt;

i – category or type of waste incinerated/open-burned, specified as follows: MSW – municipal solid waste; ISW: industrial solid waste; HW: hazardous waste; CW: clinical waste, SS: sewage sludge; others (to be specified).

Nitrous oxide is emitted in combustion processes at relatively low combustion temperatures between 500 and 950°C. Other important factors affecting the emissions are the type of air pollution control device, type and nitrogen content of the waste and the fraction of excess air.

The calculation of nitrous oxide emissions is based on Equation 5.5 in the 2006 IPCC Guidelines, Volume 5, Chapter 5, page 5.14):

$$N_2O\ Emissions = \Sigma_i\ (IW_i \bullet EF_i) \bullet 10^{-6}$$

Where:

N_2O Emissions – N_2O emissions in inventory year, kt/yr;

IW_i – amount of solid waste of type *i* incinerated or open-burned, kt/yr;

EF_i – N_2O emission factor, kg N_2O/kt waste type *i* (default value used – 0.15 kg N_2O/t of MSW, is available in the 2006 IPCC Guidelines, Volume 5, Chapter 5, Table 5.6, page 5.22);

10^{-6} – conversion factor, from kg to kt;

i – category or type of waste incinerated/open-burned, specified as follows: MSW – municipal solid waste; ISW: industrial solid waste; HW: hazardous waste; CW: clinical waste, SS: sewage sludge; others (to be specified).

The calculation of indirect GHG emissions (NO_x, CO, NMVOC, and SO_2) from incineration or open burning of waste is based on the methodology available in the EMEP/EEA Air Pollutant Emission Inventory Guidebook (2019):

$$\textit{Indirect GHG Emissions} = \Sigma_i (IW_i \bullet EF_i) \bullet 10^{-6}$$

Where:

Indirect GHG Emissions – indirect GHG emissions (NO_x, CO, NMVOC, and SO_2) in inventory year, kt/yr;

IW_i – amount of solid waste of type *i* incinerated or open-burned, kt/yr;

EF_i – emission factor, kg indirect GHG/kt waste (default values are presented below, in Table 7-24);

i – category or type of waste incinerated/open-burned, specified as follows: MSW – municipal solid waste; ISW: industrial solid waste; HW: hazardous waste; CW: clinical waste, SS: sewage sludge; others (to be specified);

10^{-6} – conversion factor, from kg to kt.

Table 7-23: Default emission factors used to estimate indirect GHG emissions from source category 5C 'Incineration and Open Burning of Waste' using a Tier 1 Approach

	NO_x, kg/t of waste	CO, kg/t of waste	NMVOC, kg/t of waste	SO_2, kg/t of waste
Solid Waste[1]	3.8	55.83	1.23	0.11
Clinical Waste[2]	2.3	0.19	0.7	0.54

Source: [1]EMEP/EEA Atmospheric Emissions Inventory Guidebook (2019), Source Category 5.C.2 'Open Burning of Waste', Table 3-1, page 6; [2]EMEP/EEA Atmospheric Emissions Inventory Guidebook (2019), Source Category 5.C.1.b.iii 'Clinical Waste Incineration', Table 3-1, page 8.

Activity data used to estimate CO_2, CH_4, and N_2O emissions from source category 5C 'Incineration and Open Burning of Waste' are presented in Table 7-24.

Table 7-24: Activity data used to estimate direct and indirect GHG emissions from source category 5C 'Incineration and Open Burning of Waste'

	Urban Population, thousand inhabitants (without Chisinau)	Rural Population, thousand inhabitants	Daily ratio of generated MSW in urban areas, kg/capita/day	Daily ratio of generated MSW in rural areas, kg/capita/day	Amount of MSW burnt in urban areas, kt	Amount of MSW burnt in rural areas, kt	Total amount of MSW burnt in the RM, kt	Amount of clinical waste incinerated, kt
1990	1,393.800	2,292.300	0.9	0.5	13.7359	33.4676	47.2035	104.63
1991	1,396.900	2,292.700	0.9	0.5	13.7664	33.4734	47.2399	150.82
1992	1,385.100	2,306.900	0.9	0.5	13.6502	33.6807	47.3309	192.98
1993	1,375.800	2,308.600	0.9	0.5	13.5585	33.7056	47.2641	232.77
1994	1,375.000	2,316.100	0.9	0.5	13.5506	33.8151	47.3657	271.55
1995	1,371.500	2,314.900	0.9	0.5	13.5161	33.7975	47.3137	314.27
1996	1,342.200	2,330.300	0.9	0.5	13.2274	34.0224	47.2498	354.22
1997	1,330.600	2,324.700	0.9	0.5	13.1131	33.9406	47.0537	379.45
1998	1,338.400	2,324.200	0.9	0.5	13.1899	33.9333	47.1233	405.15
1999	1,327.100	2,324.300	0.9	0.5	13.0786	33.9348	47.0134	323.39
2000	1,320.000	2,320.100	0.9	0.5	13.0086	33.8735	46.8821	390.54
2001	1,286.800	2,337.500	0.9	0.5	12.6814	34.1275	46.8089	380.73
2002	1,278.100	2,329.600	0.9	0.5	12.5957	34.0122	46.6078	456.79
2003	1,271.800	2,318.800	0.9	0.5	12.5336	33.8545	46.3881	542.24
2004	1,257.000	2,311.500	0.9	0.5	12.3877	33.7479	46.1356	611.59
2005	1,081.537	2,344.706	0.9	0.5	10.6585	34.2327	44.8912	607.57
2006	1,059.808	2,286.778	0.9	0.5	10.4444	33.3870	43.8314	594.60
2007	1,051.759	2,215.968	0.9	0.5	10.3651	32.3531	42.7182	579.28
2008	1,014.702	2,167.468	0.9	0.5	9.9999	31.6450	41.6449	634.47

	Urban Population, thousand inhabitants (without Chisinau)	Rural Population, thousand inhabitants	Daily ratio of generated MSW in urban areas, kg/capita/day	Daily ratio of generated MSW in rural areas, kg/capita/day	Amount of MSW burnt in urban areas, kt	Amount of MSW burnt in rural areas, kt	Total amount of MSW burnt in the RM, kt	Amount of clinical waste incinerated, kt
2009	982.763	2,119.550	0.9	0.5	9.6851	30.9454	40.6306	696.60
2010	955.154	2,068.202	0.9	0.5	9.4130	30.1957	39.6088	757.50
2011	926.817	2,016.882	0.9	0.5	9.1338	29.4465	38.5802	840.26
2012	895.220	1,967.323	0.9	0.5	8.8224	28.7229	37.5453	880.87
2013	867.103	1,913.519	0.9	0.5	8.5453	27.9374	36.4827	811.83
2014	837.565	1,862.314	0.9	0.5	8.2542	27.1898	35.4440	729.29
2015	827.991	1,839.168	1.0	0.6	9.0665	32.2222	41.2887	575.23
2016	807.264	1,810.523	1.0	0.6	8.8395	31.7204	40.5599	469.32
2017	786.323	1,778.329	1.1	0.7	9.4713	36.3490	45.8203	355.49
2018	767.614	1,741.750	1.1	0.7	9.2459	35.6014	44.8473	248.26
2019	744.696	1,711.068	1.1	0.7	8.9699	34.9742	43.9441	101.67
2020	729.511	1684.800	1.1	0.7	9.9586	34.4367	44.3953	239.03

7.4.3. Uncertainties and Time-Series Consistency

The main factors affecting uncertainties are associated with the estimation methodology, the EFs used to estimate GHG emissions from source category 5C 'Incineration and Open Burning of Waste' as well as the quality of the AD available. Thus, uncertainties associated with the default emission factors used to estimate CO_2, CH_4, and N_2O emissions from source category 5C 'Incineration and Open Burning of Waste' reach circa 25% for CO_2, circa 50% for CH_4, and circa 100% for N_2O. Uncertainties associated with the activity data on the estimated amount of waste burnt by the rural and urban population could reach circa 40%. Thus, combined uncertainties for source category 5C 'Incineration and Open Burning of Waste' constitute circa 47.17% for CO_2 emissions, circa 64.03% for CH_4, and circa 107.70% for N_2O emissions, respectively (Annex 5-3.5). In view of ensuring time series consistency of results, the same approach was used for the entire period under review, in conformity with good practices applied in the GHG emissions inventory.

7.4.4. Quality Assurance and Quality Control

Standard verification and quality control form and checklist was filled in for the respective category following a Tier 1 approach. Verification was focused on various aspects such as: correct use of AD obtained from different reference sources, including the Statistical Yearbooks of the RM and those of the ATULBD, on ensuring correct use of the default emission factors available in the 2006 IPCC Guidelines. The AD and methods used for the estimation GHG emissions from category 5C 'Incineration and Open Burning of Waste' were documented and archived both in hard copies and electronically etc.

7.4.5. Recalculations

Direct and indirect GHG emissions from category 5C 'Incineration and Open burning of Waste' were recalculated within the current inventory cycle for 2019, particularly due to the need of adjusting AD with the population number. In comparison with the results recorded in the BUR3 of the RM to the UNFCCC (2021), the above-mentioned changes resulted in an insignificant upward trend in direct GHG (CO_2, CH_4, and N_2O) emissions from category 5C 'Incineration and Open Burning of Waste'.

Table 7-25: Comparative results of direct GHG emissions from source category 5C 'Incineration and Open Burning of Waste' included in the BUR3 and NC5 of the RM to the UNFCCC, kt CO_2 equivalent

	1990	1991	1992	1993	1994	1995	1996	1997
BUR3	24.2621	24.3113	24.3859	24.3780	24.4557	24.4574	24.4511	24.3673
NC5	24.2621	24.3113	24.3859	24.3780	24.4557	24.4574	24.4511	24.3673
Difference, %	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	1998	1999	2000	2001	2002	2003	2004	2005
BUR3	24.4200	24.3095	24.2867	24.2427	24.1900	24.1339	24.0505	23.4100
NC5	24.4200	24.3095	24.2867	24.2427	24.1900	24.1339	24.0505	23.4100
Difference, %	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	2006	2007	2008	2009	2010	2011	2012	2013
BUR3	22.8582	22.2776	21.7640	21.2853	20.8019	20.3296	19.8260	19.2357
NC5	22.8582	22.2776	21.7640	21.2853	20.8019	20.3296	19.8260	19.2357
Difference, %	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

	2014	2015	2016	2017	2018	2019	2020	%
BUR3	18.6487	21.5422	21.0986	23.71928897	23.14959521	22.5520		
NC5	18.6487	21.5422	21.0986	23.7193	23.1496	22.5896	22.2913	-8.1
Difference, %	0.0	0.0	0.0	0.0	0.0	0.2		

Abbreviations: BUR3 – Third Biennial Update Report of the RM to the UNFCCC, NC5 – Fifth National Communication of the RM to the UNFCCC.

The obtained results allow us to assert that direct GHG emissions from the respective category decreased in the RM by circa 8.1% between 1990 and 2020.

The table below shows the evolution of direct and indirect GHG emissions from incineration and open burning of household and clinical waste between 1990 and 2020. The obtained results allow us to assert that direct and indirect GHG emissions from the respective category decreased in the RM by circa 5.8% within the reference period (Table 7-26).

Table 7-26: Evolution of direct and indirect GHG emissions from source category 5C 'Incineration and Open Burning of Waste' in the RM between 1990-2020

	1990	1991	1992	1993	1994	1995	1996	1997
CO_2 emissions, kt	14.9667	14.9994	15.0476	15.0447	15.0947	15.0979	15.0960	15.0456
CH_4 emissions, kt	0.3075	0.3080	0.3089	0.3087	0.3096	0.3096	0.3094	0.3083
N_2O emissions, kt	0.0054	0.0054	0.0054	0.0054	0.0054	0.0054	0.0054	0.0054
NO_x emissions, kt	0.1503	0.1506	0.1510	0.1508	0.1512	0.1512	0.1511	0.1505
CO emissions, kt	2.6354	2.6374	2.6425	2.6388	2.6445	2.6416	2.6380	2.6271
NMVOC emissions, kt	0.0581	0.0582	0.0584	0.0583	0.0584	0.0584	0.0584	0.0581
SO_2 emissions, kt	0.0052	0.0053	0.0053	0.0053	0.0054	0.0054	0.0054	0.0054
	1998	1999	2000	2001	2002	2003	2004	2005
CO_2 emissions, kt	15.0794	15.0071	14.9965	14.9689	14.9402	14.9100	14.8621	14.4670
CH_4 emissions, kt	0.3089	0.3077	0.3073	0.3067	0.3059	0.3050	0.3039	0.2957
N_2O emissions, kt	0.0054	0.0054	0.0054	0.0054	0.0054	0.0054	0.0053	0.0052
NO_x emissions, kt	0.1508	0.1502	0.1500	0.1497	0.1493	0.1488	0.1481	0.1442
CO emissions, kt	2.6310	2.6248	2.6175	2.6134	2.6022	2.5899	2.5759	2.5064
NMVOC emissions, kt	0.0582	0.0581	0.0579	0.0578	0.0576	0.0574	0.0572	0.0556
SO_2 emissions, kt	0.0054	0.0053	0.0054	0.0054	0.0054	0.0054	0.0054	0.0053
	2006	2007	2008	2009	2010	2011	2012	2013
CO_2 emissions, kt	14.1260	13.7672	13.4533	13.1613	12.8663	12.5793	12.2708	11.9033
CH_4 emissions, kt	0.2888	0.2814	0.2748	0.2686	0.2624	0.2562	0.2498	0.2424
N_2O emissions, kt	0.0051	0.0049	0.0048	0.0047	0.0046	0.0045	0.0044	0.0043
NO_x emissions, kt	0.1408	0.1372	0.1339	0.1308	0.1277	0.1246	0.1214	0.1179
CO emissions, kt	2.4472	2.3851	2.3252	2.2685	2.2115	2.1541	2.0963	2.0370
NMVOC emissions, kt	0.0543	0.0529	0.0517	0.0505	0.0492	0.0480	0.0468	0.0454
SO_2 emissions, kt	0.0051	0.0050	0.0049	0.0048	0.0048	0.0047	0.0046	0.0045
	2014	2015	2016	2017	2018	2019	2020	%
CO_2 emissions, kt	11.5371	13.3135	13.0346	14.6448	14.2880	13.9352	13.7583	-8.1
CH_4 emissions, kt	0.2351	0.2721	0.2667	0.3001	0.2931	0.2863	7.0563	-8.2
N_2O emissions, kt	0.0041	0.0048	0.0047	0.0053	0.0051	0.0050	1.4767	-8.2
NO_x emissions, kt	0.1144	0.1326	0.1301	0.1465	0.1432	0.1400	0.1379	-8.3
CO emissions, kt	1.9790	2.3053	2.2645	2.5582	2.5039	2.4534	2.4110	-8.5
NMVOC emissions, kt	0.0441	0.0512	0.0502	0.0566	0.0553	0.0541	0.0533	-8.3
SO_2 emissions, kt	0.0043	0.0049	0.0047	0.0052	0.0051	0.0049	0.0049	-7.0

7.4.6. Planned Improvements

In the coming years, it should be mentioned that the Waste Management Automated Information System (<www.siamd.gov.md>) will include most of the waste collection operators, which will facilitate data collection on municipal waste or similar waste collected from the population and economic agents, as well as on the number of people benefiting from waste collection systems. It shall thereby be possible to improve the quality of the activity data used for estimating emissions from source category 5C 'Incineration and Open Burning of Waste'.

7.5. Wastewater Treatment and Discharge (Category 5D)

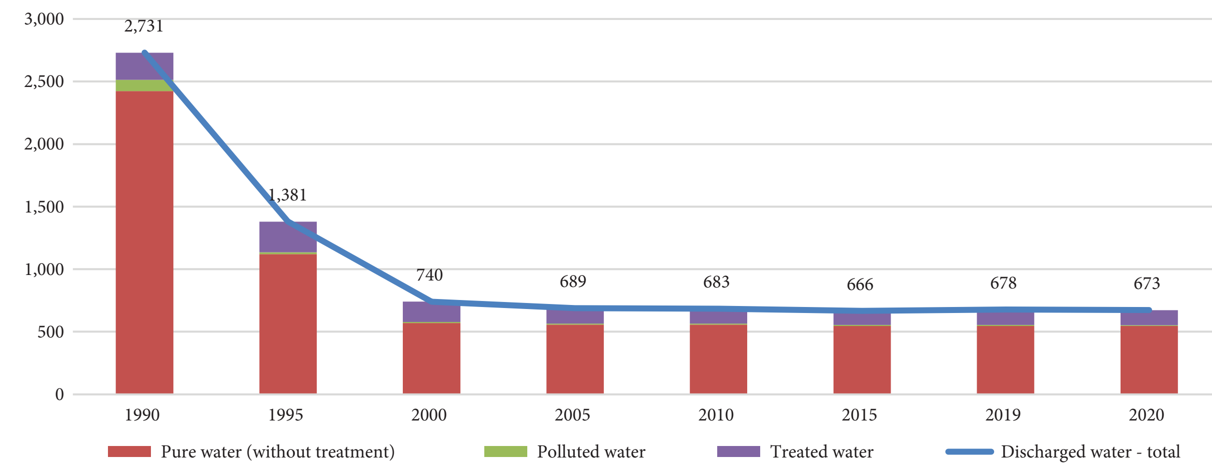
The public sewage system represents an assembly of technological installations, functional equipment and specific facilities through which the public sewage service is operating. The system comprises the following components: public sewage networks, pumping stations, treatment plants, discharging facilities.

In the Republic of Moldova, the current sewage system is underdeveloped and has a low capacity in the context of fully securing the population's access to quality sewage services. At the same time, there is a lack of experience and application of new technologies in this area. With recent investments in the water supply and sewage sector, attempts have been made to apply well-known European practices. These refer to the implementation of new technologies for wastewater treatment, drinking water treatment, the use of new materials (plastics) for pipes in water and sewage systems, which are superior to pipes made of corrosive and expensive metal materials.

Municipal wastewater in the Republic of Moldova is collected centrally, together with industrial wastewater and is directed for treatment in biological treatment plants. The wastewater treatment scheme is the classic one and has a different level of treatment in urban and rural areas, and depends on the degree of technical endowment of the installations. The main methods of wastewater treatment, according to the data presented are: mechanical, biological based on the degradation of organic substances, and chemical with the use of reagents, as well as combined methods.

Water quality is influenced by the discharge of untreated or insufficiently treated wastewater from wastewater treatment plants from natural sources. The biggest volumes of untreated used waters come from areas supplied with water, but do not have sewage systems and treatment plants. Based on statistical data, the volume of wastewater discharged has been relatively stable over the last 10 years and the share of polluted water is relatively low, varying from 1.2 to 1.5%, with a significant increase in 2016.

However, it should be noted that a steady decrease in the volume of wastewater discharge, water intake, and use has been recorded un the past 30 years (Figure 7-8).



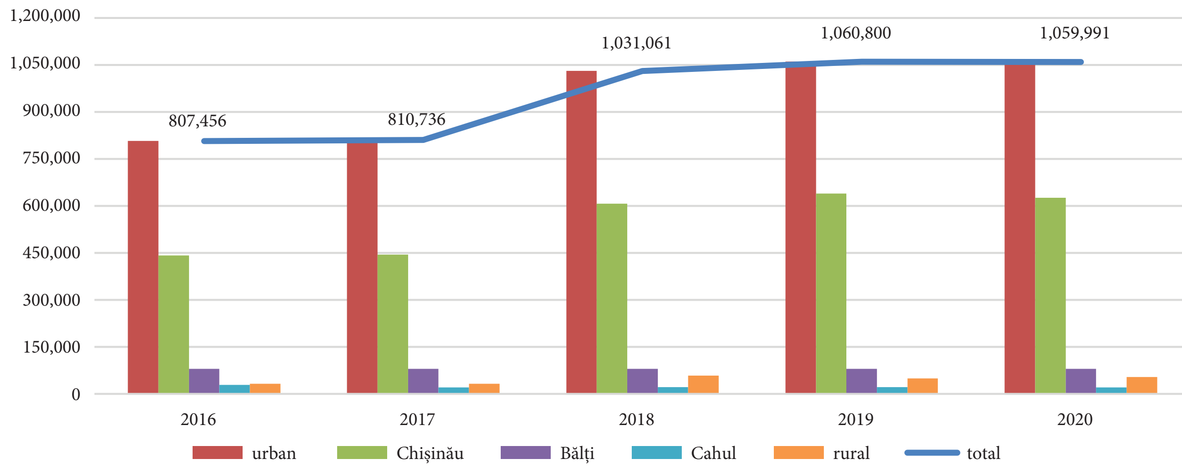
Source: NBS

Figure 7-8: Discharge of wastewater, mine and groundwater drained in surface water bodies, mil. m^3.

Thus, between 1990 and 2020, the respective volume decreased by circa 75.2%, from 2.731 million m^3 to 673 million m^3. Due to the low number of operational wastewater treatment plants, the amount of pollutants from wastewater discharged from managed sources, as well as the maximum allowable concentration set by current standards, are still above the limit set by environmental authorities. During this period, the volume of polluted wastewater discharged into water bodies decreased by circa 91.1 %, from 90 million m^3 in 1990 to 8 million m^3 in 2020. In 2020, 6.4 million tonnes of suspended solids, 96 million tonnes of residue, 15.9 million tonnes of sulphates, 61.8 million tonnes of chlorides, 200 tonnes of nitrogen, 295 tonnes of nitrates, 528 tonnes of phosphorus, 50 tonnes of petroleum products, and 427 tonnes of ammonium nitrate were recorded in wastewater.

The discharge of wastewater from consumers is carried out through sewage discharge systems, which currently do not fully cover all localities of the country. The quality of sewage services provided to the population is low. All urban areas in developing regions have wastewater treatment plants, but most existing facilities are run-down and inefficient. Most existing plants provide only mechanical treatment, while high-energy biological installations are decommissioned due to high operating costs. The quality of treated wastewater in all urban areas, except for some cities, does not comply to the existing discharge rules. Exceedances of maximum pollutant concentrations in treated wastewater are detected in ammonium, suspended substances and organic substances expressed in BOD_5. Only 97% of urban areas in developing regions have wastewater treatment plants; whereas in rural areas, only 3-8% of the population have sewage systems. Some urban areas (for example, Soroca) do not have a treatment plant and untreated municipal wastewater is discharged directly into the cross-border river Dniester (National Program for the Implementation of the Protocol on Water and Health in the Republic of Moldova 2016-2025 (Government Decision No. 1063 dated 16.09.2016).

Based on statistical data, between 2016 and 2020, the number of people connected to the public sewage system has increased by 31%, from 807.456 thousand to 1.059,991 thousand, most of whom are from Chisinau (see Figure 7-9).



Source: National Bureau of Statistics

Figure 7-9: Population connected to public sewer system, people.

As for the connection rate, it also increased between 2016 and 2020, from 22.7% to 29.9%, the highest connection rate being recorded in Chisinau, whereas the lowest one in all rural localities, some of which are not even connected.

It should be mentioned that 2.231,154 thousand people are connected to the public water system in 2020, which is twice more than those who are connected to the sewer system. Therefore, a quantity of waste water is generated, which is not treated and is collected in non-centralized systems, such as latrines or septic tanks, or is discharged directly into emissaries, as in Soroca town.

The number of wastewater treatment plants modestly increased between 2016 and 2020, from 87 to 92 plants, of which 73 and 81, respectively, were operational.

In 2020 the total length of the public sewer networks was 2.9 thousand km or 38.9 km more than in 2019. In 2020, 31.7 km of public sewer were built, 1.4 km fewer than in 2019, and 14.6 km were rebuilt, 7.1 km more, respectively. Most of the new public sewer networks, 23.5 km (or 74.1% of the total length built) were built in the Centre: Calarasi, Dubasari, and Hancesti districts. 8.1% of the total localities of the country were provided with public sewer systems, 94.5% – municipalities and towns, and 4.9% – rural areas.

There is still a considerable discrepancy between towns and villages, rural localieties from Briceni, Drochia, Falesti, Glodeni, Ocnita, Soroca, Rezina, Soldanesti, Basarabeasca, Cantemir and Leova districts have not had acces to a centralised sewer system.

The volume of discharged and treated wastewater is decreasing, and the total volume of discharged wastewater in 2020 constituted 66.9 million m^3, 3.5 million m^3 less compared to 2019.

In 2020, circa 71% of the total public sewer systems were connected to water treatment plants. There are no localities in Glodeni and Rezina districts connected to a water treatment plan; 64.9 million m^3 of wastewater were treated in water treatment plants (97.0%).

The use of the new wastewater treatment technology in Soroca (constructed wetland zones – CWZ) was not supported by the vast majority of the population and was not implemented, but experience was gained in designing these systems. Using this experience, the technology of CWZ spread later throughout the country, being built and put into operation in Orhei town in September 2013. The station uses built-up wetland technology, which has lower maintenance and operating costs compared to traditional technologies. The CWZ experience was applied in the villages Rusca, Sarata Galbena.

In small rural communities, the application of decentralized treatment solutions (septic tanks, Eco-san toilets, compact wastewater treatment plants for public/commercial buildings) have proven to be effective.

Sewage systems, which ensure the discharge and treatment of wastewater, have a high degree of wear, are run-down and obsolete, as they have operated for more than 25-30 years without reconstruction, and require technological modernization, respectively.

Currently, the management of sludge produced at wastewater treatment plants is inadequate and does not comply with the requirements of the regulations in force. A major problem that exists in the wastewater treatment process that significantly influences the environment is the lack of modern processing facilities for sludge formed as a result of wastewater treatment. The classic method used to treat sludge is to store it on sludge platforms. Based on the fact that the design capacities of all existing installations are, as a rule, larger (circa 2-10 times, and in some localities even more) than the actual recorded volumes of water generation; there are unused surfaces to store sludge at all these sites. Only in big cities, such as Chisinau, Balti and Cahul, due to the lack of modern sludge treatment technologies, its storage is carried out in layers larger than 50 cm, which causes anaerobic processes and induces the formation of methane emissions.

In 2009, in order to overcome the existing situation, for the purpose of sludge processing and odour removal, the wastewater treatment plant in Chisinau implemented the pilot-project for raw sludge dewatering using the 'Geotube' method. The annual capacity of the sludge dewatering process is 584 thousand m^3 with 95% humidity, which has a capacity of 97.3 thousand m^3 after dewatering and 70% humidity. Two open storage facilities were built to store the sludge from the 'Geotube' bags after the dewatering process.

It should be noted that rehabilitation works of the Wastewater Treatment Plant in Chisinau were initiated in 2018. The project includes the construction of a new sludge treatment facility, infrastructure renovation, construction of several specialized facilities and installation of the wastewater filtering equipment. A power plant using sludge as raw material is planned to be built. Electricity will be produced as a result of biogas production, providing the wastewater treatment plant with 50% of the electricity required to operate. The rehabilitation works of the Chisinau Wastewater Treatment Plant have been carried out so far in proportion of 30%, but have been slowed down due to the COVID-19 pandemic.

7.5.1. Source Category Description

Within source category 5D 'Wastewater Treatment and Discharge' CH_4 and N2O emissions from 5D1 'Domestic Wastewater', as well as CH_4 emissions from 5D2 'Industrial Wastewater' were estimated.

5D1 'Domestic Wastewater'

Domestic wastewater is the product of using water for domestic purposes. The process of treating domestic wastewaters and sludge from treatment facilities implies CH_4 generation and NMVOC, but in a smaller amount. The wastewater treatment scheme is a classic one and has a different treatment level in urban and rural areas, depending on the technical endowment of the installations. The main wastewater treatment methods are: mechanical, biological (based on organic matter decomposition), chemical (using reagents), as well as combined methods. In some cases, wastewater is discharged directly into surface basins without special treatment, and in other cases they are treated and discharged with different levels of organic matter load.

Domestic wastewater is discharged through a network that currently does not fully cover the country's localities. The quality of sewage services provided to the population is poor. All urban areas in the developing regions have wastewater treatment facilities, but most of them are run-down and inefficient.

The majority of the existing facilities provide only a mechanical treatment, while biological facilities with a larger energy consumption are shut down due to high operation costs. The quality of treated wastewater in all urban areas, except for certain cities, do not meet the existing discharging standards. Exceedances of maximum concentrations of pollutants in treated wastewater are detected in ammonia, suspended substances and organic substances expressed in BOD_5.

Only 97% of urban areas in developing regions have wastewater treatment plants, and in rural areas, only 3-8% of the population are connected to the sewer system. Some urban areas (for example, Soroca) do not have a treatment plant and untreated municipal wastewater is discharged directly into the cross-border river Dniester[125].

The amount of GHG emissions generated under this source category depends on domestic wastewater management practices used in the Republic of Moldova, as well as the percentage of the population connected to centralized sewer systems and wastewater treatment. The most widespread wastewater treatment method used in the RM is the traditional biological aerobic treatment. Another source of GHG emissions is from the sludge from the wastewater treatment, which is subject to aerobic and anaerobic treatment, by storage on sludge fields.

Currently, domestic wastewater treatment is carried out only partially in most urban areas of the RM. It should be noted that in most rural localities the sewage systems were run-down. In urban localities, where the wastewater treatment plants operate, the sludge is treated by storing it on sludge platforms. Because the design capacities of all existing facilities are usually larger (circa 2-10 times, and in some localities even more) than the actual recorded volumes of water generation; there are free surfaces to store sludge at all these sites. Only in large cities, such as Chisinau, Balti and Cahul, due to the lack of sludge treatment technologies, its storage is carried out in layers larger than 50 cm, which causes anaerobic processes and induces the formation of methane emissions. However, compared to the total sludge storage area, these areas are insignificant to be taken into account in the emission calculation process.

Domestic wastewater from individual households in urban and rural areas not connected to a sewer system are usually collected in latrines.

5D2 'Industrial Wastewater'

In the Republic of Moldova industrial wastewater is treated using the network for municipal domestic wastewater. After generation, industrial wastewater is discharged into the sewage systems of the domestic wastewater, being thus treated together. Industrial wastewater is redirected to sewage systems based on the technical conditions issued by the operators of 'Apa-Canal' enterprises. At the same time, based on the results of the inventory of existing wastewater treatment plants, it was found that the respective enterprises allowed the connection of several economic agents from the industrial sector to the urban sewer systems due to insufficient volume of wastewater needed for the proper functioning of domestic wastewater treatment plants, which meant that the economic agents did not have to build local industrial wastewater treatment plants. Within the industrial sector, the processing industries contribute the most to the generation of wastewater with an increased content of organic biodegradable substances.

7.5.2. Methodological Issues, Emission Factors and Data Sources

Methane emissions from source category 5D 'Wastewater Treatment and Discharge' were estimated using a Tier 1 method available in the 2006 IPCC Guidelines, following several steps.

5D1 'Domestic Wastewater'

Step I: Estimating total organically degradable carbon in wastewater (TOW)

Estimation of total organically degradable carbon in wastewater (TOW). Available methodology in the 2006 IPCC Guidelines implies estimating total organically degradable carbon in wastewater generated by all households, either connected or not to the sewage system. The value of this index is

[125] Government Decision of the RM No. 1063 dated 16.09.2016 on the approval of The National Program for the Implementation of The Protocol on Water and Health in Moldova for 2016-2025. Published: 20.09.2016 in Official Monitor of the RM No. 314, article No. 1141, modified HG1090 dated 18.12.17, MO440/20.12.17 article 1214, <http://lex.justice.md/index.php?action=view&view=doc&lang=1&id=366749>.

influenced, particularly, by the population number (urban and rural population), respectively by the biochemical oxygen demand (BOD) component in wastewater.

Total organically degradable carbon in wastewater was estimated following Equation 6.3 from the 2006 IPCC Guidelines (Volume 5, Chapter 6, page 6.13):

$$TOW = P \bullet BOD \bullet 0.001 \bullet I \bullet D$$

Where:

TOW – total organics in wastewater in inventory year, kg BOD/yr;

P – country population in inventory year (person);

BOD – country-specific per capita BOD in inventory year, g/person/day, the default value used for the European countries represents 60 g BOD_5/person/day (2006 IPCC Guidelines, Volume 5, Chapter 6, Table 6.4, page 6.14); in the Republic of Moldova the country-specific value is 60 BOD/person/day (SNIP G.03.02-2015 Table 7.1);

0.001 = conversion from grams BOD to kg BOD;

I – correction factor for additional industrial BOD discharged into sewers (for collected the default is 1.25, for uncollected the default is 1.00);

D – number of days in a calendar year (365 days in regular years and 366 days in leap years: 1992, 1996, 2000, 2004, 2008, 2012, 2016, 2020).

Table 7-27: AD used to estimate CH_4 emissions from source category 5D1 'Domestic Wastewater' in the RM between 1990-2020

	1990	1991	1992	1993	1994	1995	1996	1997
TOW_{rural}, kt BOD_5/yr	50.2014	50.2101	50.6595	50.5583	50.7226	50.6963	51.1734	50.9109
TOW_{urban}, kt BOD_5/ yr	50.9494	51.1913	51.0182	50.7817	50.7605	51.3491	50.0804	48.5297
TOW_{total}, kt BOD_5/ yr	95.5190	95.6220	95.7258	95.2168	95.3241	95.2190	95.1834	94.6080
	1998	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**
TOW_{rural}, kt BOD_5/yr	50.9000	50.9022	50.9494	51.1913	51.0182	50.7817	50.7605	51.3491
TOW_{urban}, kt BOD_5/ yr	47.5976	46.4181	43.5555	42.6787	42.4882	42.3218	42.1456	38.1659
TOW_{total}, kt BOD_5/ yr	94.7350	94.4985	94.5049	93.8700	93.5064	93.1035	92.9062	89.5150
	2006	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**
TOW_{rural}, kt BOD_5/yr	50.0804	48.5297	47.5976	46.4181	45.2936	44.1697	43.2024	41.9061
TOW_{urban}, kt BOD_5/ yr	37.6682	37.4525	36.8445	36.0466	35.4463	34.8542	34.3195	33.7020
TOW_{total}, kt BOD_5/ yr	87.7486	85.9822	84.4421	82.4647	80.7399	79.0239	77.5219	75.6081
	2014	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**%**
TOW_{rural}, kt BOD_5/yr	40.7847	40.2778	39.7591	38.9454	38.1443	37.4724	36.9976	-26.3
TOW_{urban}, kt BOD_5/ yr	33.1142	32.9856	32.6845	32.2417	31.9218	31.5381	31.2911	-38.6
TOW_{total}, kt BOD_5/ yr	73.8989	73.2634	72.4436	71.1871	70.0661	69.0105	68.2886	-28.5

Step II: Selecting wastewater treatment systems and discharge pathways

The second step consists of selecting wastewater treatment and discharge pathways according to national conditions and by taking into consideration country-specific activity data. By applying Equation 6.2 from the 2006 IPCC Guidelines (Volume 5, Chapter 6, page 6.12) it is possible to obtain the EFs for each wastewater treatment system and discharge pathway. The value of the country-specific emission factor depends on the methane producing capacity (B_0), and the methane correction factor (MCF) specific to the respective wastewater treatment system and discharge pathway, respectively. B_0 represents the maximum methane producing capacity in a certain amount of organic substances (expressed in BOD) in wastewater. MCF reveals the extent to which the methane producing capacity (B_0) is achieved within each type of wastewater treatment and discharge system. This is also an index of the degree that demonstrates to what extent the wastewater treatment system is anaerobic.

$$EFj = B_0 \bullet MCF_j$$

Where:

EF_j – emission factor, kg CH_4/kg BOD_5;

j – each treatment/discharge pathway or system;

B_0 – maximum methane producing capacity, kg CH_4/kg BOD_5 (according to the 2006 IPCC Guidelines, Volume 5, Chapter 6, Table 6.2, page 6.12, the default value used is 0.6);

MCF_j – methane correction factor (fraction) (Table 7-28).

Table 7-28: EFs used to estimate CH_4 emissions from source category 5D1 'Domestic Wastewater'

Type of system	Wastewater treatment systems and discharge pathways, j	B_o, kg CH_4/kg BOD_5	MCF	EF, kg CH_4/kg BOD_5
Untreated systems	River and lake discharge without the preventive wastewater treatment	0.6	0.1	0.06
	Stagnant sewer	0.6	0.5	0.30
	Flowing sewer (open or closed)	0.6	0.0	0.0
Treated systems	Centralized, aerobic treatment plant, well managed	0.6	0.1	0.6
	Centralized, aerobic treatment plant, not well managed	0.6	0.2	0.12
	Anaerobic digester for sludge	0.6	0.8	0.48
	Anaerobic shallow lagoon (<2 m)	0.6	0.2	0.12
	Anaerobic deep lagoon (>2 m)	0.6	0.8	0.48
	Septic system (half of BOD settles in anaerobic tank)	0.6	0.3	0.18
	Latrine, dry climate, ground water table lower than latrine, small family (3-5 persons)	0.6	0.1	0.06
	Latrine, dry climate, ground water table lower than latrine, communal (many users)	0.6	0.5	0.30
	Latrine, wet climate/flush water use, ground water table higher than latrine	0.6	0.7	0.42
	Latrine, regular sediment removal for fertilizer	0.6	0.1	0.06

Step III: Estimating total methane emissions from wastewater treatment and discharge

The third step consists of estimating total methane emissions from source category 5D1 'Domestic Wastewater' as a sum of emissions from each wastewater treatment system and discharge pathway in the country. The assessment is according to Equation 6.1 from the 2006 IPCC Guidelines (Volume 5, Chapter 6, page 6.11):

$$CH_4\ Emissions = [\Sigma_{ij}\ (U_i \bullet T_{ij} \bullet EF_j)] \bullet (TOW - S) - R,$$

Where:

CH_4 *Emissions* – methane emissions in inventory year, kg CH_4/yr;

TOW – total organics in wastewater in inventory year, kg BOD/yr;

S – organic component removed as sludge in inventory year, kg BOD/yr;

Ui – fraction of population in income group *i,* in inventory year (fraction);

$T_{i,j}$ – degree of utilisation of treatment/discharge pathway or system, *j*, for each income group fraction *i,* in inventory year (fraction);

i – income group: rural – low income, urban – high income, and urban – low income;

j – each treatment/discharge pathway or system;

EF_j – emission factor, kg CH_4/kg BOD;

R – amount of methane recovered in inventory year, kg CH_4/yr.

Table 7-29: Share of different groups from the total population in the RM (U_i fraction, where 100% = 1.0) for 1990-2020

	1990	1991	1992	1993	1994	1995	1996	1997
U_{rural}	0.526	0.525	0.529	0.531	0.532	0.532	0.538	0.538
$U_{urban, low income}$	0.289	0.290	0.287	0.286	0.285	0.284	0.282	0.282
$U_{urban, high income}$	0.186	0.185	0.183	0.184	0.183	0.184	0.180	0.180
	1998	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**
U_{rural}	0.537	0.539	0.539	0.545	0.546	0.545	0.546	0.572
$U_{urban, low income}$	0.280	0.280	0.279	0.277	0.277	0.277	0.270	0.286
$U_{urban, high income}$	0.182	0.181	0.182	0.177	0.177	0.178	0.184	0.142
	2006	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**
U_{rural}	0.570	0.565	0.565	0.565	0.564	0.562	0.562	0.560
$U_{urban, low income}$	0.287	0.283	0.285	0.286	0.286	0.286	0.287	0.288
$U_{urban, high income}$	0.143	0.152	0.150	0.150	0.151	0.151	0.151	0.152
	2014	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**%**
U_{rural}	0.558	0.556	0.555	0.553	0.551	0.550	0.548	4.3
$U_{urban, low income}$	0.289	0.289	0.292	0.295	0.298	0.301	0.147	-49.1
$U_{urban, high income}$	0.154	0.155	0.153	0.152	0.151	0.149	0.305	64.1

According to the recommendations set out in the 2006 IPCC Guidelines (Volume 5, Chapter 6, pages 6.14-6.15), the population generating wastewater is to be divided into groups depending on the level of economic development and implicitly by the urbanization degree of localities (Table 7-29), on which the access to wastewater collection and treatment systems, and the efficiency of these systems depends.

In the Republic of Moldova the population was divided into the following groups:

- population with high urbanization rate and high incomes; this group comprises the population of Chisinau, Balti, Tiraspol, Bender, Ribnita and Cahul municipalities (Table 7-30), whose population is connected to sewer systems and has access to centralized aerobic treatment plants for domestic and industrial wastewater collected together; their efficiency varies from well managed to not well managed; it is worth mentioning that a small part of the population of these municipalities is not connected to the centralized sewer system, the wastewater being collected in latrines and septic systems (with or without discharge);

- population with low urbanization rate and low incomes; this group comprises the population of other cities in the RM, whose population is largely connected to sewage systems, which are rather not well managed; another part of the population within this group is not connected to sewage systems, the wastewater being collected in latrines and septic systems (with or without discharge);
- rural population; this group comprises the rural population of the RM, whose income is generally significantly lower than the level attributed to the urban population; a small part of the population of this group is connected to not well managed sewage systems; while most of the population is not connected to any sewage system, wastewater being collected in latrines (usually without discharge).

Table 7-30: Population of the Republic of Moldova with high urbanization rate and high income between 1990-2020, thousand inhabitants

	1990	1991	1992	1993	1994	1995	1996	1997
Chisinau	675.5	676.7	667.1	663.4	661.6	661.5	661.9	664.7
Balti	161.7	161.8	159.0	157.5	156.1	154.8	153.5	153.4
Bender	132.2	133.0	132.7	129.3	128.6	126.8	124.7	123.4
Tiraspol	183.7	186.0	186.2	185.1	185.6	183.1	176.8	173.1
Ribnita	62.2	62.9	63.0	62.4	63.2	63.4	62.5	62.0
Cahul	44.0	44.3	44.6	43.6	43.7	43.4	43.1	43.0
Total, $P_{urban, high income}$	1259.3	1264.7	1252.6	1241.3	1238.8	1233.0	1222.5	1219.6
	1998	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**
Chisinau	663.2	663.6	663.4	662.0	662.0	660.7	662.2	661.2
Balti	152.4	152.0	151.3	146.7	146.5	145.9	144.3	144.2
Bender	122.4	121.2	119.6	117.6	116.0	114.8	96.9	85.8
Tiraspol	170.5	168.0	164.9	161.9	159.2	155.8	144.0	142.1
Ribnita	61.6	61.1	60.5	59.6	58.5	57.5	53.5	52.8
Cahul	42.7	42.6	42.4	41.2	41.2	41.1	41.0	40.8
Total, $P_{urban, high income}$	1212.8	1208.5	1202.1	1189.0	1183.4	1175.8	1141.9	1126.9
	2006	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**
Chisinau	660.2	658.4	663.1	663.2	663.4	664.7	667.6	671.8
Balti	143.2	142.2	143.2	143.2	143.3	144.0	144.3	144.8
Bender	95.0	94.4	94.1	93.8	93.3	93.0	92.4	91.9
Tiraspol	140.4	138.6	137.3	137.8	136.8	135.7	134.8	133.8
Ribnita	52.2	51.4	50.8	50.1	49.4	48.8	48.5	47.9
Cahul	40.7	39.2	39.0	39.4	39.4	39.7	39.8	39.8
Total, $P_{urban, high income}$	1131.7	1124.2	1127.5	1127.5	1125.6	1125.9	1127.4	1130.0
	2014	**2015**	**2016**	**2017**	**2018**	**2019**	**2020***	**%**
Chisinau	674.5	678.2	681.1	685.9	690.0	695.4	698.7	3.4
Balti	144.9	145.3	145.8	146.3	146.6	146.9	147.4	-8.8
Bender	91.0	84.7	83.8	83.7	83.2	83.4	83.4	-36.9
Tiraspol	132.9	128.9	128.2	128.0	127.0	127.7	128.4	-30.1
Ribnita	47.6	45.4	44.8	44.7	44.4	44.0	44.0	-29.3
Cahul	39.6	39.6	39.6	39.5	39.5	39.4	39.4	-10.5
Total, $P_{urban, high income}$	1130.5	1122.1	1123.3	1128.1	1130.7	1136.8	1141.3	-9.4

*due to the lack of statistical data for 2020, the population of Chisinau, Balti and Cahul was deduced using the extrapolation method

Source:<http://statbank.statistica.md/pxweb/pxweb/ro/20%20Populatia%20si%20procesele%20demografice/?rxid=b2ff27d7-0b96-43c9-934b-42e1a2a9a774>; Statistical Yearbooks of the ATULBD for the period 1998-2020 http://mer.gospmr.org/gosudarstvennaya-sluzhba-statistiki/informacziya/ezhegodnik-gosudarstvennoj-sluzhby-statistiki.html.

Thus, considering the level of economic development of the localities of the RM, the degree of urbanization, and the degree of connection to the wastewater collection and treatment systems, respectively, according to statistical data on the access to sewage systems and to expert opinion, the values of country-specific emission factors used to estimate CH_4 emissions from the most representative wastewater treatment and discharge systems and for each population group of the RM during the reference period were established (1990-2020) (Table 7-31).

Table 7-31: Country-specific factors used to estimate CH_4 emissions from source category 5D1 'Domestic Wastewater' for 1990-2020

Year	Degree of use of the wastewater treatment systems and discharge pathways j, for each population group – T_{ij}															
	U = urban, high income					U = urban, low income						U = rural				
	U_i	Centralized, aerobic treatment plant, well managed	Centralized, aerobic treatment plant, not well managed	Latrines, ground water table lower than latrine, (3-5 persons)	Septic tanks	U_i	Centralized, aerobic treatment plant, well managed	Centralized, aerobic treatment plant, not well managed	Latrines, ground water table lower than latrine, (3-5 persons)	Septic tanks	Wastewater discharge in river and lakes	U_i	Centralized, aerobic treatment plant, well managed	Centralized, aerobic treatment plant, not well managed	Latrines, ground water table lower than latrine, (3-5 persons)	Septic tanks
1990	0.289	0.900	0.000	0.100	0.000	0.186	0.300	0.300	0.400	0.000	0.000	0.526	0.100	0.000	0.900	0.000
1991	0.290	0.882	0.020	0.098	0.000	0.185	0.280	0.320	0.400	0.000	0.000	0.525	0.100	0.000	0.900	0.000
1992	0.287	0.874	0.030	0.096	0.000	0.183	0.260	0.340	0.400	0.000	0.020	0.529	0.080	0.000	0.920	0.000
1993	0.286	0.866	0.040	0.094	0.000	0.184	0.240	0.360	0.360	0.000	0.040	0.531	0.060	0.000	0.940	0.000
1994	0.285	0.858	0.050	0.092	0.000	0.183	0.220	0.380	0.340	0.000	0.060	0.532	0.040	0.000	0.960	0.000
1995	0.284	0.850	0.060	0.090	0.000	0.184	0.180	0.400	0.340	0.000	0.080	0.532	0.020	0.000	0.980	0.000
1996	0.282	0.870	0.070	0.060	0.000	0.180	0.140	0.420	0.340	0.000	0.100	0.538	0.010	0.000	0.990	0.000
1997	0.282	0.900	0.080	0.020	0.000	0.180	0.090	0.440	0.350	0.000	0.120	0.538	0.000	0.015	0.985	0.000
1998	0.280	0.880	0.090	0.030	0.000	0.182	0.060	0.460	0.340	0.000	0.140	0.537	0.000	0.015	0.985	0.000
1999	0.280	0.850	0.100	0.050	0.000	0.181	0.020	0.480	0.350	0.000	0.150	0.539	0.000	0.017	0.983	0.000
2000	0.279	0.830	0.100	0.070	0.000	0.182	0.010	0.490	0.340	0.000	0.160	0.539	0.000	0.018	0.982	0.000
2001	0.277	0.800	0.100	0.100	0.000	0.177	0.010	0.490	0.320	0.000	0.180	0.545	0.001	0.019	0.980	0.000
2002	0.277	0.800	0.100	0.100	0.000	0.177	0.020	0.480	0.300	0.000	0.200	0.546	0.002	0.020	0.978	0.000
2003	0.277	0.800	0.100	0.100	0.000	0.178	0.030	0.470	0.300	0.000	0.200	0.545	0.003	0.021	0.976	0.000
2004	0.270	0.800	0.100	0.100	0.000	0.184	0.040	0.460	0.320	0.000	0.180	0.546	0.004	0.022	0.974	0.000
2005	0.286	0.801	0.090	0.109	0.000	0.142	0.040	0.460	0.330	0.000	0.170	0.572	0.005	0.023	0.972	0.000
2006	0.287	0.801	0.080	0.119	0.000	0.143	0.060	0.440	0.340	0.000	0.160	0.570	0.007	0.023	0.970	0.000
2007	0.283	0.801	0.070	0.119	0.010	0.152	0.070	0.430	0.350	0.000	0.150	0.565	0.009	0.023	0.968	0.000
2008	0.285	0.801	0.060	0.129	0.010	0.150	0.080	0.420	0.355	0.005	0.140	0.565	0.011	0.023	0.966	0.000
2009	0.286	0.802	0.060	0.128	0.010	0.150	0.090	0.410	0.335	0.015	0.150	0.565	0.013	0.023	0.959	0.005
2010	0.286	0.804	0.050	0.136	0.010	0.151	0.110	0.390	0.340	0.020	0.140	0.564	0.014	0.023	0.956	0.007
2011	0.286	0.806	0.050	0.134	0.010	0.151	0.150	0.350	0.340	0.030	0.130	0.562	0.015	0.024	0.946	0.015
2012	0.287	0.808	0.050	0.132	0.010	0.151	0.170	0.330	0.340	0.040	0.120	0.562	0.016	0.025	0.941	0.018
2013	0.288	0.810	0.050	0.125	0.015	0.152	0.200	0.300	0.340	0.050	0.110	0.560	0.017	0.026	0.937	0.020
2014	0.289	0.812	0.050	0.123	0.015	0.154	0.230	0.270	0.340	0.060	0.100	0.558	0.018	0.028	0.932	0.022
2015	0.289	0.813	0.050	0.122	0.015	0.155	0.260	0.240	0.350	0.060	0.090	0.556	0.019	0.028	0.928	0.025
2016	0.292	0.813	0.050	0.122	0.015	0.153	0.280	0.220	0.360	0.060	0.080	0.555	0.020	0.022	0.932	0.026
2017	0.295	0.816	0.040	0.126	0.018	0.152	0.300	0.220	0.348	0.062	0.070	0.553	0.022	0.020	0.931	0.027
2018	0.298	0.825	0.040	0.117	0.018	0.151	0.320	0.230	0.318	0.062	0.070	0.551	0.025	0.018	0.929	0.028
2019	0.301	0.831	0.040	0.111	0.018	0.149	0.340	0.210	0.318	0.062	0.070	0.550	0.025	0.017	0.930	0.028
2020	0.305	0.820	0.040	0.120	0.020	0.147	0.340	0.210	0.320	0.065	0.065	0.548	0.028	0.017	0.925	0.030

5D2 'Industrial Wastewater'

Step I: Estimating total organically degradable carbon in industrial wastewater (TOW)

According to the methodology available in the 2006 IPCC Guidelines, the amount of organically degradable carbon in wastewater (TOW) is a function of industrial output (product) P (tonnes/yr), wastewater generation W (m^3/tonne of product) and degradable organics concentration in wastewater COD (kg COD/m^3).

The amount of total organically degradable carbon in wastewater (TOW) for the industrial sector was estimated using Equation 6.6 from the 2006 IPCC Guidelines (Volume 5, Chapter 6, page 6.22):

$$TOW_{ind} = P_i \bullet W_i \bullet D_{ind}$$

Where:

TOW_{ind} – total organically degradable material in wastewater for industry *i*, kg COD/yr [126];

P_i – total industrial product for industrial sector *i*, t/yr;

W_i – wastewater generated, $m^3/t_{product}$;

D_{ind} – chemical oxygen demand (industrial degradable organic component in wastewater) kg CCO/m^3.

For this purpose, activity data on the generation of industrial wastewater (by industry) and its discharge into sewage networks was used.

[126] COD – chemical oxygen demand.

Each industry branch was assigned a certain value of the degradable organic component expressed in kg COD/m^3 of industrial wastewater, the amount of wastewater generated per industrial production output unit expressed in m^3/tonnes of product (Table 7-32), as well as the amount of annual output for each industry branch (Table 7-33).

Table 7-32 EFs used to estimate CH_4 emissions from source category 5D2 'Industrial Wastewater'

Industry Production	D_{ind} – industrial degradable organic component, kg CDO/m^3	W_{ind} – amount of wastewater generated per industrial production output unit, m^3/t
Canned meat	4.1	13.0
Canned vegetables and fruit	5.0	20.0
Beer	2.9	6.3
Wine and sparkling wine	1.5	23.0
Cognac and brandy	11.0	24.0
Meat and sausages	4.1	13.0
Dairy products	2.7	7.0
Sugar	3.2	11.0
Fish	2.5	13.0
Vegetable oil and fats	0.8	3.1
Soft drinks	1.0	3.8
Corrugated cardboard	9.0	162.0
Plastics and resins	3.7	0.6
Paint and varnishes	3.0	67.0
Detergents and soap	0.6	2.5
Leather	7.0	4.2
Textiles	1.0	42.6

Source: 2006 IPCC Guidelines, Volume 5, Chapter 6, Table 6.9, page 6.22; Mircea Gh. Negulescu et al. (1968), Industrial Wastewater Treatment, Technical Publishing House, Bucharest, 1968; CEC VNII VODGEO GOSSTROI of the USSR (1982), Consolidated Norms in Water Supply and Water Disposal for Different Industries, Moscow, 1982; Sewage System for Populated Areas and Industrial Plants. Handbook. 'Stroiizdat' Moscow, 1981.

Table 7-33: AD on industrial output used to estimate CH_4 emissions from source category 5D2 'Industrial Wastewater', kt

	1990	1991	1992	1993	1994	1995	1996	1997
Canned meat	15.0000	9.6000	5.8083	3.2694	1.7231	1.7500	1.5000	3.1000
Canned vegetables and fruit	499.3000	462.4000	394.6500	403.4000	244.2500	176.7000	126.2000	200.1000
Fruit and vegetable juices	273.6000	260.0000	89.1000	104.6000	50.8000	44.8000	49.4000	88.3000
Canned vegetables	149.6000	143.0000	74.3000	72.0000	62.4000	41.1000	20.5000	26.6000
Processed and canned fruit	76.1000	59.4000	48.2000	53.9000	17.6000	10.6000	17.6000	18.2000
Beer	76.0000	66.0000	43.0000	36.0000	28.5000	30.2900	25.6000	26.2700
Grape wine	163.0000	143.0000	92.0000	103.0000	97.7800	99.6900	145.8000	194.1500
Sparkling wine	8.0400	7.8300	8.5400	8.8800	7.4200	9.4800	14.1900	13.4500
Cognac	13.9400	14.0200	7.5000	7.4000	7.9300	10.2700	4.5700	5.8600
Brandy and liqueurs	5.5900	5.5600	6.7600	13.9400	26.4700	41.2700	33.5800	23.7000
Meat	257.9000	218.5000	136.0000	114.2000	85.9000	58.4000	52.6000	50.8000
Sausages	50.0000	52.9000	27.3000	14.7000	9.0000	8.9000	8.0000	9.6000
Butter	27.0000	21.8333	18.8026	11.0521	9.6601	6.8000	4.7000	2.9560
Margarine	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Cheese and cottage cheese	12.2000	10.0000	5.4000	4.9000	3.2000	2.1000	1.7000	1.2130
Curd, curd cream, yogurt, kefir, sour cream	138.0000	115.4000	70.1000	65.1000	48.8000	21.7000	11.9000	20.5000
Ice cream	11.5200	9.6000	6.4000	2.9000	2.5000	2.4000	3.0000	3.2510
Milk and whipped cream with a fat content <6 %	454.8000	382.6000	180.5000	175.1000	86.7000	39.5000	36.1000	26.6000
Milk and whipped cream in solid form	15.5000	12.0000	9.2000	4.3000	4.7000	4.4000	3.1000	2.6470
Crude oil, not chemically modified	125.6000	117.9000	57.3000	60.3000	50.4000	50.7000	39.4000	35.2000
Granulated sugar	435.8000	236.9000	208.0000	230.2000	166.7000	218.7000	264.5000	213.3000
Fish and fish products	9.5000	5.2000	6.5000	9.5000	2.1000	0.0000	0.0000	0.9000
Mineral and aerated water	51.9240	34.6160	19.7741	13.7495	11.3820	10.0025	10.1200	9.7715
Other non-alcoholic drinks	131.3300	86.2200	32.4067	18.7033	17.0813	20.4900	15.0800	14.3300
Paper and corrugated cardboard	5.3400	4.6500	1.1100	1.0200	0.2400	0.4200	0.5100	0.7200
Boxes and crates of paper or corrugated cardboard	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Paper and articles of paper for household use	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Synthetic resins	17.5000	14.6000	5.8390	4.7920	1.5100	1.4240	1.3499	1.2757
Paint and Varnishes	11.7000	8.8000	6.0000	3.1000	1.2000	0.8000	0.7000	0.5090
Soap	11.7000	8.0000	4.8000	2.7000	0.7000	0.6000	0.5000	0.6080
Washing and cleaning products	15.0000	10.1000	9.9000	4.9000	1.2000	1.4000	1.6000	0.2930
Rough leather goods	0.4389	0.4039	0.1057	0.0637	0.0273	0.0469	0.0539	0.0532
Leather boxing clothes	1.1739	1.1732	0.8974	0.6111	0.1820	0.1428	0.1771	0.2135
Cotton yarn	31.6000	32.6000	16.6680	8.5610	4.2520	2.6550	6.5240	5.3640
Fabrics	33.5400	16.7700	11.3718	7.5753	5.0481	3.7606	7.6810	7.2966
Polymer film	5.2000	4.4000	2.6000	2.3000	1.2000	0.7120	1.8960	1.2850

	1998	1999	2000	2001	2002	2003	2004	2005
Canned meat	2.3500	1.8600	2.8450	2.0710	2.2130	3.1920	2.2004	0.7394
Canned vegetables and fruit	135.4000	98.5920	93.8520	113.8750	80.8610	111.1940	80.4062	86.2642
Fruit and vegetable juices	67.4000	32.1000	46.7000	59.7000	31.2560	56.8840	36.8720	30.0230
Canned vegetables	27.2000	44.5270	22.1190	28.8760	22.7240	25.5340	22.7389	51.3414
Processed and canned fruit	6.6000	5.2160	6.1160	5.4230	5.2310	16.0760	18.5955	18.3317
Beer	30.0100	22.0900	25.7900	33.6200	46.2400	59.9100	69.5700	77.7800
Grapes wine	123.9600	69.0100	109.2240	156.4230	149.3980	192.1830	335.1400	364.3500
Sparkling wine	5.1900	6.7520	4.1620	5.8430	6.1300	7.3850	9.3830	10.5130
Cognac	4.9700	4.8590	7.1770	9.5560	10.3810	13.6110	14.2800	17.1080
Brandy and liqueurs	17.4100	8.7000	4.8900	5.9400	7.7900	13.9800	21.2910	23.8760
Meat	27.3000	25.7170	13.3510	7.3010	11.2620	14.8550	10.1797	6.6512
Sausages	8.0000	9.4340	10.1680	11.6550	13.8420	15.0260	15.5663	17.2410
Butter	2.8950	2.3740	2.8440	3.3600	2.7170	2.8630	3.8396	3.5927
Margarine	0.0000	0.0000	0.0240	1.0340	2.6160	3.3010	3.5150	3.3904
Cheese and cottage cheese	1.3280	1.3250	1.2120	1.4840	1.8950	1.8950	1.9410	2.4354
Curd, curd cream, yogurt, kefir, sour cream	26.8000	20.7000	17.1000	21.9000	16.8390	22.2620	20.9580	26.5315
Ice cream	4.3890	4.2640	4.3950	5.1820	6.3210	8.0730	7.2870	8.1050
Milk and whipped cream with a fat content <6 %	32.4000	25.9836	26.7640	35.1710	43.0600	16.9250	16.0490	20.7842
Milk and whipped cream in solid form	2.3890	1.9620	3.1140	5.0000	4.1860	3.7090	5.0590	4.5649
Crude oil, not chemically modified	28.7000	24.2640	31.3430	43.4860	53.6320	77.0065	96.0916	83.3940
Granulated sugar	194.5000	100.5000	105.4000	132.6000	167.6000	107.1000	110.9000	133.4720
Fish and fish products	0.8000	1.0000	1.9000	2.3000	2.7000	2.7000	2.7000	3.0000
Mineral and aerated water	18.5780	24.5845	30.9170	39.0390	54.2220	62.8040	75.2730	97.3095
Other non-alcoholic drinks	15.5700	15.1400	19.1800	30.9100	51.3700	63.4500	69.7430	69.4380
Paper and corrugated cardboard	0.3900	0.1800	0.1680	0.3852	0.1890	0.1851	0.4710	0.6051
Boxes and crates of paper or corrugated cardboard	0.0000	0.0000	0.0000	0.0000	19.4590	21.4362	20.9159	19.4070
Paper and articles of paper for household use	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	1.2300
Synthetic resins	1.2015	1.1273	1.0532	0.9790	0.7760	0.7080	0.9100	1.0480
Paint and Varnishes	0.3700	0.6740	2.0540	2.8700	4.0950	3.4430	5.1360	6.2690
Soap	0.3010	0.2310	0.2310	0.2800	0.2320	0.3386	0.3859	0.3171
Washing and cleaning products	0.1720	0.2580	0.3860	0.8210	0.2550	0.2430	0.4930	0.5329
Rough leather goods	0.0553	0.0182	0.0126	0.0119	0.0042	0.0021	0.0000	0.0000
Leather boxing clothes	0.0945	0.0399	0.0427	0.0595	0.1351	0.0420	0.0000	0.0000
Cotton yarn	10.5520	8.1310	13.0300	12.4000	12.5010	13.3000	16.2000	18.5368
Fabrics	13.6442	11.4858	17.0640	16.3416	16.8372	19.2924	20.6245	23.8233
Polymer film	1.2680	0.7010	1.7340	2.1410	3.3240	4.2110	4.2269	4.6179
	2006	2007	2008	2009	2010	2011	2012	2013
Canned meat	1.0623	1.3773	1.5551	1.1945	1.5981	1.4334	1.6541	0.9687
Canned vegetables and fruit	99.8960	93.9519	102.6686	60.2366	75.9771	71.0091	81.1089	100.8438
Fruit and vegetable juices	29.7320	53.7770	39.0420	28.1630	31.8517	34.7581	55.4276	60.1185
Canned vegetables	44.4091	22.7010	41.9393	26.5049	29.8896	26.3356	24.2911	25.1141
Processed and canned fruit	17.2757	16.5240	17.7808	3.7379	7.9848	6.7582	0.4362	10.7412
Beer	91.3270	101.4630	86.6590	78.1740	95.2600	106.8120	111.8440	102.9270
Grapes wine	188.6770	125.8120	155.2970	126.3050	128.5500	126.0570	142.2020	155.1660
Sparkling wine	4.0160	5.4070	5.7200	4.9970	5.5610	6.8640	6.5390	5.9950
Cognac	7.9140	8.2360	10.3730	6.9780	7.4648	9.1182	10.9404	11.7971
Brandy and liqueurs	19.6250	17.2160	12.9110	11.0800	12.7106	14.0214	16.5864	19.6140
Meat	10.2284	16.1218	12.8085	16.2600	24.6992	28.5094	31.5970	35.4950
Sausages	18.0348	20.7754	22.4660	17.0567	16.6971	17.9632	19.6328	21.2650
Butter	3.5214	3.5873	4.6969	4.2223	4.5858	4.2581	4.3918	5.8109
Margarine	2.6237	2.2254	1.9399	1.6573	1.2742	1.1188	0.4841	0.7065
Cheese and cottage cheese	2.0805	2.3106	2.6091	1.4627	1.8283	2.1531	2.2500	2.5252
Curd, curd cream, yogurt, kefir, sour cream	28.2782	32.3514	32.3734	32.9614	32.9990	35.4123	39.2828	41.2117
Ice cream	8.6090	8.2280	7.6790	7.0100	8.4903	8.3131	9.4363	10.1727
Milk and whipped cream with a fat content <6 %	50.3485	55.2711	66.5970	61.3976	65.0562	62.9209	62.3969	65.3133
Milk and whipped cream in solid form	3.8055	2.6760	2.6927	1.8205	1.2170	0.6254	0.5363	0.4391
Crude oil, not chemically modified	81.4707	84.9667	79.3068	83.8810	80.7054	89.7872	96.8282	65.5020
Granulated sugar	149.0460	73.9640	133.9660	38.3730	103.2090	88.4358	83.4395	140.2973
Fish and fish products	2.5000	2.3000	4.6000	3.7000	1.3000	7.5782	7.7319	8.4903
Mineral and aerated water	108.4890	136.5175	130.3580	117.8035	122.6675	114.3700	114.3750	100.4695
Other non-alcoholic drinks	81.3440	101.5940	87.5260	67.6170	73.0430	80.7460	79.7340	70.5450
Paper and corrugated cardboard	1.9500	2.7000	1.1400	0.8700	1.2900	2.5205	1.3243	2.4671
Boxes and crates of paper or corrugated cardboard	18.3144	15.6609	18.8347	16.9096	18.5745	15.2446	14.4642	14.1000
Paper and articles of paper for household use	1.2369	1.7384	3.1207	3.6216	4.5732	4.2573	3.8273	5.0582
Synthetic resins	0.8250	1.0260	0.9610	0.7770	1.5160	1.6570	1.7740	1.8420
Paint and Varnishes	8.3192	11.0453	11.5573	11.8224	12.8644	18.0112	17.9074	12.3448
Soap	0.5260	0.5620	0.3992	0.3803	0.5375	0.5231	0.5702	0.6367
Washing and cleaning products	0.7691	1.0336	0.4506	0.4818	0.6181	0.7266	0.7983	1.8922
Rough leather goods	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0070
Leather boxing clothes	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0354
Cotton yarn	18.7278	21.3193	20.6354	14.8669	16.1545	13.0776	14.2897	14.8861
Fabrics	23.6613	26.4401	26.7866	18.1294	21.7768	17.5440	19.6279	24.2389
Polymer film	3.8992	3.9898	3.6509	2.9260	3.8273	4.2210	3.7603	4.0993

	2014	2015	2016	2017	2018	2019	2020*	%
Canned meat	0.8254	0.7692	0.8059	0.8857	0.9264	0.9165	0.9165	-93.9
Canned vegetables and fruit	104.2502	70.8641	86.0845	96.5954	115.8198	127.3990	127.3990	-74.5
Fruit and vegetable juices	58.8351	46.8604	59.2039	66.4173	76.6846	97.8975	98.8975	-63.9
Canned vegetables	30.3953	15.6735	16.6947	19.6426	25.6280	17.9110	17.9110	-88.0
Processed and canned fruit	7.5983	7.8947	9.4269	8.2385	12.5437	9.4220	9.4220	-87.6
Beer	98.4750	99.4540	84.7840	86.6470	81.9540	83.9200	93.9200	23.6
Grapes wine	140.9460	135.6530	134.5750	165.2320	171.7260	178.7100	188.7100	15.8
Sparkling wine	5.2200	5.0230	6.3320	6.5240	6.7440	6.7440	6.7440	-16.1
Cognac	9.3947	7.0160	5.0136	8.3995	8.7688	9.1899	9.1999	-34.0
Brandy and liqueurs	18.3376	16.2335	16.2781	15.6941	15.1922	14.2986	14.3086	156.0
Meat	44.0721	45.9578	45.9408	55.9312	62.2331	62.6450	63.6450	-75.3
Sausages	20.8237	21.7388	21.2708	23.2253	24.7975	25.9510	25.9510	-48.1
Butter	5.0078	5.0619	6.1377	5.0529	4.2698	4.3030	5.3030	-80.4
Margarine	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0
Cheese and cottage cheese	2.4810	2.4999	2.4974	2.9929	2.9505	2.6970	3.6970	-69.7
Curd, curd cream, yogurt, kefir, sour cream	40.8897	41.8399	43.3456	43.8680	44.4851	45.9870	46.9870	-66.0
Ice cream	10.4775	10.7061	11.0764	11.3940	11.8096	11.3666	12.3666	7.3
Milk and whipped cream with a fat content <6 %	78.7233	79.9697	85.9574	79.9910	69.0612	61.2870	61.2870	-86.5
Milk and whipped cream in solid form	1.0417	1.3567	1.6746	2.4736	2.2761	0.8640	0.8640	-94.4
Crude oil, not chemically modified	113.2231	109.5341	79.9627	86.8112	106.3061	124.6610	125.6610	0.0
Granulated sugar	177.6949	84.5192	99.9991	128.9798	73.9057	86.9250	86.9250	-80.1
Fish and fish products	8.7740	9.9659	8.0857	7.7882	7.9539	7.4032	8.4032	-11.5
Mineral and aerated water	115.6950	126.3115	132.5725	145.4610	158.8045	171.4730	171.9730	231.2
Other non-alcoholic drinks	70.7000	70.4130	50.7920	53.2040	56.0080	58.0500	68.0500	-48.2
Paper and corrugated cardboard	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0
Boxes and crates of paper or corrugated cardboard	11.8000	11.7000	11.9859	13.7391	14.3899	14.3950	14.3950	0.0
Paper and articles of paper for household use	5.6556	6.7399	5.5412	5.2392	5.2531	5.5440	5.5440	0.0
Synthetic resins	1.7390	0.9290	1.4530	1.3460	2.1280	2.4700	3.4700	-80.2
Paint and Varnishes	17.6886	26.8614	32.8377	30.0688	29.8377	29.5239	29.5249	152.3
Soap	0.7865	0.9932	0.9945	1.2430	1.2611	1.5400	1.5400	-86.8
Washing and cleaning products	1.4163	1.7602	2.8214	2.1552	2.6744	3.7150	3.7150	-75.2
Rough leather goods	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0070	-98.4
Leather boxing clothes	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0070	-99.4
Cotton yarn	13.1928	10.4445	13.5470	13.3450	12.9340	12.4560	12.4560	-60.6
Fabrics	18.2870	13.9804	17.6704	17.6714	17.2275	16.4660	16.6660	-50.3
Polymer film	4.5321	3.5812	3.5267	3.3510	3.6732	3.3540	3.3540	-35.5

Source: National Bureau of Statistics of the Republic of Moldova, through Letter No. 06-39/08 dated 23.02.2011 (AD for the period 1992-2010); Statistical Reports PRODMOLD-A 'Total production, as a natural expression, in the Republic of Moldova, by product type, for the period 2005-2020'; Statistical Yearbooks of the ATULBD for 1998 (page 176-184), 2000 (page 99-100), 2002 (page 103-104), 2006 (page 93-94), 2009 (page 92-93), 2011 (page 94-96), 2014 (page 89-90), 2015 (page 89-90), 2016 (page 98-99), 2020 (page 102-104); Express Information, Key Performance Indicators for the Industry Sector in the Republic for 2020, 2019, 2018, 2017, 2016. <http://mer.gospmr.org/gosudarstvennaya-sluzhba-statistiki/informacziya/ezhegodnik-gosudarstvennoj-sluzhby-statistiki.html, http://mer.gospmr.org/gosudarstvennaya-sluzhba-statistiki/informacziya/osnovnye-pokazateli-raboty-promyshlennosti.html>

Table 7-34: Total industrial organic wastewater (TOW_i) by industry branch in the RM between 1990-2020, kt COD/yr

	1990	1991	1992	1993	1994	1995	1996	1997
Food industry	158.6281	138.7174	91.0192	94.2480	64.9960	58.3199	51.3862	60.9473
Paper and cardboard	7.7857	6.7797	1.6184	1.4872	0.3499	0.6124	0.7436	1.0498
Plastics in primary forms	0.0389	0.0324	0.0130	0.0106	0.0034	0.0032	0.0030	0.0028
Paints and Varnishes	2.3517	1.7688	1.2060	0.6231	0.2412	0.1608	0.1407	0.1023
Soap, detergents and beauty care products	0.0401	0.0272	0.0221	0.0114	0.0029	0.0030	0.0032	0.0014
Leather goods	0.0474	0.0464	0.0295	0.0198	0.0062	0.0056	0.0068	0.0078
Cotton yarn and fabrics	2.7750	2.1032	1.1945	0.6874	0.3962	0.2733	0.6051	0.5393
Plastic plates, sheets, tubes and poles	0.0115	0.0098	0.0058	0.0051	0.0027	0.0016	0.0042	0.0029
TOW_i, total	**171.6784**	**149.4848**	**95.1084**	**97.0926**	**65.9984**	**59.3797**	**52.8928**	**62.6536**
	1998	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**
Food industry	44.9792	31.4643	30.9406	38.7096	34.4597	43.6393	45.7879	52.0304
Paper and cardboard	0.5686	0.2624	0.2449	0.5616	28.6468	31.5238	31.1821	30.9710
Plastics in primary forms	0.0027	0.0025	0.0023	0.0022	0.0017	0.0016	0.0020	0.0023
Paints and Varnishes	0.0744	0.1355	0.4129	0.5769	0.8231	0.6920	1.0323	1.2601
Soap, detergents and beauty care products	0.0007	0.0007	0.0009	0.0017	0.0007	0.0009	0.0013	0.0013
Leather goods	0.0044	0.0017	0.0016	0.0021	0.0041	0.0013	0.0000	0.0000
Cotton yarn and fabrics	1.0308	0.8357	1.2820	1.2244	1.2498	1.3884	1.5687	1.8045
Plastic plates, sheets, tubes and poles	0.0028	0.0016	0.0038	0.0048	0.0074	0.0093	0.0094	0.0103
TOW_i, total	**46.6635**	**32.7044**	**32.8891**	**41.0832**	**65.1933**	**77.2567**	**79.5837**	**86.0799**
	2006	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**
Food industry	44.4083	39.6450	43.5225	28.9018	35.3565	35.5787	39.7981	46.9033
Paper and cardboard	31.3489	29.3048	33.6731	31.2029	35.6302	32.1087	28.5999	31.5298
Plastics in primary forms	0.0018	0.0023	0.0021	0.0017	0.0034	0.0037	0.0039	0.0041
Paints and Varnishes	1.6722	2.2201	2.3230	2.3763	2.5857	3.6203	3.5994	2.4813
Soap, detergents and beauty care products	0.0019	0.0024	0.0013	0.0013	0.0017	0.0019	0.0021	0.0038
Leather goods	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0012
Cotton yarn and fabrics	1.8058	2.0346	2.0202	1.4056	1.6159	1.3045	1.4449	1.6667
Plastic plates, sheets, tubes and poles	0.0087	0.0089	0.0081	0.0065	0.0085	0.0094	0.0083	0.0091
TOW_i, total	**79.2476**	**73.2180**	**81.5502**	**63.8962**	**75.2019**	**72.6271**	**73.4567**	**82.5993**

	2014	2015	2016	2017	2018	2019	2020	%
Food industry	47.9231	37.5780	40.3235	45.7435	48.2245	51.0389	51.8757	-67.3
Paper and cardboard	25.4503	26.8853	25.5545	27.6703	28.6396	29.0711	29.0711	273.4
Plastics in primary forms	0.0039	0.0021	0.0032	0.0030	0.0047	0.0055	0.0077	-80.2
Paints and Varnishes	3.5554	5.3991	6.6004	6.0438	5.9974	5.9343	5.9345	152.4
Soap, detergents and beauty care products	0.0033	0.0041	0.0057	0.0051	0.0059	0.0079	0.0079	-80.3
Leather goods	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	-100.0
Cotton yarn and fabrics	1.3410	1.0405	1.3299	1.3213	1.2849	1.2321	1.2406	-55.3
Plastic plates, sheets, tubes and poles	0.0101	0.0080	0.0078	0.0074	0.0082	0.0074	0.0074	-35.5
TOW_i, total	**78.2870**	**70.9171**	**73.8250**	**80.7945**	**84.1651**	**87.2972**	**88.1449**	**-48.7**

Step II: Selecting wastewater treatment systems and discharge pathways for industrial wastewater

The second step consists of selecting wastewater treatment and discharge pathways according to national conditions and by taking into consideration country-specific activity data. EFs for each wastewater treatment system and discharge pathway can be obtained by applying Equation 6.2 from the 2006 IPCC Guidelines (Volume 5, Chapter 6, page 6.12).

The value of the emission factor tipical of a wastewater treatment and discharge system depends on the methane producing capacity (B_0), and the methane correction factor (MCF) specific to the respective wastewater treatment system and discharge pathway, respectively. B_0 constitutes the maximum methane producing capacity in a certain amount of organic substances (expressed in COD) within industrial wastewater. MCF indicates the extent to which the methane producing capacity (B_0) is achieved within each type of wastewater treatment and discharge system. This is also an index of degree that demonstrates to what extent the wastewater treatment system is anaerobic.

$$EFj = B_0 \bullet MCF_j$$

Where:

EF_j – emission factor, kg CH_4/kg COD;

j – each treatment/discharge pathway or system;

B_0 – maximum methane producing capacity, kg CH_4/kg COD (according to the 2006 IPCC Guidelines, Volume 5, Chapter 6, Table 6.2, page 6.12, the default value used for industrial wastewater is 0.25);

MCF_j – methane correction factor (fraction) (Table 7-35).

Table 7-35: EFs used to estimate CH_4 emissions from source category 5D2 'Industrial wastewater'

Type of system	Wastewater treatment systems and discharge pathways, j	B_o, kg CH_4/kg COD_5	MCF	EF, kg CH_4/kg COD_5
Untreated systems	River and lake discharge without the preventive wastewater treatment	0.25	0.1	0.025
Treated systems	Centralized, aerobic treatment plant, well managed	0.25	0.1	0.050
	Centralized, aerobic treatment plant, not well managed	0.25	0.2	0.025

Step III: Estimating total methane emissions from industrial wastewater treatment and discharge

The third step consists of estimating total methane emissions from source category 5D2 'Industrial wastewater' as a sum of emissions from each wastewater treatment system and discharge pathway. Similar to domestic wastewater, the assessment for industrial wastewater is according to Equation 6.1 from the 2006 IPCC Guidelines (Volume 5, Chapter 6, page 6.11):

$$CH_4\ Emissions = [\Sigma_{ij}\ (U_i \bullet T_{ij} \bullet EF_j)] \bullet (TOW - S) - R,$$

Where:

CH_4 Emissions – methane emissions in inventory year, kg CH_4/yr;

TOW – total organics in wastewater in inventory year, kg COD/yr;

S – organic component removed as sludge in inventory year, kg BOD/yr;

Ui – fraction of population in income group *i,* in inventory year (fraction);

$T_{i,j}$ – degree of utilisation of treatment/discharge pathway or system, *j*, for each income group fraction *i,* in inventory year (fraction);

i – income group: rural – low income, urban – low income;

j – each treatment/discharge pathway or system;

EF_j – emission factor, kg CH_4/kg COD;

R – amount of methane recovered in inventory year, kg CH_4/yr.

It should be noted that as industrial wastewater is discharged together with domestic wastewater, and most of the economic agents connected to the sewage systems operate in urban areas, the distribution among different wastewater management practices was allocated to the urban population, and subsequently divided into two subcategories: population with a high level of urbanization and population with a low level of urbanization, considering only centralized wastewater collecting systems and direct wastewater discharge into rivers and lakes (a situation which occurs in certain cities in the country).

Thus, similarly to domestic wastewater, by considering the level of economic development of localities of the RM, degree of urbanization, and degree of connection to wastewater collection and treatment systems, respectively, according to expert opinion, the values of country-specific factors used to estimate CH_4 emissions from industrial wastewater during the reference period were established (1990-2020) (Table 7-36). These values are based on statistical data related to the number of economic agents by economic activity in the territory.

N_2O Emissions from source category 5D1 'Domestic Wastewater'

Wastewater disposal into natural waterways is an important source of nitrous oxide emissions. These may be direct emissions from wastewater treatment plants or indirect emissions from wastewater after disposal of effluent into water bodies (rivers, lakes, or the sea).

Nitrous oxide emissions from source category 5D1 'Domestic Wastewater' were estimated following recommendations set in the 2006 IPCC Guidelines, based on a Tier 1 approach.

The assessment is according to Equation 6.7 from the 2006 IPCC Guidelines (Volume 5, Chapter 6, page 6.25):

$$N_2O\ Emissions = N_{EFFLUENT} \bullet EF_{EFFLUENT} \bullet 44/28$$

Where:

N_2O Emissions – N_2O emissions in inventory year, kg N_2O/yr;

$N_{EFFLUENT}$ – total nitrogen in the effluent discharged to aquatic environments, kg N/yr;

$EF_{EFFLUENT}$ – emission factor for N_2O emissions from discharged wastewater, kg N_2O-N/kg N; the default value used is 0.005 kg N_2O-N/kg N (2006 IPCC Guidelines, Volume 5, Chapter 6, Table 6.11, page 6.27);

[44/28] – mass ratio of N_2O-N to N_2O.

Activity data that are needed to estimate N_2O emissions is the nitrogen content in the wastewater effluent, country population and average annual per capita protein generation.

In order to estimate average annual per capita protein generation, the 'non-consumed' protein, as well as industrial and commercial protein discharged into the sewer systems will additionally be considered.

Table 7-36: Country-specific factors used to estimate CH_4 emissions from source category 5D2 'Industrial Wastewater' for 1990-2020

Year	Degree of use of the wastewater treatment systems and discharge pathways j, for each population group – T_{ij}						
	U = urban, high income			U = urban, low income			
	U_i	Centralized, aerobic treatment plant, well managed	Centralized, aerobic treatment plant, not well managed	U_i	Centralized, aerobic treatment plant, well managed	Centralized, aerobic treatment plant, not well managed	Wastewater discharge in rivers and lakes
1990	0.639	1.00	0.00	0.361	0.30	0.70	0.00
1991	0.641	0.98	0.02	0.359	0.35	0.65	0.00
1992	0.642	0.97	0.03	0.358	0.40	0.60	0.00
1993	0.644	0.96	0.04	0.356	0.42	0.58	0.00
1994	0.646	0.95	0.05	0.354	0.42	0.58	0.00
1995	0.647	0.94	0.06	0.353	0.44	0.56	0.00
1996	0.649	0.93	0.07	0.351	0.44	0.51	0.05

Year	Degree of use of the wastewater treatment systems and discharge pathways j, for each population group – T_{ij}						
	U = urban, high income			U = urban, low income			
	U_i	Centralized, aerobic treatment plant, well managed	Centralized, aerobic treatment plant, not well managed	U_i	Centralized, aerobic treatment plant, well managed	Centralized, aerobic treatment plant, not well managed	Wastewater discharge in rivers and lakes
1997	0.651	0.92	0.08	0.349	0.44	0.51	0.05
1998	0.653	0.91	0.09	0.347	0.46	0.49	0.05
1999	0.654	0.90	0.10	0.346	0.48	0.47	0.05
2000	0.656	0.90	0.10	0.344	0.50	0.40	0.10
2001	0.658	0.90	0.10	0.342	0.52	0.38	0.10
2002	0.660	0.90	0.10	0.340	0.52	0.38	0.10
2003	0.661	0.90	0.10	0.339	0.50	0.34	0.16
2004	0.663	0.90	0.10	0.337	0.48	0.36	0.16
2005	0.662	0.91	0.09	0.338	0.49	0.35	0.16
2006	0.669	0.92	0.08	0.331	0.47	0.35	0.18
2007	0.668	0.93	0.07	0.332	0.46	0.34	0.20
2008	0.672	0.94	0.06	0.328	0.45	0.35	0.20
2009	0.236	0.95	0.05	0.326	0.44	0.37	0.19
2010	0.670	0.95	0.05	0.330	0.41	0.40	0.19
2011	0.662	0.95	0.05	0.338	0.39	0.42	0.19
2012	0.657	0.95	0.05	0.343	0.38	0.43	0.19
2013	0.651	0.95	0.05	0.349	0.36	0.43	0.21
2014	0.652	0.95	0.05	0.348	0.34	0.46	0.20
2015	0.631	0.95	0.05	0.369	0.32	0.47	0.21
2016	0.629	0.95	0.05	0.371	0.28	0.52	0.20
2017	0.628	0.96	0.04	0.372	0.372	0.27	0.55
2018	0.628	0.96	0.04	0.372	0.372	0.27	0.55
2019	0.627	0.96	0.04	0.373	0.373	0.27	0.55
2020	0.624	0.624	0.97	0.376	0.30	0.52	0.18

Food and food waste that is not consumed but can be washed down the drain, as well as bath and laundry water, and industrial production waste and commercial food waste, e.g. from grocery stores and butchers, respectively, can be expected to contribute to nitrogen loadings and should be taken into consideration in the assessment process.

The total nitrogen in the effluent is estimated according to Equation 6.8 from the 2006 IPCC Guidelines (Volume 5, Chapter 6, page 6.25):

$$N_{EFFLUENT} = (P \bullet Protein \bullet F_{NPR} \bullet F_{NON-CON} \bullet F_{IND-COM}) - N_{SLUDGE}$$

Where:

$N_{EFFLUENT}$ – total annual amount of nitrogen in the wastewater effluent, kg N/yr;

P – human population;

Protein – annual per capita protein consumption, kg/person/yr;

F_{NPR} – fraction of nitrogen in protein, default = 0.16 kg N/kg protein (2006 IPCC Guidelines, Volume 5, Chapter 6, Table 6.11, page 6.27);

$F_{NON-CON}$ – factor for non-consumed protein added to the wastewater (according to the 2006 IPCC Guidelines, Volume 5, Chapter 6, Table 6.11, page 6.27, default values are 1.1 for countries with no garbage disposals, and 1.4 for countries with garbage disposals);

$F_{IND-COM}$ – factor for industrial and commercial co-discharged protein into the sewer system (according to the 2006 IPCC Guidelines, Volume 5, Chapter 6, Table 6.11, page 6.27, the default value is 1.25);

N_{SLUDGE} – nitrogen removed with sludge (according to the 2006 IPCC Guidelines, Volume 5, Chapter 6, page 6.25, the default value is 0), kg N/yr.

N_2O emissions from advanced centralised wastewater treatment plants are typically much lower than those from effluent and may only be of interest for countries that have predominantly advanced centralized wastewater treatment plants with controlled nitrification and denitrification technologies.

N_2O emissions from such plants can be estimated according to Equation 6.9 from the 2006 IPCC Guidelines (Volume 5, Chapter 6, page 6.26):

$$N2O_{PLANT} = P \bullet T_{PLANT} \bullet F_{IND-COM} \bullet EF_{PLANT}$$

Where:

N_2O_{PLANT} – total N_2O emissions from plants in inventory year, kg N_2O/yr;

P – human population covered by high-powered centralised wastewater treatment plants;

T_{PLANT} – degree of utilisation of modern, centralized WWT plants, % (in the RM, it corresponds to $U_{urban, high\ income}$);

$F_{IND-COM}$ – fraction of industrial and commercial co-discharged protein (default = 1.25, according to the 2006 IPCC Guidelines, Volume 5, Chapter 6, Table 6.11, page 6.27);

EF_{PLANT} – emission factor, 3.2 g N_2O/person/yr (2006 IPCC Guidelines, Volume 5, Chapter 6, page 6.26).

If we consider including N_2O emissions from modern, centralized plants (N_2O_{PLANT}), the amount of nitrogen associated with these emissions (N_{WWT}) will be calculated and subtracted from the $N_{EFFLUENT}$. The N_{WWT} can be calculated by multiplying the values obtained for N_2O_{PLANTS} by 28/44 (conversion factor from N_2O to N_2O-N).

Activity data on average per capita protein consumption in the RM is provided by the FAO (Table 7-37). For the RM, AD is available on the website of the organisation only since 1992, while for 1990 and 1991 data were extrapolated taking into consideration the evolution of the respective indicator for the USSR. Also, as AD for 2014-2015 was not available on the FAO website during the compilation of the national GHG emissions inventory, they were extrapolated considering the evolution of that indicator between 2012-2013.

Table 7-37: AD used to estimate N_2O emissions from domestic wastewater treatment and discharge

	1990	1991	1992	1993	1994	1995	1996	1997
Proteins, g/per capita/day	84.27	77.69	71.11	67.06	65.02	65.90	64.93	66.52
Proteins, kg/per capita/day	0.08	0.08	0.07	0.07	0.07	0.07	0.06	0.07
Proteins, kg/per capita/year	30.76	28.36	26.03	24.48	23.73	24.05	23.76	24.28
	1998	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**
Proteins, g/per capita/day	67.44	66.15	67.72	68.94	71.00	68.87	65.70	62.50
Proteins, kg/per capita/day	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.06
Proteins, kg/per capita/year	24.62	24.14	24.79	25.16	25.92	25.14	24.05	22.81
	2006	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**
Proteins, g/per capita/day	65.70	62.20	58.10	60.70	60.00	61.60	63.30	65.20
Proteins, kg/per capita/day	0.07	0.06	0.06	0.06	0.06	0.06	0.06	0.07
Proteins, kg/per capita/year	23.98	22.70	21.26	22.16	21.90	22.48	23.17	23.80
	2014	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**%**
Proteins, g/per capita/day	66.00	67.70	69.30	72.70	76.10	77.60	78.6	-6.73
Proteins, kg/per capita/day	0.07	0.07	0.07	0.07	0.08	0.08	0.1	-6.73
Proteins, kg/per capita/year	24.09	24.71	25.36	26.54	27.78	28.32	28.7	-6.73

Source: UN database on food, FAOSTAT, FAO Statistics Division 2017, 13 June 2018, <http://www.fao.org/faostat/en/#data/CL>, since 2006 protein consumption is available on the NBS database <https://statbank.statistica.md/pxweb/pxweb/ro/30%20Statistica%20sociala/30%20Statistica%20sociala__04%20NIV__04%20NIV__NIV060/NIV060300.px/table/tableViewLayout1/?rxid=b2ff27d7-0b96-43c9-934b-42e1a2a9a774>.

NMVOC Emissions from Source Category 5D1 'Domestic Wastewater'

NMVOC emissions from source category 5D1 'Domestic Wastewater' were estimated following recommendations set in the EMEP/EEA Air Pollutant Emission Inventory Guidebook (2019):

$$NMVOC\ Emissions = AR \bullet EF \bullet 10^{-6}$$

Where:

NMVOC Emissions – NMVOC emissions in inventory year, kt/yr;

AR = the activity rate for total wastewater discharged in inventory year, million m^3/yr (see Table 7-28);

EF – emission factor, mg NMVOC/m^3 wastewater discharged (according to the EMEP/EEA Air Pollutant Emission Inventory Guidebook (2019), source category 5D 'Wastewater Handling', Table 3-1, page 7, the default value is 15 kg NMVOC/million m^3 wastewater discharged);

10^{-6} – conversion factor, from kg to kt.

7.5.3. Uncertainties and Time-Series Consistency

The primary factors affecting uncertainties are the estimation methodology, the emission factors used to estimate CH_4 and N_2O emissions from source category 5D 'Wastewater Treatment and Discharge' and the quality of the available activity data.

According to the information available in the 2006 IPCC Guidelines (Volume 5, Chapter 6, pages 6-17 and 6-23), uncertainties associated with the maximum methane producing capacity (B_0) could reach circa 30%; uncertainties associated with the methane correction factor (fraction) (MCF) for well managed plants could reach circa 10%, for not well managed plants – circa 30%, whereas for latrines – circa 50%. Uncertainties related to population (P) could reach circa 5%; uncertainties related to BOD values (g/per capita/day) – circa 30%; uncertainties related to the fraction of population divided depending on income level – circa 15%; uncertainties related to the urbanisation level and access to wastewater treatment systems and discharge pathways could vary from 3% (for countries that have well developed statistical systems) up to circa 50% (for countries with poorly developed statistical systems). Uncertainties related to activity data regarding industrial production for countries with poorly developed statistical systems could reach circa 25%; whereas those related to the W product (water consumption per unit of production) and COD (kg COD per cubic meter of wastewater) could reach a magnitude two (-50%, +100%).

In the Republic of Moldova, total uncertainties related to activity data used to estimate CH_4 and N_2O emissions from source category 5D 'Wastewater Treatment and Discharge' were considered to be circa 40%, whereas total uncertainties related to emission factors – circa 40% for methane emissions, and circa 50% for nitrous oxide emissions, respectively. Thus, combined uncertainties of activity data and methane emissions constitute circa 56.56%, whereas for nitrous oxide emissions – circa 64.03% (Annex 5-3.5).

In view of ensuring time series consistency of results, the same approach was used for the entire period under review, in conformity with good practices applied in the GHG emissions inventory.

7.5.4. Quality Assurance and Quality Control

A standard verification and quality control form was filled in for this category following a Tier 1 approach. Verification was focused on various aspects such as: comparing and ensuring correct use of the emission factors, including the default emission factors available in the 2006 IPCC Guidelines; correct use of AD obtained from different reference sources, including the Statistical Yearbooks of the Republic of Moldova and of those of the ATULBD, as well as the FAO database; using the scientific literature in the field regarding planning water norms for different industries. The AD and methods used for estimating GHG emissions from category 5D 'Wastewater Treatment and Discharge' were documented and archived both in hard copies and electronically.

7.5.5. Recalculations

Recalculations were made for CH_4 emissions from category 5D 'Wastewater Treatment and Discharge' for 2019 as a result of updated activity data associated with the population number.

In comparison with the results recorded in the BUR3 of the RM to the UNFCCC (2021), the changes made in this inventory cycle resulted in an insignificant increase in CH_4 emissions from category 5D 'Wastewater Treatment and Discharge' (Table 7-38). The obtained results allow us to assert that CH_4 emissions from the respective category decreased in the RM by circa 32.8% between 1990 and 2020.

Table 7-38: Comparative results of CH_4 emissions from source category 5D 'Wastewater Treatment and Discharge' included in the BUR3 of the RM to the UNFCCC, kt CO_2 equivalent

	1990	1991	1992	1993	1994	1995	1996	1997
BUR3	352.9650	341.5835	307.5895	309.9724	289.3528	287.1429	283.2511	289.6535
NC5	352.9650	341.5835	307.5895	309.9724	289.3528	287.1429	283.2511	289.6535
Difference, %	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	1998	1999	2000	2001	2002	2003	2004	2005
BUR3	279.2682	270.5697	271.7416	277.2468	294.4618	302.0785	303.7548	299.3127
NC5	279.2682	270.5697	271.7416	277.2468	294.4618	302.0785	303.7548	299.3127
Difference, %	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

	2006	2007	2008	2009	2010	2011	2012	2013
BUR3	288.2073	278.9966	280.4470	261.8981	265.2106	258.2525	255.0776	256.3568
NC5	288.2073	278.9966	280.4470	261.8981	265.2106	258.2525	255.0776	256.3568
Difference, %	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	2014	2015	2016	2017	2018	2019	2020	%
BUR3	248.3385	240.8280	239.7768	235.7799	239.0924	237.6771		
NC5	248.3385	240.8280	239.7768	235.7799	239.0924	237.9196	237.2010	-32.8
Difference, %	0.0	0.0	0.0	0.0	0.0	0.1		

Abbreviations: BUR3 – Third Biennial Update Report of the RM to the UNFCCC, NC5 – Fifth National Communication of the RM to the UNFCCC.

Recalculations of N_2O emissions from category 5D 'Wastewater Treatment and Discharge' were also carried out for 2019, with changes made in the current inventory cycle resulting in an insignificant reduction of emissions (Table 7-39). For 2020, N_2O emissions from category 5D 'Wastewater Treatment and Discharge' were estimated for the first time. The obtained results allow us to assert that N_2O emissions from the respective category decreased in the RM by circa 33.5% between 1990 and 2020.

Table 7-39: Comparative results of N_2O emissions from source category 5D 'Wastewater Treatment and Discharge' included in the BUR3 and NC5 of the RM to the UNFCCC, kt CO_2 equivalent

	1990	1991	1992	1993	1994	1995	1996	1997
BUR3	87.9499	81.1694	74.3744	69.7653	67.7185	68.5592	67.5246	68.7603
NC5	87.9499	81.1694	74.3744	69.7653	67.7185	68.5592	67.5246	68.7603
Difference, %	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	1998	1999	2000	2001	2002	2003	2004	2005
BUR3	69.8045	68.2978	69.9236	70.7055	72.5363	70.0571	66.6893	61.1268
NC5	69.8045	68.2978	69.9236	70.7055	72.5363	70.0571	66.6893	61.1268
Difference, %	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	2006	2007	2008	2009	2010	2011	2012	2013
BUR3	62.9886	58.4323	53.6028	54.6899	52.9287	53.1868	53.6146	53.8608
NC5	62.9886	58.4323	53.6028	54.6899	52.9287	53.1868	53.6146	53.8608
Difference, %	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	2014	2015	2016	2017	2018	2019	2020	%
BUR3	53.2891	54.1915	54.8516	56.5448	58.2573	58.4302		
NC5	53.2891	54.1915	54.8516	56.5448	58.2573	58.5106	58.4843	-33.5
Difference, %	0.0	0.0	0.0	0.0	0.0	0.1		

Abbreviations: BUR3 – Third Biennial Update Report of the RM to the UNFCCC, NC5 – Fifth National Communication of the RM to the UNFCCC.

Table 7-40: Comparative results of direct GHG emissions from source category 5D 'Wastewater Treatment and Discharge' included in the BUR3 and NC5 of the RM to the UNFCCC, kt CO_2 equivalent

	1990	1991	1992	1993	1994	1995	1996	1997
BUR3	440.9149	422.7530	381.9639	379.7377	357.0713	355.7021	350.7757	358.4138
NC5	440.9149	422.7530	381.9639	379.7377	357.0713	355.7021	350.7757	358.4138
Difference, %	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	1998	1999	2000	2001	2002	2003	2004	2005
BUR3	349.0727	338.8674	341.6652	347.9523	366.9981	372.1356	370.4440	360.4395
NC5	349.0727	338.8674	341.6652	347.9523	366.9981	372.1356	370.4440	360.4395
Difference, %	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	2006	2007	2008	2009	2010	2011	2012	2013
BUR3	351.1959	337.4289	334.0498	316.5880	318.1393	311.4394	308.6921	310.2176
NC5	351.1959	337.4289	334.0498	316.5880	318.1393	311.4394	308.6921	310.2176
Difference, %	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	2014	2015	2016	2017	2018	2019	2020	%
BUR3	301.6276	295.0195	294.6284	292.3246	297.3497	296.1073		
NC5	301.6276	295.0195	294.6284	292.3246	297.3497	296.4302	295.6853	-32.9
Difference, %	0.0	0.0	0.0	0.0	0.0	0.1		

Abbreviations: BUR3 – Third Biennial Update Report of the RM to the UNFCCC, NC5 – Fifth National Communication of the RM to the UNFCCC.

The table below presents the evolution of NMVOC emissions from 5D 'Wastewater Treatment and Discharge' between 1990 and 2020. NMVOC emissions were not reviewed in the current inventory cycle. The obtained results allow us to assert that NMVOC emissions from the respective category decreased in the RM by 75.2% (Table 7-41).

Table 7-41: NMVOC emissions from source category 5D 'Wastewater Treatment and Discharge' included in the NC5 of the RM to the UNFCCC

	1990	1991	1992	1993	1994	1995	1996	1997
NMVOC	0.0410	0.0373	0.0335	0.0299	0.0272	0.0207	0.0208	0.0186
	1998	1999	2000	2001	2002	2003	2004	2005
NMVOC	0.0155	0.0119	0.0111	0.0106	0.0104	0.0103	0.0103	0.0103

	2006	2007	2008	2009	2010	2011	2012	2013
NMVOC	0.0103	0.0102	0.0102	0.0102	0.0102	0.0102	0.0101	0.0101
	2014	2015	2016	2017	2018	2019	2020	%
NMVOC	0.0100	0.0100	0.0100	0.0100	0.0102	0.0102	0.0102	-75.2

7.5.6. Planned Improvements

In order to improve the population's access to quality water supply and waste collection systems, various sector action plans are adopted at different levels in the Republic of Moldova.

At the national level, the Strategy on Water Supply and Sanitation (2014-2030)[127] (modified by Government Decision No. 442/2020[128]) was approved by Government Decision No. 199/2014, which denotes the impact of climate change, combined with the lack of water in the country, noting that ensuring water supply in the future requires integrated urban planning, which does not include actions to reduce GHG emissions from the wastewater management sector. Thus, the general objective of the Strategy is to ensure the gradual access to safe water and adequate sanitation for all localities and population of the Republic of Moldova, thus contributing to the improvement of health, dignity and quality of life and economic development of the country.

The Regulation on Wastewater Discharge in Water Bodies, approved by Government Decision No. 802 as of 09.10.2013 aims to regulate the provisions of discharge, the introduction of specific substances into a body of surface water, groundwater or underwater land. Thus, the Regulation indicates the emission limit values applicable to the discharge of wastewater from the industrial sectors (activities) into a body of surface water.

The Regulation on the requirements for the provisions of collection, treatment and discharge of wastewater in the sewage system and/or in water outlets for urban and rural localities, approved by Government Decision No. 950/2013[129] aims to regulate the conditions of collection, treatment of wastewater in the sewage system and/or in water outlets. Thus, the Regulation provides maximum permissible limit values for the wastewater loading with pollutants into natural discharges, which will contribute to the safe reduction of emissions from this sector.

Economic instruments will focus on the concept of 'sustainable cost recovery of services' with three main characteristics: an appropriate combination of tariffs, fees and transfers to finance recurring and capital costs and to boost other forms of financing; predictability of public subsidies to facilitate investment (planning); tariff policies that make services accessible to all, including the poorest categories, while ensuring the sustainability of service providers.

The planning perspective of the sector may significantly improve the management of wastewater and sludge from source category 5D 'Wastewater Treatment and Discharge'. Sludge treatment will reduce the risk of affecting the quality of natural water resources, which is becoming increasingly sensitive to climate change. The above-listed actions will contribute to the fulfilment of the obligations of the Republic of Moldova towards the implementation of the provisions of the Protocol on Water and Health and other international treaties, which aim to reduce the share of the population without access to drinking water sources and sewer systems, as well as the provisions of the UNFCCC.

The planning of phased harmonization of national water legislation with that of the European Union is also a good tool to enhance the implementation of best practices on wastewater treatment technologies and sludge within this sector, which would allow the capture and sustainable use of methane emissions from sludge storage fields (including for the production of thermal and electric energy). Studying the possibility to use country-specific information on the BOD fraction removed with sludge, maximum methane formation capacity, methane correction factor and other relevant parameters used to estimate emissions from source category 5D 'Wastewater Treatment and Discharge' in the process of estimating methane emissions will improve the quality of the next national GHG inventories.

[127] <http://lex.justice.md/index.php?action=view&view=doc&lang=1&id=352311>
[128] < https://www.legis.md/cautare/getResults?doc_id=122313&lang=ro>
[129] < https://www.legis.md/cautare/getResults?doc_id=120783&lang=ro>

8. RECALCULATIONS AND PLANNED IMPROVEMENTS

This chapter summarizes the explanations and justifications for the recalculations of direct GHG emissions performed to the Republic of Moldova's GHG Inventory for the period 1990-2019, included in the BUR3 of the RM to the UNFCCC (2021), as well as planned improvements for the future inventory cycles. Specific information at source category level associated with the respective recalculations and planned improvements can also be found in Chapters 3-7 of the National Inventory Report: 1990-2020.

8.1. Explanations and Justifications for Recalculations

The National Inventory Team reviewed and recalculated GHG emissions and CO_2 removals for each calendar year covered by the GHG inventory for the period from 1990 through 2019, a component part of the Third Biennial Update Report of the RM to the UNFCCC (2021). These activities were carried out during the on-going process of improving the quality of the National GHG Inventory (including taking into account updated activity data, methodological approaches available in the 2006 IPCC Guidelines, considering new source categories in the inventory for the first time, updating country-specific emission factor values and correcting identified errors).

Thus, improvements were made in all sectors in the current inventory cycle (the use of higher level methodologies, revision of previously used methodological approaches, emission factors, updated activity data, addition of new source categories, etc.), which resulted in the need to perform recalculations of national GHG emissions for the period from 1990 through 2019, reported in the BUR3 of the RM to the UNFCCC (Chapter 2 'National GHG Inventory').

In comparison with the results recorded in the BUR3 of the RM to the UNFCCC (2021), the changes made during the compilation of the current inventory resulted in a marginal decrease in total direct GHG emissions in the years 1990-2009, 2011, 2013 and 2015-2019, varying from a minimum of -0.2% to a maximum of -1.7% in 2016, respectively in a marginal increase in total direct GHG emissions in the years 2010, 2012 and 2014, varying from a minimum of +0.2% to a maximum of +0.4% in 2014 (Table 8-1).

Table 8-1: Recalculation results of total direct GHG emissions included in the BUR3 of the RM to the UNFCCC, Mt CO_2 equivalent

	1990	1991	1992	1993	1994	1995	1996	1997
BUR3	45.3487	39.1255	31.2699	24.5235	21.1746	17.7666	17.5533	15.8773
NC5	45.2484	38.9698	31.1390	24.4083	21.0598	17.6587	17.4427	15.8305
Difference, %	-0.2	-0.4	-0.4	-0.5	-0.5	-0.6	-0.6	-0.3
	1998	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**
BUR3	14.2292	11.9511	11.0391	11.7365	11.6392	12.0733	12.6310	13.0252
NC5	14.1548	11.8882	10.9667	11.6640	11.5573	12.0039	12.5630	12.9513
Difference, %	-0.5	-0.5	-0.7	-0.6	-0.7	-0.6	-0.5	-0.6
	2006	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**
BUR3	12.2163	12.2220	12.6964	12.6698	13.3331	13.7595	13.2349	13.0439
NC5	12.1315	12.1686	12.6400	12.6097	13.3628	13.7031	13.2877	12.9792
Difference, %	-0.7	-0.4	-0.4	-0.5	0.2	-0.4	0.4	-0.5
	2014	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**%**
BUR3	13.1730	13.1996	13.5035	13.2445	13.9078	13.8100		
NC5	13.2277	13.0092	13.2801	13.1258	13.7640	13.7518	13.6617	-69.8
Difference, %	0.4	-1.4	-1.7	-0.9	-1.0	-0.4		

Abbreviations: BUR3 – Third Biennial Update Report of the RM to the UNFCCC; NC5 – Fifth National Communication of the RM to the UNFCCC

With reference to the net direct GHG emissions included in the BUR3 of the RM to the UNFCCC (2021), changes made in the compilation of the current inventory resulted in an insignificant decrease in net direct GHG emissions in the years 1990-2019, varying from a minimum of -0.8% in 1990 to a maximum of -3.9% in 2016 (Table 8-2).

Table 8-2: Recalculation results of total net direct GHG emissions included in the BUR3 of the RM to the UNFCCC, Mt CO_2 equivalent

	1990	1991	1992	1993	1994	1995	1996	1997
BUR3	43.9609	36.6725	29.4236	22.6543	19.3714	16.0050	15.3463	14.0326
NC5	43.5909	36.2482	29.0229	22.2692	18.9867	15.6276	14.9660	13.7147
Difference, %	-0.8	-1.2	-1.4	-1.7	-2.0	-2.4	-2.5	-2.3

	1998	1999	2000	2001	2002	2003	2004	2005
BUR3	12.3653	10.3782	9.1852	10.2376	10.0530	10.5567	10.9408	11.6293
NC5	12.0190	10.0440	8.8434	9.8970	9.7030	10.2191	10.6051	11.2837
Difference, %	-2.8	-3.2	-3.7	-3.3	-3.5	-3.2	-3.1	-3.0
	2006	2007	2008	2009	2010	2011	2012	2013
BUR3	10.6973	10.5071	11.2869	11.6491	12.3792	12.8635	12.3081	12.2463
NC5	10.3381	10.1794	10.9564	11.3147	12.1347	12.5332	12.0886	11.9082
Difference, %	-3.4	-3.1	-2.9	-2.9	-2.0	-2.6	-1.8	-2.8
	2014	2015	2016	2017	2018	2019	2020	%
BUR3	12.7241	12.2961	12.8459	12.5307	13.3477	14.1058		
NC5	12.5029	11.8273	12.3426	12.1325	12.9230	13.7651	13.6582	-68.7
Difference, %	-1.7	-3.8	-3.9	-3.2	-3.2	-2.4		

Abbreviation: BUR3 – Third Biennial Update Report of the RM to the UNFCCC; NC5 – Fifth National Communication of the RM to the UNFCCC.

8.1.1. Sector 1 'Energy'

Recalculations of direct GHG emissions from Sector 1 'Energy' were performed based on the following considerations:

1A1 'Energy Industries'

- activity data associated with the consumption of natural gas for the years 2015, 2016 were updated for sources 1A1aii 'Combined Heat and Power Generation' and 1A1aiii 'Heat Plants', based on the information presented in the Energy Balance (2021, .pdf format);
- in 2017-2019, when considering fuel consumption from sources 1Alai 'Electricity Generation' and 1A1aiii 'Heat Plants' for the left bank of the Dniester River, indirect calculation methods were used (in the absence of real data, previously submitted by JSC 'Moldovagaz');
- once the Energy Balances of the RM were published in MS Excel format for the years 2015-2019, it became easier to monitor and allocate fuel consumption within source 1A1b 'Petroleum Refining', thereby avoiding misallocations; thus, data on fuel consumption for the period 2003-2014 within this source were excluded from the data string; the total volume of petroleum products were accounted for in RM during the respective period, which does not represent the quantity of fuel consumed in oil refineries for energy purposes; at the same time, for the period 2015-2019; at the same time, the amounts of oil and lubricants utilised at oil refineries were excluded from rubric 'Other Petroleum Products' within source 1A1b for the period 2015-2019.

1A2 'Manufacturing Industries and Construction'

- the emission factors for category 1A2 'Manufacturing Industries and Construction' were corrected: liquefied petroleum gases, for CO_2 emissions – 63.100 (instead of 64.200); solid fuels, for CH_4 emissions – 1 (instead of 10);
- the missing data regarding 'Other Bituminous Coal' consumption was added for the years 2010, 2012 and 2014;
- starting with the year 2015, changes have been made associated with the reallocation of activity data from source categories 1A1aii 'Combined Heat and Power Generation' and 1A1aiii 'Heat Plants – Energy Producers for Own Consumption' to source category 1A2m 'Non-specified Industry';
- with reference to category 1A2 'Manufacturing Industries and Construction', consumption of aviation fuels has been detected in the Energy Balances of RM, which have been reallocated to source category 1A3a; simultaneously, gasoline and diesel oil consumption allocated in the Energy Balances for some years to source category 1A2 'Manufacturing Industries and Construction' has been reallocated to source category 1A3b 'Road Transportation', as they are consumed on national roads.

1A3a 'Civil Aviation' (1A3aii Domestic Aviation)

- the CO_2 emission factor value has been corrected: from 69.300 to 70.000 kg/TJ.

1A3b 'Road Transportation'

- restoring gasoline and diesel oil consumption for road transportation for the territory on the left bank of the Dniester River, based on specific per capita consumption on the right bank of the Dniester River, by considering the updated data on the country's population;
- restoring natural gas and liquefied petroleum gas consumption for road transportation for the territory on the left bank of the Dniester River based on specific per capita consumption on the right bank of the Dniester River, by considering the updated data on the country's population.

1A3d 'Water-borne Navigation'

- restoring diesel oil consumption for water-borne navigation for the territory on the left bank of the Dniester River, based on the specific per capita consumption on the right bank of the Dniester River, by considering the updated data on the country's population.

1A3e 'Other Transportation' (Pipeline Transport)

- restoring natural gas consumption for pipeline transport for the territory on the left bank of the Dniester River, based on the specific per capita consumption on the right bank of the Dniester River, by considering the updated data on the country's population.

1A4 'Other Sectors'

- data regarding other bituminous coal consumption in category 1A4b for years 1991-1992 were updated.

1B2 'Fugitive Emissions from Oil and Natural Gas'

- activity data associated with the volume of imported natural gas were considered for the calculation of GHG emissions from sources 1B2bii4 'Transmission and storage of natural gas' and 1B2bi 'Venting gas'.

CO_2 Emissions from Biomass

- activity data regarding biomass consumption has been updated for the years 2016, 2018, and 2019.

In comparison with the results included in the BUR3 of the RM to the UNFCCC (2021), these changes made in the current inventory cycle resulted in an increase in direct GHG emissions from Sector 1 'Energy' for the period 1990-2019, varying from a minimum increase of +0.2% in 1991 to a maximum increase of 2.1% in 2014, and a decrease in direct GHG emissions, respectively, for the years 2015-2016 and 2018, varying from a minimum decrease of 0.03% in 2018 to a maximum decrease of 0.8% in 2016 (Table 8-3).

Table 8-3: Recalculation results of total direct GHG emissions from Sector 1 'Energy' included in the BUR3 of the RM to the UNFCCC, Mt CO_2 equivalent

	1990	1991	1992	1993	1994	1995	1996	1997
BUR3	36.8953	31.2043	24.3515	18.1696	15.2946	12.3097	12.2798	11.0094
NC5	36.9929	31.2587	24.4198	18.2540	15.3775	12.3913	12.3740	11.1206
Difference, %	0.3	0.2	0.3	0.5	0.5	0.7	0.8	1.0
	1998	1999	2000	2001	2002	2003	2004	2005
BUR3	9.5700	7.5571	6.8761	7.4994	7.2925	7.9740	8.4757	8.7644
NC5	9.6520	7.6403	6.9409	7.5701	7.3557	8.0419	8.5459	8.8365
Difference, %	0.9	1.1	0.9	0.9	0.9	0.9	0.8	0.8
	2006	2007	2008	2009	2010	2011	2012	2013
BUR3	7.9199	8.0885	8.3876	8.8010	9.3278	9.7144	9.2874	8.9802
NC5	7.9821	8.1547	8.4509	8.8753	9.4964	9.7876	9.4652	9.0359
Difference, %	0.8	0.8	0.8	0.8	1.8	0.8	1.9	0.6
	2014	2015	2016	2017	2018	2019	2020	%
BUR3	8.8830	9.1825	9.3349	8.8995	9.4093	9.3217		
NC5	9.0697	9.1196	9.2566	8.9249	9.4069	9.4014	9.5499	-74.6
Difference, %	2.1	-0.7	-0.8	0.3	-0.03	0.9		

Abbreviation: BUR3 – Third Biennial Update Report of the RM to the UNFCCC; NC5 – Fifth National Communication of the RM to the UNFCCC.

8.1.2. Sector 2 'Industrial Processes and Product Use'

Recalculation of total direct GHG emissions from Sector 2 'Industrial Processes and Product Use' were performed for the following reasons:

2A3 'Glass Production'

- CO_2 emissions from glass production were recalculated for the period 1990-2019 as a result of updated activity data regarding the amount of glass produced, based on the information collected through surveys from the SOE 'Chisinau Glass Factory', and JSC 'Glass Container Company' and JSC 'Glass Container Prim' in Chisinau, and as a result of updated conversion coefficients: the average weight of a conventional glass container was changed from 0.48 kg to 0.52 kg, the average weight of a sterilizer glass jar was changed from 0.25 kg to 0.26 kg.

2A4 'Ceramic Production'

- GHG emissions from ceramic production were recalculated for 2016-2019 as a result of updated activity data used. The recalculation impact is non-essential, resulting in a decrease in GHG emissions from ceramic production of around 0.1% over that period. Starting with 2018, in the Statistical Reports PRODMOLD-A 'Production in total natural expression by Republic, by types of products' there is no information on ceramic production in the Republic of Moldova. In the previous inventory cycle, the activity data for 2019 were extrapolated based on the trend recorded in previous years. In the current inventory cycle, this approach has been discarded until the cause of non-inclusion of ceramic production in the respective statistical report is identified (activity data could be confidential, or alternatively the production of ceramics may have ceased since 2019).

2A4 'Other Uses of Soda Ash'

- CO_2 emissions from the other uses of soda ash were recalculated for the period 1990-2001 as a result of updated information on annual soda ash consumption in the glass industry (given that soda ash consumption in the respective industry was equivalent to 250 kg of soda ash per tonne of glass produced[130] between 1990 and 1994, and 200 kg of soda ash per tonne of glass produced between 1995 and 2001). No recalculations were made for 2002-2019 as the values associated with the annual soda ash consumption in the glass industry were estimated by direct questioning of functional glass factories in the Republic of Moldova.

2D1 'Lubricant Use'

- CO_2 emissions from source category 2D1 'Lubricant Use' were recalculated for 2019 as a result of using the updated value of lubricant consumption available in the Energy Balance of the RM for 2019.

2D2 'Paraffine Wax Use'

- CO_2 emissions from source category 2D2 'Paraffine Wax Use' were recalculated for 2019 as a result of using the updated value of paraffin wax consumption available in the Energy Balance of the RM for 2019.

2F1 'Refrigeration and Air Conditioning'

- HFC emissions from source category 2F1 'Refrigeration and Air Conditioning' were recalculated for the period 2007-2019 as a result of:

a) updating the share of refrigerants incorporated in refrigeration and air conditioning equipment in the RM;

b) updating data on the share of transport units equipped with air conditioning equipment, provided by the Public Services Agency of the Republic of Moldova, based on the information included in the State Transport Register.

2F2 'Foam Blowing Agents'

- HFC emissions from source category 2F2 'Foam Blowing Agents' were recalculated for 2018 and 2019, following as a result of the updated share of blowing agents in expanded foam products imported into the RM.

2G1 'Electrical equipment'

- SF_6 and CF_4 emissions from category 2G1 'Electrical Equipment' were recalculated for the period 2015-2019 due to the updated total number of medium-tension electrical circuit breakers in the management of JSC 'RED-North'.

2G4 'Other'

- indirect CO_2 emissions from category 2G4 'Other' were recalculated for the period 2018-2019 due to updated AD regarding the use of cigars/cigarettes and shoes in the Republic of Moldova, available in official reference sources: the Automated System for Customs Data ASYCUDA World, which ensures the management and processing of customs forms and documents used

[130] Russian National Trade Point. Conjuncture. Goods and Markets. Soda Ash on the World Market. http://www.rusimpex.ru/Content/Economics/Conjuncture/99_11002.htm>.

in customs procedures, respectively in the Statistical Yearbooks of the RM and the Statistical Reports PRODMOLD-A 'Total production, as a natural expression, in the Republic of Moldova, by product type', as well as in the Statistical Yearbooks of the ATULBD.

In comparison with the results included in the BUR3 of the RM to the UNFCCC (2021), the changes made in the current inventory cycle resulted in an insignificant increase in GHG emissions for 1990-2010, 2012-2013, 2015 and 2017-2018, and an insignificant decrease in direct GHG emissions, respectively, for 2011, 2014, 2016, and 2019 (Table 8-4).

Table 8-4: Recalculation results of direct GHG emissions from Sector 2 'Industrial Processes and Product Use' included in the BUR3 of the RM to the UNFCCC, Mt CO_2 equivalent

	1990	1991	1992	1993	1994	1995	1996	1997
BUR3	1.6037	1.4098	0.8216	0.7371	0.5562	0.4562	0.4163	0.4544
NC5	1.6052	1.4113	0.8225	0.7379	0.5566	0.4567	0.4169	0.4548
Difference, %	0.10	0.11	0.11	0.11	0.06	0.11	0.16	0.10
	1998	1999	2000	2001	2002	2003	2004	2005
BUR3	0.3782	0.3419	0.3144	0.3186	0.3688	0.3971	0.4707	0.5713
NC5	0.3787	0.3422	0.3158	0.3198	0.3703	0.3986	0.4722	0.5731
Difference, %	0.13	0.09	0.43	0.38	0.42	0.36	0.32	0.30
	2006	2007	2008	2009	2010	2011	2012	2013
BUR3	0.6775	0.9361	1.0242	0.5295	0.5600	0.6649	0.6829	0.7326
NC5	0.6791	0.9373	1.0256	0.5303	0.5612	0.6649	0.6829	0.7332
Difference, %	0.24	0.13	0.13	0.16	0.22	-0.01	0.01	0.08
	2014	2015	2016	2017	2018	2019	2020	%
BUR3	0.7605	0.7628	0.7480	0.7768	0.9592	0.9922		
NC5	0.7602	0.7651	0.7469	0.7797	0.9647	0.9912	0.9988	-37.8
Difference, %	-0.03	0.31	-0.14	0.38	0.57	-0.10		

Abbreviations: BUR3 – Third Biennial Update Report of the RM to the UNFCCC, NC5 – Fifth National Communication of the RM to the UNFCCC.

8.1.3. Sector 3 'Agriculture'

Recalculations of total direct GHG emissions from Sector 3 'Agriculture' were performed for the following reasons:

3A 'Enteric Fermentation'

- CH_4 emissions from source category 3A 'Enteric fermentation' were recalculated as a result of updating the activity data used on the number of domestic livestock and the productivity of domestic livestock population for the years 2017-2019, as available in the Statistical Annual Report No. 24-agr 'Animal Breeding Sector', Number of livestock and poultry in all households categories as of January 1, and as a result of the updated DE values for the period 2017-2019 expressed as a percentage of gross energy, GE values and country-specific emission factors for cattle, and sheep and goats, calculated using a Tier 2 methodology.

3B 'Manure Management'

- CH_4 emissions from category 3B 'Manure Management' were recalculated for the period 1998-2019 as a result of updating the share manure management systems (MS%) in the RM for livestock and poultry, based on a study developed in 2015, as well as in 2021 by specialists from the National Agency for Food Safety. The most relevant updates were related to the change over time in the share of 'liquid systems', 'solid storage', as well as considering such management systems as 'anaerobic digestion of animal manure in digesters' and 'pit storage < 1 month' for the first time;
- N_2O emissions from category 3B 'Manure Management' were recalculated for the period 1990-2019 as a result of updating the values of shares of manure management systems (MS%) applied in the RM, based on results of the study conducted in 2015 and 2021 by specialists from the National Agency for Food Safety, and as a result of the correction of the default emission factor value used (FE_3, kg N_2O-N/kg N excreted) for the manure management system 'Solid storage' (the value '0.02 kg N_2O-N/kg N excreted' was used in the previous inventory cycle, typical of the manure management system 'Dry lot'), whereas in the current inventory cycle the value 0.01 kg N_2O-N/kg N excreted was used, characteristic to the manure management system 'Solid storage with deep bedding, without active mixing'. Additionally, for specific animal categories, the default values used regarding the losses of N, which volatilize into NH_3 and NO_x, were corrected/adjusted

for some Manure Management S,% ($_{GasMS}$ and $_{LossMS}$), because in the previous inventory cycle for certain categories of animals such as dairy cows, other cattle and swine, values were incorrectly used for lower N losses than those used by default according to the 2006 IPCC Guidelines.

3Da2 'Organic N Fertilizers'

- Direct N_2O_{ON} emissions from source category 3D.a.2 'Organic N Fertilizers' were recalculated for the period 1998-2019 as a result of the updated share of manure management systems (MS%) applied in the RM, based on the results of studies conducted in 2015 and 2021 by specialists of the National Agency for Food Safety. As a result, the values associated with the total amount of nitrogen excreted in all manure management systems and the amount of N available for application to agricultural soils in the Republic of Moldova have also been changed.

3Da3 'Urine and Dung Deposited by Grazing Animals'

- Direct N_2O_{PRP} emissions from source category 3D.a.3 'Urine and Dung Deposited by Grazing Animals' were recalculated for the period 2012-2019, particularly due to the use of updated shares of manure management systems (MS%) applied, based on studies developed in 2015 and 2021 by specialists of the National Agency for Food Safety.

3Da4 'Crop Residues Returned to Soil'

- Direct N_2O_{CR} emissions from source category 3D.a.4 'Crop Residues Returned to Soil' were recalculated for the years 2012-2019 as a result of updated statistical activity data for the ATULBD, based on Press Releases 'Sown area, crop average yield and harvest in 2012-2020' (excluding households)[131].

3Da5 'Nitrogen Mineralization Associated with Loss of Soil Organic Matter'

- Direct N_2O_{SOM} emissions from source category 3D.a.5 'Nitrogen Mineralization Associated with Loss of Soil Organic Matter' as a result of land-use or management change in the RM were recalculated for the period 1990-2021, using a Tier 2 methodology from the 2006 IPCC Guidelines (Equation 2.25, Volume 4, Chapter 2, page 2.30), based on country-specific values, measured in July-August 2021, offered by professor Valerian Cerbari, Head of the Pedology Laboratory of the 'Nicolae Dimo' Institute of Pedology, Agrochemistry and Soil Protection, having carried out research in order to determine and describe the evolution of organic carbon stocks in arable soils in 3 geographical areas of the Republic of Moldova (North – Napadova commune, Floresti district; Centre – Ivancea commune, Orhei district; and South – Lebedenco commune, Cahul district).

3Db1 'Atmospheric Deposition of Nitrogen Oxides (NO_x) and Ammonia (NH_4)'

- Indirect N_2O_{ATD} emissions from source category 3D.b.1 'Atmospheric Deposition of Nitrogen Oxides (NO_x) and Ammonia (NH_4)' were recalculated for the period 1998-2019 as a result of updated shares of manure management systems (MS%) applied, based on studies developed in 2015 and 2021 by specialists of the National Agency for Food Safety, and updated values associated with the total amount of excreted N within all manure management systems and the amount of nitrogen available to be applied to agricultural soils in the Republic of Moldova.

3Db2 'Nitrogen Leaching and Run-off'

- Indirect N_2O_L emissions from source category 3D.b.2 'Nitrogen Leaching and Run-off' were recalculated for the period 1990-2019 as a result of updated statistical activity data for the ATULBD, based on the Press Releases 'Sown area, crop average yield and harvest in 2012-2020' (excluding households); as a result of the updated shares of manure management systems (MS%) applied in the RM, based on the studies carried out in 2015 and 2021 by specialists of the National Agency for Food Safety; and as a result of changing the values associated with the total quantity of excreted N within all manure management systems and the amount of nitrogen available to be applied to agricultural soils; respectively, as a result of updated country-specific values of annual mineral soil carbon loss between 1990-2020, based on research conducted by the 'Nicolae Dimo' Institute

[131] Press Release 'Sown area, crop average yield and harvest in 2012-2020' (excluding households). Tiraspol, 2013-2021. P. 15.

of Pedology, Agrochemistry and Soil Protection between July-August 2021 in order to determine and describe the evolution of organic carbon stocks in arable soils in 3 geographical areas of the Republic of Moldova (North – Napadova commune, Floresti district; Centre – Ivancea commune, Orhei district; and South – Lebedenco commune, Cahul district).

In comparison with the results included in the BUR3 of the RM to the UNFCCC (2021), the changes made in the current inventory cycle resulted in a downward trend in direct GHG emissions for 1990-2019, varying from a minimum decrease of 4.8% in 1990 to a maximum decrease of 8.4% in 2009 (Table 8-5).

Table 8-5: Recalculation results of direct GHG emissions from Sector 3 'Agriculture' included in the BUR3 of the RM to the UNFCCC, Mt CO_2 equivalent

	1990	1991	1992	1993	1994	1995	1996	1997
BUR3	5.3355	4.9634	4.5461	4.0067	3.7312	3.4103	3.2641	2.8258
NC5	5.0767	4.6954	4.2923	3.7546	3.4834	3.1734	3.0137	2.6246
Difference, %	-4.8	-5.4	-5.6	-6.3	-6.6	-6.9	-7.7	-7.1
	1998	1999	2000	2001	2002	2003	2004	2005
BUR3	2.7171	2.4927	2.3121	2.4080	2.4778	2.2347	2.2340	2.2403
NC5	2.5194	2.3069	2.1362	2.2282	2.2975	2.0642	2.0641	2.0632
Difference, %	-7.3	-7.5	-7.6	-7.5	-7.3	-7.6	-7.6	-7.9
	2006	2007	2008	2009	2010	2011	2012	2013
BUR3	2.1819	1.7714	1.8428	1.8844	1.9667	1.8915	1.7906	1.9148
NC5	2.0054	1.6241	1.6966	1.7252	1.8037	1.7402	1.6453	1.7747
Difference, %	-8.1	-8.3	-7.9	-8.4	-8.3	-8.0	-8.1	-7.3
	2014	2015	2016	2017	2018	2019	2020	%
BUR3	2.1240	1.8484	1.9875	2.0379	1.9930	1.9435		
NC5	1.9740	1.7012	1.8267	1.8817	1.8373	1.7987	1.5464	-69.5
Difference, %	-7.1	-8.0	-8.1	-7.7	-7.8	-7.4		

Abbreviations: BUR3 – Third Biennial Update Report of the RM to the UNFCCC, NC5 – Fifth National Communication of the RM to the UNFCCC.

8.1.4. Sector 4 'Land Use, Land-Use Change and Forestry'

Recalculations of net direct GHG emissions from Sector 4 'LULUCF' were performed for the following reasons:

4B 'Cropland'

- For the period 1990-2019, recalculations were only made for subcategory 4B1.2 'Annual Change in Carbon Stocks in Mineral Soils'. The recalculations for the respective category are due to the updated activity data that emerged from the improvement of the Land Use and Land-Use Change Matrix for the period 1970-2019; a reduction in the value of the country-specific emission factor, i.e. the coefficient for average annual loss of soil organic carbon for this category for the entire period under review (from 0.355 tonnes C/ha/yr to 0.310 tonnes C/ha/yr)[132].

In comparison with the results recorded in the BUR3 of the RM to the UNFCCC (2021), the changes made in the current inventory cycle resulted in an upward trend in net CO_2 removals for the years 1990--2018, varying from a minimum of +10.9% in 1991 to a maximum of +61.5% in 2014, and in a downward trend in net CO_2 removals in 2019 (-95.5%), respectively (Table 8-6).

Table 8-6: Recalculation results of net CO_2 removals from Sector 4 'Land Use, Land-Use Change and Forestry' included in the BUR3 of the RM to the UNFCCC, Mt CO_2

	1990	1991	1992	1993	1994	1995	1996	1997
BUR3	-1.3878	-2.4531	-1.8464	-1.8691	-1.8032	-1.7616	-2.2070	-1.8447
NC5	-1.6575	-2.7216	-2.1161	-2.1392	-2.0731	-2.0311	-2.4767	-2.1157
Difference, %	19.4	10.9	14.6	14.4	15.0	15.3	12.2	14.7
	1998	1999	2000	2001	2002	2003	2004	2005
BUR3	-1.8639	-1.5728	-1.8539	-1.4988	-1.5862	-1.5166	-1.6902	-1.3960
NC5	-2.1358	-1.8442	-2.1233	-1.7670	-1.8543	-1.7848	-1.9579	-1.6675
Difference, %	14.6	17.3	14.5	17.9	16.9	17.7	15.8	19.5
	2006	2007	2008	2009	2010	2011	2012	2013
BUR3	-1.5190	-1.7149	-1.4094	-1.0207	-0.9539	-0.8960	-0.9268	-0.7976
NC5	-1.7934	-1.9892	-1.6836	-1.2950	-1.2282	-1.1699	-1.1991	-1.0710
Difference, %	18.1	16.0	19.5	26.9	28.7	30.6	29.4	34.3

[132] V. Cerbari (2021), Expert report for the determination and description of the evolution of organic carbon stocks in arable soils in 3 geographical areas of the Republic of Moldova (North – Napadova commune, Floresti district; Center – Ivancea commune, Orhei district; South – Lebedenco commune, Cahul district), PI 'EPIU', 16 P.

	2014	2015	2016	2017	2018	2019	2020	%
BUR3	-0.4489	-0.9035	-0.6576	-0.7138	-0.5601	0.2958		
NC5	-0.7247	-1.1819	-0.9375	-0.9933	-0.8411	0.0133	-0.0035	-99.8
Difference, %	61.5	30.8	42.6	39.2	50.2	-95.5		

Abbreviations: BUR3 – Third Biennial Update Report of the RM to the UNFCCC, NC5 – Fifth National Communication of the RM to the UNFCCC.

8.1.5. Sector 5 'Waste'

Recalculations of direct GHG emissions from Sector 5 'Waste' were performed based on the following considerations:

5A 'Solid waste disposal'

- GHG emissions from category 5A 'Solid Waste Disposal' were recalculated in the current inventory cycle for the entire period 1990-2020 as a result of an error identified in the calculation model for CH_4 emissions (in the calculation formula, the link to a calculation parameter was incorrectly indicated, which caused a consecutive error for the entire time series). Concomitantly, the value of inert waste was updated for the period 2016-2019, from 31% to 41%, according to the morphological composition of waste);

5C 'Incineration and Open Burning of Waste'

- Direct and indirect GHG emissions from category 5C 'Incineration and Open Burning of Waste' were recalculated for 2019 particularly as a result of updated activity data associated with the population number.

5D 'Wastewater Treatment and Discharge'

- Recalculations were made for CH_4 emissions from category 5D 'Wastewater Treatment and Discharge' for 2019 as a result of updated activity data associated with the population number.

In comparison with the results recorded in the previous inventory cycle, the changes made resulted in an insignificant upward trend in direct GHG emissions between 1990 and 2019, varying from a minimum of 0.5% in 2019 and a maximum of 3.9% in 1990 (Table 8-7).

Table 8-7: Recalculation results of direct GHG emissions from Sector 5 'Waste' included in the BUR3 of the RM to the UNFCCC, Mt CO_2 equivalent

	1990	1991	1992	1993	1994	1995	1996	1997
BUR3	1.5142	1.5480	1.5508	1.6101	1.5925	1.5904	1.5931	1.5876
NC5	1.5735	1.6044	1.6044	1.6619	1.6418	1.6373	1.6382	1.6305
Difference, %	3.9	3.6	3.5	3.2	3.1	2.9	2.8	2.7
	1998	1999	2000	2001	2002	2003	2004	2005
BUR3	1.5639	1.5594	1.5364	1.5105	1.5001	1.4674	1.4506	1.4492
NC5	1.6047	1.5988	1.5739	1.5459	1.5339	1.4992	1.4808	1.4785
Difference, %	2.6	2.5	2.4	2.3	2.2	2.2	2.1	2.0
	2006	2007	2008	2009	2010	2011	2012	2013
BUR3	1.4370	1.4260	1.4417	1.4548	1.4786	1.4887	1.4741	1.4163
NC5	1.4649	1.4525	1.4670	1.4788	1.5015	1.5104	1.4942	1.4355
Difference, %	1.9	1.9	1.7	1.6	1.5	1.5	1.4	1.4
	2014	2015	2016	2017	2018	2019	2020	%
BUR3	1.4055	1.4059	1.4331	1.5303	1.5463	1.5526		
NC5	1.4237	1.4232	1.4499	1.5394	1.5552	1.5605	1.5666	-0.4
Difference, %	1.3	1.2	1.2	0.6	0.6	0.5		

Abbreviations: BUR3 – Third Biennial Update Report of the RM to the UNFCCC, NC5 – Fifth National Communication of the RM to the UNFCCC.

8.2. Planned Improvements

A series of improvements is planned for the next inventory cycles. Planned procedural and institutional improvements, as well as planned improvements at sectoral level are presented below.

8.2.1. Institutional and Procedural Improvements

The estimations process of anthropogenic GHG emissions and removals could be enhanced through the following institutional and procedural improvements:

- enhancing the data management system used in each inventory cycle, as well as the periodical archiving of the inventory and the documentation on which inventory was drawn up, in order to comply with the principle of transparency;

- enhancing the level of knowledge of national experts and institutions involved in the compilation of the national GHG emission inventory by organising a series of thematic trainings;
- enhancing the professional skills of national experts involved in the inventory of GHG emissions from Key Categories, with the purpose of realizing the gradual transition from default emission factors and Tier 1 methodologies to country-specific emission factors and Tier 2 and 3 methodologies.

8.2.2. Planned Improvements

Sector 1 'Energy'

The process of monitoring GHG emissions from Sector 1 'Energy' could be improved with:

- availability of new activity data on fuel consumption for electricity and heat production (source category 1A1 'Energy Industries); for industrial production and the construction sector (source category 1A2 'Manufacturing Industries and Construction'); for energy supply to the commercial/ institutional, residential, agriculture/forestry/fishing sectors (source category 1A4 'Other Sectors'), and for other works and energy needs (source category 1A5 'Other'), respectively, for the territory on the Left Bank of the Dniester River (filling in existing gaps for some years); there could also be potential improvements in identifying additional data sources or updating activity data in official statistical publications;
- for source category 1A3a 'Civil Aviation' in the EBs of the RM, aviation gasoline consumption can be found expressly only for the years 1990, 1993 and 1998; there is also a series of AD associated with aviation gasoline consumption for the years 2011-2020 provided by the Civil Aeronautical Authority of the RM, all of which allowed reconstruction by the interpolation method and/or by reallocations of fuel consumption within source category 1A3a 'Civil Aviation' from other source categories. The national inventory team is aware of the inconsistency of activity data associated with aviation gasoline consumption (data being collected from two separate reference sources); however, this inconsistency would be difficult to eliminate at the moment. In the next inventory cycle, various options shall be analysed in order to improve the quality of the national greenhouse gas inventory from the respective source category;
- using higher-tier methodology for source categories 1A3a 'Civil Aviation' (Tier 2b), and 1A3c 'Railways' (Tier 2) (these are currently not key categories, a switch to higher-tier methodologies is thereby not cost-effective, not to mention the effort to be put in by the national inventory team);
- collecting additional activity data necessary for the use of the COPERT 4.9 model (1A3b 'Road Transportation') for the entire period under review (for the time being, it has been possible to collect the activity data necessary to run the respective program only for the period 1995-2019);
- availability of additional data on fugitive leaks from oil and natural gas distribution networks (from the infrastructure needed to produce, collect, process, refine and distribute oil products and natural gases to final consumers; from equipment functioning, evaporation and venting losses, flaring, accidental releases from pipeline dig-ins, etc.) (source category 1B2 'Fugitive Emissions from Oil and Natural Gas), i.e., in the case of adopting a higher-ranking estimation methodology, the possibility to obtain AD associated with LPG consumption on the LBDR for the entire period under review will also be estimated;
- using a higher methodology to estimate GHG emissions from 'International Aviation' (e.g., the Tier 3 calculation methodology available in the EMEP/EEA Air Pollutant Emission Inventory Guidebook (2019), which considers the actual emission values for each aircraft type according to the flight distance, and the emission calculator available in the updated version of the EMEP/EEA Air Pollutant Emission Inventory Guidebook (2019) could also be used;
- extension of the data recording method on biomass consumption used in the 'Research on Energy Consumption in Households', conducted by the NBS of the RM with the support of experts in the Energy Community in 2015 and for the period 1990-2009, thus ensuring the consistency of the results obtained for this source category for the entire time series covered by the inventory;

- availability of new AD on biomass consumption (CO_2 Emissions from Biomass) on the Left Bank of the Dniester River and filling existing gaps for some years.

Sector 2 'Industrial Processes and Product Use'

The process of monitoring GHG emissions from Sector 2 'IPPU' could be improved with:

- updating the activity data used to estimate GHG emissions from category 2A 'Mineral Industry' for the period 1990-2020;
- updating activity data on raw material consumption per tonne of production, as well as the specific electrode consumption per tonne of steel produced by enterprises in the Republic of Moldova under category 2C1 'Iron and Steel Production';
- updating the activity data used to estimate GHG emissions from category 2D 'Non-Energy Products from Fuels and Solvent Use' for the period 1990-2020;
- capacity-building activities by setting up an on-line information system for collecting AD from companies that import, use, dispose, recover and recycle freons and refrigerant equipment. This information system will provide the National Agency on Regulation of Nuclear, Radiological and Chemical Activities, the Environment Agency and the Ministry of Environment with more accurate activity data, which could potentially contribute to reducing uncertainties in the estimation of GHG emissions from category 2F 'Product Uses as Substitutes for ODS' in the Republic of Moldova;
- updating the activity data used to estimate GHG emissions from category 2G 'Other Product Manufacture and Use' for the period 1990-2020.

Sector 3 'Agriculture'

The process of monitoring GHG emissions from Sector 3 'Agriculture' could be improved with:

- updating AD and productivity indicators used to estimate GHG emissions from category 3A 'Enteric Fermentation' based on the Tier 2 methodology, particularly for cattle and sheep, the categories of animals with the highest share in the structure of CH_4 emissions from this source category;
- updating AD and productivity indicators used to estimate methane emissions from category 3B 'Manure Management', particularly for cattle and swine, the categories of animals with a higher share in the structure of methane emissions from this source category; as well as activities on specifying coefficient values used to estimate national EFs based on the Tier 2 methodology;
- collecting additional data used to estimate N_2O emissions from source category 3B 'Manure Management', particularly data related to the share of manure management systems at national level during the period under review (historical data, starting with 1990, as well as for the recent period, periodically – once every 3 years), as well as data associated with specifying country-specific values of $N_{ex(T)}$ excretion rates (kg N/head/year) for the categories of animals in the RM;
- updating AD and country-specific coefficients used to estimate direct N_2O emissions from crop residues returned to soils in the RM;
- updating country-specific coefficients used to estimate direct N_2O emissions from nitrogen mineralization as a result of carbon losses resulting from land-use changes and soil management practices in the Republic of Moldova; it is thereby relevant to establish the values of humus content in arable soils once every 3 years, (layer – 0-30 cm) in the northern part of the country (Napadova commune, Floresti district), and in the south of the country (Lebedenco commune, Cahul district), respectively, in order to identify the national average (SOC_0) and the average annual losses in the RM during the reporting period to the UNFCCC.

Sector 4 'Land Use, Land-Use Change and Forestry'

The process of monitoring GHG emissions/removals from Sector 4 'LULUCF' could be improved with:

- improving records on actual wood consumption from forests in the Republic of Moldova, as well as updating national emission/removal factors within category 4A 'Forest Land' (e.g., wood density, biomass expansion factor, emission factors from forest fires, etc.);

- improving records pertaining to the actual volume of wood mass from windbreak management and other types of forest vegetation (subcategory 4B1.1 'Cropland Covered with Woody Vegetation'), as well as activities aimed at the verification of emission/removal factors specific to perennial plantations (current biomass increments, biomass harvesting during clearings, etc.);
- improving the country-specific methodology (Banaru, 2000) and improving the quality of activity data used to estimate CO_2 emissions/removals in mineral soils for subcategory 4B1.2 'Annual Change in Carbon Stocks in Mineral Soils';
- improving cadastral records (as main sources of activity data) by mentioning in their explanatory notes the land-use categories to which the land excluded from the agricultural circuit is transferred (category 4C 'Grassland');
- improving cadastral records (as main sources of activity data) by accurately mentioning in their explanatory notes the initial land-use categories transferred to category 4D 'Wetlands';
- improving cadastral records (as main sources of activity data) by accurately mentioning in their explanatory notes the initial land-use categories transferred to category 4E 'Settlements';
- improving cadastral records (as main sources of activity data) by accurately mentioning in their explanatory notes the initial land-use categories transferred to category 4F 'Other Land'; at the same time, it is necessary to analyse the input-output process of land to category 4F 'Other Land', including in terms of establishing the average conversion period;
- the possibility to improve statistical records (as the main sources of activity data) regarding wood product production/export/import within category 4G 'Harvested Wood Products'.

Sector 5 'Waste'

The process of monitoring direct GHG emissions from Sector 5 'Waste' could be improved with:

- imposing a new approach to dealing with environmental issues in the Republic of Moldova, in accordance with the country's commitments under ratified international conventions and agreements, and in terms of sustainable development, as well as from the perspective of the country's integration to the European Union respectively; promoting statistical records on waste generated and the essential restructuring of waste management by taking into account international practices and EU standards in the field of MSW management;
- in the context of implementing Government Decision No. 501/2018 on the Instruction on keeping records and transmitting data on waste and its management, respectively in the context of implementing Government Decision No. 682/2018 on the Concept of the Waste Management Automated Information System (SIAMD), through which the reporting system www.siamd.gov.md was developed, given that the years 2019 and 2020 were the first reporting years in the new system, it is recognized that the information collected does not reflect the actual situation in the field of waste management; thus, for example, the amount of MSW generated in rural localities are not subject to statistical records, as there are usually no waste collection services; also, altbeit there are waste processing companies operating in the RM, the information on the amount of recycled waste is not subject to strict statistical records; taking into account the RM's trend towards alignment with EU standards, the sector needs to be significantly restructured; in this context, most SWDS are to be re-established, and their number – drastically reduced;
- updating activity data, particularly to review the transformation coefficient of the volume of MSW into quantity. In recent years, there have been upward trends in the share of packaging in the total amount of waste generated per capita, and the Sanitation Service in Chisinau shows that 1 m^3 of MSW constitutes 180-200 kg, which means that the coefficient 0.4kg/1m^3 of MSW will be reviewed. In the next period, we shall analyse the AD reported in the Automated Information System, in the the National Register of Emissions and Transfer of Pollutants, and in the Waste Management Automated Information System, by the waste collection services in the country;
- updating the study on the morphological composition of solid waste, with the involvement of the Environmental Reference Laboratory of the Environment Agency, MSW generated in Chisinau, respectively in the cities of Causeni and Straseni. It will also be necessary to include the weighing of waste trucks in order to infer the transformation coefficient of the volume of MSW into quantity;

- the proper implementation of the Waste Management Strategy in the Republic of Moldova for 2013-2027, which stipulates the development of integrated municipal waste management systems by harmonizing the legislative, institutional and regulatory framework with European Union standards, based on the regional approach (geographical location, economic development, the existence of access roads, pedological and hydrogeological conditions, population number, etc.); promoting and implementing selective collection systems in all localities in both the residential and industrial sectors, as well as sorting, composting and recycling facilities; development of municipal waste disposal capacities through the construction of seven SWDS at regional level and two mechanical-biological treatment plants in Chisinau and Balti municipalities; in this context, it should be mentioned that Law No. 89 on the ratification of the Financing Agreement between the Republic of Moldova and the European Investment Bank regarding the implementation of the project 'Solid Waste in the Republic of Moldova' was approved in June 2020. Through this agreement between the European Investment Bank and the Government of the Republic of Moldova, a loan of 100 million euros will be granted for the improvement of solid waste management services in the country. The loan will be offered in several instalments, the first instalment being 25 million euros. This Agreement aims to implement the Waste Management Strategy 2013-2027 in the Republic of Moldova, involving projects aimed at modernizing and developing Solid Waste Management Systems and facilities in eight regions of our country. The projects will provide localities with new waste collection systems, mechanical-biological waste treatment plants and new regional sanitary landfills for the entire country. The projects will aim to reduce the negative impact on the environment and human health, by modernizing waste collection systems and separate collection of recyclable materials and bio-waste, as well as rehabilitating or discontinuing landfills. Regional landfills will be equipped with biogas recovery systems, as it will contribute to the reduction of GHG emissions and therefore to the achievement of the updated NDC, in accordance with to the provisions of the Paris Agreement;
- the practices of composting organic waste at national level should be specified for source category 5B 'Biological Treatment of Solid Waste' in order to determine the existence of these platforms in urban and rural localities, especially those with waste collection services; at the same time, with the implementation of a new integrated waste management system, waste composting facilities shall be developed, which would considerably reduce the impact on the environment and take control of biogas emissions;
- with reference to source category 5C 'Incineration and Open Burning of Waste', it is necessary to mention the fact that the Waste Management Automated Information System has already been developed and economic agents have submitted the first reports for the years 2019 and 2020; In the coming years, when the respective system becomes fully operational and includes all economic operators, all data on waste management shall be available, including treatment by incineration or burning. At the same time, SIAMD will allow the collection of data on municipal waste or similar waste collected from the population and economic agents, as well as on the number of people benefiting from the waste collection service, this data being reported by the waste collection operators. It shall thereby be possible to improve the quality of activity data used for estimating emissions from the respective source category;
- improving the population's access to quality water supply and waste collection services, in the context of implementing Government Decision No. 199 dated 20.03.2014 on the Strategy of Water Supply and Sanitation (2014-2028) (modified through Government Decision No. 442/2020), ensuring gradual access to quality water supply and waste collection services for all localities and population of the Republic of Moldova, thus contributing to the improvement of health, dignity and quality of life as well as to the economic development of the country;
- providing the entire population with access to improved waste collection systems by 2025, including up to 50% with sewage systems; increasing the performance levels of collective systems of water supply, sanitation and other types; increasing the degree of implementation of good practices recognized in the field of integrated water management as well as water supply and sanitation; reduce the amount of untreated wastewater discharged by 50%, and reducing untre-

ated rainwater discharged into natural receptors; improving sludge managements and quality of treated wastewater from centralized sewer systems or other waste collection systems, in the context of fully implementing Government Decision No. 1063 dated 16.09.2016 on approving the National Program for the Implementation of the Protocol on Water and Health in the Republic of Moldova for 2016-2025; the respective program also plans to establish several indicators to ensure the population's access to improved waste collection systems, and efficiency for managing the collective sanitation systems as well as other systems; ensuring effective collective sewer systems in 7 cities in the country by 2025; the application of good practices in the field of water supply management, water and sanitation management; ensuring sludge disposal or reutilisation from centralized collective sewer systems or other types of sewer systems;

- regulating the conditions of discharge, the introduction of specific substances into a body of surface water, groundwater or water fields, in the context of implementing the Regulation on Wastewater Discharge in Water Bodies, approved through Government Decision No. 802 dated 09.10.2013; the Regulation indicates the emission limit values applicable to the discharge of wastewater from the industrial sectors (activities) into a body of surface water. It is expected that this regulation will produce a positive effect on the quality of AD and a decrease in emissions from source category 5D 'Wastewater Treatment and Discharge', respectively;
- regulating the conditions for wastewater collection, treatment and discharge in the sewer system and/or in emissaries, in the context of implementing the Regulation on Requirements for Wastewater Collection, Treatment and Discharge in the Sewage System and/or in Emissaries for Urban and Rural Areas, approved through the Government Decision No. 950 dated 25.11.2013; the Regulation stipulates what the maximum allowable limit values for pollutants in discharged water into natural water emissaries are, which will contribute to a decrease in emissions within source category 5D 'Wastewater Treatment and Discharge';
- implementing Regional Sectoral Plans for Water and Sanitation Supply by applying clearly defined regulatory, institutional and economic instruments:
    - *regulatory instruments* – will focus on a set of normative laws (Water Law No. 272 as of 23.12.2011, Law No. 303 on Public Service for Water and Sanitation Supply, the Regulation on Requirements for Wastewater Collection, Treatment and Discharge in the Sewer System and/or in Emissaries for Urban and Rural Areas, Government Decision No. 950 dated 25.11.2013 on the approval of the Regulation on Requirements for Wastewater Collection, Treatment and Discharge in the Sewer System and/or in Emissaries for Urban and Rural Areas, Regional Sectoral Plans related to water and sanitation and other); These regulatory instruments through their provisions will improve the quality of water and sanitation services, of wastewater, rain water and sludge management, thus improving the quality of services within the sector;
    - *institutional instruments* – will focus on the regionalization of services within this sector which will encourage water supply providers to associate with regional companies, based on inter-municipal associations/enterprises or public-private partnerships (PPP) capable of becoming strong models of economically viable enterprises. The process of strengthening water providers will be accompanied by tariff adjustment to ensure proper operation and maintenance of systems in order to provide new users with these services. Currently, the Action Plan for 2018-2028 on the regionalization of water supply and sewer systems is promoted, created in order to implement the Strategy on water supply and sanitation for 2014-2028 and the National Program for the Implementation of the Protocol on Water and Health in the Republic of Moldova for 2016-2025. The Plan includes the establishment of regional operators, which constitutes an essential process for ensuring compliance with the acquis communautaire on offering access to quality water supply to the entire population as a fundamental human right. One of the major objectives is to organize and strengthen the institutional capacity of the existing licensed operators by extending the area of water supply and sewer systems to include other administrative-territorial units. Another important goal is to optimize the

number of operators, through their territorial grouping, in order to create viable regional operators by reducing the number of existing ones and establishing 5 major regional operators, according to the following administrative-territorial criteria: North-West Operator – Briceni, Ocnita, Edinet, Donduseni, Glodeni, Falesti districts; Acva-North Operator – Rascani, Drochia, Sangerei, Telenesti, Floresti, Soroca, Soldanesti, Rezina districts and Balti municipality; Centre Operator – Chisinau municipality, Ungheni, Calarasi, Straseni, Orhei, Anenii Noi, Nisporeni, Ialoveni, Hancesti districts; South-West Operator – Leova, Cimislia, Causeni, Stefan-Voda, Cantemir and Cahul districts; ATU Gagauzia Operator;

  - *economic instruments* – will focus on the concept of 'sustainable cost recovery of services' with three main characteristics: an appropriate combination of tariffs, fees and transfers to finance recurring and capital costs and to boost other forms of financing; predictability of public subsidies to facilitate investment (planning); tariff policies that make services accessible to all, including the poorest categories, while ensuring sustainability of service providers.

- the planning of phased harmonization of national water legislation with that of the EU will enhance the implementation of best practices on sludge and wastewater treatment technologies within the sector, which would allow the capture and the sustainable use of methane emissions from sludge storage fields (including for the production of thermal and electric energy);
- using country-specific information on the degradable organic component (BOD_5) in wastewater; BOD fraction removed with sludge; maximum methane formation capacity; methane correction factor and other relevant parameters used to estimate emissions from source category 5D 'Wastewater Treatment and Discharge' in the process of calculating methane emissions will improve the quality of the next national GHG inventories.

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ANNEXES

Annex 1. Key Categories

Annex 1-1. Key Categories – Methodology

According to the 2006 IPCC Guidelines, it is considered good practice to identify key categories of emissions and removals so as to contribute to the inventory quality. The identification practice is intended to help prioritize efforts to improve inventory quality. A key category is defined as *'a priority category within the national inventory system because its estimates influence total national direct greenhouse gas emissions, both in terms of absolute annual emissions as a trend over a period, or both'*.

This annex describes the key category analysis carried out for the Republic of Moldova's inventory, covering the period 1990-2020. The 2006 IPCC Guidelines first requires that inventories be disaggregated into categories from which key source and sink categories may be identified. Source and sink categories are defined according to the following recommendations:

- source category emissions, identified according to standard classification (2006 IPCC Guidelines), expressed in CO_2 equivalent units, calculated using the Global Warming Potential for 100 years (GWP) (IPCC AR4, 2013);
- a source category should be identified for each gas emitted by the source, since the methodological approaches, emission factors, and uncertainties utilised differ for each gas;
- source categories that use the same emission factors based on common methodological approaches are to be aggregated before analysis.

The analysis of key source and sink categories in the Republic of Moldova was carried out following the Tier 1 approach in the 2006 IPCC Guidelines (key categories were identified by quantitative methods using a predetermined cumulative emission threshold) and the Tier 2 approach (key categories were identified by considering the uncertainties of the inventory results for the respective categories).

The quantitative approach identifies key categories from two perspectives. The first analyses each category's contribution to total national emissions. The second perspective analyses the trend of emission contributions from each category to identify where the greatest absolute changes (either increases or decreases) were recorded over a given time. The percentage contributions to both levels and trends in emissions are calculated and sorted from greatest to least. A cumulative total is calculated for both approaches. The 2006 IPCC Guidelines determined that a cumulative contribution threshold of 95% for both level and trend assessments is a reasonable approximation of circa 90% uncertainty for the Tier 1 methodological approach. The 95% cumulative contribution threshold was used in this analysis to define a higher threshold for identifying key categories. Thus, when source and/or sink contributions are sorted in decreasing order (from highest to lowest), those that contribute to 95% of the cumulative total, from a quantitative point of view, are considered key categories.

When using a Tier 1 approach, the level contribution of each source is calculated according to Equation A1-1.1 (Equation 4.1 in the 2006 IPCC Guidelines, Volume 1, Chapter 4.3.1):

Equation A1-1.1:

$$L_{x,t} = |E_{x,t}| / \Sigma\, |E_{y,t}|$$

Where:

$L_{x,t}$ = level assessment for source or sink x in latest inventory year (year t);

$E_{x,t}|$ = absolute value of emission or removal estimate of source or sink category x in year t (expressed in CO_2 equivalent);

$\Sigma\, |E_{y,t}|$ = total contribution, which is the sum of the absolute values of emissions and removals in year t calculated using the aggregation level chosen by the country for key category analysis. Because both GHG emissions and removals are entered with positive sign, the total contribution/ level can be larger than a country's total emissions, less removals.

Trend contribution of each source is calculated according to Equation A1-1.2 (Equation 4.2 in the 2006 IPCC Guidelines, Volume 1, Chapter 4.3.1):

Equation A1-1.2:

$$T_{x,t} = |E_{x,0}| / \Sigma |E_{y,0}| \bullet |[(E_{x,t} - E_{x,0})/E_{x,0}] - [(\Sigma E_{y,t} - \Sigma E_{y,0}) / |\Sigma E_{y,0}|]|$$

Where:

$T_{x,t}$ = trend assessment of source or sink category *x* in year *t*, compared to the base year (year 0);

$E_{x,0}|$ = absolute value of emission or removal estimate of source or sink category *x* in year 0;

$E_{x,t}$ and $E_{x,0}$ = absolute value of emission or removal estimate of source or sink category *x* in years *t* and 0, respectively;

$\Sigma E_{y,t}$ and $\Sigma E_{y,0}$ = total inventory estimates in years *t* and 0, respectively.

Should a Tier 2 approach be utilised, the level contribution of each category is calculated following Equation A1-1.3 (Equation 4.4 in the 2006 IPCC Guidelines, Volume 1, Chapter 4.3.2):

Equation A1-1.3:

$$LU_{x,t} = (L_{x,t} \bullet U_{x,t}) / \Sigma [(L_{y,t} \bullet U_{y,t})]$$

Where:

$LU_{x,t}$ = level assessment for category *x* in latest inventory year (year *t*) with uncertainty;

$L_{x,t}$ = level assessment for source or sink *x* in latest inventory (year *t*);

$U_{x,t}$ = category percentage uncertainty in year *t* calculated following the methodologies described in the 2006 IPCC Guidelines, Volume 1, Chapter 3 (Column G in Table 3.3); it should be noted that the uncertainties reported in Table 3.3 are asymmetrical, the relative uncertainty should be used; the relative uncertainty will always have a positive sign.

When using a Tier 2 approach (considering GHG emission uncertainty), a cumulative contribution threshold of 90% of the sum of all $LU_{x,t}$ was used in this analysis in order to define the limits in identifying key categories. Thus, when $LU_{x,t}$ contributions sorted in decreasing order (from highest to lowest) constitute 90% of the cumulative total, from a quantitative point of view, they are considered key categories.

Trend contribution of each source is calculated following Equation A1-1.4 (Equation 4.5 in the 2006 IPCC Guidelines, Volume 1, Chapter 4.3.2):

Equation A1-1.4:

$$TU_{x,t} = (T_{x,t} \bullet U_{x,t})$$

Where:

$TU_{x,t}$ = trend assessment for category *x* in latest inventory year (year *t*) with uncertainty;

$T_{x,t}$ = trend assessment for source or sink category *x* in year *t* in the latest inventory year (year *t*) calculated according to Equation 4.2 in the 2006 IPCC Guidelines, Volume 1, Chapter 4.3.1;

$U_{x,t}$ = category percentage uncertainty in year *t* calculated following the methodologies described in the 2006 IPCC Guidelines, Volume 1, Chapter 3 (Column G in Table 3.3); the relative uncertainty will always have a positive sign.

When using a Tier 2 approach (considering GHG emission uncertainty), a cumulative contribution threshold of 90% of the sum of all $TU_{x,t}$ was used in this analysis in order to define the limits in identifying the key categories. Thus, when $TU_{x,t}$ contributions sorted in decreasing order (from highest to lowest) constitute 90% of the cumulative total, from a quantitative point of view, they are considered key categories.

The key category analysis was performed using the Key Category Estimation Tool developed by the United States Environment Protection Agency (US EPA) (US EPA's Key Category Calculation Tool v2.5)[133].

[133] <https://19january2017snapshot.epa.gov/climatechange/national-ghg-inventory-capacity-building_.html>

Annex 1-2. Results of Key Category Analysis, following Tier 1 and Tier 2 methods, without LULUCF

Tier 1 – Level Assessment for 1990

Key Categories estimated using a Tier 1 method, Level Assessment, Base Year (1990)	GHG Emissions in 1990 (kt CO_2 eq.)	Level Assessment	Cumulative Sum (%)
1A1 – Fuel Combustion – Energy Industries (Liquid Fuels) – CO_2	7,447.11	0.16	16.5%
1A1 – Fuel Combustion – Energy Industries (Gaseous Fuels) – CO_2	7,414.29	0.16	32.8%
1A1 – Fuel Combustion – Energy Industries (Solid Fuels) – CO_2	6,438.89	0.14	47.1%
1A4b – Fuel Combustion – Other Sectors – Residential – CO_2	4,410.07	0.10	56.8%
1A3b – Fuel Combustion – Transport – Road Transportation – CO_2	4,112.35	0.09	65.9%
3A – Enteric Fermentation – CH_4	2,189.43	0.05	70.7%
1A2 – Fuel Combustion – Manufacturing Industries and Construction – CO_2	1,915.67	0.04	75.0%
1A4c – Fuel Combustion – Other Sectors – Agriculture/Forestry/Fishing – CO_2	1,548.35	0.03	78.4%
1A4a – Fuel Combustion – Other Sectors – Commercial/Institutional – CO_2	1,413.84	0.03	81.5%
3Da – Direct N_2O emissions from Agricultural Soils – N_2O	1,138.56	0.03	84.0%
5A – Solid Waste Disposal – CH_4	1,106.00	0.02	86.5%
2A1 – Mineral Industry – Cement Production – CO_2	971.70	0.02	88.6%
1B2 – Fugitive Emissions from Fuels – Oil and Natural Gas – Natural Gas – CH_4	910.74	0.02	90.6%
3B – Manure Management – CH_4	495.10	0.01	91.7%
3B1 – Direct N_2O Emissions from Manure Management – N_2O	489.81	0.01	92.8%
3B5 – Indirect N_2O Emissions from Manure Management – N_2O	409.90	0.01	93.7%
1A3c – Fuel Combustion – Transport – Railways – CO_2	403.47	0.01	94.6%
3Db – Indirect N_2O Emissions from Agricultural Soils – N_2O	353.35	0.01	95.4%

Tier 1 – Level Assessment for 2020

Key Categories estimated using a Tier 1 method, Level Assessment, 2020	GHG Emissions in 2020 (kt CO_2 eq.)	Level Assessment	Cumulative Sum (%)
1A3b – Fuel Combustion – Transport – Road Transportation – CO_2	2,430.97	0.18	44.4%
1A4b – Fuel Combustion – Other Sectors – Residential – CO_2	1,429.86	0.10	54.8%
5A – Solid Waste Disposal – CH_4	1,246.18	0.09	64.0%
1A2 – Fuel Combustion – Manufacturing Industries and Construction – CO_2	801.44	0.06	69.8%
3Da – Direct N_2O emissions from Agricultural Soils – N_2O	699.44	0.05	74.9%
2A1 – Mineral Industry – Cement Production – CO_2	467.52	0.03	78.4%
3A – Enteric Fermentation – CH_4	389.04	0.03	81.2%
1A4c – Fuel Combustion – Other Sectors – Agriculture/Forestry/Fishing – CO_2	323.53	0.02	83.6%
1A4a – Fuel Combustion – Other Sectors – Commercial/Institutional – CO_2	296.71	0.02	85.7%
5D – Wastewater Treatment and Discharge – CH_4	237.20	0.02	87.5%
1B2b – Fugitive Emissions from Fuels – Oil and Natural Gas – Natural Gas – CH_4	234.66	0.02	89.2%
1A4b – Fuel Combustion – Other Sectors – Residential – CH_4	208.58	0.02	90.7%
3Db – Indirect N_2O Emissions from Agricultural Soils – N_2O	204.56	0.01	92.2%
2D – Non-Energy Products from Fuels and Solvent Use – CO_2	195.36	0.01	93.7%
2F1 – Product Use as Substitutes for ODS – Refrigeration and Air Conditioning – HFCs	153.08	0.01	94.8%
3B1 – Direct N_2O emissions from Manure Management – N_2O	101.23	0.01	95.5%

Tier 1 – Trend Assessment

Key Categories estimated using a Tier 1 method, Trend Assessment	GHG Emissions in 2020 (kt CO_2 eq.)	Trend Assessment	Cumulative Sum (%)
1A1 – Fuel Combustion – Energy Industries (Liquid Fuels) – CO_2	3.93	0.05	21.4%
1A1 – Fuel Combustion – Energy Industries (Solid Fuels) – CO_2	0.44	0.04	39.9%
1A1 – Fuel Combustion – Energy Industries (Gaseous Fuels) – CO_2	3,630.01	0.03	53.1%
1A3b – Fuel Combustion – Transport – Road Transportation – CO_2	2,430.97	0.03	64.4%
5A – Solid Waste Disposal – CH_4	1,246.18	0.02	73.1%
3Da – Direct N_2O emissions from Agricultural Soils – N_2O	699.44	0.01	76.5%
3A – Enteric Fermentation – CH_4	389.04	0.01	79.1%
1A2 – Fuel Combustion – Manufacturing Industries and Construction – CO_2	801.44	0.00	81.2%
2A1 – Mineral Industry – Cement Production – CO_2	467.52	0.00	82.9%
2F1 – Product Use as Substitutes for ODS – Refrigeration and Air Conditioning – HFCs	153.08	0.00	84.3%
1A4c – Fuel Combustion – Other Sectors – Agriculture/Forestry/Fishing – CO_2	323.53	0.00	85.7%
5D – Wastewater Treatment and Discharge – CH_4	237.20	0.00	87.0%
1A4a – Fuel Combustion – Other Sectors – Commercial/Institutional – CO_2	296.71	0.00	88.2%
1A4b – Fuel Combustion – Other Sectors – Residential – CH_4	208.58	0.00	89.4%
2D – Non-Energy Products from Fuels and Solvent Use – CO_2	195.36	0.00	90.6%
3B – Manure Management – CH_4	44.37	0.00	91.6%
1A3c – Fuel Combustion – Transport – Railways – CO_2	19.04	0.00	92.6%
1A4b – Fuel Combustion – Other Sectors – Residential – CO_2	1,429.86	0.00	93.5%
3Db – Indirect N_2O Emissions from Agricultural Soils – N_2O	204.56	0.00	94.4%
2F2 – Product Use as Substitutes for ODS – Foam Blowing Agents – HFCs	89.27	0.00	95.3%

Tier 2 – Level Assessment for 1990

Key Categories estimated using a Tier 2 method, Base Year Level Assessment	GHG Emissions in 1990 (kt CO_2 eq.)	Relative Level Assessment with Uncertainty	Cumulative Sum (%)
3B5 – Indirect N_2O Emissions from Manure Management – N_2O	409.90	0.09	9.1%
3Db – Indirect N_2O Emissions from Agricultural Soils – N_2O	353.35	0.09	17.8%
5A – Solid Waste Disposal – CH_4	1,106.00	0.08	25.9%
1A1 – Fuel Combustion – Energy Industries (Liquid Fuels) – CO_2	7,447.11	0.08	33.5%
1A1 – Fuel Combustion – Energy Industries (Gaseous Fuels) – CO_2	7,414.29	0.08	41.2%
3B1 – Direct N_2O emissions from Manure Management – N_2O	489.81	0.07	48.7%
3A – Enteric Fermentation – CH_4	2,189.43	0.07	55.8%
1A1 – Fuel Combustion – Energy Industries (Solid Fuels) – CO_2	6,438.89	0.07	62.4%
1B2b – Fugitive Emissions from Fuels – Oil and Natural Gas – Natural Gas – CH_4	910.74	0.05	67.1%
1A4b – Fuel Combustion – Other Sectors – Residential – CO_2	4,410.07	0.05	71.7%
3Da – Direct N_2O emissions from Agricultural Soils – N_2O	1,138.56	0.04	76.2%
1A3b – Fuel Combustion – Transport – Road Transportation – CO_2	4,112.35	0.04	80.4%
5D – Wastewater Treatment and Discharge – CH_4	352.96	0.03	83.3%
3B – Manure Management – CH_4	495.10	0.02	85.6%
1A4b – Fuel Combustion – Other Sectors – Residential – CH_4	273.92	0.02	87.6%
1A2 – Fuel Combustion – Manufacturing Industries and Construction – CO_2	1,915.67	0.02	89.6%
1A4c – Fuel Combustion – Other Sectors – Agriculture/Forestry/Fishing – CO_2	1,548.35	0.02	91.2%

Tier 2 – Level Assessment for 2020

Key Categories estimated using a Tier 2 method, Current Year Level Assessment	GHG Emissions in 2020 (kt CO_2 eq.)	Relative Level Assessment with Uncertainty	Cumulative Sum (%)
5A – Solid Waste Disposal – CH_4	1,246.18	0.22	22.3%
3Db – Indirect N_2O Emissions from Agricultural Soils – N_2O	204.56	0.12	34.6%
1A1 – Fuel Combustion – Energy Industries (Gaseous Fuels) – CO_2	3,630.01	0.09	43.8%
3Da – Direct N_2O emissions from Agricultural Soils – N_2O	699.44	0.07	50.6%
1A3b – Fuel Combustion – Transport – Road Transportation – CO_2	2,430.97	0.06	56.7%
5D – Wastewater Treatment and Discharge – CH_4	237.20	0.05	61.5%
3B1 – Direct N_2O emissions from Manure Management – N_2O	101.23	0.04	65.3%
1A4b – Fuel Combustion – Other Sectors – Residential – CH_4	208.58	0.04	69.1%
1A4b – Fuel Combustion – Other Sectors – Residential – CO_2	1,429.86	0.04	72.7%
3B5 – Indirect N_2O Emissions from Manure Management – N_2O	65.19	0.04	76.3%
3A – Enteric Fermentation – CH_4	389.04	0.03	79.4%
1B2b – Fugitive Emissions from Fuels – Oil and Natural Gas – Natural Gas – CH_4	234.66	0.03	82.4%
2F1 – Product Use as Substitutes for ODS – Refrigeration and Air Conditioning – HFCs	153.08	0.03	85.3%
2D Non-Energy Products from Fuels and Solvent Use – CO_2	195.36	0.03	88.1%
1A2 – Fuel Combustion – Manufacturing Industries and Construction – CO_2	801.44	0.02	90.2%

Tier 2 – Trend Assessment

Key Categories estimated using a Tier 2 method, Trend Assessment	GHG Emissions in 2020 (kt CO_2 eq.)	Relative Level Assessment with Uncertainty	Cumulative Sum (%)
5A – Solid Waste Disposal – CH_4	1,246.18	0.24	23.7%
3Db – Indirect N_2O Emissions from Agricultural Soils – N_2O	204.56	0.09	32.2%
1A1 – Fuel Combustion – Energy Industries (Liquid Fuels) – CO_2	3.93	0.08	40.4%
1A1 – Fuel Combustion – Energy Industries (Gaseous Fuels) – CO_2	0.44	0.07	47.6%
1A1 – Fuel Combustion – Energy Industries (Solid Fuels) – CO_2	3,630.01	0.05	52.7%
3Da – Direct N_2O emissions from Agricultural Soils – N_2O	699.44	0.05	57.6%
3B5 – Indirect N_2O Emissions from Manure Management – N_2O	65.19	0.05	62.3%
1A3b – Fuel Combustion – Transport – Road Transportation – CO_2	2,430.97	0.04	66.7%
2F1 – Product Use as Substitutes for ODS – Refrigeration and Air Conditioning – HFCs	153.08	0.04	70.9%
5D – Wastewater Treatment and Discharge – CH_4	237.20	0.04	74.8%
1A4b – Fuel Combustion – Other Sectors – Residential – CH_4	208.58	0.03	78.1%
3A – Enteric Fermentation – CH_4	389.04	0.03	81.2%
2D – Non-Energy Products from Fuels and Solvent Use – CO_2	195.36	0.03	83.8%
3B1 – Direct N_2O emissions from Manure Management – N_2O	101.23	0.03	86.4%
2F2 – Product Use as Substitutes for ODS – Foam Blowing Agents – HFCs	89.27	0.02	88.3%
3B – Manure Management – CH_4	44.37	0.02	90.0%

Key Category Summary Table

Key Categories Summary Table based on Results of Level and Trend Assessments
1A1 – Fuel Combustion – Energy Industries (Liquid Fuels) – CO_2
1A1 – Fuel Combustion – Energy Industries (Gaseous Fuels) – CO_2
1A1 – Fuel Combustion – Energy Industries (Solid Fuels) – CO_2
1A2 – Fuel Combustion – Manufacturing Industries and Construction – CO_2
1A3b – Fuel Combustion – Transport – Road Transportation – CO_2
1A3c – Fuel Combustion – Transport – Railways – CO_2
1A4a – Fuel Combustion – Other Sectors – Commercial/Institutional – CO_2
1A4b – Fuel Combustion – Other Sectors – Residential – CO_2
1A4b – Fuel Combustion – Other Sectors – Residential – CH_4
1A4c – Fuel Combustion – Other Sectors – Agriculture/Forestry/Fishing – CO_2
1B2b – Fugitive Emissions from Fuels – Oil and Natural Gas – Natural Gas – CH_4
2A1 – Mineral Industry – Cement Production – CO_2
2D – Non-Energy Products from Fuels and Solvent Use – CO_2
2F1 – Product Use as Substitutes for ODS – Refrigeration and Air Conditioning – HFCs
2F2 – Product Use as Substitutes for ODS – Foam Blowing Agents – HFCs
3A – Enteric Fermentation – CH_4
3B – Manure Management – CH_4
3B1 – Direct N_2O emissions from Manure Management – N_2O
3B5 – Indirect N_2O Emissions from Manure Management – N_2O
3Da – Direct N_2O emissions from Agricultural Soils – N_2O
3Db – Indirect N_2O emissions from Agricultural Soils – N_2O
5A – Solid Waste Disposal – CH_4
5D – Wastewater Treatment and Discharge – CH_4

Annex 1-3. Results of Key Category Analysis, following Tier 1 and Tier 2 methods, with LULUCF

Tier 1 – Level Assessment for 1990

Key Categories estimated using a Tier 1 method, Base Year Level Assessment	GHG Emissions in 1990 (kt CO_2 eq.)	Level Assessment	Cumulative Sum (%)
1A1 – Fuel Combustion – Energy Industries (Liquid Fuels) – CO_2	7,447.11	0.14	14.2%
1A1 – Fuel Combustion – Energy Industries (Gaseous Fuels) – CO_2	7,414.29	0.14	28.3%
1A1 – Fuel Combustion – Energy Industries (Solid Fuels) – CO_2	6,438.89	0.12	40.6%
1A4b – Fuel Combustion – Other Sectors – Residential – CO_2	4,410.07	0.08	49.0%
1A3b – Fuel Combustion – Transport – Road Transportation – CO_2	4,112.35	0.08	56.8%
4B1 – Cropland Remaining Cropland (Emissions) – CO_2	2,333.34	0.04	61.3%
3A – Enteric Fermentation – CH_4	2,189.43	0.04	65.4%
1A2 – Fuel Combustion – Manufacturing Industries and Construction – CO_2	1,915.67	0.04	69.1%
4A1 – Forest Land Remaining Forest Land (Removals) – CO_2	-1,579.04	0.03	72.1%
1A4c – Fuel Combustion – Other Sectors – Agriculture/Forestry/Fishing – CO_2	1,548.35	0.03	75.0%
1A4a – Fuel Combustion – Other Sectors – Commercial/Institutional – CO_2	1,413.84	0.03	77.7%
4C2 Land Converted to Grassland (Removals) – CO_2	-1,205.69	0.02	80.0%
3Da – Direct N_2O emissions from Agricultural Soils – N_2O	1,138.56	0.02	82.2%
5A – Solid Waste Disposal – CH_4	1,106.00	0.02	84.3%
4A2 – Land Converted to Grassland (Removals) – CO_2	-984.39	0.02	86.2%
2A1 – Mineral Industry – Cement Production – CO_2	971.70	0.02	88.0%
1B2b – Fugitive Emissions from Fuels – Oil and Natural Gas – Natural Gas – CH_4	910.74	0.02	89.8%
4D2 – Land Converted to Wetlands (Removals) – CO_2	-555.38	0.01	90.8%
3B – Manure Management – CH_4	495.10	0.01	91.8%
3B1 – Direct N_2O emissions from Manure Management – N_2O	489.81	0.01	92.7%
3B5 – Indirect N_2O Emissions from Manure Management – N_2O	409.90	0.01	93.5%
1A3c – Fuel Combustion – Transport – Railways – CO_2	403.47	0.01	94.3%
3Db – Indirect N_2O Emissions from Agricultural Soils – N_2O	353.35	0.01	94.9%
5D – Wastewater Treatment and Discharge – CH_4	352.96	0.01	95.6%

Tier 1 – Level Assessment for 2020

Key Categories estimated using a Tier 1 method, Current Year Level Assessment	GHG Emissions in 2020 (kt CO_2 eq.)	Level Assessment	Cumulative Sum (%)
1A1 – Fuel Combustion – Energy Industries (Gaseous Fuels) – CO_2	3,630.01	0.20	20.1%
1A3b – Fuel Combustion – Transport – Road Transportation – CO_2	2,430.97	0.13	33.6%
4B1 – Cropland Remaining Cropland (Emissions) – CO_2	1,558.08	0.09	42.2%
1A4b – Fuel Combustion – Other Sectors – Residential – CO_2	1,429.86	0.08	50.1%
5A – Solid Waste Disposal – CH_4	1,246.18	0.07	57.1%
4A1 – Forest Land Remaining Forest Land (Removals) – CO_2	-1,159.88	0.06	63.5%
1A2 – Fuel Combustion – Manufacturing Industries and Construction – CO_2	801.44	0.04	67.9%
4A2 – Land Converted to Grassland (Removals) – CO_2	-727.44	0.04	72.0%
3Da – Direct N_2O emissions from Agricultural Soils – N_2O	699.44	0.04	75.8%
2A1 – Mineral Industry – Cement Production – CO_2	467.52	0.03	78.4%
3A – Enteric Fermentation – CH_4	389.04	0.02	80.6%
4F2 – Land Converted to Other Land (Emissions) – CO_2	329.14	0.02	82.4%
1A4c – Fuel Combustion – Other Sectors – Agriculture/Forestry/Fishing – CO_2	323.53	0.02	84.2%
1A4a – Fuel Combustion – Other Sectors – Commercial/Institutional – CO_2	296.71	0.02	85.8%
5D – Wastewater Treatment and Discharge – CH_4	237.20	0.01	87.2%
1B2b – Fugitive Emissions from Fuels – Oil and Natural Gas – Natural Gas – CH_4	234.66	0.01	88.5%
4C2 – Land Converted to Grassland (Removals) – CO_2	-223.15	0.01	89.7%
1A4b – Fuel Combustion – Other Sectors – Residential – CH_4	208.58	0.01	90.8%
3Db – Indirect N_2O Emissions from Agricultural Soils – N_2O	204.56	0.01	92.0%
2D – Non-Energy Products from Fuels and Solvent Use – CO_2	195.36	0.01	93.1%
4E2 – Land Converted to Settlements (Emissions) – N_2O	167.50	0.01	94.0%
2F1 – Product Use as Substitutes for ODS – Refrigeration and Air Conditioning – HFCs	153.08	0.01	94.8%
3B1 – Direct N_2O emissions from Manure Management – N_2O	101.23	0.01	95.4%

Tier 1 – Trend Assessment

Key Categories estimated using a Tier 1 method, Trend Assessment	GHG Emissions in 2020 (kt CO_2 eq.)	Trend Assessment	Cumulative Sum (%)
1A1 – Fuel Combustion – Energy Industries (Liquid Fuels) – CO_2	3.93	0.04	13.6%
1A1 – Fuel Combustion – Energy Industries (Solid Fuels) – CO_2	0.44	0.04	25.4%
4C2 – Land Converted to Grassland (Removals) – CO_2	-223.15	0.03	35.9%
4A1 – Forest Land Remaining Forest Land (Removals) – CO_2	-1,159.88	0.03	44.7%
1A1 – Fuel Combustion – Energy Industries (Gaseous Fuels) – CO_2	3,630.01	0.02	52.4%
1A3b – Fuel Combustion – Transport – Road Transportation – CO_2	2,430.97	0.02	59.0%
4A2 – Land Converted to Forest Land (Removals) – CO_2	-727.44	0.02	64.5%
5A – Solid Waste Disposal – CH_4	1,246.18	0.02	69.7%
4D2 – Land Converted to Wetlands (Removals) – CO_2	-82.81	0.02	74.7%
4B1 – Cropland Remaining Cropland (Emissions) – CO_2	1,558.08	0.02	79.5%
3Da – Direct N_2O emissions from Agricultural Soils – N_2O	699.44	0.01	81.5%
3A – Enteric Fermentation – CH_4	389.04	0.01	83.3%
4F2 – Land Converted to Other Land (Emissions) – CO_2	329.14	0.01	84.9%
4G – Harvested Wood Products – CO_2	34.69	0.00	86.3%
1A2 – Fuel Combustion – Manufacturing Industries and Construction – CO_2	801.44	0.00	87.5%
2A1 – Mineral Industry – Cement Production – CO_2	467.52	0.00	88.4%
1A4c – Fuel Combustion – Other Sectors – Agriculture/Forestry/Fishing – CO_2	323.53	0.00	89.4%
2F1 – Product Use as Substitutes for ODS – Refrigeration and Air Conditioning – HFCs	153.08	0.00	90.3%
1A4a – Fuel Combustion – Other Sectors – Commercial/Institutional – CO_2	296.71	0.00	91.1%
5D – Wastewater Treatment and Discharge – CH_4	237.20	0.00	91.9%
1A4b – Fuel Combustion – Other Sectors – Residential – CH_4	208.58	0.00	92.6%
2D – Non-Energy Products from Fuels and Solvent Use – CO_2	195.36	0.00	93.3%
4E2 – Land Converted to Settlements (emissions) – N_2O	167.50	0.00	94.0%
3B – Manure Management – CH_4	44.37	0.00	94.6%
1A3c – Fuel Combustion – Transport – Railways – CO_2	19.04	0.00	95.2%

Tier 2 – Level Assessment for 1990

Key Categories estimated using a Tier 2 method, Base Year Level Assessment	GHG Emissions in 1990 (kt CO_2 eq.)	Relative Level Assessment with Uncertainty	Cumulative Sum (%)
3B5 – Indirect N_2O Emissions from Manure Management – N_2O	409.90	0.08	7.8%
3Db – Indirect N_2O Emissions from Agricultural Soils – N_2O	353.35	0.07	15.2%
5A – Solid Waste Disposal – CH_4	1,106.00	0.07	22.1%
1A1 – Fuel Combustion – Energy Industries (Liquid Fuels) – CO_2	7,447.11	0.07	28.7%
1A1 – Fuel Combustion – Energy Industries (Gaseous Fuels) – CO_2	7,414.29	0.07	35.2%
3B1 – Direct N_2O emissions from Manure Management – N_2O	489.81	0.06	41.6%
3A – Enteric Fermentation – CH_4	2,189.43	0.06	47.7%
1A1 – Fuel Combustion – Energy Industries (Solid Fuels) – CO_2	6,438.89	0.06	53.4%
4B1 – Cropland Remaining Cropland (Emissions) – CO_2	2,333.34	0.04	57.5%
1B2b – Fugitive Emissions from Fuels – Oil and Natural Gas – Natural Gas – CH_4	910.74	0.04	61.5%
1A4b – Fuel Combustion – Other Sectors – Residential – CO_2	4,410.07	0.04	65.4%
3Da – Direct N_2O emissions from Agricultural Soils – N_2O	1,138.56	0.04	69.2%
1A3b – Fuel Combustion – Transport – Road Transportation – CO_2	4,112.35	0.04	72.8%
4A1 – Forest Land Remaining Forest Land (Removals) – CO_2	-1,579.04	0.03	76.0%
4C2 – Land Converted to Grassland (Removals) – CO_2	-1,205.69	0.03	78.7%
5D – Wastewater Treatment and Discharge – CH_4	352.96	0.02	81.2%
3B – Manure Management – CH_4	495.10	0.02	83.1%
4A2 – Land Converted to Forest Land (Removals) – CO_2	-984.39	0.02	85.1%
1A4b – Fuel Combustion – Other Sectors – Residential – CH_4	273.92	0.02	86.8%
1A2 – Fuel Combustion – Manufacturing Industries and Construction – CO_2	1,915.67	0.02	88.5%
1A4c – Fuel Combustion – Other Sectors – Agriculture/Forestry/Fishing – CO_2	1,548.35	0.01	89.8%
1A4a – Fuel Combustion – Other Sectors – Commercial/Institutional – CO_2	1,413.84	0.01	91.1%

Tier 2 – Level Assessment for 2020

Key Categories estimated using a Tier 2 method, Current Year Level Assessment	GHG Emissions in 2020 (kt CO_2 eq.)	Relative Level Assessment with Uncertainty	Cumulative Sum (%)
5A – Solid Waste Disposal – CH_4	1,246.18	0.18	17.9%
3Db – Indirect N_2O Emissions from Agricultural Soils – N_2O	204.56	0.10	27.7%
1A1 – Fuel Combustion – Energy Industries (Gaseous Fuels) – CO_2	3,630.01	0.07	35.1%
4B1 – Cropland Remaining Cropland (Emissions) – CO_2	1,558.08	0.06	41.4%
3Da – Direct N_2O emissions from Agricultural Soils – N_2O	699.44	0.05	46.8%
4A1 – Forest Land Remaining Forest Land (Removals) – CO_2	-1,159.88	0.05	52.1%
1A3b – Fuel Combustion – Transport – Road Transportation – CO_2	2,430.97	0.05	57.0%
5D – Wastewater Treatment and Discharge – CH_4	237.20	0.04	60.8%
4A2 – Land Converted to Forest Land (Removals) – CO_2	-727.44	0.03	64.1%
3B1 – Direct N_2O emissions from Manure Management – N_2O	101.23	0.03	67.2%
1A4b – Fuel Combustion – Other Sectors – Residential – CH_4	208.58	0.03	70.2%
1A4b – Fuel Combustion – Other Sectors – Residential – CO_2	1,429.86	0.03	73.1%
3B5 – Indirect N_2O Emissions from Manure Management – N_2O	65.19	0.03	75.9%
3A – Enteric Fermentation – CH_4	389.04	0.02	78.4%
1B2b – Fugitive Emissions from Fuels – Oil and Natural Gas – Natural Gas – CH_4	234.66	0.02	80.8%
2F1 – Product Use as Substitutes for ODS – Refrigeration and Air Conditioning – HFCs	153.08	0.02	83.2%
2D – Non-Energy Products from Fuels and Solvent Use – CO_2	195.36	0.02	85.4%
1A2 – Fuel Combustion – Manufacturing Industries and Construction – CO_2	801.44	0.02	87.1%
4E2 – Land Converted to Settlements (Emissions) – N_2O	167.50	0.02	88.6%
4F2 – Land Converted to Other Land (Emissions) – CO_2	329.14	0.01	89.9%
4C2 – Land Converted to Grassland (Removals) – CO_2	-223.15	0.01	91.1%

Tier 2 – Trend Assessment

Key Categories estimated using a Tier 2 method, Trend Assessment	GHG Emissions in 2020 (kt CO_2 eq.)	Relative Level Assessment with Uncertainty	Cumulative Sum (%)
5A – Solid Waste Disposal – CH_4	1,246.18	0.15	14.8%
4C2 – Land Converted to Grassland (Removals) – CO_2	-223.15	0.11	25.5%
4A1 – Forest Land Remaining Forest Land (Removals) – CO_2	-1,159.88	0.08	33.4%
1A1 – Fuel Combustion – Energy Industries (Liquid Fuels) – CO_2	3.93	0.05	38.8%
3Db – Indirect N_2O Emissions from Agricultural Soils – N_2O	204.56	0.05	44.0%
4A2 – Land Converted to Forrest Land (Removals) – CO_2	-727.44	0.05	48.8%
1A1 – Fuel Combustion – Energy Industries (Solid Fuels) – CO_2	0.44	0.05	53.5%
4D2 – Land Converted to Wetlands (Removals) – CO_2	-82.81	0.04	57.5%
4B1 – Cropland Remaining Cropland (Emissions) – CO_2	1,558.08	0.04	61.3%
3B5 – Indirect N_2O Emissions from Manure Management – N_2O	65.19	0.03	64.5%
1A1 – Fuel Combustion – Energy Industries (Gaseous Fuels) – CO_2	3,630.01	0.03	67.6%
3Da – Direct N_2O emissions from Agricultural Soils – N_2O	699.44	0.03	70.6%
2F1 – Product Use as Substitutes for ODS – Refrigeration and Air Conditioning – HFCs	153.08	0.03	73.3%
1A3b – Fuel Combustion – Transport – Road Transportation – CO_2	2,430.97	0.03	76.0%
4G – Harvested Wood Products – CO_2	34.69	0.03	78.5%
5D – Wastewater Treatment and Discharge – CH_4	237.20	0.02	80.8%
3A – Enteric Fermentation – CH_4	389.04	0.02	83.0%
1A4b – Fuel Combustion – Other Sectors – Residential – CH_4	208.58	0.02	85.1%
3B1 – Direct N_2O emissions from Manure Management – N_2O	101.23	0.02	86.9%
2D – Non-Energy Products from Fuels and Solvent Use – CO_2	195.36	0.02	88.5%
4F2 – Land Converted to Other Land (Emissions) – CO_2	329.14	0.01	89.8%
2F2 – Product Use as Substitutes for ODS – Foam Blowing Agents – HFCs	89.27	0.01	91.0%

Key Category Summary Table

Key Categories Summary Table based on Results of Level and Trend Assessments
1A1 – Fuel Combustion – Energy Industries (Gaseous Fuels) – CO_2
1A1 – Fuel Combustion – Energy Industries (Liquid Fuels) – CO_2
1A1 – Fuel Combustion – Energy Industries (Solid Fuels) – CO_2
1A2 – Fuel Combustion – Manufacturing Industries and Construction – CO_2
1A3b – Fuel Combustion – Transport – Road Transportation – CO_2
1A3c – Fuel Combustion – Transport – Railways – CO_2
1A4a – Fuel Combustion – Other Sectors – Commercial/Institutional – CO_2
1A4b – Fuel Combustion – Other Sectors – Residential – CO_2
1A4b – Fuel Combustion – Other Sectors – Residential – CH_4
1A4c – Fuel Combustion – Other Sectors – Agriculture/Forestry/Fishing – CO_2
1B2b – Fugitive Emissions from Fuels – Oil and Natural Gas – Natural Gas – CH_4
2A1 – Mineral Industry – Cement Production – CO_2
2D – Non-Energy Products from Fuels and Solvent Use – CO_2
2F1 – Product Use as Substitutes for ODS – Refrigeration and Air Conditioning – HFCs
2F2 – Product Use as Substitutes for ODS – Foam Blowing Agents – HFCs
3A – Enteric Fermentation – CH_4
3B – Manure Management – CH_4
3B1 – Direct N_2O emissions from Manure Management – N_2O
3B5 – Indirect N_2O Emissions from Manure Management – N_2O
3Da – Direct N_2O emissions from Agricultural Soils – N_2O
3Db – Indirect N_2O Emissions from Agricultural Soils – N_2O
4A1 – Forest Land Remaining Forest Land (Removals) – CO_2
4A2 – Land Converted to Forest Land (Removals) – CO_2
4B1 – Cropland Remaining Cropland (Emissions) – CO_2
4C2 – Land Converted to Grassland (Removals) – CO_2
4D2 – Land Converted to Wetlands (Removals) – CO_2
4E2 – Land Converted to Settlements – N_2O
4F2 – Land Converted to Other Land (Emissions) – CO_2
4G – Harvested Wood Products – CO_2
5A – Solid Waste Disposal – CH_4
5D – Wastewater Treatment and Discharge – CH_4

Annex 2. Energy Balances of the Republic of Moldova for 2020 (in natural units) (without ATULBD)

SUPPLY AND CONSUMPTION	Coal, including														Peat and Peat Products, kt	Shale, kt	Natural Gas, million m^3 stand.**
	Anthracite, kt	Coke Coal, kt	Other Bituminous Coal, kt	Semibituminous Coal, kt	Lignite, kt	Coke, kt	Coke Gas, kt	Coke Dust, kt	Semicoke, kt	Solid Fuel Briquettes, kt	Brown Coal Briquettes, kt	Coal Tar, kt	Coal gas, water gas, generator gas and similar gases, except for gas from wells, and other gaseous hydrocarbons, million m^3	Other Coal Products, kt			
	110	121	129	210	220	311	312	313	314	320	330	340	350	390	1110	2000	3000
A	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
Primary production																	
Inputs from other sources																	
Import	106		27														1075
Export																	
Stock variation	11		-8														-5
Stock at the start of the year	54		14														17
Stock at the end of the year	65		6														12
GROSS DOMESTIC CONSUMPTION CALCULATED	**95**		**35**														**1080**
REAL GROSS DOMESTIC CONSUMPTION	**95**		**35**														**1080**
TRANSFORMATION, INPUTS																	434
Power plants																	
Combined heat plants – public energy producers																	331
Combined heat plants – producers for own consumption																	17
Heat plants – public energy producers																	37
Heat plants – producers for own consumption																	49
Oil refineries																	
Petrochemical plants																	
Liquefaction plants																	
Charcoal production plants																	
Other transformation installations																	
TRANSFORMATION, OUTPUTS																	
Power plants																	
Combined heat plants – public energy producers																	
Combined heat plants – producers for own consumption																	
Heat plants – public energy producers																	
Heat plants – producers for own consumption																	
Oil refineries																	
Petrochemical plants																	
Liquefaction plants																	
Charcoal production plants																	
Other transformation installations																	
Energy used in the Energy Sector																	

SUPPLY AND CONSUMPTION	Coal, including														Peat and Peat Products, kt	Shale, kt	Natural Gas, million m^3 stand.**
	Anthracite, kt	Coke Coal, kt	Other Bituminous Coal, kt	Semibituminous Coal, kt	Lignite, kt	Coke, kt	Coke Gas, kt	Coke Dust, kt	Semicoke, kt	Solid Fuel Briquettes, kt	Brown Coal Briquettes, kt	Coal Tar, kt	Coal gas, water gas, generator gas and similar gases, except for gas from wells, and other gaseous hydrocarbons, million m^3	Other Coal Products, kt			
	110	121	129	210	220	311	312	313	314	320	330	340	350	390	1110	2000	3000
A	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
Oil refineries																	
Petrochemical plants																	
Power, combined heat plants																	
Pumping storage plants																	
Not specified elsewhere																	
LOSSES																	**30**
FINAL CONSUMPTION	**95**		**35**														**616**
FINAL ENERGY CONSUMPTION	**95**		**35**														**616**
INDUSTRY	**1**		**34**														**89**
Mining																	
Food processing, beverages and tobacco	1																27
Textiles and leather industry																	2
Wood processing, manufacture of wood and cork products, except furniture; manufacture of straw products and from other vegetable plaiting materials																	
Printing and reproduction of recorded media																	1
Chemical and petrochemical industry (including the pharmaceutical industry)																	3
Non-metallic minerals			34														53
Metal industry																	
Car engineering industry																	
Production of trailers, semitrailers and other transportation means																	1
Other industries n.c.e.																	1
Construction																	1
TRANSPORT																	**14**
Railways																	
Terrestrial passenger and cargo transport by vehicles																	9
Pipeline transportation																	5
Navigation																	
Aviation																	
Other supplementary activities for transport																	
OTHER	**94**		**1**														**513**
Agriculture/forestry/fishing	2																4
Commercial/institutional																	9
Communal services	24		1														97

SUPPLY AND CONSUMPTION	Coal, including														Peat and Peat Products, kt	Shale, kt	Natural Gas, million m³ stand.**
	Anthracite, kt	Coke Coal, kt	Other Bituminous Coal, kt	Semibituminous Coal, kt	Lignite, kt	Coke, kt	Coke Gas, kt	Coke Dust, kt	Semicoke, kt	Solid Fuel Briquettes, kt	Brown Coal Briquettes, kt	Coal Tar, kt	Coal gas, water gas, generator gas and similar gases, except for gas from wells, and other gaseous hydrocarbons, million m³	Other Coal Products, kt			
	110	**121**	**129**	**210**	**220**	**311**	**312**	**313**	**314**	**320**	**330**	**340**	**350**	**390**	**1110**	**2000**	**3000**
A	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**
Residential	68																403
Not specified elsewhere																	
CONSUMED FOR NON-ENERGY PURPOSES																	
Statistical differences																	

SUPPLY AND CONSUMPTION	Oil Products, including																				
	Oil, kt	Other Gaseous Hydrocarbons (ethylene, propylene, butylene, butadiene and others), million m³ stand.**	Raw materials for refineries, kt	Additives and oxygenated compounds, kt	Other hydrocarbons, kt	Gas from wells, million m³	Ethane, million m³	Liquefied (petroleum) gases, kt	Naphtha, kt	Aviation gasoline, kt	Gasoline, kt	Gasoline for jet engines, kt	Kerosene for jet engines, kt	Other kerosene gases, kt	Diesel oil, kt	Residual fuel oil, kt	White-spirit Petroleum, kt	Oils and greases (lubricants), kt	Paraffins, kt	Petroleum coke, kt	Petroleum bitumen, kt	Other petroleum products, kt
	4100	**4200**	**4300**	**4400**	**4500**	**4610**	**4620**	**4630**	**4640**	**4651**	**4652**	**4653**	**4661**	**4669**	**4671**	**4680**	**4691**	**4692**	**4693**	**4694**	**4695**	**4699**
A	**18**	**19**	**20**	**21**	**22**	**23**	**24**	**25**	**26**	**27**	**28**	**31**	**32**	**33**	**34**	**35**	**36**	**37**	**38**	**39**	**40**	**41**
Primary production	6																					
Inputs from other sources																						
Import				1				63			163		16		608	5		9		29	66	
Export	4										8		5			2						
Stock variation													-1		10	4				1	-1	
Stock at the start of the year	1							6		1	18		4		54	47		4		1	5	
Stock at the end of the year	1							6		1	18		3		64	51		4		2	4	
GROSS DOMESTIC CONSUMPTION CALCULATED	**2**			**1**				**63**			**155**		**12**		**598**	**-1**		**9**		**28**	**67**	
REAL GROSS DOMESTIC CONSUMPTION	**2**			**1**				**63**			**155**		**12**		**598**	**-1**		**9**		**28**	**67**	
TRANSFORMATION, INPUTS	1			1							4				2							
Power plants																						
Combined heat plants – public energy producers																						
Combined heat plants – own consumption																						
Heat plants – public energy producers																						
Heat plants – own consumption																						
Oil refineries																						
Petrochemical plants	1			1							4				2							
Liquefaction plants																						

SUPPLY AND CONSUMPTION	Oil Products, including																					
	Oil, kt	Other Gaseous Hydrocarbons (ethylene, propylene, butylene, butadiene and others), million m³ stand.**	Raw materials for refineries, kt	Additives and oxygenated compounds, kt	Other hydrocarbons, kt	Gas from wells, million m³	Ethane, million m³	Liquefied (petroleum) gases, kt	Naphtha, kt	Aviation gasoline, kt	Gasoline, kt	Gasoline for jet engines, kt	Kerosene for jet engines, kt	Other kerosene gases, kt	Diesel oil, kt	Residual fuel oil, kt	White-spirit Petroleum, kt	Oils and greases (lubricants), kt	Paraffins, kt	Petroleum coke, kt	Petroleum bitumen, kt	Other petroleum products, kt
	4100	4200	4300	4400	4500	4610	4620	4630	4640	4651	4652	4653	4661	4669	4671	4680	4691	4692	4693	4694	4695	4699
A	18	19	20	21	22	23	24	25	26	27	28	31	32	33	34	35	36	37	38	39	40	41
Charcoal production plants																						
Other transformation installations																						
TRANSFORMATION, OUTPUTS											**4**					**2**						
Power plants																						
Combined heat plants – public energy producers																						
Combined heat plants – own consumption																						
Heat plants – public energy producers																						
Heat plants – own consumption																						
Oil refineries																						
Petrochemical plants											4					2						
Liquefaction plants																						
Charcoal production plants																						
Other transformation installations																						
Energy used in the Energy Sector																						
Oil refineries																						
Petrochemical plants																						
Power, combined heat plants																						
Pumping storage plants																						
Not specified elsewhere																						
LOSSES								**1**			**1**				**1**							
FINAL CONSUMPTION	**1**							**62**			**154**		**12**		**595**	**1**		**9**		**28**	**67**	
FINAL ENERGY CONSUMPTION	**1**							**62**			**154**		**12**		**595**	**1**				**28**		
INDUSTRY	**1**							**1**							**12**	**1**				**28**		
Mining															4							
Food processing, beverages and tobacco								1														
Textiles and leather industry																						
Wood processing, manufacture of wood and cork products, except furniture; manufacture of straw products and from other vegetable plaiting materials																						
Printing and reproduction of recorded media																						
Chemical and petrochemical industry (including the pharmaceutical industry)																						
Non-metallic minerals																				28		
Metal industry																						

SUPPLY AND CONSUMPTION	Oil Products, including																					
	Oil, kt	Other Gaseous Hydrocarbons (ethylene, propylene, butylene, butadiene and others), million m^3 stand.**	Raw materials for refineries, kt	Additives and oxygenated compounds, kt	Other hydrocarbons, kt	Gas from wells, million m^3	Ethane, million m^3	Liquefied (petroleum) gases, kt	Naphtha, kt	Aviation gasoline, kt	Gasoline, kt	Gasoline for jet engines, kt	Kerosene for jet engines, kt	Other kerosene gases, kt	Diesel oil, kt	Residual fuel oil, kt	White-spirit Petroleum, kt	Oils and greases (lubricants), kt	Paraffins, kt	Petroleum coke, kt	Petroleum bitumen, kt	Other petroleum products, kt
	4100	**4200**	**4300**	**4400**	**4500**	**4610**	**4620**	**4630**	**4640**	**4651**	**4652**	**4653**	**4661**	**4669**	**4671**	**4680**	**4691**	**4692**	**4693**	**4694**	**4695**	**4699**
A	**18**	**19**	**20**	**21**	**22**	**23**	**24**	**25**	**26**	**27**	**28**	**31**	**32**	**33**	**34**	**35**	**36**	**37**	**38**	**39**	**40**	**41**
Car engineering industry																						
Production of trailers, semitrailers and other transport means																						
Other industries n.c.e.																						
Construction	1														8	1						
TRANSPORT								**11**			**154**		**12**		**472**							
Railways															5							
Terrestrial passenger and cargo transport by vehicles								11			154				465							
Pipeline transportation																						
Navigation																						
Aviation													12									
Other supplementary activities for transport															2							
OTHER								**50**							**111**							
Agriculture/forestry/fishing															110							
Commercial/institutional																						
Communal services															1							
Residential								50														
Not specified elsewhere																						
CONSUMED FOR NON-ENERGY PURPOSES																		**9**			**67**	
Statistical differences																						

SUPPLY AND CONSUMPTION	Biofuels and Waste, including															Waste, including		Electricity, million kWh	Heat, thousand Gcal.	Other types of fuel, kt
	Briquettes and wood pellets and other vegetable waste, kt	Fuel Wood, thousand m^3 comp.***	Wood Waste, kt	Animal Waste, kt	Black Lye, kt	Agricultural fuel residues, kt	Charcoal, kt	Biogasoline, kt	Biodiesel oil, kt	Biodiesel oil for jet engines, kt	Other types of liquid fuels, kt CC	Gas from organic waste, million m^3	Gas from sewage sludge, million m^3	Other types of biogases from anaerobic fermentation, million m^3	Biogas from heating processes million m^3	Industrial waste, kt	Urban waste, kt			
	5111	**5112**	**5119**	**5130**	**5140**	**5150**	**5160**	**5210**	**5220**	**5230**	**5290**	**5311**	**5312**	**5319**	**5320**	**6100**	**6200**	**7000**	**8000**	**9900**
A	**42**	**43**	**44**	**45**	**46**	**47**	**48**	**49**	**50**	**51**	**52**	**53**	**54**	**55**	**56**	**57**	**58**	**63**	**64**	**65**
Primary production	31	3298	28	13		69						19						102		
Inputs from other sources																		3251		
Import	2		1				1											167		
Export	3																			
Stock variation	8	37	-5			-2														
Stock at the start of the year	6	81	8			4														
Stock at the end of the year	14	117	3			2														
GROSS DOMESTIC CONSUMPTION CALCULATED	**22**	**3261**	**34**	**13**		**71**	**1**					**19**						**3520**		
REAL GROSS DOMESTIC CONSUMPTION	**22**	**3261**	**34**	**13**		**71**	**1**					**19**						**3520**		
TRANSFORMATION, INPUTS	5	8	1			30						17						102		
Power plants												9						102		
Combined heat plants – public energy producers																				
Combined heat plants – own consumption												8								
Heat plants – public energy producers	1																			
Heat plants – own consumption	4		1			30														
Oil refineries																				
Petrochemical plants																				
Liquefaction plants																				
Charcoal production plants		8																		
Other transformation installations																				
TRANSFORMATION, OUTPUTS							**1**											**983**	**2235**	
Power plants																		115		
Combined heat plants – public energy producers																		835	1359	
Combined heat plants – own consumption																		33	99	
Heat plants – public energy producers																			344	
Heat plants – own consumption																			433	
Oil refineries																				
Petrochemical plants																				
Liquefaction plants																				
Charcoal production plants							1													
Other transformation installations																				
Energy used in the Energy Sector																		**190**	**12**	
Oil refineries																				
Petrochemical plants																			4	

SUPPLY AND CONSUMPTION	Biofuels and Waste, including															Waste, including		Electricity, million kWh	Heat, thousand Gcal.	Other types of fuel, kt
	Briquettes and wood pellets and other vegetable waste, kt	Fuel Wood, thousand m³ comp.***	Wood Waste, kt	Animal Waste, kt	Black Lye, kt	Agricultural fuel residues, kt	Charcoal, kt	Biogasoline, kt	Biodiesel oil, kt	Biodiesel oil for jet engines, kt	Other types of liquid fuels, kt CC	Gas from organic waste, million m³	Gas from sewage sludge, million m³	Other types of biogases from anaerobic fermentation, million m³	Biogas from heating processes million m³	Industrial waste, kt	Urban waste, kt			
	5111	**5112**	**5119**	**5130**	**5140**	**5150**	**5160**	**5210**	**5220**	**5230**	**5290**	**5311**	**5312**	**5319**	**5320**	**6100**	**6200**	**7000**	**8000**	**9900**
A	**42**	**43**	**44**	**45**	**46**	**47**	**48**	**49**	**50**	**51**	**52**	**53**	**54**	**55**	**56**	**57**	**58**	**63**	**64**	**65**
Power, combined heat plants																		148	1	
Pumping storage plants																				
Not specified elsewhere																		42	7	
LOSSES																		**404**	**331**	
FINAL CONSUMPTION	**17**	**3253**	**33**	**13**		**41**	**2**					**2**						**3807**	**1892**	
FINAL ENERGY CONSUMPTION	**17**	**3252**	**29**			**8**	**2**					**2**						**3807**	**1892**	
INDUSTRY		**2**										**2**						**705**	**441**	
Mining																		17		
Food Processing, Beverages and Tobacco		1																332	369	
Textiles and leather industry																		42	12	
Wood processing, manufacture of wood and cork products, except furniture; manufacture of straw products and from other vegetable plaiting materials		1																6		
Printing and reproduction of recorded media																		13	4	
Chemical and petrochemical industry (including the pharmaceutical industry)																		33	54	
Non-metallic minerals																		157		
Metal industry																		3		
Car engineering industry																		26	1	
Production of trailers, semitrailers and other transport means																		8		
Other industries n.c.e.																		51	1	
Construction																		17		
TRANSPORT																		**42**		
Railways																				
Terrestrial passenger and cargo transport by vehicles																		40		
Pipeline transportation																		2		
Navigation																				
Aviation																				
Other supplementary activities for transport																				
OTHER	**17**	**3249**	**29**			**8**	**2**											**3060**	**1451**	
Agriculture/forestry/fishing	1	5																77		
Commercial/institutional		2	1				1											429	10	
Communal services	6	22				4												824	350	
Residential	10	3220	28			4	1											1730	1091	
Not specified elsewhere																				
CONSUMED FOR NON-ENERGY PURPOSES		**1**	**4**	**13**		**33**														
Statistical differences																				

Annex 3. Additional information associated with activity data, country-specific coefficients/parameters and methodologies used to estimate sectoral GHG emissions

Annex 3-1: Additional information associated with activity data and calculation methodologies utilised to estimate GHG emissions from Sector 1 'Energy'

Annex 3-1.1: Additional information associated with activity data utilised to estimate GHG emissions from Sector 1 'Energy' for the ATULBD

Table 3-1.1.1: Fuel consumption for heat and power generation (1A1 'Energy Industries') in the ATULBD between 1994-2020

	1994	1995	1996	1997	1998	1999	2000	2001	2002
Natural gas, million m^3, including:	1,297.95	1,098.40	1,281.50	1,261.40	1,081.33	1,028.50	1,030.80	1,187.80	862.50
MTPP Dnestrovsk	1,030.00	1,098.40	1,231.80	1,113.30	856.60	841.30	768.40	937.40	719.30
Residual fuel oil, kt	228.00	26.10	23.60	6.05	26.92	NA	NA	NA	NA
Other bituminous coal, kt	1,686.60	882.90	806.34	281.87	182.42	NA	NA	NA	NA
	2003	2004	2005	2006	2007	2008	2009	2010	2011
Natural gas, million m^3, including:	931.50	970.50	972.10	611.10	885.70	995.20	1,448.30	1,549.90	1,428.80
MTPP Dnestrovsk	756.20	838.70	805.40	429.40	719.00	766.20	1,267.20	1,339.40	1,220.00
Residual fuel oil, kt	NA	NA	NA	NA	NA	NA	NA	NA	NA
Other bituminous coal, kt	NA	NA	NA	NA	NA	NA	NA	NA	NA
	2012	2013	2014	2015	2016	2017	2018	2019	2020
Natural gas, million m^3, including:	1,458.80	958.40	1,350.70	1,539.00	1,504.00	1,192.81*	1,307.39*	1,280.60*	1,545.48
MTPP Dnestrovsk	1,255.80	754.30	1,162.60	1,348.00	1,312.00	999.30	1,111.50	1,095.50	1,362.63
Residual fuel oil, kt	2.56	1.84	1.47	1.37	2.00	0.67	0.84	0.37	0.57
Other bituminous coal, kt	13.17	312.19	2.64	1.98	7.38	0.00	0.44	0.73	0.18

*recalculated based on the indirect method

Table 3-1.1.2: Fuel consumption within source category 1A2 'Manufacturing Industries and Construction' for the ATULBD between 1994-2020

	1994	1995	1996	1997	1998	1999	2000	2001	2002
Natural gas, million m^3	275.10	71.72	52.11	151.50	146.50	136.10	143.90	174.50	73.20
	2003	2004	2005	2006	2007	2008	2009	2010	2011
Natural gas, million m^3	79.00	71.90	102.50	133.90	232.60	250.50	121.90	113.50	123.00
Residual fuel oil, kt						0.8715	0.5705	0.3208	0.3098
Other bituminous coal, kt						0.0737	0.1473	0.1108	0.1102
LPG, kt									0.057
	2012	2013	2014	2015	2016	2017	2018	2019	2020
Natural gas, million m^3	134.90	110.80	129.70	108.00	120.00	100.00	108.00	112.00	385,77
Residual fuel oil, kt	0.2581	0.3713	0.3713	0.3713	0.3713	0.3606	0.289	0.1269	0,1269
Other bituminous coal, kt	0.0840	0.0324	0.0722	0.0641	0.0622	0.335	0.0206	0.0151	0,0109
LPG, kt	0.0346	0.0291	0.0249	0.0204	0.0204	0.0133	0.011	0.0121	0.0000

Source: JSC 'Moldovagaz' through Letters No. 604 dated 01.04.1999, as a response to Letter No. 02-541 dated 28.05.2001; Letter No. 02-156 dated 06.02.2004, as a response to Letter No. 257-01-07 dated 26.01.2004; Letter No. 06-1253 dated 27.09.2006, as a response to Letter No.01-07/1400 dated 25.08.2006; Letter No. 07-730 dated 6.6.2007, as a response to Letter No. 47/21-103 dated 31.05.2007; Letter No. 02/1-476 dated 23.02.2011, as a response to Letter No. 03-07/175 dated 02.02.2011; Letter No. 02/1-288 dated 22.01.2014, as a response to Letter No. 320/2014-01-01 dated 03.01.2014; Letter No. 02/1-507 dated 10.02.2015, as a response to Letter No. 407/2015-01-09 dated 29.01.2015; Letter No. 02/1-2183 dated 03.06.2016, as a response to Letter No. 512/2016-05-01 dated 10.05.2016; Letter No. 03/2-74 dated 12.01.2018, as a response to Letter No. 601/2017-12-03 dated 14.12.2017; Letter No. Nr. 03/4-676 dated 03.03.2020, as a response to Letter No. 08-310/1 dated 11.02.2020. State Statistical Service of the Transnistrian Moldovan Republic (2021), Socio-economic development of the TMR for 2020. Tiraspol, 2021, 85 p.; State Statistical Service of the Transnistrian Moldovan Republic (2020), Socio-economic development of the TMR for 2019. Tiraspol, 2020, 84 p.; State Statistical Service of the Transnistrian Moldovan Republic (2019), Socio-economic development of the TMR for 2018.Tiraspol, 2019, 84 p.; State Statistical Service of the Transnistrian Moldovan Republic (2018), Socio-economic development of the TMR for 2017. Tiraspol, 2018, 80 p.; State Statistical Service of the Transnistrian Moldovan Republic (2017), Socio-economic development of the TMR for 2016. Tiraspol, 2017, 81p.; State Statistical Service of the Transnistrian Moldovan Republic (2016), Socio-economic development of the TMR for 2015. Tiraspol, 2016, 81 p.; State Statistical Service of the Transnistrian Moldovan Republic (2015), Socio-economic development of the TMR for 2014. Tiraspol, 2015. 81 p.; State Statistical Service of the Transnistrian Moldovan Republic (2013), Socio-economic development of the TMR for 2012. Tiraspol, 2013. 85 p.; State Statistical Service of the Transnistrian Moldovan Republic (2012), Socio-economic development of the TMR for 2011, Chapter 4 'Material and Energy Resources', page 23. Tiraspol, 2012. 85 p.; State Statistical Service of the Transnistrian Moldovan Republic (2011), Socio-economic development of the TMR for 2010, Chapter 4 'Energy Resources', page 21. Tiraspol, 2011. 79 p.; State Statistical Service of the Transnistrian Moldovan Republic (2010), Socio-economic development of the TMR for 2009, Chapter 4 'Material Resources', page 20. Tiraspol, 2010. 75 p.

Table 3-1.1.3: Fuel consumption within source category 1A3b 'Road Transportation' for the ATULBD between 1995-2020

	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Compressed natural gas, million m^3	4.1	6.9	1.8	2.2	5.2	4.8	5.0	5.0	NO	NO	NO	NO

Source: JSC 'Moldovagaz' through Letter No. 02/1-476 dated 23.02.2011, as a response to Letter No. 03-07/175 dated 02.02.2011; Letter No. 02/1-288 dated 22.01.2014, as a response to Letter No. 320/2014-01-01 dated 03.01.2014; Letter No. 02/1-507 dated 10.02.2015, as a response to Letter No. 407/2015-01-09 dated 29.01.2015; Letter No. 02/1-2183 dated 03.06.2016, as a response to Letter No. 512/2016-05-01 dated 10.05.2016; Letter No. 03/2-74 dated 12.01.2018, as a response to Letter No. 601/2017-12-03 dated 14.12.2017.

Table 3-1.1.4: Fuel consumption within source category 1A4a 'Commercial/Institutional' for the ATULBD between 1999-2020

	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
Natural gas, million m^3	6.8	9.3	13.6	81.8	87.4	229.0	181.6	151.9	14.4	19.8	16.1
Bituminous coal, kt	NO	NO	NO	NO	NO	NO	NO	NO	NO	0.062	0.0626
Residual fuel oil, kt	NO	NO	NO	NO	NO	NO	NO	NO	NO	0.0868	0.1369
	2010	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**
Natural gas, million m^3	37.70	209.20	202.30	99.900	105.10	27.00	17.6852	19.00	22.00	18.80	16.40
Bituminous coal, kt	0.0127	0.0412	0.0087	0.0356	0.0127	0.0050	0.0027	0.0021	0.0302	0.0214	0.0138
Residual fuel oil, kt	0.1063	0.0399	0.0400	0.0430	0.0820	0.0283	0.0776	0.0181	NO	3.000	NO
LPG, kt	NO	0.0026	0.00109	0.0012	0.0011	0.0012	0.06571	0.0016	0.0014	0.0013	0.0023

Table 3-1.1.5: Fuel consumption within source category 1A4b 'Residential' for the ATULBD between 1995-2020

	1995	1996	1997	1998	1999	2000	2001	2002	2003
LPG, kt *	2.5	2.3	1.4	1.3	0.8	0.4	0.3	0.4	0.5
Natural gas, million m^3 *	216.6	163.4	354.8	321.6	293.2	NO	196.4	175.4	176.6
Natural gas, million m^3 **	NO	NO	NO	NO	294.2	217.9	196.4	163.5	176.6
	2004	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**
LPG, kt *	0.5	0.5	0.5	0.4486	0.4962	0.3869	0.5798	0.606	0.477
Natural gas, million m^3*	162.8	164.8	161.2	150.8	150.0	156.0	174.3	184.5	184.1
Natural gas, million m^3**	132.0	144.2	157.0	149.2	148.7	154.7	173.0	184.5	184.1
Fuelwood, thousand m^3 comp.*	NO	NO	NO	NO	NO	10.2	10.8	10.0	5.4
	2013	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**%**
LPG, kt *	0.3836	0.3525	0.2753	0.231	0.1439	0.1466	0.1176	0.1118	99.96
Natural gas, million m^3 *	180.6	180.1	175.00	185.7	190.7	199.1	183.6	180.8	99.17
Fuelwood, thousand m^3 comp.*	4.7	7.7	10.9	6.9	5.4	4.6	8.2	7.2	99.98

Source: * Statistical Yearbooks of the ATULBD for 2000 (page 22), 2006 (page 22), 2009 -2013 (page 23); Press-Release The State of Housing and Communal Services of the Republic for 2011-2020; ** JSC 'Moldovagaz' Letter No. 06-1253 dated 27.09.2006 and Letter No. 02/1476 dated 23.02.2011; Letter No. 02/1-288 dated 22.12.2014, as a response to Letter No. 320/2014-01-01 dated 03.01.2014; 2013-2014 JSC 'Moldovagaz' Letter No. 02/1-507 dated 10.02.2015; 2015 – through Letter No. 02/1-2183 dated 03.06.2015, as a response to Letter No. 512/2016-05-01 dated 10.05.2016; 2016 – through Letter 03/2-74 dated 12.01.2018, as a response to Letter No. 601/2017-12-03 dated 14.12.2017; 2017-2019 – through Letter No. 03/4-676 dated 03.03.2020, as a response to Letter No. 08-310/1 dated 11.02.2020.

Table 3-1.1.6: Fuel consumption within source category1A4c 'Agriculture/Forestry/Fishing' for the ATULBD between 1995-2020

	1995	1996	1997	1998	1999	2000	2001	2002	2003
Diesel oil, kt *1)	26.7732	21.4371	28.5957	22.0698	20.4030	14.5584	14.3541	11.1636	7.7409
Gasoline, kt *	9.6830	6.1160	8.8580	5.7920	3.0730	1.7550	1.6930	1.2220	1.2580
Natural gas, mil. m^3 **	NO	0	NO	NO	NO	NO	NO	NO	0.9
	2004	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**
Diesel oil, kt *1)	6.9372	4.8546	4.0239	2.9331	2.6505	3.5037	7.4195	8.3934	9.2448
Gasoline, kt *	0.7810	0.6120	0.5740	0.3980	0.3340	0.4230	0.6460	0.582	0.613
Natural gas, mil. m^3 **	0.7	0.4	NO	NO	0.1	NO	0.1	0.1	0.2
Residual fuel oil, kt ***	NO	NO	NO	NO	0.0032	0.0032	0.0032	0.193	0.0032
Coal, kt ***	NO	NO	NO	NO	0.0153	0.0115	0.0090	0.031	0.024
	2013	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**%**
Diesel oil, kt *1)	10.5	10.2465	9.717	NO	NO	NO	NO	NO	
Gasoline, kt *	0.849	0.721	0.6431	NO	NO	NO	NO	NO	
Natural gas, mil. m^3 **	NO	NO	NO	NO	NO	NO	NO	NO	
Residual fuel oil, kt ***	0.0032	NO	NO	NO	NO	NO	NO	NO	
Coal, kt ***	0.024	0.024	0.022	0.0373	0.014	0.014	0.006	0.006	-99.93

1) 90% diesel oil 1A4c

Source: *Statistical Yearbooks of the ATULBD for the years 2000 (page 106), 2006 (page 107), 2009 (page 106) 2010 (page 108), 2011 (page 109), 2012 (page 113), 2013 (page 102); 2014 (page 102); 2015 (page 95; **Official Letter from JSC 'Moldovagaz' as a response to Letter No. 06-1253 dated 27.09.2006 and No. 02/1476 dated 23.02.2011; 2011-2012 – Official Letter from JSC 'Moldovagaz' as a response to Letter No. 02/1-288 dated 22.02.2014; 2013-2014 – Official Letter from JSC 'Moldovagaz' as a response to Letter No. 02/1-507 dated 10.02.2015; 2015 – through Letter No. 02/1-2183 dated 03.06.2016, as a response to Letter No. 512/2016-05-01 dated 10.05.2016; 2016 – through Letter No. 03/2-74 dated 12.01.2018, as a response to Letter No. 601/2017-12-03 dated 14.12.2017; 2017-2019 – through Letter No. 03/4-676 dated 03.03.2020, as a response to Letter No. 08-310/1 dated 11.02.2020.

*** State Statistical Service of the Transnistrian Moldovan Republic (2021), Socio-economic development of the TMR for 2020. Tiraspol, 2021, P. 85; State Statistical Service of the Transnistrian Moldovan Republic (2020), Socio-economic development of the TMR for 2019. Tiraspol, 2020, P. 22; State Statistical Service of the Transnistrian Moldovan Republic (2019), Socio-economic development of the TMR for 2018. Tiraspol, 2019, P. 81; State Statistical Service of the Transnistrian Moldovan Republic (2018), Socio-economic development of the TMR for 2017. Tiraspol, 2018, P. 80; State Statistical Service of the Transnistrian Moldovan Republic (2017), Socio-economic development of the TMR for 2016. Tiraspol, 2017, P. 81; State Statistical Service of the Transnistrian Moldovan Republic (2016) (final data), Socio-economic development of the TMR for 2015. Tiraspol, 2016, P. 81; State Statistical Service of the Transnistrian Moldovan Republic (2015) (final data), Socio-economic development of the TMR for 2014. Tiraspol, 2015, P. 81; State Statistical Service of the Transnistrian Moldovan Republic (2014) (final data), Socio-economic development of the TMR for 2013. Tiraspol, 2014, P. 81; State Statistical Service of the Transnistrian Moldovan Republic (2013), Socio-economic development of the TMR for 2012, Chapter 4 'Material and Energy Resources', P. 21. Tiraspol, 2012, P. 85; State Statistical Service of the Transnistrian Moldovan Republic (2012), Socio-economic development of the TMR for 2011, Chapter 4 'Material and Energy Resources', P. 23. Tiraspol, 2012, P. 85; State Statistical Service of the Transnistrian Moldovan Republic (2011), Socio-economic development of the TMR for 2010, Chapter 4 'Energy Resources', P. 21. Tiraspol, 2011, P. 79; State Statistical Service of the Transnistrian Moldovan Republic (2010), Socio-economic development of the TMR for 2019, Chapter 4 'Material Resources', P. 20. Tiraspol, 2010, P. 75;

Table 3-1.1.7: Fuel consumption within source category 1A5 'Other' for the ATULBD between 2014-2020

	2014	2015	2016	2017	2018	2019	2020
Bituminous coal, kt	9.400	8.700	9.000	9.400	9.700	9.500	9.300

Source: State Statistical Service of the Transnistrian Moldovan Republic (2010), Fuel and Energy Consumption in the TMR between 2014-2020.

Annex 3-2. Additional information associated with activity data, and country-specific coefficients/ parameters used to estimate GHG emissions from Sector 2 'Industrial Processes and Product Use'

Table 3-2.1: Raw materials and Energy Balance for cement production at JSC 'Lafarge Cement' cement plant in Rezina

No.	Name	Measure Units	Consumption Norm	No.	Name	Measure Units	Consumption Norm
Input				Output			
Materials							
1	Clinker	kg/t cement	786.9	1	Cement	kg	1000
2	Gypsum	- „ – „ -	57.7	2	Technological loss	kg/t cement	30
3	Mineral Supplements	- „ – „ -	185.4				
Fuel							
1	Fuel, total	kg c.e./t cement	126.4	1	Clinker drying	kg c.e./t cement	121.7
				2	Supplements drying	kg c.e./t cement	4.7

Table 3-2.2: Average concentration of CaO and MgO in clay used for brick production at SOE 'Macon' JSC in Chisinau between 1990-2020

Year	Average Concentration of CaO in Clay Used, %				Average Concentration of MgO in Clay Used, %			
	From Horungii Mici Quarry	From Pruncul Quarry	From Micauti Quarry	From Purcel Quarry	From Horungii Mici Quarry	From Pruncul Quarry	From Micauti Quarry	From Purcel Quarry
1990-1996	6.915	4.08	8.22	8.44	2.67	3.21	3.57	3.03
1997-2004	6.915	4.08	8.22	8.44	2.67	3.21	3.57	3.21
2005-2010	5.87-7.96	4.08	8.22	8.44	2.16-3.18	3.21	3.57	3.03
2011-2020	6.66	4.08	6.70	8.44	2.60	3.21	2.93	3.03

Annex 3-3. Additional information on livestock and poultry breeds in the Republic of Moldova used to estimate GHG emissions from Sector 3 'Agriculture'

Cattle

The most widespread breeds in the RM in the early 1990s were *Steppe Red* and *Estonian Red* (in the South and partially in the Centre), *Simmental* (in the North and partially in the Centre), and *Spotted Black* (most often used in cross-breeding with local breeds, but also bred as pure blood); *Holstein, Ayrshire* and *Jersey* were not bred as purebred, but used for cross-breeding (Bucataru, Radionov, 1997; Bucataru, Radionov, Urzica, 2002; Bivol, Ciubotaru, 2005) (Table -3.1). Currently, most cattle bred in the RM are half-breeds from crossbreeding, not purebred. It should be mentioned that lately, a new kind of cattle (*Moldovan Spotted Black*[134]) was crossbred as a result of crossbreeding of *Steppe Red* and *Simmental* with the improved races *Spotted Black* and *Holstein*.

Table 3-3.1: Features of Cattle Races Bred in the Republic of Moldova

Cattle breed	Production	Live Weight,, kg		Milk Yield, kg	Content of:		Weight of Calf at Birth, kg
		♀	♂		Fat in milk, %	Protein in milk, %	
Spotted Black	milk	650-750	900-1100	5000-7000	3.4-3.7	3.2-3.3	35-39
Simmental	mixed	600-800	1100-1300	3000-5500	3.9-4.2	3.4-3.5	40-43
Steppe Red	milk	450-550	800-900	3000-5000	3.7-3.9	3.3-3.5	28-35
Estonian Red	milk	500-550	850-950	3500-5000	3.8-4.3	3.2-3.5	34-38
Holstein	milk	650-750	900-1150	6000-10000	3.3-3.6	3.0-3.1	40-45
Ayrshire	milk	400-500	600-700	4000-5000	3.9-4.5	3.5-3.6	30-33
Jersey	milk	300-350	400-450	3000-4000	5.0-6.5	3.7-4.5	20-25

Swine

The following breeds and types of swine are bred in the country: *Big White* (as purebreds and as maternal form in industrial crosses and in crossbreeding), *Bacon Estonian* (used for industrial crosses with *Big White*, *Steppe White Ukrainian* and for crossbreeding), *Steppe White Ukrainian* (boars are used for industrial crosses with other breeds), *Southern Moldavian type for meat 'Sudic'* (Southern) (used in crossbreeding as paternal form) (Bucataru, Radionov, Urzica, 2002; Bivol, Ciubotaru, 2005) (Table 3-3.2). Races more often used for crossbreeding in the RM are *Landrace* (used in crossbreeding with other brees to obtain half-bred gilts F_1), *Duroc* (used as a paternal breed in three-way and four-way crossbreeding), and *Hampshire* (used as paternal form in various crossbreeding schemes).

[134] The features of the type Moldovan Spotted Black are the following: cows yield big amounts of milk (6000 kg) after the first birth, the milking intensity is 1.8-2.5 kg/minute, production maturity is 25-27 months, effective production term is 4-6 births, weight of calf at birth is 30-35 kg; breeding heifers at 6 months of age weight 165 kg, at 12 months – circa 270 kg, and at 18 months – circa 375 kg, and young cattle left for fattening have daily weight gain of 1200 g, slaughtering efficiency being of 55%.

Table 3-3.2: Features of swine breeds and types bred in the Republic of Moldova

Breeds and Types of Swine	Production	Live Weight, kg		Proliferation, piglets in one birth	Average daily weight gain, g	Nutrition units per 1 kg of weight gain
		♀	♂			
The Big White	meat	300-350	220-260	11-12	600-650	4.0-4.1
Bacon Estonian	bacon	280-310	230-250	10-11	600-700	3.8-4.0
Steppe White Ukrainian	meat and fat	300-350	230-250	10-12	600-650	3.9-4.2
Moldavian type for meat 'Sudic'	meat	330-350	240-250	10-11	700-800	3.3-3.7
Ladrace	bacon	300-320	230-250	10-12	600-700	3.8-3.9
Duroc	meat	270-300	230-250	8-9	700-750	3.5-3.9
Hampshire	meat	230-280	200-230	9-10	650-700	3.7-4.0

Sheep

The sheep bred in the Republic of Moldova are represented by the *Karakul, Tsigaie, Turcana* and *Frisian* breeds (Table 3-3.3).

Table 3-3.3: Features of sheep races bred in the Republic of Moldova

Sheep Breeds	Production	Live Weight, kg		Fertility, lambs per 100 sheep	Wool sheared, kg	Milk Yield, kg	Content in Milk, %:	
		♀	♂				fats	proteins
Karakul	skins-milk	70-80	45-50	110-120	2.0-3.5	60-80	7.0-8.0	5.5-6.5
Tsigaie	wool-milk, wool-meet	85-95	45-50	110-130	3.5-7.5	75-120	6.5-7.0	5.0-6.0
Frisian	milk	80-90	65-70	190-210	3.5-5.0	500-600	5.9-6.5	5.0-5.5

The most typical colours of the *Karakul* breed are black and frosty. This breed was regionalized in the northern and central part of the country; it is well adaptable and is not demanding in terms of feed and maintenance conditions. *Tsigaie* sheep are well adaptable to warm climate, are bred in the South of the country and are a breed of sheep with semi-fine wool and has considerable fattening abilities. In comparison with other breeds, the *Frisian* breed has high milk yield indicators and high fertility performance at crossbreeding and improves these features in crossbreeds under special feeding and maintenance conditions (Bucataru, Radionov, Urzica, 2002; Bucataru, Radionov, Varban, 2003; Bivol, Ciubotaru, 2005).

Goats

Most native goats (90%) have thick and short hairy caver, consisting of thick and long fibres (over 70%) and down (less than 30%) of white colour (21.2%), red (20.9%), black (25.2%), and spotted (32.7%), with horns (73.0%) and with no 'ear rings' (73.3%). The research made revealed that the goats gene pool to a large extent is represented by less productive crossbreeds, but well adapted to the climate conditions of the country. Among the improved races, recommended for improving goat productivity in the Republic of Moldova are *Saanen* (a breed with high milk productivity and high indices for fertility and longevity, which is used for crossbreeding aimed to improve the milk yield of local goats), *French Alpine* (is well adapted for grasslands and not demanding in terms of feeding and maintenance conditions, is used to improve native breeds), and *Angora* (is the most valuable breed of wool goats, it may be used for crossbreeding with other breeds to improve the quality of the wool cover) (Bucataru, Radionov, Urzica, 2002; Bucataru, Radionov, Varban, 2003; Bivol, Ciubotaru, 2005) (Table 3-3.4).

Table 3-3.4: Features of goat breeds in the Republic of Moldova

Goat Breeds	Production	Live Weight, kg		Fertility, lambs per 100 goats	Wool sheared, kg	Milk Yield, kg	Content in Milk, %:	
		♀	♂				fats	proteins
Saanen	milk	75-85	45-55	150-170	2.0-3.5	700-800	3.7	3.0
French Alpine	milk	80-95	50-65	125-135	2.5-3.5	550-650	3.7	3.0
Angora	wool, down	50-60	30-40	120-130	3.0-4.0	150-200	4.2	3.8
Local Goats	milk	42-49	35-41	164-169	2.0-3.0	224-323	4.7	3.4

Horses and mules

The following breeds of horses and interspecies hybrids are bred in the RM: *Orlov* (resistant, easily adaptable, hound-gutted, with light traction and riding abilities, live weight: 500-550 kg), *of Don* (resistant, can be used for different kinds of work in the most diverse environmental conditions, with light traction and riding abilities, live weight: 500-550 kg) and *Vladimir Heavy Harness* has harmonious features and energetic temper, with heavy traction and rapid motion abilities, live weight: 700-750 kg), and also assess and mules[135] in the Southern part of the country (Bucataru, Radionov, Urzica, 2002).

Rabbits

Breeds of rabbits in the RM (Table 3-3.5) can be classified by the following criteria: main production – meat, fur, mix, wool; live weight – big (over 5 kg), medium (3-5 kg), small (2-3 kg) and dwarf (less than 2 kg); length of hair – normal, short, long (Bucataru, Maciuc, 2005).

Table 3-3.5: Features of rabbit breeds in the Republic of Moldova

Rabbit Breeds	Production	Live weight, kg	Fertility, rabbits per one birth
Big White	Meat and fur	5.5-9.0	6-8
Big Grey	Meat and fur	5.5-6.5	6-8
Butterfly	Meat and fur	5.0-6.0	6-8
Big Chinchilla	Meat and fur	3.5-5.5	6-8
Vienna Blue	Meat and fur	4.0-5.0	6-12
Silver	Meat and fur	4.0-5.0	6-12
Black-red	Meat and fur	4.5-5.5	8-12
New Zeeland White	Meat and fur	3.5-5.5	8-12
California	Meat and fur	3.6-4.8	6-8
Himalaya (Russian)	Meat and fur	2.4	6-8
Angora	Meat and wool	2.5-5.0	6-9

Chicken

The most widespread chicken breeds in the Republic of Moldova are: *Leghorn, Moldovan Bare Neck, Silver Adler, Kucino, Rhode Island, Plymouth-rock, New-Hampshire*, and *Cornish* (Bucataru, Radionov, Urzica, 2002; Bivol, Ciubotaru, 2005) (Table 3-3.6).

Table 3-3.6: Features of chicken breeds in the Republic of Moldova

Chicken Breeds	Production	Live Weight, kg		Annual number of laid eggs, pieces	Egg weight, g
		♀	♂		
Leghorn	eggs	2.6-3.0	1.8-2.0	220-240	57-61
Moldovan Bare Neck	meat-eggs	2.7-3.3	2.0-2.5	160-190	58-62
Silver Adler	meat-eggs	3.3-3.7	2.5-3.0	170-180	58-61
Kucino	meat-eggs	3.7-4.1	2.5-3.0	170-190	58-61
Rhode Island	meat-eggs	3.5-4.0	2.5-3.0	170-180	55-63
Plymouth-rock	meat-eggs	3.5-4.0	2.5-3.0	160-180	58-60
New-Hampshire	meat-eggs	3.8-4.1	2.5-3.0	170-200	56-62
Cornish	meat	4.5-5.0	3.4-4.0	100-130	60-65

Turkeys

The most widespread turkey breeds in the Republic of Moldova are *Suntanned with Large Chest, White with Large Chest*, and *North-Caucasian Suntanned* (Bucataru, Radionov, Urzica, 2002) (Table 3-3.7).

Table 3-3.7: Features of turkey breeds in the Republic of Moldova

Turkey Breeds	Live Weight, kg		Annual number of laid eggs, pieces	Egg weight, g
	♀	♂		
Suntanned with Large Chest	14-17	8-11	70-90	80-90
White with Large Chest	9-20	6-10	70-110	78-82
North-Caucasian Suntanned	13-14	6.5-7.0	75-80	80-85

Geese

The most widespread goose breeds in the Republic of Moldova are: *Holmogor, White Italian, Kuban,* and *Chinese* (Bucataru, Radionov, Urzica, 2002) (Table 3-3.8).

Table 3-3.8: Features of goose breeds in the Republic of Moldova

Geese Breeds	Category	Live Weight, kg		Annual number of laid eggs, pieces	Egg weight, g
		♀	♂		
Holmogor	Heavy race	9.0-10.0	7.0-8.0	30-40	180-200
White Italian	Semi-heavy race	7.5-8.5	6.5-7.5	30-40	160-170
Kuban	Light race	5.0-5.5	4.0-4.5	70-75	140-160
Chinese	Light race	5.0-5.5	4.0-4.5	60-70	140-160

[135] A mule is an interspecies hybrid, obtained by crossbreeding of a mare and an ass, with a live weight of 370-390 kg, of 130-150 cm height in withers and a span of life of 30-40 years, is resistant to diseases, and is well adaptable to the environment, not demanding in terms of feeding and maintenance conditions, has a greater working power than a horse, but is sterile.

Ducks

There are preponderantly four breeds of ducks in the Republic of Moldova: *Beijing, Mirror, Grey Ukrainian* and *Polish* (Bucataru, Radionov, Urzica, 2002) (Table 3-3.9).

Table 3-3.9: Features of duck breeds in the Republic of Moldova

Ducks Breeds	Production	Live Weight, kg		Annual number of laid eggs, pieces	Egg weight, g
		♀	♂		
Beijing	meat	3.5-4.5	3.0-3.5	90-120	80-90
Mirror	meet-eggs	3.2-3.8	2.8-3.2	150-180	80-90
Grey Ukrainian	meat	3.3-3.7	2.8-3.2	110-130	80-90
Polish	meat	5.0-6.0	2.0-3.0	80-100	70-80

Annex 3-4. Additional information associated with country-specific coefficients/parameters used to estimate GHG emissions/removals from Sector 4 'LULUCF'

Annex 3-4.1. Additional information associated with category 4A 'Forest Land'

Annex 3-4.1.1. General structure of the forestry fund in the Republic of Moldova

Structure Elements	Total / average	Species							
		ST	GO	STP	PLA	SA	PA	FR	TE
Area, ha	386 395.4	57 152.1	46 289.2	7 240.8	5 071.2	4 707.1	6 859.1	30 290.6	13 666.8
Proportions of above-ground species, %	100.0	14.8	12.0	1.9	1.3	1.2	1.8	7.8	3.5
Average production class	3.9	3.6	2.8	3.0	3.1	4.0	3.7	3.4	3.1
Average consistency	0.76	0.75	0.76	0.73	0.75	0.66	0.76	0.77	0.78
Average age, years	45	68	79	79	38	35	35	60	67
Current growth, m^3/yr/ha	3.8	4.2	3.9	0.9	5.6	6.5	2.3	4.4	6.4
Annual growth, m^3	1 457 791	241 111	178 467	6 875	28 262	30 540	16 046	134 292	87 863
Average volume per standing wood, m^3/ha	118	184	234	119	174	106	90	195	238
Standing wood, m^3	45 407 785	10 536 945	10 843 035	863 755	881 432	498 840	615 719	5 909 773	3 256 044
Proportion of species per volume, %	100.0	23.2	23.9	1.9	1.9	1.1	1.3	13.0	7.2
Structure Elements	Total / average	Species							
		CA	ULC	NU	SC	DR	DM	DT	EX
Area, ha	386 395.4	20 576.9	6 261.9	11 762.7	127 902.7	6 033.0	3 886.9	38 257.4	437.0
Proportions of above-ground species, %	100.0	5.3	1.6	3.1	33.1	1.6	1.0	9.9	0.1
Average production class	3.9	3.6	4.4	4.8	4.6	3.9	3.7	4.1	4.5
Average consistency	0.76	0.79	0.68	0.63	0.77	0.69	0.67	0.72	0.74
Average age, years	45	60	28	34	17	34	33	37	28
Current growth, m^3/yr/ha	3.8	5.0	2.9	2.7	3.2	4.7	4.6	3.1	2.6
Annual growth, m^3	1 457 791	102 138	17 927	32 332	414 757	28 455	18 012	119 572	1142
Average volume per standing wood, m^3/ha	118	152	62	34	30	89	116	84	70
Standing wood, m^3	45 407 785	3 131 245	386 897	403 949	3 841 412	534 891	450 882	3 222 509	30 457
Proportion of species per volume, %	100.0	6.9	0.8	0.9	8.5	1.2	1.0	7.1	0.1

Annex 3-4.1.2. Abbreviations used in category 4A 'Forest Land'

Full name of species	Abbreviations in Romanian
Pedunculate oak	ST
Durmast	GO
Downy oak	STP
White poplar	PLA
White willow	SA
Field maple	PA
Common maple	FR
Lime*	TE
Hornbeam	CA
Field elm	ULC
Common walnut	NU
Field elm	ULC
Acacia	SC
Various resinous species	DR
Various softwood species	DM
Various hardwood species	DT
Various exotic species	EX

Note: * includes 3 species (silver lime, big leaf linden tree, foul lime).

Annex 3-4.1.3. Abbreviations used in the process of forest management in the Republic of Moldova

Full name of species	Abbreviation	Full name of species	Abbreviation	Full name of species	Abbreviation
Turkish hazel	ALT	Wilmott	FRP	Sycamore	PTL
Grey alder	AN	Italian oak	GI	White Willow	SA
Black alder	ANN	Honey locust	GL	Goat willow	SAC
Tatar maple	AR	Durmast	GO	Brittle willow	SAP
American maple	ARA	Field maple	JU	Sorb	SB
Fir tree	BR	Larch	LA	Acacia	SC
Hornbeam	CA	Apple tree	MA	Russian olive	SL
Horse chestnut	CAP	Birch	ME	Rowan	SR
Sweet chestnut	CAS	Flowering ash	MJ	Pedunculate oak	ST
Cherry plum	CD	Spruce	MO	Greyish oak	STB
Turkey oak	CE	Common walnut	NU	Downy oak	STP
Cherry tree	CI	American walnut	NUA	Red oak	STR
Oriental hornbeam	CR	Sumac	OT	Taxodium	TA
Tree of heaven	CS	Norway maple	PA	Silver lime	TS
Mulberry	DD	Mountain maple	PAM	Big leaf linden tree	TEM
Various softwood	DM	Sylvester pine	PI	Foul lime	TEP
Various resinous	DR	Black pine	PIN	Yew	TI
Various hardwood	DT	White poplar	PLA	White cedar	TU
Douglas fir	DU	Grey poplar	PLC	Field elm	ULC
Various exotic	EX	Black poplar	PLN	Mountain elm	ULM
Beech	FA	Trembling poplar	PLT	European white elm	ULV
Common ash tree	FR	Pear tree	PR	Turkish cherry	VIT
American ash tree	FRA	Plum tree	PRN		

Annex 3-4.2. Methodology used to determine carbon balance in agricultural soils for the estimation of GHG emissions

The methodology for determining the carbon balance in agricultural soils for the estimation of GHG emissions (Banaru, 2000)[136] was used by the Republic of Moldova to compile its GHG emission inventories within the Second National Communication (2010), Third National Communication (2014) and the First Biennial Update Report (2016).

In 2010, the methodology was updated[137] due to the availability of new scientific data and considering available data in the 2006 IPCC Guidelines.

Principles laid at the basis of the method are, as follows:

- carbon balance represents the difference between carbon entering the soil (humification of vegetable residues and organic fertilizers) and carbon coming out of the soil due to organic matter mineralization process;
- the amount of organic matter in soil can be estimated considering the Nitrogen export accumulated in crop yield (main and additional) removed from the cropland;
- the amount of Carbon entered and stored in soil can be estimated according to the mass of crop residues and the amount of organic fertilizers applied considering the carbon content and the humification coefficients;
- a positive and neutral carbon balance indicates the absence of GHG emissions;
- a negative balance occurs when the carbon coming out of the soil exceeds the amount of organic matter stored through humification processes and indicates the existence of GHG emissions to the extent of the assessed deficit;
- carbon balance estimation by the proposed method can be used for one field, crop rotation, agricultural farm, administrative-territorial unit, as well as for the total area of agricultural lands in the country, for a period of one year or longer.

Arguments supporting the principles used to develop the methodology

The possibility to use the nitrogen export by crops from soil for estimating the humus consumption was argued by I.V. Tiurin (1965), the idea being further developed by A.M. Likov (1979). The close

[136] Banaru, Anatol (2000), Methodology to Calculate CO2 Emissions from Arable Soils. In the collection of papers 'Climate Change. Research, Studies, Solutions'. Ministry of Environment / UNDP Moldova. 'Bons Offices' Ltd. Chisinau, 2000. P. 115-123.

[137] Cerbari, V., Scorpan, V., Taranu, M. (2010), The potential for reducing the CO2 emissions from arable soils of the Republic of Moldova. Mediul Ambiant (Environment), Scientific Journal of Information and Ecological Culture, No. 1 (49), February 2010, ISSN: 1810-9551. P. 6-13.

link between carbon emissions and the amount of N released from soils due to the biochemical decomposition of organic matter was considered. The content of carbon and nitrogen in humus is stable with minor variations within the pedogeographical zone' limits. The carbon-nitrogen ratio in humus in the RM's soils is circa 10.7, varying closely from 10.1 to 11.3 (Krupenikov, 1967; Krupenikov, Ganenco, 1984). This is the typical ratio of the surface layer of soils, decreasing slightly in deeper layers.

Considering the stable carbon-nitrogen ratio of the soil organic matter and knowing the nitrogen export stored in crop yield (main and additional) removed from the cropland, it is possible to estimate the amount of carbon released from soil together with the nitrogen, i.e., the carbon released through carbon dioxide emissions.

While performing calculations, it should be considered that part of the nitrogen used by plants may have a different source than the humus. Therefore, the atmospheric Nitrogen fixed by leguminous crops, the N from synthetic and organic fertilizers, as well as the N from crop residues should be subtracted from the total nitrogen export. A small amount of N enters the soil with atmospheric precipitations (circa 7 kg/ha), and through non-symbiotic fixation (circa 5 kg/ha). The N from these sources corresponds to denitrification and leaching losses and should not be considered.

In order to estimate the carbon balance and the GHG emissions from soil, the amount of CO_2 entered and fixed in the soil together with the crop yield that was not removed and the organic fertilizers used should be determined. Other carbon sources entering the soil, such as the carbon from seeds and the atmospheric carbon fixed by the blue algae are considered to be insignificant.

The amount of carbon entering the soil is determined by considering the humification coefficients of crop residues and organic fertilizers, as well as by the carbon content in humus.

The difference between the carbon coming out and the carbon entering the soil (balance) should consider CO_2 emissions should the mineralization processes prevail over the humification processes.

The exposed principles were used by several authors to determine the humus balance in agricultural soils and to develop measures for fertility conservation and enhancement (Likov, 1979; Diakonova, 1984, 1990; Lozanovskaya et al., 1987; Popov et al., 1987; Turcan, Banaru, 1994). Obtaining satisfactory results is conditioned by specifying the indicators used at local and regional level in connection with their variation according to pedo-climatic factors.

The developed methodology aims to estimate CO_2 emissions from cropland. During this exercise, data from international and national scientific literature were used, including information published in the last 15 years: Ungurean et al., 1997; Boincean, 1999; Rusu et al., 2005; Nicolaev, Boincean et al., 2006.

Following all the above mentioned, the carbon balance can be estimated using the following equation:

$$B_C \pm = (V_I - C_O) \bullet Area_{(T)}$$

Where:

- B_C – carbon balance, tonnes;
- V_I – carbon entered into the soil through crop yield and organic matter humification, tonnes/yr;
- C_O – carbon coming out from the soil through CO_2 emissions as a result of humus mineralization, tonnes/yr;
- $Area_{(T)}$ – area covered with T crop, ha.

The amount of carbon entered in soil (V) can be estimated using the following equation:

$$V = V_1 + V_2$$

Where:

- V_1 – carbon returned to soils with crop residues, tonnes/yr;
- V_2 – carbon returned to soils with organic fertilizers, tonnes/yr.

The amount of carbon in crop residues returned to soils (V_1) can be estimated using the following equation:

$$V_1 = [(Crop_{(T)} \bullet R_{AG(T)} \bullet (1\text{-}Frac_{Remove(T)}) + Crop_{(T)} \bullet R_{BG(T)}) \bullet k_1] / 1.724^{138}$$

Where:

$Crop_{(T)}$ – harvested annual dry matter yield for crop *T*, (t CM)/ha;

Where:

$$Crop_{(T)} = YieldFresh_{(T)} \bullet DRY$$

$YieldFresh_{(T)}$ – harvested fresh yield for crop *T*, t/ha;

DRY – dry matter fraction of harvested crop *T*, kg CM/t of yield[139];

$R_{AG(T)}$ – ratio of above-ground residues dry matter to harvested yield for crop *T* (Crop(*T*)), t CM_{AG}/t CM[140];

$R_{BG(T)}$ – ratio of below-ground residues to harvested yield for crop *T*, CM m_{BG}/t CM[141];

$Frac_{Remove(T)}$ – fraction of above-ground residues of crop *T* removed and used for other purposes[142];

k_1– coefficient reflecting the humification of crop residues[143];

1.724 – coefficient reflecting the conversion from humus to carbon[144].

The coefficients used to estimate the amount of carbon from crop residues returned to soils come from different reference sources, including the 2006 IPCC Guidelines (Table 3-4.2.1).

Table 3-4.2.1: Coefficients used to estimate the amount of C in crop residues returned to soils

Crop	DRY	$R_{AG(T)}$	$R_{BG(T)}$	$Frac_{Remove(T)}$	k_1
Winter wheat (crop residues returned to soils without N inputs during stubble-turning)	0.89	1.40	0.23	0.75	0.11
Winter wheat (crop residues returned to soils with N inputs during stubble-turning)	0.89	1.40	0.23	0.75	0.19
Winter rye (crop residues returned to soils without N inputs during stubble-turning)	0.88	1.30	0.22	0.75	0.11
Winter rye (crop residues returned to soils with N inputs during stubble-turning)	0.88	1.30	0.22	0.75	0.19
Barley (crop residues returned to soils without N inputs during stubble-turning)	0.89	1.17	0.22	0.75	0.11
Barley (crop residues returned to soils with N inputs during stubble-turning)	0.89	1.17	0.22	0.75	0.20
Oat (crop residues returned to soils without N inputs during stubble-turning)	0.89	1.17	0.25	0.75	0.11
Oat (crop residues returned to soils with N inputs during stubble-turning)	0.89	1.17	0.25	0.75	0.20
Buckwheat (crop residues returned to soils without N inputs during stubble-turning)	0.88	1.17	0.25	0.75	0.11
Buckwheat (crop residues returned to soils with N inputs during stubble-turning)	0.88	1.17	0.25	0.75	0.20
Millet (crop residues returned to soils without N inputs during stubble-turning)	0.88	1.17	0.22	0.40	0.11
Millet (crop residues returned to soils with N inputs during stubble-turning)	0.88	1.17	0.22	0.40	0.20
Grain maize (crop residues returned to soils without N inputs during stubble-turning)	0.87	1.17	0.22	0.70	0.11
Grain maize (crop residues returned to soils with N inputs during stubble-turning)	0.87	1.17	0.22	0.70	0.20
Sorghum (crop residues returned to soils without N inputs during stubble-turning)	0.89	1.17	0.22	0.50	0.11
Sorghum (crop residues returned to soils with N inputs during stubble-turning)	0.89	1.17	0.22	0.50	0.20
Pea, bean, vetch	0.90	1.30	0.19	0.40	0.25
Soy	0.91	1.30	0.19	0.00	0.25
Sugar beet	0.22	0.29	0.20	0.00	0.10
Sunflower (crop residues returned to soils without N inputs during stubble-turning)	0.90	3.80	0.22	0.40	0.08
Sunflower (crop residues returned to soils with N inputs during stubble-turning)	0.90	3.80	0.22	0.40	0.15
Tobacco	0.90	5.77	0.19	0.00	0.10
Grain rapeseed	0.88	1.17	0.22	0.00	0.11
Potatoes	0.22	0.17	0.20	0.00	0.13
Vegetables	0.22	0.17	0.20	0.00	0.13
Melons and gourds	0.22	0.17	0.20	0.00	0.13
Fodder beet	0.22	0.14	0.20	0.00	0.10
Maize for silo and green fodder	0.23	0.25	0.22	0.77	0.17
Perennial grasses for green fodder, silage and fodder	0.26	0.25	0.40	0.74	0.25
Annual grasses (vetch and oat) for green fodder	0.22	0.25	0.40	0.78	0.22
Annual grasses (peas and oat) for green fodder	0.22	0.25	0.40	0.78	0.22

The amount of carbon in organic fertilizers returned to soils (V_2) can be estimated using the following equation:

$$V_2 = (F_{ON} \bullet k_2) / 1.724$$

138 Arinushkina E.V. Guidelines for Chemical Analysis of Soils (in Russian). Moscow, Moscow State University Press, 1961. P.136.
139 2006 IPCC Guidelines, Volume 4, Chapter 11, Table 11.2, P. 11.17.
140 Nicolaev N., Boincean B., Sidorov M., Vanicovici Gh., Coltun V. (2006), Agrotechnics. Ministry of Education and Youth of the Republic of Moldova – Balti: Balti University Press, 2006, P. 298.
141 2006 IPCC Guidelines, Volume 4, Chapter 11, Table 11.2, Page 11.17.
142 Expert opinion, Prof. Valerian Cerbari, 'Nicolae Dimo' Institute of Pedology, Agrochemistry and Soil Protection.
143 Rusu M., Marghitas M., Oroian I., Mihailescu T., Dumitras A. (2005), Agrochemistry Treaty (in Romanian). Bucuresti, Publishing House Ceres, 2005. 672 P.
144 Arinushkina E.V. Guidelines for Chemical Analysis of Soils (in Russian). Moscow, Moscow State University Press, 1961. P 136.

Where:

F_{ON} – Total annual amount of organic N applied to soils, (t/yr);

$$F_{ON} = F_{AM} + F_{SEW} + F_{COMP} + F_{OOA}$$

Where:

F_{AM} – annual amount of animal manure N applied to soils, t/yr;

F_{SEW} – annual amount of total sewage N that is applied to soils, t/yr;

F_{COMP} – annual amount of total compost N applied to soils, t/yr;

F_{OOA} – annual amount of other organic amendments used as fertilizer t/yr;

k_2 – coefficient reflecting the humification of organic fertilizers (Table 3-4.2.2)[145];

1.724 – coefficient reflecting the transition from humus to carbon[146].

Table 3-4.2.2: Norms of humus accumulation in soil on the account of applied organic fertilizers and their humification coefficients

Organic Fertilizers	Applied dose, t/ha	Humus Accumulation		k_2
		from the applied dose, t/ha	from 1 t of fertilizer, kg/t	
Animal manure with bedding (moisture 52%)	40	5.2	130	0.13
Semiliquid manure (moisture 82%)	50	1.6	29	0.03
Solid fraction of manure without bedding (moisture 65%)	40	3.1	78	0.08
Compost of manure solid fraction and soil (moisture 50%)	40	3.2	81	0.08
Poultry manure (moisture 48%)	10	1.8	180	0.18
Sludge from wastewater treatment (moisture 56%)	40	4.1	102	0.10
Defecate from sugar factories (moisture 44%)	40	1.0	25	0.03
Lignin from bio-chemical factories (moisture 66%)	80	13.3	165	0.17
Sludge from bio-chemical factories (moisture 80%)	80	3.5	45	0.05
Compost from manure and sludge from wastewater treatment (moisture 54%)	80	9.8	121	0.12
Compost from manure and defecate (moisture 48%)	80	9.5	119	0.12
Compost of sludge from wastewater treatment and defecate (moisture 50%)	80	5.4	67	0.07
Compost of sludge from wastewater treatment, defecate and manure (moisture 51%)	120	10.8	90	0.09
Average	**44**	**4.1**	**93**	**0.10**

The amount of carbon coming out of the soils can be estimated using the following equation:

$$C = [E_R - (E_M + E_O + E_V + E_S)] \bullet r_1 \bullet r_2 \bullet R$$

Where:

E_R – the amount of N exported from the main and additional crop yield, t/yr; can be estimated using the following equation:

$$E_{r\,(T)} = (Yield\ Fresh_{(T)} \bullet k_{3\,(T)}) / 10^3$$

Where:

$Yield\ Fresh_{(T)}$ – harvested fresh yield for crop T, t/ha;

$k_{3(T)}$ – coefficient reflecting the N export with the crop yield for crop T, kg/t (see Table 3-4.2.3)[147].

Table 3-4.2.3: Export of nitrogen with the crop yield, kg per 1 tonne of the main crop, taking into account the secondary crop (average data for the RM)

Crop	Export of Nitrogen, kg/t
Winter wheat	33
Winter barley	30
Spring barley	30
Oat	30
Grain maize	28
Peas	44
Beans	40
Vetch, vetch mixtures	50
Sorghum	30

[145] Banaru A. (2003), Guidebook for Organic Fertilisers Use (in Romanian). ACSA/Agricultural Extension and Education Agency, the World Bank Project RISP – Rural Investments and Services and TACIS FDMOL 9901 Support to Developing Education, Research and Extension Services in Agriculture Project. Chisinau, 2003, 52 P.

[146] Arinushkina E.V. Guidelines for Chemical Analysis of Soils (in Russian). Moscow, Moscow State University Press, 1961. P. 136

[147] Banaru A. (2002), Methodological Guidelines to Determine Humus Balance in Agricultural Soils (in Romanian). Ministry of Agriculture and Food Industry. 'Nicolae Dimo' Institute of Pedology, Agrochemistry and Soil Protection and TACIS FDMOL 9901 Support to Developing Education, Research and Extension Services in Agriculture Project, Chisinau, 2002. 23 P.

Crop	Export of Nitrogen, kg/t
Sugar beat	6
Sunflower	49
Soy	65
Tobacco	36
Potatoes	7
Vegetables	3
Fodder beet	3
Silo maize and green fodder	4
Annual herbs for hay	21
Annual herbs for green fodder	5
Perennial herbs for hay	30
Perennial herbs for green fodder	9
Vineyards	7
Orchards	2
Pastures and hay fields	18

E_M – the amount of N export from inorganic fertilizers can be estimated using the following equation:

$$E_M = F_{SN} \bullet k_4$$

Where:

F_{SN} – total amount of inorganic N fertilizers applied to soils, tonnes of active substance per year; can be estimated using the following equation:

$$F_{SN} = F_T \bullet (P_{SN}/10^2)$$

Where:

F_T – total amount of inorganic fertilizers applied to soils, t/yr;

P_{SN} – percentage share of N in inorganic fertilizers, % of active substance (Table 3-4.2.4);

k_4 – coefficient reflecting the N use from inorganic fertilizers; constitutes circa 50% of the applied quantity (Banaru, 2002).

Table 3-4.2.4: Nitrogen content in inorganic fertilizers applied more frequently in the country

Inorganic fertilizers	Chemical formula	Active substance, %
Anhydrous ammonia	NH_3	82.0
Sulphate of ammonia	$(NH_4)_2SO_4$	20.5
Ammonium chloride	NH_4Cl	26.0
Potassium nitrate	KNO_3	13.5
Calcium nitrate	$Ca(NO_3)_2$	15.0
Sodium nitrate	$NaNO_3$	16.0
Ammonia nitrate	NH_4NO_3	34.4
Calcium ammonium nitrate	$NH_4NO_3 \bullet CaCO_3$	20.0
Ammonium sulphate	$NH_4NO_3 \bullet (NH_4)_2SO_4$	26.0
Urea	$CO(NH_2)_2$	46.0
Calcium cyanamide	$CaCN_2$	21.0
Ammonium phosphate	$NH_4H_2PO_4$	11.0
Diammonium phosphate	$(NH_4)_2HPO_4$	16.0
Superphosphate	Complex formula	4.0
Ammonium polyphosphate	Complex formula	18.0
Nitrophosphate	Complex formula	22.0
Nitro-ammonium phosphate	Complex formula	23.0
Nitroammophos	Complex formula	16.0
Mixed liquid fertilizers	Complex formula	10.0

E_O – the amount of N exported from organic fertilizers; can be estimated using the following equation:

$$E_O = F_{ON} \bullet k_5$$

Where:

F_{ON} – total N content in organic fertilizers applied to soils, t/yr; can be estimated using the following equation:

$$F_{ON} = F_T \bullet (P_{ON}/10^2)$$

Where:

F_T – total amount of organic fertilizers applied to soils, t/yr;

P_{ON} – percentage share of N in organic fertilizers, % active substance (Table 3-4.2.5);

k_5 – average coefficient reflecting the N content in organic fertilizers (Banaru, 2002) (Table 3-4.2.5).

Table 3-4.2.5: Nitrogen content in organic fertilizers applied in the country

Organic fertilizers	Nitrogen content, %	Average coefficients for nitrogen use from organic fertilizers, %
Animal manure with bedding	0.71	13
Semiliquid manure	0.30	14
Solid fraction of manure	0.57	13
Poultry manure	1.53	33
Sludge from wastewater treatment	0.86	12
Defecate from sugar factories	0.13	12
Lignin of hydrolysis	0.14	1
Sludge of hydrolysis	0.33	9
Solid fraction of manure + soil	0.71	16
Manure + sludge from wastewater treatment	0.79	16
Manure + defecate	0.45	16
Manure + defecate + sludge	0.58	16

The use of recalculation coefficients available in Table 3-4.5.6, enables AD conversion related to the use of various organic fertilizers in animal manure with bedding.

Table 3-4.2.6: Coefficients for re-calculation of different forms and types of organic fertilizers in animal manure with bedding

Type and form of organic fertilizers	Recalculation coefficients
Animal manure with bedding (up to 77% moisture), solid fraction	1.00
Manure without bedding and semiliquid manure (90-93% moisture)	0.50
Liquid manure (93-97% moisture)	0.25
Residual wastewater from zoo-technical complexes (moisture over 97%)	0.10
Compost of peat and manure (1:1)	1.20
Compost of peat and poultry manure	1.30
Poultry manure	1.20
Straw (with added nitrogen – 10 kg per 1 t)	3.40
Sapropel	0.25
Defecate from sugar factories	0.25
Green fertilizers (natural moisture)	0.25
Sludge produced from wastewater treatment	0.80
Composts from municipal solid waste	0.90

E_V – the amount of N from crop residues returned to soils; can be estimated using the following equation:

$$E_V = F_{CR} \bullet k_6$$

Where:

F_{CR} – annual amount of N in crop residues returned to soils annually, t N/yr; can be estimated using the following equation:

$$F_{CR} = (Crop_{(T)} \bullet R_{AG\,(T)} \bullet (1\text{-}Frac_{Remove\,(T)}) + Crop_{(T)} \bullet R_{BG\,(T)}) \bullet (P_{CR}/10^2) \bullet (k_6/10^2)$$

Where:

$Crop_{(T)}$ – harvested annual dry matter yield for crop T t CM/ha;

$R_{AG\,(T)}$ – ratio of above-ground residues to harvested yield for crop T (Crop(T)), t CM_{AG}/t CM[148];

$R_{BG\,(T)}$ – ratio of below-ground residues to harvested yield for crop T, t CM_{BG}/t CM[149];

$Frac_{Remove(T)}$ – fraction of above-ground residues of crop T removed and used for other purposes[150];

P_{CR} – amount of Nitrogen in crop residues, % active substance (see Table 3-4.2.7);

k_6 – coefficient reflecting the N in crop residues (Banaru, 2002) (see Table 3-4.2.7).

[148] Nicolaev N., Boincean B., Sidorov M., Vanicovici Gh., Coltun V. (2006), Agrotechnics. Ministry of Education and Youth of the Republic of Moldova. – Balti: Balti University Press, 2006, P. 298.
[149] 2006 IPCC Guidelines, Volume 4, Chapter 11, Table 11.2, Page 11.17.
[150] Expert opinion, Prof. Valerian Cerbari, 'Nicolae Dimo' Institute of Pedology, Agrochemistry and Soil Protection.

Table 3-4.2.7: Amount of N in crop residues (country-specific average values)

Crop	k_6, content of nitrogen, %	Amount of used N from crop residues, % of total
Winter wheat	0.50	Amount of used N from crop residues constitutes 25% of the total
Winter rye	1.05	
Winter barley	0.80	
Oat	0.60	
Millet	1.25	
Buckwheat	0.60	
Leguminous crops	2.08	
Grain maize	1.08	
Grain sorghum	1.00	
Other cereal crops	0.60	
Sugar beet	1.65	
Sunflower	0.95	
Soy	2.08	
Tobacco	1.30	
Grain rapeseed	1.05	
Potatoes	0.40	
Vegetables	2.09	
Melons and gourds	1.19	
Root crops for fodder	1.65	
Maize for silo and green fodder	1.08	
Perennial grasses for green fodder, silage and fodder	2.48	
Annual grasses for green fodder	1.60	
Vetch green manure, above-ground dry mass	4.20	
Vetch green manure, below-ground dry mass	1.40	

E_S – the amount of N fixed and exported from soils by vegetables and perennial herbs; the quality of symbiotic nitrogen can be estimated using the following equation:

$$E_{S(T)} = YieldFresh_{(T)} \bullet (k_{7\,(T)} / 10^3) \bullet (k_{8\,(T)} / 10^2)$$

Where:

$YieldFresh_{(T)}$ – harvested fresh yield for crop T, t/ha;

$k_{7(T)}$ – coefficients reflecting symbiotic nitrogen fixation for crop T (Banaru, 2002) (Table 3-4.2.8);

$k_{8(T)}$ – coefficients reflecting symbiotic nitrogen export for crop T (Banaru, 2002) (Table 3-4.2.8).

Table 3-4.2.8: Fixation and export of nitrogen by vegetables and perennial herbs (average values from the scientific literature in the field)

Crops	Nitrogen fixation, kg/t production	Nitrogen export, % of the total export
Peas	44	60
Beans	37	60
Soy	70	60
Vetch	50	60
Vetch in mixtures	5	37
Perennial herbs	30	70

r_1 – coefficient reflecting the humus mineralization dependence by soil granulometry[151] (see Table 3-4.2.9).

Table 3-4.2.9: Humus mineralization correction coefficient based on soil granulometry (according to Likov, 1979)

Soil granulometry	Correction coefficient (r_1)
Argillaceous clay	0.8
Clay	1.0
Sandy clay	1.2
Clayey sand	1.4
Sand	1.8

r_2 – coefficient reflecting the humus mineralization dependence based on the technology applied to crop[152] (see Table 3-4.2.10).

[151] Likov A.M. On the Methods of Estimating the Humus Balance in Soils Used in Intensive Agriculture (in Russian). Timiryazev Agricultural Academy Bulletin, 1979. Nr. 6, pp. 14-20.
[152] Idem.

Table 3-4.2.10: Humus mineralization correction coefficient based on technology applied to crop (according to Likov, 1979)

Crops	Correction coefficient (r_2)
Perennial herbs	1.0
One year cereal crops	1.2
Perishable crops	1.6

R – carbon-nitrogen ratio of the soil organic matter (humus) (R = C : N), according to the 2006 IPCC Guidelines, the default value for Cropland Remaining Cropland is 10 (range from 8 to 15); according to national sources (Krupenikov, 1967; Krupenikov, Ganenco, 1984; Banaru, 2002) the carbon-nitrogen ratio of humus in the RM's soils is 10.7 (range from 10.1 to 11.3).

CO_2 emissions from soils engaged in farming can be estimated using the following equation:

$$CO_2 = \pm B \bullet 44/12$$

Where:

B – carbon balance, tonnes;

[44/12] – mass ratio between C and CO_2.

As for the results obtained using this methodology, it is necessary to mention that over the last two decades, agriculture in the RM has mainly been based on exploitation of the natural fertility of soils (and/or the existing humus content in soils). As a result, any increase in crop yield (as it happened, for example, in 1997, 2004, 2008, 2013, 2014 or 2016) caused particularly by favourable climatic factors, and not followed by the compensation of organic matter loss in soil, used for crop development, leads to increased CO_2 emissions. Thus, the intensification of the dehumidification processes (mineralization of organic matter in soil) within the current subsistence agriculture leads to decreased carbon stocks in humus, respectively to increased CO_2 emissions as well as to the decrease in soil quality and fertility.

The significant decrease between 1990 and 2020 in carbon returned to soil with animal manure (by 81.8%), and in below-ground and above-ground crop residues, respectively (by 81.0%) led to a shift from a positive carbon balance between 1990 and 1992 (the period before the agrarian reform in the country) to a deeply negative balance in the last 20 to 25 years (Table 3-4.2.11).

Table 3-4.2.11: Carbon balance in arable land (cropland) in the RM between 1990-2020

	1990	1991	1992	1993	1994	1995	1996	1997
Carbon introduced in soil with organic fertilizers, kt	364.4	409.2	281.2	363.0	119.6	182.2	92.6	177.4
Carbon introduced in soil with above- and below-ground residues, kt	556.5	491.4	451.3	385.3	374.2	340.5	352.2	277.2
Carbon losses from soil due to humus mineralization, kt	-388.0	-393.5	-323.2	-1,029.4	-618.8	-955.1	-823.7	-1,268.9
Carbon balance in cropland, kt	532.9	507.0	409.4	-281.0	-124.9	-432.5	-378.8	-814.3
Carbon balance in cropland, t/ha	0.31	0.30	0.24	-0.16	-0.07	-0.25	-0.22	-0.47
	1998	1999	2000	2001	2002	2003	2004	2005
Carbon introduced in soil with organic fertilizers, kt	150.0	142.3	76.9	148.5	148.3	62.1	165.3	169.4
Carbon introduced in soil with above- and below-ground residues, kt	261.4	238.1	211.7	216.0	217.8	206.4	198.8	209.3
Carbon losses from soil due to humus mineralization, kt	-1,035.6	-957.9	-911.8	-1,046.0	-1,101.5	-861.9	-1,257.9	-1,220.0
Carbon balance in cropland, kt	-624.2	-577.5	-623.3	-681.5	-735.4	-593.4	-893.8	-841.3
Carbon balance in cropland, t/ha	-0.37	-0.35	-0.37	-0.40	-0.43	-0.37	-0.53	-0.50
	2006	2007	2008	2009	2010	2011	2012	2013
Carbon introduced in soil with organic fertilizers, kt	157.3	44.4	184.2	134.9	174.8	175.0	54.0	189.9
Carbon introduced in soil with above- and below-ground residues, kt	214.2	165.2	162.3	181.0	186.5	170.9	157.9	149.9
Carbon losses from soil due to humus mineralization, kt	-1,067.2	-363.9	-1,291.3	-907.9	-1,101.2	-1,143.9	-518.4	-1,202.6
Carbon balance in cropland, kt	-695.6	-154.2	-944.8	-592.0	-739.8	-797.9	-306.6	-862.7
Carbon balance in cropland, t/ha	-0.45	-0.10	-0.61	-0.37	-0.46	-0.50	-0.19	-0.52
	2014	2015	2016	2017	2018	2019	2020	%
Carbon introduced in soil with organic fertilizers, kt	214.1	81.1	212.4	245.7	248.4	253.0	66.5	-81.8
Carbon introduced in soil with above- and below-ground residues, kt	163.3	158.8	160.7	153.4	135.1	122.2	105.6	-81.0
Carbon losses from soil due to humus mineralization, kt	-1,223.0	-998.2	-1,365.2	-1,533.3	-1,534.4	-1,492.2	-561.1	44.6
Carbon balance in cropland, kt	-845.6	-758.4	-992.1	-1,134.2	-1,150.8	-1,117.1	-389.1	-173.0
Carbon balance in cropland, t/ha	-0.50	-0.45	-0.58	-0.66	-0.66	-0.65	-0.23	-173.1

It should be noted that the carbon balance in the arable land constituted on average -0.23 t/ha per year between 1990 and 2005, whereas for the 2006-2020 time series it already reached an average of circa -0.46 t/ha per year (Table 3-4.2.12).

Table 3-4.2.12 presents other relevant information in the calculation process, including the total area of cropland, as well as data on crop yields recorded between 1990 and 2020.

Regarding the 'Methodology to Calculate CO_2 Emissions from Agricultural Soils for the estimation of GHG emissions' the following should also be mentioned:

- the balance (difference) between the carbon entered and coming out of the soil, related to one unit of area (ha), is multiplied by total area ($Area_{(T)}$) of crop *T*;
- in the described order, the carbon balance is estimated for each crop (T) separately;
- the estimation of the carbon balance for the total area of croplands in the country is performed by adding the data for each crop (T);
- the positive and negative values are summed;
- should the sum have a positive value, the carbon balance should be considered positive, and proves that the soils in croplands are a source of CO_2 removals;
- should the sum have a negative value, the carbon balance should be considered negative and proves that the soils in croplands are a source of CO_2 emissions.

Table 3-4.2.12: Carbon Balance and CO_2 emissions from all arable lands in the Republic of Moldova for the period 1990-2020

Years	Area of cropland, ha	Crop yields, t	Crop yields, t d.m.	Carbon					CO_2	
				Carbon introduced in soil with organic fertilizers, t	Carbon introduced in soil with above- and below-ground residues, t	Carbon losses from soil due to humus mineralization, kt	Carbon balance		Emissions balance	
							t	t/ha	t	t/ha
1990	1,697,840	17,188,730	5,922,312	364,400	556,491	-387,994	532,896	0.31	-1,953,954	-1.15
1991	1,695,380	19,527,955	6,809,184	409,193	491,357	-393,501	507,049	0.30	-1,859,181	-1.10
1992	1,686,980	12,907,263	4,556,155	281,237	451,341	-323,214	409,365	0.24	-1,501,003	-0.89
1993	1,759,280	15,345,591	5,922,214	363,033	385,324	-1,029,396	-281,038	-0.16	1,030,474	0.59
1994	1,704,040	9,598,540	3,510,318	119,589	374,233	-618,759	-124,937	-0.07	458,103	0.27
1995	1,713,799	10,244,424	4,155,627	182,191	340,463	-955,137	-432,483	-0.25	1,585,770	0.93
1996	1,707,440	7,306,163	3,100,899	92,624	352,228	-823,666	-378,815	-0.22	1,388,988	0.81
1997	1,718,540	8,317,933	4,185,792	177,412	277,196	-1,268,896	-814,288	-0.47	2,985,723	1.74
1998	1,709,040	6,870,799	3,391,396	149,951	261,388	-1,035,567	-624,228	-0.37	2,288,836	1.34
1999	1,654,100	5,583,312	2,953,880	142,264	238,109	-957,900	-577,528	-0.35	2,117,602	1.28
2000	1,692,900	4,885,494	2,630,067	76,860	211,711	-911,844	-623,273	-0.37	2,285,335	1.35
2001	1,724,235	5,621,814	3,229,053	148,467	215,965	-1,045,975	-681,543	-0.40	2,498,992	1.45
2002	1,726,800	5,495,606	3,205,702	148,343	217,797	-1,101,542	-735,402	-0.43	2,696,473	1.56
2003	1,588,474	4,057,652	2,290,355	62,085	206,407	-861,884	-593,391	-0.37	2,175,766	1.37
2004	1,676,000	5,579,823	3,530,408	165,334	198,783	-1,257,895	-893,778	-0.53	3,277,187	1.96
2005	1,690,054	5,640,911	3,471,787	169,437	209,259	-1,219,995	-841,299	-0.50	3,084,764	1.83
2006	1,539,051	5,345,640	3,043,778	157,349	214,232	-1,067,180	-695,599	-0.45	2,550,530	1.66
2007	1,543,304	2,534,568	1,331,746	44,403	165,222	-363,866	-154,241	-0.10	565,552	0.37
2008	1,544,512	5,948,617	3,802,219	184,168	162,266	-1,291,250	-944,816	-0.61	3,464,325	2.24
2009	1,582,620	4,054,261	2,676,943	134,921	180,990	-907,886	-591,975	-0.37	2,170,573	1.37
2010	1,613,660	5,223,762	3,230,241	174,835	186,507	-1,101,171	-739,828	-0.46	2,712,703	1.68
2011	1,609,878	5,088,336	3,287,993	174,994	170,941	-1,143,870	-797,935	-0.50	2,925,761	1.82
2012	1,641,372	2,975,829	1,756,507	53,958	157,903	-518,441	-306,579	-0.19	1,124,123	0.68
2013	1,652,276	5,640,731	3,619,055	189,946	149,935	-1,202,605	-862,724	-0.52	3,163,321	1.91
2014	1,684,385	6,381,750	3,982,576	214,072	163,266	-1,222,952	-845,615	-0.50	3,100,587	1.84
2015	1,678,526	4,208,990	2,878,957	81,061	158,793	-998,217	-758,363	-0.45	2,780,664	1.66
2016	1,701,597	5,667,955	3,921,977	212,412	160,722	-1,365,248	-992,114	-0.58	3,637,750	2.14
2017	1,720,985	6,374,212	4,432,581	245,655	153,426	-1,533,316	-1,134,235	-0.66	4,158,861	2.42
2018	1,735,120	6,311,629	4,517,039	248,420	135,137	-1,534,405	-1,150,848	-0.66	4,219,775	2.43
2019	1,708,205	6,300,092	4,572,429	252,965	122,172	-1,492,194	-1,117,058	-0.65	4,095,878	2.40
2020	1,696,461	3,451,868	2,283,148	66,461	105,556	-561,070	-389,054	-0.23	1,426,530	0.84
1990-2020	**1,670,866**	**7,086,460**	**3,619,430**	**177,034**	**237,907**	**-983,769**	**-568,828**	**-0.34**	**2,085,704**	**1.25**
1990-2005	1,696,556	9,010,751	3,929,072	190,776	311,753	-887,073	-384,543	-0.23	1,156,995	0.77
2006-2020	**1,643,464**	**5,033,883**	**3,289,146**	**162,375**	**159,138**	**-1,086,911**	**-765,399**	**-0.46**	**2,806,462**	**1.70**

Annex 4. Quality Assurance and Quality Control

Annex 4.1. Quality Assurance and Quality Control Form for the National GHG Inventory of the Republic of Moldova (National Inventory Report: 1990-2020. Greenhouse Gas Sources and Sinks in the Republic of Moldova)

Document: National Inventory Report: 1990-2020. Greenhouse Gas Sources and Sinks in the Republic of Moldova

Stage of Report Preparation: final draft report

Highlight all categories subject to verification: tables and figures, equations, references, general editing, content editing

Surname and first name of expert: ____________________

Organization in which he/she operates and his/her function: ____________________

INSTRUCTIONS FOR COMPLETING THIS FORM:

This form is to be completed for each chapter and provides a record of the checks performed and any corrective actions taken.

The form should be completed electronically. Once completed, the form should be submitted to the National Inventory Team Leader on the electronic address: <marius.taranu@clima.md>, together with paper copies, signed and personally presented at the following address: 51A Alexandru cel Bun St, MD 2012, Chisinau, Republic of Moldova.

The first page of this form summarizes the results of control/verifications (once completed) and highlights any significant findings or actions to be undertaken on quality assurance of the National GHG Inventory. The expert takes personal responsibility for the process of inventory quality assurance and control at sectoral level (separate chapter of the National Inventory Report for 1990-2020). Checks/rows that are not relevant or not available should indicate 'n/r' or 'n/a' (not left blank or crossed out).

All information sources associated with the inventory compilation process for each sector require clear references in the respective column of the form (support documentation).

Document Verification Summary: National Inventory Report: 1990-2020. Greenhouse Gas Sources and Sinks in the Republic of Moldova	
Summary of results of checks and corrective actions taken:	
Suggested checks to be performed in the future:	Unsolved problems after corrective actions taken:

Quality Assurance and Quality Control Form: National Inventory Report: 1990-2020. Greenhouse Gas Sources and Sinks in the Republic of Moldova.
Chapter: ____________________

	Item	Completed Check			Acțiune de corecție		
		Date	Individual (first name, last name)	Errors (Y/N)	Date	Individual (first name, last name)	Individual (first name, last name))
TABLES AND FIGURES							
1	Check whether numbers in tables in the respective chapter match numbers in reporting tables (the reporting format provided by the 2006 IPCC Guidelines and/or the decisions of the COP)						
2	Check whether numbers in tables specific to source categories (see the respective subchapters of the Report) correspond to numbers in tables from 'Overview of the sector'						
3	Check whether numbers in the text are consistent with numbers in tables						
4	Check whether table formatting is consistent						
5	Check whether the information presented in figures is consistent with tables and the content						
6	Check whether table titles and numbers included are consistent with the content						
EQUATIONS – ALL EQUATIONS WILL CONTAIN THE FOLLOWING FEATURES							
7	Equation should be written in the text according to the following example: z = x + y						
8	For the multiplication sign – use the • symbol, not the letter x or * symbol						
9	Equation is to be centred						
10	After an equation, use: Where, and define the variables						
11	Defining variables is paragraphed with the following style 'Table No.: Text' (first word in bold)						
REFERENCES							

12	Check consistency of references used in multiple sections (e.g.: the 2006 IPCC Guidelines, not the IPCC Guidelines)						
13	Check whether text citations and references in the text correspond to the ones in the Bibliography						
14	Check that the style of references is consistent						
15	Web-addresses should not include hyperlinks, but need to be included in brackets < >						
GENERAL FORMAT							
16	All acronyms are spelled out the first time, not subsequent times throughout each chapter						
17	Check that all dashes are similar, use the symbol 'insert' to insert a dash (–)						
18	Check whether all fonts in text, headings, titles, and subheadings are consistent						
19	Check whether notes and comments are removed from document						
20	Check whether all references to annexes in the text are consistent with the corresponding number of annexes						
21	Check whether the name of all gases, such as CO2 and N2O use the letter 'O', not '0'						
22	All numbers in the GHG formulas are to be subscribed (e.g.: CO2, SF6, CH4, N2O, etc.)						
23	Notes under tables are to be written in a smaller font than the text						
24	Check whether the number of decimal points used in text and tables correspond						
25	Check whether the size, style and indenting of chapter and subchapter numbers are consistent						
26	Check whether spell check is complete						
27	Check whether the numbering of tables, figures, annexes, and references in the text is correct						
OTHER ASPECTS							
28	Other (specify):						

Annex 4.2. Category-Specific Tier 1 Quality Control Procedures

National Inventory Report: 1990-2020

Source Category: ______________________________

Surname and first name of expert: ______________________________

Organization in which he/she operates and his/her function: ______________________________

INSTRUCTIONS FOR COMPLETING THIS FORM:

This form is to be completed for each individual source category (according to the Tier 1 methodological approach), ensuring the control/verifications performed, as well as the corrective actions taken. The form is to be completed electronically. Once completed, the form should be submitted to the National Inventory Team Leader on the electronic address: <marius.taranu@clima.md>, together with paper copies, signed and personally presented at the following address: 51A Alexandru cel Bun St, MD 2012, Chisinau, Republic of Moldova.

The first page of this form summarizes the results of the control/verifications (once completed) and highlights any significant findings or actions to be undertaken on ensuring the high quality of the National GHG Inventory. The expert takes personal responsibility for the process of inventory quality assurance and control at individual source category level. Not all checks included in the forms will be applicable at source category level; checks/rows that are not relevant or not available should indicate 'n/r' or 'n/a' (not left blank or crossed out). All information sources associated with the inventory compilation process for each source category require clear references in the respective column of the form (support documentation).

Summary of Verifications, Quality Control and Corrective Actions	
Summary of results of checks and corrective actions taken:	
Suggested checks to be performed in the future:	Unsolved problems after corrective actions taken:

Verification and Quality Control Form for Individual Source Categories

Source Category: ____

	Quality Control Activities/Verifications and Quality Control Procedures	Check Completed			Corrective Action		Supporting documents (reference sources)
		Date	Individual (first name, last name)	Errors (Y/N)	Individual (first name, last name)	Date	
Data Gathering, Input, and Handling Checks							
1	Check whether assumptions and criteria for the selection of activity data and emission factors are documented: • cross-check descriptions of activity data and emission factors with information on categories and ensure that these are properly recorded and archived						
2	Check for transcription errors in data input and reference: • confirm that bibliographical data references are properly cited in the internal documentation • cross-check a sample of input data from each category (parameters used in calculations) for transcription errors • use electronic data where possible to minimize transcription errors • check that spreadsheet features are used to minimize user/entry error: - avoid hardwiring factors into formulas - create automatic look-up tables for common values used throughout calculations - use cell protection so fixed data cannot accidentally be changed - use cross-checks for calculations performed						
3	Check whether emissions/removals are calculated correctly: • reproduce a representative calculation sample of GHG emissions/ removals • Should calculation models be used, selectively simulate calculations to determine relative accuracy						
4	Check whether parameters and measurement units of emissions/removals units are correctly recorded and whether appropriate conversion factors are used: • check whether measurement units are properly labelled in calculation sheets • check whether measurement units are correctly used from beginning to end of calculations • check whether conversion factors are correctly used • check whether temporal and spatial adjustment factors are used correctly						
5	Check the integrity of database files and archive: • confirm that the appropriate data processing steps are correctly represented in the database • confirm that data relationships are correctly represented in the database • ensure whether data sets are properly labelled and have the correct design specifications • ensure whether adequate documentation of database and model structure and operation are archived						
6	Check the consistency of data used in more categories: • identify parameters (e.g., activity data, constants) that are common for multiple categories and confirm that there is consistency in the values used for these parameters in the emission/removal calculations						
7	Check whether the movement of inventory data among processing steps is correct: • check whether emission/removal data are correctly aggregated from lower reporting levels to higher reporting levels when preparing summaries at category and sectoral levels • check whether emission/removal data are correctly transcribed in different intermediate products						
	DATA DOCUMENTATION						
8	Review of internal documentation and archiving: • check whether there is detailed internal documentation to support the estimates and enable duplication of calculations • check that every primary data element has a reference for the source of the data (via cell comments or another system) • check whether inventory data, supporting data, and inventory records are archived and stored to facilitate detailed review • check whether the archive is closed and retained in secure place following completion of the inventory • check integrity of any data archiving arrangements of outside organizations involved in inventory preparation						
	CALCULATION CHECKS						

Verification and Quality Control Form for Individual Source Categories **Source Category:** ______							
Quality Control Activities/Verifications and Quality Control Procedures		**Check Completed**			**Corrective Action**		**Supporting documents (reference sources)**
		Date	**Individual (first name, last name)**	**Errors (Y/N)**	**Individual (first name, last name)**	**Date**	
9	Check methodological and data changes resulting in recalculations of emissions/removals: • check for temporal consistency in time series input data for each category • check for consistency in the algorithm/method used for calculations throughout the time series • reproduce a representative sample of emission calculations to ensure mathematical correctness						
10	Check time series consistency: • check for temporal consistency in time series input data for each category • check for consistency in the algorithm/method used for calculations throughout the time series • check methodological and data changes resulting in recalculations of emissions/removals • check whether the effects of mitigation activities have been appropriately reflected in time series calculations						
11	Check completeness: • confirm that estimates are reported for all categories and for all years from the base year to the latest year covered by the inventory • for subcategories, confirm that calculations cover the entire category • provide clear definition of 'Other' type categories • check that known data gaps that result in incomplete category emission/removal estimates are properly documented, including qualitative evaluation of the importance of the estimated value in connection with total net emissions (e.g., subcategories classified as 'not estimated')						
12	Trend checks: • for each category, compare current inventory estimates with previous estimates, if available. Should there be significant changes or deviations from expected trends, re-check estimates and explain differences. Significant changes in emissions or removals from previous years may indicate possible input or calculation errors. • check value of default emission factors (aggregated emissions/removals divided by activity data) across time series. Are changes in emissions or removals reflected in the evolution trends of these values? • check whether there are any unusual or inexplicable trends for activity data or other parameters used to estimate GHG emissions/removals						

Annex 4.3. Category-Specific Tier 2 Quality Control Procedures

National Inventory Report: 1990-2020

Source Category: ______

Surname and first name of expert: ______

Organization in which he/she operates and his/her function: ______

INSTRUCTIONS FOR COMPLETING THIS FORM:

This form is to be completed for each individual source category (according to the Tier 2 methodological approach), ensuring the control/verifications performed, as well as the corrective actions taken. The form is to be completed electronically. Once completed, the form should be submitted to the National Inventory Team Leader on the electronic address: <marius.taranu@clima.md>, together with paper copies, signed and personally presented at the following address: 51A Alexandru cel Bun St, MD 2012, Chisinau, Republic of Moldova.

The first page of this form summarizes the results of the control/verifications and highlights any significant findings or actions to be undertaken on ensuring the high quality of the National GHG Inventory. The expert takes personal responsibility for the process of inventory quality assurance and control at individual source category level. Not all checks included in the forms will be applicable at source category level; checks/rows that are not relevant or not available should indicate 'n/r' or 'n/a' (not be left blank or crossed out). All sources of information associated with the inventory compilation process for each source category require clear references in the respective column of the form (support documentation).

Summary of Verifications, Quality Control and Corrective Actions	
Summary of results of checks and corrective actions taken:	
Suggested checks to be performed in the future:	Unsolved problems after corrective actions taken:

Verification and Quality Control Form for Individual Source Categories **Source Category:** ______								
Quality Control Activities/Verifications and Quality Control Procedures		**Check Completed**			**Corrective Action**		**Supporting documents (reference sources)**
		Date	**Individual (first name, last name)**	**Errors (Y/N)**	**Individual (first name, last name)**	**Date**	
1	Assess the applicability of default factors: • assess whether national circumstances are similar to those used to develop the IPCC default factors • compare default factors with factors for specific site, enterprise, or location of emissions source • consider options for obtaining country-specific factors • document results of this assessment						
2	Review country-specific factors: • QC the data used to develop the country-specific factor • assess whether general QC activities (Level 1) were applied during the studies carried out to develop country-specific factors • compare country-specific factors with defaults factors, document any significant discrepancies • compare country-specific factors to site or plant-level factors • compare country-specific factors with factors from other countries (using the IPCC Emission Factor Database) • document results of this assessment						
3	Review measurements on site, enterprise, or location of the emission source: • determine whether national or international (e.g., ISO) standards were used in measurements • ensure measurement equipment is calibrated and maintained properly • compare direct measurements with estimates using a default factor; document any significant discrepancies						
4	Evaluate time series consistency: • review significant (>10%) changes in year-over-year estimates for categories and subcategories • compare top-down and bottom-up estimates for similar orders of magnitude • conduct reference calculations that use stoichiometric ratios and conservation of mass and energy						
5	Review national level activity data: • determine the level of QC performed by the data collection agency. If inadequate, consider alternative data sources such as IPCC defaults and international data sets. Adjust the relevant uncertainty accordingly • evaluate time series consistency • compare activity data from multiple references if possible						
6	Review site-specific activity data: • determine if national or international (e.g., ISO) standards were used in estimates • compare aggregated site-specific data (e.g., production) to national statistics/data • compare data across similar sites (national or international) • compare top-down and bottom-up estimates for similar orders of magnitude						
7	QC uncertainty estimates: • apply QC techniques to uncertainty estimates • review uncertainty calculations • document uncertainty assumptions and qualifications of any expert consulted						
8	Verify emission/removal estimates: • compare GHG emission/removal estimates to other national or international results at the national, sectoral, sub-sectoral, or GHG level as available						

Annex 5. Uncertainty of Greenhouse Gas Emissions

Annex 5-1. Overall Inventory Uncertainty in the Republic of Moldova for 2020

IPCC Category	Gas	Emissions / Removals in 1990	Emissions / Removals in 2020	Activity Data Uncertainty (1)	Emission Factor Uncertainty	Combined Uncertainty	Contribution to Variance by Category in 2020	Type A Sensitivity	Type B Sensitivity	Uncertainty in the Trend in GHG Emissions Introduced by the Emission Factor	Uncertainty in the Trend in GHG emissions Introduced by AD	Uncertainty Introduced into the Trend of Total Sectoral Emissions
		kt CO_2 equivalent	kt CO_2 equivalent	%	%	%		%	%	%	%	%
		Input Data	Input Data	Input Data	Input Data	$\sqrt{E^2+F^2}$	$\frac{(G \bullet D)^2}{(\sum D)^2}$		$\left\lvert \frac{D}{\sum C} \right\rvert$	I*F	J*E*sqrt(2)	K^2 + L^2
1A1 Energy Industries	CO_2	21 300.2929	3 634.3761	5	5	7.0711	3.5403	0.0694	0.0834	0.3470	0.5895	0.4679
1A1 Energy Industries	CH_4	12.2813	1.6353	5	50	50.2494	0.0000	0.0001	0.0000	0.0025	0.0003	0.0000
1A1 Energy Industries	N_2O	51.6671	1.9598	3	50	50.0899	0.0001	0.0003	0.0000	0.0163	0.0002	0.0003
1A2 Manufacturing Industries and Construction	CO_2	1 915.6706	801.4383	5	5	7.0711	0.1722	0.0046	0.0184	0.0231	0.1300	0.0174
1A2 Manufacturing Industries and Construction	CH_4	1.7449	0.7451	5	50	50.2494	0.0000	0.0000	0.0000	0.0002	0.0001	0.0000
1A2 Manufacturing Industries and Construction	N_2O	4.3486	1.4657	3	50	50.0899	0.0000	0.0000	0.0000	0.0001	0.0001	0.0000
1A3 Transport	CO_2	4 698.2416	2 462.2411	5	5	7.0711	1.6250	0.0227	0.0565	0.1135	0.3994	0.1724
1A3 Transport	CH_4	33.6681	10.8793	5	40	40.3113	0.0010	0.0000	0.0002	0.0003	0.0018	0.0000
1A3 Transport	N_2O	106.7291	38.7861	5	50	50.2494	0.0204	0.0001	0.0009	0.0061	0.0063	0.0001
1A4 Other Sectors	CO_2	7 372.2624	2 050.0916	5	5	7.0711	1.1265	0.0060	0.0470	0.0298	0.3326	0.1115
1A4 Other Sectors	CH_4	287.5113	213.3738	5	50	50.2494	0.6162	0.0028	0.0049	0.1414	0.0346	0.0212
1A4 Other Sectors	N_2O	181.5317	68.5953	3	50	50.0899	0.0633	0.0003	0.0016	0.0134	0.0067	0.0002
1A5 Other	CO_2	113.9722	22.3816	5	5	7.0711	0.0001	0.0003	0.0005	0.0015	0.0036	0.0000
1A5 Other	CH_4	0.2726	0.0059	5	50	50.2494	0.0000	0.0000	0.0000	0.0001	0.0000	0.0000
1A5 Other	N_2O	1.3253	0.1058	3	50	50.0899	0.0000	0.0000	0.0000	0.0004	0.0000	0.0000
1B2 Fugitive Emissions from Oil and Natural Gas	CO_2	0.6632	1.5797	25	25	35.3553	0.0000	0.0000	0.0000	0.0008	0.0013	0.0000
1B2 Fugitive Emissions from Oil and Natural Gas	CH_4	910.7440	240.2276	25	25	35.3553	0.3867	0.0010	0.0055	0.0259	0.1948	0.0386
1B2 Fugitive Emissions from Oil and Natural Gas	N_2O	0.0002	0.0027	25	25	35.3553	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
2A1 Cement Production	CO_2	971.6967	467.5178	2	3	3.6056	0.0152	0.0037	0.0107	0.0112	0.0303	0.0010
2A2 Lime Production	CO_2	264.3143	21.0641	10	2	10.1980	0.0002	0.0014	0.0005	0.0028	0.0068	0.0001
2A3 Glass Production	CO_2	27.4888	32.8367	15	10	18.0278	0.0019	0.0006	0.0008	0.0056	0.0160	0.0003
2A4 Other Processes Uses of Carbonates	CO_2	75.4601	15.4743	20	5	20.6155	0.0005	0.0002	0.0004	0.0009	0.0100	0.0001
2C1 Iron and steel production	CO_2	28.5023	18.6972	5	10	11.1803	0.0002	0.0002	0.0004	0.0022	0.0030	0.0000
2D1 Lubricant Use	CO_2	24.7987	5.0839	5	50	50.2494	0.0003	0.0001	0.0001	0.0031	0.0008	0.0000
2D2 Paraffin Wax Use	CO_2	0.1138	0.1198	20	100	101.9804	0.0000	0.0000	0.0000	0.0002	0.0001	0.0000
2D3 Solvent Use	CO_2	204.1460	186.8249	20	35	40.3113	0.3040	0.0028	0.0043	0.0986	0.1212	0.0244
2D4 Other (Urea-Based Catalysts)	CO_2	5.3005	3.3358	20	2	20.0998	0.0000	0.0000	0.0001	0.0001	0.0022	0.0000
2F1 Refrigeration and Air Conditioning	HFCs		153.0784	20	50	53.8516	0.3643	0.0035	0.0035	0.1756	0.0993	0.0407
2F2 Foam Blowing Agents	HFCs		89.2686	30	30	42.4264	0.0769	0.0020	0.0020	0.0614	0.0869	0.0113
2F3 Fire Protection	HFCs		2.9626	5	20	20.6155	0.0000	0.0001	0.0001	0.0014	0.0005	0.0000
2F4 Aerosols	HFCs		0.0072	5	5	7.0711	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
2G1 Electrical Equipment	SF_6		1.5790	5	20	20.6155	0.0000	0.0000	0.0000	0.0007	0.0003	0.0000
2G1 Electrical Equipment	PFC		0.0403	5	20	20.6155	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
2G3 N_2O from Product Uses	N_2O	0.0197		5	3	5.8310	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

IPCC Category	Gas	Emissions / Removals in 1990	Emissions / Removals in 2020	Activity Data Uncertainty (1)	Emission Factor Uncertainty	Combined Uncertainty	Contribution to Variance by Category in 2020	Type A Sensitivity	Type B Sensitivity	Uncertainty in the Trend in GHG Emissions Introduced by the Emission Factor	Uncertainty in the Trend in GHG emissions Introduced by AD	Uncertainty Introduced into the Trend of Total Sectoral Emissions
		kt CO_2 equivalent	kt CO_2 equivalent	%	%	%		%	%	%	%	%
2G4 Other Product Use	CO_2	3.4010	0.9412	5	50	50.2494	0.0000	0.0000	0.0000	0.0001	0.0002	0.0000
3A Enteric Fermentation	CH_4	2 189.4276	389.0391	10	20	22.3607	0.4057	0.0068	0.0089	0.1362	0.1262	0.0345
3B Manure Management	CH_4	495.0955	44.3673	10	30	31.6228	0.0106	0.0025	0.0010	0.0762	0.0144	0.0060
3Ba Direct N_2O Emissions from Manure Management	N_2O	489.8100	101.2293	30	100	104.4031	0.5988	0.0012	0.0023	0.1198	0.0985	0.0241
3Bb Indirect N_2O Emissions from Manure Management	N_2O	409.9043	65.1882	30	150	152.9706	0.5330	0.0015	0.0015	0.2176	0.0634	0.0514
3Da1 Synthetic N Fertilizers Application	N_2O	431.2911	351.9420	5	6	7.8102	0.0405	0.0050	0.0081	0.0298	0.0571	0.0041
3Da2 Organic N Applied as Fertilizer	N_2O	255.4218	48.4486	30	6	30.5941	0.0118	0.0007	0.0011	0.0043	0.0472	0.0022
3D13 Urine and Dung N Deposited on Pasture	N_2O	53.8411	31.5771	30	50	58.3095	0.0182	0.0003	0.0007	0.0169	0.0307	0.0012
3Da4 N in Crop Residue	N_2O	162.9604	35.5893	5	25	25.4951	0.0044	0.0004	0.0008	0.0089	0.0058	0.0001
3Da5 N Mineralization	N_2O	235.0498	231.8810	5	25	25.4951	0.1874	0.0036	0.0053	0.0907	0.0376	0.0096
3Db1 Atmospheric Deposition of NO_x and NH_4	N_2O	101.3066	49.3100	70	150	165.5295	0.3571	0.0004	0.0011	0.0605	0.1120	0.0162
3Db2 N Leaching/Runoff from Managed Soils	N_2O	252.0425	155.2480	75	150	167.7051	3.6338	0.0017	0.0036	0.2625	0.3778	0.2116
3H Urea application	CO_2	0.5820	42.6156	30	50	58.3095	0.0331	0.0010	0.0010	0.0487	0.0415	0.0041
4A1 Forest Land Remaining Forest Land	CO_2	-1 579.0396	-1 159.8803	15	5	15.8114	1.8029	0.0153	0.0266	0.0763	0.5644	0.3244
4A2 Land Converted to Forest Land	CO_2	-984.3932	-727.4426	15	5	15.8114	0.7092	0.0096	0.0167	0.0481	0.3540	0.1276
4A2 Land Converted to Forest Land (Non-CO_2 Emissions from Vegetation Fires)	CH_4	0.2072	0.7233	10	30	31.6228	0.0000	0.0000	0.0000	0.0005	0.0002	0.0000
4A2 Land Converted to Forest Land (Non-CO_2 Emissions from Vegetation Fires)	N_2O	0.1366	0.4769	10	30	31.6228	0.0000	0.0000	0.0000	0.0003	0.0002	0.0000
4B1 Cropland Remaining Cropland	CO_2	2 333.3383	1 558.0806	10	10	14.1421	2.6027	0.0190	0.0357	0.1896	0.5055	0.2915
4B1 Cropland Remaining Cropland (Non-CO_2 Emissions from Vegetation Fires)	CH_4	2.4461	0.0801	10	30	31.6228	0.0000	0.0000	0.0000	0.0005	0.0000	0.0000
4B1 Cropland Remaining Cropland (Non-CO_2 Emissions from Vegetation Fires)	N_2O	0.7559	0.0248	10	30	31.6228	0.0000	0.0000	0.0000	0.0001	0.0000	0.0000
4B2 Land Converted to Cropland	CO_2	45.7503	71.8214	10	10	14.1421	0.0055	0.0013	0.0016	0.0132	0.0233	0.0007
4C2 Land Converted to Grassland	CO_2	-1 205.6938	-223.1528	15	10	18.0278	0.0868	0.0035	0.0051	0.0355	0.1086	0.0131
4D2 Land Converted to Wetlands	CO_2	-555.3798	-82.8099	10	10	14.1421	0.0074	0.0021	0.0019	0.0209	0.0269	0.0012
4E2 Land Converted to Settlements	CO_2	84.7480	27.2098	10	10	14.1421	0.0008	0.0000	0.0006	0.0002	0.0088	0.0001
4E2 Land Converted to Settlements	N_2O	169.4814	167.5004	10	30	31.6228	0.1504	0.0026	0.0038	0.0787	0.0543	0.0092
4F2 Land Converted to Other Land	CO_2	152.3638	329.1445	10	10	14.1421	0.1161	0.0065	0.0076	0.0646	0.1068	0.0156
4H HWP	CO_2	-122.1804	34.6883	30	10	31.6228	0.0065	0.0017	0.0008	0.0167	0.0338	0.0014
5A Solid Waste Disposal	CH_4	1 105.9965	1 246.1821	30	40	50.0000	20.8121	0.0206	0.0286	0.8253	1.2129	2.1523
5B Biological Treatment of Solid Waste	CH_4	1.3597	1.4180	50	50	70.7107	0.0001	0.0000	0.0000	0.0011	0.0023	0.0000
5B Biological Treatment of Solid Waste	N_2O	0.9725	1.0142	50	50	70.7107	0.0000	0.0000	0.0000	0.0008	0.0016	0.0000
5C Incineration and Open Burning of Waste	CO_2	14.9667	13.7583	40	25	47.1699	0.0023	0.0002	0.0003	0.0052	0.0179	0.0003
5C Incineration and Open Burning of Waste	CH_4	7.6876	7.0563	40	50	64.0312	0.0011	0.0001	0.0002	0.0053	0.0092	0.0001
5C Incineration and Open Burning of Waste	N_2O	1.6078	1.4767	40	100	107.7033	0.0001	0.0000	0.0000	0.0022	0.0019	0.0000
5D Wastewater Treatment and Discharge	CH_4	352.9650	237.2010	40	40	56.5685	0.9652	0.0029	0.0054	0.1162	0.3078	0.1082
5D Wastewater Treatment and Discharge	N_2O	87.9499	58.4843	40	50	64.0312	0.0752	0.0007	0.0013	0.0355	0.0759	0.0070
END												
Total		**43 590.9487**	**13 658.2138**				**41.49**					**4.33**
Total Uncertainties						**Uncertainty in total inventory %:**	**6.44**				**Trend uncertainty %:**	**2.08**

Annex 5-2. Summary of Direct Greenhouse Gas Uncertainties

Annex 5-2.1. Carbon Dioxide Uncertainties

IPCC Category	Gas	Emissions / Removals in 1990	Emissions / Removals in 2020	Activity Data Uncertainty	Emission Factor Uncertainty	Combined Uncertainty	Contribution to Variance by Category in 2020	Type A Sensitivity	Type B Sensitivity	Uncertainty in the Trend in GHG Emissions Introduced by Emission Factor	Uncertainty in the Trend in GHG emissions Introduced by AD	Uncertainty Introduced into the Trend of Total Sectoral Emissions
		kt CO_2 equivalent	kt CO_2 equivalent	%	%	%		%	%	%	%	%
		Input Data	Input Data	Input Data	Input Data	$\sqrt{E^2+F^2}$	$\frac{(G \bullet D)^2}{(\sum D)^2}$		$\left\|\frac{D}{\sum C}\right\|$	I*F	J*E*sqrt(2)	K^2 + L^2
1A1 Energy Industries	CO_2	21 300.2929	3 634.3761	5	5	7.0711	7.1542	0.0616	0.1033	0.3080	0.7303	0.6282
1A2 Manufacturing Industries and Construction	CO_2	1 915.6706	801.4383	5	5	7.0711	0.3479	0.0079	0.0228	0.0395	0.1610	0.0275
1A3 Transport	CO_2	4 698.2416	2 462.2411	5	5	7.0711	3.2837	0.0335	0.0700	0.1674	0.4947	0.2728
1A4 Other Sectors	CO_2	7 372.2624	2 050.0916	5	5	7.0711	2.2764	0.0011	0.0583	0.0053	0.4119	0.1697
1A5 Other	CO_2	113.9722	22.3816	5	5	7.0711	0.0003	0.0002	0.0006	0.0012	0.0045	0.0000
1B2 Fugitive Emissions from Oil and Natural Gas	CO_2	0.6632	1.5797	25	25	35.3553	0.0000	0.0000	0.0000	0.0010	0.0016	0.0000
2A1 Cement Production	CO_2	971.6967	467.5178	2	3	3.6056	0.0308	0.0057	0.0133	0.0172	0.0376	0.0017
2A2 Lime Production	CO_2	264.3143	21.0641	10	2	10.1980	0.0005	0.0015	0.0006	0.0029	0.0085	0.0001
2A3 Glass Production	CO_2	27.4888	32.8367	15	10	18.0278	0.0038	0.0007	0.0009	0.0072	0.0198	0.0004
2A4 Other Processes Uses of Carbonates	CO_2	75.4601	15.4743	20	5	20.6155	0.0011	0.0001	0.0004	0.0007	0.0124	0.0002
2C1 Iron and Steel Production	CO_2	28.5023	18.6972	5	10	11.1803	0.0005	0.0003	0.0005	0.0031	0.0038	0.0000
2D1 Lubricant Use	CO_2	24.7987	5.0839	5	50	50.2494	0.0007	0.0000	0.0001	0.0024	0.0010	0.0000
2D2 Paraffin Wax Use	CO_2	0.1138	0.1198	20	100	101.9804	0.0000	0.0000	0.0000	0.0003	0.0001	0.0000
2D3 Solvent Use	CO_2	204.1460	186.8249	20	35	40.3113	0.6144	0.0037	0.0053	0.1304	0.1502	0.0395
2D4 Other (Urea-Based Catalysts)	CO_2	5.3005	3.3358	20	2	20.0998	0.0000	0.0001	0.0001	0.0001	0.0027	0.0000
2G4 Other Product Use	CO_2	3.4010	0.9412	5	50	50.2494	0.0000	0.0000	0.0000	0.0000	0.0002	0.0000
3H Urea Application	CO_2	0.5820	42.6156	30	50	58.3095	0.0669	0.0012	0.0012	0.0603	0.0514	0.0063
4A1 Forest Land Remaining Forest Land	CO_2	-1 579.0396	-1 159.8803	15	5	15.8114	3.6433	0.0207	0.0330	0.1036	0.6992	0.4996
4A2 Land Converted to Forest Land	CO_2	-984.3932	-727.4426	15	5	15.8114	1.4331	0.0130	0.0207	0.0652	0.4385	0.1965
4B1 Cropland Remaining Cropland	CO_2	2 333.3383	1 558.0806	10	10	14.1421	5.2595	0.0262	0.0443	0.2615	0.6261	0.4605
4B2 Land Converted to Cropland	CO_2	45.7503	71.8214	10	10	14.1421	0.0112	0.0017	0.0020	0.0169	0.0289	0.0011
4C2 Land Converted to Grassland	CO_2	-1 205.6938	-223.1528	15	10	18.0278	0.1753	0.0030	0.0063	0.0301	0.1345	0.0190
4D2 Land Converted to Wetlands	CO_2	-555.3798	-82.8099	10	10	14.1421	0.0149	0.0020	0.0024	0.0196	0.0333	0.0015
4E2 Land Converted to Settlements	CO_2	84.7480	27.2098	10	10	14.1421	0.0016	0.0001	0.0008	0.0012	0.0109	0.0001
4F2 Land Converted to Other Land	CO_2	152.3638	329.1445	10	10	14.1421	0.2347	0.0082	0.0094	0.0817	0.1323	0.0242
4H HWP	CO_2	-122.1804	34.6883	30	10	31.6228	0.0130	0.0019	0.0010	0.0193	0.0418	0.0021
5C Incineration and Open Burning of Waste	CO_2	14.9667	13.7583	40	25	47.1699	0.0046	0.0003	0.0004	0.0069	0.0221	0.0005
END												
Total		**35 191.3877**	**9 608.0373**				**24.57**					**2.35**
Total Uncertainties						**Uncertainty in total inventory %:**	**4.96**				**Trend uncertainty %:**	**1.53**

Annex 5-2.2 Methane Uncertainties

IPCC Category	Gas	Emissions / Removals in 1990	Emissions / Removals in 2020	Activity Data Uncertainty	Emission Factor Uncertainty	Combined Uncertainty	Contribution to Variance by Category in 2020	Type A Sensitivity	Type B Sensitivity	Uncertainty in the Trend in GHG Emissions Introduced by the Emission Factor	Uncertainty in the Trend in GHG emissions Introduced by AD	Uncertainty Introduced into the Trend of Total Sectoral Emissions
		kt CO_2 equivalent	kt CO_2 equivalent	%	%	%		%	%	%	%	%
		Input Data	Input Data	Input Data	Input Data	$\sqrt{E^2+F^2}$	$\frac{(G \bullet D)^2}{(\sum D)^2}$		$\left\lvert\frac{D}{\sum C}\right\rvert$	I*F	J*E*sqrt(2)	K^2 + L^2
1A1 Energy Industries	CH_4	12.2813	1.6353	5	50	50.2494	0.0012	0.0007	0.0003	0.0352	0.0021	0.0012
1A2 Manufacturing Industries and Construction	CH_4	1.7449	0.7451	5	50	50.2494	0.0002	0.0000	0.0001	0.0003	0.0010	0.0000
1A3 Transport	CH_4	33.6681	10.8793	5	40	40.3113	0.0336	0.0007	0.0020	0.0299	0.0142	0.0011
1A4 Other sectors	CH_4	287.5113	213.3738	5	50	50.2494	20.0762	0.0159	0.0395	0.7957	0.2793	0.7111
1A5 Other	CH_4	0.2726	0.0059	5	50	50.2494	0.0000	0.0000	0.0000	0.0011	0.0000	0.0000
1B2 Fugitive Emissions from Oil and Natural Gas	CH_4	910.7440	240.2276	25	25	35.3553	12.5978	0.0302	0.0445	0.7543	1.5724	3.0415
3A Enteric Fermentation	CH_4	2 189.4276	389.0391	10	20	22.3607	13.2158	0.1071	0.0720	2.1423	1.0186	5.6271
3B Manure Management	CH_4	495.0955	44.3673	10	30	31.6228	0.3438	0.0324	0.0082	0.9709	0.1162	0.9562
4A2 Land Converted to Forest Land	CH_4	0.2072	0.7233	10	30	31.6228	0.0001	0.0001	0.0001	0.0035	0.0019	0.0000
4B1 Cropland Remaining Cropland	CH_4	2.4461	0.0801	10	30	31.6228	0.0000	0.0002	0.0000	0.0056	0.0002	0.0000
5A Solid Waste Disposal	CH_4	1 105.9965	1 246.1821	30	40	50.0000	678.0184	0.1397	0.2307	5.5886	9.7884	127.0448
5B Biological Treatment of Solid Waste	CH_4	1.3597	1.4180	50	50	70.7107	0.0018	0.0002	0.0003	0.0076	0.0186	0.0004
5C Incineration and Open Burning of Waste	CH_4	7.6876	7.0563	40	50	64.0312	0.0357	0.0007	0.0013	0.0338	0.0739	0.0066
5D Wastewater Treatment and Discharge	CH_4	352.9650	237.2010	40	40	56.5685	31.4428	0.0150	0.0439	0.5982	2.4842	6.5290
END												
Total		**5 401.4074**	**2 392.9342**				**755.77**					**143.92**
Total Uncertainties						**Uncertainty in total inventory %:**	**27.49**				**Trend uncertainty %:**	**12.00**

Annex 5-2.3. Nitrous Oxide Uncertainties

IPCC Category	Gas	Emissions / Removals in 1990	Emissions / Removals in 2020	Activity Data Uncertainty	Emission Factor Uncertainty	Combined Uncertainty	Contribution to Variance by Category in 2020	Type A Sensitivity	Type B Sensitivity	Uncertainty in the Trend in GHG Emissions Introduced by the Emission Factor	Uncertainty in the Trend in GHG emissions Introduced by AD	Uncertainty Introduced into the Trend of Total Sectoral Emissions
		kt CO_2 equivalent	kt CO_2 equivalent	%	%	%		%	%	%	%	%
		Input Data	Input Data	Input Data	Input Data	$\sqrt{E^2+F^2}$	$\frac{(G \bullet D)^2}{(\sum D)^2}$		$\left\lvert\frac{D}{\sum C}\right\rvert$	I*F	J*E*sqrt(2)	K^2 + L^2
1A1 Energy Industries	N_2O	51.6671	1.9598	3	50	50.0899	0.0048	0.0075	0.0007	0.3726	0.0028	0.1388
1A2 Manufacturing Industries and Construction	N_2O	4.3486	1.4657	3	50	50.0899	0.0027	0.0002	0.0005	0.0097	0.0021	0.0001
1A3 Transport	N_2O	106.7291	38.7861	5	50	50.2494	1.9098	0.0038	0.0129	0.1904	0.0915	0.0446
1A4 Other Sectors	N_2O	181.5317	68.5953	3	50	50.0899	5.9356	0.0056	0.0229	0.2799	0.0971	0.0878
1A5 Other	N_2O	1.3253	0.1058	3	50	50.0899	0.0000	0.0002	0.0000	0.0086	0.0001	0.0001
1B2 Fugitive Emissions from Oil and Natural Gas	N_2O	0.0002	0.0027	25	25	35.3553	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
2G3 N_2O from Product Uses (Medical Applications)	N_2O	0.0197		5	3	5.8310	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
3Ba Direct N_2O Emissions from Manure Management	N_2O	489.8100	101.2293	30	100	104.4031	56.1581	0.0430	0.0338	4.3014	1.4325	20.5540
3Bb Indirect N_2O Emissions From Manure Management	N_2O	409.9043	65.1882	30	150	152.9706	49.9951	0.0425	0.0217	6.3766	0.9225	41.5117
3Da1 Inorganic N Fertilizers	N_2O	431.2911	351.9420	5	6	7.8102	3.7988	0.0496	0.1174	0.2979	0.8300	0.7777
3Da2 Organic N Fertilizers	N_2O	255.4218	48.4486	30	6	30.5941	1.1046	0.0239	0.0162	0.1434	0.6856	0.4906

3D13 Urine and Dung N Deposited on Pasture	N_2O	53.8411	31.5771	30	50	58.3095	1.7045	0.0021	0.0105	0.1042	0.4468	0.2105
3Da4 N in Crop Residue	N_2O	162.9604	35.5893	5	25	25.4951	0.4139	0.0137	0.0119	0.3422	0.0839	0.1242
3Da5 N Mineralization	N_2O	235.0498	231.8810	5	25	25.4951	17.5718	0.0404	0.0773	1.0108	0.5469	1.3208
3Db1 Atmospheric Deposition of NO_x and NH_4	N_2O	101.3066	49.3100	70	150	165.5295	33.4960	0.0006	0.0164	0.0828	1.6281	2.6577
3Db2 N Leaching/Runoff from Managed Soils	N_2O	252.0425	155.2480	75	150	167.7051	340.8144	0.0122	0.0518	1.8341	5.4922	33.5283
4A2 Land Converted to Forest Land	N_2O	0.1366	0.4769	10	30	31.6228	0.0001	0.0001	0.0002	0.0041	0.0022	0.0000
4B1 Cropland Remaining Cropland	N_2O	0.7559	0.0248	10	30	31.6228	0.0000	0.0001	0.0000	0.0033	0.0001	0.0000
4E2 Land Converted to Settlements	N_2O	169.4814	167.5004	10	30	31.6228	14.1060	0.0293	0.0559	0.8778	0.7901	1.3948
5B Biological Treatment of Solid Waste	N_2O	0.9725	1.0142	50	50	70.7107	0.0026	0.0002	0.0003	0.0093	0.0239	0.0007
5C Incineration and Open Burning of Waste	N_2O	1.6078	1.4767	40	100	107.7033	0.0127	0.0002	0.0005	0.0240	0.0279	0.0014
5D Wastewater Treatment and Discharge	N_2O	87.9499	58.4843	40	50	64.0312	7.0507	0.0057	0.0195	0.2853	1.1035	1.2990
END												
Total		**2 998.1536**	**1 410.3062**				**534.08**					**104.14**
Total Uncertainties						**Uncertainty in total inventory %:**	**23.11**				**Trend uncertainty %:**	**10.21**

Annex 5-3. GHG Emission Uncertainty at Sectoral Level

Annex 5-3.1. Overall Inventory Uncertainty for Sector 1 'Energy'

IPCC Category	Gas	Emissions / Removals in 1990	Emissions / Removals in 2020	Activity Data Uncertainty	Emission Factor Uncertainty	Combined Uncertainty	Contribution to Variance by Category in 2020	Type A Sensitivity	Type B Sensitivity	Uncertainty in the Trend in GHG Emissions Introduced by the Emission Factor	Uncertainty in the Trend in GHG emissions Introduced by AD	Uncertainty Introduced into the Trend of Total Sectoral Emissions
		kt CO_2 equivalent	kt CO_2 equivalent	%	%	%		%	%	%	%	%
		Input Data	Input Data	Input Data	Input Data	$\sqrt{E^2+F^2}$	$\frac{(G \bullet D)^2}{(\sum D)^2}$		$\left\lvert\frac{D}{\sum C}\right\rvert$	I*F	J*E*sqrt(2)	K^2 + L^2
1A1 Energy Industries	CO_2	21 300.2929	3 634.3761	5	5	7.0711	7.2416	0.0501	0.0982	0.2506	0.6947	0.5454
1A1 Energy Industries	CH_4	12.2813	1.6353	5	50	50.2494	0.0001	0.0000	0.0000	0.0021	0.0003	0.0000
1A1 Energy Industries	N_2O	51.6671	1.9598	3	50	50.0899	0.0001	0.0003	0.0001	0.0154	0.0002	0.0002
1A2 Manufacturing Industries and Construction	CO_2	1 915.6706	801.4383	5	5	7.0711	0.3521	0.0083	0.0217	0.0415	0.1532	0.0252
1A2 Manufacturing Industries and Construction	CH_4	1.7449	0.7451	5	50	50.2494	0.0000	0.0000	0.0000	0.0004	0.0001	0.0000
1A2 Manufacturing Industries and Construction	N_2O	4.3486	1.4657	3	50	50.0899	0.0001	0.0000	0.0000	0.0005	0.0002	0.0000
1A3 Transport	CO_2	4 698.2416	2 462.2411	5	5	7.0711	3.3238	0.0337	0.0666	0.1687	0.4706	0.2500
1A3 Transport	CH_4	33.6681	10.8793	5	40	40.3113	0.0021	0.0001	0.0003	0.0024	0.0021	0.0000
1A3 Transport	N_2O	106.7291	38.7861	5	50	50.2494	0.0417	0.0003	0.0010	0.0152	0.0074	0.0003
1A4 Other sectors	CO_2	7 372.2624	2 050.0916	5	5	7.0711	2.3042	0.0040	0.0554	0.0198	0.3919	0.1540
1A4 Other sectors	CH_4	287.5113	213.3738	5	50	50.2494	1.2605	0.0038	0.0058	0.1881	0.0408	0.0370
1A4 Other sectors	N_2O	181.5317	68.5953	3	50	50.0899	0.1294	0.0006	0.0019	0.0294	0.0079	0.0009
1A5 Other	CO_2	113.9722	22.3816	5	5	7.0711	0.0003	0.0002	0.0006	0.0010	0.0043	0.0000
1A5 Other	CH_4	0.2726	0.0059	5	50	50.2494	0.0000	0.0000	0.0000	0.0001	0.0000	0.0000
1A5 Other	N_2O	1.3253	0.1058	3	50	50.0899	0.0000	0.0000	0.0000	0.0003	0.0000	0.0000
1B2 Fugitive Emissions from Oil and Natural Gas	CO_2	0.6632	1.5797	25	25	35.3553	0.0000	0.0000	0.0000	0.0010	0.0015	0.0000
1B2 Fugitive Emissions from Oil and Natural Gas	CH_4	910.7440	240.2276	25	25	35.3553	0.7910	0.0001	0.0065	0.0035	0.2296	0.0527
1B2 Fugitive Emissions from Oil and Natural Gas	N_2O	0.0002	0.0027	25	25	35.3553	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
END												
Total		**36 992.9272**	**9 549.8909**				**15.4470**					**1.0657**
Total Uncertainties						**Uncertainty in total inventory %:**	**3.93**				**Trend uncertainty %:**	**1.03**

Annex 5-3.2. Overall Inventory Uncertainty for Sector 2 'Industrial Processes and Product Use'

IPCC Category	Gas	Emissions / Removals in 1990	Emissions/ Removals in 2020	Activity Data Uncertainty	Emission Factor Uncertainty	Combined Uncertainty	Contribution to Variance by Category in 2020	Type A Sensitivity	Type B Sensitivity	Uncertainty in the Trend in GHG Emissions Introduced by the Emission Factor	Uncertainty in the Trend in GHG emissions Introduced by AD	Uncertainty Introduced into the Trend of Total Sectoral Emissions
		kt CO_2 equivalent	kt CO_2 equivalent	%	%	%		%	%	%	%	%
		Input Data	Input Data	Input Data	Input Data	$\sqrt{E^2+F^2}$	$\frac{(G \bullet D)^2}{(\sum D)^2}$		$\left\|\frac{D}{\sum C}\right\|$	I*F	J*E*sqrt(2)	K^2 + L^2
2A1 Cement Production	CO_2	971.6967	467.5178	2	3	3.6056	2.8481	0.0849	0.2912	0.2547	0.8238	0.7435
2A2 Lime Production	CO_2	264.3143	21.0641	10	2	10.1980	0.0463	0.0892	0.0131	0.1784	0.1856	0.0663
2A3 Glass Production	CO_2	27.4888	32.8367	15	10	18.0278	0.3513	0.0098	0.0205	0.0980	0.4339	0.1979
2A4 Other Processes Uses of Carbonates	CO_2	75.4601	15.4743	20	5	20.6155	0.1020	0.0196	0.0096	0.0980	0.2727	0.0839
2C1 Iron and Steel Production	CO_2	28.5023	18.6972	5	10	11.1803	0.0438	0.0006	0.0116	0.0060	0.0824	0.0068
2D1 Lubricant Use	CO_2	24.7987	5.0839	5	50	50.2494	0.0654	0.0064	0.0032	0.3222	0.0224	0.1043
2D2 Paraffin Wax Use	CO_2	0.1138	0.1198	20	100	101.9804	0.0001	0.0000	0.0001	0.0031	0.0021	0.0000
2D3 Solvent Use	CO_2	204.1460	186.8249	20	35	40.3113	56.8510	0.0372	0.1164	1.3022	3.2918	12.5319
2D4 Other (Urea-Based Catalysts)	CO_2	5.3005	3.3358	20	2	20.0998	0.0045	0.0000	0.0021	0.0000	0.0588	0.0035
2F1 Refrigeration and Air Conditioning	HFCs		153.0784	20	50	53.8516	68.1147	0.0954	0.0954	4.7681	2.6972	30.0096
2F2 Foam Blowing Agents	HFCs		89.2686	30	30	42.4264	14.3776	0.0556	0.0556	1.6683	2.3594	8.3499
2F3 Fire Protection	HFCs		2.9626	5	20	20.6155	0.0037	0.0018	0.0018	0.0369	0.0131	0.0015
2F4 Aerosols	HFCs		0.0072	5	5	7.0711	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
2G1 Electrical Equipment	SF_6		1.5790	5	20	20.6155	0.0011	0.0010	0.0010	0.0197	0.0070	0.0004
2G1 Electrical Equipment	PFC		0.0403	5	20	20.6155	0.0000	0.0000	0.0000	0.0005	0.0002	0.0000
2G3 N_2O from Product Uses	N_2O	0.0197		5	3	5.8310	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
2G4 Other Product Use	CO_2	3.4010	0.9412	5	50	50.2494	0.0022	0.0007	0.0006	0.0366	0.0041	0.0014
END												
Total		**1 605.2421**	**998.8320**				**142.81**					**52.10**
Total Uncertainties						**Uncertainty in total inventory %:**	**11.95**				**Trend uncertainty %:**	**7.22**

Annex 5-3.3. Overall Inventory Uncertainty for Sector 3 'Agriculture'

IPCC Category	Gas	Emissions / Removals in 1990	Emissions / Removals in 2020	Activity Data Uncertainty	Emission Factor Uncertainty	Combined Uncertainty	Contribution to Variance by Category in 2020	Type A Sensitivity	Type B Sensitivity	Uncertainty in the Trend in GHG Emissions Introduced by the Emission Factor	Uncertainty in the Trend in GHG emissions Introduced by AD	Uncertainty Introduced into the Trend of Total Sectoral Emissions
		kt CO_2 equivalent	kt CO_2 equivalent	%	%	%		%	%	%	%	%
		Input Data	Input Data	Input Data	Input Data	$\sqrt{E^2+F^2}$	$\frac{(G \bullet D)^2}{(\sum D)^2}$		$\left\|\frac{D}{\sum C}\right\|$	I*F	J*E*sqrt(2)	K^2 + L^2
3A Enteric Fermentation	CH_4	2 189.4276	389.0391	10	20	22.3607	31.6441	0.0545	0.0766	1.0900	1.0837	2.3627
3B Manure Management	CH_4	495.0955	44.3673	10	30	31.6228	0.8231	0.0209	0.0087	0.6284	0.1236	0.4102
3Ba Direct N_2O Emissions from Manure Management	N_2O	489.8100	101.2293	30	100	104.4031	46.7063	0.0094	0.0199	0.9440	0.8460	1.6069
3Bb Indirect N_2O Emissions from Manure Management	N_2O	409.9043	65.1882	30	150	152.9706	41.5806	0.0117	0.0128	1.7617	0.5448	3.4005

3Da1 Inorganic N-Fertilizers	N_2O	431.2911	351.9420	5	6	7.8102	3.1594	0.0434	0.0693	0.2605	0.4902	0.3081
3Da2 Organic N-Fertilizers	N_2O	255.4218	48.4486	30	6	30.5941	0.9187	0.0058	0.0095	0.0347	0.4049	0.1651
3D13 Urine and Dung N Deposited on Pasture	N_2O	53.8411	31.5771	30	50	58.3095	1.4176	0.0030	0.0062	0.1495	0.2639	0.0920
3Da4 N in Crop Residue	N_2O	162.9604	35.5893	5	25	25.4951	0.3443	0.0028	0.0070	0.0692	0.0496	0.0072
3Da5 N Mineralization	N_2O	235.0498	231.8810	5	25	25.4951	14.6144	0.0316	0.0457	0.7889	0.3230	0.7267
3Db1 Atmospheric Deposition of NO_x and NH_4	N_2O	101.3066	49.3100	70	150	165.5295	27.8584	0.0036	0.0097	0.5450	0.9615	1.2216
3Db2 N Leaching/Runoff from Managed Soils	N_2O	252.0425	155.2480	75	150	167.7051	283.4530	0.0154	0.0306	2.3175	3.2435	15.8911
3H Urea Application	CO_2	0.5820	42.6156	30	50	58.3095	2.5820	0.0084	0.0084	0.4180	0.3561	0.3015
END												
Total		**5 076.7326**	**1 546.4355**				**455.10**					**26.49**
Total Uncertainties						**Uncertainty in total inventory %:**	**21.33**				**Trend uncertainty %:**	**5.15**

Annex 5-3.4. Overall Inventory Uncertainty for Sector 4 'LULUCF'

IPCC Category	Gas	Emissions / Removals in 1990	Emissions / Removals in 2020	Activity Data Uncertainty	Emission Factor Uncertainty	Combined Uncertainty	Contribution to Variance by Category in 2020	Type A Sensitivity	Type B Sensitivity	Uncertainty in the Trend in GHG Emissions Introduced by the Emission Factor	Uncertainty in the Trend in GHG emissions Introduced by AD	Uncertainty Introduced into the Trend of Total Sectoral Emissions
		kt CO_2 equivalent	kt CO_2 equivalent	%	%	%		%	%	%	%	%
		Input Data	Input Data	Input Data	Input Data	$\sqrt{E^2+F^2}$	$\frac{(G \bullet D)^2}{(\sum D)^2}$		$\left\|\frac{D}{\sum C}\right\|$	I*F	J*E*sqrt(2)	K^2 + L^2
4A1 Forest Land Remaining Forest Land	CO_2	-1 579.0396	-1 159.8803	15	5	15.8114	17.5072	0.0280	0.1603	0.1402	3.4004	11.5822
4A2 Land Converted to Forest Land	CO_2	-984.3932	-727.4426	15	5	15.8114	6.8863	0.0181	0.1005	0.0905	2.1326	4.5562
4A2 Land Converted to Forest Land	CH_4	0.2072	0.7233	10	30	31.6228	0.0000	0.0001	0.0001	0.0025	0.0014	0.0000
4A2 Land Converted to Forest Land	N_2O	0.1366	0.4769	10	30	31.6228	0.0000	0.0001	0.0001	0.0016	0.0009	0.0000
4B1 Cropland Remaining Cropland	CO_2	2 333.3383	1 558.0806	10	10	14.1421	25.2732	0.0199	0.2153	0.1993	3.0452	9.3128
4B1 Cropland Remaining Cropland	CH_4	2.4461	0.0801	10	30	31.6228	0.0000	0.0002	0.0000	0.0058	0.0002	0.0000
4B1 Cropland Remaining Cropland	N_2O	0.7559	0.0248	10	50	50.9902	0.0000	0.0001	0.0000	0.0030	0.0000	0.0000
4B2 Land Converted to Cropland	CO_2	45.7503	71.8214	10	10	14.1421	0.0537	0.0061	0.0099	0.0610	0.1404	0.0234
4C2 Land Converted to Grassland	CO_2	-1 205.6938	-223.1528	15	10	18.0278	0.8424	0.0700	0.0308	0.6997	0.6542	0.9176
4D2 Land Converted to Wetlands	CO_2	-555.3798	-82.8099	10	10	14.1421	0.0714	0.0350	0.0114	0.3502	0.1618	0.1488
4E2 Land Converted to Settlements	CO_2	84.7480	27.2098	10	10	14.1421	0.0077	0.0033	0.0038	0.0333	0.0532	0.0039
4E2 Land Converted to Settlements	N_2O	169.4814	167.5004	10	30	31.6228	1.4604	0.0090	0.0231	0.2688	0.3274	0.1794
4F2 Land Converted to Other Land	CO_2	152.3638	329.1445	10	10	14.1421	1.1279	0.0327	0.0455	0.3273	0.6433	0.5209
4H HWP	CO_2	-122.1804	34.6883	30	10	31.6228	0.0626	0.0054	0.0048	0.0543	0.2034	0.0443
END												
Total		**-1 657.4590**	**-3.5354**				**53.29**					**27.29**
Total Uncertainties						**Uncertainty in total inventory %:**	**7.30**				**Trend uncertainty %:**	**5.22**

Annex 5-3.5. Overall Inventory Uncertainty for Sector 5 'Waste'

IPCC Category	Gas	Emissions / Removals in 1990	Emissions / Removals in 2020	Activity Data Uncertainty	Emission Factor Uncertainty	Combined Uncertainty	Contribution to Variance by Category in 2020	Type A Sensitivity	Type B Sensitivity	Uncertainty in the Trend in GHG Emissions Introduced by the Emission Factor	Uncertainty in the Trend in GHG emissions Introduced by AD	Uncertainty Introduced into the Trend of Total Sectoral Emissions
		kt CO_2 equivalent	kt CO_2 equivalent	%	%	%		%	%	%	%	%
		Input Data	Input Data	Input Data	Input Data	$\sqrt{E^2+F^2}$	$\frac{(G \bullet D)^2}{(\sum D)^2}$		$\left\lvert\frac{D}{\sum C}\right\rvert$	I*F	J*E*sqrt(2)	K^2 + L^2
5A Solid Waste Disposal	CH_4	1 105.9965	1 246.1821	30	40	50.0000	1581.9468	0.0915	0.7920	3.6615	33.6008	1142.4191
5B Biological Treatment of Solid Waste	CH_4	1.3597	1.4180	50	50	70.7107	0.0041	0.0000	0.0009	0.0020	0.0637	0.0041
5B Biological Treatment of Solid Waste	N_2O	0.9725	1.0142	50	50	70.7107	0.0021	0.0000	0.0006	0.0015	0.0456	0.0021
5C Incineration and Open Burning of Waste	CO_2	14.9667	13.7583	40	25	47.1699	0.1716	0.0007	0.0087	0.0182	0.4946	0.2450
5C Incineration and Open Burning of Waste	CH_4	7.6876	7.0563	40	50	64.0312	0.0832	0.0004	0.0045	0.0190	0.2537	0.0647
5C Incineration and Open Burning of Waste	N_2O	1.6078	1.4767	40	100	107.7033	0.0103	0.0001	0.0009	0.0079	0.0531	0.0029
5D Wastewater Treatment and Discharge	CH_4	352.9650	237.2010	40	40	56.5685	73.3621	0.0724	0.1507	2.8969	8.5275	81.1108
5D Wastewater Treatment and Discharge	N_2O	87.9499	58.4843	40	50	64.0312	5.7141	0.0185	0.0372	0.9235	2.1025	5.2736
END												
Total		**1 573.5058**	**1 566.5908**				**1 661.29**					**1 229.12**
Total Uncertainties						**Total Uncertainties %:**	**40.76**				**Trend uncertainty %:**	**35.06**

Annex 6. Sectoral and Summary Reports on GHG Emissions in the Republic of Moldova within 1990-2020

Annex 6-1. Sectoral Report for Sector 1 'Energy' within 1990-2020

1990

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2	CH_4	N_2O	NO_x	CO	NMVOC	SO_2
	(kt)						
1. Total Energy	**35 401.1029**	**49.8489**	**1.1597**	**91.6413**	**270.6568**	**31.9022**	**148.7237**
A. Fuel combustion activities (sectoral approach)	**35 400.4397**	**13.4191**	**1.1597**	**91.6413**	**270.6568**	**31.2464**	**148.7237**
1. Energy industries	**21 300.2929**	**0.4913**	**0.1734**	**39.4664**	**7.2099**	**0.6297**	**102.3606**
a. Public electricity and heat production	21 300.2929	0.4913	0.1734	39.4664	7.2099	0.6297	102.3606
b. Petroleum refining	NO	NO	NO	NO	NO	NO	NO
c. Manufacture of solid fuels and other energy industries	NO	NO	NO	NO	NO	NO	NO
2. Manufacturing industries and construction	**1 915.6706**	**0.0698**	**0.0146**	**8.9397**	**3.4622**	**0.8735**	**2.6760**
a. Iron and steel	140.4257	0.0024	0.0005	0.1903	0.2114	0.0647	0.1441
b. Non-ferrous metals	NO	NO	NO	NO	NO	NO	NO
c. Chemicals	19.5198	0.0005	0.0001	0.0588	0.0122	0.0075	0.0039
d. Pulp, paper and print	NO	NO	NO	NO	NO	NO	NO
e. Food processing, beverages and tobacco	218.3465	0.0096	0.0026	1.0006	0.8491	0.1447	0.7228
f. Non-metallic minerals	1 409.4460	0.0469	0.0100	7.3715	1.8998	0.5416	1.4541
g. Transport equipment	NO	NO	NO	NO	NO	NO	NO
h. Machinery	80.2053	0.0031	0.0004	0.1458	0.1876	0.0422	0.1473
i. Mining and quarrying	8.6233	0.0005	0.0001	0.0501	0.0307	0.0046	0.0282
j. Wood and wood production	8.8101	0.0046	0.0006	0.0415	0.0892	0.0474	0.0036
k. Construction	10.0221	0.0003	0.0001	0.0463	0.0073	0.0036	0.0038
l. Textile and leather	20.2718	0.0019	0.0003	0.0348	0.1750	0.0174	0.1682
m. Other industries	NO	NO	NO	NO	NO	NO	NO
3. Transport	**4 698.2416**	**1.3467**	**0.3582**	**20.8774**	**70.8644**	**9.0718**	**0.7843**
a. Domestic aviation	72.3324	0.0005	0.0021	0.0001	0.0284	0.0004	0.0000
b. Road transportation	4 112.3462	1.3202	0.1997	14.0495	69.4192	8.4388	0.6806
c. Railways	403.4745	0.0226	0.1557	6.7071	1.3696	0.5952	0.1024
d. Domestic navigation	18.9103	0.0018	0.0005	0.0005	0.0000	0.0000	0.0001
e. Other transportation	91.1782	0.0016	0.0002	0.1203	0.0471	0.0374	0.0011
4. Other sectors	**7 372.2624**	**11.5005**	**0.6092**	**21.5980**	**188.2917**	**20.5488**	**42.5973**
a. Commercial/institutional	1 413.8434	0.2471	0.0204	2.8346	11.4100	1.2276	10.1050
b. Residential	4 410.0721	10.9567	0.0600	4.7280	166.3414	17.7118	31.5785
c. Agriculture/forestry/fishing	1 548.3469	0.2967	0.5288	14.0354	10.5404	1.6094	0.9137
ci. Stationary	160.5842	0.1930	0.0018	0.5222	0.6712	0.0894	0.5995
cii. Mobile	1 387.7627	0.1037	0.5269	13.5132	9.8692	1.5200	0.3142
5. Other	**113.9722**	**0.0109**	**0.0044**	**0.7597**	**0.8286**	**0.1226**	**0.3055**
a. Stationary	41.9609	0.0020	0.0007	0.0908	0.3458	0.0459	0.2890
b. Mobile	72.0113	0.0089	0.0037	0.6690	0.4828	0.0767	0.0165
B. Fugitive emissions from fuels	**0.6632**	**36.4298**	**0.0000**	**NO**	**NO**	**0.6558**	**NO**
1. Solid fuels	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**
a. Coal mining and handling	NO	NO	NO	NO	NO	NO	
b. Solid fuel transformation	NO	NO	NO	NO	NO	NO	NO
c. Other	NO	NO	NO	NO	NO	NO	NO
2. Oil and natural gas and other emissions from energy production	**0.6632**	**36.4298**	**0.0000**	**NO**	**NO**	**0.6558**	**NO**
a. Oil	0.1075	0.0000	0.0000	NO	NO	0.0000	NO
b. Natural gas	0.5557	36.4298				0.6558	NO
c. Venting and flaring	NO	NO	NO	NO	NO	NO	NO
d. Other	NO	NO	NO	NO	NO	NO	NO
C. CO_2 Transport and storage	**NO**						
1. Transport of CO_2	NO						
2. Injection and storage	NO						
3. Other	NO						
Memo items:							
International bunkers	**193.4599**	**0.0153**	**0.0063**	**0.7651**	**0.5859**	**0.2298**	**0.0613**
Aviation	193.4599	0.0153	0.0063	0.7651	0.5859	0.2298	0.0613
Navigation	NO	NO	NO	NO	NO	NO	NO
Multilateral operations	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**
CO_2 emissions from biomass	**232.8093**						
CO_2 captured	NO						
For domestic storage	NO						
For storage in other countries	NO						

1991

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2	CH_4	N_2O	NO_X	CO	NMVOC	SO_2
	(kt)						
1. Total Energy	**29 898.2495**	**44.1221**	**0.8637**	**74.8304**	**196.1625**	**23.1980**	**123.1468**
A. Fuel combustion activities (sectoral approach)	**29 897.6098**	**9.6597**	**0.8637**	**74.8304**	**196.1625**	**22.5794**	**123.1468**
1. Energy industries	**18 927.0336**	**0.4230**	**0.1562**	**35.0660**	**6.4107**	**0.5515**	**90.5225**
a. Public electricity and heat production	18 927.0336	0.4230	0.1562	35.0660	6.4107	0.5515	90.5225
b. Petroleum refining	NO	NO	NO	NO	NO	NO	NO
c. Manufacture of solid fuels and other energy industries	NO	NO	NO	NO	NO	NO	NO
2. Manufacturing industries and construction	**1 283.0799**	**0.0487**	**0.0095**	**6.4952**	**1.7418**	**0.5459**	**1.2222**
a. Iron and steel	NO	NO	NO	NO	NO	NO	NO
b. Non-ferrous metals	NO	NO	NO	NO	NO	NO	NO
c. Chemicals	NO	NO	NO	NO	NO	NO	NO
d. Pulp, paper and print	NO	NO	NO	NO	NO	NO	NO
e. Food processing, beverages and tobacco	178.3639	0.0078	0.0021	0.7971	0.7121	0.1198	0.6078
f. Non-metallic minerals	1 022.1104	0.0344	0.0065	5.4552	0.8022	0.3525	0.4871
g. Transport equipment	NO	NO	NO	NO	NO	NO	NO
h. Machinery	65.7107	0.0024	0.0004	0.1556	0.1470	0.0315	0.1198
i. Mining and quarrying	NO	NO	NO	NO	NO	NO	NO
j. Wood and wood production	7.4013	0.0038	0.0005	0.0377	0.0734	0.0388	0.0033
k. Construction	9.4936	0.0003	0.0001	0.0495	0.0072	0.0033	0.0043
l. Textile and leather	NO	NO	NO	NO	NO	NO	NO
m. Other industries	NO	NO	NO	NO	NO	NO	NO
3. Transport	**3 656.1040**	**1.0343**	**0.2931**	**16.6517**	**53.9238**	**6.9484**	**0.6152**
a. Domestic aviation	54.7486	0.0004	0.0016	0.0001	0.0215	0.0003	0.0000
b. Road transportation	3 168.4585	1.0125	0.1538	10.8163	52.6919	6.4080	0.5267
c. Railways	356.6274	0.0200	0.1376	5.7352	1.1711	0.5089	0.0876
d. Domestic navigation	0.2877	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
e. Other transportation	75.9818	0.0014	0.0001	0.1002	0.0393	0.0312	0.0009
4. Other sectors	**5 925.0237**	**8.1465**	**0.4014**	**15.9595**	**133.4692**	**14.4481**	**30.5092**
a. Commercial/institutional	1 001.8165	0.1805	0.0145	1.9330	8.1628	0.8850	7.2071
b. Residential	3 871.5122	7.7492	0.0474	3.8795	116.6588	12.3838	22.5925
c. Agriculture/forestry/fishing	1 051.6950	0.2167	0.3395	10.1470	8.6476	1.1793	0.7096
ci. Stationary	158.5106	0.1454	0.0016	0.5499	0.5381	0.0765	0.4858
cii. Mobile	893.1844	0.0713	0.3378	9.5970	8.1096	1.1028	0.2239
5. Other	**106.3685**	**0.0072**	**0.0034**	**0.6579**	**0.6170**	**0.0855**	**0.2778**
a. Stationary	51.5108	0.0011	0.0006	0.1355	0.2916	0.0316	0.2649
b. Mobile	54.8577	0.0061	0.0028	0.5224	0.3255	0.0539	0.0128
B. Fugitive emissions from fuels	**0.6397**	**34.4624**	**0.0000**	**NO**	**NO**	**0.6186**	**NO**
1. Solid fuels	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**
a. Coal mining and handling	NO	NO	NO	NO	NO	NO	
b. Solid fuel transformation	NO	NO	NO	NO	NO	NO	NO
c. Other	NO	NO	NO	NO	NO	NO	NO
2. Oil and natural gas and other emissions from energy production	**0.6397**	**34.4624**	**0.0000**	**NO**	**NO**	**0.6186**	**NO**
a. Oil	0.0942	0.0000	0.0000	NO	NO	0.0000	NO
b. Natural gas	0.5455	34.4624				0.6186	NO
c. Venting and flaring	NO	NO	NO	NO	NO	NO	NO
d. Other	NO	NO	NO	NO	NO	NO	NO
C. CO_2 Transport and storage	**NO**						
1. Transport of CO_2	NO						
2. Injection and storage	NO						
3. Other	NO						
Memo items:							
International bunkers	**147.3846**	**0.0117**	**0.0048**	**0.5829**	**0.4464**	**0.2298**	**0.0467**
Aviation	147.3846	0.0117	0.0048	0.5829	0.4464	0.2298	0.0467
Navigation	NO	NO	NO	NO	NO	NO	NO
Multilateral operations	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**
CO_2 emissions from biomass	**201.2009**						
CO_2 captured	NO						
For domestic storage	NO						
For storage in other countries	NO						

1992

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2	CH_4	N_2O	NO_X	CO	NMVOC	SO_2
	(kt)						
1. Total Energy	**23 310.7327**	**37.1762**	**0.6030**	**56.4998**	**124.6003**	**15.0948**	**91.1666**
A. Fuel combustion activities (sectoral approach)	**23 310.1924**	**6.0510**	**0.6030**	**56.4998**	**124.6003**	**14.5354**	**91.1666**
1. Energy industries	**15 660.9863**	**0.3579**	**0.1219**	**28.7536**	**5.5760**	**0.4762**	**71.2477**
a. Public electricity and heat production	15 660.9863	0.3579	0.1219	28.7536	5.5760	0.4762	71.2477
b. Petroleum refining	NO	NO	NO	NO	NO	NO	NO
c. Manufacture of solid fuels and other energy industries	NO	NO	NO	NO	NO	NO	NO
2. Manufacturing industries and construction	**932.0767**	**0.0351**	**0.0069**	**4.5687**	**1.3199**	**0.4056**	**0.9295**
a. Iron and steel	NO	NO	NO	NO	NO	NO	NO

b. Non-ferrous metals	NO	NO	NO	NO	NO	NO	NO
c. Chemicals	NO	NO	NO	NO	NO	NO	NO
d. Pulp, paper and print	NO	NO	NO	NO	NO	NO	NO
e. Food processing, beverages and tobacco	138.3812	0.0060	0.0017	0.5936	0.5750	0.0948	0.4927
f. Non-metallic minerals	727.5218	0.0238	0.0044	3.7221	0.5686	0.2540	0.3366
g. Transport equipment	NO	NO	NO	NO	NO	NO	NO
h. Machinery	51.2162	0.0020	0.0003	0.1662	0.1115	0.0235	0.0924
i. Mining and quarrying	NO	NO	NO	NO	NO	NO	NO
j. Wood and wood production	5.9925	0.0030	0.0004	0.0340	0.0575	0.0302	0.0031
k. Construction	8.9651	0.0003	0.0001	0.0527	0.0072	0.0030	0.0047
l. Textile and leather	NO	NO	NO	NO	NO	NO	NO
m. Other industries	NO	NO	NO	NO	NO	NO	NO
3. Transport	**2 615.2237**	**0.7228**	**0.2234**	**12.5061**	**37.2521**	**4.8651**	**0.4462**
a. Domestic aviation	37.1649	0.0003	0.0011	0.0000	0.0146	0.0002	0.0000
b. Road transportation	2 224.5569	0.7049	0.1079	7.6675	36.2354	4.4188	0.3728
c. Railways	296.2694	0.0166	0.1143	4.7633	0.9727	0.4227	0.0727
d. Domestic navigation	0.2461	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
e. Other transportation	56.9864	0.0010	0.0001	0.0752	0.0295	0.0234	0.0007
4. Other sectors	**4 024.1583**	**4.9306**	**0.2486**	**10.1939**	**80.1095**	**8.7371**	**18.3826**
a. Commercial/institutional	663.3266	0.1233	0.0093	1.2969	5.1389	0.5724	4.5184
b. Residential	2 702.0817	4.6722	0.0309	2.6187	69.7443	7.4391	13.4124
c. Agriculture/forestry/fishing	658.7500	0.1350	0.2084	6.2784	5.2263	0.7256	0.4518
ci. Stationary	111.0452	0.0917	0.0011	0.3902	0.3480	0.0514	0.3144
cii. Mobile	547.7048	0.0433	0.2073	5.8882	4.8783	0.6743	0.1373
5. Other	**77.7474**	**0.0046**	**0.0023**	**0.4776**	**0.3429**	**0.0514**	**0.1606**
a. Stationary	42.5895	0.0012	0.0004	0.1334	0.1655	0.0202	0.1522
b. Mobile	35.1579	0.0034	0.0018	0.3442	0.1774	0.0313	0.0084
B. Fugitive emissions from fuels	**0.5403**	**31.1252**	**0.0000**	**NO**	**NO**	**0.5594**	**NO**
1. Solid fuels	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**
a. Coal mining and handling	NO	NO	NO	NO	NO	NO	
b. Solid fuel transformation	NO	NO	NO	NO	NO	NO	NO
c. Other	NO	NO	NO	NO	NO	NO	NO
2. Oil and natural gas and other emissions from energy production	**0.5403**	**31.1252**	**0.0000**	**NO**	**NO**	**0.5594**	**NO**
a. Oil	0.0555	0.0000	0.0000	NO	NO	0.0000	NO
b. Natural gas	0.4848	31.1252				0.5594	NO
c. Venting and flaring	NO	NO	NO	NO	NO	NO	NO
d. Other	NO	NO	NO	NO	NO	NO	NO
C. CO_2 Transport and storage	**NO**						
1. Transport of CO_2	NO						
2. Injection and storage	NO						
3. Other	NO						
Memo items:							
International bunkers	**108.5369**	**0.0086**	**0.0036**	**0.4293**	**0.3287**	**0.2298**	**0.0344**
Aviation	108.5369	0.0086	0.0036	0.4293	0.3287	0.2298	0.0344
Navigation	NO	NO	NO	NO	NO	NO	NO
Multilateral operations	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**
CO_2 emissions from biomass	**169.5924**						
CO_2 captured	NO						
For domestic storage	NO						
For storage in other countries	NO						

1993

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2	CH_4	N_2O	NO_X	CO	NMVOC	SO_2
	(kt)						
1. Total Energy	**17 340.7506**	**30.5682**	**0.5000**	**44.6713**	**61.0487**	**8.2416**	**71.7032**
A. Fuel combustion activities (sectoral approach)	**17 340.2918**	**2.5952**	**0.5000**	**44.6713**	**61.0487**	**7.7383**	**71.7032**
1. Energy industries	**12 640.6006**	**0.2823**	**0.1058**	**23.6435**	**4.2355**	**0.3687**	**62.2743**
a. Public electricity and heat production	12 640.6006	0.2823	0.1058	23.6435	4.2355	0.3687	62.2743
b. Petroleum refining	NO	NO	NO	NO	NO	NO	NO
c. Manufacture of solid fuels and other energy industries	NO	NO	NO	NO	NO	NO	NO
2. Manufacturing industries and construction	**617.5604**	**0.0229**	**0.0045**	**2.8651**	**0.9464**	**0.2784**	**0.6753**
a. Iron and steel	0.9630	0.0000	0.0000	0.0016	0.0084	0.0008	0.0081
b. Non-ferrous metals	NO	NO	NO	NO	NO	NO	NO
c. Chemicals	NO	NO	NO	NO	NO	NO	NO
d. Pulp, paper and print	NO	NO	NO	NO	NO	NO	NO
e. Food processing, beverages and tobacco	99.0801	0.0042	0.0012	0.3937	0.4412	0.0703	0.3803
f. Non-metallic minerals	432.9331	0.0133	0.0024	1.9891	0.3351	0.1554	0.1862
g. Transport equipment	NO	NO	NO	NO	NO	NO	NO
h. Machinery	37.1299	0.0016	0.0003	0.1799	0.0764	0.0157	0.0652
i. Mining and quarrying	NO	NO	NO	NO	NO	NO	NO
j. Wood and wood production	4.5837	0.0022	0.0003	0.0302	0.0417	0.0217	0.0028
k. Construction	10.0674	0.0004	0.0001	0.0657	0.0112	0.0034	0.0087
l. Textile and leather	0.5898	0.0001	0.0000	0.0010	0.0056	0.0005	0.0054

m. Other industries	32.2134	0.0012	0.0002	0.2040	0.0269	0.0106	0.0185
3. Transport	**1 854.7578**	**0.4928**	**0.1808**	**9.9160**	**24.6271**	**3.3175**	**0.3241**
a. Domestic aviation	19.5811	0.0001	0.0006	0.0000	0.0077	0.0001	0.0000
b. Road transportation	1 538.5798	0.4769	0.0744	5.3306	23.6776	2.9040	0.2543
c. Railways	274.0715	0.0153	0.1058	4.5560	0.9303	0.4043	0.0696
d. Domestic navigation	0.2841	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
e. Other transportation	22.2414	0.0004	0.0000	0.0293	0.0115	0.0091	0.0003
4. Other sectors	**2 133.9212**	**1.7913**	**0.2065**	**7.7876**	**30.6143**	**3.6883**	**8.0858**
a. Commercial/institutional	589.8426	0.0968	0.0081	1.2145	4.4553	0.4890	3.9426
b. Residential	979.3320	1.5728	0.0109	1.0172	23.0558	2.5808	3.7608
c. Agriculture/forestry/fishing	564.7466	0.1217	0.1875	5.5560	3.1032	0.6185	0.3824
ci. Stationary	76.7498	0.0890	0.0009	0.2572	0.3046	0.0481	0.2594
cii. Mobile	487.9968	0.0327	0.1865	5.2988	2.7986	0.5704	0.1230
5. Other	**93.4518**	**0.0058**	**0.0024**	**0.4591**	**0.6253**	**0.0853**	**0.3437**
a. Stationary	62.1343	0.0021	0.0008	0.1586	0.3875	0.0485	0.3369
b. Mobile	31.3175	0.0038	0.0016	0.3005	0.2378	0.0369	0.0068
B. Fugitive emissions from fuels	**0.4587**	**27.9730**	**0.0000**	**NO**	**NO**	**0.5033**	**NO**
1. Solid fuels	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**
a. Coal mining and handling	NO	NO	NO	NO	NO	NO	
b. Solid fuel transformation	NO	NO	NO	NO	NO	NO	NO
c. Other	NO	NO	NO	NO	NO	NO	NO
2. Oil and natural gas and other emissions from energy production	**0.4587**	**27.9730**	**0.0000**	**NO**	**NO**	**0.5033**	**NO**
a. Oil	0.0294	0.0000	0.0000	NO	NO	0.0000	NO
b. Natural gas	0.4294	27.9730				0.5033	NO
c. Venting and flaring	NO	NO	NO	NO	NO	NO	NO
d. Other	NO	NO	NO	NO	NO	NO	NO
C. CO_2 Transport and storage	**NO**						
1. Transport of CO_2	NO						
2. Injection and storage	NO						
3. Other	NO						
Memo items:							
International bunkers	**55.2342**	**0.0044**	**0.0018**	**0.2184**	**0.1673**	**0.2298**	**0.0175**
Aviation	55.2342	0.0044	0.0018	0.2184	0.1673	0.2298	0.0175
Navigation	NO	NO	NO	NO	NO	NO	NO
Multilateral operations	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**
CO_2 emissions from biomass	**143.2360**						
CO_2 captured	NO						
For domestic storage	NO						
For storage in other countries	NO						

1994

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2	CH_4	N_2O	NO_X	CO	NMVOC	SO_2
	(kt)						
1. Total Energy	**14 491.6621**	**30.0466**	**0.4536**	**35.0613**	**68.5397**	**8.8760**	**56.8740**
A. Fuel combustion activities (sectoral approach)	**14 491.2336**	**3.0879**	**0.4536**	**35.0613**	**68.5397**	**8.3910**	**56.8740**
1. Energy industries	**9 961.8515**	**0.1888**	**0.0872**	**18.8108**	**3.5570**	**0.2847**	**47.1207**
a. Public electricity and heat production	9 961.8515	0.1888	0.0872	18.8108	3.5570	0.2847	47.1207
b. Petroleum refining	NO	NO	NO	NO	NO	NO	NO
c. Manufacture of solid fuels and other energy industries	NO	NO	NO	NO	NO	NO	NO
2. Manufacturing industries and construction	**737.3282**	**0.0147**	**0.0023**	**1.2545**	**0.7747**	**0.3253**	**0.4083**
a. Iron and steel	NO	NO	NO	NO	NO	NO	NO
b. Non-ferrous metals	NO	NO	NO	NO	NO	NO	NO
c. Chemicals	NO	NO	NO	NO	NO	NO	NO
d. Pulp, paper and print	NO	NO	NO	NO	NO	NO	NO
e. Food processing, beverages and tobacco	66.6336	0.0014	0.0008	0.2339	0.3778	0.0427	0.3590
f. Non-metallic minerals	138.3445	0.0027	0.0004	0.2560	0.1016	0.0569	0.0358
g. Transport equipment	NO	NO	NO	NO	NO	NO	NO
h. Machinery	10.1211	0.0003	0.0001	0.0495	0.0075	0.0036	0.0042
i. Mining and quarrying	NO	NO	NO	NO	NO	NO	NO
j. Wood and wood production	0.0000	0.0009	0.0001	0.0026	0.0165	0.0087	0.0003
k. Construction	6.1935	0.0002	0.0000	0.0324	0.0047	0.0021	0.0028
l. Textile and leather	NO	NO	NO	NO	NO	NO	NO
m. Other industries	NO	NO	NO	NO	NO	NO	NO
3. Transport	**1 612.9419**	**0.4373**	**0.1096**	**6.0604**	**22.3481**	**2.8670**	**0.2180**
a. Domestic aviation	19.7669	0.0001	0.0006	0.0000	0.0078	0.0001	0.0000
b. Road transportation	1 380.0873	0.4292	0.0668	4.1136	21.9171	2.6637	0.1891
c. Railways	108.8607	0.0061	0.0420	1.8096	0.3695	0.1606	0.0276
d. Domestic navigation	0.2218	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
e. Other transportation	104.0053	0.0019	0.0002	0.1372	0.0538	0.0426	0.0012
4. Other sectors	**2 090.7472**	**2.4402**	**0.2529**	**8.6031**	**41.2528**	**4.8276**	**8.8679**
a. Commercial/institutional	386.9544	0.0757	0.0058	0.7644	3.2117	0.3524	2.8277
b. Residential	1 062.6784	2.2578	0.0145	1.1542	33.6023	3.7128	5.7460
c. Agriculture/forestry/fishing	641.1144	0.1067	0.2326	6.6845	4.4387	0.7624	0.2942

ci. Stationary	32.3295	0.0637	0.0006	0.0911	0.1888	0.0360	0.1407
cii. Mobile	608.7849	0.0430	0.2321	6.5934	4.2499	0.7264	0.1535
5. Other	**88.3648**	**0.0069**	**0.0016**	**0.3325**	**0.6071**	**0.0863**	**0.2592**
a. Stationary	71.3256	0.0026	0.0008	0.1867	0.3052	0.0469	0.2561
b. Mobile	17.0392	0.0042	0.0008	0.1458	0.3020	0.0394	0.0031
B. Fugitive emissions from fuels	**0.4285**	**26.9587**	**0.0000**	**NO**	**NO**	**0.4850**	**NO**
1. Solid fuels	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**
a. Coal mining and handling	NO	NO	NO	NO	NO	NO	
b. Solid fuel transformation	NO	NO	NO	NO	NO	NO	NO
c. Other	NO	NO	NO	NO	NO	NO	NO
2. Oil and natural gas and other emissions from energy production	**0.4285**	**26.9587**	**0.0000**	**NO**	**NO**	**0.4850**	**NO**
a. Oil	0.0140	0.0000	0.0000	NO	NO	0.0000	NO
b. Natural gas	0.4145	26.9587				0.4850	NO
c. Venting and flaring	NO	NO	NO	NO	NO	NO	NO
d. Other	NO	NO	NO	NO	NO	NO	NO
C. CO_2 Transport and storage	**NO**						
1. Transport of CO_2	NO						
2. Injection and storage	NO						
3. Other	NO						
Memo items:							
International bunkers	**30.8414**	**0.0024**	**0.0010**	**0.1220**	**0.0934**	**0.2298**	**0.0098**
Aviation	30.8414	0.0024	0.0010	0.1220	0.0934	0.2298	0.0098
Navigation	NO	NO	NO	NO	NO	NO	NO
Multilateral operations	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**
CO_2 emissions from biomass	**157.4600**						
CO_2 captured	NO						
For domestic storage	NO						
For storage in other countries	NO						

1995

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2	CH_4	N_2O	NO_X	CO	NMVOC	SO_2
	(kt)						
1. Total Energy	**11 476.3176**	**31.4701**	**0.4305**	**29.4895**	**58.2503**	**7.3134**	**31.3056**
A. Fuel combustion activities (sectoral approach)	**11 475.8783**	**1.9344**	**0.4305**	**29.4895**	**58.2503**	**6.7793**	**31.3056**
1. Energy industries	**7 174.0286**	**0.1370**	**0.0502**	**12.9854**	**3.1484**	**0.2369**	**25.5949**
a. Public electricity and heat production	7 174.0286	0.1370	0.0502	12.9854	3.1484	0.2369	25.5949
b. Petroleum refining	NO	NO	NO	NO	NO	NO	NO
c. Manufacture of solid fuels and other energy industries	NO	NO	NO	NO	NO	NO	NO
2. Manufacturing industries and construction	**386.3466**	**0.0080**	**0.0015**	**0.6898**	**0.5732**	**0.1809**	**0.3808**
a. Iron and steel	37.3285	0.0007	0.0001	0.0492	0.0193	0.0153	0.0004
b. Non-ferrous metals	NO	NO	NO	NO	NO	NO	NO
c. Chemicals	0.1362	0.0000	0.0000	0.0002	0.0001	0.0001	0.0000
d. Pulp, paper and print	3.6784	0.0001	0.0000	0.0049	0.0019	0.0015	0.0000
e. Food processing, beverages and tobacco	98.4890	0.0027	0.0009	0.2607	0.3959	0.0624	0.3459
f. Non-metallic minerals	159.9009	0.0029	0.0004	0.2361	0.1096	0.0665	0.0307
g. Transport equipment	NO	NO	NO	NO	NO	NO	NO
h. Machinery	31.1666	0.0006	0.0001	0.0411	0.0161	0.0128	0.0004
i. Mining and quarrying	NO	NO	NO	NO	NO	NO	NO
j. Wood and wood production	1.9073	0.0000	0.0000	0.0025	0.0010	0.0008	0.0000
k. Construction	13.9589	0.0003	0.0001	0.0427	0.0087	0.0053	0.0029
l. Textile and leather	20.1628	0.0004	0.0000	0.0266	0.0104	0.0083	0.0002
m. Other industries	19.6179	0.0003	0.0000	0.0259	0.0101	0.0080	0.0002
3. Transport	**1 617.6947**	**0.4447**	**0.1058**	**6.1549**	**23.3801**	**2.9715**	**0.2340**
a. Domestic aviation	19.9155	0.0001	0.0006	0.0000	0.0078	0.0001	0.0000
b. Road transportation	1 401.7612	0.4374	0.0680	4.4280	22.9950	2.7889	0.2084
c. Railways	95.9593	0.0054	0.0370	1.5952	0.3257	0.1416	0.0244
d. Domestic navigation	0.2143	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
e. Other transportation	99.8443	0.0018	0.0002	0.1317	0.0516	0.0409	0.0012
4. Other sectors	**2 172.1646**	**1.3343**	**0.2708**	**9.1456**	**30.5187**	**3.2884**	**4.8320**
a. Commercial/institutional	395.4161	0.0766	0.0059	0.7759	3.3189	0.3623	2.9241
b. Residential	1 068.7561	1.1441	0.0112	1.0930	15.7025	1.9490	1.6609
c. Agriculture/forestry/fishing	707.9924	0.1136	0.2536	7.2766	11.4973	0.9770	0.2471
ci. Stationary	18.7639	0.0361	0.0003	0.0376	0.1054	0.0205	0.0771
cii. Mobile	689.2285	0.0775	0.2534	7.2390	11.3919	0.9565	0.1700
5. Other	**125.6438**	**0.0104**	**0.0022**	**0.5138**	**0.6299**	**0.1015**	**0.2639**
a. Stationary	104.4054	0.0050	0.0011	0.3366	0.3173	0.0599	0.2593
b. Mobile	21.2384	0.0054	0.0011	0.1771	0.3125	0.0416	0.0046
B. Fugitive emissions from fuels	**0.4393**	**29.5357**	**0.0000**	**NO**	**NO**	**0.5341**	**NO**
1. Solid fuels	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**
a. Coal mining and handling	NO	NO	NO	NO	NO	NO	
b. Solid fuel transformation	NO	NO	NO	NO	NO	NO	NO
c. Other	NO	NO	NO	NO	NO	NO	NO
2. Oil and natural gas and other emissions from energy production	**0.4393**	**29.5357**	**0.0000**	**NO**	**NO**	**0.5341**	**NO**

a. Oil	0.0140	0.0000	0.0000	NO	NO	0.0000	NO
b. Natural gas	0.4253	29.5357				0.5341	NO
c. Venting and flaring	NO	NO	NO	NO	NO	NO	NO
d. Other	NO	NO	NO	NO	NO	NO	NO
C. CO_2 Transport and storage	**NO**						
1. Transport of CO_2	NO						
2. Injection and storage	NO						
3. Other	NO						
Memo items:							
International bunkers	**41.9508**	**0.0066**	**0.0014**	**0.1676**	**0.1539**	**0.2298**	**0.0133**
Aviation	41.9508	0.0066	0.0014	0.1676	0.1539	0.2298	0.0133
Navigation	NO	NO	NO	NO	NO	NO	NO
Multilateral operations	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**
CO_2 emissions from biomass	**230.0480**						
CO_2 captured	NO						
For domestic storage	NO						
For storage in other countries	NO						

1996

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2	CH_4	N_2O	NO_X	CO	NMVOC	SO_2
	(kt)						
1. Total Energy	**11 379.8429**	**35.3011**	**0.3745**	**27.6843**	**71.3532**	**8.7724**	**31.5576**
A. Fuel combustion activities (sectoral approach)	**11 379.3471**	**2.9694**	**0.3745**	**27.6843**	**71.3532**	**8.1891**	**31.5576**
1. Energy industries	**7 107.0544**	**0.1353**	**0.0469**	**12.7474**	**3.2595**	**0.2422**	**23.4411**
a. Public electricity and heat production	7 107.0544	0.1353	0.0469	12.7474	3.2595	0.2422	23.4411
b. Petroleum refining	NO	NO	NO	NO	NO	NO	NO
c. Manufacture of solid fuels and other energy industries	NO	NO	NO	NO	NO	NO	NO
2. Manufacturing industries and construction	**326.3785**	**0.0070**	**0.0016**	**0.6523**	**0.6498**	**0.1616**	**0.4916**
a. Iron and steel	27.9139	0.0005	0.0000	0.0368	0.0144	0.0114	0.0003
b. Non-ferrous metals	NO	NO	NO	NO	NO	NO	NO
c. Chemicals	0.0990	0.0000	0.0000	0.0001	0.0001	0.0000	0.0000
d. Pulp, paper and print	1.9797	0.0000	0.0000	0.0026	0.0010	0.0008	0.0000
e. Food processing, beverages and tobacco	102.3296	0.0029	0.0010	0.2913	0.4272	0.0651	0.3770
f. Non-metallic minerals	126.9882	0.0023	0.0004	0.1968	0.1701	0.0573	0.1094
g. Transport equipment	NO	NO	NO	NO	NO	NO	NO
h. Machinery	17.5511	0.0003	0.0000	0.0232	0.0091	0.0072	0.0002
i. Mining and quarrying	NO	NO	NO	NO	NO	NO	NO
j. Wood and wood production	0.8909	0.0000	0.0000	0.0012	0.0005	0.0004	0.0000
k. Construction	13.3874	0.0004	0.0001	0.0538	0.0092	0.0049	0.0042
l. Textile and leather	19.7971	0.0004	0.0000	0.0261	0.0102	0.0081	0.0002
m. Other industries	15.4417	0.0003	0.0000	0.0204	0.0080	0.0063	0.0002
3. Transport	**1 578.3769**	**0.4312**	**0.1009**	**5.9472**	**22.3021**	**2.8506**	**0.2207**
a. Domestic aviation	20.0344	0.0001	0.0006	0.0000	0.0079	0.0001	0.0000
b. Road transportation	1 324.4333	0.4233	0.0641	4.2140	21.9055	2.6555	0.1954
c. Railways	93.1056	0.0052	0.0359	1.5477	0.3160	0.1373	0.0236
d. Domestic navigation	0.2325	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
e. Other transportation	140.5711	0.0025	0.0003	0.1854	0.0727	0.0576	0.0017
4. Other sectors	**2 285.6997**	**2.3850**	**0.2228**	**7.8951**	**44.6759**	**4.8360**	**7.2025**
a. Commercial/institutional	362.4420	0.0905	0.0056	0.7011	2.9937	0.3484	2.5956
b. Residential	1 349.8119	2.1821	0.0175	1.4404	31.3610	3.6754	4.3875
c. Agriculture/forestry/fishing	573.4458	0.1124	0.1997	5.7537	10.3212	0.8122	0.2194
ci. Stationary	26.9754	0.0459	0.0005	0.0693	0.1310	0.0316	0.0857
cii. Mobile	546.4704	0.0666	0.1992	5.6843	10.1902	0.7806	0.1338
5. Other	**81.8376**	**0.0109**	**0.0023**	**0.4423**	**0.4659**	**0.0987**	**0.2016**
a. Stationary	58.7906	0.0062	0.0012	0.2011	0.2969	0.0717	0.1964
b. Mobile	23.0470	0.0047	0.0012	0.2412	0.1689	0.0271	0.0051
B. Fugitive emissions from fuels	**0.4958**	**32.3317**	**0.0000**	**NO**	**NO**	**0.5834**	**NO**
1. Solid fuels	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**
a. Coal mining and handling	NO	NO	NO	NO	NO	NO	
b. Solid fuel transformation	NO	NO	NO	NO	NO	NO	NO
c. Other	NO	NO	NO	NO	NO	NO	NO
2. Oil and natural gas and other emissions from energy production	**0.4958**	**32.3317**	**0.0000**	**NO**	**NO**	**0.5834**	**NO**
a. Oil	0.0162	0.0000	0.0000	NO	NO	0.0000	NO
b. Natural gas	0.4796	32.3317				0.5834	NO
c. Venting and flaring	NO	NO	NO	NO	NO	NO	NO
d. Other	NO	NO	NO	NO	NO	NO	NO
C. CO_2 Transport and storage	**NO**						
1. Transport of CO_2	NO						
2. Injection and storage	NO						
3. Other	NO						
Memo items:							
International bunkers	**56.7300**	**0.0048**	**0.0018**	**0.2197**	**0.1539**	**0.0822**	**0.0180**

Aviation	56.7300	0.0048	0.0018	0.2197	0.1539	0.0822	0.0180
Navigation	NO	NO	NO	NO	NO	NO	NO
Multilateral operations	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**
CO_2 emissions from biomass	**294.0280**						
CO_2 captured	NO						
For domestic storage	NO						
For storage in other countries	NO						

1997

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2	CH_4	N_2O	NO_X	CO	NMVOC	SO_2
	(kt)						
1. Total Energy	**10 275.2096**	**29.7284**	**0.3430**	**24.5339**	**64.6496**	**7.9555**	**16.2511**
A. Fuel combustion activities (sectoral approach)	**10 274.7201**	**2.3177**	**0.3429**	**24.5339**	**64.6496**	**7.4670**	**16.2511**
1. Energy industries	**5 615.6123**	**0.1108**	**0.0244**	**9.5174**	**3.1362**	**0.2233**	**10.5370**
a. Public electricity and heat production	5 615.6123	0.1108	0.0244	9.5174	3.1362	0.2233	10.5370
b. Petroleum refining	NO	NO	NO	NO	NO	NO	NO
c. Manufacture of solid fuels and other energy industries	NO	NO	NO	NO	NO	NO	NO
2. Manufacturing industries and construction	**563.8972**	**0.0145**	**0.0023**	**0.9216**	**0.7564**	**0.2860**	**0.4152**
a. Iron and steel	101.5868	0.0018	0.0002	0.1340	0.0525	0.0416	0.0012
b. Non-ferrous metals	NO	NO	NO	NO	NO	NO	NO
c. Chemicals	0.2878	0.0000	0.0000	0.0004	0.0001	0.0001	0.0000
d. Pulp, paper and print	5.1801	0.0001	0.0000	0.0068	0.0027	0.0021	0.0001
e. Food processing, beverages and tobacco	134.6161	0.0066	0.0014	0.2913	0.4533	0.1068	0.3242
f. Non-metallic minerals	173.1187	0.0031	0.0005	0.2562	0.1684	0.0748	0.0839
g. Transport equipment	NO	NO	NO	NO	NO	NO	NO
h. Machinery	41.3852	0.0007	0.0001	0.0546	0.0214	0.0170	0.0005
i. Mining and quarrying	NO	NO	NO	NO	NO	NO	NO
j. Wood and wood production	1.4389	0.0000	0.0000	0.0019	0.0007	0.0006	0.0000
k. Construction	22.5394	0.0005	0.0001	0.0659	0.0139	0.0086	0.0043
l. Textile and leather	45.7572	0.0008	0.0001	0.0604	0.0237	0.0188	0.0005
m. Other industries	37.9871	0.0007	0.0001	0.0501	0.0196	0.0156	0.0005
3. Transport	**1 516.0213**	**0.4009**	**0.0976**	**5.9219**	**24.4735**	**3.0625**	**0.2299**
a. Domestic aviation	20.1295	0.0001	0.0006	0.0000	0.0079	0.0001	0.0000
b. Road transportation	1 357.1694	0.3952	0.0661	4.5148	24.1637	2.9204	0.2089
c. Railways	80.0082	0.0045	0.0309	1.3300	0.2716	0.1180	0.0203
d. Domestic navigation	0.2506	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
e. Other transportation	58.4636	0.0010	0.0001	0.0771	0.0302	0.0240	0.0007
4. Other sectors	**2 502.5306**	**1.7835**	**0.2165**	**7.8855**	**35.7839**	**3.8166**	**4.8638**
a. Commercial/institutional	307.2393	0.0668	0.0046	0.5690	2.5613	0.2901	2.2341
b. Residential	1 621.9510	1.5902	0.0153	1.6364	21.8422	2.6721	2.4605
c. Agriculture/forestry/fishing	573.3403	0.1265	0.1967	5.6801	11.3804	0.8544	0.1692
ci. Stationary	31.3633	0.0554	0.0007	0.0802	0.1313	0.0568	0.0372
cii. Mobile	541.9770	0.0710	0.1960	5.5999	11.2491	0.7976	0.1320
5. Other	**76.6587**	**0.0081**	**0.0020**	**0.2875**	**0.4997**	**0.0785**	**0.2051**
a. Stationary	51.7920	0.0031	0.0007	0.1428	0.2585	0.0462	0.2014
b. Mobile	24.8668	0.0050	0.0013	0.1447	0.2412	0.0324	0.0038
B. Fugitive emissions from fuels	**0.4895**	**27.4107**	**0.0000**	**NO**	**NO**	**0.4886**	**NO**
1. Solid fuels	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**
a. Coal mining and handling	NO	NO	NO	NO	NO	NO	
b. Solid fuel transformation	NO	NO	NO	NO	NO	NO	NO
c. Other	NO	NO	NO	NO	NO	NO	NO
2. Oil and natural gas and other emissions from energy production	**0.4895**	**27.4107**	**0.0000**	**NO**	**NO**	**0.4886**	**NO**
a. Oil	0.0191	0.0000	0.0000	NO	NO	0.0000	NO
b. Natural gas	0.4703	27.4107				0.4886	NO
c. Venting and flaring	NO	NO	NO	NO	NO	NO	NO
d. Other	NO	NO	NO	NO	NO	NO	NO
C. CO_2 Transport and storage	**NO**						
1. Transport of CO_2	NO						
2. Injection and storage	NO						
3. Other	NO						
Memo items:							
International bunkers	**66.1918**	**0.0054**	**0.0021**	**0.2640**	**0.1777**	**0.0937**	**0.0210**
Aviation	66.1918	0.0054	0.0021	0.2640	0.1777	0.0937	0.0210
Navigation	NO	NO	NO	NO	NO	NO	NO
Multilateral operations	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**
CO_2 emissions from biomass	**291.1280**						
CO_2 captured	NO						
For domestic storage	NO						
For storage in other countries	NO						

1998

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2	CH_4	N_2O	NO_X	CO	NMVOC	SO_2
	(kt)						
1. Total Energy	**8 891.0345**	**27.2535**	**0.2672**	**20.5268**	**49.2098**	**6.4073**	**12.0120**
A. Fuel combustion activities (sectoral approach)	**8 890.5850**	**1.7122**	**0.2672**	**20.5268**	**49.2098**	**5.9514**	**12.0120**
1. Energy industries	**4 836.6106**	**0.0962**	**0.0190**	**8.1103**	**2.7791**	**0.1972**	**7.9288**
a. Public electricity and heat production	4 836.6106	0.0962	0.0190	8.1103	2.7791	0.1972	7.9288
b. Petroleum refining	NO	NO	NO	NO	NO	NO	NO
c. Manufacture of solid fuels and other energy industries	NO	NO	NO	NO	NO	NO	NO
2. Manufacturing industries and construction	**539.2845**	**0.0149**	**0.0022**	**0.8912**	**0.6944**	**0.2954**	**0.3171**
a. Iron and steel	91.5553	0.0016	0.0002	0.1208	0.0473	0.0375	0.0011
b. Non-ferrous metals	NO	NO	NO	NO	NO	NO	NO
c. Chemicals	5.5657	0.0001	0.0000	0.0073	0.0029	0.0023	0.0001
d. Pulp, paper and print	4.1743	0.0001	0.0000	0.0055	0.0022	0.0017	0.0000
e. Food processing, beverages and tobacco	126.0899	0.0065	0.0013	0.2911	0.4192	0.1080	0.2800
f. Non-metallic minerals	161.3491	0.0038	0.0005	0.2436	0.1435	0.0846	0.0313
g. Transport equipment	NO	NO	NO	NO	NO	NO	NO
h. Machinery	28.0343	0.0005	0.0000	0.0370	0.0145	0.0115	0.0003
i. Mining and quarrying	NO	NO	NO	NO	NO	NO	NO
j. Wood and wood production	1.3914	0.0000	0.0000	0.0018	0.0007	0.0006	0.0000
k. Construction	19.2728	0.0004	0.0001	0.0497	0.0115	0.0075	0.0029
l. Textile and leather	63.1704	0.0011	0.0001	0.0833	0.0327	0.0259	0.0008
m. Other industries	38.6814	0.0007	0.0001	0.0510	0.0200	0.0159	0.0005
3. Transport	**1 363.1855**	**0.4034**	**0.0827**	**4.9702**	**21.3567**	**2.6620**	**0.1945**
a. Domestic aviation	20.5100	0.0001	0.0006	0.0000	0.0081	0.0001	0.0000
b. Road transportation	1 226.8853	0.3989	0.0591	3.9117	21.1185	2.5514	0.1788
c. Railways	59.1972	0.0033	0.0228	0.9840	0.2009	0.0873	0.0150
d. Domestic navigation	0.1567	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
e. Other transportation	56.4364	0.0010	0.0001	0.0744	0.0292	0.0231	0.0007
4. Other sectors	**2 078.6760**	**1.1889**	**0.1612**	**6.1632**	**23.7935**	**2.6926**	**3.3628**
a. Commercial/institutional	305.5365	0.0669	0.0047	0.5770	2.6137	0.2925	2.2854
b. Residential	1 339.7948	1.0523	0.0123	1.3409	13.7327	1.8101	0.9304
c. Agriculture/forestry/fishing	433.3447	0.0696	0.1442	4.2453	7.4470	0.5901	0.1470
ci. Stationary	38.7431	0.0215	0.0003	0.1101	0.0766	0.0233	0.0497
cii. Mobile	394.6016	0.0481	0.1439	4.1351	7.3705	0.5668	0.0973
5. Other	**72.8283**	**0.0088**	**0.0021**	**0.3919**	**0.5862**	**0.1041**	**0.2088**
a. Stationary	50.4380	0.0048	0.0010	0.1495	0.2909	0.0624	0.2034
b. Mobile	22.3903	0.0041	0.0011	0.2424	0.2953	0.0417	0.0054
B. Fugitive emissions from fuels	**0.4495**	**25.5413**	**0.0000**	**NO**	**NO**	**0.4559**	**NO**
1. Solid fuels	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**
a. Coal mining and handling	NO	NO	NO	NO	NO	NO	
b. Solid fuel transformation	NO	NO	NO	NO	NO	NO	NO
c. Other	NO	NO	NO	NO	NO	NO	NO
2. Oil and natural gas and other emissions from energy production	**0.4495**	**25.5413**	**0.0000**	**NO**	**NO**	**0.4559**	**NO**
a. Oil	0.0184	0.0000	0.0000	NO	NO	0.0000	NO
b. Natural gas	0.4311	25.5413				0.4559	NO
c. Venting and flaring	NO	NO	NO	NO	NO	NO	NO
d. Other	NO	NO	NO	NO	NO	NO	NO
C. CO_2 Transport and storage	**NO**						
1. Transport of CO_2	NO						
2. Injection and storage	NO						
3. Other	NO						
Memo items:							
International bunkers	**53.5923**	**0.0041**	**0.0017**	**0.2144**	**0.1439**	**0.0721**	**0.0170**
Aviation	53.5923	0.0041	0.0017	0.2144	0.1439	0.0721	0.0170
Navigation	NO	NO	NO	NO	NO	NO	NO
Multilateral operations	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**
CO_2 emissions from biomass	**269.0120**						
CO_2 captured	NO						
For domestic storage	NO						
For storage in other countries	NO						

1999

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2	CH_4	N_2O	NO_X	CO	NMVOC	SO_2
	(kt)						
1. Total Energy	**6 913.7785**	**26.8852**	**0.1824**	**14.8145**	**37.0134**	**5.0420**	**5.4970**
A. Fuel combustion activities (sectoral approach)	**6 913.3665**	**1.5525**	**0.1824**	**14.8145**	**37.0134**	**4.5862**	**5.4970**
1. Energy industries	**3 660.2540**	**0.0727**	**0.0088**	**5.8881**	**2.3787**	**0.1638**	**2.1288**
a. Public electricity and heat production	3 660.2540	0.0727	0.0088	5.8881	2.3787	0.1638	2.1288
b. Petroleum refining	NO	NO	NO	NO	NO	NO	NO
c. Manufacture of solid fuels and other energy industries	NO	NO	NO	NO	NO	NO	NO
2. Manufacturing industries and construction	**483.9580**	**0.0108**	**0.0016**	**0.7410**	**0.5239**	**0.2274**	**0.2536**
a. Iron and steel	94.6213	0.0017	0.0002	0.1248	0.0489	0.0388	0.0011

b. Non-ferrous metals	NO	NO	NO	NO	NO	NO	NO
c. Chemicals	4.9120	0.0001	0.0000	0.0065	0.0025	0.0020	0.0001
d. Pulp, paper and print	3.1023	0.0001	0.0000	0.0041	0.0016	0.0013	0.0000
e. Food processing, beverages and tobacco	96.0412	0.0039	0.0008	0.2161	0.2971	0.0672	0.2216
f. Non-metallic minerals	153.1548	0.0027	0.0003	0.2033	0.1047	0.0642	0.0279
g. Transport equipment	NO	NO	NO	NO	NO	NO	NO
h. Machinery	21.7411	0.0004	0.0000	0.0287	0.0112	0.0089	0.0003
i. Mining and quarrying	NO	NO	NO	NO	NO	NO	NO
j. Wood and wood production	1.0341	0.0000	0.0000	0.0014	0.0005	0.0004	0.0000
k. Construction	16.2809	0.0003	0.0000	0.0334	0.0092	0.0065	0.0015
l. Textile and leather	57.6518	0.0010	0.0001	0.0760	0.0298	0.0236	0.0007
m. Other industries	35.4184	0.0006	0.0001	0.0467	0.0183	0.0145	0.0004
3. Transport	**910.5958**	**0.2475**	**0.0514**	**3.3339**	**12.5288**	**1.5798**	**0.1366**
a. Domestic aviation	2.0300	0.0000	0.0001	0.0000	0.0008	0.0000	0.0000
b. Road transportation	815.2586	0.2446	0.0394	2.7392	12.3912	1.5088	0.1281
c. Railways	30.8413	0.0017	0.0119	0.5127	0.1047	0.0455	0.0078
d. Domestic navigation	0.2609	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
e. Other transportation	62.2050	0.0011	0.0001	0.0821	0.0322	0.0255	0.0007
4. Other sectors	**1 809.4024**	**1.2151**	**0.1190**	**4.7057**	**21.2190**	**2.5511**	**2.8154**
a. Commercial/institutional	228.3903	0.0500	0.0033	0.4263	1.8054	0.2102	1.5675
b. Residential	1 283.2132	1.1327	0.0126	1.2942	15.0238	1.9524	1.1679
c. Agriculture/forestry/fishing	297.7989	0.0324	0.1031	2.9851	4.3898	0.3885	0.0800
ci. Stationary	18.5433	0.0021	0.0001	0.0488	0.0160	0.0064	0.0111
cii. Mobile	279.2556	0.0304	0.1030	2.9363	4.3738	0.3822	0.0689
5. Other	**49.1563**	**0.0065**	**0.0016**	**0.1458**	**0.3630**	**0.0640**	**0.1625**
a. Stationary	30.9893	0.0033	0.0007	0.0812	0.2285	0.0465	0.1608
b. Mobile	18.1670	0.0032	0.0009	0.0645	0.1345	0.0175	0.0017
B. Fugitive emissions from fuels	**0.4121**	**25.3327**	**0.0000**	**NO**	**NO**	**0.4558**	**NO**
1. Solid fuels	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**
a. Coal mining and handling	NO	NO	NO	NO	NO	NO	
b. Solid fuel transformation	NO	NO	NO	NO	NO	NO	NO
c. Other	NO	NO	NO	NO	NO	NO	NO
2. Oil and natural gas and other emissions from energy production	**0.4121**	**25.3327**	**0.0000**	**NO**	**NO**	**0.4558**	**NO**
a. Oil	0.0228	0.0000	0.0000	NO	NO	0.0000	NO
b. Natural gas	0.3892	25.3327				0.4558	NO
c. Venting and flaring	NO	NO	NO	NO	NO	NO	NO
d. Other	NO	NO	NO	NO	NO	NO	NO
C. CO_2 Transport and storage	**NO**						
1. Transport of CO_2	NO						
2. Injection and storage	NO						
3. Other	NO						
Memo items:							
International bunkers	**63.0390**	**0.0040**	**0.0020**	**0.2517**	**0.1574**	**0.0796**	**0.0200**
Aviation	63.0390	0.0040	0.0020	0.2517	0.1574	0.0796	0.0200
Navigation	NO	NO	NO	NO	NO	NO	NO
Multilateral operations	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**
CO_2 emissions from biomass	**266.1120**						
CO_2 captured	NO						
For domestic storage	NO						
For storage in other countries	NO						

2000

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2	CH_4	N_2O	NO_X	CO	NMVOC	SO_2
	(kt)						
1. Total Energy	**6 189.8822**	**28.1005**	**0.1627**	**13.5115**	**34.6241**	**4.9241**	**3.9685**
A. Fuel combustion activities (sectoral approach)	**6 189.4898**	**1.5357**	**0.1627**	**13.5115**	**34.6241**	**4.4422**	**3.9685**
1. Energy industries	**3 155.7517**	**0.0610**	**0.0069**	**5.0439**	**2.1204**	**0.1437**	**0.9753**
a. Public electricity and heat production	3 155.7517	0.0610	0.0069	5.0439	2.1204	0.1437	0.9753
b. Petroleum refining	NO	NO	NO	NO	NO	NO	NO
c. Manufacture of solid fuels and other energy industries	NO	NO	NO	NO	NO	NO	NO
2. Manufacturing industries and construction	**520.9679**	**0.0098**	**0.0014**	**0.7914**	**0.4871**	**0.2261**	**0.2274**
a. Iron and steel	97.5840	0.0017	0.0002	0.1287	0.0504	0.0400	0.0012
b. Non-ferrous metals	NO	NO	NO	NO	NO	NO	NO
c. Chemicals	5.1935	0.0001	0.0000	0.0069	0.0027	0.0021	0.0001
d. Pulp, paper and print	4.9202	0.0001	0.0000	0.0065	0.0025	0.0020	0.0001
e. Food processing, beverages and tobacco	81.8114	0.0020	0.0006	0.1988	0.2338	0.0448	0.1948
f. Non-metallic minerals	184.8715	0.0033	0.0004	0.2453	0.1211	0.0772	0.0283
g. Transport equipment	NO	NO	NO	NO	NO	NO	NO
h. Machinery	25.7242	0.0005	0.0000	0.0339	0.0133	0.0105	0.0003
i. Mining and quarrying	NO	NO	NO	NO	NO	NO	NO
j. Wood and wood production	1.6401	0.0000	0.0000	0.0022	0.0008	0.0007	0.0000
k. Construction	9.6117	0.0002	0.0000	0.0246	0.0057	0.0037	0.0015
l. Textile and leather	80.6367	0.0014	0.0001	0.1064	0.0417	0.0331	0.0010

m. Other industries	28.9745	0.0005	0.0001	0.0382	0.0150	0.0119	0.0003
3. Transport	**982.2638**	**0.2519**	**0.0574**	**3.7206**	**12.4426**	**1.5683**	**0.1582**
a. Domestic aviation	2.0300	0.0000	0.0001	0.0000	0.0008	0.0000	0.0000
b. Road transportation	911.8524	0.2494	0.0444	3.1202	12.3106	1.5048	0.1514
c. Railways	33.3462	0.0019	0.0129	0.5543	0.1132	0.0492	0.0063
d. Domestic navigation	0.1154	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
e. Other transportation	34.9198	0.0006	0.0001	0.0461	0.0181	0.0143	0.0004
4. Other sectors	**1 494.1182**	**1.2084**	**0.0960**	**3.8246**	**19.3419**	**2.4620**	**2.4553**
a. Commercial/institutional	205.2273	0.0475	0.0027	0.3932	1.4361	0.1789	1.2316
b. Residential	1 052.5201	1.1385	0.0126	1.0868	15.2688	1.9972	1.1697
c. Agriculture/forestry/fishing	236.3708	0.0225	0.0807	2.3445	2.6371	0.2859	0.0541
ci. Stationary	20.7663	0.0024	0.0001	0.0580	0.0188	0.0070	0.0139
cii. Mobile	215.6045	0.0201	0.0806	2.2865	2.6183	0.2790	0.0401
5. Other	**36.3881**	**0.0046**	**0.0010**	**0.1311**	**0.2320**	**0.0421**	**0.1523**
a. Stationary	26.5856	0.0021	0.0005	0.0540	0.2033	0.0364	0.1515
b. Mobile	9.8025	0.0025	0.0005	0.0770	0.0287	0.0057	0.0008
B. Fugitive emissions from fuels	**0.3924**	**26.5648**	**0.0000**	**NO**	**NO**	**0.4819**	**NO**
1. Solid fuels	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**
a. Coal mining and handling	NO	NO	NO	NO	NO	NO	
b. Solid fuel transformation	NO	NO	NO	NO	NO	NO	NO
c. Other	NO	NO	NO	NO	NO	NO	NO
2. Oil and natural gas and other emissions from energy production	**0.3924**	**26.5648**	**0.0000**	**NO**	**NO**	**0.4819**	**NO**
a. Oil	0.0258	0.0000	0.0000	NO	NO	0.0000	NO
b. Natural gas	0.3666	26.5648				0.4819	NO
c. Venting and flaring	NO	NO	NO	NO	NO	NO	NO
d. Other	NO	NO	NO	NO	NO	NO	NO
C. CO_2 Transport and storage	**NO**						
1. Transport of CO_2	NO						
2. Injection and storage	NO						
3. Other	NO						
Memo items:							
International bunkers	**63.0779**	**0.0043**	**0.0020**	**0.2591**	**0.1688**	**0.0773**	**0.0200**
Aviation	63.0779	0.0043	0.0020	0.2591	0.1688	0.0773	0.0200
Navigation	NO	NO	NO	NO	NO	NO	NO
Multilateral operations	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**
CO_2 emissions from biomass	**272.3720**						
CO_2 captured	NO						
For domestic storage	NO						
For storage in other countries	NO						

2001

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2	CH_4	N_2O	NO_X	CO	NMVOC	SO_2
	(kt)						
1. Total Energy	**6 819.3643**	**28.0333**	**0.1673**	**14.9244**	**33.4823**	**4.8324**	**3.4823**
A. Fuel combustion activities (sectoral approach)	**6 818.9369**	**1.4121**	**0.1673**	**14.9244**	**33.4823**	**4.3519**	**3.4823**
1. Energy industries	**3 677.7189**	**0.0726**	**0.0080**	**5.8773**	**2.5004**	**0.1689**	**0.8801**
a. Public electricity and heat production	3 677.7189	0.0726	0.0080	5.8773	2.5004	0.1689	0.8801
b. Petroleum refining	NO	NO	NO	NO	NO	NO	NO
c. Manufacture of solid fuels and other energy industries	NO	NO	NO	NO	NO	NO	NO
2. Manufacturing industries and construction	**601.9346**	**0.0123**	**0.0019**	**1.1500**	**0.5744**	**0.2598**	**0.2566**
a. Iron and steel	117.6721	0.0021	0.0002	0.1552	0.0608	0.0482	0.0014
b. Non-ferrous metals	NO	NO	NO	NO	NO	NO	NO
c. Chemicals	4.3091	0.0001	0.0000	0.0057	0.0022	0.0018	0.0001
d. Pulp, paper and print	7.9553	0.0001	0.0000	0.0105	0.0041	0.0033	0.0001
e. Food processing, beverages and tobacco	87.0728	0.0020	0.0007	0.2196	0.2889	0.0494	0.2492
f. Non-metallic minerals	201.0700	0.0046	0.0006	0.5046	0.1225	0.0820	0.0024
g. Transport equipment	NO	NO	NO	NO	NO	NO	NO
h. Machinery	29.8276	0.0005	0.0001	0.0393	0.0154	0.0122	0.0004
i. Mining and quarrying	NO	NO	NO	NO	NO	NO	NO
j. Wood and wood production	3.6462	0.0001	0.0000	0.0048	0.0019	0.0015	0.0000
k. Construction	11.1639	0.0002	0.0000	0.0266	0.0065	0.0044	0.0015
l. Textile and leather	98.4468	0.0018	0.0002	0.1299	0.0509	0.0404	0.0012
m. Other industries	40.7709	0.0007	0.0001	0.0538	0.0211	0.0167	0.0005
3. Transport	**1 061.7864**	**0.2667**	**0.0634**	**3.9981**	**13.3140**	**1.6688**	**0.1332**
a. Domestic aviation	0.0982	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
b. Road transportation	1 008.2244	0.2644	0.0495	3.3792	13.1832	1.6088	0.1262
c. Railways	35.8469	0.0020	0.0138	0.5959	0.1217	0.0529	0.0068
d. Domestic navigation	0.2082	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
e. Other transportation	17.4087	0.0003	0.0000	0.0230	0.0090	0.0071	0.0002
4. Other sectors	**1 434.1009**	**1.0554**	**0.0928**	**3.7425**	**16.7367**	**2.1939**	**2.1063**
a. Commercial/institutional	236.4333	0.0681	0.0032	0.4574	1.5666	0.2133	1.3118
b. Residential	967.0035	0.9564	0.0113	0.9940	12.5835	1.6945	0.7359
c. Agriculture/forestry/fishing	230.6641	0.0309	0.0783	2.2910	2.5866	0.2862	0.0586

ci. Stationary	21.7542	0.0113	0.0003	0.0740	0.0390	0.0155	0.0197
cii. Mobile	208.9099	0.0195	0.0781	2.2170	2.5476	0.2707	0.0389
5. Other	**43.3961**	**0.0050**	**0.0012**	**0.1565**	**0.3569**	**0.0605**	**0.1061**
a. Stationary	28.7767	0.0023	0.0005	0.0593	0.1541	0.0341	0.1047
b. Mobile	14.6194	0.0027	0.0007	0.0973	0.2027	0.0264	0.0014
B. Fugitive emissions from fuels	**0.4274**	**26.6212**	**0.0000**	**NO**	**NO**	**0.4805**	**NO**
1. Solid fuels	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**
a. Coal mining and handling	NO	NO	NO	NO	NO	NO	
b. Solid fuel transformation	NO	NO	NO	NO	NO	NO	NO
c. Other	NO	NO	NO	NO	NO	NO	NO
2. Oil and natural gas and other emissions from energy production	**0.4274**	**26.6212**	**0.0000**	**NO**	**NO**	**0.4805**	**NO**
a. Oil	0.0346	0.0000	0.0000	NO	NO	0.0000	NO
b. Natural gas	0.3928	26.6212				0.4805	NO
c. Venting and flaring	NO	NO	NO	NO	NO	NO	NO
d. Other	NO	NO	NO	NO	NO	NO	NO
C. CO_2 Transport and storage	**NO**						
1. Transport of CO_2	NO						
2. Injection and storage	NO						
3. Other	NO						
Memo items:							
International bunkers	**50.4863**	**0.0039**	**0.0016**	**0.1936**	**0.1468**	**0.0630**	**0.0160**
Aviation	50.4863	0.0039	0.0016	0.1936	0.1468	0.0630	0.0160
Navigation	NO	NO	NO	NO	NO	NO	NO
Multilateral operations	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**
CO_2 emissions from biomass	**282.2280**						
CO_2 captured	NO						
For domestic storage	NO						
For storage in other countries	NO						

2002

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2	CH_4	N_2O	NO_x	CO	NMVOC	SO_2
	(kt)						
1. Total Energy	**6 538.3068**	**30.1374**	**0.2146**	**15.5363**	**40.7317**	**5.9151**	**4.2675**
A. Fuel combustion activities (sectoral approach)	**6 537.9006**	**1.7746**	**0.2146**	**15.5363**	**40.7317**	**5.3987**	**4.2675**
1. Energy industries	**2 933.2101**	**0.0614**	**0.0069**	**4.6959**	**2.0055**	**0.1356**	**0.6884**
a. Public electricity and heat production	2 933.2101	0.0614	0.0069	4.6959	2.0055	0.1356	0.6884
b. Petroleum refining	NO	NO	NO	NO	NO	NO	NO
c. Manufacture of solid fuels and other energy industries	NO	NO	NO	NO	NO	NO	NO
2. Manufacturing industries and construction	**411.7767**	**0.0077**	**0.0011**	**0.6019**	**0.4089**	**0.1809**	**0.2019**
a. Iron and steel	27.2532	0.0005	0.0000	0.0359	0.0141	0.0112	0.0003
b. Non-ferrous metals	NO	NO	NO	NO	NO	NO	NO
c. Chemicals	1.6686	0.0000	0.0000	0.0022	0.0009	0.0007	0.0000
d. Pulp, paper and print	0.5562	0.0000	0.0000	0.0007	0.0003	0.0002	0.0000
e. Food processing, beverages and tobacco	61.6934	0.0014	0.0005	0.1236	0.2269	0.0376	0.1959
f. Non-metallic minerals	219.0040	0.0039	0.0004	0.2889	0.1132	0.0898	0.0026
g. Transport equipment	NO	NO	NO	NO	NO	NO	NO
h. Machinery	11.2157	0.0002	0.0000	0.0148	0.0058	0.0046	0.0001
i. Mining and quarrying	NO	NO	NO	NO	NO	NO	NO
j. Wood and wood production	1.8076	0.0000	0.0000	0.0024	0.0009	0.0007	0.0000
k. Construction	8.4872	0.0002	0.0000	0.0277	0.0054	0.0032	0.0020
l. Textile and leather	41.4359	0.0007	0.0001	0.0547	0.0214	0.0170	0.0005
m. Other industries	38.6550	0.0007	0.0001	0.0510	0.0200	0.0158	0.0005
3. Transport	**1 405.6363**	**0.3418**	**0.0947**	**5.6192**	**17.2878**	**2.2088**	**0.1735**
a. Domestic aviation	0.0849	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
b. Road transportation	1 285.4781	0.3365	0.0631	4.2122	16.9911	2.0728	0.1575
c. Railways	81.6327	0.0046	0.0315	1.3570	0.2771	0.1204	0.0155
d. Domestic navigation	0.4824	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
e. Other transportation	37.9581	0.0007	0.0001	0.0501	0.0196	0.0156	0.0005
4. Other sectors	**1 747.8245**	**1.3555**	**0.1103**	**4.4782**	**20.7434**	**2.8052**	**3.0494**
a. Commercial/institutional	426.8063	0.0852	0.0039	0.6876	1.9660	0.3107	1.5930
b. Residential	1 065.7157	1.2513	0.0134	1.1067	16.9457	2.1953	1.4044
c. Agriculture/forestry/fishing	255.3025	0.0189	0.0930	2.6839	1.8318	0.2992	0.0521
ci. Stationary	10.9356	0.0012	0.0000	0.0267	0.0089	0.0039	0.0056
cii. Mobile	244.3669	0.0178	0.0930	2.6572	1.8229	0.2953	0.0464
5. Other	**39.4529**	**0.0083**	**0.0016**	**0.1411**	**0.2860**	**0.0683**	**0.1543**
a. Stationary	25.3685	0.0047	0.0009	0.0632	0.2530	0.0620	0.1534
b. Mobile	14.0844	0.0036	0.0007	0.0779	0.0330	0.0063	0.0008
B. Fugitive emissions from fuels	**0.4062**	**28.3628**	**0.0000**	**NO**	**NO**	**0.5164**	**NO**
1. Solid fuels	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**
a. Coal mining and handling	NO	NO	NO	NO	NO	NO	
b. Solid fuel transformation	NO	NO	NO	NO	NO	NO	NO
c. Other	NO	NO	NO	NO	NO	NO	NO
2. Oil and natural gas and other emissions from energy production	**0.4062**	**28.3628**	**0.0000**	**NO**	**NO**	**0.5164**	**NO**

a. Oil	0.0353	0.0000	0.0000	NO	NO	0.0000	NO
b. Natural gas	0.3708	28.3628				0.5164	NO
c. Venting and flaring	NO	NO	NO	NO	NO	NO	NO
d. Other	NO	NO	NO	NO	NO	NO	NO
C. CO_2 Transport and storage	**NO**						
1. Transport of CO_2	NO						
2. Injection and storage	NO						
3. Other	NO						
Memo items:							
International bunkers	**59.9541**	**0.0036**	**0.0020**	**0.2413**	**0.1619**	**0.0653**	**0.0190**
Aviation	59.9541	0.0036	0.0020	0.2413	0.1619	0.0653	0.0190
Navigation	NO	NO	NO	NO	NO	NO	NO
Multilateral operations	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**
CO_2 emissions from biomass	**322.0800**						
CO_2 captured	NO						
For domestic storage	NO						
For storage in other countries	NO						

2003

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2	CH_4	N_2O	NO_X	CO	NMVOC	SO_2
	(kt)						
1. Total Energy	**7 179.5364**	**32.0059**	**0.2087**	**16.5078**	**49.7946**	**7.0723**	**5.7398**
A. Fuel combustion activities (sectoral approach)	**7 178.4599**	**2.2674**	**0.2087**	**16.5078**	**49.7946**	**6.4898**	**5.7398**
1. Energy industries	**3 036.7432**	**0.0626**	**0.0069**	**4.8529**	**2.0895**	**0.1407**	**0.5251**
a. Public electricity and heat production	3 036.7432	0.0626	0.0069	4.8529	2.0895	0.1407	0.5251
b. Petroleum refining	NO	NO	NO	NO	NO	NO	NO
c. Manufacture of solid fuels and other energy industries	NO	NO	NO	NO	NO	NO	NO
2. Manufacturing industries and construction	**439.9447**	**0.0083**	**0.0011**	**0.6706**	**0.3922**	**0.1897**	**0.1716**
a. Iron and steel	46.9701	0.0008	0.0001	0.0620	0.0243	0.0193	0.0006
b. Non-ferrous metals	NO	NO	NO	NO	NO	NO	NO
c. Chemicals	1.8008	0.0000	0.0000	0.0024	0.0009	0.0007	0.0000
d. Pulp, paper and print	2.2833	0.0000	0.0000	0.0030	0.0012	0.0009	0.0000
e. Food processing, beverages and tobacco	88.2390	0.0020	0.0005	0.1944	0.2096	0.0457	0.1661
f. Non-metallic minerals	216.6633	0.0039	0.0004	0.2981	0.1128	0.0886	0.0040
g. Transport equipment	NO	NO	NO	NO	NO	NO	NO
h. Machinery	13.6320	0.0002	0.0000	0.0180	0.0070	0.0056	0.0002
i. Mining and quarrying	NO	NO	NO	NO	NO	NO	NO
j. Wood and wood production	1.8008	0.0000	0.0000	0.0024	0.0009	0.0007	0.0000
k. Construction	5.8287	0.0001	0.0000	0.0077	0.0030	0.0024	0.0001
l. Textile and leather	26.4113	0.0005	0.0000	0.0348	0.0137	0.0108	0.0003
m. Other industries	36.3155	0.0006	0.0001	0.0479	0.0188	0.0149	0.0004
3. Transport	**1 588.6955**	**0.4003**	**0.0912**	**6.1096**	**20.6504**	**2.5992**	**0.2110**
a. Domestic aviation	0.6558	0.0000	0.0000	0.0000	0.0003	0.0000	0.0000
b. Road transportation	1 517.2708	0.3973	0.0744	5.3531	20.4890	2.5242	0.2024
c. Railways	43.3647	0.0024	0.0167	0.7209	0.1472	0.0640	0.0083
d. Domestic navigation	0.4371	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
e. Other transportation	26.9671	0.0005	0.0000	0.0356	0.0139	0.0111	0.0003
4. Other sectors	**2 084.6537**	**1.7920**	**0.1085**	**4.7321**	**26.3815**	**3.5078**	**4.7236**
a. Commercial/institutional	580.5169	0.2144	0.0072	0.9785	3.2421	0.5411	2.5345
b. Residential	1 266.4167	1.5509	0.0154	1.3135	21.3449	2.6822	2.1437
c. Agriculture/forestry/fishing	237.7201	0.0267	0.0859	2.4401	1.7945	0.2845	0.0454
ci. Stationary	12.1050	0.0099	0.0002	0.0246	0.0244	0.0134	0.0032
cii. Mobile	225.6151	0.0168	0.0857	2.4155	1.7701	0.2711	0.0422
5. Other	**28.4228**	**0.0043**	**0.0009**	**0.1427**	**0.2811**	**0.0524**	**0.1085**
a. Stationary	20.4111	0.0027	0.0005	0.0565	0.1610	0.0359	0.1069
b. Mobile	8.0117	0.0016	0.0004	0.0862	0.1201	0.0166	0.0017
B. Fugitive emissions from fuels	**1.0765**	**29.7385**	**0.0000**	**NO**	**NO**	**0.5825**	**NO**
1. Solid fuels	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**
a. Coal mining and handling	NO	NO	NO	NO	NO	NO	
b. Solid fuel transformation	NO	NO	NO	NO	NO	NO	NO
c. Other	NO	NO	NO	NO	NO	NO	NO
2. Oil and natural gas and other emissions from energy production	**1.0765**	**29.7385**	**0.0000**	**NO**	**NO**	**0.5825**	**NO**
a. Oil	0.6825	0.0436	0.0000	NO	NO	0.0423	NO
b. Natural gas	0.3940	29.6949				0.5401	NO
c. Venting and flaring	NO	NO	NO	NO	NO	NO	NO
d. Other	NO	NO	NO	NO	NO	NO	NO
C. CO_2 Transport and storage	**NO**						
1. Transport of CO_2	NO						
2. Injection and storage	NO						
3. Other	NO						
Memo items:							
International bunkers	**34.7676**	**0.0035**	**0.0012**	**0.1317**	**0.1223**	**0.0403**	**0.0110**

Aviation	34.7676	0.0035	0.0012	0.1317	0.1223	0.0403	0.0110
Navigation	NO	NO	NO	NO	NO	NO	NO
Multilateral operations	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**
CO_2 emissions from biomass	**373.5760**						
CO_2 captured	NO						
For domestic storage	NO						
For storage in other countries	NO						

2004

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2	CH_4	N_2O	NO_X	CO	NMVOC	SO_2
	(kt)						
1. Total Energy	**7 630.4387**	**34.1013**	**0.2113**	**17.7126**	**46.7598**	**7.1333**	**4.8271**
A. Fuel combustion activities (sectoral approach)	**7 629.3163**	**1.9771**	**0.2113**	**17.7126**	**46.7598**	**6.2260**	**4.8271**
1. Energy industries	**3 107.0816**	**0.0639**	**0.0071**	**4.9649**	**2.1435**	**0.1442**	**0.4804**
a. Public electricity and heat production	3 107.0816	0.0639	0.0071	4.9649	2.1435	0.1442	0.4804
b. Petroleum refining	NO	NO	NO	NO	NO	NO	NO
c. Manufacture of solid fuels and other energy industries	NO	NO	NO	NO	NO	NO	NO
2. Manufacturing industries and construction	**448.3884**	**0.0097**	**0.0014**	**0.7048**	**0.4457**	**0.2047**	**0.2034**
a. Iron and steel	45.9378	0.0008	0.0001	0.0607	0.0264	0.0190	0.0032
b. Non-ferrous metals	NO	NO	NO	NO	NO	NO	NO
c. Chemicals	2.4700	0.0000	0.0000	0.0037	0.0013	0.0010	0.0001
d. Pulp, paper and print	2.5342	0.0000	0.0000	0.0033	0.0013	0.0010	0.0000
e. Food processing, beverages and tobacco	72.6628	0.0026	0.0006	0.1748	0.2245	0.0476	0.1747
f. Non-metallic minerals	241.5400	0.0043	0.0005	0.3300	0.1379	0.0996	0.0165
g. Transport equipment	NO	NO	NO	NO	NO	NO	NO
h. Machinery	13.6301	0.0003	0.0000	0.0190	0.0106	0.0058	0.0039
i. Mining and quarrying	NO	NO	NO	NO	NO	NO	NO
j. Wood and wood production	1.5422	0.0002	0.0000	0.0031	0.0048	0.0027	0.0001
k. Construction	9.3591	0.0003	0.0000	0.0311	0.0075	0.0039	0.0031
l. Textile and leather	25.7064	0.0005	0.0000	0.0351	0.0134	0.0105	0.0004
m. Other industries	33.0059	0.0006	0.0001	0.0440	0.0180	0.0136	0.0013
3. Transport	**1 786.1813**	**0.4311**	**0.1062**	**7.1263**	**22.4044**	**2.8401**	**0.2464**
a. Domestic aviation	0.3500	0.0000	0.0000	0.0000	0.0001	0.0000	0.0000
b. Road transportation	1 682.5044	0.4270	0.0829	6.0728	22.1785	2.7341	0.2344
c. Railways	59.9718	0.0034	0.0231	0.9969	0.2036	0.0885	0.0114
d. Domestic navigation	0.4437	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
e. Other transportation	42.9114	0.0008	0.0001	0.0566	0.0222	0.0176	0.0005
4. Other sectors	**2 260.0278**	**1.4692**	**0.0957**	**4.7005**	**21.4786**	**2.9899**	**3.8578**
a. Commercial/institutional	822.7869	0.1775	0.0062	1.2643	2.8567	0.5596	2.1550
b. Residential	1 220.2545	1.2703	0.0130	1.2394	17.2761	2.1827	1.6543
c. Agriculture/forestry/fishing	216.9864	0.0214	0.0764	2.1967	1.3459	0.2475	0.0485
ci. Stationary	17.0312	0.0075	0.0001	0.0282	0.0245	0.0103	0.0107
cii. Mobile	199.9552	0.0139	0.0763	2.1685	1.3214	0.2373	0.0378
5. Other	**27.6373**	**0.0031**	**0.0010**	**0.2161**	**0.2875**	**0.0472**	**0.0392**
a. Stationary	11.3982	0.0010	0.0002	0.0210	0.0596	0.0148	0.0372
b. Mobile	16.2391	0.0021	0.0008	0.1951	0.2280	0.0324	0.0019
B. Fugitive emissions from fuels	**1.1223**	**32.1242**	**0.0000**	**NO**	**NO**	**0.9073**	**NO**
1. Solid fuels	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**
a. Coal mining and handling	NO	NO	NO	NO	NO	NO	
b. Solid fuel transformation	NO	NO	NO	NO	NO	NO	NO
c. Other	NO	NO	NO	NO	NO	NO	NO
2. Oil and natural gas and other emissions from energy production	**1.1223**	**32.1242**	**0.0000**	**NO**	**NO**	**0.9073**	**NO**
a. Oil	0.7008	0.2735	0.0000	NO	NO	0.3269	NO
b. Natural gas	0.4215	31.8508				0.5804	NO
c. Venting and flaring	NO	NO	NO	NO	NO	NO	NO
d. Other	NO	NO	NO	NO	NO	NO	NO
C. CO_2 Transport and storage	**NO**						
1. Transport of CO_2	NO						
2. Injection and storage	NO						
3. Other	NO						
Memo items:							
International bunkers	**34.7903**	**0.0035**	**0.0012**	**0.1283**	**0.1296**	**0.0344**	**0.0110**
Aviation	34.7903	0.0035	0.0012	0.1283	0.1296	0.0344	0.0110
Navigation	NO	NO	NO	NO	NO	NO	NO
Multilateral operations	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**
CO_2 emissions from biomass	**307.6800**						
CO_2 captured	NO						
For domestic storage	NO						
For storage in other countries	NO						

2005

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2	CH_4	N_2O	NO_X	CO	NMVOC	SO_2
	(kt)						
1. Total Energy	**7 873.9844**	**35.9818**	**0.2113**	**18.0996**	**48.4438**	**7.2370**	**4.4251**
A. Fuel combustion activities (sectoral approach)	**7 872.8438**	**2.0747**	**0.2113**	**18.0996**	**48.4438**	**6.4175**	**4.4251**
1. Energy industries	**3 229.4503**	**0.0660**	**0.0072**	**5.1572**	**2.2318**	**0.1500**	**0.4400**
a. Public electricity and heat production	3 229.4503	0.0660	0.0072	5.1572	2.2318	0.1500	0.4400
b. Petroleum refining	NO	NO	NO	NO	NO	NO	NO
c. Manufacture of solid fuels and other energy industries	NO	NO	NO	NO	NO	NO	NO
2. Manufacturing industries and construction	**576.6569**	**0.0113**	**0.0015**	**0.8627**	**0.4875**	**0.2515**	**0.1899**
a. Iron and steel	67.1236	0.0012	0.0001	0.0887	0.0391	0.0277	0.0053
b. Non-ferrous metals	NO	NO	NO	NO	NO	NO	NO
c. Chemicals	3.3632	0.0001	0.0000	0.0082	0.0020	0.0013	0.0005
d. Pulp, paper and print	3.1614	0.0001	0.0000	0.0042	0.0016	0.0013	0.0000
e. Food processing, beverages and tobacco	78.2877	0.0021	0.0005	0.1730	0.2036	0.0444	0.1598
f. Non-metallic minerals	311.1738	0.0056	0.0006	0.4239	0.1740	0.1281	0.0177
g. Transport equipment	NO	NO	NO	NO	NO	NO	NO
h. Machinery	18.8073	0.0004	0.0000	0.0254	0.0130	0.0081	0.0030
i. Mining and quarrying	0.2244	0.0000	0.0000	0.0003	0.0001	0.0001	0.0000
j. Wood and wood production	2.1000	0.0002	0.0000	0.0046	0.0046	0.0027	0.0002
k. Construction	7.9570	0.0002	0.0000	0.0184	0.0055	0.0032	0.0019
l. Textile and leather	38.6593	0.0007	0.0001	0.0535	0.0202	0.0158	0.0007
m. Other industries	45.7991	0.0008	0.0001	0.0625	0.0238	0.0188	0.0008
3. Transport	**1 821.7199**	**0.4397**	**0.1150**	**7.5129**	**22.8675**	**2.9169**	**0.0452**
a. Domestic aviation	1.6800	0.0000	0.0000	0.0000	0.0007	0.0000	0.0000
b. Road transportation	1 698.1445	0.4344	0.0836	6.1126	22.5709	2.7807	0.0427
c. Railways	81.0126	0.0045	0.0313	1.3467	0.2750	0.1195	0.0021
d. Domestic navigation	0.2572	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
e. Other transportation	40.6256	0.0007	0.0001	0.0536	0.0210	0.0167	0.0005
4. Other sectors	**2 219.0765**	**1.5553**	**0.0866**	**4.3367**	**22.7299**	**3.0691**	**3.7081**
a. Commercial/institutional	702.3918	0.1394	0.0050	1.0584	2.3491	0.4633	1.7723
b. Residential	1 331.6290	1.3938	0.0140	1.3513	19.0413	2.3831	1.9247
c. Agriculture/forestry/fishing	185.0557	0.0221	0.0675	1.9270	1.3395	0.2227	0.0112
ci. Stationary	7.8184	0.0091	0.0001	0.0155	0.0226	0.0100	0.0067
cii. Mobile	177.2373	0.0130	0.0674	1.9115	1.3168	0.2128	0.0045
5. Other	**25.9403**	**0.0024**	**0.0010**	**0.2301**	**0.1272**	**0.0300**	**0.0418**
a. Stationary	11.6992	0.0011	0.0002	0.0215	0.0654	0.0163	0.0405
b. Mobile	14.2411	0.0013	0.0007	0.2086	0.0618	0.0137	0.0013
B. Fugitive emissions from fuels	**1.1406**	**33.9070**	**0.0000**	**NO**	**NO**	**0.8196**	**NO**
1. Solid fuels	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**
a. Coal mining and handling	NO	NO	NO	NO	NO	NO	
b. Solid fuel transformation	NO	NO	NO	NO	NO	NO	NO
c. Other	NO	NO	NO	NO	NO	NO	NO
2. Oil and natural gas and other emissions from energy production	**1.1406**	**33.9070**	**0.0000**	**NO**	**NO**	**0.8196**	**NO**
a. Oil	0.6943	0.1750	0.0000	NO	NO	0.2050	NO
b. Natural gas	0.4463	33.7321				0.6146	NO
c. Venting and flaring	NO	NO	NO	NO	NO	NO	NO
d. Other	NO	NO	NO	NO	NO	NO	NO
C. CO_2 Transport and storage	**NO**						
1. Transport of CO_2	NO						
2. Injection and storage	NO						
3. Other	NO						
Memo items:							
International bunkers	**37.9260**	**0.0035**	**0.0013**	**0.1433**	**0.1362**	**0.0373**	**0.0120**
Aviation	37.9260	0.0035	0.0013	0.1433	0.1362	0.0373	0.0120
Navigation	NO	NO	NO	NO	NO	NO	NO
Multilateral operations	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**
CO_2 emissions from biomass	**307.3920**						
CO_2 captured	NO						
For domestic storage	NO						
For storage in other countries	NO						

2006

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2	CH_4	N_2O	NO_X	CO	NMVOC	SO_2
	(kt)						
1. Total Energy	**7 114.2233**	**32.1351**	**0.2164**	**17.0365**	**49.3930**	**7.3505**	**4.5538**
A. Fuel combustion activities (sectoral approach)	**7 112.9809**	**2.2706**	**0.2164**	**17.0365**	**49.3930**	**6.6436**	**4.5538**
1. Energy industries	**2 492.9310**	**0.0517**	**0.0057**	**3.9840**	**1.7263**	**0.1160**	**0.3339**
a. Public electricity and heat production	2 492.9310	0.0517	0.0057	3.9840	1.7263	0.1160	0.3339
b. Petroleum refining	NO	NO	NO	NO	NO	NO	NO
c. Manufacture of solid fuels and other energy industries	NO	NO	NO	NO	NO	NO	NO
2. Manufacturing industries and construction	**635.2427**	**0.0119**	**0.0015**	**0.9501**	**0.4873**	**0.2692**	**0.1695**
a. Iron and steel	76.1837	0.0014	0.0001	0.1007	0.0446	0.0315	0.0063

b. Non-ferrous metals	NO	NO	NO	NO	NO	NO	NO
c. Chemicals	4.7471	0.0001	0.0000	0.0113	0.0028	0.0019	0.0006
d. Pulp, paper and print	3.9945	0.0001	0.0000	0.0053	0.0021	0.0016	0.0000
e. Food processing, beverages and tobacco	90.9680	0.0019	0.0005	0.1877	0.1909	0.0453	0.1473
f. Non-metallic minerals	308.9902	0.0056	0.0006	0.4204	0.1614	0.1265	0.0060
g. Transport equipment	0.5049	0.0000	0.0000	0.0007	0.0003	0.0002	0.0000
h. Machinery	25.8939	0.0005	0.0001	0.0351	0.0170	0.0108	0.0040
i. Mining and quarrying	NO	NO	NO	NO	NO	NO	NO
j. Wood and wood production	1.9401	0.0001	0.0000	0.0032	0.0022	0.0014	0.0001
k. Construction	16.6913	0.0004	0.0001	0.0444	0.0115	0.0069	0.0036
l. Textile and leather	59.7847	0.0011	0.0001	0.0797	0.0310	0.0245	0.0008
m. Other industries	45.5442	0.0008	0.0001	0.0618	0.0237	0.0187	0.0007
3. Transport	**1 742.1028**	**0.4060**	**0.1198**	**7.4749**	**21.0274**	**2.7125**	**0.0436**
a. Domestic aviation	0.1972	0.0000	0.0000	0.0000	0.0001	0.0000	0.0000
b. Road transportation	1 632.5243	0.4001	0.0807	5.7813	20.6797	2.5600	0.0409
c. Railways	101.2768	0.0057	0.0391	1.6835	0.3438	0.1494	0.0026
d. Domestic navigation	0.5150	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
e. Other transportation	7.5894	0.0001	0.0000	0.0100	0.0039	0.0031	0.0001
4. Other sectors	**2 203.6648**	**1.7981**	**0.0881**	**4.2950**	**25.7482**	**3.4823**	**3.8856**
a. Commercial/institutional	644.5057	0.1450	0.0050	0.9774	2.2544	0.4462	1.6893
b. Residential	1 380.1564	1.6302	0.0164	1.4268	22.3504	2.8199	2.1869
c. Agriculture/forestry/fishing	179.0027	0.0229	0.0668	1.8908	1.1435	0.2162	0.0094
ci. Stationary	4.4555	0.0109	0.0001	0.0097	0.0240	0.0110	0.0049
cii. Mobile	174.5472	0.0120	0.0666	1.8811	1.1194	0.2052	0.0044
5. Other	**39.0397**	**0.0029**	**0.0013**	**0.3325**	**0.4037**	**0.0635**	**0.1212**
a. Stationary	21.4826	0.0013	0.0004	0.0397	0.1547	0.0256	0.1197
b. Mobile	17.5571	0.0016	0.0009	0.2928	0.2491	0.0379	0.0015
B. Fugitive emissions from fuels	**1.2424**	**29.8644**	**0.0000**	**NO**	**NO**	**0.7069**	**NO**
1. Solid fuels	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**
a. Coal mining and handling	NO	NO	NO	NO	NO	NO	
b. Solid fuel transformation	NO	NO	NO	NO	NO	NO	NO
c. Other	NO	NO	NO	NO	NO	NO	NO
2. Oil and natural gas and other emissions from energy production	**1.2424**	**29.8644**	**0.0000**	**NO**	**NO**	**0.7069**	**NO**
a. Oil	0.8506	0.1484	0.0000	NO	NO	0.1653	NO
b. Natural gas	0.3918	29.7161				0.5416	NO
c. Venting and flaring	NO	NO	NO	NO	NO	NO	NO
d. Other	NO	NO	NO	NO	NO	NO	NO
C. CO_2 Transport and storage	**NO**						
1. Transport of CO_2	NO						
2. Injection and storage	NO						
3. Other	NO						
Memo items:							
International bunkers	**37.9241**	**0.0039**	**0.0013**	**0.1428**	**0.1424**	**0.0397**	**0.0120**
Aviation	37.9241	0.0039	0.0013	0.1428	0.1424	0.0397	0.0120
Navigation	NO	NO	NO	NO	NO	NO	NO
Multilateral operations	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**
CO_2 emissions from biomass	**361.4360**						
CO_2 captured	NO						
For domestic storage	NO						
For storage in other countries	NO						

2007

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2	CH_4	N_2O	NO_X	CO	NMVOC	SO_2
	(kt)						
1. Total Energy	**7 251.2550**	**33.6430**	**0.2092**	**17.4545**	**42.9555**	**6.7550**	**3.1042**
A. Fuel combustion activities (sectoral approach)	**7 249.9793**	**1.8066**	**0.2092**	**17.4545**	**42.9555**	**5.8517**	**3.1042**
1. Energy industries	**2 890.4481**	**0.0592**	**0.0063**	**4.6122**	**2.0151**	**0.1350**	**0.2113**
a. Public electricity and heat production	2 890.4481	0.0592	0.0063	4.6122	2.0151	0.1350	0.2113
b. Petroleum refining	NO	NO	NO	NO	NO	NO	NO
c. Manufacture of solid fuels and other energy industries	NO	NO	NO	NO	NO	NO	NO
2. Manufacturing industries and construction	**801.5026**	**0.0149**	**0.0017**	**1.1306**	**0.5048**	**0.3350**	**0.0989**
a. Iron and steel	205.9880	0.0037	0.0004	0.2719	0.1109	0.0847	0.0070
b. Non-ferrous metals	NO	NO	NO	NO	NO	NO	NO
c. Chemicals	4.8741	0.0001	0.0000	0.0069	0.0026	0.0020	0.0001
d. Pulp, paper and print	3.7308	0.0001	0.0000	0.0049	0.0019	0.0015	0.0000
e. Food processing, beverages and tobacco	86.7246	0.0018	0.0003	0.1434	0.1174	0.0404	0.0730
f. Non-metallic minerals	304.0575	0.0055	0.0006	0.4151	0.1598	0.1245	0.0069
g. Transport equipment	NO	NO	NO	NO	NO	NO	NO
h. Machinery	32.7994	0.0006	0.0001	0.0456	0.0215	0.0137	0.0051
i. Mining and quarrying	0.1122	0.0000	0.0000	0.0001	0.0001	0.0000	0.0000
j. Wood and wood production	1.2629	0.0002	0.0000	0.0029	0.0036	0.0020	0.0002
k. Construction	46.3088	0.0009	0.0001	0.0855	0.0255	0.0186	0.0033
l. Textile and leather	60.1808	0.0011	0.0001	0.0795	0.0329	0.0248	0.0025

m. Other industries	55.4634	0.0010	0.0001	0.0748	0.0288	0.0227	0.0008
3. Transport	**1 846.7731**	**0.4274**	**0.1253**	**7.9312**	**21.7418**	**2.8091**	**0.0462**
a. Domestic aviation	1.0500	0.0000	0.0000	0.0000	0.0004	0.0000	0.0000
b. Road transportation	1 739.9570	0.4216	0.0860	6.2324	21.3936	2.6573	0.0436
c. Railways	101.9157	0.0057	0.0393	1.6942	0.3459	0.1503	0.0026
d. Domestic navigation	0.3437	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
e. Other transportation	3.5068	0.0001	0.0000	0.0046	0.0018	0.0014	0.0000
4. Other sectors	**1 666.7458**	**1.3012**	**0.0741**	**3.3949**	**18.3862**	**2.5173**	**2.6494**
a. Commercial/institutional	361.9216	0.1193	0.0039	0.5932	1.7515	0.3099	1.3479
b. Residential	1 152.4286	1.1664	0.0126	1.1728	15.6716	2.0252	1.2959
c. Agriculture/forestry/fishing	152.3956	0.0155	0.0576	1.6289	0.9631	0.1822	0.0057
ci. Stationary	1.8161	0.0052	0.0001	0.0039	0.0113	0.0053	0.0019
cii. Mobile	150.5795	0.0103	0.0575	1.6250	0.9519	0.1768	0.0038
5. Other	**44.5097**	**0.0039**	**0.0017**	**0.3855**	**0.3075**	**0.0552**	**0.0983**
a. Stationary	17.7980	0.0014	0.0003	0.0335	0.1302	0.0238	0.0962
b. Mobile	26.7117	0.0025	0.0014	0.3520	0.1773	0.0315	0.0020
B. Fugitive emissions from fuels	**1.2757**	**31.8364**	**0.0000**	**NO**	**NO**	**0.9033**	**NO**
1. Solid fuels	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**
a. Coal mining and handling	NO	NO	NO	NO	NO	NO	
b. Solid fuel transformation	NO	NO	NO	NO	NO	NO	NO
c. Other	NO	NO	NO	NO	NO	NO	NO
2. Oil and natural gas and other emissions from energy production	**1.2757**	**31.8364**	**0.0000**	**NO**	**NO**	**0.9033**	**NO**
a. Oil	0.8624	0.2797	0.0000	NO	NO	0.3279	NO
b. Natural gas	0.4132	31.5567				0.5754	NO
c. Venting and flaring	NO	NO	NO	NO	NO	NO	NO
d. Other	NO	NO	NO	NO	NO	NO	NO
C. CO_2 Transport and storage	**NO**						
1. Transport of CO_2	NO						
2. Injection and storage	NO						
3. Other	NO						
Memo items:							
International bunkers	**44.2052**	**0.0027**	**0.0015**	**0.1782**	**0.1296**	**0.0393**	**0.0140**
Aviation	44.2052	0.0027	0.0015	0.1782	0.1296	0.0393	0.0140
Navigation	NO	NO	NO	NO	NO	NO	NO
Multilateral operations	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**
CO_2 emissions from biomass	**304.6560**						
CO_2 captured	NO						
For domestic storage	NO						
For storage in other countries	NO						

2008

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2	CH_4	N_2O	NO_X	CO	NMVOC	SO_2
	(kt)						
1. Total Energy	**7 548.6755**	**33.5536**	**0.2128**	**18.1364**	**45.6619**	**7.3512**	**4.6736**
A. Fuel combustion activities (sectoral approach)	**7 547.3826**	**1.8613**	**0.2127**	**18.1364**	**45.6619**	**6.1704**	**4.6736**
1. Energy industries	**2 990.8419**	**0.0652**	**0.0072**	**4.7865**	**2.0898**	**0.1404**	**0.3057**
a. Public electricity and heat production	2 990.8419	0.0652	0.0072	4.7865	2.0898	0.1404	0.3057
b. Petroleum refining	NO	NO	NO	NO	NO	NO	NO
c. Manufacture of solid fuels and other energy industries	NO	NO	NO	NO	NO	NO	NO
2. Manufacturing industries and construction	**885.5633**	**0.0154**	**0.0045**	**1.3642**	**2.2677**	**0.4690**	**1.8477**
a. Iron and steel	215.0757	0.0039	0.0004	0.2907	0.1150	0.0882	0.0067
b. Non-ferrous metals	NO	NO	NO	NO	NO	NO	NO
c. Chemicals	5.5350	0.0001	0.0000	0.0074	0.0029	0.0023	0.0001
d. Pulp, paper and print	4.2395	0.0001	0.0000	0.0056	0.0022	0.0017	0.0001
e. Food processing, beverages and tobacco	98.5689	0.0020	0.0004	0.1801	0.1271	0.0448	0.0783
f. Non-metallic minerals	337.2789	0.0048	0.0032	0.5476	1.8897	0.2357	1.7515
g. Transport equipment	NO	NO	NO	NO	NO	NO	NO
h. Machinery	31.7603	0.0006	0.0001	0.0476	0.0204	0.0132	0.0047
i. Mining and quarrying	0.0561	0.0000	0.0000	0.0001	0.0000	0.0000	0.0000
j. Wood and wood production	0.7587	0.0004	0.0001	0.0022	0.0078	0.0042	0.0002
k. Construction	58.0267	0.0011	0.0001	0.0969	0.0321	0.0238	0.0031
l. Textile and leather	59.2250	0.0011	0.0001	0.0825	0.0311	0.0243	0.0014
m. Other industries	75.0387	0.0014	0.0001	0.1035	0.0393	0.0307	0.0016
3. Transport	**1 949.9802**	**0.4511**	**0.1272**	**8.2916**	**22.7260**	**2.9400**	**0.0485**
a. Domestic aviation	0.1515	0.0000	0.0000	0.0000	0.0001	0.0000	0.0000
b. Road transportation	1 851.1078	0.4458	0.0910	6.7279	22.4055	2.7999	0.0461
c. Railways	93.6942	0.0052	0.0362	1.5575	0.3180	0.1382	0.0024
d. Domestic navigation	0.3441	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
e. Other transportation	4.6826	0.0001	0.0000	0.0062	0.0024	0.0019	0.0001
4. Other sectors	**1 677.3708**	**1.3260**	**0.0723**	**3.3719**	**18.2724**	**2.5708**	**2.3550**
a. Commercial/institutional	370.7184	0.1296	0.0040	0.6218	1.6815	0.3165	1.2642
b. Residential	1 156.8420	1.1821	0.0135	1.1865	15.7179	2.0802	1.0848
c. Agriculture/forestry/fishing	149.8105	0.0143	0.0549	1.5636	0.8729	0.1741	0.0060

ci. Stationary	6.1945	0.0046	0.0001	0.0097	0.0117	0.0059	0.0024
cii. Mobile	143.6160	0.0097	0.0549	1.5539	0.8613	0.1681	0.0036
5. Other	**43.6263**	**0.0036**	**0.0015**	**0.3223**	**0.3060**	**0.0503**	**0.1167**
a. Stationary	20.3604	0.0011	0.0003	0.0393	0.1450	0.0228	0.1147
b. Mobile	23.2659	0.0025	0.0012	0.2830	0.1610	0.0274	0.0020
B. Fugitive emissions from fuels	**1.2929**	**31.6922**	**0.0000**	**NO**	**NO**	**1.1807**	**NO**
1. Solid fuels	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**
a. Coal mining and handling	NO	NO	NO	NO	NO	NO	
b. Solid fuel transformation	NO	NO	NO	NO	NO	NO	NO
c. Other	NO	NO	NO	NO	NO	NO	NO
2. Oil and natural gas and other emissions from energy production	**1.2929**	**31.6922**	**0.0000**	**NO**	**NO**	**1.1807**	**NO**
a. Oil	0.8808	0.5096	0.0000	NO	NO	0.6125	NO
b. Natural gas	0.4121	31.1826				0.5682	NO
c. Venting and flaring	NO	NO	NO	NO	NO	NO	NO
d. Other	NO	NO	NO	NO	NO	NO	NO
C. CO_2 Transport and storage	**NO**						
1. Transport of CO_2	NO						
2. Injection and storage	NO						
3. Other	NO						
Memo items:							
International bunkers	**44.1680**	**0.0016**	**0.0014**	**0.1855**	**0.1080**	**0.0365**	**0.0140**
Aviation	44.1680	0.0016	0.0014	0.1855	0.1080	0.0365	0.0140
Navigation	NO	NO	NO	NO	NO	NO	NO
Multilateral operations	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**
CO_2 emissions from biomass	**352.4520**						
CO_2 captured	NO						
For domestic storage	NO						
For storage in other countries	NO						

2009

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2	CH_4	N_2O	NO_X	CO	NMVOC	SO_2
	(kt)						
1. Total Energy	**8 093.8632**	**28.9540**	**0.1933**	**18.0332**	**45.9932**	**7.2201**	**4.6938**
A. Fuel combustion activities (sectoral approach)	**8 092.5702**	**1.9828**	**0.1933**	**18.0332**	**45.9932**	**6.0503**	**4.6938**
1. Energy industries	**3 835.5110**	**0.0831**	**0.0092**	**6.1430**	**2.6585**	**0.1791**	**0.6150**
a. Public electricity and heat production	3 835.5110	0.0831	0.0092	6.1430	2.6585	0.1791	0.6150
b. Petroleum refining	NO	NO	NO	NO	NO	NO	NO
c. Manufacture of solid fuels and other energy industries	NO	NO	NO	NO	NO	NO	NO
2. Manufacturing industries and construction	**501.9635**	**0.0080**	**0.0030**	**0.7725**	**1.6620**	**0.2842**	**1.4375**
a. Iron and steel	74.7795	0.0013	0.0001	0.1017	0.0399	0.0307	0.0023
b. Non-ferrous metals	NO	NO	NO	NO	NO	NO	NO
c. Chemicals	3.7690	0.0001	0.0000	0.0050	0.0020	0.0015	0.0001
d. Pulp, paper and print	2.8343	0.0001	0.0000	0.0038	0.0015	0.0012	0.0001
e. Food processing, beverages and tobacco	54.5104	0.0009	0.0002	0.0751	0.0756	0.0249	0.0491
f. Non-metallic minerals	226.9508	0.0030	0.0025	0.3882	1.4683	0.1689	1.3807
g. Transport equipment	NO	NO	NO	NO	NO	NO	NO
h. Machinery	13.5838	0.0002	0.0000	0.0184	0.0072	0.0056	0.0004
i. Mining and quarrying	NO	NO	NO	NO	NO	NO	NO
j. Wood and wood production	0.2337	0.0000	0.0000	0.0003	0.0001	0.0001	0.0000
k. Construction	9.3637	0.0002	0.0000	0.0223	0.0056	0.0037	0.0013
l. Textile and leather	38.8219	0.0007	0.0001	0.0527	0.0207	0.0159	0.0012
m. Other industries	77.1164	0.0014	0.0001	0.1049	0.0412	0.0316	0.0024
3. Transport	**1 919.6624**	**0.4575**	**0.1112**	**7.5165**	**22.6058**	**2.8767**	**0.0046**
a. Domestic aviation	0.0760	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
b. Road transportation	1 856.2592	0.4544	0.0914	6.6480	22.4255	2.7962	0.0043
c. Railways	51.3203	0.0029	0.0198	0.8531	0.1742	0.0757	0.0001
d. Domestic navigation	0.3447	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
e. Other transportation	11.6623	0.0002	0.0000	0.0154	0.0060	0.0048	0.0001
4. Other sectors	**1 824.9424**	**1.4331**	**0.0696**	**3.4994**	**18.9129**	**2.6852**	**2.6186**
a. Commercial/institutional	476.5648	0.2179	0.0053	0.7996	1.9153	0.4377	1.3016
b. Residential	1 209.2046	1.1981	0.0130	1.2291	16.0649	2.0783	1.3140
c. Agriculture/forestry/fishing	139.1730	0.0171	0.0513	1.4707	0.9328	0.1692	0.0029
ci. Stationary	4.6102	0.0074	0.0001	0.0087	0.0165	0.0083	0.0025
cii. Mobile	134.5628	0.0098	0.0512	1.4619	0.9163	0.1609	0.0004
5. Other	**10.4909**	**0.0011**	**0.0003**	**0.1018**	**0.1540**	**0.0251**	**0.0182**
a. Stationary	7.4748	0.0006	0.0001	0.0162	0.0299	0.0081	0.0181
b. Mobile	3.0161	0.0006	0.0002	0.0856	0.1241	0.0170	0.0000
B. Fugitive emissions from fuels	**1.2930**	**26.9712**	**0.0000**	**NO**	**NO**	**1.1698**	**NO**
1. Solid fuels	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**
a. Coal mining and handling	NO	NO	NO	NO	NO	NO	
b. Solid fuel transformation	NO	NO	NO	NO	NO	NO	NO
c. Other	NO	NO	NO	NO	NO	NO	NO
2. Oil and natural gas and other emissions from energy production	**1.2930**	**26.9712**	**0.0000**	**NO**	**NO**	**1.1698**	**NO**

a. Oil	0.8893	0.5753	0.0000	NO	NO	0.6938	NO
b. Natural gas	0.4037	26.3959				0.4760	NO
c. Venting and flaring	NO	NO	NO	NO	NO	NO	NO
d. Other	NO	NO	NO	NO	NO	NO	NO
C. CO_2 Transport and storage	**NO**						
1. Transport of CO_2	NO						
2. Injection and storage	NO						
3. Other	NO						
Memo items:							
International bunkers	**44.1719**	**0.0017**	**0.0014**	**0.1878**	**0.1094**	**0.0380**	**0.0140**
Aviation	44.1719	0.0017	0.0014	0.1878	0.1094	0.0380	0.0140
Navigation	NO	NO	NO	NO	NO	NO	NO
Multilateral operations	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**
CO_2 emissions from biomass	**362.1000**						
CO_2 captured	NO						
For domestic storage	NO						
For storage in other countries	NO						

2010

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2	CH_4	N_2O	NO_X	CO	NMVOC	SO_2
	(kt)						
1. Total Energy	**8 719.0513**	**28.5855**	**0.2105**	**19.9684**	**48.6806**	**7.2606**	**4.8053**
A. Fuel combustion activities (sectoral approach)	**8 717.7555**	**2.1371**	**0.2105**	**19.9684**	**48.6806**	**6.3424**	**4.8053**
1. Energy industries	**4 047.8107**	**0.0891**	**0.0098**	**6.4814**	**2.8196**	**0.1898**	**0.5281**
a. Public electricity and heat production	4 047.8107	0.0891	0.0098	6.4814	2.8196	0.1898	0.5281
b. Petroleum refining	NO	NO	NO	NO	NO	NO	NO
c. Manufacture of solid fuels and other energy industries	NO	NO	NO	NO	NO	NO	NO
2. Manufacturing industries and construction	**516.1412**	**0.0094**	**0.0030**	**0.8397**	**1.5071**	**0.2868**	**1.2574**
a. Iron and steel	40.8744	0.0007	0.0001	0.0550	0.0243	0.0169	0.0038
b. Non-ferrous metals	NO	NO	NO	NO	NO	NO	NO
c. Chemicals	3.9111	0.0001	0.0000	0.0053	0.0021	0.0016	0.0001
d. Pulp, paper and print	3.0075	0.0001	0.0000	0.0044	0.0016	0.0012	0.0001
e. Food processing, beverages and tobacco	69.4206	0.0014	0.0003	0.1206	0.1018	0.0328	0.0647
f. Non-metallic minerals	240.4992	0.0034	0.0022	0.3945	1.2754	0.1627	1.1778
g. Transport equipment	NO	NO	NO	NO	NO	NO	NO
h. Machinery	17.7529	0.0004	0.0000	0.0283	0.0126	0.0080	0.0027
i. Mining and quarrying	NO	NO	NO	NO	NO	NO	NO
j. Wood and wood production	0.6096	0.0006	0.0001	0.0027	0.0123	0.0065	0.0002
k. Construction	17.0147	0.0005	0.0001	0.0626	0.0117	0.0066	0.0047
l. Textile and leather	48.7909	0.0009	0.0001	0.0655	0.0258	0.0200	0.0013
m. Other industries	74.2603	0.0013	0.0001	0.1006	0.0394	0.0305	0.0020
3. Transport	**2 140.5138**	**0.4708**	**0.1225**	**8.7584**	**22.2774**	**2.8861**	**0.0052**
a. Domestic aviation	0.3500	0.0000	0.0000	0.0000	0.0001	0.0000	0.0000
b. Road transportation	2 069.9797	0.4675	0.1023	7.8668	22.0908	2.8018	0.0048
c. Railways	52.2332	0.0029	0.0202	0.8683	0.1773	0.0771	0.0001
d. Domestic navigation	0.2590	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
e. Other transportation	17.6919	0.0003	0.0000	0.0233	0.0091	0.0073	0.0002
4. Other sectors	**1 985.9921**	**1.5654**	**0.0746**	**3.7644**	**21.8247**	**2.9363**	**2.9155**
a. Commercial/institutional	477.2015	0.1304	0.0035	0.7498	1.3667	0.3305	0.9312
b. Residential	1 353.0451	1.4132	0.0141	1.3733	19.3270	2.4123	1.9815
c. Agriculture/forestry/fishing	155.7455	0.0218	0.0570	1.6413	1.1309	0.1935	0.0028
ci. Stationary	5.8039	0.0105	0.0001	0.0106	0.0226	0.0118	0.0023
cii. Mobile	149.9416	0.0114	0.0569	1.6307	1.1083	0.1818	0.0005
5. Other	**27.2976**	**0.0023**	**0.0006**	**0.1245**	**0.2519**	**0.0434**	**0.0991**
a. Stationary	23.7958	0.0017	0.0004	0.0438	0.1389	0.0278	0.0991
b. Mobile	3.5018	0.0007	0.0002	0.0806	0.1130	0.0156	0.0000
B. Fugitive emissions from fuels	**1.2958**	**26.4485**	**0.0000**	**NO**	**NO**	**0.9181**	**NO**
1. Solid fuels	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**
a. Coal mining and handling	NO	NO	NO	NO	NO	NO	
b. Solid fuel transformation	NO	NO	NO	NO	NO	NO	NO
c. Other	NO	NO	NO	NO	NO	NO	NO
2. Oil and natural gas and other emissions from energy production	**1.2958**	**26.4485**	**0.0000**	**NO**	**NO**	**0.9181**	**NO**
a. Oil	0.8778	0.3783	0.0000	NO	NO	0.4499	NO
b. Natural gas	0.4180	26.0702				0.4683	NO
c. Venting and flaring	NO	NO	NO	NO	NO	NO	NO
d. Other	NO	NO	NO	NO	NO	NO	NO
C. CO_2 Transport and storage	**NO**						
1. Transport of CO_2	NO						
2. Injection and storage	NO						
3. Other	NO						
Memo items:							
International bunkers	**41.0593**	**0.0026**	**0.0014**	**0.1667**	**0.1218**	**0.0377**	**0.0130**

Aviation	41.0593	0.0026	0.0014	0.1667	0.1218	0.0377	0.0130
Navigation	NO	NO	NO	NO	NO	NO	NO
Multilateral operations	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**
CO_2 emissions from biomass	**341.0480**						
CO_2 captured	NO						
For domestic storage	NO						
For storage in other countries	NO						

2011

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2	CH_4	N_2O	NO_X	CO	NMVOC	SO_2
	(kt)						
1. Total Energy	**8 926.8957**	**31.8482**	**0.2164**	**20.3098**	**51.1208**	**7.8715**	**4.8128**
A. Fuel combustion activities (sectoral approach)	**8 925.5610**	**2.2550**	**0.2164**	**20.3098**	**51.1208**	**6.8151**	**4.8128**
1. Energy industries	**3 746.1444**	**0.0799**	**0.0087**	**5.9885**	**2.6096**	**0.1753**	**0.3978**
a. Public electricity and heat production	3 746.1444	0.0799	0.0087	5.9885	2.6096	0.1753	0.3978
b. Petroleum refining	NO	NO	NO	NO	NO	NO	NO
c. Manufacture of solid fuels and other energy industries	NO	NO	NO	NO	NO	NO	NO
2. Manufacturing industries and construction	**576.1765**	**0.0107**	**0.0036**	**0.9067**	**1.8629**	**0.3338**	**1.5810**
a. Iron and steel	53.4812	0.0010	0.0001	0.0726	0.0327	0.0222	0.0058
b. Non-ferrous metals	NO	NO	NO	NO	NO	NO	NO
c. Chemicals	5.8483	0.0001	0.0000	0.0152	0.0035	0.0023	0.0010
d. Pulp, paper and print	5.6177	0.0001	0.0000	0.0074	0.0029	0.0023	0.0001
e. Food processing, beverages and tobacco	74.0144	0.0015	0.0003	0.1077	0.1108	0.0356	0.0720
f. Non-metallic minerals	276.1631	0.0037	0.0027	0.4479	1.6002	0.1933	1.4921
g. Transport equipment	NO	NO	NO	NO	NO	NO	NO
h. Machinery	19.4958	0.0005	0.0001	0.0279	0.0144	0.0093	0.0024
i. Mining and quarrying	NO	NO	NO	NO	NO	NO	NO
j. Wood and wood production	0.5716	0.0011	0.0001	0.0039	0.0202	0.0107	0.0004
k. Construction	16.2006	0.0004	0.0001	0.0551	0.0109	0.0064	0.0040
l. Textile and leather	48.3914	0.0009	0.0001	0.0652	0.0267	0.0205	0.0012
m. Other industries	76.3923	0.0014	0.0001	0.1037	0.0405	0.0313	0.0020
3. Transport	**2 272.6744**	**0.4687**	**0.1281**	**9.1192**	**22.9464**	**2.9620**	**0.0056**
a. Domestic aviation	0.0700	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
b. Road transportation	2 197.5929	0.4655	0.1094	8.2831	22.7690	2.8800	0.0052
c. Railways	48.1916	0.0027	0.0186	0.8011	0.1636	0.0711	0.0001
d. Domestic navigation	0.2596	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
e. Other transportation	26.5603	0.0005	0.0000	0.0350	0.0137	0.0109	0.0003
4. Other sectors	**2 310.7777**	**1.6944**	**0.0756**	**4.1423**	**23.3551**	**3.2990**	**2.7405**
a. Commercial/institutional	806.0042	0.1538	0.0040	1.1678	1.5327	0.4616	0.9375
b. Residential	1 352.5610	1.5224	0.0161	1.3930	20.6430	2.6529	1.7971
c. Agriculture/forestry/fishing	152.2126	0.0182	0.0555	1.5815	1.1793	0.1845	0.0058
ci. Stationary	5.8163	0.0067	0.0001	0.0099	0.0168	0.0071	0.0054
cii. Mobile	146.3963	0.0114	0.0554	1.5716	1.1625	0.1773	0.0005
5. Other	**19.7881**	**0.0013**	**0.0004**	**0.1531**	**0.3469**	**0.0449**	**0.0879**
a. Stationary	15.9259	0.0007	0.0002	0.0276	0.1091	0.0164	0.0878
b. Mobile	3.8622	0.0006	0.0002	0.1255	0.2378	0.0285	0.0001
B. Fugitive emissions from fuels	**1.3347**	**29.5932**	**0.0000**	**NO**	**NO**	**1.0564**	**NO**
1. Solid fuels	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**
a. Coal mining and handling	NO	NO	NO	NO	NO	NO	
b. Solid fuel transformation	NO	NO	NO	NO	NO	NO	NO
c. Other	NO	NO	NO	NO	NO	NO	NO
2. Oil and natural gas and other emissions from energy production	**1.3347**	**29.5932**	**0.0000**	**NO**	**NO**	**1.0564**	**NO**
a. Oil	0.8859	0.4439	0.0000	NO	NO	0.5312	NO
b. Natural gas	0.4488	29.1493				0.5252	NO
c. Venting and flaring	NO	NO	NO	NO	NO	NO	NO
d. Other	NO	NO	NO	NO	NO	NO	NO
C. CO_2 Transport and storage	**NO**						
1. Transport of CO_2	NO						
2. Injection and storage	NO						
3. Other	NO						
Memo items:							
International bunkers	**41.0082**	**0.0028**	**0.0013**	**0.1611**	**0.1246**	**0.0496**	**0.0130**
Aviation	41.0082	0.0028	0.0013	0.1611	0.1246	0.0496	0.0130
Navigation	NO	NO	NO	NO	NO	NO	NO
Multilateral operations	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**
CO_2 emissions from biomass	**384.6400**						
CO_2 captured	NO						
For domestic storage	NO						
For storage in other countries	NO						

2012

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2	CH_4	N_2O	NO_X	CO	NMVOC	SO_2
	(kt)						
1. Total Energy	**8 614.8544**	**31.6092**	**0.2019**	**19.2239**	**49.8924**	**7.6602**	**4.9700**
A. Fuel combustion activities (sectoral approach)	**8 613.5235**	**2.4176**	**0.2019**	**19.2239**	**49.8924**	**6.6913**	**4.9700**
1. Energy industries	**3 803.4077**	**0.0755**	**0.0086**	**6.0853**	**2.6153**	**0.1756**	**0.6665**
a. Public electricity and heat production	3 803.4077	0.0755	0.0086	6.0853	2.6153	0.1756	0.6665
b. Petroleum refining	NO	NO	NO	NO	NO	NO	NO
c. Manufacture of solid fuels and other energy industries	NO	NO	NO	NO	NO	NO	NO
2. Manufacturing industries and construction	**539.1478**	**0.0106**	**0.0030**	**0.8256**	**1.4506**	**0.3009**	**1.1715**
a. Iron and steel	65.1107	0.0012	0.0001	0.0872	0.0342	0.0267	0.0014
b. Non-ferrous metals	NO	NO	NO	NO	NO	NO	NO
c. Chemicals	5.8764	0.0001	0.0000	0.0079	0.0031	0.0024	0.0001
d. Pulp, paper and print	3.5210	0.0001	0.0000	0.0047	0.0018	0.0014	0.0000
e. Food processing, beverages and tobacco	81.6297	0.0016	0.0003	0.1199	0.1299	0.0400	0.0862
f. Non-metallic minerals	216.6810	0.0031	0.0020	0.3462	1.1625	0.1481	1.0735
g. Transport equipment	NO	NO	NO	NO	NO	NO	NO
h. Machinery	18.8442	0.0004	0.0000	0.0257	0.0117	0.0078	0.0022
i. Mining and quarrying	NO	NO	NO	NO	NO	NO	NO
j. Wood and wood production	1.1744	0.0014	0.0002	0.0065	0.0263	0.0140	0.0006
k. Construction	18.8991	0.0005	0.0001	0.0564	0.0121	0.0075	0.0038
l. Textile and leather	46.8611	0.0009	0.0001	0.0629	0.0266	0.0199	0.0019
m. Other industries	80.5503	0.0014	0.0001	0.1083	0.0424	0.0330	0.0018
3. Transport	**1 992.5651**	**0.4049**	**0.1152**	**8.2265**	**19.3038**	**2.5284**	**0.0048**
a. Domestic aviation	0.1400	0.0000	0.0000	0.0000	0.0001	0.0000	0.0000
b. Road transportation	1 916.4223	0.4016	0.0951	7.3317	19.1151	2.4420	0.0044
c. Railways	51.9397	0.0029	0.0200	0.8634	0.1763	0.0766	0.0001
d. Domestic navigation	0.2601	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
e. Other transportation	23.8030	0.0004	0.0000	0.0314	0.0123	0.0098	0.0003
4. Other sectors	**2 271.4679**	**1.9260**	**0.0750**	**4.0329**	**26.3885**	**3.6707**	**3.1225**
a. Commercial/institutional	777.0093	0.1756	0.0041	1.1061	1.4891	0.4719	0.8608
b. Residential	1 345.5955	1.7270	0.0175	1.4064	23.7408	3.0150	2.2553
c. Agriculture/forestry/fishing	148.8631	0.0235	0.0534	1.5204	1.1586	0.1838	0.0065
ci. Stationary	8.4205	0.0126	0.0002	0.0145	0.0290	0.0137	0.0060
cii. Mobile	140.4426	0.0109	0.0532	1.5059	1.1296	0.1701	0.0004
5. Other	**6.9350**	**0.0006**	**0.0002**	**0.0536**	**0.1342**	**0.0157**	**0.0047**
a. Stationary	3.5864	0.0001	0.0000	0.0057	0.0070	0.0019	0.0046
b. Mobile	3.3486	0.0005	0.0002	0.0479	0.1273	0.0138	0.0000
B. Fugitive emissions from fuels	**1.3309**	**29.1916**	**0.0000**	**NO**	**NO**	**0.9690**	**NO**
1. Solid fuels	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**
a. Coal mining and handling	NO	NO	NO	NO	NO	NO	
b. Solid fuel transformation	NO	NO	NO	NO	NO	NO	NO
c. Other	NO	NO	NO	NO	NO	NO	NO
2. Oil and natural gas and other emissions from energy production	**1.3309**	**29.1916**	**0.0000**	**NO**	**NO**	**0.9690**	**NO**
a. Oil	0.8861	0.3783	0.0000	NO	NO	0.4499	NO
b. Natural gas	0.4448	28.8133				0.5191	NO
c. Venting and flaring	NO	NO	NO	NO	NO	NO	NO
d. Other	NO	NO	NO	NO	NO	NO	NO
C. CO_2 Transport and storage	**NO**						
1. Transport of CO_2	NO						
2. Injection and storage	NO						
3. Other	NO						
Memo items:							
International bunkers	**47.3142**	**0.0028**	**0.0015**	**0.1806**	**0.1322**	**0.0558**	**0.0150**
Aviation	47.3142	0.0028	0.0015	0.1806	0.1322	0.0558	0.0150
Navigation	NO	NO	NO	NO	NO	NO	NO
Multilateral operations	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**
CO_2 emissions from biomass	**403.3840**						
CO_2 captured	NO						
For domestic storage	NO						
For storage in other countries	NO						

2013

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2	CH_4	N_2O	NO_X	CO	NMVOC	SO_2
	(kt)						
1. Total Energy	**8 227.6443**	**29.7144**	**0.2194**	**19.3494**	**50.9262**	**7.6008**	**12.4523**
A. Fuel combustion activities (sectoral approach)	**8 225.9844**	**2.4705**	**0.2194**	**19.3494**	**50.9262**	**6.7020**	**12.4523**
1. Energy industries	**3 596.7176**	**0.0677**	**0.0188**	**6.2249**	**2.0253**	**0.1397**	**7.1268**
a. Public electricity and heat production	3 596.7176	0.0677	0.0188	6.2249	2.0253	0.1397	7.1268
b. Petroleum refining	NO	NO	NO	NO	NO	NO	NO
c. Manufacture of solid fuels and other energy industries	NO	NO	NO	NO	NO	NO	NO
2. Manufacturing industries and construction	**577.6855**	**0.0097**	**0.0042**	**0.8830**	**2.3030**	**0.3557**	**2.0352**
a. Iron and steel	31.7703	0.0006	0.0001	0.0430	0.0183	0.0131	0.0024

b. Non-ferrous metals	NO	NO	NO	NO	NO	NO	NO
c. Chemicals	7.4355	0.0004	0.0000	0.0180	0.0083	0.0050	0.0010
d. Pulp, paper and print	3.6648	0.0001	0.0000	0.0049	0.0019	0.0015	0.0000
e. Food processing, beverages and tobacco	83.9180	0.0019	0.0003	0.1167	0.1201	0.0420	0.0715
f. Non-metallic minerals	302.7477	0.0038	0.0034	0.4935	2.0691	0.2295	1.9568
g. Transport equipment	NO	NO	NO	NO	NO	NO	NO
h. Machinery	17.7354	0.0003	0.0000	0.0239	0.0093	0.0073	0.0003
i. Mining and quarrying	NO	NO	NO	NO	NO	NO	NO
j. Wood and wood production	4.6059	0.0005	0.0001	0.0073	0.0098	0.0058	0.0002
k. Construction	14.8862	0.0003	0.0000	0.0260	0.0082	0.0061	0.0009
l. Textile and leather	51.6214	0.0009	0.0001	0.0697	0.0270	0.0211	0.0010
m. Other industries	59.3005	0.0011	0.0001	0.0801	0.0310	0.0243	0.0011
3. Transport	**2 101.2934**	**0.4086**	**0.1153**	**8.4230**	**18.8125**	**2.4595**	**0.0049**
a. Domestic aviation	0.1965	0.0000	0.0000	0.0000	0.0001	0.0000	0.0000
b. Road transportation	2 052.7538	0.4065	0.1024	7.8501	18.6917	2.4043	0.0046
c. Railways	33.2930	0.0019	0.0128	0.5534	0.1130	0.0491	0.0001
d. Domestic navigation	0.2608	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
e. Other transportation	14.7893	0.0003	0.0000	0.0195	0.0076	0.0061	0.0002
4. Other sectors	**1 947.9381**	**1.9842**	**0.0809**	**3.7783**	**27.7557**	**3.7434**	**3.2852**
a. Commercial/institutional	471.0134	0.1303	0.0035	0.6965	1.3776	0.3334	0.9323
b. Residential	1 311.5084	1.8255	0.0186	1.3894	25.1279	3.2071	2.3343
c. Agriculture/forestry/fishing	165.4163	0.0284	0.0589	1.6923	1.2502	0.2029	0.0185
ci. Stationary	10.5355	0.0166	0.0002	0.0184	0.0420	0.0149	0.0181
cii. Mobile	154.8808	0.0118	0.0587	1.6739	1.2082	0.1880	0.0005
5. Other	**2.3497**	**0.0003**	**0.0001**	**0.0403**	**0.0297**	**0.0037**	**0.0003**
a. Stationary	0.2064	0.0000	0.0000	0.0008	0.0002	0.0001	0.0003
b. Mobile	2.1433	0.0003	0.0001	0.0395	0.0295	0.0036	0.0000
B. Fugitive emissions from fuels	**1.6599**	**27.2439**	**0.0000**	**NO**	**NO**	**0.8989**	**NO**
1. Solid fuels	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**
a. Coal mining and handling	NO	NO	NO	NO	NO	NO	
b. Solid fuel transformation	NO	NO	NO	NO	NO	NO	NO
c. Other	NO	NO	NO	NO	NO	NO	NO
2. Oil and natural gas and other emissions from energy production	**1.6599**	**27.2439**	**0.0000**	**NO**	**NO**	**0.8989**	**NO**
a. Oil	1.2856	0.3539	0.0000	NO	NO	0.4105	NO
b. Natural gas	0.3743	26.8900				0.4883	NO
c. Venting and flaring	NO	NO	NO	NO	NO	NO	NO
d. Other	NO	NO	NO	NO	NO	NO	NO
C. CO_2 Transport and storage	**NO**						
1. Transport of CO_2	NO						
2. Injection and storage	NO						
3. Other	NO						
Memo items:							
International bunkers	**41.0717**	**0.0046**	**0.0013**	**0.1592**	**0.1584**	**0.0571**	**0.0130**
Aviation	41.0717	0.0046	0.0013	0.1592	0.1584	0.0571	0.0130
Navigation	NO	NO	NO	NO	NO	NO	NO
Multilateral operations	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**
CO_2 emissions from biomass	**429.2796**						
CO_2 captured	NO						
For domestic storage	NO						
For storage in other countries	NO						

2014

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2	CH_4	N_2O	NO_X	CO	NMVOC	SO_2
	(kt)						
1. Total Energy	**8 214.8567**	**31.2848**	**0.2441**	**19.1555**	**77.8236**	**11.7283**	**4.6819**
A. Fuel combustion activities (sectoral approach)	**8 213.1659**	**4.5778**	**0.2441**	**19.1555**	**77.8236**	**10.9231**	**4.6819**
1. Energy industries	**3 555.9756**	**0.0750**	**0.0082**	**5.6971**	**2.4781**	**0.1664**	**0.4068**
a. Public electricity and heat production	3 555.9756	0.0750	0.0082	5.6971	2.4781	0.1664	0.4068
b. Petroleum refining	NO	NO	NO	NO	NO	NO	NO
c. Manufacture of solid fuels and other energy industries	NO	NO	NO	NO	NO	NO	NO
2. Manufacturing industries and construction	**563.8971**	**0.0099**	**0.0036**	**0.8995**	**1.9366**	**0.3298**	**1.6679**
a. Iron and steel	67.3974	0.0012	0.0001	0.0907	0.0354	0.0276	0.0015
b. Non-ferrous metals	NO	NO	NO	NO	NO	NO	NO
c. Chemicals	6.5826	0.0001	0.0000	0.0088	0.0034	0.0027	0.0001
d. Pulp, paper and print	3.8055	0.0001	0.0000	0.0050	0.0020	0.0016	0.0001
e. Food processing, beverages and tobacco	93.5312	0.0021	0.0004	0.1736	0.1611	0.0468	0.1083
f. Non-metallic minerals	240.7850	0.0031	0.0027	0.3979	1.6441	0.1840	1.5525
g. Transport equipment	NO	NO	NO	NO	NO	NO	NO
h. Machinery	10.9025	0.0002	0.0000	0.0147	0.0057	0.0045	0.0002
i. Mining and quarrying	NO	NO	NO	NO	NO	NO	NO
j. Wood and wood production	2.3703	0.0005	0.0001	0.0046	0.0104	0.0058	0.0002
k. Construction	23.9060	0.0005	0.0001	0.0499	0.0143	0.0099	0.0024
l. Textile and leather	34.8300	0.0006	0.0001	0.0468	0.0183	0.0143	0.0007

m. Other industries	79.7866	0.0014	0.0001	0.1074	0.0419	0.0327	0.0017
3. Transport	**2 140.5508**	**0.4056**	**0.1070**	**8.0152**	**18.5701**	**2.4006**	**0.0049**
a. Domestic aviation	0.1400	0.0000	0.0000	0.0000	0.0001	0.0000	0.0000
b. Road transportation	2 115.9635	0.4049	0.1058	7.9433	18.5506	2.3885	0.0047
c. Railways	2.7887	0.0002	0.0011	0.0464	0.0095	0.0041	0.0000
d. Domestic navigation	2.3529	0.0002	0.0001	0.0001	0.0000	0.0000	0.0000
e. Other transportation	19.3057	0.0003	0.0000	0.0255	0.0100	0.0079	0.0002
4. Other sectors	**1 927.7357**	**4.0868**	**0.1247**	**4.4921**	**54.5828**	**8.0026**	**2.4012**
a. Commercial/institutional	482.9781	0.1892	0.0038	0.7164	1.2199	0.3830	0.6697
b. Residential	1 246.5418	3.8638	0.0477	1.6926	51.8127	7.3703	1.7147
c. Agriculture/forestry/fishing	198.2158	0.0339	0.0732	2.0830	1.5501	0.2492	0.0168
ci. Stationary	5.7310	0.0191	0.0002	0.0124	0.0444	0.0165	0.0162
cii. Mobile	192.4849	0.0147	0.0730	2.0706	1.5057	0.2327	0.0006
5. Other	**25.0067**	**0.0006**	**0.0005**	**0.0516**	**0.2560**	**0.0237**	**0.2011**
a. Stationary	22.8029	0.0002	0.0004	0.0421	0.2229	0.0213	0.2011
b. Mobile	2.2039	0.0003	0.0001	0.0095	0.0331	0.0025	0.0000
B. Fugitive emissions from fuels	**1.6908**	**26.7070**	**0.0000**	**NO**	**NO**	**0.8052**	**NO**
1. Solid fuels	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**
a. Coal mining and handling	NO	NO	NO	NO	NO	NO	
b. Solid fuel transformation	NO	NO	NO	NO	NO	NO	NO
c. Other	NO	NO	NO	NO	NO	NO	NO
2. Oil and natural gas and other emissions from energy production	**1.6908**	**26.7070**	**0.0000**	**NO**	**NO**	**0.8052**	**NO**
a. Oil	1.2829	0.2883	0.0000	NO	NO	0.3292	NO
b. Natural gas	0.4079	26.4187				0.4760	NO
c. Venting and flaring	NO	NO	NO	NO	NO	NO	NO
d. Other	NO	NO	NO	NO	NO	NO	NO
C. CO_2 Transport and storage	**NO**						
1. Transport of CO_2	NO						
2. Injection and storage	NO						
3. Other	NO						
Memo items:							
International bunkers	**53.6855**	**0.0034**	**0.0018**	**0.2110**	**0.1599**	**0.0553**	**0.0170**
Aviation	53.6855	0.0034	0.0018	0.2110	0.1599	0.0553	0.0170
Navigation	NO	NO	NO	NO	NO	NO	NO
Multilateral operations	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**
CO_2 emissions from biomass	**1 314.4896**						
CO_2 captured	NO						
For domestic storage	NO						
For storage in other countries	NO						

2015

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2	CH_4	N_2O	NO_x	CO	NMVOC	SO_2
	(kt)						
1. Total Energy	**8 277.6210**	**30.5108**	**0.2660**	**20.0982**	**81.9714**	**12.2797**	**4.2232**
A. Fuel combustion activities (sectoral approach)	**8 275.9434**	**4.8476**	**0.2660**	**20.0982**	**81.9714**	**11.5338**	**4.2232**
1. Energy industries	**3 684.4508**	**0.0658**	**0.0067**	**5.8503**	**2.5548**	**0.1705**	**0.1072**
a. Public electricity and heat production	3 680.5003	0.0657	0.0067	5.8439	2.5540	0.1704	0.0871
b. Petroleum refining	3.9505	0.0002	0.0000	0.0065	0.0008	0.0001	0.0201
c. Manufacture of solid fuels and other energy industries	NO	NO	NO	NO	NO	NO	NO
2. Manufacturing industries and construction	**517.0989**	**0.0100**	**0.0035**	**0.7978**	**1.8079**	**0.3136**	**1.5442**
a. Iron and steel	49.7713	0.0009	0.0001	0.0672	0.0262	0.0204	0.0011
b. Non-ferrous metals	NO	NO	NO	NO	NO	NO	NO
c. Chemicals	4.5092	0.0002	0.0000	0.0089	0.0048	0.0030	0.0004
d. Pulp, paper and print	4.1181	0.0001	0.0000	0.0055	0.0021	0.0017	0.0001
e. Food processing, beverages and tobacco	85.9071	0.0027	0.0004	0.1245	0.1168	0.0489	0.0528
f. Non-metallic minerals	239.3253	0.0032	0.0026	0.4005	1.5777	0.1805	1.4848
g. Transport equipment	0.0000	0.0000	0.0000	0.0001	0.0006	0.0003	0.0000
h. Machinery	9.3882	0.0002	0.0000	0.0131	0.0058	0.0039	0.0011
i. Mining and quarrying	NO	NO	NO	NO	NO	NO	NO
j. Wood and wood production	0.2065	0.0004	0.0001	0.0015	0.0075	0.0040	0.0001
k. Construction	13.5991	0.0003	0.0000	0.0274	0.0077	0.0055	0.0013
l. Textile and leather	26.9906	0.0005	0.0001	0.0365	0.0147	0.0114	0.0006
m. Other industries	83.2836	0.0015	0.0002	0.1125	0.0438	0.0341	0.0019
3. Transport	**2 261.4456**	**0.4285**	**0.1197**	**8.8431**	**19.1901**	**2.5021**	**0.0051**
a. Domestic aviation	0.3113	0.0000	0.0000	0.0000	0.0001	0.0000	0.0000
b. Road transportation	2 216.7708	0.4267	0.1109	8.4436	19.1036	2.4609	0.0048
c. Railways	22.4827	0.0013	0.0087	0.3737	0.0763	0.0332	0.0000
d. Domestic navigation	2.4400	0.0002	0.0001	0.0001	0.0000	0.0000	0.0000
e. Other transportation	19.4409	0.0003	0.0000	0.0256	0.0100	0.0080	0.0002
4. Other sectors	**1 790.2120**	**4.3428**	**0.1357**	**4.5595**	**58.1877**	**8.5261**	**2.3805**
a. Commercial/institutional	340.0285	0.1451	0.0032	0.5495	1.0622	0.2889	0.6518
b. Residential	1 231.3854	4.1654	0.0518	1.7302	55.8313	7.9789	1.7027
c. Agriculture/forestry/fishing	218.7982	0.0323	0.0807	2.2799	1.2941	0.2583	0.0260

ci. Stationary	7.9737	0.0180	0.0002	0.0147	0.0468	0.0134	0.0253
cii. Mobile	210.8245	0.0142	0.0806	2.2652	1.2474	0.2449	0.0007
5. Other	**22.7360**	**0.0005**	**0.0004**	**0.0475**	**0.2309**	**0.0216**	**0.1861**
a. Stationary	21.0924	0.0002	0.0003	0.0389	0.2062	0.0197	0.1861
b. Mobile	1.6436	0.0003	0.0001	0.0086	0.0247	0.0019	0.0000
B. Fugitive emissions from fuels	**1.6776**	**25.6632**	**0.0000**	**NO**	**NO**	**0.7458**	**NO**
1. Solid fuels	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**
a. Coal mining and handling	NO	NO	NO	NO	NO	NO	
b. Solid fuel transformation	NO	NO	NO	NO	NO	NO	NO
c. Other	NO	NO	NO	NO	NO	NO	NO
2. Oil and natural gas and other emissions from energy production	**1.6776**	**25.6632**	**0.0000**	**NO**	**NO**	**0.7458**	**NO**
a. Oil	1.2797	0.2554	0.0000	NO	NO	0.2886	NO
b. Natural gas	0.3979	25.4078				0.4573	NO
c. Venting and flaring	NO	NO	NO	NO	NO	NO	NO
d. Other	NO	NO	NO	NO	NO	NO	NO
C. CO_2 Transport and storage	**NO**						
1. Transport of CO_2	NO						
2. Injection and storage	NO						
3. Other	NO						
Memo items:							
International bunkers	**56.8077**	**0.0056**	**0.0018**	**0.2255**	**0.1841**	**0.0817**	**0.0180**
Aviation	56.8077	0.0056	0.0018	0.2255	0.1841	0.0817	0.0180
Navigation	NO	NO	NO	NO	NO	NO	NO
Multilateral operations	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**
CO_2 emissions from biomass	**1 428.4386**						
CO_2 captured	NO						
For domestic storage	NO						
For storage in other countries	NO						

2016

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2	CH_4	N_2O	NO_x	CO	NMVOC	SO_2
	(kt)						
1. Total Energy	**8 353.8926**	**32.7079**	**0.2853**	**20.9516**	**85.7020**	**12.9977**	**3.4387**
A. Fuel combustion activities (sectoral approach)	**8 352.2025**	**5.2344**	**0.2853**	**20.9516**	**85.7020**	**12.2579**	**3.4387**
1. Energy industries	**3 644.8751**	**0.0657**	**0.0069**	**5.7964**	**2.5196**	**0.1682**	**0.2330**
a. Public electricity and heat production	3 640.8500	0.0656	0.0069	5.7904	2.5187	0.1681	0.2166
b. Petroleum refining	4.0252	0.0002	0.0000	0.0059	0.0008	0.0001	0.0164
c. Manufacture of solid fuels and other energy industries	NO	NO	NO	NO	NO	NO	NO
2. Manufacturing industries and construction	**488.6172**	**0.0092**	**0.0026**	**0.7463**	**1.2679**	**0.2653**	**1.0227**
a. Iron and steel	41.7344	0.0007	0.0001	0.0563	0.0219	0.0171	0.0009
b. Non-ferrous metals	NO	NO	NO	NO	NO	NO	NO
c. Chemicals	6.1742	0.0001	0.0000	0.0087	0.0033	0.0025	0.0002
d. Pulp, paper and print	3.4368	0.0001	0.0000	0.0046	0.0018	0.0014	0.0000
e. Food processing, beverages and tobacco	96.7552	0.0026	0.0004	0.1609	0.1222	0.0495	0.0614
f. Non-metallic minerals	179.8937	0.0025	0.0017	0.2892	1.0247	0.1258	0.9526
g. Transport equipment	0.6240	0.0000	0.0000	0.0047	0.0006	0.0002	0.0000
h. Machinery	11.3215	0.0003	0.0000	0.0158	0.0083	0.0050	0.0021
i. Mining and quarrying	NO	NO	NO	NO	NO	NO	NO
j. Wood and wood production	0.2293	0.0002	0.0000	0.0008	0.0030	0.0016	0.0001
k. Construction	15.6972	0.0004	0.0000	0.0262	0.0097	0.0070	0.0009
l. Textile and leather	33.6230	0.0006	0.0001	0.0454	0.0182	0.0141	0.0007
m. Other industries	99.1279	0.0018	0.0002	0.1338	0.0544	0.0411	0.0039
3. Transport	**2 428.3642**	**0.4966**	**0.1370**	**9.8296**	**19.6407**	**2.5824**	**0.0054**
a. Domestic aviation	0.2301	0.0000	0.0000	0.0000	0.0001	0.0000	0.0000
b. Road transportation	2 362.5871	0.4935	0.1188	9.0276	19.4727	2.5063	0.0051
c. Railways	46.9095	0.0026	0.0181	0.7798	0.1592	0.0692	0.0001
d. Domestic navigation	1.8175	0.0002	0.0000	0.0000	0.0000	0.0000	0.0000
e. Other transportation	16.8200	0.0003	0.0000	0.0222	0.0087	0.0069	0.0002
4. Other sectors	**1 767.4874**	**4.6624**	**0.1384**	**4.5317**	**62.0479**	**9.2199**	**1.9853**
a. Commercial/institutional	338.3570	0.1263	0.0029	0.5233	1.0317	0.2712	0.6526
b. Residential	1 218.4931	4.5000	0.0574	1.7856	59.9968	8.6972	1.3069
c. Agriculture/forestry/fishing	210.6373	0.0361	0.0781	2.2228	1.0193	0.2515	0.0257
ci. Stationary	7.8135	0.0235	0.0002	0.0164	0.0570	0.0190	0.0251
cii. Mobile	202.8239	0.0126	0.0779	2.2064	0.9624	0.2325	0.0006
5. Other	**22.8586**	**0.0005**	**0.0004**	**0.0476**	**0.2260**	**0.0221**	**0.1923**
a. Stationary	21.6596	0.0002	0.0003	0.0396	0.2132	0.0203	0.1923
b. Mobile	1.1989	0.0002	0.0001	0.0080	0.0128	0.0017	0.0000
B. Fugitive emissions from fuels	**1.6900**	**27.4735**	**0.0000**	**NO**	**NO**	**0.7398**	**NO**
1. Solid fuels	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**
a. Coal mining and handling	NO	NO	NO	NO	NO	NO	
b. Solid fuel transformation	NO	NO	NO	NO	NO	NO	NO
c. Other	NO	NO	NO	NO	NO	NO	NO
2. Oil and natural gas and other emissions from energy production	**1.6900**	**27.4735**	**0.0000**	**NO**	**NO**	**0.7398**	**NO**
a. Oil	1.2788	0.2226	0.0000	NO	NO	0.2479	NO
b. Natural gas	0.4113	27.2510				0.4919	NO

c. Venting and flaring	NO	NO	NO	NO	NO	NO	NO
d. Other	NO	NO	NO	NO	NO	NO	NO
C. CO_2 Transport and storage	**NO**						
1. Transport of CO_2	NO						
2. Injection and storage	NO						
3. Other	NO						
Memo items:							
International bunkers	**100.9698**	**0.0062**	**0.0033**	**0.4139**	**0.2665**	**0.1113**	**0.0320**
Aviation	100.9698	0.0062	0.0033	0.4139	0.2665	0.1113	0.0320
Navigation	NO	NO	NO	NO	NO	NO	NO
Multilateral operations	NO	NO	NO	NO	NO	NO	NO
CO_2 emissions from biomass	**1 603.1890**						
CO_2 captured	NO						
For domestic storage	NO						
For storage in other countries	NO						

2017

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2	CH_4	N_2O	NO_X	CO	NMVOC	SO_2
	(kt)						
1. Total Energy	**7 934.3500**	**35.6745**	**0.3312**	**21.2407**	**107.7886**	**16.2093**	**4.3204**
A. Fuel combustion activities (sectoral approach)	**7 932.6739**	**6.9284**	**0.3312**	**21.2407**	**107.7886**	**15.4842**	**4.3204**
1. Energy industries	**2 996.5052**	**0.0543**	**0.0055**	**4.7627**	**2.0849**	**0.1391**	**0.0472**
a. Public electricity and heat production	2 992.6702	0.0542	0.0055	4.7573	2.0841	0.1390	0.0333
b. Petroleum refining	3.8350	0.0002	0.0000	0.0054	0.0008	0.0001	0.0140
c. Manufacture of solid fuels and other energy industries	NO	NO	NO	NO	NO	NO	NO
2. Manufacturing industries and construction	**501.6022**	**0.0128**	**0.0029**	**0.9406**	**1.3692**	**0.2706**	**1.1299**
a. Iron and steel	60.4496	0.0011	0.0001	0.0817	0.0339	0.0249	0.0035
b. Non-ferrous metals	NO	NO	NO	NO	NO	NO	NO
c. Chemicals	4.8893	0.0001	0.0000	0.0067	0.0038	0.0026	0.0002
d. Pulp, paper and print	1.0009	0.0000	0.0000	0.0013	0.0005	0.0004	0.0000
e. Food processing, beverages and tobacco	95.0436	0.0026	0.0004	0.1418	0.1115	0.0497	0.0481
f. Non-metallic minerals	230.4297	0.0067	0.0022	0.5447	1.1514	0.1457	1.0684
g. Transport equipment	0.1122	0.0000	0.0000	0.0002	0.0006	0.0003	0.0000
h. Machinery	10.1061	0.0002	0.0000	0.0146	0.0075	0.0043	0.0024
i. Mining and quarrying	NO	NO	NO	NO	NO	NO	NO
j. Wood and wood production	0.2561	0.0001	0.0000	0.0010	0.0019	0.0010	0.0001
k. Construction	14.3249	0.0003	0.0000	0.0343	0.0089	0.0057	0.0023
l. Textile and leather	25.0213	0.0005	0.0001	0.0358	0.0146	0.0106	0.0014
m. Other industries	59.9686	0.0011	0.0001	0.0785	0.0347	0.0253	0.0034
3. Transport	**2 451.2471**	**0.4838**	**0.1350**	**9.7868**	**19.0444**	**2.5083**	**0.0054**
a. Domestic aviation	0.5868	0.0000	0.0000	0.0000	0.0002	0.0000	0.0000
b. Road transportation	2 390.4768	0.4811	0.1203	9.1302	18.9050	2.4440	0.0051
c. Railways	37.8634	0.0021	0.0146	0.6294	0.1285	0.0559	0.0001
d. Domestic navigation	1.7329	0.0002	0.0000	0.0000	0.0000	0.0000	0.0000
e. Other transportation	20.5873	0.0004	0.0000	0.0272	0.0106	0.0084	0.0002
4. Other sectors	**1 960.6971**	**6.3772**	**0.1874**	**5.7093**	**85.0674**	**12.5450**	**2.9370**
a. Commercial/institutional	335.0924	0.1784	0.0036	0.5315	1.1387	0.3228	0.6628
b. Residential	1 338.5229	6.1521	0.0770	2.1429	82.5867	11.8845	2.2317
c. Agriculture/forestry/fishing	287.0818	0.0467	0.1067	3.0348	1.3421	0.3377	0.0425
ci. Stationary	9.9673	0.0297	0.0003	0.0206	0.0759	0.0211	0.0416
cii. Mobile	277.1146	0.0170	0.1064	3.0143	1.2662	0.3166	0.0009
5. Other	**22.6223**	**0.0002**	**0.0004**	**0.0414**	**0.2226**	**0.0212**	**0.2009**
a. Stationary	22.6223	0.0002	0.0004	0.0414	0.2226	0.0212	0.2009
b. Mobile	NO, NE	NO, NE	NO, NE	NO, NE	NO, NE	NO, NE	NO, NE
B. Fugitive emissions from fuels	**1.6760**	**28.7461**	**0.0000**	**NO**	**NO**	**0.7251**	**NO**
1. Solid fuels	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**
a. Coal mining and handling	NO	NO	NO	NO	NO	NO	
b. Solid fuel transformation	NO	NO	NO	NO	NO	NO	NO
c. Other	NO	NO	NO	NO	NO	NO	NO
2. Oil and natural gas and other emissions from energy production	**1.6760**	**28.7461**	**0.0000**	**NO**	**NO**	**0.7251**	**NO**
a. Oil	1.2717	0.1897	0.0000	NO	NO	0.2072	NO
b. Natural gas	0.4043	28.5563				0.5179	NO
c. Venting and flaring	NO	NO	NO	NO	NO	NO	NO
d. Other	NO	NO	NO	NO	NO	NO	NO
C. CO_2 Transport and storage	**NO**						
1. Transport of CO_2	NO						
2. Injection and storage	NO						
3. Other	NO						
Memo items:							
International bunkers	**148.2788**	**0.0058**	**0.0048**	**0.5821**	**0.3478**	**0.1423**	**0.0470**
Aviation	148.2788	0.0058	0.0048	0.5821	0.3478	0.1423	0.0470
Navigation	NO	NO	NO	NO	NO	NO	NO
Multilateral operations	NO	NO	NO	NO	NO	NO	NO
CO_2 emissions from biomass	**2 122.7228**						
CO_2 captured	NO						
For domestic storage	NO						
For storage in other countries	NO						

2018

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2	CH_4	N_2O	NO_x	CO	NMVOC	SO_2
	(kt)						
1. Total Energy	**8 350.5473**	**37.7167**	**0.3805**	**22.6342**	**156.7217**	**23.6900**	**3.5780**
A. Fuel combustion activities (sectoral approach)	**8 348.8621**	**10.6064**	**0.3805**	**22.6342**	**156.7217**	**22.9976**	**3.5780**
1. Energy industries	**3 255.3655**	**0.0593**	**0.0060**	**5.1810**	**2.2679**	**0.1513**	**0.0570**
a. Public electricity and heat production	3 252.3143	0.0591	0.0060	5.1766	2.2673	0.1512	0.0455
b. Petroleum refining	3.0512	0.0001	0.0000	0.0043	0.0006	0.0001	0.0115
c. Manufacture of solid fuels and other energy industries	NO	NO	NO	NO	NO	NO	NO
2. Manufacturing industries and construction	**594.3248**	**0.0144**	**0.0031**	**1.2726**	**1.2408**	**0.2948**	**0.9561**
a. Iron and steel	65.6957	0.0012	0.0001	0.0869	0.0360	0.0270	0.0029
b. Non-ferrous metals	NO	NO	NO	NO	NO	NO	NO
c. Chemicals	6.2768	0.0002	0.0000	0.0085	0.0051	0.0035	0.0003
d. Pulp, paper and print	3.0670	0.0002	0.0000	0.0044	0.0039	0.0025	0.0001
e. Food processing, beverages and tobacco	108.5391	0.0033	0.0005	0.1579	0.1361	0.0599	0.0574
f. Non-metallic minerals	292.0067	0.0070	0.0022	0.8417	0.9877	0.1504	0.8876
g. Transport equipment	0.3927	0.0000	0.0000	0.0006	0.0008	0.0005	0.0000
h. Machinery	11.3814	0.0002	0.0000	0.0164	0.0072	0.0047	0.0015
i. Mining and quarrying	0.0642	0.0000	0.0000	0.0005	0.0001	0.0000	0.0000
j. Wood and wood production	0.2701	0.0002	0.0000	0.0012	0.0030	0.0016	0.0001
k. Construction	16.0620	0.0003	0.0000	0.0358	0.0096	0.0064	0.0022
l. Textile and leather	27.3122	0.0005	0.0001	0.0358	0.0155	0.0115	0.0011
m. Other industries	63.2568	0.0012	0.0001	0.0827	0.0358	0.0266	0.0028
3. Transport	**2 529.5773**	**0.5024**	**0.1334**	**9.7840**	**19.8910**	**2.5892**	**0.0056**
a. Domestic aviation	0.1535	0.0000	0.0000	0.0000	0.0001	0.0000	0.0000
b. Road transportation	2 489.2483	0.5008	0.1254	9.4194	19.8120	2.5516	0.0053
c. Railways	20.4915	0.0011	0.0079	0.3406	0.0696	0.0302	0.0000
d. Domestic navigation	1.5629	0.0001	0.0000	0.0000	0.0000	0.0000	0.0000
e. Other transportation	18.1211	0.0003	0.0000	0.0239	0.0094	0.0074	0.0002
4. Other sectors	**1 946.2502**	**10.0301**	**0.2376**	**6.3540**	**133.0922**	**19.9404**	**2.3520**
a. Commercial/institutional	343.4576	0.1814	0.0036	0.5367	1.1329	0.3301	0.6440
b. Residential	1 316.6041	9.8051	0.1277	2.7543	130.7890	19.2736	1.6723
c. Agriculture/forestry/fishing	286.1884	0.0436	0.1063	3.0630	1.1703	0.3367	0.0356
ci. Stationary	10.9565	0.0276	0.0003	0.0213	0.0704	0.0217	0.0347
cii. Mobile	275.2319	0.0160	0.1060	3.0418	1.1000	0.3150	0.0009
5. Other	**23.3443**	**0.0002**	**0.0004**	**0.0427**	**0.2297**	**0.0219**	**0.2073**
a. Stationary	23.3443	0.0002	0.0004	0.0427	0.2297	0.0219	0.2073
b. Mobile	NO, NE	NO, NE	NO, NE	NO, NE	NO, NE	NO, NE	NO, NE
B. Fugitive emissions from fuels	**1.6852**	**27.1103**	**0.0000**	**NO**	**NO**	**0.6924**	**NO**
1. Solid fuels	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**
a. Coal mining and handling	NO	NO	NO	NO	NO	NO	
b. Solid fuel transformation	NO	NO	NO	NO	NO	NO	NO
c. Other	NO	NO	NO	NO	NO	NO	NO
2. Oil and natural gas and other emissions from energy production	**1.6852**	**27.1103**	**0.0000**	**NO**	**NO**	**0.6924**	**NO**
a. Oil	1.2710	0.1897	0.0000	NO	NO	0.2072	NO
b. Natural gas	0.4142	26.9206				0.4852	NO
c. Venting and flaring	NO	NO	NO	NO	NO	NO	NO
d. Other	NO	NO	NO	NO	NO	NO	NO
C. CO_2 Transport and storage	**NO**						
1. Transport of CO_2	NO						
2. Injection and storage	NO						
3. Other	NO						
Memo items:							
International bunkers	**170.4060**	**0.0071**	**0.0058**	**0.6507**	**0.5113**	**0.1537**	**0.0540**
Aviation	170.4060	0.0071	0.0058	0.6507	0.5113	0.1537	0.0540
Navigation	NO	NO	NO	NO	NO	NO	NO
Multilateral operations	NO	NO	NO	NO	NO	NO	NO
CO_2 emissions from biomass	**3 583.0567**						
CO_2 captured	NO						
For domestic storage	NO						
For storage in other countries	NO						

2019

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2	CH_4	N_2O	NO_x	CO	NMVOC	SO_2
	(kt)						
1. Total Energy	**8 583.6814**	**28.1492**	**0.3826**	**23.0076**	**141.6541**	**21.1796**	**4.4562**
A. Fuel combustion activities (sectoral approach)	**8 582.0532**	**9.3467**	**0.3826**	**23.0076**	**141.6541**	**20.6437**	**4.4562**
1. Energy industries	**3 124.4150**	**0.0562**	**0.0057**	**4.9700**	**2.1753**	**0.1451**	**0.0468**
a. Public electricity and heat production	3 123.0860	0.0561	0.0057	4.9676	2.1750	0.1450	0.0387
b. Petroleum refining	1.3290	0.0001	0.0000	0.0024	0.0003	0.0000	0.0081
c. Manufacture of solid fuels and other energy industries	NO	NO	NO	NO	NO	NO	NO
2. Manufacturing industries and construction	**717.7258**	**0.0298**	**0.0052**	**1.2740**	**1.5229**	**0.4796**	**0.9216**
a. Iron and steel	56.6283	0.0010	0.0001	0.0762	0.0294	0.0232	0.0008
b. Non-ferrous metals	NO	NO	NO	NO	NO	NO	NO
c. Chemicals	7.2441	0.0002	0.0000	0.0098	0.0049	0.0036	0.0001

d. Pulp, paper and print	3.1434	0.0001	0.0000	0.0042	0.0025	0.0013	0.0009
e. Food processing, beverages and tobacco	92.3256	0.0021	0.0003	0.1324	0.0897	0.0435	0.0357
f. Non-metallic minerals	281.4803	0.0061	0.0022	0.8540	0.9517	0.1433	0.8585
g. Transport equipment	0.7854	0.0001	0.0000	0.0012	0.0015	0.0009	0.0000
h. Machinery	13.7478	0.0003	0.0000	0.0200	0.0073	0.0056	0.0004
i. Mining and quarrying	0.2805	0.0000	0.0000	0.0004	0.0001	0.0001	0.0000
j. Wood and wood production	0.1889	0.0000	0.0000	0.0008	0.0007	0.0004	0.0000
k. Construction	16.9468	0.0004	0.0001	0.0407	0.0100	0.0067	0.0019
l. Textile and leather	35.0678	0.0006	0.0001	0.0465	0.0182	0.0144	0.0005
m. Other industries	209.8869	0.0189	0.0025	0.0879	0.4069	0.2365	0.0227
3. Transport	**2 611.5525**	**0.4983**	**0.1390**	**10.1388**	**20.5687**	**2.6841**	**0.0058**
a. Domestic aviation	0.2835	0.0000	0.0000	0.0000	0.0001	0.0000	0.0000
b. Road transportation	2 567.7380	0.4964	0.1294	9.6891	20.4725	2.6392	0.0055
c. Railways	24.5271	0.0014	0.0095	0.4270	0.0872	0.0379	0.0000
d. Domestic navigation	1.8260	0.0002	0.0000	0.0000	0.0000	0.0000	0.0000
e. Other transportation	17.1780	0.0003	0.0000	0.0227	0.0089	0.0070	0.0002
4. Other sectors	**2 105.4970**	**8.7623**	**0.2323**	**6.5829**	**117.1622**	**17.3135**	**3.2791**
a. Commercial/institutional	331.3196	0.1635	0.0032	0.5137	1.0310	0.3058	0.5807
b. Residential	1 448.8232	8.5530	0.1081	2.6327	114.7833	16.6329	2.6586
c. Agriculture/forestry/fishing	325.3542	0.0458	0.1210	3.4366	1.3478	0.3748	0.0398
ci. Stationary	11.8344	0.0274	0.0003	0.0222	0.0711	0.0202	0.0388
cii. Mobile	313.5198	0.0183	0.1207	3.4144	1.2767	0.3546	0.0010
5. Other	**22.8629**	**0.0002**	**0.0004**	**0.0418**	**0.2250**	**0.0215**	**0.2030**
a. Stationary	22.8629	0.0002	0.0004	0.0418	0.2250	0.0215	0.2030
b. Mobile	NO, NE	NO, NE	NO, NE	NO, NE	NO, NE	NO, NE	NO, NE
B. Fugitive emissions from fuels	**1.6282**	**18.8024**	**0.0000**	**NO**	**NO**	**0.5359**	**NO**
1. Solid fuels	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**
a. Coal mining and handling	NO	NO	NO	NO	NO	NO	
b. Solid fuel transformation	NO	NO	NO	NO	NO	NO	NO
c. Other	NO	NO	NO	NO	NO	NO	NO
2. Oil and natural gas and other emissions from energy production	**1.6282**	**18.8024**	**0.0000**	**NO**	**NO**	**0.5359**	**NO**
a. Oil	1.2673	0.1897	0.0000	NO	NO	0.2072	NO
b. Natural gas	0.3609	18.6127				0.3287	NO
c. Venting and flaring	NO	NO	NO	NO	NO	NO	NO
d. Other	NO	NO	NO	NO	NO	NO	NO
C. CO_2 Transport and storage	**NO**						
1. Transport of CO_2	NO						
2. Injection and storage	NO						
3. Other	NO						
Memo items:							
International bunkers	**151.5015**	**0.0055**	**0.0051**	**0.6236**	**0.4162**	**0.1199**	**0.0480**
Aviation	151.5015	0.0055	0.0051	0.6236	0.4162	0.1199	0.0480
Navigation	NO	NO	NO	NO	NO	NO	NO
Multilateral operations	NO	NO	NO	NO	NO	NO	NO
CO_2 emissions from biomass	**2 976.2234**						
CO_2 captured	NO						
For domestic storage	NO						
For storage in other countries	NO						

2020

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2	CH_4	N_2O	NO_x	CO	NMVOC	SO_2
	(kt)						
1. Total Energy	**8 972.1085**	**18.6747**	**0.3722**	**22.4651**	**136.3310**	**20.4625**	**3.4896**
A. Fuel combustion activities (sectoral approach)	**8 970.5288**	**9.0656**	**0.3722**	**22.4651**	**136.3310**	**20.0607**	**3.4896**
1. Energy industries	**3 634.3761**	**0.0654**	**0.0066**	**5.7797**	**2.5315**	**0.1688**	**0.0361**
a. Public electricity and heat production	3 632.8213	0.0653	0.0066	5.7783	2.5312	0.1688	0.0339
b. Petroleum refining	1.5548	0.0001	0.0000	0.0015	0.0003	0.0000	0.0022
c. Manufacture of solid fuels and other energy industries	NO	NO	NO	NO	NO	NO	NO
2. Manufacturing industries and construction	**801.4383**	**0.0298**	**0.0049**	**0.4409**	**1.4200**	**0.5045**	**0.7768**
a. Iron and steel	92.9040	0.0017	0.0002	0.1230	0.0481	0.0381	0.0012
b. Non-ferrous metals	NO	NO	NO	NO	NO	NO	NO
c. Chemicals	12.9779	0.0003	0.0000	0.0101	0.0073	0.0056	0.0002
d. Pulp, paper and print	3.4562	0.0001	0.0000	0.0009	0.0027	0.0015	0.0009
e. Food processing, beverages and tobacco	98.8192	0.0021	0.0003	0.0582	0.0814	0.0444	0.0265
f. Non-metallic minerals	260.6500	0.0053	0.0019	0.0000	0.8204	0.1319	0.7278
g. Transport equipment	0.7854	0.0000	0.0000	0.0000	0.0010	0.0006	0.0000
h. Machinery	16.8542	0.0003	0.0000	0.0212	0.0096	0.0070	0.0011
i. Mining and quarrying	0.2244	0.0000	0.0000	0.0000	0.0001	0.0001	0.0000
j. Wood and wood production	0.1629	0.0002	0.0000	0.0001	0.0047	0.0025	0.0001
k. Construction	18.4240	0.0004	0.0001	0.0194	0.0107	0.0073	0.0017
l. Textile and leather	45.7624	0.0008	0.0001	0.0564	0.0243	0.0191	0.0006
m. Other industries	250.4178	0.0186	0.0024	0.1516	0.4098	0.2465	0.0166
3. Transport	**2 462.2411**	**0.4352**	**0.1302**	**9.7000**	**18.3931**	**2.4165**	**0.0054**
a. Domestic aviation	0.0700	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

b. Road transportation	2 430.9715	0.4338	0.1228	9.3853	18.3260	2.3852	0.0053
c. Railways	19.0437	0.0011	0.0074	0.2994	0.0611	0.0266	0.0000
d. Domestic navigation	0.6088	0.0001	0.0000	0.0000	0.0000	0.0000	0.0000
e. Other transportation	11.5471	0.0002	0.0000	0.0152	0.0060	0.0047	0.0001
4. Other sectors	**2 050.0916**	**8.5350**	**0.2302**	**6.5036**	**113.7660**	**16.9499**	**2.4726**
a. Commercial/institutional	296.7071	0.1391	0.0028	0.4577	0.9161	0.2657	0.5287
b. Residential	1 429.8584	8.3431	0.1075	2.6051	111.4334	16.3025	1.8981
c. Agriculture/forestry/fishing	323.5261	0.0528	0.1199	3.4408	1.4166	0.3817	0.0458
ci. Stationary	12.8030	0.0343	0.0003	0.0252	0.0869	0.0258	0.0448
cii. Mobile	310.7231	0.0185	0.1196	3.4155	1.3297	0.3560	0.0010
5. Other	**22.3816**	**0.0002**	**0.0004**	**0.0409**	**0.2203**	**0.0210**	**0.1987**
a. Stationary	22.3816	0.0002	0.0004	0.0409	0.2203	0.0210	0.1987
b. Mobile	NO, NE	NO, NE	NO, NE	NO, NE	NO, NE	NO, NE	NO, NE
B. Fugitive emissions from fuels	**1.5797**	**9.6091**	**0.0000**	**NO**	**NO**	**0.4018**	**NO**
1. Solid fuels	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**
a. Coal mining and handling	NO	NO	NO	NO	NO	NO	
b. Solid fuel transformation	NO	NO	NO	NO	NO	NO	NO
c. Other	NO	NO	NO	NO	NO	NO	NO
2. Oil and natural gas and other emissions from energy production	**1.5797**	**9.6091**	**0.0000**	**NO**	**NO**	**0.4018**	**NO**
a. Oil	1.2676	0.2226	0.0000	NO	NO	0.2479	NO
b. Natural gas	0.3122	9.3865				0.1539	NO
c. Venting and flaring	NO	NO	NO	NO	NO	NO	NO
d. Other	NO	NO	NO	NO	NO	NO	NO
C. CO_2 Transport and storage	**NO**						
1. Transport of CO_2	NO						
2. Injection and storage	NO						
3. Other	NO						
Memo items:							
International bunkers	**35.2495**	**0.0002**	**0.0010**	**0.1233**	**0.0493**	**0.0247**	**0.0000**
Aviation	35.2495	0.0002	0.0010	0.1233	0.0493	0.0247	0.0000
Navigation	NO	NO	NO	NO	NO	NO	NO
Multilateral operations	NO	NO	NO	NO	NO	NO	NO
CO_2 emissions from biomass	**2 985.9162**						
CO_2 captured	NO						
For domestic storage	NO						
For storage in other countries	NO						

Annex 6-2. Sectoral Report for Sector 2 'Industrial Processes and Product Use', 1990-2020

1990

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2	CH_4	N_2O	HFCs	PFCs	Unspecified mix of HFCs and PFCs	SF_6	NF_3	NO_x	CO	NMVOC	SO_2
	(kt)			CO_2 equivalent (kt)					(kt)			
2. Total Industrial Processes and Product Use	**1 605.2224**	**NO**	**0.0001**	**NO**	**NO**	**NO**	**NO**	**NO**	**3.7596**	**5.4932**	**106.5516**	**1.3845**
A. Mineral industry	**1 338.9600**								**3.6040**	**3.4372**	**0.0340**	**1.3202**
1. Cement production	971.6967								2.2355	2.6210	0.0324	0.6737
2. Lime production	264.3143								0.4875	0.6909		0.1125
3. Glass production	27.4888								0.7589		0.0016	0.5077
4. Other process uses of carbonates	75.4601								0.1221	0.1254		0.0263
B. Chemical industry	**NO**	**NO**	**NO**						**NO**	**NO**	**0.0650**	**NO**
1. Ammonia production	NO	NO	NO						NO	NO	NO	NO
2. Nitric acid production			NO						NO			
3. Adipic acid production	NO		NO						NO	NO	NO	
4. Caprolactam, glyoxal and glyoxylic acid production	NO		NO								NO	NO
5. Carbide production	NO	NO							NO	NO	NO	NO
6. Titanium dioxide production	NO											
7. Soda ash production	NO											
8. Petrochemical and carbon black production	NO	NO							NO	NO	NO	NO
9. Fluorochemical production				NO	NO	NO	NO	NO				
10. Other	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0.0650	NO
C. Metal industry	**28.5023**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**0.0925**	**1.2102**	**0.0370**	**0.0427**
1. Iron and steel production	28.5023	NO							0.0925	1.2102	0.0370	0.0427
2. Ferroalloys production	NO	NO							NO	NO	NO	NO
3. Aluminium production	NO				NO		NO		NO	NO	NO	NO
4. Magnesium production	NO			NO	NO	NO	NO		NO	NO	NO	NO
5. Lead production	NO								NO	NO	NO	NO
6. Zinc production	NO								NO	NO	NO	NO
7. Other	NO	NO	NO						NO	NO	NO	NO
D. Non-energy products from fuels and solvent use	**234.3591**	**NO**	**NO**						**0.0434**	**0.2441**	**92.7937**	**0.0216**
1. Lubricant use	24.7987	NO	NO						NO	NO	NO	NO
2. Paraffin wax use	0.1138	NO	NO						NO	NO	NO	NO
3. Solvent use	204.1460	NO	NO						0.0434	0.2441	92.7937	0.0216
4. Other	5.3005	NO	NO						NO	NO	NO	NO
E. Electronics industry				**NO**	**NO**	**NO**	**NO**	**NO**				
1. Integrated circuit or semiconductor				NO	NO	NO	NO	NO				

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2	CH_4	N_2O	HFCs	PFCs	Unspecified mix of HFCs and PFCs	SF_6	NF_3	NO_x	CO	NMVOC	SO_2
2. TFT flat panel display				NO	NO	NO	NO	NO				
3. Photovoltaics				NO	NO	NO	NO	NO				
4. Heat transfer fluid				NO	NO	NO	NO	NO				
5. Other				NO	NO	NO	NO	NO				
F. Product uses as substitutes for ODS				**NO**	**NO**	**NO**	**NO**	**NO**				
1. Refrigeration and air conditioning				NO	NO	NO	NO	NO				
2. Foam blowing agents				NO	NO	NO	NO	NO				
3. Fire protection				NO	NO	NO	NO	NO				
4. Aerosols				NO	NO	NO	NO	NO				
5. Solvents				NO	NO	NO	NO	NO				
6. Other applications				NO	NO	NO	NO	NO				
G. Other product manufacture and use	**3.4010**	**NO**	**0.0001**	**NO**	**NO**	**NO**	**NO**	**NO**	**0.0197**	**0.6017**	**1.5459**	**NO**
1. Electrical equipment				NO	NO	NO	NO	NO				
2. SF_6 and PFCs from other product use							NO					
3. N_2O from product uses			0.0001									
4. Other	3.4010	NO	NO	NO	NO	NO	NO	NO	0.0197	0.6017	1.5459	NO
H. Other									**NO**	**NO**	**12.0760**	**NO**
1. Pulp and Paper Industry									NO	NO	NO	NO
2. Food and Beverages Industry									NO	NO	12.0760	NO
3. Other									NO	NO	NO	NO

1991

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2	CH_4	N_2O	HFCs	PFCs	Unspecified mix of HFCs and PFCs	SF_6	NF_3	NO_x	CO	NMVOC	SO_2
	(kt)			CO_2 equivalent (kt)					(kt)			
2. Total Industrial Processes and Product Use	**1 411.2739**	**NO**	**0.0001**	**NO**	**NO**	**NO**	**NO**	**NO**	**3.4408**	**4.9046**	**87.8865**	**1.2988**
A. Mineral industry	**1 190.1632**								**3.3045**	**3.0431**	**0.0316**	**1.2438**
1. Cement production	900.7877								2.0682	2.4249	0.0300	0.6233
2. Lime production	192.2260								0.3546	0.5024		0.0818
3. Glass production	27.1894								0.7689		0.0016	0.5144
4. Other process uses of carbonates	69.9600								0.1127	0.1158		0.0243
B. Chemical industry	**NO**	**NO**	**NO**						**NO**	**NO**	**0.0544**	**NO**
1. Ammonia production	NO	NO	NO						NO	NO	NO	NO
2. Nitric acid production			NO						NO			
3. Adipic acid production	NO		NO						NO	NO	NO	
4. Caprolactam, glyoxal and glyoxylic acid production	NO		NO								NO	NO
5. Carbide production	NO	NO							NO	NO	NO	NO
6. Titanium dioxide production	NO											
7. Soda ash production	NO											
8. Petrochemical and carbon black production	NO	NO							NO	NO	NO	NO
9. Fluorochemical production				NO	NO	NO	NO	NO				
10. Other	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0.0544	NO
C. Metal industry	**24.7297**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**0.0803**	**1.0502**	**0.0323**	**0.0371**
1. Iron and steel production	24.7297	NO							0.0803	1.0502	0.0323	0.0371
2. Ferroalloys production	NO	NO							NO	NO	NO	NO
3. Aluminium production	NO				NO		NO		NO	NO	NO	NO
4. Magnesium production	NO			NO	NO	NO	NO		NO	NO	NO	NO
5. Lead production	NO								NO	NO	NO	NO
6. Zinc production	NO								NO	NO	NO	NO
7. Other	NO	NO	NO						NO	NO	NO	NO
D. Non-energy products from fuels and solvent use	**193.3185**	**NO**	**NO**						**0.0361**	**0.2030**	**76.2635**	**0.0180**
1. Lubricant use	20.7617	NO	NO						NO	NO	NO	NO
2. Paraffin wax use	0.0953	NO	NO						NO	NO	NO	NO
3. Solvent use	167.7797	NO	NO						0.0361	0.2030	76.2635	0.0180
4. Other	4.6818	NO	NO						NO	NO	NO	NO
E. Electronics industry				**NO**	**NO**	**NO**	**NO**	**NO**				
1. Integrated circuit or semiconductor				NO	NO	NO	NO	NO				
2. TFT flat panel display				NO	NO	NO	NO	NO				
3. Photovoltaics				NO	NO	NO	NO	NO				
4. Heat transfer fluid				NO	NO	NO	NO	NO				
5. Other				NO	NO	NO	NO	NO				
F. Product uses as substitutes for ODS				**NO**	**NO**	**NO**	**NO**	**NO**				
1. Refrigeration and air conditioning				NO	NO	NO	NO	NO				
2. Foam blowing agents				NO	NO	NO	NO	NO				
3. Fire protection				NO	NO	NO	NO	NO				
4. Aerosols				NO	NO	NO	NO	NO				
5. Solvents				NO	NO	NO	NO	NO				
6. Other applications				NO	NO	NO	NO	NO				
G. Other product manufacture and use	**3.0625**	**NO**	**0.0001**	**NO**	**NO**	**NO**	**NO**	**NO**	**0.0199**	**0.6083**	**1.3920**	**NO**
1. Electrical equipment				NO	NO	NO	NO	NO				
2. SF_6 and PFCs from other product use							NO					
3. N_2O from product uses			0.0001									
4. Other	3.0625	NO	NO	NO	NO	NO	NO	NO	0.0199	0.6083	1.3920	NO
H. Other									**NO**	**NO**	**10.1126**	**NO**
1. Pulp and Paper Industry									NO	NO	NO	NO
2. Food and Beverages Industry									NO	NO	10.1126	NO
3. Other									NO	NO	NO	NO

1992

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2	CH_4	N_2O	HFCs	PFCs	Unspecified mix of HFCs and PFCs	SF_6	NF_3	NO_x	CO	NMVOC	SO_2
	(kt)			CO_2 equivalent (kt)					(kt)			
2. Total Industrial Processes and Product Use	**822.4617**	**NO**	**0.0001**	**NO**	**NO**	**NO**	**NO**	**NO**	**1.8526**	**3.4045**	**72.1808**	**0.6827**
A. Mineral industry	**641.7935**								**1.7257**	**1.6459**	**0.0166**	**0.6316**
1. Cement production	474.3138								1.0912	1.2794	0.0158	0.3289
2. Lime production	116.1612								0.2143	0.3036		0.0495
3. Glass production	13.5306								0.3590		0.0008	0.2401
4. Other process uses of carbonates	37.7879								0.0613	0.0629		0.0132
B. Chemical industry	**NO**	**NO**	**NO**						**NO**	**NO**	**0.0238**	**NO**
1. Ammonia production	NO	NO	NO						NO	NO	NO	NO
2. Nitric acid production			NO						NO			
3. Adipic acid production	NO		NO						NO	NO	NO	
4. Caprolactam, glyoxal and glyoxylic acid production	NO		NO								NO	NO
5. Carbide production	NO	NO							NO	NO	NO	NO
6. Titanium dioxide production	NO											
7. Soda ash production	NO											
8. Petrochemical and carbon black production	NO	NO							NO	NO	NO	NO
9. Fluorochemical production				NO	NO	NO	NO	NO				
10. Other	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0.0238	NO
C. Metal industry	**23.9922**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**0.0780**	**1.0194**	**0.0314**	**0.0360**
1. Iron and steel production	23.9922	NO							0.0780	1.0194	0.0314	0.0360
2. Ferroalloys production	NO	NO							NO	NO	NO	NO
3. Aluminium production	NO				NO		NO		NO	NO	NO	NO
4. Magnesium production	NO			NO	NO	NO	NO		NO	NO	NO	NO
5. Lead production	NO								NO	NO	NO	NO
6. Zinc production	NO								NO	NO	NO	NO
7. Other	NO	NO	NO						NO	NO	NO	NO
D. Non-energy products from fuels and solvent use	**154.2628**	**NO**	**NO**						**0.0304**	**0.1706**	**62.9651**	**0.0151**
1. Lubricant use	12.1110	NO	NO						NO	NO	NO	NO
2. Paraffin wax use	0.0556	NO	NO						NO	NO	NO	NO
3. Solvent use	138.5232	NO	NO						0.0304	0.1706	62.9651	0.0151
4. Other	3.5730	NO	NO						NO	NO	NO	NO
E. Electronics industry				**NO**	**NO**	**NO**	**NO**	**NO**				
1. Integrated circuit or semiconductor				NO	NO	NO	NO	NO				
2. TFT flat panel display				NO	NO	NO	NO	NO				
3. Photovoltaics				NO	NO	NO	NO	NO				
4. Heat transfer fluid				NO	NO	NO	NO	NO				
5. Other				NO	NO	NO	NO	NO				
F. Product uses as substitutes for ODS				**NO**	**NO**	**NO**	**NO**	**NO**				
1. Refrigeration and air conditioning				NO	NO	NO	NO	NO				
2. Foam blowing agents				NO	NO	NO	NO	NO				
3. Fire protection				NO	NO	NO	NO	NO				
4. Aerosols				NO	NO	NO	NO	NO				
5. Solvents				NO	NO	NO	NO	NO				
6. Other applications				NO	NO	NO	NO	NO				
G. Other product manufacture and use	**2.4132**	**NO**	**0.0001**	**NO**	**NO**	**NO**	**NO**	**NO**	**0.0186**	**0.5686**	**1.0969**	**NO**
1. Electrical equipment				NO	NO	NO	NO	NO				
2. SF_6 and PFCs from other product use							NO					
3. N_2O from product uses			0.0001									
4. Other	2.4132	NO	NO	NO	NO	NO	NO	NO	0.0186	0.5686	1.0969	NO
H. Other									**NO**	**NO**	**8.0471**	**NO**
1. Pulp and Paper Industry									NO	NO	NO	NO
2. Food and Beverages Industry									NO	NO	8.0471	NO
3. Other									NO	NO	NO	NO

1993

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2	CH_4	N_2O	HFCs	PFCs	Unspecified mix of HFCs and PFCs	SF_6	NF_3	NO_x	CO	NMVOC	SO_2
	(kt)			CO_2 equivalent (kt)					(kt)			
2. Total Industrial Processes and Product Use	**737.8604**	**NO**	**0.0001**	**NO**	**NO**	**NO**	**NO**	**NO**	**1.7577**	**3.2411**	**60.2824**	**0.6658**
A. Mineral industry	**587.5786**								**1.6352**	**1.4853**	**0.0144**	**0.6172**
1. Cement production	405.7165								0.9338	1.0949	0.0135	0.2814
2. Lime production	112.7887								0.2080	0.2948		0.0480
3. Glass production	12.1968								0.4002		0.0008	0.2677
4. Other process uses of carbonates	56.8766								0.0931	0.0957		0.0200
B. Chemical industry	**NO**	**NO**	**NO**						**NO**	**NO**	**0.0199**	**NO**
1. Ammonia production	NO	NO	NO						NO	NO	NO	NO
2. Nitric acid production			NO						NO			
3. Adipic acid production	NO		NO						NO	NO	NO	
4. Caprolactam, glyoxal and glyoxylic acid production	NO		NO								NO	NO
5. Carbide production	NO	NO							NO	NO	NO	NO
6. Titanium dioxide production	NO											

7. Soda ash production	NO											
8. Petrochemical and carbon black production	NO	NO							NO	NO	NO	NO
9. Fluorochemical production				NO	NO	NO	NO	NO				
10. Other	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0.0199	NO
C. Metal industry	**24.4250**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**0.0794**	**1.0383**	**0.0315**	**0.0366**
1. Iron and steel production	24.4250	NO							0.0794	1.0383	0.0315	0.0366
2. Ferroalloys production	NO	NO							NO	NO	NO	NO
3. Aluminium production	NO				NO		NO		NO	NO	NO	NO
4. Magnesium production	NO			NO	NO	NO	NO		NO	NO	NO	NO
5. Lead production	NO								NO	NO	NO	NO
6. Zinc production	NO								NO	NO	NO	NO
7. Other	NO	NO	NO						NO	NO	NO	NO
D. Non-energy products from fuels and solvent use	**123.8759**	**NO**	**NO**						**0.0241**	**0.1356**	**50.1008**	**0.0120**
1. Lubricant use	10.9576	NO	NO						NO	NO	NO	NO
2. Paraffin wax use	0.0503	NO	NO						NO	NO	NO	NO
3. Solvent use	110.2218	NO	NO						0.0241	0.1356	50.1008	0.0120
4. Other	2.6463	NO	NO						NO	NO	NO	NO
E. Electronics industry				**NO**	**NO**	**NO**	**NO**	**NO**				
1. Integrated circuit or semiconductor				NO	NO	NO	NO	NO				
2. TFT flat panel display				NO	NO	NO	NO	NO				
3. Photovoltaics				NO	NO	NO	NO	NO				
4. Heat transfer fluid				NO	NO	NO	NO	NO				
5. Other				NO	NO	NO	NO	NO				
F. Product uses as substitutes for ODS				**NO**	**NO**	**NO**	**NO**	**NO**				
1. Refrigeration and air conditioning				NO	NO	NO	NO	NO				
2. Foam blowing agents				NO	NO	NO	NO	NO				
3. Fire protection				NO	NO	NO	NO	NO				
4. Aerosols				NO	NO	NO	NO	NO				
5. Solvents				NO	NO	NO	NO	NO				
6. Other applications				NO	NO	NO	NO	NO				
G. Other product manufacture and use	**1.9809**	**NO**	**0.0001**	**NO**	**NO**	**NO**	**NO**	**NO**	**0.0190**	**0.5819**	**0.9004**	**NO**
1. Electrical equipment				NO	NO	NO	NO	NO				
2. SF_6 and PFCs from other product use							NO					
3. N_2O from product uses			0.0001									
4. Other	1.9809	NO	NO	NO	NO	NO	NO	NO	0.0190	0.5819	0.9004	NO
H. Other									**NO**	**NO**	**9.2154**	**NO**
1. Pulp and Paper Industry									NO	NO	NO	NO
2. Food and Beverages Industry									NO	NO	9.2154	NO
3. Other									NO	NO	NO	NO

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GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2	CH_4	N_2O	HFCs	PFCs	Unspecified mix of HFCs and PFCs	SF_6	NF_3	NO_x	CO	NMVOC	SO_2
	(kt)			CO_2 equivalent (kt)					(kt)			
2. Total Industrial Processes and Product Use	**556.5852**	**NO**	**0.0001**	**NO**	**NO**	**NO**	**NO**	**NO**	**1.3900**	**2.8404**	**40.9265**	**0.5323**
A. Mineral industry	**445.3398**								**1.2757**	**1.1521**	**0.0116**	**0.4870**
1. Cement production	328.4361								0.7552	0.8854	0.0110	0.2276
2. Lime production	83.8378								0.1546	0.2191		0.0357
3. Glass production	4.3269								0.3196		0.0007	0.2138
4. Other process uses of carbonates	28.7391								0.0463	0.0475		0.0100
B. Chemical industry	**NO**	**NO**	**NO**						**NO**	**NO**	**0.0074**	**NO**
1. Ammonia production	NO	NO	NO						NO	NO	NO	NO
2. Nitric acid production			NO						NO			
3. Adipic acid production	NO		NO						NO	NO	NO	
4. Caprolactam, glyoxal and glyoxylic acid production	NO		NO								NO	NO
5. Carbide production	NO	NO							NO	NO	NO	NO
6. Titanium dioxide production	NO											
7. Soda ash production	NO											
8. Petrochemical and carbon black production	NO	NO							NO	NO	NO	NO
9. Fluorochemical production				NO	NO	NO	NO	NO				
10. Other	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0.0074	NO
C. Metal industry	**25.3289**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**0.0824**	**1.0774**	**0.0322**	**0.0380**
1. Iron and steel production	25.3289	NO							0.0824	1.0774	0.0322	0.0380
2. Ferroalloys production	NO	NO							NO	NO	NO	NO
3. Aluminium production	NO				NO		NO		NO	NO	NO	NO
4. Magnesium production	NO			NO	NO	NO	NO		NO	NO	NO	NO
5. Lead production	NO								NO	NO	NO	NO
6. Zinc production	NO								NO	NO	NO	NO
7. Other	NO	NO	NO						NO	NO	NO	NO
D. Non-energy products from fuels and solvent use	**84.4738**	**NO**	**NO**						**0.0146**	**0.0820**	**32.7972**	**0.0073**
1. Lubricant use	10.1022	NO	NO						NO	NO	NO	NO
2. Paraffin wax use	0.0464	NO	NO						NO	NO	NO	NO
3. Solvent use	72.1539	NO	NO						0.0146	0.0820	32.7972	0.0073
4. Other	2.1713	NO	NO						NO	NO	NO	NO
E. Electronics industry				**NO**	**NO**	**NO**	**NO**	**NO**				
1. Integrated circuit or semiconductor				NO	NO	NO	NO	NO				
2. TFT flat panel display				NO	NO	NO	NO	NO				

3. Photovoltaics				NO	NO	NO	NO	NO				
4. Heat transfer fluid				NO	NO	NO	NO	NO				
5. Other				NO	NO	NO	NO	NO				
F. Product uses as substitutes for ODS				**NO**	**NO**	**NO**	**NO**	**NO**				
1. Refrigeration and air conditioning				NO	NO	NO	NO	NO				
2. Foam blowing agents				NO	NO	NO	NO	NO				
3. Fire protection				NO	NO	NO	NO	NO				
4. Aerosols				NO	NO	NO	NO	NO				
5. Solvents				NO	NO	NO	NO	NO				
6. Other applications				NO	NO	NO	NO	NO				
G. Other product manufacture and use	**1.4426**	**NO**	**0.0001**	**NO**	**NO**	**NO**	**NO**	**NO**	**0.0173**	**0.5290**	**0.6557**	**NO**
1. Electrical equipment				NO	NO	NO	NO	NO				
2. SF_6 and PFCs from other product use							NO					
3. N_2O from product uses			0.0001									
4. Other	1.4426	NO	NO	NO	NO	NO	NO	NO	0.0173	0.5290	0.6557	NO
H. Other									**NO**	**NO**	**7.4223**	**NO**
1. Pulp and Paper Industry									NO	NO	NO	NO
2. Food and Beverages Industry									NO	NO	7.4223	NO
3. Other									NO	NO	NO	NO

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GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2	CH_4	N_2O	HFCs	PFCs	Unspecified mix of HFCs and PFCs	SF_6	NF_3	NO_x	CO	NMVOC	SO_2
	(kt)			CO_2 equivalent (kt)					(kt)			
2. Total Industrial Processes and Product Use	**455.6262**	**NO**	**0.0000**	**1.0298**	**NO**	**NO**	**NO**	**NO**	**1.2059**	**2.5644**	**39.1321**	**0.4898**
A. Mineral industry	**351.6610**								**1.0921**	**0.9044**	**0.0090**	**0.4438**
1. Cement production	248.5258								0.5705	0.6689	0.0083	0.1719
2. Lime production	78.0227								0.1439	0.2039		0.0332
3. Glass production	5.5292								0.3469		0.0007	0.2321
4. Other process uses of carbonates	19.5834								0.0307	0.0315		0.0066
B. Chemical industry	**NO**	**NO**	**NO**						**NO**	**NO**	**0.0060**	**NO**
1. Ammonia production	NO	NO	NO						NO	NO	NO	NO
2. Nitric acid production			NO						NO			
3. Adipic acid production	NO		NO						NO	NO	NO	
4. Caprolactam, glyoxal and glyoxylic acid production	NO		NO								NO	NO
5. Carbide production	NO	NO							NO	NO	NO	NO
6. Titanium dioxide production	NO											
7. Soda ash production	NO											
8. Petrochemical and carbon black production	NO	NO							NO	NO	NO	NO
9. Fluorochemical production				NO	NO	NO	NO	NO				
10. Other	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0.0060	NO
C. Metal industry	**26.2369**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**0.0854**	**1.1166**	**0.0327**	**0.0394**
1. Iron and steel production	26.2369	NO							0.0854	1.1166	0.0327	0.0394
2. Ferroalloys production	NO	NO							NO	NO	NO	NO
3. Aluminium production	NO				NO		NO		NO	NO	NO	NO
4. Magnesium production	NO			NO	NO	NO	NO		NO	NO	NO	NO
5. Lead production	NO								NO	NO	NO	NO
6. Zinc production	NO								NO	NO	NO	NO
7. Other	NO	NO	NO						NO	NO	NO	NO
D. Non-energy products from fuels and solvent use	**76.5607**	**NO**	**NO**						**0.0132**	**0.0740**	**29.2180**	**0.0065**
1. Lubricant use	10.1316	NO	NO						NO	NO	NO	NO
2. Paraffin wax use	0.0465	NO	NO						NO	NO	NO	NO
3. Solvent use	64.2795	NO	NO						0.0132	0.0740	29.2180	0.0065
4. Other	2.1031	NO	NO						NO	NO	NO	NO
E. Electronics industry				**NO**	**NO**	**NO**	**NO**	**NO**				
1. Integrated circuit or semiconductor				NO	NO	NO	NO	NO				
2. TFT flat panel display				NO	NO	NO	NO	NO				
3. Photovoltaics				NO	NO	NO	NO	NO				
4. Heat transfer fluid				NO	NO	NO	NO	NO				
5. Other				NO	NO	NO	NO	NO				
F. Product uses as substitutes for ODS				**1.0298**	**NO**	**NO**	**NO**	**NO**				
1. Refrigeration and air conditioning				0.7535	NO	NO	NO	NO				
2. Foam blowing agents				0.2763	NO	NO	NO	NO				
3. Fire protection				NO	NO	NO	NO	NO				
4. Aerosols				NO	NO	NO	NO	NO				
5. Solvents				NO	NO	NO	NO	NO				
6. Other applications				NO	NO	NO	NO	NO				
G. Other product manufacture and use	**1.1676**	**NO**	**0.0000**	**NO**	**NO**	**NO**	**NO**	**NO**	**0.0153**	**0.4695**	**0.5307**	**NO**
1. Electrical equipment				NO	NO	NO	NO	NO				
2. SF_6 and PFCs from other product use							NO					
3. N_2O from product uses			0.0000									
4. Other	1.1676	NO	NO	NO	NO	NO	NO	NO	0.0153	0.4695	0.5307	NO
H. Other									**NO**	**NO**	**9.3357**	**NO**
1. Pulp and Paper Industry									NO	NO	NO	NO
2. Food and Beverages Industry									NO	NO	9.3357	NO
3. Other									NO	NO	NO	NO

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GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2	CH_4	N_2O	HFCs	PFCs	Unspecified mix of HFCs and PFCs	SF_6	NF_3	NO_x	CO	NMVOC	SO_2
	(kt)			CO_2 equivalent (kt)					(kt)			
2. Total Industrial Processes and Product Use	**415.2620**	**NO**	**0.0000**	**1.6593**	**NO**	**NO**	**NO**	**NO**	**1.0530**	**2.6496**	**36.1550**	**0.4158**
A. Mineral industry	**316.3598**								**0.9331**	**0.8037**	**0.0070**	**0.3697**
1. Cement production	193.1220								0.4434	0.5198	0.0064	0.1336
2. Lime production	97.7677								0.1803	0.2555		0.0416
3. Glass production	8.2108								0.2819		0.0006	0.1886
4. Other process uses of carbonates	17.2592								0.0276	0.0283		0.0059
B. Chemical industry	**NO**	**NO**	**NO**						**NO**	**NO**	**0.0085**	**NO**
1. Ammonia production	NO	NO	NO						NO	NO	NO	NO
2. Nitric acid production			NO						NO			
3. Adipic acid production	NO		NO						NO	NO	NO	
4. Caprolactam, glyoxal and glyoxylic acid production	NO		NO								NO	NO
5. Carbide production	NO	NO							NO	NO	NO	NO
6. Titanium dioxide production	NO											
7. Soda ash production	NO											
8. Petrochemical and carbon black production	NO	NO							NO	NO	NO	NO
9. Fluorochemical production				NO	NO	NO	NO	NO				
10. Other	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0.0085	NO
C. Metal industry	**26.7261**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**0.0870**	**1.1375**	**0.0332**	**0.0401**
1. Iron and steel production	26.7261	NO							0.0870	1.1375	0.0332	0.0401
2. Ferroalloys production	NO	NO							NO	NO	NO	NO
3. Aluminium production	NO				NO		NO		NO	NO	NO	NO
4. Magnesium production	NO			NO	NO	NO	NO		NO	NO	NO	NO
5. Lead production	NO								NO	NO	NO	NO
6. Zinc production	NO								NO	NO	NO	NO
7. Other	NO	NO	NO						NO	NO	NO	NO
D. Non-energy products from fuels and solvent use	**71.0712**	**NO**	**NO**						**0.0119**	**0.0671**	**27.0276**	**0.0059**
1. Lubricant use	9.7676	NO	NO						NO	NO	NO	NO
2. Paraffin wax use	0.0448	NO	NO						NO	NO	NO	NO
3. Solvent use	59.4608	NO	NO						0.0119	0.0671	27.0276	0.0059
4. Other	1.7979	NO	NO						NO	NO	NO	NO
E. Electronics industry				NO	**NO**	**NO**	**NO**	**NO**				
1. Integrated circuit or semiconductor				NO	NO	NO	NO	NO				
2. TFT flat panel display				NO	NO	NO	NO	NO				
3. Photovoltaics				NO	NO	NO	NO	NO				
4. Heat transfer fluid				NO	NO	NO	NO	NO				
5. Other				NO	NO	NO	NO	NO				
F. Product uses as substitutes for ODS				**1.6593**	**NO**	**NO**	**NO**	**NO**				
1. Refrigeration and air conditioning				1.2463	NO	NO	NO	NO				
2. Foam blowing agents				0.4130	NO	NO	NO	NO				
3. Fire protection				NO	NO	NO	NO	NO				
4. Aerosols				NO	NO	NO	NO	NO				
5. Solvents				NO	NO	NO	NO	NO				
6. Other applications				NO	NO	NO	NO	NO				
G. Other product manufacture and use	**1.1050**	**NO**	**0.0000**	**NO**	**NO**	**NO**	**NO**	**NO**	**0.0210**	**0.6414**	**0.5023**	**NO**
1. Electrical equipment				NO	NO	NO	NO	NO				
2. SF_6 and PFCs from other product use							NO					
3. N_2O from product uses			0.0000									
4. Other	1.1050	NO	NO	NO	NO	NO	NO	NO	0.0210	0.6414	0.5023	NO
H. Other									**NO**	**NO**	**8.5764**	**NO**
1. Pulp and Paper Industry									NO	NO	NO	NO
2. Food and Beverages Industry									NO	NO	8.5764	NO
3. Other									NO	NO	NO	NO

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GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2	CH_4	N_2O	HFCs	PFCs	Unspecified mix of HFCs and PFCs	SF_6	NF_3	NO_x	CO	NMVOC	SO_2
	(kt)			CO_2 equivalent (kt)					(kt)			
2. Total Industrial Processes and Product Use	**452.4924**	**NO**	**0.0000**	**2.3137**	**NO**	**NO**	**NO**	**NO**	**1.2598**	**3.0011**	**22.3412**	**0.4985**
A. Mineral industry	**377.0608**								**1.1298**	**0.9721**	**0.0097**	**0.4479**
1. Cement production	270.1273								0.6207	0.7278	0.0090	0.1871
2. Lime production	81.2988								0.1500	0.2125		0.0346
3. Glass production	5.4581								0.3282		0.0007	0.2195
4. Other process uses of carbonates	20.1767								0.0309	0.0318		0.0067
B. Chemical industry	**NO**	**NO**	**NO**						**NO**	**NO**	**0.0068**	**NO**
1. Ammonia production	NO	NO	NO						NO	NO	NO	NO
2. Nitric acid production			NO						NO			
3. Adipic acid production	NO		NO						NO	NO	NO	
4. Caprolactam, glyoxal and glyoxylic acid production	NO		NO								NO	NO
5. Carbide production	NO	NO							NO	NO	NO	NO
6. Titanium dioxide production	NO											

7. Soda ash production	NO											
8. Petrochemical and carbon black production	NO	NO							NO	NO	NO	NO
9. Fluorochemical production				NO	NO	NO	NO	NO				
10. Other	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0.0068	NO
C. Metal industry	**32.3806**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**0.1054**	**1.3781**	**0.0401**	**0.0486**
1. Iron and steel production	32.3806	NO							0.1054	1.3781	0.0401	0.0486
2. Ferroalloys production	NO	NO							NO	NO	NO	NO
3. Aluminium production	NO				NO		NO		NO	NO	NO	NO
4. Magnesium production	NO			NO	NO	NO	NO		NO	NO	NO	NO
5. Lead production	NO								NO	NO	NO	NO
6. Zinc production	NO								NO	NO	NO	NO
7. Other	NO	NO	NO						NO	NO	NO	NO
D. Non-energy products from fuels and solvent use	**42.0528**	**NO**	**NO**						**0.0040**	**0.0227**	**14.1331**	**0.0020**
1. Lubricant use	9.2153	NO	NO						NO	NO	NO	NO
2. Paraffin wax use	0.0423	NO	NO						NO	NO	NO	NO
3. Solvent use	31.0929	NO	NO						0.0040	0.0227	14.1331	0.0020
4. Other	1.7024	NO	NO						NO	NO	NO	NO
E. Electronics industry				**NO**	**NO**	**NO**	**NO**	**NO**				
1. Integrated circuit or semiconductor				NO	NO	NO	NO	NO				
2. TFT flat panel display				NO	NO	NO	NO	NO				
3. Photovoltaics				NO	NO	NO	NO	NO				
4. Heat transfer fluid				NO	NO	NO	NO	NO				
5. Other				NO	NO	NO	NO	NO				
F. Product uses as substitutes for ODS				**2.3137**	**NO**	**NO**	**NO**	**NO**				
1. Refrigeration and air conditioning				1.7920	NO	NO	NO	NO				
2. Foam blowing agents				0.5216	NO	NO	NO	NO				
3. Fire protection				NO	NO	NO	NO	NO				
4. Aerosols				NO	NO	NO	NO	NO				
5. Solvents				NO	NO	NO	NO	NO				
6. Other applications				NO	NO	NO	NO	NO				
G. Other product manufacture and use	**0.9982**	**NO**	**0.0000**	**NO**	**NO**	**NO**	**NO**	**NO**	**0.0205**	**0.6281**	**0.4537**	**NO**
1. Electrical equipment				NO	NO	NO	NO	NO				
2. SF_6 and PFCs from other product use							NO					
3. N_2O from product uses			0.0000									
4. Other	0.9982	NO	NO	NO	NO	NO	NO	NO	0.0205	0.6281	0.4537	NO
H. Other									**NO**	**NO**	**7.6977**	**NO**
1. Pulp and Paper Industry									NO	NO	NO	NO
2. Food and Beverages Industry									NO	NO	7.6977	NO
3. Other									NO	NO	NO	NO

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GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2	CH_4	N_2O	HFCs	PFCs	Unspecified mix of HFCs and PFCs	SF_6	NF_3	NO_x	CO	NMVOC	SO_2
	(kt)			CO_2 equivalent (kt)					(kt)			
2. Total Industrial Processes and Product Use	**375.5168**	**NO**	**0.0000**	**3.1372**	**NO**	**NO**	**NO**	**NO**	**1.1142**	**2.5238**	**19.9607**	**0.4646**
A. Mineral industry	**308.4801**								**1.0014**	**0.7878**	**0.0079**	**0.4198**
1. Cement production	215.0572								0.4937	0.5788	0.0072	0.1488
2. Lime production	68.5945								0.1265	0.1793		0.0292
3. Glass production	5.8586								0.3523		0.0007	0.2356
4. Other process uses of carbonates	18.9698								0.0289	0.0297		0.0062
B. Chemical industry	**NO**	**NO**	**NO**						**NO**	**NO**	**0.0066**	**NO**
1. Ammonia production	NO	NO	NO						NO	NO	NO	NO
2. Nitric acid production			NO						NO			
3. Adipic acid production	NO		NO						NO	NO	NO	
4. Caprolactam, glyoxal and glyoxylic acid production	NO		NO								NO	NO
5. Carbide production	NO	NO							NO	NO	NO	NO
6. Titanium dioxide production	NO											
7. Soda ash production	NO											
8. Petrochemical and carbon black production	NO	NO							NO	NO	NO	NO
9. Fluorochemical production				NO	NO	NO	NO	NO				
10. Other	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0.0066	NO
C. Metal industry	**28.6822**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**0.0934**	**1.2208**	**0.0371**	**0.0431**
1. Iron and steel production	28.6822	NO							0.0934	1.2208	0.0371	0.0431
2. Ferroalloys production	NO	NO							NO	NO	NO	NO
3. Aluminium production	NO				NO		NO		NO	NO	NO	NO
4. Magnesium production	NO			NO	NO	NO	NO		NO	NO	NO	NO
5. Lead production	NO								NO	NO	NO	NO
6. Zinc production	NO								NO	NO	NO	NO
7. Other	NO	NO	NO						NO	NO	NO	NO
D. Non-energy products from fuels and solvent use	**37.6084**	**NO**	**NO**						**0.0033**	**0.0185**	**13.2678**	**0.0016**
1. Lubricant use	7.0105	NO	NO						NO	NO	NO	NO
2. Paraffin wax use	0.0322	NO	NO						NO	NO	NO	NO
3. Solvent use	29.1892	NO	NO						0.0033	0.0185	13.2678	0.0016
4. Other	1.3765	NO	NO						NO	NO	NO	NO
E. Electronics industry				**NO**	**NO**	**NO**	**NO**	**NO**				
1. Integrated circuit or semiconductor				NO	NO	NO	NO	NO				

2. TFT flat panel display				NO	NO	NO	NO	NO				
3. Photovoltaics				NO	NO	NO	NO	NO				
4. Heat transfer fluid				NO	NO	NO	NO	NO				
5. Other				NO	NO	NO	NO	NO				
F. Product uses as substitutes for ODS				**3.1372**	**NO**	**NO**	**NO**	**NO**				
1. Refrigeration and air conditioning				2.4126	NO	NO	NO	NO				
2. Foam blowing agents				0.7246	NO	NO	NO	NO				
3. Fire protection				NO	NO	NO	NO	NO				
4. Aerosols				NO	NO	NO	NO	NO				
5. Solvents				NO	NO	NO	NO	NO				
6. Other applications				NO	NO	NO	NO	NO				
G. Other product manufacture and use	**0.7460**	**NO**	**0.0000**	**NO**	**NO**	**NO**	**NO**	**NO**	**0.0162**	**0.4967**	**0.3391**	**NO**
1. Electrical equipment				NO	NO	NO	NO	NO				
2. SF_6 and PFCs from other product use							NO					
3. N_2O from product uses			0.0000									
4. Other	0.7460	NO	NO	NO	NO	NO	NO	NO	0.0162	0.4967	0.3391	NO
H. Other									**NO**	**NO**	**6.3022**	**NO**
1. Pulp and Paper Industry									NO	NO	NO	NO
2. Food and Beverages Industry									NO	NO	6.3022	NO
3. Other									NO	NO	NO	NO

1999

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2	CH_4	N_2O	HFCs	PFCs	Unspecified mix of HFCs and PFCs	SF_6	NF_3	NO_x	CO	NMVOC	SO_2
	(kt)			CO_2 equivalent (kt)					(kt)			
2. Total Industrial Processes and Product Use	**338.2305**	**NO**	**0.0000**	**4.0002**	**NO**	**NO**	**NO**	**NO**	**0.9796**	**2.6451**	**17.0520**	**0.3987**
A. Mineral industry	**271.7103**								**0.8542**	**0.6973**	**0.0076**	**0.3494**
1. Cement production	210.8122								0.4844	0.5680	0.0070	0.1460
2. Lime production	37.8903								0.0699	0.0990		0.0161
3. Glass production	3.9427								0.2704		0.0006	0.1809
4. Other process uses of carbonates	19.0650								0.0294	0.0302		0.0063
B. Chemical industry	**NO**	**NO**	**NO**						**NO**	**NO**	**0.0050**	**NO**
1. Ammonia production	NO	NO	NO						NO	NO	NO	NO
2. Nitric acid production			NO						NO			
3. Adipic acid production	NO		NO						NO	NO	NO	
4. Caprolactam, glyoxal and glyoxylic acid production	NO		NO								NO	NO
5. Carbide production	NO	NO							NO	NO	NO	NO
6. Titanium dioxide production	NO											
7. Soda ash production	NO											
8. Petrochemical and carbon black production	NO	NO							NO	NO	NO	NO
9. Fluorochemical production				NO	NO	NO	NO	NO				
10. Other	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0.0050	NO
C. Metal industry	**31.7942**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**0.1035**	**1.3533**	**0.0408**	**0.0478**
1. Iron and steel production	31.7942	NO							0.1035	1.3533	0.0408	0.0478
2. Ferroalloys production	NO	NO							NO	NO	NO	NO
3. Aluminium production	NO				NO		NO		NO	NO	NO	NO
4. Magnesium production	NO			NO	NO	NO	NO		NO	NO	NO	NO
5. Lead production	NO								NO	NO	NO	NO
6. Zinc production	NO								NO	NO	NO	NO
7. Other	NO	NO	NO						NO	NO	NO	NO
D. Non-energy products from fuels and solvent use	**34.0839**	**NO**	**NO**						**0.0031**	**0.0172**	**12.7587**	**0.0015**
1. Lubricant use	4.9998	NO	NO						NO	NO	NO	NO
2. Paraffin wax use	0.0230	NO	NO						NO	NO	NO	NO
3. Solvent use	28.0692	NO	NO						0.0031	0.0172	12.7587	0.0015
4. Other	0.9920	NO	NO						NO	NO	NO	NO
E. Electronics industry				**NO**	**NO**	**NO**	**NO**	**NO**				
1. Integrated circuit or semiconductor				NO	NO	NO	NO	NO				
2. TFT flat panel display				NO	NO	NO	NO	NO				
3. Photovoltaics				NO	NO	NO	NO	NO				
4. Heat transfer fluid				NO	NO	NO	NO	NO				
5. Other				NO	NO	NO	NO	NO				
F. Product uses as substitutes for ODS				**4.0002**	**NO**	**NO**	**NO**	**NO**				
1. Refrigeration and air conditioning				3.0811	NO	NO	NO	NO				
2. Foam blowing agents				0.9191	NO	NO	NO	NO				
3. Fire protection				NO	NO	NO	NO	NO				
4. Aerosols				NO	NO	NO	NO	NO				
5. Solvents				NO	NO	NO	NO	NO				
6. Other applications				NO	NO	NO	NO	NO				
G. Other product manufacture and use	**0.6421**	**NO**	**0.0000**	**NO**	**NO**	**NO**	**NO**	**NO**	**0.0189**	**0.5773**	**0.2919**	**NO**
1. Electrical equipment				NO	NO	NO	NO	NO				
2. SF_6 and PFCs from other product use							NO					
3. N_2O from product uses			0.0000									
4. Other	0.6421	NO	NO	NO	NO	NO	NO	NO	0.0189	0.5773	0.2919	NO
H. Other									**NO**	**NO**	**3.9481**	**NO**
1. Pulp and Paper Industry									NO	NO	NO	NO
2. Food and Beverages Industry									NO	NO	3.9481	NO
3. Other									NO	NO	NO	NO

2000

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2	CH_4	N_2O	HFCs	PFCs	Unspecified mix of HFCs and PFCs	SF_6	NF_3	NO_x	CO	NMVOC	SO_2
	(kt)			CO_2 equivalent (kt)					(kt)			
2. Total Industrial Processes and Product Use	**310.6441**	**NO**	**0.0000**	**5.1199**	**NO**	**NO**	**NO**	**NO**	**1.1392**	**2.7463**	**16.6714**	**0.5399**
A. Mineral industry	**240.7803**								**0.9987**	**0.5762**	**0.0068**	**0.4842**
1. Cement production	172.7600								0.3975	0.4660	0.0058	0.1198
2. Lime production	31.4020								0.0579	0.0821		0.0134
3. Glass production	18.0314								0.5159		0.0011	0.3451
4. Other process uses of carbonates	18.5869								0.0274	0.0282		0.0059
B. Chemical industry	**NO**	**NO**	**NO**						**NO**	**NO**	**0.0073**	**NO**
1. Ammonia production	NO	NO	NO						NO	NO	NO	NO
2. Nitric acid production			NO						NO			
3. Adipic acid production	NO		NO						NO	NO	NO	
4. Caprolactam, glyoxal and glyoxylic acid production	NO		NO								NO	NO
5. Carbide production	NO	NO							NO	NO	NO	NO
6. Titanium dioxide production	NO											
7. Soda ash production	NO											
8. Petrochemical and carbon black production	NO	NO							NO	NO	NO	NO
9. Fluorochemical production				NO	NO	NO	NO	NO				
10. Other	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0.0073	NO
C. Metal industry	**36.2689**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**0.1181**	**1.5438**	**0.0462**	**0.0545**
1. Iron and steel production	36.2689	NO							0.1181	1.5438	0.0462	0.0545
2. Ferroalloys production	NO	NO							NO	NO	NO	NO
3. Aluminium production	NO				NO		NO		NO	NO	NO	NO
4. Magnesium production	NO			NO	NO	NO	NO		NO	NO	NO	NO
5. Lead production	NO								NO	NO	NO	NO
6. Zinc production	NO								NO	NO	NO	NO
7. Other	NO	NO	NO						NO	NO	NO	NO
D. Non-energy products from fuels and solvent use	**32.6395**	**NO**	**NO**						**0.0025**	**0.0139**	**12.5638**	**0.0012**
1. Lubricant use	3.9115	NO	NO						NO	NO	NO	NO
2. Paraffin wax use	0.0180	NO	NO						NO	NO	NO	NO
3. Solvent use	27.6403	NO	NO						0.0025	0.0139	12.5638	0.0012
4. Other	1.0697	NO	NO						NO	NO	NO	NO
E. Electronics industry				**NO**	**NO**	**NO**	**NO**	**NO**				
1. Integrated circuit or semiconductor				NO	NO	NO	NO	NO				
2. TFT flat panel display				NO	NO	NO	NO	NO				
3. Photovoltaics				NO	NO	NO	NO	NO				
4. Heat transfer fluid				NO	NO	NO	NO	NO				
5. Other				NO	NO	NO	NO	NO				
F. Product uses as substitutes for ODS				**5.1199**	**NO**	**NO**	**NO**	**NO**				
1. Refrigeration and air conditioning				3.8190	NO	NO	NO	NO				
2. Foam blowing agents				1.3010	NO	NO	NO	NO				
3. Fire protection				NO	NO	NO	NO	NO				
4. Aerosols				NO	NO	NO	NO	NO				
5. Solvents				NO	NO	NO	NO	NO				
6. Other applications				NO	NO	NO	NO	NO				
G. Other product manufacture and use	**0.9554**	**NO**	**0.0000**	**NO**	**NO**	**NO**	**NO**	**NO**	**0.0200**	**0.6124**	**0.4343**	**NO**
1. Electrical equipment				NO	NO	NO	NO	NO				
2. SF_6 and PFCs from other product use							NO					
3. N_2O from product uses			0.0000									
4. Other	0.9554	NO	NO	NO	NO	NO	NO	NO	0.0200	0.6124	0.4343	NO
H. Other									**NO**	**NO**	**3.6129**	**NO**
1. Pulp and Paper Industry									NO	NO	NO	NO
2. Food and Beverages Industry									NO	NO	3.6129	NO
3. Other									NO	NO	NO	NO

2001

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2	CH_4	N_2O	HFCs	PFCs	Unspecified mix of HFCs and PFCs	SF_6	NF_3	NO_x	CO	NMVOC	SO_2
	(kt)			CO_2 equivalent (kt)					(kt)			
2. Total Industrial Processes and Product Use	**312.9423**	**NO**	**0.0000**	**6.8681**	**NO**	**NO**	**NO**	**NO**	**1.0901**	**2.8557**	**18.4464**	**0.5066**
A. Mineral industry	**237.0750**								**0.9409**	**0.5713**	**0.0068**	**0.4470**
1. Cement production	173.8847								0.3995	0.4684	0.0058	0.1204
2. Lime production	28.4519								0.0525	0.0744		0.0121
3. Glass production	16.3227								0.4612		0.0010	0.3085
4. Other process uses of carbonates	18.4157								0.0278	0.0285		0.0060
B. Chemical industry	**NO**	**NO**	**NO**						**NO**	**NO**	**0.0080**	**NO**
1. Ammonia production	NO	NO	NO						NO	NO	NO	NO
2. Nitric acid production			NO						NO			
3. Adipic acid production	NO		NO						NO	NO	NO	
4. Caprolactam, glyoxal and glyoxylic acid production	NO		NO								NO	NO
5. Carbide production	NO	NO							NO	NO	NO	NO
6. Titanium dioxide production	NO											

7. Soda ash production	NO											
8. Petrochemical and carbon black production	NO	NO							NO	NO	NO	NO
9. Fluorochemical production				NO	NO	NO	NO	NO				
10. Other	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0.0080	NO
C. Metal industry	**38.6274**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**0.1257**	**1.6441**	**0.0500**	**0.0580**
1. Iron and steel production	38.6274	NO							0.1257	1.6441	0.0500	0.0580
2. Ferroalloys production	NO	NO							NO	NO	NO	NO
3. Aluminium production	NO				NO		NO		NO	NO	NO	NO
4. Magnesium production	NO			NO	NO	NO	NO		NO	NO	NO	NO
5. Lead production	NO								NO	NO	NO	NO
6. Zinc production	NO								NO	NO	NO	NO
7. Other	NO	NO	NO						NO	NO	NO	NO
D. Non-energy products from fuels and solvent use	**36.4195**	**NO**	**NO**						**0.0031**	**0.0174**	**14.0195**	**0.0015**
1. Lubricant use	4.3872	NO	NO						NO	NO	NO	NO
2. Paraffin wax use	0.0201	NO	NO						NO	NO	NO	NO
3. Solvent use	30.8429	NO	NO						0.0031	0.0174	14.0195	0.0015
4. Other	1.1693	NO	NO						NO	NO	NO	NO
E. Electronics industry				**NO**	**NO**	**NO**	**NO**	**NO**				
1. Integrated circuit or semiconductor				NO	NO	NO	NO	NO				
2. TFT flat panel display				NO	NO	NO	NO	NO				
3. Photovoltaics				NO	NO	NO	NO	NO				
4. Heat transfer fluid				NO	NO	NO	NO	NO				
5. Other				NO	NO	NO	NO	NO				
F. Product uses as substitutes for ODS				**6.8681**	**NO**	**NO**	**NO**	**NO**				
1. Refrigeration and air conditioning				5.0012	NO	NO	NO	NO				
2. Foam blowing agents				1.8669	NO	NO	NO	NO				
3. Fire protection				NO	NO	NO	NO	NO				
4. Aerosols				NO	NO	NO	NO	NO				
5. Solvents				NO	NO	NO	NO	NO				
6. Other applications				NO	NO	NO	NO	NO				
G. Other product manufacture and use	**0.8204**	**NO**	**0.0000**	**NO**	**NO**	**NO**	**NO**	**NO**	**0.0203**	**0.6229**	**0.3729**	**NO**
1. Electrical equipment				NO	NO	NO	NO	NO				
2. SF_6 and PFCs from other product use							NO					
3. N_2O from product uses			0.0000									
4. Other	0.8204	NO	NO	NO	NO	NO	NO	NO	0.0203	0.6229	0.3729	NO
H. Other									**NO**	**NO**	**3.9893**	**NO**
1. Pulp and Paper Industry									NO	NO	NO	NO
2. Food and Beverages Industry									NO	NO	3.9893	NO
3. Other									NO	NO	NO	NO

2002

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2	CH_4	N_2O	HFCs	PFCs	Unspecified mix of HFCs and PFCs	SF_6	NF_3	NO_x	CO	NMVOC	SO_2
	(kt)			CO_2 equivalent (kt)					(kt)			
2. Total Industrial Processes and Product Use	**361.1500**	**NO**	**0.0000**	**9.1227**	**NO**	**NO**	**NO**	**NO**	**1.2039**	**2.0646**	**19.7692**	**0.5494**
A. Mineral industry	**301.4884**								**1.1197**	**0.7266**	**0.0084**	**0.5172**
1. Cement production	219.1917								0.5048	0.5919	0.0073	0.1521
2. Lime production	38.2546								0.0706	0.1000		0.0163
3. Glass production	22.0121								0.5106		0.0011	0.3415
4. Other process uses of carbonates	22.0299								0.0338	0.0347		0.0073
B. Chemical industry	**NO**	**NO**	**NO**						**NO**	**NO**	**0.0104**	**NO**
1. Ammonia production	NO	NO	NO						NO	NO	NO	NO
2. Nitric acid production			NO						NO			
3. Adipic acid production	NO		NO						NO	NO	NO	
4. Caprolactam, glyoxal and glyoxylic acid production	NO		NO								NO	NO
5. Carbide production	NO	NO							NO	NO	NO	NO
6. Titanium dioxide production	NO											
7. Soda ash production	NO											
8. Petrochemical and carbon black production	NO	NO							NO	NO	NO	NO
9. Fluorochemical production				NO	NO	NO	NO	NO				
10. Other	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0.0104	NO
C. Metal industry	**20.5030**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**0.0667**	**0.8725**	**0.0263**	**0.0308**
1. Iron and steel production	20.5030	NO							0.0667	0.8725	0.0263	0.0308
2. Ferroalloys production	NO	NO							NO	NO	NO	NO
3. Aluminium production	NO				NO		NO		NO	NO	NO	NO
4. Magnesium production	NO			NO	NO	NO	NO		NO	NO	NO	NO
5. Lead production	NO								NO	NO	NO	NO
6. Zinc production	NO								NO	NO	NO	NO
7. Other	NO	NO	NO						NO	NO	NO	NO
D. Non-energy products from fuels and solvent use	**38.3743**	**NO**	**NO**						**0.0027**	**0.0153**	**14.8206**	**0.0013**
1. Lubricant use	4.3239	NO	NO						NO	NO	NO	NO
2. Paraffin wax use	0.0198	NO	NO						NO	NO	NO	NO
3. Solvent use	32.6053	NO	NO						0.0027	0.0153	14.8206	0.0013
4. Other	1.4252	NO	NO						NO	NO	NO	NO
E. Electronics industry				**NO**	**NO**	**NO**	**NO**	**NO**				
1. Integrated circuit or semiconductor				NO	NO	NO	NO	NO				
2. TFT flat panel display				NO	NO	NO	NO	NO				

3. Photovoltaics				NO	NO	NO	NO	NO				
4. Heat transfer fluid				NO	NO	NO	NO	NO				
5. Other				NO	NO	NO	NO	NO				
F. Product uses as substitutes for ODS				**9.1227**	**NO**	**NO**	**NO**	**NO**				
1. Refrigeration and air conditioning				6.1655	NO	NO	NO	NO				
2. Foam blowing agents				2.9571	NO	NO	NO	NO				
3. Fire protection				NO	NO	NO	NO	NO				
4. Aerosols				NO	NO	NO	NO	NO				
5. Solvents				NO	NO	NO	NO	NO				
6. Other applications				NO	NO	NO	NO	NO				
G. Other product manufacture and use	**0.7843**	**NO**	**0.0000**	**NO**	**NO**	**NO**	**NO**	**NO**	**0.0147**	**0.4503**	**0.3565**	**NO**
1. Electrical equipment				NO	NO	NO	NO	NO				
2. SF_6 and PFCs from other product use							NO					
3. N_2O from product uses			0.0000									
4. Other	0.7843	NO	NO	NO	NO	NO	NO	NO	0.0147	0.4503	0.3565	NO
H. Other									**NO**	**NO**	**4.5471**	**NO**
1. Pulp and Paper Industry									NO	NO	NO	NO
2. Food and Beverages Industry									NO	NO	4.5471	NO
3. Other									NO	NO	NO	NO

2003

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2	CH_4	N_2O	HFCs	PFCs	Unspecified mix of HFCs and PFCs	SF_6	NF_3	NO_x	CO	NMVOC	SO_2
	(kt)			CO_2 equivalent (kt)					(kt)			
2. Total Industrial Processes and Product Use	**386.3885**	**NO**	**0.0000**	**12.1632**	**NO**	**NO**	**0.0000**	**NO**	**1.2824**	**2.8260**	**19.6528**	**0.5819**
A. Mineral industry	**309.0730**								**1.1464**	**0.7495**	**0.0092**	**0.5274**
1. Cement production	245.6276								0.5618	0.6586	0.0081	0.1693
2. Lime production	20.5213								0.0379	0.0536		0.0087
3. Glass production	20.3190								0.5106		0.0011	0.3415
4. Other process uses of carbonates	22.6051								0.0363	0.0372		0.0078
B. Chemical industry	**NO**	**NO**	**NO**						**NO**	**NO**	**0.0123**	**NO**
1. Ammonia production	NO	NO	NO						NO	NO	NO	NO
2. Nitric acid production			NO						NO			
3. Adipic acid production	NO		NO						NO	NO	NO	
4. Caprolactam, glyoxal and glyoxylic acid production	NO		NO								NO	NO
5. Carbide production	NO	NO							NO	NO	NO	NO
6. Titanium dioxide production	NO											
7. Soda ash production	NO											
8. Petrochemical and carbon black production	NO	NO							NO	NO	NO	NO
9. Fluorochemical production				NO	NO	NO	NO	NO				
10. Other	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0.0123	NO
C. Metal industry	**35.4283**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**0.1153**	**1.5074**	**0.0456**	**0.0532**
1. Iron and steel production	35.4283	NO							0.1153	1.5074	0.0456	0.0532
2. Ferroalloys production	NO	NO							NO	NO	NO	NO
3. Aluminium production	NO						NO		NO	NO	NO	NO
4. Magnesium production	NO			NO			NO		NO	NO	NO	NO
5. Lead production	NO								NO	NO	NO	NO
6. Zinc production	NO								NO	NO	NO	NO
7. Other	NO	NO	NO						NO	NO	NO	NO
D. Non-energy products from fuels and solvent use	**40.9252**	**NO**	**NO**						**0.0026**	**0.0145**	**14.8735**	**0.0013**
1. Lubricant use	6.5825	NO	NO						NO	NO	NO	NO
2. Paraffin wax use	0.0302	NO	NO						NO	NO	NO	NO
3. Solvent use	32.7216	NO	NO						0.0026	0.0145	14.8735	0.0013
4. Other	1.5908	NO	NO						NO	NO	NO	NO
E. Electronics industry				**NO**	**NO**	**NO**	**NO**	**NO**				
1. Integrated circuit or semiconductor				NO	NO	NO	NO	NO				
2. TFT flat panel display				NO	NO	NO	NO	NO				
3. Photovoltaics				NO	NO	NO	NO	NO				
4. Heat transfer fluid				NO	NO	NO	NO	NO				
5. Other				NO	NO	NO	NO	NO				
F. Product uses as substitutes for ODS				**12.1632**	**NO**	**NO**	**NO**	**NO**				
1. Refrigeration and air conditioning				7.3862	NO	NO	NO	NO				
2. Foam blowing agents				4.7770	NO	NO	NO	NO				
3. Fire protection				NO	NO	NO	NO	NO				
4. Aerosols				0.0001	NO	NO	NO	NO				
5. Solvents				NO	NO	NO	NO	NO				
6. Other applications				NO	NO	NO	NO	NO				
G. Other product manufacture and use	**0.9620**	**NO**	**0.0000**	**NO**	**NO**	**NO**	**0.0000**	**NO**	**0.0181**	**0.5545**	**0.4373**	**NO**
1. Electrical equipment				NO	NO	NO	0.0000	NO				
2. SF_6 and PFCs from other product use							NO					
3. N_2O from product uses			0.0000									
4. Other	0.9620	NO	NO	NO	NO	NO	NO	NO	0.0181	0.5545	0.4373	NO
H. Other									**NO**	**NO**	**4.2749**	**NO**
1. Pulp and Paper Industry									NO	NO	NO	NO
2. Food and Beverages Industry									NO	NO	4.2749	NO
3. Other									NO	NO	NO	NO

2004

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2	CH_4	N_2O	HFCs	PFCs	Unspecified mix of HFCs and PFCs	SF_6	NF_3	NO_x	CO	NMVOC	SO_2
	(kt)			CO_2 equivalent (kt)					(kt)			
2. Total Industrial Processes and Product Use	**456.1463**	**NO**	**0.0001**	**16.0027**	**NO**	**NO**	**0.0000**	**NO**	**1.4368**	**3.2083**	**31.1819**	**0.6438**
A. Mineral industry	**350.4572**								**1.2780**	**0.8629**	**0.0106**	**0.5790**
1. Cement production	282.5765								0.6524	0.7649	0.0095	0.1966
2. Lime production	20.5790								0.0380	0.0538		0.0088
3. Glass production	21.0712								0.5446		0.0011	0.3643
4. Other process uses of carbonates	26.2305								0.0431	0.0443		0.0093
B. Chemical industry	**NO**	**NO**	**NO**						**NO**	**NO**	**0.0129**	**NO**
1. Ammonia production	NO	NO	NO						NO	NO	NO	NO
2. Nitric acid production			NO						NO			
3. Adipic acid production	NO		NO						NO	NO	NO	
4. Caprolactam, glyoxal and glyoxylic acid production	NO		NO								NO	NO
5. Carbide production	NO	NO							NO	NO	NO	NO
6. Titanium dioxide production	NO											
7. Soda ash production	NO											
8. Petrochemical and carbon black production	NO	NO							NO	NO	NO	NO
9. Fluorochemical production				NO	NO	NO	NO	NO				
10. Other	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0.0129	NO
C. Metal industry	**40.5084**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**0.1318**	**1.7236**	**0.0522**	**0.0608**
1. Iron and steel production	40.5084	NO							0.1318	1.7236	0.0522	0.0608
2. Ferroalloys production	NO	NO							NO	NO	NO	NO
3. Aluminium production	NO						NO		NO	NO	NO	NO
4. Magnesium production	NO			NO			NO		NO	NO	NO	NO
5. Lead production	NO								NO	NO	NO	NO
6. Zinc production	NO								NO	NO	NO	NO
7. Other	NO	NO	NO						NO	NO	NO	NO
D. Non-energy products from fuels and solvent use	**64.1303**	**NO**	**NO**						**0.0082**	**0.0459**	**25.3328**	**0.0041**
1. Lubricant use	6.5622	NO	NO						NO	NO	NO	NO
2. Paraffin wax use	0.0301	NO	NO						NO	NO	NO	NO
3. Solvent use	55.7321	NO	NO						0.0082	0.0459	25.3328	0.0041
4. Other	1.8059	NO	NO						NO	NO	NO	NO
E. Electronics industry				**NO**	**NO**	**NO**	**NO**	**NO**				
1. Integrated circuit or semiconductor				NO	NO	NO	NO	NO				
2. TFT flat panel display				NO	NO	NO	NO	NO				
3. Photovoltaics				NO	NO	NO	NO	NO				
4. Heat transfer fluid				NO	NO	NO	NO	NO				
5. Other				NO	NO	NO	NO	NO				
F. Product uses as substitutes for ODS				**16.0027**	**NO**	**NO**	**NO**	**NO**				
1. Refrigeration and air conditioning				8.5552	NO	NO	NO	NO				
2. Foam blowing agents				7.4473	NO	NO	NO	NO				
3. Fire protection				NO	NO	NO	NO	NO				
4. Aerosols				0.0002	NO	NO	NO	NO				
5. Solvents				NO	NO	NO	NO	NO				
6. Other applications				NO	NO	NO	NO	NO				
G. Other product manufacture and use	**1.0504**	**NO**	**0.0001**	**NO**	**NO**	**NO**	**0.0000**	**NO**	**0.0188**	**0.5759**	**0.4774**	**NO**
1. Electrical equipment				NO	NO	NO	0.0000	NO				
2. SF_6 and PFCs from other product use							NO					
3. N_2O from product uses			0.0001									
4. Other	1.0504	NO	NO	NO	NO	NO	NO	NO	0.0188	0.5759	0.4774	NO
H. Other									**NO**	**NO**	**5.2960**	**NO**
1. Pulp and Paper Industry									NO	NO	NO	NO
2. Food and Beverages Industry									NO	NO	5.2960	NO
3. Other									NO	NO	NO	NO

2005

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2	CH_4	N_2O	HFCs	PFCs	Unspecified mix of HFCs and PFCs	SF_6	NF_3	NO_x	CO	NMVOC	SO_2
	(kt)			CO_2 equivalent (kt)					(kt)			
2. Total Industrial Processes and Product Use	**550.4807**	**NO**	**0.0001**	**22.5106**	**NO**	**NO**	**0.0000**	**NO**	**1.7183**	**3.4998**	**33.6173**	**0.7558**
A. Mineral industry	**439.1892**								**1.5556**	**1.1045**	**0.0135**	**0.6890**
1. Cement production	365.0817								0.8422	0.9874	0.0122	0.2538
2. Lime production	27.8408								0.0514	0.0728		0.0119
3. Glass production	24.2258								0.6189		0.0013	0.4140
4. Other process uses of carbonates	22.0409								0.0431	0.0443		0.0093
B. Chemical industry	**NO**	**NO**	**NO**						**NO**	**NO**	**0.0149**	**NO**
1. Ammonia production	NO	NO	NO						NO	NO	NO	NO
2. Nitric acid production			NO						NO			
3. Adipic acid production	NO		NO						NO	NO	NO	
4. Caprolactam, glyoxal and glyoxylic acid production	NO		NO								NO	NO
5. Carbide production	NO	NO							NO	NO	NO	NO
6. Titanium dioxide production	NO											

7. Soda ash production	NO											
8. Petrochemical and carbon black production	NO	NO							NO	NO	NO	NO
9. Fluorochemical production				NO	NO	NO	NO	NO				
10. Other	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0.0149	NO
C. Metal industry	**41.9358**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**0.1364**	**1.7839**	**0.0545**	**0.0630**
1. Iron and steel production	41.9358	NO							0.1364	1.7839	0.0545	0.0630
2. Ferroalloys production	NO	NO							NO	NO	NO	NO
3. Aluminium production	NO						NO		NO	NO	NO	NO
4. Magnesium production	NO			NO			NO		NO	NO	NO	NO
5. Lead production	NO								NO	NO	NO	NO
6. Zinc production	NO								NO	NO	NO	NO
7. Other	NO	NO	NO						NO	NO	NO	NO
D. Non-energy products from fuels and solvent use	**68.1910**	**NO**	**NO**						**0.0077**	**0.0431**	**27.2264**	**0.0038**
1. Lubricant use	6.4692	NO	NO						NO	NO	NO	NO
2. Paraffin wax use	0.0149	NO	NO						NO	NO	NO	NO
3. Solvent use	59.8981	NO	NO						0.0077	0.0431	27.2264	0.0038
4. Other	1.8088	NO	NO						NO	NO	NO	NO
E. Electronics industry				**NO**	**NO**	**NO**	**NO**	**NO**				
1. Integrated circuit or semiconductor				NO	NO	NO	NO	NO				
2. TFT flat panel display				NO	NO	NO	NO	NO				
3. Photovoltaics				NO	NO	NO	NO	NO				
4. Heat transfer fluid				NO	NO	NO	NO	NO				
5. Other				NO	NO	NO	NO	NO				
F. Product uses as substitutes for ODS				**22.5106**	**NO**	**NO**	**NO**	**NO**				
1. Refrigeration and air conditioning				10.2213	NO	NO	NO	NO				
2. Foam blowing agents				12.2889	NO	NO	NO	NO				
3. Fire protection				NO	NO	NO	NO	NO				
4. Aerosols				0.0004	NO	NO	NO	NO				
5. Solvents				NO	NO	NO	NO	NO				
6. Other applications				NO	NO	NO	NO	NO				
G. Other product manufacture and use	**1.1646**	**NO**	**0.0001**	**NO**	**NO**	**NO**	**0.0000**	**NO**	**0.0186**	**0.5683**	**0.5294**	**NO**
1. Electrical equipment				NO	NO	NO	0.0000	NO				
2. SF_6 and PFCs from other product use							NO					
3. N_2O from product uses			0.0001									
4. Other	1.1646	NO	NO	NO	NO	NO	NO	NO	0.0186	0.5683	0.5294	NO
H. Other									**NO**	**NO**	**5.7786**	**NO**
1. Pulp and Paper Industry									NO	NO	NO	NO
2. Food and Beverages Industry									NO	NO	5.7786	NO
3. Other									NO	NO	NO	NO

2006

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2	CH_4	N_2O	HFCs	PFCs	Unspecified mix of HFCs and PFCs	SF_6	NF_3	NO_x	CO	NMVOC	SO_2
	(kt)			CO_2 equivalent (kt)					(kt)			
2. Total Industrial Processes and Product Use	**645.4865**	**NO**	**0.0001**	**33.2493**	**0.0231**	**NO**	**0.0000**	**NO**	**1.8503**	**3.1294**	**38.8065**	**0.7739**
A. Mineral industry	**535.4220**								**1.7321**	**1.3597**	**0.0165**	**0.7272**
1. Cement production	457.0753								1.0555	1.2376	0.0153	0.3181
2. Lime production	30.1048								0.0555	0.0787		0.0128
3. Glass production	24.9541								0.5787		0.0012	0.3871
4. Other process uses of carbonates	23.2878								0.0423	0.0434		0.0091
B. Chemical industry	**NO**	**NO**	**NO**						**NO**	**NO**	**0.0130**	**NO**
1. Ammonia production	NO	NO	NO						NO	NO	NO	NO
2. Nitric acid production			NO						NO			
3. Adipic acid production	NO		NO						NO	NO	NO	
4. Caprolactam, glyoxal and glyoxylic acid production	NO		NO								NO	NO
5. Carbide production	NO	NO							NO	NO	NO	NO
6. Titanium dioxide production	NO											
7. Soda ash production	NO											
8. Petrochemical and carbon black production	NO	NO							NO	NO	NO	NO
9. Fluorochemical production				NO	NO	NO	NO	NO				
10. Other	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0.0130	NO
C. Metal industry	**27.0182**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**0.0879**	**1.1492**	**0.0355**	**0.0406**
1. Iron and steel production	27.0182	NO							0.0879	1.1492	0.0355	0.0406
2. Ferroalloys production	NO	NO							NO	NO	NO	NO
3. Aluminium production	NO				NO		NO		NO	NO	NO	NO
4. Magnesium production	NO			NO	NO		NO		NO	NO	NO	NO
5. Lead production	NO								NO	NO	NO	NO
6. Zinc production	NO								NO	NO	NO	NO
7. Other	NO	NO	NO						NO	NO	NO	NO
D. Non-energy products from fuels and solvent use	**81.9807**	**NO**	**NO**						**0.0124**	**0.0697**	**33.2258**	**0.0062**
1. Lubricant use	6.9861	NO	NO						NO	NO	NO	NO
2. Paraffin wax use	0.0594	NO	NO						NO	NO	NO	NO
3. Solvent use	73.0967	NO	NO						0.0124	0.0697	33.2258	0.0062
4. Other	1.8385	NO	NO						NO	NO	NO	NO
E. Electronics industry				**NO**	**NO**	**NO**	**NO**	**NO**				
1. Integrated circuit or semiconductor				NO	NO	NO	NO	NO				
2. TFT flat panel display				NO	NO	NO	NO	NO				

3. Photovoltaics				NO	NO	NO	NO	NO				
4. Heat transfer fluid				NO	NO	NO	NO	NO				
5. Other				NO	NO	NO	NO	NO				
F. Product uses as substitutes for ODS				**33.2493**	**NO**	**NO**	**NO**	**NO**				
1. Refrigeration and air conditioning				14.7472	NO	NO	NO	NO				
2. Foam blowing agents				18.5004	NO	NO	NO	NO				
3. Fire protection				NO	NO	NO	NO	NO				
4. Aerosols				0.0018	NO	NO	NO	NO				
5. Solvents				NO	NO	NO	NO	NO				
6. Other applications				NO	NO	NO	NO	NO				
G. Other product manufacture and use	**1.0655**	**NO**	**0.0001**	**NO**	**0.0231**	**NO**	**0.0000**	**NO**	**0.0180**	**0.5508**	**0.4843**	**NO**
1. Electrical equipment				NO	0.0231	NO	0.0000	NO				
2. SF_6 and PFCs from other product use							NO					
3. N_2O from product uses			0.0001									
4. Other	1.0655	NO	NO	NO	NO	NO	NO	NO	0.0180	0.5508	0.4843	NO
H. Other									**NO**	**NO**	**5.0313**	**NO**
1. Pulp and Paper Industry									NO	NO	NO	NO
2. Food and Beverages Industry									NO	NO	5.0313	NO
3. Other									NO	NO	NO	NO

2007

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2	CH_4	N_2O	HFCs	PFCs	Unspecified mix of HFCs and PFCs	SF_6	NF_3	NO_x	CO	NMVOC	SO_2
	(kt)			CO_2 equivalent (kt)					(kt)			
2. Total Industrial Processes and Product Use	**892.1071**	**NO**	**NO**	**44.7872**	**0.0231**	**NO**	**0.0000**	**NO**	**2.3881**	**4.3206**	**39.1522**	**0.9238**
A. Mineral industry	**767.6859**								**2.2296**	**1.9983**	**0.0245**	**0.8593**
1. Cement production	702.6656								1.6161	1.8948	0.0234	0.4870
2. Lime production	21.9382								0.0405	0.0573		0.0093
3. Glass production	21.5727								0.5281		0.0011	0.3533
4. Other process uses of carbonates	21.5093								0.0449	0.0462		0.0097
B. Chemical industry	**NO**	**NO**	**NO**						**NO**	**NO**	**0.0139**	**NO**
1. Ammonia production	NO	NO	NO						NO	NO	NO	NO
2. Nitric acid production			NO						NO			
3. Adipic acid production	NO		NO						NO	NO	NO	
4. Caprolactam, glyoxal and glyoxylic acid production	NO		NO								NO	NO
5. Carbide production	NO	NO							NO	NO	NO	NO
6. Titanium dioxide production	NO											
7. Soda ash production	NO											
8. Petrochemical and carbon black production	NO	NO							NO	NO	NO	NO
9. Fluorochemical production				NO	NO	NO	NO	NO				
10. Other	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0.0139	NO
C. Metal industry	**38.6127**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**0.1256**	**1.6426**	**0.0508**	**0.0580**
1. Iron and steel production	38.6127	NO							0.1256	1.6426	0.0508	0.0580
2. Ferroalloys production	NO	NO							NO	NO	NO	NO
3. Aluminium production	NO				NO		NO		NO	NO	NO	NO
4. Magnesium production	NO			NO	NO		NO		NO	NO	NO	NO
5. Lead production	NO								NO	NO	NO	NO
6. Zinc production	NO								NO	NO	NO	NO
7. Other	NO	NO	NO						NO	NO	NO	NO
D. Non-energy products from fuels and solvent use	**84.7433**	**NO**	**NO**						**0.0130**	**0.0732**	**34.9915**	**0.0065**
1. Lubricant use	5.7679	NO	NO						NO	NO	NO	NO
2. Paraffin wax use	0.0595	NO	NO						NO	NO	NO	NO
3. Solvent use	76.9812	NO	NO						0.0130	0.0732	34.9915	0.0065
4. Other	1.9347	NO	NO						NO	NO	NO	NO
E. Electronics industry				**NO**	**NO**	**NO**	**NO**	**NO**				
1. Integrated circuit or semiconductor				NO	NO	NO	NO	NO				
2. TFT flat panel display				NO	NO	NO	NO	NO				
3. Photovoltaics				NO	NO	NO	NO	NO				
4. Heat transfer fluid				NO	NO	NO	NO	NO				
5. Other				NO	NO	NO	NO	NO				
F. Product uses as substitutes for ODS				**44.7872**	**NO**	**NO**	**NO**	**NO**				
1. Refrigeration and air conditioning				17.2562	NO	NO	NO	NO				
2. Foam blowing agents				27.5284	NO	NO	NO	NO				
3. Fire protection				NO	NO	NO	NO	NO				
4. Aerosols				0.0026	NO	NO	NO	NO				
5. Solvents				NO	NO	NO	NO	NO				
6. Other applications				NO	NO	NO	NO	NO				
G. Other product manufacture and use	**1.0652**	**NO**	**NO**	**NO**	**0.0231**	**NO**	**0.0000**	**NO**	**0.0198**	**0.6066**	**0.4842**	**NO**
1. Electrical equipment				NO	0.0231	NO	0.0000	NO				
2. SF_6 and PFCs from other product use							NO					
3. N_2O from product uses			NO									
4. Other	1.0652	NO	NO	NO	NO	NO	NO	NO	0.0198	0.6066	0.4842	NO
H. Other									**NO**	**NO**	**3.5873**	**NO**
1. Pulp and Paper Industry									NO	NO	NO	NO
2. Food and Beverages Industry									NO	NO	3.5873	NO
3. Other									NO	NO	NO	NO

2008

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2	CH_4	N_2O	HFCs	PFCs	Unspecified mix of HFCs and PFCs	SF_6	NF_3	NO_x	CO	NMVOC	SO_2
	(kt)			CO_2 equivalent (kt)					(kt)			
2. Total Industrial Processes and Product Use	**967.6859**	**NO**	**NO**	**57.3610**	**0.0288**	**NO**	**0.0000**	**NO**	**2.5679**	**4.3540**	**32.0314**	**0.9601**
A. Mineral industry	**864.4658**								**2.4282**	**2.2832**	**0.0278**	**0.9032**
1. Cement production	789.9160								1.8448	2.1630	0.0268	0.5560
2. Lime production	29.1378								0.0537	0.0762		0.0124
3. Glass production	24.1759								0.4867		0.0010	0.3256
4. Other process uses of carbonates	21.2360								0.0429	0.0441		0.0092
B. Chemical industry	**NO**	**NO**	**NO**						**NO**	**NO**	**0.0122**	**NO**
1. Ammonia production	NO	NO	NO						NO	NO	NO	NO
2. Nitric acid production			NO						NO			
3. Adipic acid production	NO		NO						NO	NO	NO	
4. Caprolactam, glyoxal and glyoxylic acid production	NO		NO								NO	NO
5. Carbide production	NO	NO							NO	NO	NO	NO
6. Titanium dioxide production	NO											
7. Soda ash production	NO											
8. Petrochemical and carbon black production	NO	NO							NO	NO	NO	NO
9. Fluorochemical production				NO	NO	NO	NO	NO				
10. Other	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0.0122	NO
C. Metal industry	**35.4118**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**0.1152**	**1.5064**	**0.0465**	**0.0532**
1. Iron and steel production	35.4118	NO							0.1152	1.5064	0.0465	0.0532
2. Ferroalloys production	NO	NO							NO	NO	NO	NO
3. Aluminium production	NO				NO		NO		NO	NO	NO	NO
4. Magnesium production	NO			NO	NO		NO		NO	NO	NO	NO
5. Lead production	NO								NO	NO	NO	NO
6. Zinc production	NO								NO	NO	NO	NO
7. Other	NO	NO	NO						NO	NO	NO	NO
D. Non-energy products from fuels and solvent use	**66.7047**	**NO**	**NO**						**0.0075**	**0.0427**	**26.5891**	**0.0037**
1. Lubricant use	6.1481	NO	NO						NO	NO	NO	NO
2. Paraffin wax use	0.0295	NO	NO						NO	NO	NO	NO
3. Solvent use	58.4959	NO	NO						0.0075	0.0427	26.5891	0.0037
4. Other	2.0312	NO	NO						NO	NO	NO	NO
E. Electronics industry				**NO**	**NO**	**NO**	**NO**	**NO**				
1. Integrated circuit or semiconductor				NO	NO	NO	NO	NO				
2. TFT flat panel display				NO	NO	NO	NO	NO				
3. Photovoltaics				NO	NO	NO	NO	NO				
4. Heat transfer fluid				NO	NO	NO	NO	NO				
5. Other				NO	NO	NO	NO	NO				
F. Product uses as substitutes for ODS				**57.3610**	**NO**	**NO**	**NO**	**NO**				
1. Refrigeration and air conditioning				19.6842	NO	NO	NO	NO				
2. Foam blowing agents				37.6745	NO	NO	NO	NO				
3. Fire protection				NO	NO	NO	NO	NO				
4. Aerosols				0.0023	NO	NO	NO	NO				
5. Solvents				NO	NO	NO	NO	NO				
6. Other applications				NO	NO	NO	NO	NO				
G. Other product manufacture and use	**1.1036**	**NO**	**NO**	**NO**	**0.0288**	**NO**	**0.0000**	**NO**	**0.0170**	**0.5217**	**0.5016**	**NO**
1. Electrical equipment				NO	0.0288	NO	0.0000	NO				
2. SF_6 and PFCs from other product use							NO					
3. N_2O from product uses			NO									
4. Other	1.1036	NO	NO	NO	NO	NO	NO	NO	0.0170	0.5217	0.5016	NO
H. Other									**NO**	**NO**	**4.8542**	**NO**
1. Pulp and Paper Industry									NO	NO	NO	NO
2. Food and Beverages Industry									NO	NO	4.8542	NO
3. Other									NO	NO	NO	NO

2009

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2	CH_4	N_2O	HFCs	PFCs	Unspecified mix of HFCs and PFCs	SF_6	NF_3	NO_x	CO	NMVOC	SO_2
	(kt)			CO_2 equivalent (kt)					(kt)			
2. Total Industrial Processes and Product Use	**462.2951**	**NO**	**NO**	**67.4790**	**0.0288**	**NO**	**0.0000**	**NO**	**1.2921**	**2.3712**	**26.6433**	**0.5246**
A. Mineral industry	**386.8478**								**1.2106**	**0.9874**	**0.0123**	**0.4962**
1. Cement production	340.5679								0.7959	0.9331	0.0115	0.2398
2. Lime production	8.4641								0.0156	0.0221		0.0036
3. Glass production	18.0724								0.3678		0.0008	0.2460
4. Other process uses of carbonates	19.7434								0.0314	0.0322		0.0068
B. Chemical industry	**NO**	**NO**	**NO**						**NO**	**NO**	**0.0100**	**NO**
1. Ammonia production	NO	NO	NO						NO	NO	NO	NO
2. Nitric acid production			NO						NO			
3. Adipic acid production	NO		NO						NO	NO	NO	
4. Caprolactam, glyoxal and glyoxylic acid production	NO		NO								NO	NO
5. Carbide production	NO	NO							NO	NO	NO	NO
6. Titanium dioxide production	NO											

7. Soda ash production	NO											
8. Petrochemical and carbon black production	NO	NO							NO	NO	NO	NO
9. Fluorochemical production				NO	NO	NO	NO	NO				
10. Other	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0.0100	NO
C. Metal industry	**17.0619**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**0.0555**	**0.7255**	**0.0227**	**0.0256**
1. Iron and steel production	17.0619	NO							0.0555	0.7255	0.0227	0.0256
2. Ferroalloys production	NO	NO							NO	NO	NO	NO
3. Aluminium production	NO				NO		NO		NO	NO	NO	NO
4. Magnesium production	NO			NO	NO		NO		NO	NO	NO	NO
5. Lead production	NO								NO	NO	NO	NO
6. Zinc production	NO								NO	NO	NO	NO
7. Other	NO	NO	NO						NO	NO	NO	NO
D. Non-energy products from fuels and solvent use	**57.5805**	**NO**	**NO**						**0.0056**	**0.0316**	**22.9783**	**0.0028**
1. Lubricant use	5.0916	NO	NO						NO	NO	NO	NO
2. Paraffin wax use	0.0742	NO	NO						NO	NO	NO	NO
3. Solvent use	50.5522	NO	NO						0.0056	0.0316	22.9783	0.0028
4. Other	1.8625	NO	NO						NO	NO	NO	NO
E. Electronics industry				**NO**	**NO**	**NO**	**NO**	**NO**				
1. Integrated circuit or semiconductor				NO	NO	NO	NO	NO				
2. TFT flat panel display				NO	NO	NO	NO	NO				
3. Photovoltaics				NO	NO	NO	NO	NO				
4. Heat transfer fluid				NO	NO	NO	NO	NO				
5. Other				NO	NO	NO	NO	NO				
F. Product uses as substitutes for ODS				**67.4790**	**NO**	**NO**	**NO**	**NO**				
1. Refrigeration and air conditioning				21.3659	NO	NO	NO	NO				
2. Foam blowing agents				46.1098	NO	NO	NO	NO				
3. Fire protection				NO	NO	NO	NO	NO				
4. Aerosols				0.0033	NO	NO	NO	NO				
5. Solvents				NO	NO	NO	NO	NO				
6. Other applications				NO	NO	NO	NO	NO				
G. Other product manufacture and use	**0.8048**	**NO**	**NO**	**NO**	**0.0288**	**NO**	**0.0000**	**NO**	**0.0205**	**0.6267**	**0.3658**	**NO**
1. Electrical equipment				NO	0.0288	NO	0.0000	NO				
2. SF_6 and PFCs from other product use							NO					
3. N_2O from product uses			NO									
4. Other	0.8048	NO	NO	NO	NO	NO	NO	NO	0.0205	0.6267	0.3658	NO
H. Other									**NO**	**NO**	**3.2541**	**NO**
1. Pulp and Paper Industry									NO	NO	NO	NO
2. Food and Beverages Industry									NO	NO	3.2541	NO
3. Other									NO	NO	NO	NO

2010

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2	CH_4	N_2O	HFCs	PFCs	Unspecified mix of HFCs and PFCs	SF_6	NF_3	NO_x	CO	NMVOC	SO_2
	(kt)			CO_2 equivalent (kt)					(kt)			
2. Total Industrial Processes and Product Use	**482.3543**	**NO**	**NO**	**78.1507**	**0.0403**	**NO**	**0.0000**	**NO**	**1.3736**	**2.2003**	**31.1949**	**0.5705**
A. Mineral industry	**405.3915**								**1.3115**	**1.0242**	**0.0127**	**0.5525**
1. Cement production	349.8333								0.8135	0.9538	0.0118	0.2452
2. Lime production	15.3644								0.0283	0.0402		0.0065
3. Glass production	21.2694								0.4402		0.0009	0.2945
4. Other process uses of carbonates	18.9244								0.0294	0.0302		0.0063
B. Chemical industry	**NO**	**NO**	**NO**						**NO**	**NO**	**0.0143**	**NO**
1. Ammonia production	NO	NO	NO						NO	NO	NO	NO
2. Nitric acid production			NO						NO			
3. Adipic acid production	NO		NO						NO	NO	NO	
4. Caprolactam, glyoxal and glyoxylic acid production	NO		NO								NO	NO
5. Carbide production	NO	NO							NO	NO	NO	NO
6. Titanium dioxide production	NO											
7. Soda ash production	NO											
8. Petrochemical and carbon black production	NO	NO							NO	NO	NO	NO
9. Fluorochemical production				NO	NO	NO	NO	NO				
10. Other	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0.0143	NO
C. Metal industry	**9.6985**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**0.0315**	**0.4121**	**0.0128**	**0.0145**
1. Iron and steel production	9.6985	NO							0.0315	0.4121	0.0128	0.0145
2. Ferroalloys production	NO	NO							NO	NO	NO	NO
3. Aluminium production	NO				NO		NO		NO	NO	NO	NO
4. Magnesium production	NO			NO	NO		NO		NO	NO	NO	NO
5. Lead production	NO								NO	NO	NO	NO
6. Zinc production	NO								NO	NO	NO	NO
7. Other	NO	NO	NO						NO	NO	NO	NO
D. Non-energy products from fuels and solvent use	**66.2398**	**NO**	**NO**						**0.0069**	**0.0392**	**26.4907**	**0.0034**
1. Lubricant use	5.4648	NO	NO						NO	NO	NO	NO
2. Paraffin wax use	0.1795	NO	NO						NO	NO	NO	NO
3. Solvent use	58.2796	NO	NO						0.0069	0.0392	26.4907	0.0034
4. Other	2.3159	NO	NO						NO	NO	NO	NO
E. Electronics industry				**NO**	**NO**	**NO**	**NO**	**NO**				
1. Integrated circuit or semiconductor				NO	NO	NO	NO	NO				

2. TFT flat panel display				NO	NO	NO	NO	NO				
3. Photovoltaics				NO	NO	NO	NO	NO				
4. Heat transfer fluid				NO	NO	NO	NO	NO				
5. Other				NO	NO	NO	NO	NO				
F. Product uses as substitutes for ODS				**78.1507**	**NO**	**NO**	**NO**	**NO**				
1. Refrigeration and air conditioning				23.5195	NO	NO	NO	NO				
2. Foam blowing agents				54.6272	NO	NO	NO	NO				
3. Fire protection				NO	NO	NO	NO	NO				
4. Aerosols				0.0040	NO	NO	NO	NO				
5. Solvents				NO	NO	NO	NO	NO				
6. Other applications				NO	NO	NO	NO	NO				
G. Other product manufacture and use	**1.0245**	**NO**	**NO**	**NO**	**0.0403**	**NO**	**0.0000**	**NO**	**0.0237**	**0.7247**	**0.4657**	**NO**
1. Electrical equipment				NO	0.0403	NO	0.0000	NO				
2. SF_6 and PFCs from other product use							NO					
3. N_2O from product uses			NO									
4. Other	1.0245	NO	NO	NO	NO	NO	NO	NO	0.0237	0.7247	0.4657	NO
H. Other									**NO**	**NO**	**4.1987**	**NO**
1. Pulp and Paper Industry									NO	NO	NO	NO
2. Food and Beverages Industry									NO	NO	4.1987	NO
3. Other									NO	NO	NO	NO

2011

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2	CH_4	N_2O	HFCs	PFCs	Unspecified mix of HFCs and PFCs	SF_6	NF_3	NO_x	CO	NMVOC	SO_2
	(kt)			CO_2 equivalent (kt)			(kt)					
2. Total Industrial Processes and Product Use	**573.6077**	**NO**	**NO**	**90.5042**	**0.0403**	**NO**	**0.0000**	**NO**	**1.6612**	**2.5605**	**33.5228**	**0.6913**
A. Mineral industry	**488.1986**								**1.5879**	**1.2450**	**0.0156**	**0.6681**
1. Cement production	427.2624								0.9986	1.1709	0.0145	0.3010
2. Lime production	16.6236								0.0307	0.0435		0.0071
3. Glass production	25.9476								0.5287		0.0011	0.3537
4. Other process uses of carbonates	18.3651								0.0299	0.0307		0.0064
B. Chemical industry	**NO**	**NO**	**NO**						**NO**	**NO**	**0.0157**	**NO**
1. Ammonia production	NO	NO	NO						NO	NO	NO	NO
2. Nitric acid production			NO						NO			
3. Adipic acid production	NO		NO						NO	NO	NO	
4. Caprolactam, glyoxal and glyoxylic acid production	NO		NO								NO	NO
5. Carbide production	NO	NO							NO	NO	NO	NO
6. Titanium dioxide production	NO											
7. Soda ash production	NO											
8. Petrochemical and carbon black production	NO	NO							NO	NO	NO	NO
9. Fluorochemical production				NO	NO	NO	NO	NO				
10. Other	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0.0157	NO
C. Metal industry	**12.8556**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**0.0418**	**0.5465**	**0.0169**	**0.0193**
1. Iron and steel production	12.8556	NO							0.0418	0.5465	0.0169	0.0193
2. Ferroalloys production	NO	NO							NO	NO	NO	NO
3. Aluminium production	NO				NO		NO		NO	NO	NO	NO
4. Magnesium production	NO			NO	NO		NO		NO	NO	NO	NO
5. Lead production	NO								NO	NO	NO	NO
6. Zinc production	NO								NO	NO	NO	NO
7. Other	NO	NO	NO						NO	NO	NO	NO
D. Non-energy products from fuels and solvent use	**71.3244**	**NO**	**NO**						**0.0078**	**0.0443**	**28.6400**	**0.0039**
1. Lubricant use	5.7762	NO	NO						NO	NO	NO	NO
2. Paraffin wax use	0.0747	NO	NO						NO	NO	NO	NO
3. Solvent use	63.0079	NO	NO						0.0078	0.0443	28.6400	0.0039
4. Other	2.4656	NO	NO						NO	NO	NO	NO
E. Electronics industry				**NO**	**NO**	**NO**	**NO**	**NO**				
1. Integrated circuit or semiconductor				NO	NO	NO	NO	NO				
2. TFT flat panel display				NO	NO	NO	NO	NO				
3. Photovoltaics				NO	NO	NO	NO	NO				
4. Heat transfer fluid				NO	NO	NO	NO	NO				
5. Other				NO	NO	NO	NO	NO				
F. Product uses as substitutes for ODS				**90.5042**	**NO**	**NO**	**NO**	**NO**				
1. Refrigeration and air conditioning				27.4542	NO	NO	NO	NO				
2. Foam blowing agents				63.0458	NO	NO	NO	NO				
3. Fire protection				NO	NO	NO	NO	NO				
4. Aerosols				0.0042	NO	NO	NO	NO				
5. Solvents				NO	NO	NO	NO	NO				
6. Other applications				NO	NO	NO	NO	NO				
G. Other product manufacture and use	**1.2291**	**NO**	**NO**	**NO**	**0.0403**	**NO**	**0.0000**	**NO**	**0.0237**	**0.7248**	**0.5587**	**NO**
1. Electrical equipment				NO	0.0403	NO	0.0000	NO				
2. SF_6 and PFCs from other product use							NO					
3. N_2O from product uses			NO									
4. Other	1.2291	NO	NO	NO	NO	NO	NO	NO	0.0237	0.7248	0.5587	NO
H. Other									**NO**	**NO**	**4.2760**	**NO**
1. Pulp and Paper Industry									NO	NO	NO	NO
2. Food and Beverages Industry									NO	NO	4.2760	NO
3. Other									NO	NO	NO	NO

2012

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2	CH_4	N_2O	HFCs	PFCs	Unspecified mix of HFCs and PFCs	SF_6	NF_3	NO_x	CO	NMVOC	SO_2
	(kt)			CO_2 equivalent (kt)					(kt)			
2. Total Industrial Processes and Product Use	**581.6659**	**NO**	**NO**	**100.4768**	**0.0403**	**NO**	**0.0000**	**NO**	**1.5683**	**2.4006**	**35.1868**	**0.6236**
A. Mineral industry	**493.1587**								**1.5008**	**1.2782**	**0.0159**	**0.6001**
1. Cement production	442.1615								1.0335	1.2118	0.0150	0.3115
2. Lime production	15.5304								0.0286	0.0406		0.0066
3. Glass production	20.8569								0.4135		0.0009	0.2766
4. Other process uses of carbonates	14.6099								0.0251	0.0258		0.0054
B. Chemical industry	**NO**	**NO**	**NO**						**NO**	**NO**	**0.0150**	**NO**
1. Ammonia production	NO	NO	NO						NO	NO	NO	NO
2. Nitric acid production			NO						NO			
3. Adipic acid production	NO		NO						NO	NO	NO	
4. Caprolactam, glyoxal and glyoxylic acid production	NO		NO								NO	NO
5. Carbide production	NO	NO							NO	NO	NO	NO
6. Titanium dioxide production	NO											
7. Soda ash production	NO											
8. Petrochemical and carbon black production	NO	NO							NO	NO	NO	NO
9. Fluorochemical production				NO	NO	NO	NO	NO				
10. Other	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0.0150	NO
C. Metal industry	**12.6973**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**0.0413**	**0.5398**	**0.0171**	**0.0191**
1. Iron and steel production	12.6973	NO							0.0413	0.5398	0.0171	0.0191
2. Ferroalloys production	NO	NO							NO	NO	NO	NO
3. Aluminium production	NO				NO		NO		NO	NO	NO	NO
4. Magnesium production	NO			NO	NO		NO		NO	NO	NO	NO
5. Lead production	NO								NO	NO	NO	NO
6. Zinc production	NO								NO	NO	NO	NO
7. Other	NO	NO	NO						NO	NO	NO	NO
D. Non-energy products from fuels and solvent use	**74.6523**	**NO**	**NO**						**0.0088**	**0.0500**	**30.6212**	**0.0044**
1. Lubricant use	4.9418	NO	NO						NO	NO	NO	NO
2. Paraffin wax use	0.1351	NO	NO						NO	NO	NO	NO
3. Solvent use	67.3666	NO	NO						0.0088	0.0500	30.6212	0.0044
4. Other	2.2088	NO	NO						NO	NO	NO	NO
E. Electronics industry				**NO**	**NO**	**NO**	**NO**	**NO**				
1. Integrated circuit or semiconductor				NO	NO	NO	NO	NO				
2. TFT flat panel display				NO	NO	NO	NO	NO				
3. Photovoltaics				NO	NO	NO	NO	NO				
4. Heat transfer fluid				NO	NO	NO	NO	NO				
5. Other				NO	NO	NO	NO	NO				
F. Product uses as substitutes for ODS				**100.4768**	**NO**	**NO**	**NO**	**NO**				
1. Refrigeration and air conditioning				30.7420	NO	NO	NO	NO				
2. Foam blowing agents				69.7304	NO	NO	NO	NO				
3. Fire protection				NO	NO	NO	NO	NO				
4. Aerosols				0.0043	NO	NO	NO	NO				
5. Solvents				NO	NO	NO	NO	NO				
6. Other applications				NO	NO	NO	NO	NO				
G. Other product manufacture and use	**1.1575**	**NO**	**NO**	**NO**	**0.0403**	**NO**	**0.0000**	**NO**	**0.0174**	**0.5326**	**0.5261**	**NO**
1. Electrical equipment				NO	0.0403	NO	0.0000	NO				
2. SF_6 and PFCs from other product use							NO					
3. N_2O from product uses			NO									
4. Other	1.1575	NO	NO	NO	NO	NO	NO	NO	0.0174	0.5326	0.5261	NO
H. Other									**NO**	**NO**	**3.9915**	**NO**
1. Pulp and Paper Industry									NO	NO	NO	NO
2. Food and Beverages Industry									NO	NO	3.9915	NO
3. Other									NO	NO	NO	NO

2013

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2	CH_4	N_2O	HFCs	PFCs	Unspecified mix of HFCs and PFCs	SF_6	NF_3	NO_x	CO	NMVOC	SO_2
	(kt)			CO_2 equivalent (kt)					(kt)			
2. Total Industrial Processes and Product Use	**623.1087**	**NO**	**NO**	**109.0841**	**0.0403**	**NO**	**0.0000**	**NO**	**1.7397**	**2.1714**	**34.2507**	**0.7091**
A. Mineral industry	**544.8742**								**1.6927**	**1.3902**	**0.0172**	**0.6929**
1. Cement production	476.9104								1.1139	1.3060	0.0162	0.3357
2. Lime production	20.7696								0.0383	0.0543		0.0088
3. Glass production	27.7204								0.5114		0.0011	0.3421
4. Other process uses of carbonates	19.4739								0.0290	0.0298		0.0063
B. Chemical industry	**NO**	**NO**	**NO**						**NO**	**NO**	**0.0159**	**NO**
1. Ammonia production	NO	NO	NO						NO	NO	NO	NO
2. Nitric acid production			NO						NO			
3. Adipic acid production	NO		NO						NO	NO	NO	
4. Caprolactam, glyoxal and glyoxylic acid production	NO		NO								NO	NO
5. Carbide production	NO	NO							NO	NO	NO	NO
6. Titanium dioxide production	NO											
7. Soda ash production	NO											
8. Petrochemical and carbon black production	NO	NO							NO	NO	NO	NO
9. Fluorochemical production				NO	NO	NO	NO	NO				

10. Other	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0.0159	NO
C. Metal industry	**7.6569**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**0.0249**	**0.3250**	**0.0100**	**0.0115**
1. Iron and steel production	7.6569	NO							0.0249	0.3250	0.0100	0.0115
2. Ferroalloys production	NO	NO							NO	NO	NO	NO
3. Aluminium production	NO				NO		NO		NO	NO	NO	NO
4. Magnesium production	NO			NO	NO		NO		NO	NO	NO	NO
5. Lead production	NO								NO	NO	NO	NO
6. Zinc production	NO								NO	NO	NO	NO
7. Other	NO	NO	NO						NO	NO	NO	NO
D. Non-energy products from fuels and solvent use	**69.4810**	**NO**	**NO**						**0.0088**	**0.0501**	**28.2397**	**0.0044**
1. Lubricant use	4.8461	NO	NO						NO	NO	NO	NO
2. Paraffin wax use	0.0751	NO	NO						NO	NO	NO	NO
3. Solvent use	62.1274	NO	NO						0.0088	0.0501	28.2397	0.0044
4. Other	2.4324	NO	NO						NO	NO	NO	NO
E. Electronics industry				**NO**	**NO**	**NO**	**NO**	**NO**				
1. Integrated circuit or semiconductor				NO	NO	NO	NO	NO				
2. TFT flat panel display				NO	NO	NO	NO	NO				
3. Photovoltaics				NO	NO	NO	NO	NO				
4. Heat transfer fluid				NO	NO	NO	NO	NO				
5. Other				NO	NO	NO	NO	NO				
F. Product uses as substitutes for ODS				**109.0841**	**NO**	**NO**	**NO**	**NO**				
1. Refrigeration and air conditioning				34.5161	NO	NO	NO	NO				
2. Foam blowing agents				74.5640	NO	NO	NO	NO				
3. Fire protection				NO	NO	NO	NO	NO				
4. Aerosols				0.0041	NO	NO	NO	NO				
5. Solvents				NO	NO	NO	NO	NO				
6. Other applications				NO	NO	NO	NO	NO				
G. Other product manufacture and use	**1.0965**	**NO**	**NO**	**NO**	**0.0403**	**NO**	**0.0000**	**NO**	**0.0133**	**0.4062**	**0.4984**	**0.0003**
1. Electrical equipment				NO	0.0403	NO	0.0000	NO				
2. SF_6 and PFCs from other product use							NO					
3. N_2O from product uses			NO									
4. Other	1.0965	NO	NO	NO	NO	NO	NO	NO	0.0133	0.4062	0.4984	0.0003
H. Other									**NO**	**NO**	**5.4694**	**NO**
1. Pulp and Paper Industry									NO	NO	NO	NO
2. Food and Beverages Industry									NO	NO	5.4694	NO
3. Other									NO	NO	NO	NO

2014

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2	CH_4	N_2O	HFCs	PFCs	Unspecified mix of HFCs and PFCs	SF_6	NF_3	NO_x	CO	NMVOC	SO_2
	(kt)			CO_2 equivalent (kt)					(kt)			
2. Total Industrial Processes and Product Use	**636.1602**	**NO**	**NO**	**122.9816**	**0.0403**	**NO**	**0.0000**	**NO**	**1.6990**	**2.3772**	**42.6162**	**0.6880**
A. Mineral industry	**533.8710**								**1.6295**	**1.3602**	**0.0167**	**0.6601**
1. Cement production	464.6082								1.0820	1.2686	0.0157	0.3261
2. Lime production	23.8218								0.0439	0.0623		0.0101
3. Glass production	26.2533								0.4750		0.0010	0.3177
4. Other process uses of carbonates	19.1877								0.0286	0.0294		0.0062
B. Chemical industry	**NO**	**NO**	**NO**						**NO**	**NO**	**0.0166**	**NO**
1. Ammonia production	NO	NO	NO						NO	NO	NO	NO
2. Nitric acid production			NO						NO			
3. Adipic acid production	NO		NO						NO	NO	NO	
4. Caprolactam, glyoxal and glyoxylic acid production	NO		NO								NO	NO
5. Carbide production	NO	NO							NO	NO	NO	NO
6. Titanium dioxide production	NO											
7. Soda ash production	NO											
8. Petrochemical and carbon black production	NO	NO							NO	NO	NO	NO
9. Fluorochemical production				NO	NO	NO	NO	NO				
10. Other	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0.0166	NO
C. Metal industry	**13.8464**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**0.0450**	**0.5882**	**0.0186**	**0.0208**
1. Iron and steel production	13.8464	NO							0.0450	0.5882	0.0186	0.0208
2. Ferroalloys production	NO	NO							NO	NO	NO	NO
3. Aluminium production	NO				NO		NO		NO	NO	NO	NO
4. Magnesium production	NO			NO	NO		NO		NO	NO	NO	NO
5. Lead production	NO								NO	NO	NO	NO
6. Zinc production	NO								NO	NO	NO	NO
7. Other	NO	NO	NO						NO	NO	NO	NO
D. Non-energy products from fuels and solvent use	**87.2367**	**NO**	**NO**						**0.0128**	**0.0723**	**36.3007**	**0.0064**
1. Lubricant use	4.7832	NO	NO						NO	NO	NO	NO
2. Paraffin wax use	0.0301	NO	NO						NO	NO	NO	NO
3. Solvent use	79.8615	NO	NO						0.0128	0.0723	36.3007	0.0064
4. Other	2.5619	NO	NO						NO	NO	NO	NO
E. Electronics industry				**NO**	**NO**	**NO**	**NO**	**NO**				
1. Integrated circuit or semiconductor				NO	NO	NO	NO	NO				
2. TFT flat panel display				NO	NO	NO	NO	NO				
3. Photovoltaics				NO	NO	NO	NO	NO				
4. Heat transfer fluid				NO	NO	NO	NO	NO				

5. Other				NO	NO	NO	NO	NO				
F. Product uses as substitutes for ODS				**122.9816**	**NO**	**NO**	**NO**	**NO**				
1. Refrigeration and air conditioning				44.9496	NO	NO	NO	NO				
2. Foam blowing agents				78.0278	NO	NO	NO	NO				
3. Fire protection				NO	NO	NO	NO	NO				
4. Aerosols				0.0043	NO	NO	NO	NO				
5. Solvents				NO	NO	NO	NO	NO				
6. Other applications				NO	NO	NO	NO	NO				
G. Other product manufacture and use	**1.2062**	**NO**	**NO**	**NO**	**0.0403**	**NO**	**0.0000**	**NO**	**0.0117**	**0.3565**	**0.5483**	**0.0007**
1. Electrical equipment				NO	0.0403	NO	0.0000	NO				
2. SF_6 and PFCs from other product use							NO					
3. N_2O from product uses			NO									
4. Other	1.2062	NO	NO	NO	NO	NO	NO	NO	0.0117	0.3565	0.5483	0.0007
H. Other									**NO**	**NO**	**5.7153**	**NO**
1. Pulp and Paper Industry									NO	NO	NO	NO
2. Food and Beverages Industry									NO	NO	5.7153	NO
3. Other									NO	NO	NO	NO

2015

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2	CH_4	N_2O	HFCs	PFCs	Unspecified mix of HFCs and PFCs	SF_6	NF_3	NO_x	CO	NMVOC	SO_2
	(kt)			CO_2 equivalent (kt)			(kt)					
2. Total Industrial Processes and Product Use	**606.9922**	**NO**	**NO**	**157.0394**	**0.0403**	**NO**	**0.0000**	**NO**	**1.6355**	**2.4169**	**39.6803**	**0.6699**
A. Mineral industry	**504.2041**								**1.5589**	**1.2767**	**0.0159**	**0.6393**
1. Cement production	443.2441								1.0311	1.2089	0.0150	0.3107
2. Lime production	15.7407								0.0290	0.0411		0.0067
3. Glass production	27.4550								0.4728		0.0010	0.3163
4. Other process uses of carbonates	17.7643								0.0259	0.0266		0.0056
B. Chemical industry	**NO**	**NO**	**NO**						**NO**	**NO**	**0.0119**	**NO**
1. Ammonia production	NO	NO	NO						NO	NO	NO	NO
2. Nitric acid production			NO						NO			
3. Adipic acid production	NO		NO						NO	NO	NO	
4. Caprolactam, glyoxal and glyoxylic acid production	NO		NO								NO	NO
5. Carbide production	NO	NO							NO	NO	NO	NO
6. Titanium dioxide production	NO											
7. Soda ash production	NO											
8. Petrochemical and carbon black production	NO	NO							NO	NO	NO	NO
9. Fluorochemical production				NO	NO	NO	NO	NO				
10. Other	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0.0119	NO
C. Metal industry	**17.2792**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**0.0561**	**0.7340**	**0.0221**	**0.0259**
1. Iron and steel production	17.2792	NO							0.0561	0.7340	0.0221	0.0259
2. Ferroalloys production	NO	NO							NO	NO	NO	NO
3. Aluminium production	NO				NO		NO		NO	NO	NO	NO
4. Magnesium production	NO			NO	NO		NO		NO	NO	NO	NO
5. Lead production	NO								NO	NO	NO	NO
6. Zinc production	NO								NO	NO	NO	NO
7. Other	NO	NO	NO						NO	NO	NO	NO
D. Non-energy products from fuels and solvent use	**84.5691**	**NO**	**NO**						**0.0089**	**0.0501**	**34.9703**	**0.0044**
1. Lubricant use	4.8165	NO	NO						NO	NO	NO	NO
2. Paraffin wax use	0.0600	NO	NO						NO	NO	NO	NO
3. Solvent use	76.9346	NO	NO						0.0089	0.0501	34.9703	0.0044
4. Other	2.7580	NO	NO						NO	NO	NO	NO
E. Electronics industry				**NO**	**NO**	**NO**	**NO**	**NO**				
1. Integrated circuit or semiconductor				NO	NO	NO	NO	NO				
2. TFT flat panel display				NO	NO	NO	NO	NO				
3. Photovoltaics				NO	NO	NO	NO	NO				
4. Heat transfer fluid				NO	NO	NO	NO	NO				
5. Other				NO	NO	NO	NO	NO				
F. Product uses as substitutes for ODS				**157.0394**	**NO**	**NO**	**NO**	**NO**				
1. Refrigeration and air conditioning				74.3853	NO	NO	NO	NO				
2. Foam blowing agents				82.6488	NO	NO	NO	NO				
3. Fire protection				NO	NO	NO	NO	NO				
4. Aerosols				0.0053	NO	NO	NO	NO				
5. Solvents				NO	NO	NO	NO	NO				
6. Other applications				NO	NO	NO	NO	NO				
G. Other product manufacture and use	**0.9397**	**NO**	**NO**	**NO**	**0.0403**	**NO**	**0.0000**	**NO**	**0.0116**	**0.3561**	**0.4271**	**0.0003**
1. Electrical equipment				NO	0.0403	NO	0.0000	NO				
2. SF_6 and PFCs from other product use							NO					
3. N_2O from product uses			NO									
4. Other	0.9397	NO	NO	NO	NO	NO	NO	NO	0.0116	0.3561	0.4271	0.0003
H. Other									**NO**	**NO**	**4.2329**	**NO**
1. Pulp and Paper Industry									NO	NO	NO	NO
2. Food and Beverages Industry									NO	NO	4.2329	NO
3. Other									NO	NO	NO	NO

2016

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2	CH_4	N_2O	HFCs	PFCs	Unspecified mix of HFCs and PFCs	SF_6	NF_3	NO_x	CO	NMVOC	SO_2
	(kt)			CO_2 equivalent (kt)					(kt)			
2. Total Industrial Processes and Product Use	**579.1078**	**NO**	**NO**	**166.7099**	**0.0403**	**NO**	**0.0000**	**NO**	**1.4983**	**1.8206**	**40.1156**	**0.5998**
A. Mineral industry	**488.0182**								**1.4633**	**1.2375**	**0.0154**	**0.5879**
1. Cement production	433.9022								1.0040	1.1771	0.0146	0.3026
2. Lime production	13.6470								0.0252	0.0357		0.0058
3. Glass production	23.8582								0.4101		0.0009	0.2743
4. Other process uses of carbonates	16.6109								0.0241	0.0247		0.0052
B. Chemical industry	**NO**	**NO**	**NO**						**NO**	**NO**	**0.0131**	**NO**
1. Ammonia production	NO	NO	NO						NO	NO	NO	NO
2. Nitric acid production			NO						NO			
3. Adipic acid production	NO		NO						NO	NO	NO	
4. Caprolactam, glyoxal and glyoxylic acid production	NO		NO								NO	NO
5. Carbide production	NO	NO							NO	NO	NO	NO
6. Titanium dioxide production	NO											
7. Soda ash production	NO											
8. Petrochemical and carbon black production	NO	NO							NO	NO	NO	NO
9. Fluorochemical production				NO	NO	NO	NO	NO				
10. Other	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0.0131	NO
C. Metal industry	**5.2203**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**0.0169**	**0.2204**	**0.0075**	**0.0078**
1. Iron and steel production	5.2203	NO							0.0169	0.2204	0.0075	0.0078
2. Ferroalloys production	NO	NO							NO	NO	NO	NO
3. Aluminium production	NO				NO		NO		NO	NO	NO	NO
4. Magnesium production	NO			NO	NO		NO		NO	NO	NO	NO
5. Lead production	NO								NO	NO	NO	NO
6. Zinc production	NO								NO	NO	NO	NO
7. Other	NO	NO	NO						NO	NO	NO	NO
D. Non-energy products from fuels and solvent use	**84.8044**	**NO**	**NO**						**0.0076**	**0.0429**	**34.9327**	**0.0038**
1. Lubricant use	4.9177	NO	NO						NO	NO	NO	NO
2. Paraffin wax use	0.0449	NO	NO						NO	NO	NO	NO
3. Solvent use	76.8520	NO	NO						0.0076	0.0429	34.9327	0.0038
4. Other	2.9897	NO	NO						NO	NO	NO	NO
E. Electronics industry				**NO**	**NO**	**NO**	**NO**	**NO**				
1. Integrated circuit or semiconductor				NO	NO	NO	NO	NO				
2. TFT flat panel display				NO	NO	NO	NO	NO				
3. Photovoltaics				NO	NO	NO	NO	NO				
4. Heat transfer fluid				NO	NO	NO	NO	NO				
5. Other				NO	NO	NO	NO	NO				
F. Product uses as substitutes for ODS				**166.7099**	**NO**	**NO**	**NO**	**NO**				
1. Refrigeration and air conditioning				82.6858	NO	NO	NO	NO				
2. Foam blowing agents				84.0180	NO	NO	NO	NO				
3. Fire protection				NO	NO	NO	NO	NO				
4. Aerosols				0.0061	NO	NO	NO	NO				
5. Solvents				NO	NO	NO	NO	NO				
6. Other applications				NO	NO	NO	NO	NO				
G. Other product manufacture and use	**1.0649**	**NO**	**NO**	**NO**	**0.0403**	**NO**	**0.0000**	**NO**	**0.0105**	**0.3198**	**0.4841**	**0.0003**
1. Electrical equipment				NO	0.0403	NO	0.0000	NO				
2. SF_6 and PFCs from other product use							NO					
3. N_2O from product uses			NO									
4. Other	1.0649	NO	NO	NO	NO	NO	NO	NO	0.0105	0.3198	0.4841	0.0003
H. Other									**NO**	**NO**	**4.6628**	**NO**
1. Pulp and Paper Industry									NO	NO	NO	NO
2. Food and Beverages Industry									NO	NO	4.6628	NO
3. Other									NO	NO	NO	NO

2017

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2	CH_4	N_2O	HFCs	PFCs	Unspecified mix of HFCs and PFCs	SF_6	NF_3	NO_x	CO	NMVOC	SO_2
	(kt)			CO_2 equivalent (kt)					(kt)			
2. Total Industrial Processes and Product Use	**592.6872**	**NO**	**NO**	**185.8945**	**0.0403**	**NO**	**0.0000**	**NO**	**1.5316**	**2.2987**	**46.2368**	**0.6257**
A. Mineral industry	**475.6060**								**1.4527**	**1.2025**	**0.0146**	**0.5922**
1. Cement production	404.9290								0.9420	1.1045	0.0137	0.2839
2. Lime production	28.8043								0.0531	0.0753		0.0123
3. Glass production	26.6873								0.4354		0.0009	0.2913
4. Other process uses of carbonates	15.1853								0.0221	0.0227		0.0048
B. Chemical industry	**NO**	**NO**	**NO**						**NO**	**NO**	**0.0123**	**NO**
1. Ammonia production	NO	NO	NO						NO	NO	NO	NO
2. Nitric acid production			NO						NO			
3. Adipic acid production	NO		NO						NO	NO	NO	
4. Caprolactam, glyoxal and glyoxylic acid production	NO		NO								NO	NO
5. Carbide production	NO	NO							NO	NO	NO	NO
6. Titanium dioxide production	NO											
7. Soda ash production	NO											
8. Petrochemical and carbon black production	NO	NO							NO	NO	NO	NO
9. Fluorochemical production				NO	NO	NO	NO	NO				

10. Other	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0.0123	NO
C. Metal industry	**18.8842**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**0.0613**	**0.8019**	**0.0249**	**0.0283**
1. Iron and steel production	18.8842	NO							0.0613	0.8019	0.0249	0.0283
2. Ferroalloys production	NO	NO							NO	NO	NO	NO
3. Aluminium production	NO				NO		NO		NO	NO	NO	NO
4. Magnesium production	NO			NO	NO		NO		NO	NO	NO	NO
5. Lead production	NO								NO	NO	NO	NO
6. Zinc production	NO								NO	NO	NO	NO
7. Other	NO	NO	NO						NO	NO	NO	NO
D. Non-energy products from fuels and solvent use	**97.0212**	**NO**	**NO**						**0.0097**	**0.0547**	**40.4418**	**0.0048**
1. Lubricant use	4.8069	NO	NO						NO	NO	NO	NO
2. Paraffin wax use	0.0599	NO	NO						NO	NO	NO	NO
3. Solvent use	88.9719	NO	NO						0.0097	0.0547	40.4418	0.0048
4. Other	3.1825	NO	NO						NO	NO	NO	NO
E. Electronics industry				**NO**	**NO**	**NO**	**NO**	**NO**				
1. Integrated circuit or semiconductor				NO	NO	NO	NO	NO				
2. TFT flat panel display				NO	NO	NO	NO	NO				
3. Photovoltaics				NO	NO	NO	NO	NO				
4. Heat transfer fluid				NO	NO	NO	NO	NO				
5. Other				NO	NO	NO	NO	NO				
F. Product uses as substitutes for ODS				**185.8945**	**NO**	**NO**	**NO**	**NO**				
1. Refrigeration and air conditioning				100.0113	NO	NO	NO	NO				
2. Foam blowing agents				85.6195	NO	NO	NO	NO				
3. Fire protection				0.2576	NO	NO	NO	NO				
4. Aerosols				0.0061	NO	NO	NO	NO				
5. Solvents				NO	NO	NO	NO	NO				
6. Other applications				NO	NO	NO	NO	NO				
G. Other product manufacture and use	**1.1757**	**NO**	**NO**	**NO**	**0.0403**	**NO**	**0.0000**	**NO**	**0.0078**	**0.2396**	**0.5344**	**0.0003**
1. Electrical equipment				NO	0.0403	NO	0.0000	NO				
2. SF_6 and PFCs from other product use							NO					
3. N_2O from product uses			NO									
4. Other	1.1757	NO	NO	NO	NO	NO	NO	NO	0.0078	0.2396	0.5344	0.0003
H. Other									**NO**	**NO**	**5.2088**	**NO**
1. Pulp and Paper Industry									NO	NO	NO	NO
2. Food and Beverages Industry									NO	NO	5.2088	NO
3. Other									NO	NO	NO	NO

2018

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2	CH_4	N_2O	HFCs	PFCs	Unspecified mix of HFCs and PFCs	SF_6	NF_3	NO_x	CO	NMVOC	SO_2
	(kt)			CO_2 equivalent (kt)			(kt)					
2. Total Industrial Processes and Product Use	**764.3984**	**NO**	**NO**	**198.8877**	**0.0403**	**NO**	**0.0001**	**NO**	**2.0269**	**2.7602**	**70.1396**	**0.8631**
A. Mineral industry	**591.9454**								**1.9255**	**1.4894**	**0.0186**	**0.8185**
1. Cement production	511.1209								1.1891	1.3941	0.0172	0.3584
2. Lime production	27.7944								0.0513	0.0726		0.0118
3. Glass production	37.2220								0.6631		0.0014	0.4436
4. Other process uses of carbonates	15.8081								0.0221	0.0227		0.0048
B. Chemical industry	**NO**	**NO**	**NO**						**NO**	**NO**	**0.0155**	**NO**
1. Ammonia production	NO	NO	NO						NO	NO	NO	NO
2. Nitric acid production			NO						NO			
3. Adipic acid production	NO		NO						NO	NO	NO	
4. Caprolactam, glyoxal and glyoxylic acid production	NO		NO								NO	NO
5. Carbide production	NO	NO							NO	NO	NO	NO
6. Titanium dioxide production	NO											
7. Soda ash production	NO											
8. Petrochemical and carbon black production	NO	NO							NO	NO	NO	NO
9. Fluorochemical production				NO	NO	NO	NO	NO				
10. Other	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0.0155	NO
C. Metal industry	**20.2133**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**0.0657**	**0.8586**	**0.0267**	**0.0303**
1. Iron and steel production	20.2133	NO							0.0657	0.8586	0.0267	0.0303
2. Ferroalloys production	NO	NO							NO	NO	NO	NO
3. Aluminium production	NO				NO		NO		NO	NO	NO	NO
4. Magnesium production	NO			NO	NO		NO		NO	NO	NO	NO
5. Lead production	NO								NO	NO	NO	NO
6. Zinc production	NO								NO	NO	NO	NO
7. Other	NO	NO	NO						NO	NO	NO	NO
D. Non-energy products from fuels and solvent use	**151.1809**	**NO**	**NO**						**0.0273**	**0.1534**	**64.9072**	**0.0136**
1. Lubricant use	5.0147	NO	NO						NO	NO	NO	NO
2. Paraffin wax use	0.1198	NO	NO						NO	NO	NO	NO
3. Solvent use	142.7958	NO	NO						0.0273	0.1534	64.9072	0.0136
4. Other	3.2507	NO	NO						NO	NO	NO	NO
E. Electronics industry				**NO**	**NO**	**NO**	**NO**	**NO**				
1. Integrated circuit or semiconductor				NO	NO	NO	NO	NO				
2. TFT flat panel display				NO	NO	NO	NO	NO				
3. Photovoltaics				NO	NO	NO	NO	NO				
4. Heat transfer fluid				NO	NO	NO	NO	NO				

5. Other				NO	NO	NO	NO	NO				
F. Product uses as substitutes for ODS				**198.8877**	**NO**	**NO**	**NO**	**NO**				
1. Refrigeration and air conditioning				110.8793	NO	NO	NO	NO				
2. Foam blowing agents				87.0518	NO	NO	NO	NO				
3. Fire protection				0.9500	NO	NO	NO	NO				
4. Aerosols				0.0066	NO	NO	NO	NO				
5. Solvents				NO	NO	NO	NO	NO				
6. Other applications				NO	NO	NO	NO	NO				
G. Other product manufacture and use	**1.0589**	**NO**	**NO**	**NO**	**0.0403**	**NO**	**0.0001**	**NO**	**0.0085**	**0.2587**	**0.4813**	**0.0007**
1. Electrical equipment				NO	0.0403	NO	0.0001	NO				
2. SF_6 and PFCs from other product use							NO					
3. N_2O from product uses			NO									
4. Other	1.0589	NO	NO	NO	NO	NO	NO	NO	0.0085	0.2587	0.4813	0.0007
H. Other									**NO**	**NO**	**4.6903**	**NO**
1. Pulp and Paper Industry									NO	NO	NO	NO
2. Food and Beverages Industry									NO	NO	4.6903	NO
3. Other									NO	NO	NO	NO

2019

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2	CH_4	N_2O	HFCs	PFCs	Unspecified mix of HFCs and PFCs	SF_6	NF_3	NO_x	CO	NMVOC	SO_2
	(kt)			CO_2 equivalent (kt)					(kt)			
2. Total Industrial Processes and Product Use	**754.2055**	**NO**	**NO**	**235.5397**	**0.0403**	**NO**	**0.0001**	**NO**	**1.8762**	**2.5375**	**66.6190**	**0.7554**
A. Mineral industry	**593.6612**								**1.7986**	**1.5265**	**0.0187**	**0.7216**
1. Cement production	523.8755								1.2187	1.4289	0.0177	0.3673
2. Lime production	27.5851								0.0509	0.0721		0.0117
3. Glass production	25.8705								0.5042		0.0011	0.3373
4. Other process uses of carbonates	16.3302								0.0248	0.0255		0.0053
B. Chemical industry	**NO**	**NO**	**NO**						**NO**	**NO**	**0.0170**	**NO**
1. Ammonia production	NO	NO	NO						NO	NO	NO	NO
2. Nitric acid production			NO						NO			
3. Adipic acid production	NO		NO						NO	NO	NO	
4. Caprolactam, glyoxal and glyoxylic acid production	NO		NO								NO	NO
5. Carbide production	NO	NO							NO	NO	NO	NO
6. Titanium dioxide production	NO											
7. Soda ash production	NO											
8. Petrochemical and carbon black production	NO	NO							NO	NO	NO	NO
9. Fluorochemical production				NO	NO	NO	NO	NO				
10. Other	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0.0170	NO
C. Metal industry	**15.7926**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**0.0513**	**0.6704**	**0.0209**	**0.0237**
1. Iron and steel production	15.7926	NO							0.0513	0.6704	0.0209	0.0237
2. Ferroalloys production	NO	NO							NO	NO	NO	NO
3. Aluminium production	NO				NO		NO		NO	NO	NO	NO
4. Magnesium production	NO			NO	NO		NO		NO	NO	NO	NO
5. Lead production	NO								NO	NO	NO	NO
6. Zinc production	NO								NO	NO	NO	NO
7. Other	NO	NO	NO						NO	NO	NO	NO
D. Non-energy products from fuels and solvent use	**143.6217**	**NO**	**NO**						**0.0186**	**0.1047**	**61.3608**	**0.0093**
1. Lubricant use	4.9454	NO	NO						NO	NO	NO	NO
2. Paraffin wax use	0.2546	NO	NO						NO	NO	NO	NO
3. Solvent use	134.9938	NO	NO						0.0186	0.1047	61.3608	0.0093
4. Other	3.4279	NO	NO						NO	NO	NO	NO
E. Electronics industry				**NO**	**NO**	**NO**	**NO**	**NO**				
1. Integrated circuit or semiconductor				NO	NO	NO	NO	NO				
2. TFT flat panel display				NO	NO	NO	NO	NO				
3. Photovoltaics				NO	NO	NO	NO	NO				
4. Heat transfer fluid				NO	NO	NO	NO	NO				
5. Other				NO	NO	NO	NO	NO				
F. Product uses as substitutes for ODS				**235.5397**	**NO**	**NO**	**NO**	**NO**				
1. Refrigeration and air conditioning				144.6478	NO	NO	NO	NO				
2. Foam blowing agents				88.5823	NO	NO	NO	NO				
3. Fire protection				2.3026	NO	NO	NO	NO				
4. Aerosols				0.0070	NO	NO	NO	NO				
5. Solvents				NO	NO	NO	NO	NO				
6. Other applications				NO	NO	NO	NO	NO				
G. Other product manufacture and use	**1.1299**	**NO**	**NO**	**NO**	**0.0403**	**NO**	**0.0001**	**NO**	**0.0077**	**0.2360**	**0.5136**	**0.0008**
1. Electrical equipment				NO	0.0403	NO	0.0001	NO				
2. SF_6 and PFCs from other product use							NO					
3. N_2O from product uses			NO									
4. Other	1.1299	NO	NO	NO	NO	NO	NO	NO	0.0077	0.2360	0.5136	0.0008
H. Other									**NO**	**NO**	**4.6880**	**NO**
1. Pulp and Paper Industry									NO	NO	NO	NO
2. Food and Beverages Industry									NO	NO	4.6880	NO
3. Other									NO	NO	NO	NO

2020

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2	CH_4	N_2O	HFCs	PFCs	Unspecified mix of HFCs and PFCs	SF_6	NF_3	NO_x	CO	NMVOC	SO_2
	(kt)			CO_2 equivalent (kt)					(kt)			
2. Total Industrial Processes and Product Use	**751.8959**	**NO**	**NO**	**245.3168**	**0.0403**	**NO**	**0.0001**	**NO**	**1.8679**	**2.6172**	**88.9154**	**0.7987**
A. Mineral industry	**536.8930**								**1.7673**	**1.3540**	**0.0171**	**0.7550**
1. Cement production	467.5178								1.0876	1.2752	0.0158	0.3278
2. Lime production	21.0641								0.0389	0.0551		0.0090
3. Glass production	32.8367								0.6177		0.0013	0.4132
4. Other process uses of carbonates	15.4743								0.0231	0.0237		0.0050
B. Chemical industry	**NO**	**NO**	**NO**						**NO**	**NO**	**0.0177**	**NO**
1. Ammonia production	NO	NO	NO						NO	NO	NO	NO
2. Nitric acid production			NO						NO			
3. Adipic acid production	NO		NO						NO	NO	NO	
4. Caprolactam, glyoxal and glyoxylic acid production	NO		NO								NO	NO
5. Carbide production	NO	NO							NO	NO	NO	NO
6. Titanium dioxide production	NO											
7. Soda ash production	NO											
8. Petrochemical and carbon black production	NO	NO							NO	NO	NO	NO
9. Fluorochemical production				NO	NO	NO	NO	NO				
10. Other	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0.0177	NO
C. Metal industry	**18.6972**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**0.0607**	**0.7940**	**0.0247**	**0.0280**
1. Iron and steel production	18.6972	NO							0.0607	0.7940	0.0247	0.0280
2. Ferroalloys production	NO	NO							NO	NO	NO	NO
3. Aluminium production	NO				NO		NO		NO	NO	NO	NO
4. Magnesium production	NO			NO	NO		NO		NO	NO	NO	NO
5. Lead production	NO								NO	NO	NO	NO
6. Zinc production	NO								NO	NO	NO	NO
7. Other	NO	NO	NO						NO	NO	NO	NO
D. Non-energy products from fuels and solvent use	**195.3645**	**NO**	**NO**						**0.0301**	**0.1689**	**84.9204**	**0.0149**
1. Lubricant use	5.0839	NO	NO						NO	NO	NO	NO
2. Paraffin wax use	0.1198	NO	NO						NO	NO	NO	NO
3. Solvent use	186.8249	NO	NO						0.0301	0.1689	84.9204	0.0149
4. Other	3.3358	NO	NO						NO	NO	NO	NO
E. Electronics industry				**NO**	**NO**	**NO**	**NO**	**NO**				
1. Integrated circuit or semiconductor				NO	NO	NO	NO	NO				
2. TFT flat panel display				NO	NO	NO	NO	NO				
3. Photovoltaics				NO	NO	NO	NO	NO				
4. Heat transfer fluid				NO	NO	NO	NO	NO				
5. Other				NO	NO	NO	NO	NO				
F. Product uses as substitutes for ODS				**245.3168**	**NO**	**NO**	**NO**	**NO**				
1. Refrigeration and air conditioning				153.0784	NO	NO	NO	NO				
2. Foam blowing agents				89.2686	NO	NO	NO	NO				
3. Fire protection				2.9626	NO	NO	NO	NO				
4. Aerosols				0.0072	NO	NO	NO	NO				
5. Solvents				NO	NO	NO	NO	NO				
6. Other applications				NO	NO	NO	NO	NO				
G. Other product manufacture and use	**0.9412**	**NO**	**NO**	**NO**	**0.0403**	**NO**	**0.0001**	**NO**	**0.0098**	**0.3004**	**0.4278**	**0.0008**
1. Electrical equipment				NO	0.0403	NO	0.0001	NO				
2. SF_6 and PFCs from other product use							NO					
3. N_2O from product uses			NO									
4. Other	0.9412	NO	NO	NO	NO	NO	NO	NO	0.0098	0.3004	0.4278	0.0008
H. Other									**NO**	**NO**	**3.5077**	**NO**
1. Pulp and Paper Industry									NO	NO	NO	NO
2. Food and Beverages Industry									NO	NO	3.5077	NO
3. Other									NO	NO	NO	NO

Annex 6-3. Sectoral Report for Sector 3 'Agriculture', 1990-2020

1990

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2	CH_4	N_2O	NO_x	CO	NMVOC
	(kt)					
3. Total Agriculture	**0.5820**	**107.3809**	**8.0256**	**NO**	**NO**	**NE, NO**
I. Livestock		**107.3809**	**3.0192**			**NE**
A. Enteric fermentation		**87.5771**				
1. Cattle		74.9935				
Dairy cattle		41.4105				
Non-dairy cattle		33.5830				
2. Sheep		8.5887				
3. Swine		2.7751				
4. Other livestock		1.2198				
Goats		0.1855				
Horses		0.8505				
Mules and asses		0.0169				
Other (rabbits)		0.1670				
B. Manure management		**19.8038**	**3.0192**			**NE**
1. Cattle		9.2140	0.7685			NE

Dairy cattle		5.3324	0.3190			NE
Non-dairy cattle		3.8816	0.4495			NE
2. Sheep		0.2365	0.2200			NE
3. Swine		9.4938	0.3793			NE
4. Other livestock		0.8595	0.2759			NE
Goats		0.0048	0.0081			NE
Horses		0.0737	0.0328			NE
Mules and asses		0.0013	0.0004			NE
Poultry		0.7571	0.2067			NE
Other (rabbits)		0.0226	0.0278			NE
5. Indirect N_2O emissions			1.3755			
C. Rice cultivation		**NO**				**NO**
D. Agricultural soils			**5.0064**			
a. Direct N_2O emissions from managed soils			3.8207			
1. Inorganic N fertilizers			1.4473			
2. Organic N fertilizers			0.8571			
a. Animal manure applied to soils			0.8571			
b. Sewage sludge applied to soils			NO, NE			
c. Other organic fertilizers applied to soils			NO, NE			
3. Urine and dung deposited by grazing animals			0.1807			
4. Crop residues			0.5468			
5. Mineralization/immobilization associated with loss/gain of soil organic matter			0.7888			
6. Cultivation of organic soils (i.e. histosols)			NO			
7. Other			NO			
b. Indirect N_2O Emissions from managed soils			1.1857			
1. Atmospheric deposition			0.3400			
2. Nitrogen leaching and run-off			0.8458			
E. Prescribed burning of savannas		**NO**	**NO**			
F. Field burning of agricultural residues		**IE**	**IE**			
G. Liming	**NO**					
H. Urea application	**0.5820**					
I. Other carbon-containing fertilizers	**NO, NE**					
J. Other	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**

1991

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2	CH_4	N_2O	NO_x	CO	NMVOC
	(kt)					
3. Total Agriculture	**0.5226**	**97.7579**	**7.5533**	**NO**	**NO**	**NE, NO**
I. Livestock		**97.7579**	**2.7389**			**NE**
A. Enteric fermentation		**81.1547**				
1. Cattle		68.6275				
Dairy cattle		38.7594				
Non-dairy cattle		29.8681				
2. Sheep		8.6126				
3. Swine		2.6295				
4. Other livestock		1.2852				
Goats		0.2474				
Horses		0.8719				
Mules and asses		0.0179				
Other (rabbits)		0.1479				
B. Manure management		**16.6032**	**2.7389**			**NE**
1. Cattle		7.4678	0.6813			NE
Dairy cattle		4.5405	0.2959			NE
Non-dairy cattle		2.9272	0.3854			NE
2. Sheep		0.2355	0.2237			NE
3. Swine		8.0652	0.3550			NE
4. Other livestock		0.8348	0.2605			NE
Goats		0.0064	0.0111			NE
Horses		0.0756	0.0288			NE
Mules and asses		0.0014	0.0004			NE
Poultry		0.7314	0.1957			NE
Other (rabbits)		0.0201	0.0244			NE
5. Indirect N_2O emissions			1.2184			
C. Rice cultivation		**NO**				**NO**
D. Agricultural soils			**4.8144**			
a. Direct N_2O emissions from managed soils			3.6928			
1. Inorganic N fertilizers			1.2996			
2. Organic N fertilizers			0.7568			
a. Animal manure applied to soils			0.7568			
b. Sewage sludge applied to soils			NO, NE			
c. Other organic fertilizers applied to soils			NO, NE			
3. Urine and dung deposited by grazing animals			0.2395			
4. Crop residues			0.6156			
5. Mineralization/immobilization associated with loss/gain of soil organic matter			0.7814			
6. Cultivation of organic soils (i.e. histosols)			NO			
7. Other			NO			
b. Indirect N_2O Emissions from managed soils			1.1215			

1. Atmospheric deposition			0.3111			
2. Nitrogen leaching and run-off			0.8105			
E. Prescribed burning of savannas		**NO**	**NO**			
F. Field burning of agricultural residues		**IE**	**IE**			
G. Liming	**NO**					
H. Urea application	**0.5226**					
I. Other carbon-containing fertilizers	**NO, NE**					
J. Other	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**

1992

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2	CH_4	N_2O	NO_x	CO	NMVOC
	(kt)					
3. Total Agriculture	**0.3905**	**94.7961**	**6.4497**	**NO**	**NO**	**NE, NO**
I. Livestock		**94.7961**	**2.4263**			**NE**
A. Enteric fermentation		**79.8715**				
1. Cattle		67.4852				
Dairy cattle		39.1801				
Non-dairy cattle		28.3051				
2. Sheep		8.7186				
3. Swine		2.2311				
4. Other livestock		1.4366				
Goats		0.3146				
Horses		0.9248				
Mules and asses		0.0211				
Other (rabbits)		0.1761				
B. Manure management		**14.9247**	**2.4263**			**NE**
1. Cattle		7.3437	0.6364			NE
Dairy cattle		4.5773	0.2943			NE
Non-dairy cattle		2.7665	0.3421			NE
2. Sheep		0.2459	0.2293			NE
3. Swine		6.6885	0.2789			NE
4. Other livestock		0.6465	0.2197			NE
Goats		0.0082	0.0138			NE
Horses		0.0802	0.0323			NE
Mules and asses		0.0016	0.0005			NE
Poultry		0.5327	0.1442			NE
Other (rabbits)		0.0239	0.0289			NE
5. Indirect N_2O emissions			1.0620			
C. Rice cultivation		**NO**				**NO**
D. Agricultural soils			**4.0234**			
a. Direct N_2O emissions from managed soils			3.0834			
1. Inorganic N fertilizers			0.9711			
2. Organic N fertilizers			0.6952			
a. Animal manure applied to soils			0.6952			
b. Sewage sludge applied to soils			NO, NE			
c. Other organic fertilizers applied to soils			NO, NE			
3. Urine and dung deposited by grazing animals			0.2251			
4. Crop residues			0.4132			
5. Mineralization/immobilization associated with loss/gain of soil organic matter			0.7787			
6. Cultivation of organic soils (i.e. histosols)			NO			
7. Other			NO			
b. Indirect N_2O Emissions from managed soils			0.9400			
1. Atmospheric deposition			0.2647			
2. Nitrogen leaching and run-off			0.6753			
E. Prescribed burning of savannas		**NO**	**NO**			
F. Field burning of agricultural residues		**IE**	**IE**			
G. Liming	**NO**					
H. Urea application	**0.3905**					
I. Other carbon-containing fertilizers	**NO, NE**					
J. Other	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**

1993

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2	CH_4	N_2O	NO_x	CO	NMVOC
	(kt)					
3. Total Agriculture	**0.1276**	**85.9140**	**5.3914**	**NO**	**NO**	**NE, NO**
I. Livestock		**85.9140**	**2.0341**			**NE**
A. Enteric fermentation		**74.9162**				
1. Cattle		62.7512				
Dairy cattle		37.6503				
Non-dairy cattle		25.1009				
2. Sheep		9.0097				
3. Swine		1.6235				
4. Other livestock		1.5318				

Goats		0.3744				
Horses		0.9802				
Mules and asses		0.0225				
Other (rabbits)		0.1548				
B. Manure management		**10.9978**	**2.0341**			**NE**
1. Cattle		5.5019	0.5585			NE
Dairy cattle		3.4585	0.2778			NE
Non-dairy cattle		2.0434	0.2806			NE
2. Sheep		0.2589	0.2349			NE
3. Swine		4.7183	0.2013			NE
4. Other livestock		0.5188	0.1843			NE
Goats		0.0097	0.0160			NE
Horses		0.0849	0.0336			NE
Mules and asses		0.0017	0.0005			NE
Poultry		0.4014	0.1089			NE
Other (rabbits)		0.0210	0.0252			NE
5. Indirect N_2O emissions			0.8552			
C. Rice cultivation		**NO**				**NO**
D. Agricultural soils			**3.3572**			
a. Direct N_2O emissions from managed soils			2.6004			
1. Inorganic N fertilizers			0.4145			
2. Organic N fertilizers			0.5935			
a. Animal manure applied to soils			0.5935			
b. Sewage sludge applied to soils			NO, NE			
c. Other organic fertilizers applied to soils			NO, NE			
3. Urine and dung deposited by grazing animals			0.2869			
4. Crop residues			0.4957			
5. Mineralization/immobilization associated with loss/gain of soil organic matter			0.8099			
6. Cultivation of organic soils (i.e. histosols)			NO			
7. Other			NO			
b. Indirect N_2O Emissions from managed soils			0.7568			
1. Atmospheric deposition			0.1960			
2. Nitrogen leaching and run-off			0.5608			
E. Prescribed burning of savannas		**NO**	**NO**			
F. Field burning of agricultural residues		**IE**	**IE**			
G. Liming	**NO**					
H. Urea application	**0.1276**					
I. Other carbon-containing fertilizers	**NO, NE**					
J. Other	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**

1994

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2	CH_4	N_2O	NO_x	CO	NMVOC
	(kt)					
3. Total Agriculture	**0.0537**	**83.5225**	**4.6821**	**NO**	**NO**	**NE, NO**
I. Livestock		**83.5225**	**1.9658**			**NE**
A. Enteric fermentation		**72.9133**				
1. Cattle		60.4337				
Dairy cattle		37.3768				
Non-dairy cattle		23.0570				
2. Sheep		9.2321				
3. Swine		1.5702				
4. Other livestock		1.6772				
Goats		0.4608				
Horses		1.0473				
Mules and asses		0.0292				
Other (rabbits)		0.1399				
B. Manure management		**10.6093**	**1.9658**			**NE**
1. Cattle		5.4501	0.5202			NE
Dairy cattle		3.5237	0.2774			NE
Non-dairy cattle		1.9264	0.2428			NE
2. Sheep		0.2679	0.2483			NE
3. Swine		4.3463	0.1863			NE
4. Other livestock		0.5449	0.1900			NE
Goats		0.0120	0.0202			NE
Horses		0.0908	0.0377			NE
Mules and asses		0.0022	0.0007			NE
Poultry		0.4210	0.1084			NE
Other (rabbits)		0.0190	0.0230			NE
5. Indirect N_2O emissions			0.8210			
C. Rice cultivation		**NO**				**NO**
D. Agricultural soils			**2.7164**			
a. Direct N_2O emissions from managed soils			2.0948			
1. Inorganic N fertilizers			0.2217			

2. Organic N fertilizers			0.5764			
a. Animal manure applied to soils			0.5764			
b. Sewage sludge applied to soils			NO, NE			
c. Other organic fertilizers applied to soils			NO, NE			
3. Urine and dung deposited by grazing animals			0.2806			
4. Crop residues			0.2353			
5. Mineralization/immobilization associated with loss/gain of soil organic matter			0.7807			
6. Cultivation of organic soils (i.e. histosols)			NO			
7. Other			NO			
b. Indirect N_2O Emissions from managed soils			0.6216			
1. Atmospheric deposition			0.1732			
2. Nitrogen leaching and run-off			0.4484			
E. Prescribed burning of savannas		**NO**	**NO**			
F. Field burning of agricultural residues		**IE**	**IE**			
G. Liming	**NO**					
H. Urea application	**0.0537**					
I. Other carbon-containing fertilizers	**NO, NE**					
J. Other	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**

1995

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2	CH_4	N_2O	NO_x	CO	NMVOC
	(kt)					
3. Total Agriculture	**0.0607**	**72.9745**	**4.5267**	**NO**	**NO**	**NE, NO**
I. Livestock		**72.9745**	**1.8043**			**NE**
A. Enteric fermentation		**64.7235**				
1. Cattle		52.9539				
Dairy cattle		34.6078				
Non-dairy cattle		18.3461				
2. Sheep		8.4987				
3. Swine		1.5246				
4. Other livestock		1.7463				
Goats		0.4820				
Horses		1.1086				
Mules and asses		0.0323				
Other (rabbits)		0.1235				
B. Manure management		**8.2510**	**1.8043**			**NE**
1. Cattle		3.6724	0.4550			NE
Dairy cattle		2.5546	0.2568			NE
Non-dairy cattle		1.1178	0.1982			NE
2. Sheep		0.2520	0.2090			NE
3. Swine		3.7683	0.2049			NE
4. Other livestock		0.5583	0.1845			NE
Goats		0.0125	0.0185			NE
Horses		0.0961	0.0389			NE
Mules and asses		0.0025	0.0007			NE
Poultry		0.4305	0.1059			NE
Other (rabbits)		0.0167	0.0204			NE
5. Indirect N_2O emissions			0.7510			
C. Rice cultivation		**NO**				**NO**
D. Agricultural soils			**2.7223**			
a. Direct N_2O emissions from managed soils			2.1147			
1. Inorganic N fertilizers			0.1652			
2. Organic N fertilizers			0.5244			
a. Animal manure applied to soils			0.5244			
b. Sewage sludge applied to soils			NO, NE			
c. Other organic fertilizers applied to soils			NO, NE			
3. Urine and dung deposited by grazing animals			0.2998			
4. Crop residues			0.3401			
5. Mineralization/immobilization associated with loss/gain of soil organic matter			0.7853			
6. Cultivation of organic soils (i.e. histosols)			NO			
7. Other			NO			
b. Indirect N_2O Emissions from managed soils			0.6076			
1. Atmospheric deposition			0.1581			
2. Nitrogen leaching and run-off			0.4496			
E. Prescribed burning of savannas		**NO**	**NO**			
F. Field burning of agricultural residues		**IE**	**IE**			
G. Liming	**NO**					
H. Urea application	**0.0607**					
I. Other carbon-containing fertilizers	**NO, NE**					
J. Other	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**

1996

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2	CH_4	N_2O	NO_x	CO	NMVOC
	(kt)					
3. Total Agriculture	**0.0911**	**67.1693**	**4.4776**	NO	NO	NE, NO
I. Livestock		**67.1693**	**1.8962**			NE
A. Enteric fermentation		**59.6750**				
1. Cattle		48.2754				
Dairy cattle		32.1785				
Non-dairy cattle		16.0969				
2. Sheep		8.1851				
3. Swine		1.4251				
4. Other livestock		1.7894				
Goats		0.5063				
Horses		1.1403				
Mules and asses		0.0308				
Other (rabbits)		0.1120				
B. Manure management		**7.4943**	**1.8962**			**NE**
1. Cattle		3.3469	0.4098			NE
Dairy cattle		2.3687	0.2398			NE
Non-dairy cattle		0.9781	0.1700			NE
2. Sheep		0.2415	0.2007			NE
3. Swine		3.3886	0.2187			NE
4. Other livestock		0.5174	0.2846			NE
Goats		0.0132	0.0195			NE
Horses		0.0988	0.0388			NE
Mules and asses		0.0023	0.0007			NE
Poultry		0.3879	0.0984			NE
Other (rabbits)		0.0152	0.1272			NE
5. Indirect N_2O emissions			0.7824			
C. Rice cultivation		**NO**				**NO**
D. Agricultural soils			**2.5815**			
a. Direct N_2O emissions from managed soils			1.9933			
1. Inorganic N fertilizers			0.2077			
2. Organic N fertilizers			0.5425			
a. Animal manure applied to soils			0.5425			
b. Sewage sludge applied to soils			NO, NE			
c. Other organic fertilizers applied to soils			NO, NE			
3. Urine and dung deposited by grazing animals			0.2763			
4. Crop residues			0.1852			
5. Mineralization/immobilization associated with loss/gain of soil organic matter			0.7816			
6. Cultivation of organic soils (i.e. histosols)			NO			
7. Other			NO			
b. Indirect N_2O Emissions from managed soils			0.5881			
1. Atmospheric deposition			0.1634			
2. Nitrogen leaching and run-off			0.4247			
E. Prescribed burning of savannas		**NO**	**NO**			
F. Field burning of agricultural residues		**IE**	**IE**			
G. Liming	**NO**					
H. Urea application	**0.0911**					
I. Other carbon-containing fertilizers	**NO, NE**					
J. Other	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**

1997

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2	CH_4	N_2O	NO_x	CO	NMVOC
	(kt)					
3. Total Agriculture	**1.0992**	**57.3905**	**3.9889**	NO	NO	NE, NO
I. Livestock		**57.3905**	**1.4681**			NE
A. Enteric fermentation		**51.3040**				
1. Cattle		41.1875				
Dairy cattle		29.1741				
Non-dairy cattle		12.0134				
2. Sheep		7.1139				
3. Swine		1.1963				
4. Other livestock		1.8063				
Goats		0.4949				
Horses		1.1773				
Mules and asses		0.0297				
Other (rabbits)		0.1043				
B. Manure management		**6.0866**	**1.4681**			**NE**
1. Cattle		2.8115	0.3627			NE
Dairy cattle		2.0983	0.2343			NE
Non-dairy cattle		0.7132	0.1285			NE

2. Sheep		0.2159	0.1621			NE
3. Swine		2.5398	0.1642			NE
4. Other livestock		0.5194	0.1682			NE
Goats		0.0129	0.0169			NE
Horses		0.1020	0.0371			NE
Mules and asses		0.0023	0.0007			NE
Poultry		0.3881	0.0962			NE
Other (rabbits)		0.0141	0.0173			NE
5. Indirect N_2O emissions			0.6109			
C. Rice cultivation		**NO**				**NO**
D. Agricultural soils			**2.5208**			
a. Direct N_2O emissions from managed soils			1.9666			
1. Inorganic N fertilizers			0.1795			
2. Organic N fertilizers			0.4269			
a. Animal manure applied to soils			0.4269			
b. Sewage sludge applied to soils			NO, NE			
c. Other organic fertilizers applied to soils			NO, NE			
3. Urine and dung deposited by grazing animals			0.2455			
4. Crop residues			0.3290			
5. Mineralization/immobilization associated with loss/gain of soil organic matter			0.7857			
6. Cultivation of organic soils (i.e. histosols)			NO			
7. Other			NO			
b. Indirect N_2O Emissions from managed soils			0.5543			
1. Atmospheric deposition			0.1333			
2. Nitrogen leaching and run-off			0.4210			
E. Prescribed burning of savannas		**NO**	**NO**			
F. Field burning of agricultural residues		**IE**	**IE**			
G. Liming	**NO**					
H. Urea application	**1.0992**					
I. Other carbon-containing fertilizers	**NO, NE**					
J. Other	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**

1998

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2	CH_4	N_2O	NO_x	CO	NMVOC
	(kt)					
3. Total Agriculture	**0.2721**	**55.4273**	**3.8036**	**NO**	**NO**	**NE, NO**
I. Livestock		**55.4273**	**1.3749**			**NE**
A. Enteric fermentation		**49.8079**				
1. Cattle		40.0305				
Dairy cattle		28.7829				
Non-dairy cattle		11.2475				
2. Sheep		6.5068				
3. Swine		1.3921				
4. Other livestock		1.8785				
Goats		0.5038				
Horses		1.2330				
Mules and asses		0.0320				
Other (rabbits)		0.1097				
B. Manure management		**5.6194**	**1.3749**			**NE**
1. Cattle		2.0923	0.3409			NE
Dairy cattle		1.6125	0.2239			NE
Non-dairy cattle		0.4798	0.1170			NE
2. Sheep		0.1988	0.1455			NE
3. Swine		2.7817	0.1481			NE
4. Other livestock		0.5466	0.1762			NE
Goats		0.0131	0.0168			NE
Horses		0.1069	0.0377			NE
Mules and asses		0.0024	0.0007			NE
Poultry		0.4093	0.1029			NE
Other (rabbits)		0.0149	0.0181			NE
5. Indirect N_2O emissions			0.5642			
C. Rice cultivation		**NO**				**NO**
D. Agricultural soils			**2.4288**			
a. Direct N_2O emissions from managed soils			1.8968			
1. Inorganic N fertilizers			0.1600			
2. Organic N fertilizers			0.4026			
a. Animal manure applied to soils			0.4026			
b. Sewage sludge applied to soils			NO, NE			
c. Other organic fertilizers applied to soils			NO, NE			
3. Urine and dung deposited by grazing animals			0.2709			
4. Crop residues			0.2816			
5. Mineralization/immobilization associated with loss/gain of soil organic matter			0.7817			
6. Cultivation of organic soils (i.e. histosols)			NO			

7. Other			NO			
b. Indirect N_2O Emissions from managed soils			0.5320			
1. Atmospheric deposition			0.1293			
2. Nitrogen leaching and run-off			0.4027			
E. Prescribed burning of savannas		**NO**	**NO**			
F. Field burning of agricultural residues		**IE**	**IE**			
G. Liming	**NO**					
H. Urea application	**0.2721**					
I. Other carbon-containing fertilizers	**NO, NE**					
J. Other	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**

1999

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2	CH_4	N_2O	NO_x	CO	NMVOC
	(kt)					
3. Total Agriculture	**0.0034**	**50.9665**	**3.4655**	**NO**	**NO**	**NE, NO**
I. Livestock		**50.9665**	**1.2401**			**NE**
A. Enteric fermentation		**46.0727**				
1. Cattle		37.0494				
Dairy cattle		27.7978				
Non-dairy cattle		9.2516				
2. Sheep		5.9250				
3. Swine		1.1270				
4. Other livestock		1.9714				
Goats		0.5331				
Horses		1.2964				
Mules and asses		0.0341				
Other (rabbits)		0.1077				
B. Manure management		**4.8938**	**1.2401**			**NE**
1. Cattle		1.9520	0.3090			NE
Dairy cattle		1.5573	0.2143			NE
Non-dairy cattle		0.3947	0.0947			NE
2. Sheep		0.1803	0.1320			NE
3. Swine		2.1871	0.1116			NE
4. Other livestock		0.5744	0.1839			NE
Goats		0.0139	0.0178			NE
Horses		0.1124	0.0376			NE
Mules and asses		0.0026	0.0007			NE
Poultry		0.4310	0.1103			NE
Other (rabbits)		0.0146	0.0175			NE
5. Indirect N_2O emissions			0.5036			
C. Rice cultivation		**NO**				**NO**
D. Agricultural soils			**2.2253**			
a. Direct N_2O emissions from managed soils			1.7425			
1. Inorganic N fertilizers			0.0929			
2. Organic N fertilizers			0.3667			
a. Animal manure applied to soils			0.3667			
b. Sewage sludge applied to soils			NO, NE			
c. Other organic fertilizers applied to soils			NO, NE			
3. Urine and dung deposited by grazing animals			0.2514			
4. Crop residues			0.2743			
5. Mineralization/immobilization associated with loss/gain of soil organic matter			0.7572			
6. Cultivation of organic soils (i.e. histosols)			NO			
7. Other			NO			
b. Indirect N_2O Emissions from managed soils			0.4828			
1. Atmospheric deposition			0.1131			
2. Nitrogen leaching and run-off			0.3697			
E. Prescribed burning of savannas		**NO**	**NO**			
F. Field burning of agricultural residues		**IE**	**IE**			
G. Liming	**NO**					
H. Urea application	**0.0034**					
I. Other carbon-containing fertilizers	**NO, NE**					
J. Other	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**

2000

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2	CH_4	N_2O	NO_x	CO	NMVOC
	(kt)					
3. Total Agriculture	**0.4397**	**47.2751**	**3.2009**	**NO**	**NO**	**NE, NO**
I. Livestock		**47.2751**	**1.0833**			**NE**
A. Enteric fermentation		**43.4313**				
1. Cattle		35.3438				
Dairy cattle		27.2476				
Non-dairy cattle		8.0962				
2. Sheep		5.2675				

3. Swine		0.7390				
4. Other livestock		2.0810				
Goats		0.5788				
Horses		1.3687				
Mules and asses		0.0384				
Other (rabbits)		0.0951				
B. Manure management		**3.8438**	**1.0833**			**NE**
1. Cattle		1.6513	0.2830			NE
Dairy cattle		1.3098	0.2075			NE
Non-dairy cattle		0.3416	0.0755			NE
2. Sheep		0.1608	0.1180			NE
3. Swine		1.4545	0.0693			NE
4. Other livestock		0.5772	0.1836			NE
Goats		0.0150	0.0194			NE
Horses		0.1186	0.0402			NE
Mules and asses		0.0029	0.0008			NE
Poultry		0.4278	0.1079			NE
Other (rabbits)		0.0129	0.0154			NE
5. Indirect N_2O emissions			0.4294			
C. Rice cultivation		**NO**				**NO**
D. Agricultural soils			**2.1176**			
a. Direct N_2O emissions from managed soils			1.6561			
1. Inorganic N fertilizers			0.1609			
2. Organic N fertilizers			0.3261			
a. Animal manure applied to soils			0.3261			
b. Sewage sludge applied to soils			NO, NE			
c. Other organic fertilizers applied to soils			NO, NE			
3. Urine and dung deposited by grazing animals			0.2447			
4. Crop residues			0.1500			
5. Mineralization/immobilization associated with loss/gain of soil organic matter			0.7743			
6. Cultivation of organic soils (i.e. histosols)			NO			
7. Other			NO			
b. Indirect N_2O Emissions from managed soils			0.4616			
1. Atmospheric deposition			0.1108			
2. Nitrogen leaching and run-off			0.3507			
E. Prescribed burning of savannas		**NO**	**NO**			
F. Field burning of agricultural residues		**IE**	**IE**			
G. Liming	**NO**					
H. Urea application	**0.4397**					
I. Other carbon-containing fertilizers	**NO, NE**					
J. Other	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**

2001

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2	CH_4	N_2O	NO_x	CO	NMVOC
	(kt)					
3. Total Agriculture	**0.1496**	**47.9939**	**3.4503**	**NO**	**NO**	**NE, NO**
I. Livestock		**47.9939**	**1.1030**			**NE**
A. Enteric fermentation		**44.1309**				
1. Cattle		35.8303				
Dairy cattle		27.6639				
Non-dairy cattle		8.1664				
2. Sheep		5.3399				
3. Swine		0.7362				
4. Other livestock		2.2245				
Goats		0.6008				
Horses		1.4680				
Mules and asses		0.0427				
Other (rabbits)		0.1129				
B. Manure management		**3.8630**	**1.1030**			**NE**
1. Cattle		1.6789	0.2872			NE
Dairy cattle		1.3334	0.2078			NE
Non-dairy cattle		0.3455	0.0795			NE
2. Sheep		0.1618	0.1123			NE
3. Swine		1.3988	0.0661			NE
4. Other livestock		0.6235	0.2002			NE
Goats		0.0156	0.0188			NE
Horses		0.1272	0.0428			NE
Mules and asses		0.0032	0.0009			NE
Poultry		0.4621	0.1190			NE
Other (rabbits)		0.0153	0.0187			NE
5. Indirect N_2O emissions			0.4372			
C. Rice cultivation		**NO**				**NO**
D. Agricultural soils			**2.3473**			

a. Direct N_2O emissions from managed soils			1.8396			
1. Inorganic N fertilizers			0.1994			
2. Organic N fertilizers			0.3326			
a. Animal manure applied to soils			0.3326			
b. Sewage sludge applied to soils			NO, NE			
c. Other organic fertilizers applied to soils			NO, NE			
3. Urine and dung deposited by grazing animals			0.2481			
4. Crop residues			0.2705			
5. Mineralization/immobilization associated with loss/gain of soil organic matter			0.7889			
6. Cultivation of organic soils (i.e. histosols)			NO			
7. Other			NO			
b. Indirect N_2O Emissions from managed soils			0.5077			
1. Atmospheric deposition			0.1162			
2. Nitrogen leaching and run-off			0.3915			
E. Prescribed burning of savannas		**NO**	**NO**			
F. Field burning of agricultural residues		**IE**	**IE**			
G. Liming	**NO**					
H. Urea application	**0.1496**					
I. Other carbon-containing fertilizers	**NO, NE**					
J. Other	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**

2002

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2	CH_4	N_2O	NO_x	CO	NMVOC
	(kt)					
3. Total Agriculture	**0.0470**	**49.0432**	**3.5951**	**NO**	**NO**	**NE, NO**
I. Livestock		**49.0432**	**1.1134**			**NE**
A. Enteric fermentation		**45.0244**				
1. Cattle		36.5787				
Dairy cattle		28.4383				
Non-dairy cattle		8.1404				
2. Sheep		5.3074				
3. Swine		0.8252				
4. Other livestock		2.3130				
Goats		0.6732				
Horses		1.4875				
Mules and asses		0.0397				
Other (rabbits)		0.1125				
B. Manure management		**4.0188**	**1.1134**			**NE**
1. Cattle		1.7151	0.2879			NE
Dairy cattle		1.3707	0.2110			NE
Non-dairy cattle		0.3444	0.0769			NE
2. Sheep		0.1603	0.1084			NE
3. Swine		1.4936	0.0720			NE
4. Other livestock		0.6498	0.2028			NE
Goats		0.0175	0.0205			NE
Horses		0.1289	0.0425			NE
Mules and asses		0.0030	0.0008			NE
Poultry		0.4851	0.1205			NE
Other (rabbits)		0.0153	0.0185			NE
5. Indirect N_2O emissions			0.4424			
C. Rice cultivation		**NO**				**NO**
D. Agricultural soils			**2.4816**			
a. Direct N_2O emissions from managed soils			1.9412			
1. Inorganic N fertilizers			0.2823			
2. Organic N fertilizers			0.3355			
a. Animal manure applied to soils			0.3355			
b. Sewage sludge applied to soils			NO, NE			
c. Other organic fertilizers applied to soils			NO, NE			
3. Urine and dung deposited by grazing animals			0.2569			
4. Crop residues			0.2764			
5. Mineralization/immobilization associated with loss/gain of soil organic matter			0.7902			
6. Cultivation of organic soils (i.e. histosols)			NO			
7. Other			NO			
b. Indirect N_2O Emissions from managed soils			0.5404			
1. Atmospheric deposition			0.1264			
2. Nitrogen leaching and run-off			0.4140			
E. Prescribed burning of savannas		**NO**	**NO**			
F. Field burning of agricultural residues		**IE**	**IE**			
G. Liming	**NO**					
H. Urea application	**0.0470**					
I. Other carbon-containing fertilizers	**NO, NE**					
J. Other	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**

2003

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2	CH_4	N_2O	NO_x	CO	NMVOC
	(kt)					
3. Total Agriculture	**0.2381**	**44.8709**	**3.1618**	NO	NO	NE, NO
I. Livestock		**44.8709**	**1.0567**			NE
A. Enteric fermentation		**41.1415**				
1. Cattle		33.0553				
Dairy cattle		25.9741				
Non-dairy cattle		7.0812				
2. Sheep		5.0960				
3. Swine		0.7146				
4. Other livestock		2.2756				
Goats		0.6461				
Horses		1.4656				
Mules and asses		0.0428				
Other (rabbits)		0.1212				
B. Manure management		**3.7294**	**1.0567**			NE
1. Cattle		1.5515	0.2579			NE
Dairy cattle		1.2520	0.1912			NE
Non-dairy cattle		0.2996	0.0667			NE
2. Sheep		0.1575	0.1065			NE
3. Swine		1.3572	0.0645			NE
4. Other livestock		0.6631	0.2083			NE
Goats		0.0168	0.0197			NE
Horses		0.1270	0.0423			NE
Mules and asses		0.0033	0.0009			NE
Poultry		0.4996	0.1259			NE
Other (rabbits)		0.0164	0.0195			NE
5. Indirect N_2O emissions			0.4195			
C. Rice cultivation		NO				NO
D. Agricultural soils			**2.1051**			
a. Direct N_2O emissions from managed soils			1.6410			
1. Inorganic N fertilizers			0.2298			
2. Organic N fertilizers			0.3179			
a. Animal manure applied to soils			0.3179			
b. Sewage sludge applied to soils			NO, NE			
c. Other organic fertilizers applied to soils			NO, NE			
3. Urine and dung deposited by grazing animals			0.2386			
4. Crop residues			0.1297			
5. Mineralization/immobilization associated with loss/gain of soil organic matter			0.7250			
6. Cultivation of organic soils (i.e. histosols)			NO			
7. Other			NO			
b. Indirect N_2O Emissions from managed soils			0.4642			
1. Atmospheric deposition			0.1158			
2. Nitrogen leaching and run-off			0.3484			
E. Prescribed burning of savannas		NO	NO			
F. Field burning of agricultural residues		IE	IE			
G. Liming	NO					
H. Urea application	**0.2381**					
I. Other carbon-containing fertilizers	NO, NE					
J. Other	NO	NO	NO	NO	NO	NO

2004

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2	CH_4	N_2O	NO_x	CO	NMVOC
	(kt)					
3. Total Agriculture	**0.3669**	**41.9611**	**3.4051**	NO	NO	NE, NO
I. Livestock		**41.9611**	**1.0264**			NE
A. Enteric fermentation		**38.4568**				
1. Cattle		30.3973				
Dairy cattle		24.1796				
Non-dairy cattle		6.2177				
2. Sheep		5.2446				
3. Swine		0.6335				
4. Other livestock		2.1815				
Goats		0.6358				
Horses		1.3646				
Mules and asses		0.0400				
Other (rabbits)		0.1410				
B. Manure management		**3.5042**	**1.0264**			NE
1. Cattle		1.5003	0.2283			NE
Dairy cattle		1.2049	0.1713			NE
Non-dairy cattle		0.2954	0.0569			NE
2. Sheep		0.1582	0.1072			NE

3. Swine		1.1323	0.0600			NE
4. Other livestock		0.7135	0.2226			NE
Goats		0.0165	0.0194			NE
Horses		0.1183	0.0387			NE
Mules and asses		0.0030	0.0008			NE
Poultry		0.5566	0.1404			NE
Other (rabbits)		0.0191	0.0231			NE
5. Indirect N_2O emissions			0.4083			
C. Rice cultivation		**NO**				**NO**
D. Agricultural soils			**2.3786**			
a. Direct N_2O emissions from managed soils			1.8643			
1. Inorganic N fertilizers			0.2524			
2. Organic N fertilizers			0.3062			
a. Animal manure applied to soils			0.3062			
b. Sewage sludge applied to soils			NO, NE			
c. Other organic fertilizers applied to soils			NO, NE			
3. Urine and dung deposited by grazing animals			0.2260			
4. Crop residues			0.3140			
5. Mineralization/immobilization associated with loss/gain of soil organic matter			0.7657			
6. Cultivation of organic soils (i.e. histosols)			NO			
7. Other			NO			
b. Indirect N_2O Emissions from managed soils			0.5143			
1. Atmospheric deposition			0.1143			
2. Nitrogen leaching and run-off			0.4000			
E. Prescribed burning of savannas		**NO**	**NO**			
F. Field burning of agricultural residues		**IE**	**IE**			
G. Liming	**NO**					
H. Urea application	**0.3669**					
I. Other carbon-containing fertilizers	**NO, NE**					
J. Other	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**

2005

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2	CH_4	N_2O	NO_x	CO	NMVOC
	(kt)					
3. Total Agriculture	**0.1739**	**40.6563**	**3.5122**	**NO**	**NO**	**NE, NO**
I. Livestock		**40.6563**	**1.1022**			**NE**
A. Enteric fermentation		**36.9611**				
1. Cattle		28.7238				
Dairy cattle		22.8364				
Non-dairy cattle		5.8874				
2. Sheep		5.3632				
3. Swine		0.7395				
4. Other livestock		2.1346				
Goats		0.6366				
Horses		1.2961				
Mules and asses		0.0374				
Other (rabbits)		0.1645				
B. Manure management		**3.6952**	**1.1022**			**NE**
1. Cattle		1.3841	0.2122			NE
Dairy cattle		1.1110	0.1584			NE
Non-dairy cattle		0.2731	0.0538			NE
2. Sheep		0.1571	0.1062			NE
3. Swine		1.2980	0.0688			NE
4. Other livestock		0.8559	0.2711			NE
Goats		0.0166	0.0194			NE
Horses		0.1123	0.0380			NE
Mules and asses		0.0028	0.0008			NE
Poultry		0.7019	0.1859			NE
Other (rabbits)		0.0223	0.0271			NE
5. Indirect N_2O emissions			0.4439			
C. Rice cultivation		**NO**				**NO**
D. Agricultural soils			**2.4100**			
a. Direct N_2O emissions from managed soils			1.8873			
1. Inorganic N fertilizers			0.2530			
2. Organic N fertilizers			0.3223			
a. Animal manure applied to soils			0.3223			
b. Sewage sludge applied to soils			NO, NE			
c. Other organic fertilizers applied to soils			NO, NE			
3. Urine and dung deposited by grazing animals			0.2241			
4. Crop residues			0.3151			
5. Mineralization/immobilization associated with loss/gain of soil organic matter			0.7728			
6. Cultivation of organic soils (i.e. histosols)			NO			
7. Other			NO			

b. Indirect N_2O Emissions from managed soils			0.5226			
1. Atmospheric deposition			0.1174			
2. Nitrogen leaching and run-off			0.4053			
E. Prescribed burning of savannas		**NO**	**NO**			
F. Field burning of agricultural residues		**IE**	**IE**			
G. Liming	**NO**					
H. Urea application	**0.1739**					
I. Other carbon-containing fertilizers	**NO, NE**					
J. Other	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**

2006

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2	CH_4	N_2O	NO_x	CO	NMVOC
	(kt)					
3. Total Agriculture	**0.1460**	**39.5494**	**3.4111**	**NO**	**NO**	**NE, NO**
I. Livestock		**39.5494**	**1.1361**			**NE**
A. Enteric fermentation		**35.7523**				
1. Cattle		27.4654				
Dairy cattle		21.6435				
Non-dairy cattle		5.8220				
2. Sheep		5.3596				
3. Swine		0.8524				
4. Other livestock		2.0749				
Goats		0.5994				
Horses		1.2468				
Mules and asses		0.0364				
Other (rabbits)		0.1923				
B. Manure management		**3.7971**	**1.1361**			**NE**
1. Cattle		1.3230	0.2038			NE
Dairy cattle		1.0530	0.1503			NE
Non-dairy cattle		0.2700	0.0535			NE
2. Sheep		0.1601	0.1112			NE
3. Swine		1.4556	0.0816			NE
4. Other livestock		0.8584	0.2803			NE
Goats		0.0156	0.0189			NE
Horses		0.1081	0.0395			NE
Mules and asses		0.0028	0.0008			NE
Poultry		0.7059	0.1894			NE
Other (rabbits)		0.0261	0.0318			NE
5. Indirect N_2O emissions			0.4591			
C. Rice cultivation		**NO**				**NO**
D. Agricultural soils			**2.2750**			
a. Direct N_2O emissions from managed soils			1.7785			
1. Inorganic N fertilizers			0.2170			
2. Organic N fertilizers			0.3300			
a. Animal manure applied to soils			0.3300			
b. Sewage sludge applied to soils			NO, NE			
c. Other organic fertilizers applied to soils			NO, NE			
3. Urine and dung deposited by grazing animals			0.2212			
4. Crop residues			0.3063			
5. Mineralization/immobilization associated with loss/gain of soil organic matter			0.7040			
6. Cultivation of organic soils (i.e. histosols)			NO			
7. Other			NO			
b. Indirect N_2O Emissions from managed soils			0.4965			
1. Atmospheric deposition			0.1152			
2. Nitrogen leaching and run-off			0.3813			
E. Prescribed burning of savannas		**NO**	**NO**			
F. Field burning of agricultural residues		**IE**	**IE**			
G. Liming	**NO**					
H. Urea application	**0.1460**					
I. Other carbon-containing fertilizers	**NO, NE**					
J. Other	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**

2007

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2	CH_4	N_2O	NO_x	CO	NMVOC
	(kt)					
3. Total Agriculture	**0.2631**	**31.5420**	**2.8030**	**NO**	**NO**	**NE, NO**
I. Livestock		**31.5420**	**0.8615**			**NE**
A. Enteric fermentation		**28.8838**				
1. Cattle		21.7190				
Dairy cattle		17.7675				
Non-dairy cattle		3.9515				
2. Sheep		4.8749				
3. Swine		0.4812				

4. Other livestock		1.8088				
Goats		0.5325				
Horses		1.0897				
Mules and asses		0.0312				
Other (rabbits)		0.1554				
B. Manure management		**2.6582**	**0.8615**			**NE**
1. Cattle		1.0477	0.1579			NE
Dairy cattle		0.8644	0.1222			NE
Non-dairy cattle		0.1833	0.0357			NE
2. Sheep		0.1444	0.0976			NE
3. Swine		0.7996	0.0461			NE
4. Other livestock		0.6665	0.2171			NE
Goats		0.0138	0.0162			NE
Horses		0.0944	0.0320			NE
Mules and asses		0.0024	0.0006			NE
Poultry		0.5348	0.1433			NE
Other (rabbits)		0.0211	0.0249			NE
5. Indirect N_2O emissions			0.3429			
C. Rice cultivation		**NO**				**NO**
D. Agricultural soils			**1.9415**			
a. Direct N_2O emissions from managed soils			1.5130			
1. Inorganic N fertilizers			0.2959			
2. Organic N fertilizers			0.2545			
a. Animal manure applied to soils			0.2545			
b. Sewage sludge applied to soils			NO, NE			
c. Other organic fertilizers applied to soils			NO, NE			
3. Urine and dung deposited by grazing animals			0.1756			
4. Crop residues			0.0804			
5. Mineralization/immobilization associated with loss/gain of soil organic matter			0.7065			
6. Cultivation of organic soils (i.e. histosols)			NO			
7. Other			NO			
b. Indirect N_2O Emissions from managed soils			0.4285			
1. Atmospheric deposition			0.1027			
2. Nitrogen leaching and run-off			0.3259			
E. Prescribed burning of savannas		**NO**	**NO**			
F. Field burning of agricultural residues		**IE**	**IE**			
G. Liming	**NO**					
H. Urea application	**0.2631**					
I. Other carbon-containing fertilizers	**NO, NE**					
J. Other	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**

2008

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2	CH_4	N_2O	NO_x	CO	NMVOC
	(kt)					
3. Total Agriculture	**0.8505**	**30.1478**	**3.1612**	**NO**	**NO**	**NE, NO**
I. Livestock		**30.1478**	**0.8529**			**NE**
A. Enteric fermentation		**27.5714**				
1. Cattle		20.4224				
Dairy cattle		16.9616				
Non-dairy cattle		3.4609				
2. Sheep		4.9237				
3. Swine		0.4544				
4. Other livestock		1.7709				
Goats		0.5596				
Horses		1.0329				
Mules and asses		0.0319				
Other (rabbits)		0.1466				
B. Manure management		**2.5764**	**0.8529**			**NE**
1. Cattle		0.9830	0.1451			NE
Dairy cattle		0.8230	0.1121			NE
Non-dairy cattle		0.1601	0.0330			NE
2. Sheep		0.1459	0.0963			NE
3. Swine		0.7488	0.0477			NE
4. Other livestock		0.6988	0.2232			NE
Goats		0.0145	0.0167			NE
Horses		0.0895	0.0303			NE
Mules and asses		0.0024	0.0007			NE
Poultry		0.5724	0.1514			NE
Other (rabbits)		0.0199	0.0242			NE
5. Indirect N_2O emissions			0.3406			
C. Rice cultivation		**NO**				**NO**
D. Agricultural soils			**2.3083**			

a. Direct N_2O emissions from managed soils			1.8084			
1. Inorganic N fertilizers			0.3446			
2. Organic N fertilizers			0.2499			
a. Animal manure applied to soils			0.2499			
b. Sewage sludge applied to soils			NO, NE			
c. Other organic fertilizers applied to soils			NO, NE			
3. Urine and dung deposited by grazing animals			0.1770			
4. Crop residues			0.3305			
5. Mineralization/immobilization associated with loss/gain of soil organic matter			0.7064			
6. Cultivation of organic soils (i.e. histosols)			NO			
7. Other			NO			
b. Indirect N_2O Emissions from managed soils			0.4999			
1. Atmospheric deposition			0.1072			
2. Nitrogen leaching and run-off			0.3927			
E. Prescribed burning of savannas		**NO**	**NO**			
F. Field burning of agricultural residues		**IE**	**IE**			
G. Liming	**NO**					
H. Urea application	**0.8505**					
I. Other carbon-containing fertilizers	**NO, NE**					
J. Other	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**

2009

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2	CH_4	N_2O	NO_x	CO	NMVOC
	(kt)					
3. Total Agriculture	**0.5864**	**31.4621**	**3.1480**	**NO**	**NO**	**NE, NO**
I. Livestock		**31.4621**	**0.9659**			**NE**
A. Enteric fermentation		**28.5438**				
1. Cattle		20.7338				
Dairy cattle		17.1419				
Non-dairy cattle		3.5919				
2. Sheep		5.4028				
3. Swine		0.6054				
4. Other livestock		1.8018				
Goats		0.6014				
Horses		1.0092				
Mules and asses		0.0294				
Other (rabbits)		0.1619				
B. Manure management		**2.9183**	**0.9659**			**NE**
1. Cattle		0.9735	0.1483			NE
Dairy cattle		0.8114	0.1135			NE
Non-dairy cattle		0.1621	0.0348			NE
2. Sheep		0.1538	0.1068			NE
3. Swine		0.9686	0.0635			NE
4. Other livestock		0.8224	0.2577			NE
Goats		0.0156	0.0190			NE
Horses		0.0875	0.0292			NE
Mules and asses		0.0022	0.0006			NE
Poultry		0.6951	0.1820			NE
Other (rabbits)		0.0220	0.0269			NE
5. Indirect N_2O emissions			0.3896			
C. Rice cultivation		**NO**				**NO**
D. Agricultural soils			**2.1821**			
a. Direct N_2O emissions from managed soils			1.7065			
1. Inorganic N fertilizers			0.2670			
2. Organic N fertilizers			0.2788			
a. Animal manure applied to soils			0.2788			
b. Sewage sludge applied to soils			NO, NE			
c. Other organic fertilizers applied to soils			NO, NE			
3. Urine and dung deposited by grazing animals			0.1900			
4. Crop residues			0.2458			
5. Mineralization/immobilization associated with loss/gain of soil organic matter			0.7250			
6. Cultivation of organic soils (i.e. histosols)			NO			
7. Other			NO			
b. Indirect N_2O Emissions from managed soils			0.4757			
1. Atmospheric deposition			0.1069			
2. Nitrogen leaching and run-off			0.3687			
E. Prescribed burning of savannas		**NO**	**NO**			
F. Field burning of agricultural residues		**IE**	**IE**			
G. Liming	**NO**					
H. Urea application	**0.5864**					
I. Other carbon-containing fertilizers	**NO, NE**					
J. Other	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**

2010

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2	CH_4	N_2O	NO_x	CO	NMVOC
	(kt)					
3. Total Agriculture	**1.7443**	**31.4952**	**3.4048**	**NO**	**NO**	**NE, NO**
I. Livestock		**31.4952**	**1.0080**			**NE**
A. Enteric fermentation		**28.3270**				
1. Cattle		20.4583				
Dairy cattle		16.7968				
Non-dairy cattle		3.6615				
2. Sheep		5.3083				
3. Swine		0.7675				
4. Other livestock		1.7929				
Goats		0.6373				
Horses		0.9646				
Mules and asses		0.0275				
Other (rabbits)		0.1635				
B. Manure management		**3.1682**	**1.0080**			**NE**
1. Cattle		0.9603	0.1463			NE
Dairy cattle		0.7951	0.1109			NE
Non-dairy cattle		0.1652	0.0354			NE
2. Sheep		0.1507	0.1047			NE
3. Swine		1.2122	0.0803			NE
4. Other livestock		0.8449	0.2668			NE
Goats		0.0166	0.0202			NE
Horses		0.0836	0.0282			NE
Mules and asses		0.0021	0.0006			NE
Poultry		0.7205	0.1906			NE
Other (rabbits)		0.0222	0.0272			NE
5. Indirect N_2O emissions			0.4100			
C. Rice cultivation		**NO**				**NO**
D. Agricultural soils			**2.3968**			
a. Direct N_2O emissions from managed soils			1.8758			
1. Inorganic N fertilizers			0.3234			
2. Organic N fertilizers			0.2873			
a. Animal manure applied to soils			0.2873			
b. Sewage sludge applied to soils			NO, NE			
c. Other organic fertilizers applied to soils			NO, NE			
3. Urine and dung deposited by grazing animals			0.1898			
4. Crop residues			0.3344			
5. Mineralization/immobilization associated with loss/gain of soil organic matter			0.7410			
6. Cultivation of organic soils (i.e. histosols)			NO			
7. Other			NO			
b. Indirect N_2O Emissions from managed soils			0.5209			
1. Atmospheric deposition			0.1142			
2. Nitrogen leaching and run-off			0.4068			
E. Prescribed burning of savannas		**NO**	**NO**			
F. Field burning of agricultural residues		**IE**	**IE**			
G. Liming	**NO**					
H. Urea application	**1.7443**					
I. Other carbon-containing fertilizers	**NO, NE**					
J. Other	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**

2011

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2	CH_4	N_2O	NO_x	CO	NMVOC
	(kt)					
3. Total Agriculture	**3.6752**	**29.6755**	**3.3378**	**NO**	**NO**	**NE, NO**
I. Livestock		**29.6755**	**0.9189**			**NE**
A. Enteric fermentation		**26.6765**				
1. Cattle		19.4806				
Dairy cattle		15.8625				
Non-dairy cattle		3.6181				
2. Sheep		4.7236				
3. Swine		0.7076				
4. Other livestock		1.7648				
Goats		0.6601				
Horses		0.9160				
Mules and asses		0.0251				
Other (rabbits)		0.1636				
B. Manure management		**2.9990**	**0.9189**			**NE**
1. Cattle		0.9142	0.1418			NE
Dairy cattle		0.7509	0.1044			NE
Non-dairy cattle		0.1633	0.0374			NE
2. Sheep		0.1357	0.0942			NE

3. Swine		1.2293	0.0762			NE
4. Other livestock		0.7198	0.2339			NE
Goats		0.0172	0.0209			NE
Horses		0.0794	0.0266			NE
Mules and asses		0.0019	0.0005			NE
Poultry		0.5992	0.1588			NE
Other (rabbits)		0.0222	0.0270			NE
5. Indirect N_2O emissions			0.3727			
C. Rice cultivation		**NO**				**NO**
D. Agricultural soils			**2.4190**			
a. Direct N_2O emissions from managed soils			1.8927			
1. Inorganic N fertilizers			0.3928			
2. Organic N fertilizers			0.2633			
a. Animal manure applied to soils			0.2633			
b. Sewage sludge applied to soils			NO, NE			
c. Other organic fertilizers applied to soils			NO, NE			
3. Urine and dung deposited by grazing animals			0.1756			
4. Crop residues			0.3340			
5. Mineralization/immobilization associated with loss/gain of soil organic matter			0.7270			
6. Cultivation of organic soils (i.e. histosols)			NO			
7. Other			NO			
b. Indirect N_2O Emissions from managed soils			0.5262			
1. Atmospheric deposition			0.1145			
2. Nitrogen leaching and run-off			0.4117			
E. Prescribed burning of savannas		**NO**	**NO**			
F. Field burning of agricultural residues		**IE**	**IE**			
G. Liming	**NO**					
H. Urea application	**3.6752**					
I. Other carbon-containing fertilizers	**NO, NE**					
J. Other	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**

2012

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2	CH_4	N_2O	NO_x	CO	NMVOC
	(kt)					
3. Total Agriculture	**5.5908**	**27.9757**	**3.1555**	**NO**	**NO**	**NE, NO**
I. Livestock		**27.9757**	**0.8439**			**NE**
A. Enteric fermentation		**25.2109**				
1. Cattle		18.3057				
Dairy cattle		14.8262				
Non-dairy cattle		3.4795				
2. Sheep		4.5222				
3. Swine		0.6576				
4. Other livestock		1.7254				
Goats		0.6892				
Horses		0.8546				
Mules and asses		0.0242				
Other (rabbits)		0.1575				
B. Manure management		**2.7648**	**0.8439**			**NE**
1. Cattle		0.8559	0.1334			NE
Dairy cattle		0.6981	0.0978			NE
Non-dairy cattle		0.1578	0.0356			NE
2. Sheep		0.1328	0.0949			NE
3. Swine		1.1790	0.0740			NE
4. Other livestock		0.5971	0.2016			NE
Goats		0.0179	0.0226			NE
Horses		0.0741	0.0258			NE
Mules and asses		0.0018	0.0005			NE
Poultry		0.4820	0.1275			NE
Other (rabbits)		0.0214	0.0253			NE
5. Indirect N_2O emissions			0.3400			
C. Rice cultivation		**NO**				**NO**
D. Agricultural soils			**2.3116**			
a. Direct N_2O emissions from managed soils			1.7965			
1. Inorganic N fertilizers			0.5355			
2. Organic N fertilizers			0.2432			
a. Animal manure applied to soils			0.2432			
b. Sewage sludge applied to soils			NO, NE			
c. Other organic fertilizers applied to soils			NO, NE			
3. Urine and dung deposited by grazing animals			0.1650			
4. Crop residues			0.1003			
5. Mineralization/immobilization associated with loss/gain of soil organic matter			0.7525			
6. Cultivation of organic soils (i.e. histosols)			NO			
7. Other			NO			

b. Indirect N_2O Emissions from managed soils			0.5151			
1. Atmospheric deposition			0.1237			
2. Nitrogen leaching and run-off			0.3913			
E. Prescribed burning of savannas		**NO**	**NO**			
F. Field burning of agricultural residues		**IE**	**IE**			
G. Liming	**NO**					
H. Urea application	**5.5908**					
I. Other carbon-containing fertilizers	**NO, NE**					
J. Other	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**

2013

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2	CH_4	N_2O	NO_x	CO	NMVOC
	(kt)					
3. Total Agriculture	**4.1840**	**28.1102**	**3.5830**	**NO**	**NO**	**NE, NO**
I. Livestock		**28.1102**	**0.7857**			**NE**
A. Enteric fermentation		**25.3945**				
1. Cattle		18.0684				
Dairy cattle		14.5984				
Non-dairy cattle		3.4700				
2. Sheep		4.9122				
3. Swine		0.6672				
4. Other livestock		1.7466				
Goats		0.7230				
Horses		0.8275				
Mules and asses		0.0214				
Other (rabbits)		0.1748				
B. Manure management		**2.7156**	**0.7857**			**NE**
1. Cattle		0.8471	0.1310			NE
Dairy cattle		0.6893	0.0955			NE
Non-dairy cattle		0.1578	0.0355			NE
2. Sheep		0.1363	0.1021			NE
3. Swine		1.2548	0.0696			NE
4. Other livestock		0.4775	0.1705			NE
Goats		0.0188	0.0250			NE
Horses		0.0717	0.0252			NE
Mules and asses		0.0016	0.0005			NE
Poultry		0.3617	0.0919			NE
Other (rabbits)		0.0237	0.0279			NE
5. Indirect N_2O emissions			0.3125			
C. Rice cultivation		**NO**				**NO**
D. Agricultural soils			**2.7973**			
a. Direct N_2O emissions from managed soils			2.1841			
1. Inorganic N fertilizers			0.6617			
2. Organic N fertilizers			0.2309			
a. Animal manure applied to soils			0.2309			
b. Sewage sludge applied to soils			NO, NE			
c. Other organic fertilizers applied to soils			NO, NE			
3. Urine and dung deposited by grazing animals			0.1586			
4. Crop residues			0.3654			
5. Mineralization/immobilization associated with loss/gain of soil organic matter			0.7675			
6. Cultivation of organic soils (i.e. histosols)			NO			
7. Other			NO			
b. Indirect N_2O Emissions from managed soils			0.6132			
1. Atmospheric deposition			0.1336			
2. Nitrogen leaching and run-off			0.4796			
E. Prescribed burning of savannas		**NO**	**NO**			
F. Field burning of agricultural residues		**IE**	**IE**			
G. Liming	**NO**					
H. Urea application	**4.1840**					
I. Other carbon-containing fertilizers	**NO, NE**					
J. Other	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**

2014

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2	CH_4	N_2O	NO_x	CO	NMVOC
	(kt)					
3. Total Agriculture	**10.2058**	**28.9203**	**4.1636**	**NO**	**NO**	**NE, NO**
I. Livestock		**28.9203**	**0.8671**			**NE**
A. Enteric fermentation		**26.1032**				
1. Cattle		18.2780				
Dairy cattle		14.7376				
Non-dairy cattle		3.5404				
2. Sheep		5.3168				
3. Swine		0.7571				

4. Other livestock		1.7513				
Goats		0.7671				
Horses		0.7699				
Mules and asses		0.0220				
Other (rabbits)		0.1924				
B. Manure management		**2.8171**	**0.8671**			**NE**
1. Cattle		0.8092	0.1390			NE
Dairy cattle		0.6572	0.0984			NE
Non-dairy cattle		0.1520	0.0406			NE
2. Sheep		0.1394	0.1170			NE
3. Swine		1.3764	0.0826			NE
4. Other livestock		0.4921	0.1828			NE
Goats		0.0199	0.0303			NE
Horses		0.0667	0.0231			NE
Mules and asses		0.0017	0.0005			NE
Poultry		0.3777	0.0973			NE
Other (rabbits)		0.0261	0.0317			NE
5. Indirect N_2O emissions			0.3457			
C. Rice cultivation		**NO**				**NO**
D. Agricultural soils			**3.2966**			
a. Direct N_2O emissions from managed soils			2.5630			
1. Inorganic N fertilizers			0.9603			
2. Organic N fertilizers			0.2515			
a. Animal manure applied to soils			0.2515			
b. Sewage sludge applied to soils			NO, NE			
c. Other organic fertilizers applied to soils			NO, NE			
3. Urine and dung deposited by grazing animals			0.1710			
4. Crop residues			0.4091			
5. Mineralization/immobilization associated with loss/gain of soil organic matter			0.7711			
6. Cultivation of organic soils (i.e. histosols)			NO			
7. Other			NO			
b. Indirect N_2O Emissions from managed soils			0.7336			
1. Atmospheric deposition			0.1694			
2. Nitrogen leaching and run-off			0.5642			
E. Prescribed burning of savannas		**NO**	**NO**			
F. Field burning of agricultural residues		**IE**	**IE**			
G. Liming	**NO**					
H. Urea application	**10.2058**					
I. Other carbon-containing fertilizers	**NO, NE**					
J. Other	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**

2015

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2	CH_4	N_2O	NO_x	CO	NMVOC
	(kt)					
3. Total Agriculture	**11.2402**	**27.9230**	**3.3285**	**NO**	**NO**	**NE, NO**
I. Livestock		**27.9230**	**0.8386**			**NE**
A. Enteric fermentation		**25.1684**				
1. Cattle		17.6976				
Dairy cattle		14.4250				
Non-dairy cattle		3.2727				
2. Sheep		5.0019				
3. Swine		0.7267				
4. Other livestock		1.7422				
Goats		0.7932				
Horses		0.7227				
Mules and asses		0.0196				
Other (rabbits)		0.2066				
B. Manure management		**2.7546**	**0.8386**			**NE**
1. Cattle		0.7838	0.1376			NE
Dairy cattle		0.6433	0.0985			NE
Non-dairy cattle		0.1405	0.0391			NE
2. Sheep		0.1372	0.1102			NE
3. Swine		1.3412	0.0758			NE
4. Other livestock		0.4924	0.1815			NE
Goats		0.0206	0.0298			NE
Horses		0.0626	0.0216			NE
Mules and asses		0.0015	0.0004			NE
Poultry		0.3796	0.0959			NE
Other (rabbits)		0.0280	0.0338			NE
5. Indirect N_2O emissions			0.3335			
C. Rice cultivation		**NO**				**NO**
D. Agricultural soils			**2.4899**			
a. Direct N_2O emissions from managed soils			1.9349			

1. Inorganic N fertilizers			0.6078			
2. Organic N fertilizers			0.2446			
a. Animal manure applied to soils			0.2446			
b. Sewage sludge applied to soils			NO, NE			
c. Other organic fertilizers applied to soils			NO, NE			
3. Urine and dung deposited by grazing animals			0.1668			
4. Crop residues			0.1448			
5. Mineralization/immobilization associated with loss/gain of soil organic matter			0.7709			
6. Cultivation of organic soils (i.e. histosols)			NO			
7. Other			NO			
b. Indirect N_2O Emissions from managed soils			0.5550			
1. Atmospheric deposition			0.1321			
2. Nitrogen leaching and run-off			0.4230			
E. Prescribed burning of savannas		**NO**	**NO**			
F. Field burning of agricultural residues		**IE**	**IE**			
G. Liming	**NO**					
H. Urea application	**11.2402**					
I. Other carbon-containing fertilizers	**NO, NE**					
J. Other	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**

2016

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2	CH_4	N_2O	NO_x	CO	NMVOC
	(kt)					
3. Total Agriculture	**12.2747**	**27.4424**	**3.7863**	**NO**	**NO**	**NE, NO**
I. Livestock		**27.4424**	**0.8631**			**NE**
A. Enteric fermentation		**24.8801**				
1. Cattle		17.3237				
Dairy cattle		13.7699				
Non-dairy cattle		3.5538				
2. Sheep		5.0967				
3. Swine		0.7047				
4. Other livestock		1.7551				
Goats		0.8352				
Horses		0.6728				
Mules and asses		0.0308				
Other (rabbits)		0.2163				
B. Manure management		**2.5622**	**0.8631**			**NE**
1. Cattle		0.7658	0.1335			NE
Dairy cattle		0.6102	0.0936			NE
Non-dairy cattle		0.1556	0.0399			NE
2. Sheep		0.1358	0.1100			NE
3. Swine		1.1517	0.0878			NE
4. Other livestock		0.5089	0.1865			NE
Goats		0.0217	0.0317			NE
Horses		0.0583	0.0198			NE
Mules and asses		0.0023	0.0006			NE
Poultry		0.3973	0.0987			NE
Other (rabbits)		0.0293	0.0357			NE
5. Indirect N_2O emissions			0.3452			
C. Rice cultivation		**NO**				**NO**
D. Agricultural soils			**2.9232**			
a. Direct N_2O emissions from managed soils			2.2815			
1. Inorganic N fertilizers			0.6821			
2. Organic N fertilizers			0.2475			
a. Animal manure applied to soils			0.2475			
b. Sewage sludge applied to soils			NO, NE			
c. Other organic fertilizers applied to soils			NO, NE			
3. Urine and dung deposited by grazing animals			0.1657			
4. Crop residues			0.4055			
5. Mineralization/immobilization associated with loss/gain of soil organic matter			0.7805			
6. Cultivation of organic soils (i.e. histosols)			NO			
7. Other			NO			
b. Indirect N_2O Emissions from managed soils			0.6417			
1. Atmospheric deposition			0.1403			
2. Nitrogen leaching and run-off			0.5014			
E. Prescribed burning of savannas		**NO**	**NO**			
F. Field burning of agricultural residues		**IE**	**IE**			
G. Liming	**NO**					
H. Urea application	**12.2747**					
I. Other carbon-containing fertilizers	**NO, NE**					
J. Other	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**

2017

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2	CH_4	N_2O	NO_x	CO	NMVOC
	(kt)					
3. Total Agriculture	**26.2081**	**25.6519**	**4.0746**	**NO**	**NO**	**NE, NO**
I. Livestock		**25.6519**	**0.8177**			**NE**
A. Enteric fermentation		**23.1354**				
1. Cattle		15.9989				
Dairy cattle		12.8523				
Non-dairy cattle		3.1465				
2. Sheep		4.7390				
3. Swine		0.6597				
4. Other livestock		1.7378				
Goats		0.8514				
Horses		0.6143				
Mules and asses		0.0500				
Other (rabbits)		0.2221				
B. Manure management		**2.5165**	**0.8177**			**NE**
1. Cattle		0.7092	0.1287			NE
Dairy cattle		0.5711	0.0870			NE
Non-dairy cattle		0.1381	0.0417			NE
2. Sheep		0.1299	0.1029			NE
3. Swine		1.1575	0.0678			NE
4. Other livestock		0.5199	0.1938			NE
Goats		0.0221	0.0315			NE
Horses		0.0532	0.0200			NE
Mules and asses		0.0038	0.0011			NE
Poultry		0.4106	0.1041			NE
Other (rabbits)		0.0301	0.0370			NE
5. Indirect N_2O emissions			0.3245			
C. Rice cultivation		**NO**				**NO**
D. Agricultural soils			**3.2570**			
a. Direct N_2O emissions from managed soils			2.5404			
1. Inorganic N fertilizers			0.8754			
2. Organic N fertilizers			0.2363			
a. Animal manure applied to soils			0.2363			
b. Sewage sludge applied to soils			NO, NE			
c. Other organic fertilizers applied to soils			NO, NE			
3. Urine and dung deposited by grazing animals			0.1610			
4. Crop residues			0.4777			
5. Mineralization/immobilization associated with loss/gain of soil organic matter			0.7900			
6. Cultivation of organic soils (i.e. histosols)			NO			
7. Other			NO			
b. Indirect N_2O Emissions from managed soils			0.7166			
1. Atmospheric deposition			0.1567			
2. Nitrogen leaching and run-off			0.5599			
E. Prescribed burning of savannas		**NO**	**NO**			
F. Field burning of agricultural residues		**IE**	**IE**			
G. Liming	**NO**					
H. Urea application	**26.2081**					
I. Other carbon-containing fertilizers	**NO, NE**					
J. Other	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**

2018

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2	CH_4	N_2O	NO_x	CO	NMVOC
	(kt)					
3. Total Agriculture	**43.3624**	**22.8526**	**4.1028**	**NO**	**NO**	**NE, NO**
I. Livestock		**22.8526**	**0.7210**			**NE**
A. Enteric fermentation		**20.6594**				
1. Cattle		14.0365				
Dairy cattle		11.2095				
Non-dairy cattle		2.8270				
2. Sheep		4.3682				
3. Swine		0.6474				
4. Other livestock		1.6073				
Goats		0.8143				
Horses		0.5480				
Mules and asses		0.0377				
Other (rabbits)		0.2074				
B. Manure management		**2.1932**	**0.7210**			**NE**
1. Cattle		0.6281	0.1131			NE
Dairy cattle		0.5004	0.0746			NE

Non-dairy cattle		0.1277	0.0386			NE
2. Sheep		0.1175	0.0931			NE
3. Swine		1.0024	0.0610			NE
4. Other livestock		0.4452	0.1687			NE
Goats		0.0212	0.0301			NE
Horses		0.0475	0.0167			NE
Mules and asses		0.0029	0.0008			NE
Poultry		0.3456	0.0867			NE
Other (rabbits)		0.0281	0.0344			NE
5. Indirect N_2O emissions			0.2851			
C. Rice cultivation		**NO**				**NO**
D. Agricultural soils			**3.3818**			
a. Direct N_2O emissions from managed soils			2.6365			
1. Inorganic N fertilizers			1.0105			
2. Organic N fertilizers			0.2081			
a. Animal manure applied to soils			0.2081			
b. Sewage sludge applied to soils			NO, NE			
c. Other organic fertilizers applied to soils			NO, NE			
3. Urine and dung deposited by grazing animals			0.1389			
4. Crop residues			0.4829			
5. Mineralization/immobilization associated with loss/gain of soil organic matter			0.7961			
6. Cultivation of organic soils (i.e. histosols)			NO			
7. Other			NO			
b. Indirect N_2O Emissions from managed soils			0.7452			
1. Atmospheric deposition			0.1618			
2. Nitrogen leaching and run-off			0.5835			
E. Prescribed burning of savannas		**NO**	**NO**			
F. Field burning of agricultural residues		**IE**	**IE**			
G. Liming	**NO**					
H. Urea application	**43.3624**					
I. Other carbon-containing fertilizers	**NO, NE**					
J. Other	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**

2019

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2	CH_4	N_2O	NO_x	CO	NMVOC
	(kt)					
3. Total Agriculture	**39.6306**	**19.6977**	**4.2505**	**NO**	**NO**	**NE, NO**
I. Livestock		**19.6977**	**0.6536**			**NE**
A. Enteric fermentation		**17.6379**				
1. Cattle		11.7974				
Dairy cattle		9.2957				
Non-dairy cattle		2.5017				
2. Sheep		3.7490				
3. Swine		0.6427				
4. Other livestock		1.4488				
Goats		0.7643				
Horses		0.4758				
Mules and asses		0.0142				
Other (rabbits)		0.1945				
B. Manure management		**2.0599**	**0.6536**			**NE**
1. Cattle		0.5279	0.0986			NE
Dairy cattle		0.4150	0.0618			NE
Non-dairy cattle		0.1130	0.0369			NE
2. Sheep		0.1018	0.0807			NE
3. Swine		1.0063	0.0563			NE
4. Other livestock		0.4238	0.1586			NE
Goats		0.0199	0.0283			NE
Horses		0.0412	0.0150			NE
Mules and asses		0.0011	0.0003			NE
Poultry		0.3353	0.0830			NE
Other (rabbits)		0.0264	0.0321			NE
5. Indirect N_2O emissions			0.2593			
C. Rice cultivation		**NO**				**NO**
D. Agricultural soils			**3.5969**			
a. Direct N_2O emissions from managed soils			2.7997			
1. Inorganic N fertilizers			1.2134			
2. Organic N fertilizers			0.1882			
a. Animal manure applied to soils			0.1882			
b. Sewage sludge applied to soils			NO, NE			

c. Other organic fertilizers applied to soils			NO, NE			
3. Urine and dung deposited by grazing animals			0.1226			
4. Crop residues			0.4909			
5. Mineralization/immobilization associated with loss/gain of soil organic matter			0.7846			
6. Cultivation of organic soils (i.e. histosols)			NO			
7. Other			NO			
b. Indirect N_2O Emissions from managed soils			0.7971			
1. Atmospheric deposition			0.1758			
2. Nitrogen leaching and run-off			0.6213			
E. Prescribed burning of savannas		**NO**	**NO**			
F. Field burning of agricultural residues		**IE**	**IE**			
G. Liming	**NO**					
H. Urea application	**39.6306**					
I. Other carbon-containing fertilizers	**NO, NE**					
J. Other	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**

2020

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2	CH_4	N_2O	NO_x	CO	NMVOC
	(kt)					
3. Total Agriculture	**42.6156**	**17.3363**	**3.5920**	**NO**	**NO**	**NE, NO**
I. Livestock		**17.3363**	**0.5584**			**NE**
A. Enteric fermentation		**15.5616**				
1. Cattle		10.2272				
Dairy cattle		7.8902				
Non-dairy cattle		2.3370				
2. Sheep		3.4210				
3. Swine		0.5504				
4. Other livestock		1.3630				
Goats		0.7486				
Horses		0.4140				
Mules and asses		0.0120				
Other (rabbits)		0.1883				
B. Manure management		**1.7747**	**0.5584**			**NE**
1. Cattle		0.4586	0.0827			NE
Dairy cattle		0.3510	0.0522			NE
Non-dairy cattle		0.1076	0.0305			NE
2. Sheep		0.0911	0.0740			NE
3. Swine		0.8560	0.0412			NE
4. Other livestock		0.3690	0.1418			NE
Goats		0.0195	0.0278			NE
Horses		0.0359	0.0131			NE
Mules and asses		0.0009	0.0003			NE
Poultry		0.2872	0.0697			NE
Other (rabbits)		0.0255	0.0310			NE
5. Indirect N_2O emissions			0.2188			
C. Rice cultivation		**NO**				**NO**
D. Agricultural soils			**3.0335**			
a. Direct N_2O emissions from managed soils			2.3471			
1. Inorganic N fertilizers			1.1810			
2. Organic N fertilizers			0.1626			
a. Animal manure applied to soils			0.1626			
b. Sewage sludge applied to soils			NO, NE			
c. Other organic fertilizers applied to soils			NO, NE			
3. Urine and dung deposited by grazing animals			0.1060			
4. Crop residues			0.1194			
5. Mineralization/immobilization associated with loss/gain of soil organic matter			0.7781			
6. Cultivation of organic soils (i.e. histosols)			NO			
7. Other			NO			
b. Indirect N_2O Emissions from managed soils			0.6864			
1. Atmospheric deposition			0.1655			
2. Nitrogen leaching and run-off			0.5210			
E. Prescribed burning of savannas		**NO**	**NO**			
F. Field burning of agricultural residues		**IE**	**IE**			
G. Liming	**NO**					
H. Urea application	**42.6156**					
I. Other carbon-containing fertilizers	**NO, NE**					
J. Other	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**

Annex 6-4. Sectoral Reports for Sector 4 'LULUCF', 1990-2020

1990

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	Net CO_2 emissions / removals	CH_4	N_2O	NO_x	CO	NMVOC
	(kt)					
4. Total LULUCF	**-1,830.4863**	**0.1061**	**0.5717**	**0.0959**	**3.5227**	**NO, NE**
A. Forest land	**-2,563.4328**	**0.0083**	**0.0005**	**0.0053**	**0.1887**	**NO, NE**
1. Forest land remaining forest land	-1,579.0396	NE	NE	NE	NE	NE
2. Land converted to forest land	-984.3932	0.0083	0.0005	0.0053	0.1887	NO
B. Cropland	**2,379.0886**	**0.0978**	**0.0025**	**0.0906**	**3.3340**	**NO**
1. Cropland remaining cropland	2,333.3383	0.0978	0.0025	0.0906	3.3340	NO
2. Land converted to cropland	45.7503	NE	NE	NE	NE	NE
C. Grassland	**-1,205.6938**	**NE**	**NE**	**NE**	**NE**	**NE**
1. Grassland remaining grassland	NO	NE	NE	NE	NE	NE
2. Land converted to grassland	-1,205.6938	NE	NE	NE	NE	NE
D. Wetlands	**-555.3798**	**NE**	**NE**	**NE**	**NE**	**NE**
1. Wetlands remaining wetlands	NO	NE	NE	NE	NE	NE
2. Land converted to wetlands	-555.3798	NE	NE	NE	NE	NE
E. Settlements	**84.7480**	**NO, NE**	**0.5687**	**NO, NE**	**NO, NE**	**NO, NE**
1. Settlements remaining settlements	NO	NE	NE	NE	NE	NE
2. Land converted to settlements	84.7480	NO	0.5687	NO	NO	NO
F. Other land	**152.3638**	**NE**	**NE**	**NE**	**NE**	**NE**
1. Other land remaining other land						
2. Land converted to other land	152.3638	NE	NE	NE	NE	NE
G. Harvested wood products	**-122.1804**					
H. Other	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**

1991

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	Net CO_2 emissions / removals	CH_4	N_2O	NO_x	CO	NMVOC
	(kt)					
4. Total LULUCF	**-2,907.8407**	**0.0960**	**0.6171**	**0.0885**	**3.2552**	**NO, NE**
A. Forest land	**-2,343.3131**	**0.0014**	**0.0001**	**0.0009**	**0.0316**	**NO, NE**
1. Forest land remaining forest land	-1,352.6491	NE	NE	NE	NE	NE
2. Land converted to forest land	-990.6641	0.0014	0.0001	0.0009	0.0316	NO
B. Cropland	**1,248.7850**	**0.0946**	**0.0025**	**0.0876**	**3.2236**	**NO**
1. Cropland remaining cropland	1,221.3997	0.0946	0.0025	0.0876	3.2236	NO
2. Land converted to cropland	27.3853	NE	NE	NE	NE	NE
C. Grassland	**-1,414.3167**	**NE**	**NE**	**NE**	**NE**	**NE**
1. Grassland remaining grassland	NO	NE	NE	NE	NE	NE
2. Land converted to grassland	-1,414.3167	NE	NE	NE	NE	NE
D. Wetlands	**-526.4627**	**NE**	**NE**	**NE**	**NE**	**NE**
1. Wetlands remaining wetlands	NO	NE	NE	NE	NE	NE
2. Land converted to wetlands	-526.4627	NE	NE	NE	NE	NE
E. Settlements	**88.7139**	**NO, NE**	**0.6145**	**NO, NE**	**NO, NE**	**NO, NE**
1. Settlements remaining settlements	NO	NE	NE	NE	NE	NE
2. Land converted to settlements	88.7139	NO	0.6145	NO	NO	NO
F. Other land	**152.3638**	**NE**	**NE**	**NE**	**NE**	**NE**
1. Other land remaining other land						
2. Land converted to other land	152.3638	NE	NE	NE	NE	NE
G. Harvested wood products	**-113.6108**					
H. Other	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**

1992

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	Net CO_2 emissions / removals	CH_4	N_2O	NO_x	CO	NMVOC
	(kt)					
4. Total LULUCF	**-2,322.9822**	**0.0879**	**0.6868**	**0.0809**	**2.9777**	**NO, NE**
A. Forest land	**-2,184.2404**	**0.0015**	**0.0001**	**0.0010**	**0.0346**	**NO, NE**
1. Forest land remaining forest land	-1,290.4237	NE	NE	NE	NE	NE
2. Land converted to forest land	-893.8167	0.0015	0.0001	0.0010	0.0346	NO
B. Cropland	**1,174.1876**	**0.0864**	**0.0022**	**0.0800**	**2.9431**	**NO**
1. Cropland remaining cropland	1,301.6309	0.0864	0.0022	0.0800	2.9431	NO
2. Land converted to cropland	-127.4433	NE	NE	NE	NE	NE
C. Grassland	**-1,428.4835**	**NE**	**NE**	**NE**	**NE**	**NE**
1. Grassland remaining grassland	NO	NE	NE	NE	NE	NE
2. Land converted to grassland	-1,428.4835	NE	NE	NE	NE	NE
D. Wetlands	**-595.5455**	**NE**	**NE**	**NE**	**NE**	**NE**
1. Wetlands remaining wetlands	NO	NE	NE	NE	NE	NE
2. Land converted to wetlands	-595.5455	NE	NE	NE	NE	NE
E. Settlements	**386.6196**	**NO, NE**	**0.6844**	**NO, NE**	**NO, NE**	**NO, NE**
1. Settlements remaining settlements	NO	NE	NE	NE	NE	NE

2. Land converted to settlements	386.6196	NO	0.6844	NO	NO	NO
F. Other land	**418.7786**	**NE**	**NE**	**NE**	**NE**	**NE**
1. Other land remaining other land						
2. Land converted to other land	418.7786	NE	NE	NE	NE	NE
G. Harvested wood products	**-94.2986**					
H. Other	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**

1993

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	Net CO_2 emissions / removals	CH_4	N_2O	NO_x	CO	NMVOC
	(kt)					
4. Total LULUCF	**-2,364.6959**	**0.1179**	**0.7469**	**0.1091**	**4.0151**	**NO, NE**
A. Forest land	**-2,193.5115**	**0.0001**	**0.0000**	**0.0001**	**0.0024**	**NO, NE**
1. Forest land remaining forest land	-1,367.4361	NE	NE	NE	NE	NE
2. Land converted to forest land	-826.0754	0.0001	0.0000	0.0001	0.0024	NO
B. Cropland	**1,442.9960**	**0.1178**	**0.0031**	**0.1090**	**4.0127**	**NO**
1. Cropland remaining cropland	1,437.8052	0.1178	0.0031	0.1090	4.0127	NO
2. Land converted to cropland	5.1908	NE	NE	NE	NE	NE
C. Grassland	**-1,303.5202**	**NE**	**NE**	**NE**	**NE**	**NE**
1. Grassland remaining grassland	NO	NE	NE	NE	NE	NE
2. Land converted to grassland	-1,303.5202	NE	NE	NE	NE	NE
D. Wetlands	**-525.8447**	**NE**	**NE**	**NE**	**NE**	**NE**
1. Wetlands remaining wetlands	NO	NE	NE	NE	NE	NE
2. Land converted to wetlands	-525.8447	NE	NE	NE	NE	NE
E. Settlements	**114.6181**	**NO, NE**	**0.7438**	**NO, NE**	**NO, NE**	**NO, NE**
1. Settlements remaining settlements	NO	NE	NE	NE	NE	NE
2. Land converted to settlements	114.6181	NO	0.7438	NO	NO	NO
F. Other land	**164.0168**	**NE**	**NE**	**NE**	**NE**	**NE**
1. Other land remaining other land						
2. Land converted to other land	164.0168	NE	NE	NE	NE	NE
G. Harvested wood products	**-63.4504**					
H. Other	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**

1994

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	Net CO_2 emissions / removals	CH_4	N_2O	NO_x	CO	NMVOC
	(kt)					
4. Total LULUCF	**-2,311.2923**	**0.0662**	**0.7938**	**0.0606**	**2.2302**	**NO, NE**
A. Forest land	**-2,108.0022**	**0.0023**	**0.0001**	**0.0015**	**0.0526**	**NO, NE**
1. Forest land remaining forest land	-1,355.1762	NE	NE	NE	NE	NE
2. Land converted to forest land	-752.8259	0.0023	0.0001	0.0015	0.0526	NO
B. Cropland	**1,206.3850**	**0.0639**	**0.0017**	**0.0592**	**2.1776**	**NO**
1. Cropland remaining cropland	1,209.7880	0.0639	0.0017	0.0592	2.1776	NO
2. Land converted to cropland	-3.4030	NE	NE	NE	NE	NE
C. Grassland	**-1,577.3332**	**NE**	**NE**	**NE**	**NE**	**NE**
1. Grassland remaining grassland	NO	NE	NE	NE	NE	NE
2. Land converted to grassland	-1,577.3332	NE	NE	NE	NE	NE
D. Wetlands	**-497.6418**	**NE**	**NE**	**NE**	**NE**	**NE**
1. Wetlands remaining wetlands	NO	NE	NE	NE	NE	NE
2. Land converted to wetlands	-497.6418	NE	NE	NE	NE	NE
E. Settlements	**130.4883**	**NO, NE**	**0.7920**	**NO, NE**	**NO, NE**	**NO, NE**
1. Settlements remaining settlements	NO	NE	NE	NE	NE	NE
2. Land converted to settlements	130.4883	NO	0.7920	NO	NO	NO
F. Other land	**549.4579**	**NE**	**NE**	**NE**	**NE**	**NE**
1. Other land remaining other land						
2. Land converted to other land	549.4579	NE	NE	NE	NE	NE
G. Harvested wood products	**-14.6464**					
H. Other	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**

1995

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	Net CO_2 emissions / removals	CH_4	N_2O	NO_x	CO	NMVOC
	(kt)					
4. Total LULUCF	**-2,284.8659**	**0.0896**	**0.8440**	**0.0829**	**3.0510**	**NO, NE**
A. Forest land	**-2,045.0670**	**0.0001**	**0.0000**	**0.0001**	**0.0030**	**NO, NE**
1. Forest land remaining forest land	-1,350.1974	NE	NE	NE	NE	NE
2. Land converted to forest land	-694.8696	0.0001	0.0000	0.0001	0.0030	NO
B. Cropland	**1,316.7230**	**0.0895**	**0.0023**	**0.0828**	**3.0480**	**NO**
1. Cropland remaining cropland	1,383.0753	0.0895	0.0023	0.0828	3.0480	NO
2. Land converted to cropland	-66.3523	NE	NE	NE	NE	NE
C. Grassland	**-1,601.1004**	**NE**	**NE**	**NE**	**NE**	**NE**
1. Grassland remaining grassland	NO	NE	NE	NE	NE	NE

2. Land converted to grassland	-1,601.1004	NE	NE	NE	NE	NE
D. Wetlands	**-469.4389**	**NE**	**NE**	**NE**	**NE**	**NE**
1. Wetlands remaining wetlands	NO	NE	NE	NE	NE	NE
2. Land converted to wetlands	-469.4389	NE	NE	NE	NE	NE
E. Settlements	**106.9167**	**NO, NE**	**0.8417**	**NO, NE**	**NO, NE**	**NO, NE**
1. Settlements remaining settlements	NO	NE	NE	NE	NE	NE
2. Land converted to settlements	106.9167	NO	0.8417	NO	NO	NO
F. Other land	**401.1281**	**NE**	**NE**	**NE**	**NE**	**NE**
1. Other land remaining other land						
2. Land converted to other land	401.1281	NE	NE	NE	NE	NE
G. Harvested wood products	**5.9727**					
H. Other	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**

1996

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	Net CO_2 emissions / removals	CH_4	N_2O	NO_x	CO	NMVOC
	(kt)					
4. Total LULUCF	**-2,740.5286**	**0.0616**	**0.8801**	**0.0569**	**2.0916**	**NO, NE**
A. Forest land	**-2,190.4337**	**0.0008**	**0.0000**	**0.0005**	**0.0176**	**NO, NE**
1. Forest land remaining forest land	-1,559.0470	NE	NE	NE	NE	NE
2. Land converted to forest land	-631.3866	0.0008	0.0000	0.0005	0.0176	NO
B. Cropland	**1,118.5241**	**0.0609**	**0.0016**	**0.0564**	**2.0740**	**NO**
1. Cropland remaining cropland	1,219.6762	0.0609	0.0016	0.0564	2.0740	NO
2. Land converted to cropland	-101.1521	NE	NE	NE	NE	NE
C. Grassland	**-1,548.0826**	**NE**	**NE**	**NE**	**NE**	**NE**
1. Grassland remaining grassland	NO	NE	NE	NE	NE	NE
2. Land converted to grassland	-1,548.0826	NE	NE	NE	NE	NE
D. Wetlands	**-441.2360**	**NE**	**NE**	**NE**	**NE**	**NE**
1. Wetlands remaining wetlands	NO	NE	NE	NE	NE	NE
2. Land converted to wetlands	-441.2360	NE	NE	NE	NE	NE
E. Settlements	**101.5910**	**NO, NE**	**0.8784**	**NO, NE**	**NO, NE**	**NO, NE**
1. Settlements remaining settlements	NO	NE	NE	NE	NE	NE
2. Land converted to settlements	101.5910	NO	0.8784	NO	NO	NO
F. Other land	**217.3293**	**NE**	**NE**	**NE**	**NE**	**NE**
1. Other land remaining other land						
2. Land converted to other land	217.3293	NE	NE	NE	NE	NE
G. Harvested wood products	**1.7792**					
H. Other	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**

1997

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	Net CO_2 emissions / removals	CH_4	N_2O	NO_x	CO	NMVOC
	(kt)					
4. Total LULUCF	**-2,390.6002**	**0.1075**	**0.9134**	**0.0995**	**3.6610**	**NO, NE**
A. Forest land	**-2,232.2854**	**0.0002**	**0.0000**	**0.0001**	**0.0053**	**NO, NE**
1. Forest land remaining forest land	-1,639.4910	NE	NE	NE	NE	NE
2. Land converted to forest land	-592.7944	0.0002	0.0000	0.0001	0.0053	NO
B. Cropland	**1,385.7903**	**0.1073**	**0.0028**	**0.0993**	**3.6556**	**NO**
1. Cropland remaining cropland	1,531.8101	0.1073	0.0028	0.0993	3.6556	NO
2. Land converted to cropland	-146.0198	NE	NE	NE	NE	NE
C. Grassland	**-1,400.8607**	**NE**	**NE**	**NE**	**NE**	**NE**
1. Grassland remaining grassland	NO	NE	NE	NE	NE	NE
2. Land converted to grassland	-1,400.8607	NE	NE	NE	NE	NE
D. Wetlands	**-413.0332**	**NE**	**NE**	**NE**	**NE**	**NE**
1. Wetlands remaining wetlands	NO	NE	NE	NE	NE	NE
2. Land converted to wetlands	-413.0332	NE	NE	NE	NE	NE
E. Settlements	**100.7954**	**NO, NE**	**0.9106**	**NO, NE**	**NO, NE**	**NO, NE**
1. Settlements remaining settlements	NO	NE	NE	NE	NE	NE
2. Land converted to settlements	100.7954	NO	0.9106	NO	NO	NO
F. Other land	**188.2363**	**NE**	**NE**	**NE**	**NE**	**NE**
1. Other land remaining other land						
2. Land converted to other land	188.2363	NE	NE	NE	NE	NE
G. Harvested wood products	**-19.2429**					
H. Other	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**

1998

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	Net CO_2 emissions / removals	CH_4	N_2O	NO_x	CO	NMVOC
	(kt)					
4. Total LULUCF	**-2,422.6056**	**0.0989**	**0.9542**	**0.0909**	**3.3430**	**NO, NE**
A. Forest land	**-2,288.4857**	**0.0023**	**0.0001**	**0.0015**	**0.0529**	**NO, NE**
1. Forest land remaining forest land	-1,732.3177	NE	NE	NE	NE	NE

2. Land converted to forest land	-556.1680	0.0023	0.0001	0.0015	0.0529	NO
B. Cropland	**1,412.0577**	**0.0966**	**0.0025**	**0.0894**	**3.2900**	**NO**
1. Cropland remaining cropland	1,566.6826	0.0966	0.0025	0.0894	3.2900	NO
2. Land converted to cropland	-154.6249	NE	NE	NE	NE	NE
C. Grassland	**-1,436.2698**	**NE**	**NE**	**NE**	**NE**	**NE**
1. Grassland remaining grassland	NO	NE	NE	NE	NE	NE
2. Land converted to grassland	-1,436.2698	NE	NE	NE	NE	NE
D. Wetlands	**-384.8303**	**NE**	**NE**	**NE**	**NE**	**NE**
1. Wetlands remaining wetlands	NO	NE	NE	NE	NE	NE
2. Land converted to wetlands	-384.8303	NE	NE	NE	NE	NE
E. Settlements	**99.0440**	**NO, NE**	**0.9516**	**NO, NE**	**NO, NE**	**NO, NE**
1. Settlements remaining settlements	NO	NE	NE	NE	NE	NE
2. Land converted to settlements	99.0440	NO	0.9516	NO	NO	NO
F. Other land	**185.0077**	**NE**	**NE**	**NE**	**NE**	**NE**
1. Other land remaining other land						
2. Land converted to other land	185.0077	NE	NE	NE	NE	NE
G. Harvested wood products	**-9.1293**					
H. Other	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**

1999

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	Net CO_2 emissions / removals	CH_4	N_2O	NO_x	CO	NMVOC
	(kt)					
4. Total LULUCF	**-2,140.4389**	**0.0956**	**0.9861**	**0.0880**	**0.1265**	**NO, NE**
A. Forest land	**-2,336.8468**	**0.0017**	**0.0001**	**0.0011**	**0.0396**	**NO, NE**
1. Forest land remaining forest land	-1,840.9058	NE	NE	NE	NE	NE
2. Land converted to forest land	-495.9410	0.0017	0.0001	0.0011	0.0396	NO
B. Cropland	**1,430.7993**	**0.0938**	**0.0024**	**0.0869**	**0.0869**	**NO**
1. Cropland remaining cropland	1,543.2413	0.0938	0.0024	0.0869	0.0869	NO
2. Land converted to cropland	-112.4420	NE	NE	NE	NE	NE
C. Grassland	**-1,433.2865**	**NE**	**NE**	**NE**	**NE**	**NE**
1. Grassland remaining grassland	NO	NE	NE	NE	NE	NE
2. Land converted to grassland	-1,433.2865	NE	NE	NE	NE	NE
D. Wetlands	**-356.6274**	**NE**	**NE**	**NE**	**NE**	**NE**
1. Wetlands remaining wetlands	NO	NE	NE	NE	NE	NE
2. Land converted to wetlands	-356.6274	NE	NE	NE	NE	NE
E. Settlements	**111.8259**	**NO, NE**	**0.9836**	**NO, NE**	**NO, NE**	**NO, NE**
1. Settlements remaining settlements	NO	NE	NE	NE	NE	NE
2. Land converted to settlements	111.8259	NO	0.9836	NO	NO	NO
F. Other land	**425.1554**	**NE**	**NE**	**NE**	**NE**	**NE**
1. Other land remaining other land						
2. Land converted to other land	425.1554	NE	NE	NE	NE	NE
G. Harvested wood products	**18.5414**					
H. Other	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**

2000

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	Net CO_2 emissions / removals	CH_4	N_2O	NO_x	CO	NMVOC
	(kt)					
4. Total LULUCF	**-2,420.5755**	**0.0365**	**0.9944**	**0.0338**	**1.2427**	**NO, NE**
A. Forest land	**-2,307.4384**	**0.0001**	**0.0000**	**0.0000**	**0.0014**	**NO, NE**
1. Forest land remaining forest land	-1,881.4545	NE	NE	NE	NE	NE
2. Land converted to forest land	-425.9839	0.0001	0.0000	0.0000	0.0014	NO
B. Cropland	**1,222.7282**	**0.0364**	**0.0009**	**0.0337**	**1.2413**	**NO**
1. Cropland remaining cropland	1,349.3665	0.0364	0.0009	0.0337	1.2413	NO
2. Land converted to cropland	-126.6383	NE	NE	NE	NE	NE
C. Grassland	**-1,291.9495**	**NE**	**NE**	**NE**	**NE**	**NE**
1. Grassland remaining grassland	NO	NE	NE	NE	NE	NE
2. Land converted to grassland	-1,291.9495	NE	NE	NE	NE	NE
D. Wetlands	**-328.4245**	**NE**	**NE**	**NE**	**NE**	**NE**
1. Wetlands remaining wetlands	NO	NE	NE	NE	NE	NE
2. Land converted to wetlands	-328.4245	NE	NE	NE	NE	NE
E. Settlements	**100.1768**	**NO, NE**	**0.9934**	**NO, NE**	**NO, NE**	**NO, NE**
1. Settlements remaining settlements	NO	NE	NE	NE	NE	NE
2. Land converted to settlements	100.1768	NO	0.9934	NO	NO	NO
F. Other land	**178.5246**	**NE**	**NE**	**NE**	**NE**	**NE**
1. Other land remaining other land						
2. Land converted to other land	178.5246	NE	NE	NE	NE	NE
G. Harvested wood products	**5.8073**					
H. Other	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**

2001

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	Net CO_2 emissions / removals	CH_4	N_2O	NO_x	CO	NMVOC
	(kt)					
4. Total LULUCF	**-2,064.7883**	**0.0508**	**0.9951**	**0.0459**	**1.6868**	**NO, NE**
A. Forest land	**-2,273.7027**	**0.0039**	**0.0002**	**0.0025**	**0.0896**	**NO, NE**
1. Forest land remaining forest land	-1,873.5555	NE	NE	NE	NE	NE
2. Land converted to forest land	-400.1473	0.0039	0.0002	0.0025	0.0896	NO
B. Cropland	**1,560.4352**	**0.0469**	**0.0012**	**0.0434**	**1.5972**	**NO**
1. Cropland remaining cropland	1,731.6866	0.0469	0.0012	0.0434	1.5972	NO
2. Land converted to cropland	-171.2515	NE	NE	NE	NE	NE
C. Grassland	**-1,290.6541**	**NE**	**NE**	**NE**	**NE**	**NE**
1. Grassland remaining grassland	NO	NE	NE	NE	NE	NE
2. Land converted to grassland	-1,290.6541	NE	NE	NE	NE	NE
D. Wetlands	**-300.2217**	**NE**	**NE**	**NE**	**NE**	**NE**
1. Wetlands remaining wetlands	NO	NE	NE	NE	NE	NE
2. Land converted to wetlands	-300.2217	NE	NE	NE	NE	NE
E. Settlements	**67.0898**	**NO, NE**	**0.9937**	**NO, NE**	**NO, NE**	**NO, NE**
1. Settlements remaining settlements	NO	NE	NE	NE	NE	NE
2. Land converted to settlements	67.0898	NO	0.9937	NO	NO	NO
F. Other land	**178.5246**	**NE**	**NE**	**NE**	**NE**	**NE**
1. Other land remaining other land						
2. Land converted to other land	178.5246	NE	NE	NE	NE	NE
G. Harvested wood products	**-6.2594**					
H. Other	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**

2002

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	Net CO_2 emissions / removals	CH_4	N_2O	NO_x	CO	NMVOC
	(kt)					
4. Total LULUCF	**-2,151.5395**	**0.0106**	**0.9965**	**0.0092**	**0.3385**	**NO, NE**
A. Forest land	**-2,267.6159**	**0.0021**	**0.0001**	**0.0013**	**0.0481**	**NO, NE**
1. Forest land remaining forest land	-1,913.5787	NE	NE	NE	NE	NE
2. Land converted to forest land	-354.0371	0.0021	0.0001	0.0013	0.0481	NO
B. Cropland	**1,156.5876**	**0.0085**	**0.0002**	**0.0079**	**0.2904**	**NO**
1. Cropland remaining cropland	1,300.6929	0.0085	0.0002	0.0079	0.2904	NO
2. Land converted to cropland	-144.1054	NE	NE	NE	NE	NE
C. Grassland	**-1,235.1380**	**NE**	**NE**	**NE**	**NE**	**NE**
1. Grassland remaining grassland	NO	NE	NE	NE	NE	NE
2. Land converted to grassland	-1,235.1380	NE	NE	NE	NE	NE
D. Wetlands	**-272.0188**	**NE**	**NE**	**NE**	**NE**	**NE**
1. Wetlands remaining wetlands	NO	NE	NE	NE	NE	NE
2. Land converted to wetlands	-272.0188	NE	NE	NE	NE	NE
E. Settlements	**67.0898**	**NO, NE**	**0.9961**	**NO, NE**	**NO, NE**	**NO, NE**
1. Settlements remaining settlements	NO	NE	NE	NE	NE	NE
2. Land converted to settlements	67.0898	NO	0.9961	NO	NO	NO
F. Other land	**456.2431**	**NE**	**NE**	**NE**	**NE**	**NE**
1. Other land remaining other land						
2. Land converted to other land	456.2431	NE	NE	NE	NE	NE
G. Harvested wood products	**-56.6873**					
H. Other	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**

2003

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	Net CO_2 emissions / removals	CH_4	N_2O	NO_x	CO	NMVOC
	(kt)					
4. Total LULUCF	**-2,079.1549**	**0.0024**	**0.9877**	**0.0016**	**0.0573**	**NO, NE**
A. Forest land	**-2,270.1176**	**0.0023**	**0.0001**	**0.0015**	**0.0526**	**NO, NE**
1. Forest land remaining forest land	-1,863.8705	NE	NE	NE	NE	NE
2. Land converted to forest land	-406.2471	0.0023	0.0001	0.0015	0.0526	NO
B. Cropland	**1,237.5523**	**0.0001**	**0.0000**	**0.0001**	**0.0046**	**NO**
1. Cropland remaining cropland	1,376.9534	0.0001	0.0000	0.0001	0.0046	NO
2. Land converted to cropland	-139.4011	NE	NE	NE	NE	NE
C. Grassland	**-1,007.1842**	**NE**	**NE**	**NE**	**NE**	**NE**
1. Grassland remaining grassland	NO	NE	NE	NE	NE	NE
2. Land converted to grassland	-1,007.1842	NE	NE	NE	NE	NE
D. Wetlands	**-243.8159**	**NE**	**NE**	**NE**	**NE**	**NE**
1. Wetlands remaining wetlands	NO	NE	NE	NE	NE	NE
2. Land converted to wetlands	-243.8159	NE	NE	NE	NE	NE
E. Settlements	**67.8615**	**NO, NE**	**0.9876**	**NO, NE**	**NO, NE**	**NO, NE**
1. Settlements remaining settlements	NO	NE	NE	NE	NE	NE
2. Land converted to settlements	67.8615	NO	0.9876	NO	NO	NO
F. Other land	**201.6619**	**NE**	**NE**	**NE**	**NE**	**NE**
1. Other land remaining other land						
2. Land converted to other land	201.6619	NE	NE	NE	NE	NE
G. Harvested wood products	**-65.1129**					
H. Other	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**

2004

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	Net CO_2 emissions / removals	CH_4	N_2O	NO_x	CO	NMVOC
	(kt)					
4. Total LULUCF	**-2,248.2613**	**0.0080**	**0.9736**	**0.0057**	**0.1401**	**NO, NE**
A. Forest land	**-2,334.7768**	**0.0061**	**0.0003**	**0.0039**	**0.1383**	**NO, NE**
1. Forest land remaining forest land	-1,904.3372	NE	NE	NE	NE	NE
2. Land converted to forest land	-430.4396	0.0061	0.0003	0.0039	0.1383	NO
B. Cropland	**1,198.5883**	**0.0020**	**0.0001**	**0.0018**	**0.0018**	**NO**
1. Cropland remaining cropland	1,321.9902	0.0020	0.0001	0.0018	0.0018	NO
2. Land converted to cropland	-123.4019	NE	NE	NE	NE	NE
C. Grassland	**-1,120.4767**	**NE**	**NE**	**NE**	**NE**	**NE**
1. Grassland remaining grassland	NO	NE	NE	NE	NE	NE
2. Land converted to grassland	-1,120.4767	NE	NE	NE	NE	NE
D. Wetlands	**-215.6130**	**NE**	**NE**	**NE**	**NE**	**NE**
1. Wetlands remaining wetlands	NO	NE	NE	NE	NE	NE
2. Land converted to wetlands	-215.6130	NE	NE	NE	NE	NE
E. Settlements	**53.6737**	**NO, NE**	**0.9732**	**NO, NE**	**NO, NE**	**NO, NE**
1. Settlements remaining settlements	NO	NE	NE	NE	NE	NE
2. Land converted to settlements	53.6737	NO	0.9732	NO	NO	NO
F. Other land	**223.8177**	**NE**	**NE**	**NE**	**NE**	**NE**
1. Other land remaining other land						
2. Land converted to other land	223.8177	NE	NE	NE	NE	NE
G. Harvested wood products	**-53.4745**					
H. Other	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**

2005

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	Net CO_2 emissions / removals	CH_4	N_2O	NO_x	CO	NMVOC
	(kt)					
4. Total LULUCF	**-1,954.3081**	**0.0099**	**0.9615**	**0.0090**	**0.3317**	**NO, NE**
A. Forest land	**-2,409.5185**	**0.0006**	**0.0000**	**0.0004**	**0.0132**	**NO, NE**
1. Forest land remaining forest land	-1,965.9956	NE	NE	NE	NE	NE
2. Land converted to forest land	-443.5229	0.0006	0.0000	0.0004	0.0132	NO
B. Cropland	**1,271.6794**	**0.0093**	**0.0002**	**0.0087**	**0.3185**	**NO**
1. Cropland remaining cropland	1,359.3685	0.0093	0.0002	0.0087	0.3185	NO
2. Land converted to cropland	-87.6890	NE	NE	NE	NE	NE
C. Grassland	**-1,058.1239**	**NE**	**NE**	**NE**	**NE**	**NE**
1. Grassland remaining grassland	NO	NE	NE	NE	NE	NE
2. Land converted to grassland	-1,058.1239	NE	NE	NE	NE	NE
D. Wetlands	**-187.4101**	**NE**	**NE**	**NE**	**NE**	**NE**
1. Wetlands remaining wetlands	NO	NE	NE	NE	NE	NE
2. Land converted to wetlands	-187.4101	NE	NE	NE	NE	NE
E. Settlements	**53.6737**	**NO, NE**	**0.9613**	**NO, NE**	**NO, NE**	**NO, NE**
1. Settlements remaining settlements	NO	NE	NE	NE	NE	NE
2. Land converted to settlements	53.6737	NO	0.9613	NO	NO	NO
F. Other land	**416.5012**	**NE**	**NE**	**NE**	**NE**	**NE**
1. Other land remaining other land						
2. Land converted to other land	416.5012	NE	NE	NE	NE	NE
G. Harvested wood products	**-41.1098**					
H. Other	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**

2006

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	Net CO_2 emissions / removals	CH_4	N_2O	NO_x	CO	NMVOC
	(kt)					
4. Total LULUCF	**-2,076.2371**	**0.0100**	**0.9483**	**0.0075**	**0.2706**	**NO, NE**
A. Forest land	**-2,366.5168**	**0.0063**	**0.0003**	**0.0040**	**0.1427**	**NO, NE**
1. Forest land remaining forest land	-1,882.9327	NE	NE	NE	NE	NE
2. Land converted to forest land	-483.5841	0.0063	0.0003	0.0040	0.1427	NO
B. Cropland	**1,303.2724**	**0.0038**	**0.0001**	**0.0035**	**0.1279**	**NO**
1. Cropland remaining cropland	1,391.9588	0.0038	0.0001	0.0035	0.1279	NO
2. Land converted to cropland	-88.6864	NE	NE	NE	NE	NE
C. Grassland	**-1,056.3692**	**NE**	**NE**	**NE**	**NE**	**NE**
1. Grassland remaining grassland	NO	NE	NE	NE	NE	NE
2. Land converted to grassland	-1,056.3692	NE	NE	NE	NE	NE
D. Wetlands	**-159.2073**	**NE**	**NE**	**NE**	**NE**	**NE**
1. Wetlands remaining wetlands	NO	NE	NE	NE	NE	NE
2. Land converted to wetlands	-159.2073	NE	NE	NE	NE	NE
E. Settlements	**53.6737**	**NO, NE**	**0.9479**	**NO, NE**	**NO, NE**	**NO, NE**
1. Settlements remaining settlements	NO	NE	NE	NE	NE	NE
2. Land converted to settlements	53.6737	NO	0.9479	NO	NO	NO
F. Other land	**189.4964**	**NE**	**NE**	**NE**	**NE**	**NE**
1. Other land remaining other land						
2. Land converted to other land	189.4964	NE	NE	NE	NE	NE
G. Harvested wood products	**-40.5864**					
H. Other	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**

2007

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	Net CO_2 emissions / removals	CH_4	N_2O	NO_x	CO	NMVOC
	(kt)					
4. Total LULUCF	**-2,268.7122**	**0.0607**	**0.9330**	**0.0405**	**1.4511**	**NO, NE**
A. Forest land	**-2,460.3855**	**0.0546**	**0.0030**	**0.0349**	**1.2432**	**NO, NE**
1. Forest land remaining forest land	-1,985.9585	NE	NE	NE	NE	NE
2. Land converted to forest land	-474.4270	0.0546	0.0030	0.0349	1.2432	NO
B. Cropland	**1,266.1250**	**0.0061**	**0.0002**	**0.0056**	**0.2079**	**NO**
1. Cropland remaining cropland	1,346.9010	0.0061	0.0002	0.0056	0.2079	NO
2. Land converted to cropland	-80.7760	NE	NE	NE	NE	NE
C. Grassland	**-1,031.2350**	**NE**	**NE**	**NE**	**NE**	**NE**
1. Grassland remaining grassland	NO	NE	NE	NE	NE	NE
2. Land converted to grassland	-1,031.2350	NE	NE	NE	NE	NE
D. Wetlands	**-131.0044**	**NE**	**NE**	**NE**	**NE**	**NE**
1. Wetlands remaining wetlands	NO	NE	NE	NE	NE	NE
2. Land converted to wetlands	-131.0044	NE	NE	NE	NE	NE
E. Settlements	**49.2742**	**NO, NE**	**0.9298**	**NO, NE**	**NO, NE**	**NO, NE**
1. Settlements remaining settlements	NO	NE	NE	NE	NE	NE
2. Land converted to settlements	49.2742	NO	0.9298	NO	NO	NO
F. Other land	**83.1072**	**NE**	**NE**	**NE**	**NE**	**NE**
1. Other land remaining other land						
2. Land converted to other land	83.1072	NE	NE	NE	NE	NE
G. Harvested wood products	**-44.5936**					
H. Other	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**

2008

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	Net CO_2 emissions / removals	CH_4	N_2O	NO_x	CO	NMVOC
	(kt)					
4. Total LULUCF	**-1,956.3934**	**0.0308**	**0.9128**	**0.0274**	**1.0067**	**NO, NE**
A. Forest land	**-2,462.7874**	**0.0038**	**0.0002**	**0.0024**	**0.0864**	**NO, NE**
1. Forest land remaining forest land	-1,985.3822	NE	NE	NE	NE	NE
2. Land converted to forest land	-477.4052	0.0038	0.0002	0.0024	0.0864	NO
B. Cropland	**1,236.6745**	**0.0270**	**0.0007**	**0.0250**	**0.9203**	**NO**
1. Cropland remaining cropland	1,329.1873	0.0270	0.0007	0.0250	0.9203	NO
2. Land converted to cropland	-92.5128	NE	NE	NE	NE	NE
C. Grassland	**-932.1498**	**NE**	**NE**	**NE**	**NE**	**NE**
1. Grassland remaining grassland	NO	NE	NE	NE	NE	NE
2. Land converted to grassland	-932.1498	NE	NE	NE	NE	NE
D. Wetlands	**-102.8015**	**NE**	**NE**	**NE**	**NE**	**NE**
1. Wetlands remaining wetlands	NO	NE	NE	NE	NE	NE
2. Land converted to wetlands	-102.8015	NE	NE	NE	NE	NE
E. Settlements	**49.2742**	**NO, NE**	**0.9119**	**NO, NE**	**NO, NE**	**NO, NE**
1. Settlements remaining settlements	NO	NE	NE	NE	NE	NE
2. Land converted to settlements	49.2742	NO	0.9119	NO	NO	NO
F. Other land	**291.0044**	**NE**	**NE**	**NE**	**NE**	**NE**
1. Other land remaining other land						
2. Land converted to other land	291.0044	NE	NE	NE	NE	NE
G. Harvested wood products	**-35.6078**					
H. Other	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**

2009

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	Net CO_2 emissions / removals	CH_4	N_2O	NO_x	CO	NMVOC
	(kt)					
4. Total LULUCF	**-1,560.6386**	**0.0126**	**0.8904**	**0.0090**	**0.3239**	**NO, NE**
A. Forest land	**-2,526.0659**	**0.0093**	**0.0005**	**0.0059**	**0.2108**	**NO, NE**
1. Forest land remaining forest land	-2,008.9453	NE	NE	NE	NE	NE
2. Land converted to forest land	-517.1206	0.0093	0.0005	0.0059	0.2108	NO
B. Cropland	**1,390.6850**	**0.0033**	**0.0001**	**0.0031**	**0.1130**	**NO**
1. Cropland remaining cropland	1,469.7549	0.0033	0.0001	0.0031	0.1130	NO
2. Land converted to cropland	-79.0698	NE	NE	NE	NE	NE
C. Grassland	**-447.6932**	**NE**	**NE**	**NE**	**NE**	**NE**
1. Grassland remaining grassland	NO	NE	NE	NE	NE	NE
2. Land converted to grassland	-447.6932	NE	NE	NE	NE	NE
D. Wetlands	**-74.5986**	**NE**	**NE**	**NE**	**NE**	**NE**
1. Wetlands remaining wetlands	NO	NE	NE	NE	NE	NE
2. Land converted to wetlands	-74.5986	NE	NE	NE	NE	NE
E. Settlements	**45.5694**	**NO, NE**	**0.8898**	**NO, NE**	**NO, NE**	**NO, NE**
1. Settlements remaining settlements	NO	NE	NE	NE	NE	NE
2. Land converted to settlements	45.5694	NO	0.8898	NO	NO	NO
F. Other land	**79.9357**	**NE**	**NE**	**NE**	**NE**	**NE**
1. Other land remaining other land						
2. Land converted to other land	79.9357	NE	NE	NE	NE	NE
G. Harvested wood products	**-28.4708**					
H. Other	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**

2010

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	Net CO_2 emissions / removals	CH_4	N_2O	NO_x	CO	NMVOC
	(kt)					
4. Total LULUCF	**-1,486.5202**	**0.0056**	**0.8665**	**0.0042**	**0.1529**	**NO, NE**
A. Forest land	**-2,484.1627**	**0.0032**	**0.0002**	**0.0021**	**0.0737**	**NO, NE**
1. Forest land remaining forest land	-1,964.0859	NE	NE	NE	NE	NE
2. Land converted to forest land	-520.0768	0.0032	0.0002	0.0021	0.0737	NO
B. Cropland	**1,271.7754**	**0.0023**	**0.0001**	**0.0022**	**0.0792**	**NO**
1. Cropland remaining cropland	1,344.7488	0.0023	0.0001	0.0022	0.0792	NO
2. Land converted to cropland	-72.9734	NE	NE	NE	NE	NE
C. Grassland	**-691.9874**	**NE**	**NE**	**NE**	**NE**	**NE**
1. Grassland remaining grassland	NO	NE	NE	NE	NE	NE
2. Land converted to grassland	-691.9874	NE	NE	NE	NE	NE
D. Wetlands	**-46.3958**	**NE**	**NE**	**NE**	**NE**	**NE**
1. Wetlands remaining wetlands	NO	NE	NE	NE	NE	NE
2. Land converted to wetlands	-46.3958	NE	NE	NE	NE	NE
E. Settlements	**45.5694**	**NO, NE**	**0.8663**	**NO, NE**	**NO, NE**	**NO, NE**
1. Settlements remaining settlements	NO	NE	NE	NE	NE	NE
2. Land converted to settlements	45.5694	NO	0.8663	NO	NO	NO
F. Other land	**441.4824**	**NE**	**NE**	**NE**	**NE**	**NE**
1. Other land remaining other land						
2. Land converted to other land	441.4824	NE	NE	NE	NE	NE
G. Harvested wood products	**-22.8014**					
H. Other	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**

2011

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	Net CO_2 emissions / removals	CH_4	N_2O	NO_x	CO	NMVOC
	(kt)					
4. Total LULUCF	**-1,421.9811**	**0.0064**	**0.8455**	**0.0047**	**0.1694**	**NO, NE**
A. Forest land	**-2,390.5712**	**0.0043**	**0.0002**	**0.0028**	**0.0987**	**NO, NE**
1. Forest land remaining forest land	-1,871.4295	NE	NE	NE	NE	NE
2. Land converted to forest land	-519.1417	0.0043	0.0002	0.0028	0.0987	NO
B. Cropland	**1,230.6841**	**0.0021**	**0.0001**	**0.0019**	**0.0707**	**NO**
1. Cropland remaining cropland	1,336.6859	0.0021	0.0001	0.0019	0.0707	NO
2. Land converted to cropland	-106.0017	NE	NE	NE	NE	NE
C. Grassland	**-638.1726**	**NE**	**NE**	**NE**	**NE**	**NE**
1. Grassland remaining grassland	NO	NE	NE	NE	NE	NE
2. Land converted to grassland	-638.1726	NE	NE	NE	NE	NE
D. Wetlands	**-75.3129**	**NE**	**NE**	**NE**	**NE**	**NE**
1. Wetlands remaining wetlands	NO	NE	NE	NE	NE	NE
2. Land converted to wetlands	-75.3129	NE	NE	NE	NE	NE
E. Settlements	**62.0438**	**NO, NE**	**0.8452**	**NO, NE**	**NO, NE**	**NO, NE**
1. Settlements remaining settlements	NO	NE	NE	NE	NE	NE
2. Land converted to settlements	62.0438	NO	0.8452	NO	NO	NO
F. Other land	**393.7285**	**NE**	**NE**	**NE**	**NE**	**NE**
1. Other land remaining other land						
2. Land converted to other land	393.7285	NE	NE	NE	NE	NE
G. Harvested wood products	**-4.3808**					
H. Other	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**

2012

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	Net CO_2 emissions / removals	CH_4	N_2O	NO_x	CO	NMVOC
	(kt)					
4. Total LULUCF	**-1,433.6639**	**0.0467**	**0.7833**	**0.0299**	**1.0665**	**NO, NE**
A. Forest land	**-2,294.8221**	**0.0464**	**0.0026**	**0.0296**	**1.0564**	**NO, NE**
1. Forest land remaining forest land	-1,702.2662	NE	NE	NE	NE	NE
2. Land converted to forest land	-592.5559	0.0464	0.0026	0.0296	1.0564	NO
B. Cropland	**1,236.5016**	**0.0003**	**0.0000**	**0.0003**	**0.0101**	**NO**
1. Cropland remaining cropland	1,321.3161	0.0003	0.0000	0.0003	0.0101	NO
2. Land converted to cropland	-84.8145	NE	NE	NE	NE	NE
C. Grassland	**-562.7510**	**NE**	**NE**	**NE**	**NE**	**NE**
1. Grassland remaining grassland	NO	NE	NE	NE	NE	NE
2. Land converted to grassland	-562.7510	NE	NE	NE	NE	NE
D. Wetlands	**-15.4700**	**NE**	**NE**	**NE**	**NE**	**NE**
1. Wetlands remaining wetlands	NO	NE	NE	NE	NE	NE
2. Land converted to wetlands	-15.4700	NE	NE	NE	NE	NE
E. Settlements	**11.8882**	**NO, NE**	**0.7807**	**NO, NE**	**NO, NE**	**NO, NE**
1. Settlements remaining settlements	NO	NE	NE	NE	NE	NE
2. Land converted to settlements	11.8882	NO	0.7807	NO	NO	NO
F. Other land	**114.1449**	**NE**	**NE**	**NE**	**NE**	**NE**
1. Other land remaining other land						
2. Land converted to other land	114.1449	NE	NE	NE	NE	NE
G. Harvested wood products	**76.8444**					
H. Other	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**

2013

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	Net CO_2 emissions / removals	CH_4	N_2O	NO_x	CO	NMVOC
	(kt)					
4. Total LULUCF	**-1,289.1465**	**0.0349**	**0.7290**	**0.0230**	**0.8236**	**NO, NE**
A. Forest land	**-2,141.8702**	**0.0322**	**0.0018**	**0.0206**	**0.7339**	**NO, NE**
1. Forest land remaining forest land	-1,531.8805	NE	NE	NE	NE	NE
2. Land converted to forest land	-609.9898	0.0322	0.0018	0.0206	0.7339	NO
B. Cropland	**1,139.9149**	**0.0026**	**0.0001**	**0.0024**	**0.0898**	**NO**
1. Cropland remaining cropland	1,416.0186	0.0026	0.0001	0.0024	0.0898	NO
2. Land converted to cropland	-276.1037	NE	NE	NE	NE	NE
C. Grassland	**-360.1740**	**NE**	**NE**	**NE**	**NE**	**NE**
1. Grassland remaining grassland	NO	NE	NE	NE	NE	NE
2. Land converted to grassland	-360.1740	NE	NE	NE	NE	NE
D. Wetlands	**-106.0998**	**NE**	**NE**	**NE**	**NE**	**NE**
1. Wetlands remaining wetlands	NO	NE	NE	NE	NE	NE
2. Land converted to wetlands	-106.0998	NE	NE	NE	NE	NE
E. Settlements	**13.7512**	**NO, NE**	**0.7272**	**NO, NE**	**NO, NE**	**NO, NE**
1. Settlements remaining settlements	NO	NE	NE	NE	NE	NE
2. Land converted to settlements	13.7512	NO	0.7272	NO	NO	NO
F. Other land	**103.4500**	**NE**	**NE**	**NE**	**NE**	**NE**
1. Other land remaining other land						
2. Land converted to other land	103.4500	NE	NE	NE	NE	NE
G. Harvested wood products	**61.8814**					
H. Other	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**

2014

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	Net CO_2 emissions / removals	CH_4	N_2O	NO_x	CO	NMVOC
	(kt)					
4. Total LULUCF	**-927.3346**	**0.0047**	**0.6794**	**0.0036**	**0.1293**	**NO, NE**
A. Forest land	**-2,134.7390**	**0.0027**	**0.0001**	**0.0017**	**0.0603**	**NO, NE**
1. Forest land remaining forest land	-1,484.6747	NE	NE	NE	NE	NE
2. Land converted to forest land	-650.0643	0.0027	0.0001	0.0017	0.0603	NO
B. Cropland	**1,174.6145**	**0.0020**	**0.0001**	**0.0019**	**0.0690**	**NO**
1. Cropland remaining cropland	1,420.2997	0.0020	0.0001	0.0019	0.0690	NO
2. Land converted to cropland	-245.6852	NE	NE	NE	NE	NE
C. Grassland	**-341.1085**	**NE**	**NE**	**NE**	**NE**	**NE**
1. Grassland remaining grassland	NO	NE	NE	NE	NE	NE
2. Land converted to grassland	-341.1085	NE	NE	NE	NE	NE
D. Wetlands	**-139.7535**	**NE**	**NE**	**NE**	**NE**	**NE**
1. Wetlands remaining wetlands	NO	NE	NE	NE	NE	NE
2. Land converted to wetlands	-139.7535	NE	NE	NE	NE	NE
E. Settlements	**18.9848**	**NO, NE**	**0.6792**	**NO, NE**	**NO, NE**	**NO, NE**
1. Settlements remaining settlements	NO	NE	NE	NE	NE	NE
2. Land converted to settlements	18.9848	NO	0.6792	NO	NO	NO
F. Other land	**436.6463**	**NE**	**NE**	**NE**	**NE**	**NE**
1. Other land remaining other land						
2. Land converted to other land	436.6463	NE	NE	NE	NE	NE
G. Harvested wood products	**58.0208**					
H. Other	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**

2015

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	Net CO_2 emissions / removals	CH_4	N_2O	NO_x	CO	NMVOC
	(kt)					
4. Total LULUCF	**-1,372.8484**	**0.0261**	**0.6385**	**0.0171**	**0.6122**	**NO, NE**
A. Forest land	**-2,159.4439**	**0.0246**	**0.0014**	**0.0157**	**0.5596**	**NO, NE**
1. Forest land remaining forest land	-1,496.3946	NE	NE	NE	NE	NE
2. Land converted to forest land	-663.0493	0.0246	0.0014	0.0157	0.5596	NO
B. Cropland	**1,112.6279**	**0.0015**	**0.0000**	**0.0014**	**0.0526**	**NO**
1. Cropland remaining cropland	1,421.9583	0.0015	0.0000	0.0014	0.0526	NO
2. Land converted to cropland	-309.3304	NE	NE	NE	NE	NE
C. Grassland	**-418.4569**	**NE**	**NE**	**NE**	**NE**	**NE**
1. Grassland remaining grassland	NO	NE	NE	NE	NE	NE
2. Land converted to grassland	-418.4569	NE	NE	NE	NE	NE
D. Wetlands	**-82.7917**	**NE**	**NE**	**NE**	**NE**	**NE**
1. Wetlands remaining wetlands	NO	NE	NE	NE	NE	NE
2. Land converted to wetlands	-82.7917	NE	NE	NE	NE	NE
E. Settlements	**39.1617**	**NO, NE**	**0.6371**	**NO, NE**	**NO, NE**	**NO, NE**
1. Settlements remaining settlements	NO	NE	NE	NE	NE	NE
2. Land converted to settlements	39.1617	NO	0.6371	NO	NO	NO
F. Other land	**86.8192**	**NE**	**NE**	**NE**	**NE**	**NE**
1. Other land remaining other land						
2. Land converted to other land	86.8192	NE	NE	NE	NE	NE
G. Harvested wood products	**49.2353**					
H. Other	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**

2016

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	Net CO_2 emissions / removals	CH_4	N_2O	NO_x	CO	NMVOC
	(kt)					
4. Total LULUCF	**-1,117.1054**	**0.0143**	**0.6016**	**0.0097**	**0.3467**	**NO, NE**
A. Forest land	**-2,115.7622**	**0.0123**	**0.0007**	**0.0079**	**0.2809**	**NO, NE**
1. Forest land remaining forest land	-1,433.2460	NE	NE	NE	NE	NE
2. Land converted to forest land	-682.5162	0.0123	0.0007	0.0079	0.2809	NO
B. Cropland	**1,111.9941**	**0.0019**	**0.0001**	**0.0018**	**0.0658**	**NO**
1. Cropland remaining cropland	1,495.4822	0.0019	0.0001	0.0018	0.0658	NO
2. Land converted to cropland	-383.4881	NE	NE	NE	NE	NE
C. Grassland	**-402.3693**	**NE**	**NE**	**NE**	**NE**	**NE**
1. Grassland remaining grassland	NO	NE	NE	NE	NE	NE
2. Land converted to grassland	-402.3693	NE	NE	NE	NE	NE
D. Wetlands	**-82.7917**	**NE**	**NE**	**NE**	**NE**	**NE**
1. Wetlands remaining wetlands	NO	NE	NE	NE	NE	NE
2. Land converted to wetlands	-82.7917	NE	NE	NE	NE	NE
E. Settlements	**19.3071**	**NO, NE**	**0.6008**	**NO, NE**	**NO, NE**	**NO, NE**
1. Settlements remaining settlements	NO	NE	NE	NE	NE	NE
2. Land converted to settlements	19.3071	NO	0.6008	NO	NO	NO
F. Other land	**351.6349**	**NE**	**NE**	**NE**	**NE**	**NE**
1. Other land remaining other land						
2. Land converted to other land	351.6349	NE	NE	NE	NE	NE
G. Harvested wood products	**0.8816**					
H. Other	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**

2017

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	Net CO_2 emissions / removals	CH_4	N_2O	NO_x	CO	NMVOC
	(kt)					
4. Total LULUCF	**-1,165.6648**	**0.0199**	**0.5767**	**0.0136**	**0.4867**	**NO, NE**
A. Forest land	**-2,016.4373**	**0.0170**	**0.0009**	**0.0109**	**0.3878**	**NO, NE**
1. Forest land remaining forest land	-1,324.5630	NE	NE	NE	NE	NE
2. Land converted to forest land	-691.8743	0.0170	0.0009	0.0109	0.3878	NO
B. Cropland	**1,089.5602**	**0.0029**	**0.0001**	**0.0027**	**0.0990**	**NO**
1. Cropland remaining cropland	1,502.1864	0.0029	0.0001	0.0027	0.0990	NO
2. Land converted to cropland	-412.6261	NE	NE	NE	NE	NE
C. Grassland	**-384.0392**	**NE**	**NE**	**NE**	**NE**	**NE**
1. Grassland remaining grassland	NO	NE	NE	NE	NE	NE
2. Land converted to grassland	-384.0392	NE	NE	NE	NE	NE
D. Wetlands	**-82.8162**	**NE**	**NE**	**NE**	**NE**	**NE**
1. Wetlands remaining wetlands	NO	NE	NE	NE	NE	NE
2. Land converted to wetlands	-82.8162	NE	NE	NE	NE	NE
E. Settlements	**77.3098**	**NO, NE**	**0.5757**	**NO, NE**	**NO, NE**	**NO, NE**
1. Settlements remaining settlements	NO	NE	NE	NE	NE	NE
2. Land converted to settlements	77.3098	NO	0.5757	NO	NO	NO
F. Other land	**218.2055**	**NE**	**NE**	**NE**	**NE**	**NE**
1. Other land remaining other land						
2. Land converted to other land	218.2055	NE	NE	NE	NE	NE
G. Harvested wood products	**-67.4476**					
H. Other	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**

2018

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	Net CO_2 emissions / removals	CH_4	N_2O	NO_x	CO	NMVOC
	(kt)					
4. Total LULUCF	**-1,006.6081**	**0.0068**	**0.5550**	**0.0046**	**0.1654**	**NO, NE**
A. Forest land	**-1,969.3582**	**0.0059**	**0.0003**	**0.0037**	**0.1334**	**NO, NE**
1. Forest land remaining forest land	-1,281.3639	NE	NE	NE	NE	NE
2. Land converted to forest land	-687.9943	0.0059	0.0003	0.0037	0.1334	NO
B. Cropland	**1,206.3949**	**0.0009**	**0.0000**	**0.0009**	**0.0321**	**NO**
1. Cropland remaining cropland	1,505.4051	0.0009	0.0000	0.0009	0.0321	NO
2. Land converted to cropland	-299.0102	NE	NE	NE	NE	NE
C. Grassland	**-440.1513**	**NE**	**NE**	**NE**	**NE**	**NE**
1. Grassland remaining grassland	NO	NE	NE	NE	NE	NE
2. Land converted to grassland	-440.1513	NE	NE	NE	NE	NE
D. Wetlands	**-82.8253**	**NE**	**NE**	**NE**	**NE**	**NE**
1. Wetlands remaining wetlands	NO	NE	NE	NE	NE	NE
2. Land converted to wetlands	-82.8253	NE	NE	NE	NE	NE
E. Settlements	**21.6217**	**NO, NE**	**0.5546**	**NO, NE**	**NO, NE**	**NO, NE**
1. Settlements remaining settlements	NO	NE	NE	NE	NE	NE
2. Land converted to settlements	21.6217	NO	0.5546	NO	NO	NO
F. Other land	**321.2138**	**NE**	**NE**	**NE**	**NE**	**NE**
1. Other land remaining other land						
2. Land converted to other land	321.2138	NE	NE	NE	NE	NE
G. Harvested wood products	**-63.5037**					
H. Other	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**

2019

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	Net CO_2 emissions / removals	CH_4	N_2O	NO_x	CO	NMVOC
	(kt)					
4. Total LULUCF	**-148.6229**	**0.0160**	**0.5421**	**0.0107**	**0.3821**	**NO, NE**
A. Forest land	**-1,950.6476**	**0.0143**	**0.0008**	**0.0091**	**0.3254**	**NO, NE**
1. Forest land remaining forest land	-1,231.1003	NE	NE	NE	NE	NE
2. Land converted to forest land	-719.5474	0.0143	0.0008	0.0091	0.3254	NO
B. Cropland	**1,507.3962**	**0.0017**	**0.0000**	**0.0015**	**0.0568**	**NO**
1. Cropland remaining cropland	1,516.6795	0.0017	0.0000	0.0015	0.0568	NO
2. Land converted to cropland	-9.2832	NE	NE	NE	NE	NE
C. Grassland	**-293.2923**	**NE**	**NE**	**NE**	**NE**	**NE**
1. Grassland remaining grassland	NO	NE	NE	NE	NE	NE
2. Land converted to grassland	-293.2923	NE	NE	NE	NE	NE
D. Wetlands	**-82.8099**	**NE**	**NE**	**NE**	**NE**	**NE**
1. Wetlands remaining wetlands	NO	NE	NE	NE	NE	NE
2. Land converted to wetlands	-82.8099	NE	NE	NE	NE	NE
E. Settlements	**116.5030**	**NO, NE**	**0.5412**	**NO, NE**	**NO, NE**	**NO, NE**
1. Settlements remaining settlements	NO	NE	NE	NE	NE	NE
2. Land converted to settlements	116.5030	NO	0.5412	NO	NO	NO
F. Other land	**611.7881**	**NE**	**NE**	**NE**	**NE**	**NE**
1. Other land remaining other land						
2. Land converted to other land	611.7881	NE	NE	NE	NE	NE
G. Harvested wood products	**-57.5604**					
H. Other	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**

2020

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	Net CO_2 emissions / removals	CH_4	N_2O	NO_x	CO	NMVOC
	(kt)					
4. Total LULUCF	**-172.3409**	**0.0321**	**0.5638**	**0.0200**	**0.7154**	**NO, NE**
A. Forest land	**-1,887.3228**	**0.0289**	**0.0016**	**0.0185**	**0.6586**	**NO, NE**
1. Forest land remaining forest land	-1,159.8803	NE	NE	NE	NE	NE
2. Land converted to forest land	-727.4426	0.0289	0.0016	0.0185	0.6586	NO
B. Cropland	**1,629.9020**	**0.0032**	**0.0001**	**0.0015**	**0.0568**	**NO**
1. Cropland remaining cropland	1,558.0806	0.0032	0.0001	0.0015	0.0568	NO
2. Land converted to cropland	71.8214	NE	NE	NE	NE	NE
C. Grassland	**-223.1528**	**NE**	**NE**	**NE**	**NE**	**NE**
1. Grassland remaining grassland	NO	NE	NE	NE	NE	NE
2. Land converted to grassland	-223.1528	NE	NE	NE	NE	NE
D. Wetlands	**-82.8099**	**NE**	**NE**	**NE**	**NE**	**NE**
1. Wetlands remaining wetlands	NO	NE	NE	NE	NE	NE
2. Land converted to wetlands	-82.8099	NE	NE	NE	NE	NE
E. Settlements	**27.2098**	**NO, NE**	**0.5621**	**NO, NE**	**NO, NE**	**NO, NE**
1. Settlements remaining settlements	NO	NE	NE	NE	NE	NE
2. Land converted to settlements	27.2098	NO	0.5621	NO	NO	NO
F. Other land	**329.1445**	**NE**	**NE**	**NE**	**NE**	**NE**
1. Other land remaining other land						
2. Land converted to other land	329.1445	NE	NE	NE	NE	NE
G. Harvested wood products	**34.6883**					
H. Other	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**

Annex 6-5. Sectoral Report for Sector 5 'Waste' 1990-2020

1990

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2	CH_4	N_2O	NO_x	CO	NMVOC	SO_2
	(kt)						
5. Total Waste	**14.9667**	**58.7204**	**0.3038**	**0.1503**	**2.6430**	**3.1194**	**0.0052**
A. Solid waste disposal	**NA, NO**	**44.2399**		**NA, NO**	**NA, NO**	**3.0203**	
1. Managed waste disposal sites	NA, NO	0.0000		NA, NO	NA	NO	
2. Unmanaged waste disposal sites	NA, NO	44.2399		NA, NO	NA	3.0203	
3. Uncategorized waste disposal sites	NO	NO		NO	NO	NO	
B. Biological treatment of solid waste		**0.0544**	**0.0033**	**NO, NE**	**0.0076**	**NO, NE**	
1. Composting		0.0544	0.0033	NO	0.0076	NO	
2. Anaerobic digestion at biogas facilities		NE	NE	NE	NE	NE	
C. Incineration and open burning of waste	**14.9667**	**0.3075**	**0.0054**	**0.1503**	**2.6354**	**0.0581**	**0.0052**
1. Waste incineration	NO	NO	NO	NO	NO	NO	NO
2. Open burning of waste	14.9667	0.3075	0.0054	0.1503	2.6354	0.0581	0.0052
D. Wastewater treatment and discharge		**14.1186**	**0.2951**	**NA, IE**	**NA, IE**	**0.0410**	
1. Domestic wastewater		14.1186	0.2951	NA	NA	0.0410	
2. Industrial wastewater		IE	IE	IE	IE	IE	
3. Other		NA	NA	NA	NA	NA	
E. Other	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**
Memo item:							
Long-term storage of C in waste disposal sites	NE						
Annual change in total long-term C storage	NE						
Annual change in total long-term C storage in HWP waste	NE						

1991

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2	CH_4	N_2O	NO_x	CO	NMVOC	SO_2
	(kt)						
5. Total Waste	**14.9994**	**60.2264**	**0.2811**	**0.1506**	**2.6451**	**3.2557**	**0.0053**
A. Solid waste disposal	**NA, NO**	**46.1999**		**NA, NO**	**NA, NO**	**3.1602**	
1. Managed waste disposal sites	NA, NO	0.0000		NA, NO	NA	NO	
2. Unmanaged waste disposal sites	NA, NO	46.1999		NA, NO	NA	3.1602	
3. Uncategorized waste disposal sites	NO	NO		NO	NO	NO	
B. Biological treatment of solid waste		**0.0551**	**0.0033**	**NO, NE**	**0.0077**	**NO, NE**	
1. Composting		0.0551	0.0033	NO	0.0077	NO	
2. Anaerobic digestion at biogas facilities		NE	NE	NE	NE	NE	
C. Incineration and open burning of waste	**14.9994**	**0.3080**	**0.0054**	**0.1506**	**2.6374**	**0.0582**	**0.0053**
1. Waste incineration	NO	NO	NO	NO	NO	NO	NO
2. Open burning of waste	14.9994	0.3080	0.0054	0.1506	2.6374	0.0582	0.0053
D. Wastewater treatment and discharge		**13.6633**	**0.2724**	**NA, IE**	**NA, IE**	**0.0373**	
1. Domestic wastewater		13.6633	0.2724	NA	NA	0.0373	
2. Industrial wastewater		IE	IE	IE	IE	IE	
3. Other		NA	NA	NA	NA	NA	
E. Other	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**
Memo item:							
Long-term storage of C in waste disposal sites	NE						
Annual change in total long-term C storage	NE						
Annual change in total long-term C storage in HWP waste	NE						

1992

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2	CH_4	N_2O	NO_x	CO	NMVOC	SO_2
	(kt)						
5. Total Waste	**15.0476**	**60.4934**	**0.2585**	**0.1510**	**2.6506**	**3.0827**	**0.0053**
A. Solid waste disposal	**NA, NE**	**47.8234**		**NA, NO**	**NA, NO**	**2.9908**	
1. Managed waste disposal sites	NA, NO	7.7952		NA, NO	NA	0.4875	
2. Unmanaged waste disposal sites	NA, NO	40.0282		NA, NO	NA	2.5033	
3. Uncategorized waste disposal sites	NO	NO		NO	NO	NO	
B. Biological treatment of solid waste		**0.0575**	**0.0035**	**NO, NE**	**0.0081**	**NO, NE**	
1. Composting		0.0575	0.0035	NO	0.0081	NO	
2. Anaerobic digestion at biogas facilities		NE	NE	NE	NE	NE	
C. Incineration and open burning of waste	**15.0476**	**0.3089**	**0.0054**	**0.1510**	**2.6425**	**0.0584**	**0.0053**
1. Waste incineration	NO	NO	NO	NO	NO	NO	NO
2. Open burning of waste	15.0476	0.3089	0.0054	0.1510	2.6425	0.0584	0.0053
D. Wastewater treatment and discharge		**12.3036**	**0.2496**	**NA, IE**	**NA, IE**	**0.0335**	
1. Domestic wastewater		12.3036	0.2496	NA	NA	0.0335	
2. Industrial wastewater		IE	IE	IE	IE	IE	
3. Other		NA	NA	NA	NA	NA	
E. Other	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**
Memo item:							
Long-term storage of C in waste disposal sites	NE						
Annual change in total long-term C storage	NE						
Annual change in total long-term C storage in HWP waste	NE						

1993

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2	CH_4	N_2O	NO_x	CO	NMVOC	SO_2
	(kt)						
5. Total Waste	**15.0447**	**62.9983**	**0.2413**	**0.1508**	**2.6428**	**2.9041**	**0.0053**
A. Solid waste disposal	**NA, NO**	**50.2619**		**NA, NO**	**NA, NO**	**2.8159**	
1. Managed waste disposal sites	NA, NO	13.6712		NA, NO	NA	0.7659	
2. Unmanaged waste disposal sites	NA, NO	36.5907		NA, NO	NA	2.0500	
3. Uncategorized waste disposal sites	NO	NO		NO	NO	NO	
B. Biological treatment of solid waste		**0.0288**	**0.0017**	**NO, NE**	**0.0040**	**NO, NE**	
1. Composting		0.0288	0.0017	NO	0.0040	NO	
2. Anaerobic digestion at biogas facilities		NE	NE	NE	NE	NE	
C. Incineration and open burning of waste	**15.0447**	**0.3087**	**0.0054**	**0.1508**	**2.6388**	**0.0583**	**0.0053**
1. Waste incineration	NO	NO	NO	NO	NO	NO	NO
2. Open burning of waste	15.0447	0.3087	0.0054	0.1508	2.6388	0.0583	0.0053
D. Wastewater treatment and discharge		**12.3989**	**0.2341**	**NA, IE**	**NA, IE**	**0.0299**	
1. Domestic wastewater		12.3989	0.2341	NA	NA	0.0299	
2. Industrial wastewater		IE	IE	IE	IE	IE	
3. Other		NA	NA	NA	NA	NA	
E. Other	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**
Memo item:							
Long-term storage of C in waste disposal sites	NE						
Annual change in total long-term C storage	NE						
Annual change in total long-term C storage in HWP waste	NE						

1994

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2	CH_4	N_2O	NO_x	CO	NMVOC	SO_2
	(kt)						
5. Total Waste	**15.0947**	**62.2747**	**0.2343**	**0.1512**	**2.6482**	**2.7991**	**0.0054**
A. Solid waste disposal	**NA, NO**	**50.3641**		**NA, NO**	**NA, NO**	**2.7135**	
1. Managed waste disposal sites	NA, NO	14.4041		NA, NO	NA	0.7761	
2. Unmanaged waste disposal sites	NA, NO	35.9600		NA, NO	NA	1.9374	
3. Uncategorized waste disposal sites	NO	NO		NO	NO	NO	
B. Biological treatment of solid waste		**0.0268**	**0.0016**	**NO, NE**	**0.0038**	**NO, NE**	
1. Composting		0.0268	0.0016	NO	0.0038	NO	
2. Anaerobic digestion at biogas facilities		NE	NE	NE	NE	NE	
C. Incineration and open burning of waste	**15.0947**	**0.3096**	**0.0054**	**0.1512**	**2.6445**	**0.0584**	**0.0054**
1. Waste incineration	NO	NO	NO	NO	NO	NO	NO
2. Open burning of waste	15.0947	0.3096	0.0054	0.1512	2.6445	0.0584	0.0054
D. Wastewater treatment and discharge		**11.5741**	**0.2272**	**NA, IE**	**NA, IE**	**0.0272**	
1. Domestic wastewater		11.5741	0.2272	NA	NA	0.0272	
2. Industrial wastewater		IE	IE	IE	IE	IE	
3. Other		NA	NA	NA	NA	NA	
E. Other	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**
Memo item:							
Long-term storage of C in waste disposal sites	NE						
Annual change in total long-term C storage	NE						
Annual change in total long-term C storage in HWP waste	NE						

1995

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2	CH_4	N_2O	NO_x	CO	NMVOC	SO_2
	(kt)						
5. Total Waste	**15.0979**	**62.0635**	**0.2370**	**0.1512**	**2.6451**	**1.7494**	**0.0054**
A. Solid waste disposal	**NA, NO**	**50.2429**		**NA, NO**	**NA, NO**	**1.6703**	
1. Managed waste disposal sites	NA, NO	15.6255		NA, NO	NA	0.5195	
2. Unmanaged waste disposal sites	NA, NO	34.6174		NA, NO	NA	1.1508	
3. Uncategorized waste disposal sites	NO	NO		NO	NO	NO	
B. Biological treatment of solid waste		**0.0253**	**0.0015**	**NO, NE**	**0.0035**	**NO, NE**	
1. Composting		0.0253	0.0015	NO	0.0035	NO	
2. Anaerobic digestion at biogas facilities		NE	NE	NE	NE	NE	
C. Incineration and open burning of waste	**15.0979**	**0.3096**	**0.0054**	**0.1512**	**2.6416**	**0.0584**	**0.0054**
1. Waste incineration	NO	NO	NO	NO	NO	NO	NO
2. Open burning of waste	15.0979	0.3096	0.0054	0.1512	2.6416	0.0584	0.0054
D. Wastewater treatment and discharge		**11.4857**	**0.2301**	**NA, IE**	**NA, IE**	**0.0207**	
1. Domestic wastewater		11.4857	0.2301	NA	NA	0.0207	
2. Industrial wastewater		IE	IE	IE	IE	IE	
3. Other		NA	NA	NA	NA	NA	
E. Other	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**
Memo item:							
Long-term storage of C in waste disposal sites	NE						
Annual change in total long-term C storage	NE						
Annual change in total long-term C storage in HWP waste	NE						

1996

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2	CH_4	N_2O	NO_x	CO	NMVOC	SO_2
	(kt)						
5. Total Waste	**15.0960**	**62.1388**	**0.2336**	**0.1511**	**2.6417**	**1.5880**	**0.0054**
A. Solid waste disposal	**NA, NO**	**50.4732**		**NA, NO**	**NA, NO**	**1.5088**	
1. Managed waste disposal sites	NA, NO	15.1420		NA, NO	NA	0.4527	
2. Unmanaged waste disposal sites	NA, NO	35.3312		NA, NO	NA	1.0562	
3. Uncategorized waste disposal sites	NO	NO		NO	NO	NO	
B. Biological treatment of solid waste		**0.0261**	**0.0016**	**NO, NE**	**0.0036**	**NO, NE**	
1. Composting		0.0261	0.0016	NO	0.0036	NO	
2. Anaerobic digestion at biogas facilities		NE	NE	NE	NE	NE	
C. Incineration and open burning of waste	**15.0960**	**0.3094**	**0.0054**	**0.1511**	**2.6380**	**0.0584**	**0.0054**
1. Waste incineration	NO	NO	NO	NO	NO	NO	NO
2. Open burning of waste	15.0960	0.3094	0.0054	0.1511	2.6380	0.0584	0.0054
D. Wastewater treatment and discharge		**11.3300**	**0.2266**	**NA, IE**	**NA, IE**	**0.0208**	
1. Domestic wastewater		11.3300	0.2266	NA	NA	0.0208	
2. Industrial wastewater		IE	IE	IE	IE	IE	
3. Other		NA	NA	NA	NA	NA	
E. Other	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**
Memo item:							
Long-term storage of C in waste disposal sites	NE						
Annual change in total long-term C storage	NE						
Annual change in total long-term C storage in HWP waste	NE						

1997

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2	CH_4	N_2O	NO_x	CO	NMVOC	SO_2
	(kt)						
5. Total Waste	**15.0456**	**61.7851**	**0.2376**	**0.1505**	**2.6305**	**1.4614**	**0.0054**
A. Solid waste disposal	**NA, NO**	**49.8661**		**NA, NO**	**NA, NO**	**1.3847**	
1. Managed waste disposal sites	NA, NO	16.3561		NA, NO	NA	0.4542	
2. Unmanaged waste disposal sites	NA, NO	33.5100		NA, NO	NA	0.9305	
3. Uncategorized waste disposal sites	NO	NO		NO	NO	NO	
B. Biological treatment of solid waste		**0.0245**	**0.0015**	**NO, NE**	**0.0034**	**NO, NE**	
1. Composting		0.0245	0.0015	NO	0.0034	NO	
2. Anaerobic digestion at biogas facilities		NE	NE	NE	NE	NE	
C. Incineration and open burning of waste	**15.0456**	**0.3083**	**0.0054**	**0.1505**	**2.6271**	**0.0581**	**0.0054**
1. Waste incineration	NO	NO	NO	NO	NO	NO	NO
2. Open burning of waste	15.0456	0.3083	0.0054	0.1505	2.6271	0.0581	0.0054
D. Wastewater treatment and discharge		**11.5861**	**0.2307**	**NA, IE**	**NA, IE**	**0.0186**	
1. Domestic wastewater		11.5861	0.2307	NA	NA	0.0186	
2. Industrial wastewater		IE	IE	IE	IE	IE	
3. Other		NA	NA	NA	NA	NA	
E. Other	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**
Memo item:							
Long-term storage of C in waste disposal sites	NE						
Annual change in total long-term C storage	NE						
Annual change in total long-term C storage in HWP waste	NE						

1998

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2	CH_4	N_2O	NO_x	CO	NMVOC	SO_2
	(kt)						
5. Total Waste	**15.0794**	**60.7090**	**0.2412**	**0.1508**	**2.6344**	**1.4245**	**0.0054**
A. Solid waste disposal	**NA, NO**	**49.2046**		**NA, NO**	**NA, NO**	**1.3509**	
1. Managed waste disposal sites	NA, NO	15.9915		NA, NO	NA	0.4390	
2. Unmanaged waste disposal sites	NA, NO	33.2131		NA, NO	NA	0.9118	
3. Uncategorized waste disposal sites	NO	NO		NO	NO	NO	
B. Biological treatment of solid waste		**0.0248**	**0.0015**	**NO, NE**	**0.0035**	**NO, NE**	
1. Composting		0.0248	0.0015	NO	0.0035	NO	
2. Anaerobic digestion at biogas facilities		NE	NE	NE	NE	NE	
C. Incineration and open burning of waste	**15.0794**	**0.3089**	**0.0054**	**0.1508**	**2.6310**	**0.0582**	**0.0054**
1. Waste incineration	NO	NO	NO	NO	NO	NO	NO
2. Open burning of waste	15.0794	0.3089	0.0054	0.1508	2.6310	0.0582	0.0054
D. Wastewater treatment and discharge		**11.1707**	**0.2342**	**NA, IE**	**NA, IE**	**0.0155**	
1. Domestic wastewater		11.1707	0.2342	NA	NA	0.0155	
2. Industrial wastewater		IE	IE	IE	IE	IE	
3. Other		NA	NA	NA	NA	NA	
E. Other	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**
Memo item:							
Long-term storage of C in waste disposal sites	NE						
Annual change in total long-term C storage	NE						
Annual change in total long-term C storage in HWP waste	NE						

1999

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2	CH_4	N_2O	NO_x	CO	NMVOC	SO_2
	(kt)						
5. Total Waste	**15.0071**	**60.5398**	**0.2360**	**0.1502**	**2.6281**	**1.3300**	**0.0053**
A. Solid waste disposal	**NA, NO**	**49.3861**		**NA, NO**	**NA, NO**	**1.2600**	
1. Managed waste disposal sites	NA, NO	16.2480		NA, NO	NA	0.4145	
2. Unmanaged waste disposal sites	NA, NO	33.1381		NA, NO	NA	0.8455	
3. Uncategorized waste disposal sites	NO	NO		NO	NO	NO	
B. Biological treatment of solid waste		**0.0232**	**0.0014**	**NO, NE**	**0.0033**	**NO, NE**	
1. Composting		0.0232	0.0014	NO	0.0033	NO	
2. Anaerobic digestion at biogas facilities		NE	NE	NE	NE	NE	
C. Incineration and open burning of waste	**15.0071**	**0.3077**	**0.0054**	**0.1502**	**2.6248**	**0.0581**	**0.0053**
1. Waste incineration	NO	NO	NO	NO	NO	NO	NO
2. Open burning of waste	15.0071	0.3077	0.0054	0.1502	2.6248	0.0581	0.0053
D. Wastewater treatment and discharge		**10.8228**	**0.2292**	**NA, IE**	**NA, IE**	**0.0119**	
1. Domestic wastewater		10.8228	0.2292	NA	NA	0.0119	
2. Industrial wastewater		IE	IE	IE	IE	IE	
3. Other		NA	NA	NA	NA	NA	
E. Other	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**
Memo item:							
Long-term storage of C in waste disposal sites	NE						
Annual change in total long-term C storage	NE						
Annual change in total long-term C storage in HWP waste	NE						

2000

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2	CH_4	N_2O	NO_x	CO	NMVOC	SO_2
	(kt)						
5. Total Waste	**14.9965**	**59.4794**	**0.2413**	**0.1500**	**2.6204**	**1.3258**	**0.0054**
A. Solid waste disposal	**NA, NO**	**48.2815**		**NA, NO**	**NA, NO**	**1.2568**	
1. Managed waste disposal sites	NA, NO	15.3535		NA, NO	NA	0.3997	
2. Unmanaged waste disposal sites	NA, NO	32.9280		NA, NO	NA	0.8571	
3. Uncategorized waste disposal sites	NO	NO		NO	NO	NO	
B. Biological treatment of solid waste		**0.0210**	**0.0013**	**NO, NE**	**0.0029**	**NO, NE**	
1. Composting		0.0210	0.0013	NO	0.0029	NO	
2. Anaerobic digestion at biogas facilities		NE	NE	NE	NE	NE	
C. Incineration and open burning of waste	**14.9965**	**0.3073**	**0.0054**	**0.1500**	**2.6175**	**0.0579**	**0.0054**
1. Waste incineration	NO	NO	NO	NO	NO	NO	NO
2. Open burning of waste	14.9965	0.3073	0.0054	0.1500	2.6175	0.0579	0.0054
D. Wastewater treatment and discharge		**10.8697**	**0.2346**	**NA, IE**	**NA, IE**	**0.0111**	
1. Domestic wastewater		10.8697	0.2346	NA	NA	0.0111	
2. Industrial wastewater		IE	IE	IE	IE	IE	
3. Other		NA	NA	NA	NA	NA	
E. Other	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**
Memo item:							
Long-term storage of C in waste disposal sites	NE						
Annual change in total long-term C storage	NE						
Annual change in total long-term C storage in HWP waste	NE						

2001

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2	CH_4	N_2O	NO_x	CO	NMVOC	SO_2
	(kt)						
5. Total Waste	**14.9689**	**58.3326**	**0.2438**	**0.1497**	**2.6161**	**1.2028**	**0.0054**
A. Solid waste disposal	**NA, NO**	**46.9170**		**NA, NO**	**NA, NO**	**1.1343**	
1. Managed waste disposal sites	NA, NO	14.9665		NA, NO	NA	0.3619	
2. Unmanaged waste disposal sites	NA, NO	31.9505		NA, NO	NA	0.7725	
3. Uncategorized waste disposal sites	NO	NO		NO	NO	NO	
B. Biological treatment of solid waste		**0.0190**	**0.0011**	**NO, NE**	**0.0027**	**NO, NE**	
1. Composting		0.0190	0.0011	NO	0.0027	NO	
2. Anaerobic digestion at biogas facilities		NE	NE	NE	NE	NE	
C. Incineration and open burning of waste	**14.9689**	**0.3067**	**0.0054**	**0.1497**	**2.6134**	**0.0578**	**0.0054**
1. Waste incineration	NO	NO	NO	NO	NO	NO	NO
2. Open burning of waste	14.9689	0.3067	0.0054	0.1497	2.6134	0.0578	0.0054
D. Wastewater treatment and discharge		**11.0899**	**0.2373**	**NA, IE**	**NA, IE**	**0.0106**	
1. Domestic wastewater		11.0899	0.2373	NA	NA	0.0106	
2. Industrial wastewater		IE	IE	IE	IE	IE	
3. Other		NA	NA	NA	NA	NA	
E. Other	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**
Memo item:							
Long-term storage of C in waste disposal sites	NE						
Annual change in total long-term C storage	NE						
Annual change in total long-term C storage in HWP waste	NE						

2002

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2	CH_4	N_2O	NO_x	CO	NMVOC	SO_2
	(kt)						
5. Total Waste	**14.9402**	**57.7765**	**0.2500**	**0.1493**	**2.6051**	**1.1999**	**0.0054**
A. Solid waste disposal	**NA, NO**	**45.6713**		**NA, NO**	**NA, NO**	**1.1318**	
1. Managed waste disposal sites	NA, NO	14.6148		NA, NO	NA	0.3622	
2. Unmanaged waste disposal sites	NA, NO	31.0565		NA, NO	NA	0.7696	
3. Uncategorized waste disposal sites	NO	NO		NO	NO	NO	
B. Biological treatment of solid waste		**0.0209**	**0.0013**	**NO, NE**	**0.0029**	**NO, NE**	
1. Composting		0.0209	0.0013	NO	0.0029	NO	
2. Anaerobic digestion at biogas facilities		NE	NE	NE	NE	NE	
C. Incineration and open burning of waste	**14.9402**	**0.3059**	**0.0054**	**0.1493**	**2.6022**	**0.0576**	**0.0054**
1. Waste incineration	NO	NO	NO	NO	NO	NO	NO
2. Open burning of waste	14.9402	0.3059	0.0054	0.1493	2.6022	0.0576	0.0054
D. Wastewater treatment and discharge		**11.7785**	**0.2434**	**NA, IE**	**NA, IE**	**0.0104**	
1. Domestic wastewater		11.7785	0.2434	NA	NA	0.0104	
2. Industrial wastewater		IE	IE	IE	IE	IE	
3. Other		NA	NA	NA	NA	NA	
E. Other	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**
Memo item:							
Long-term storage of C in waste disposal sites	NE						
Annual change in total long-term C storage	NE						
Annual change in total long-term C storage in HWP waste	NE						

2003

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2	CH_4	N_2O	NO_x	CO	NMVOC	SO_2
	(kt)						
5. Total Waste	**14.9100**	**56.4890**	**0.2418**	**0.1488**	**2.5930**	**1.0868**	**0.0054**
A. Solid waste disposal	**NA, NO**	**44.0789**		**NA, NO**	**NA, NO**	**1.0191**	
1. Managed waste disposal sites	NA, NO	13.4881		NA, NO	NA	0.3119	
2. Unmanaged waste disposal sites	NA, NO	30.5907		NA, NO	NA	0.7073	
3. Uncategorized waste disposal sites	NO	NO		NO	NO	NO	
B. Biological treatment of solid waste		**0.0219**	**0.0013**	**NO, NE**	**0.0031**	**NO, NE**	
1. Composting		0.0219	0.0013	NO	0.0031	NO	
2. Anaerobic digestion at biogas facilities		NE	NE	NE	NE	NE	
C. Incineration and open burning of waste	**14.9100**	**0.3050**	**0.0054**	**0.1488**	**2.5899**	**0.0574**	**0.0054**
1. Waste incineration	NO	NO	NO	NO	NO	NO	NO
2. Open burning of waste	14.9100	0.3050	0.0054	0.1488	2.5899	0.0574	0.0054
D. Wastewater treatment and discharge		**12.0831**	**0.2351**	**NA, IE**	**NA, IE**	**0.0103**	
1. Domestic wastewater		12.0831	0.2351	NA	NA	0.0103	
2. Industrial wastewater		IE	IE	IE	IE	IE	
3. Other		NA	NA	NA	NA	NA	
E. Other	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**
Memo item:							
Long-term storage of C in waste disposal sites	NE						
Annual change in total long-term C storage	NE						
Annual change in total long-term C storage in HWP waste	NE						

2004

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2	CH_4	N_2O	NO_x	CO	NMVOC	SO_2
	(kt)						
5. Total Waste	**14.8621**	**55.8907**	**0.2305**	**0.1481**	**2.5791**	**1.1456**	**0.0054**
A. Solid waste disposal	**NA, NO**	**43.4137**		**NA, NO**	**NA, NO**	**1.0781**	
1. Managed waste disposal sites	NA, NO	12.7636		NA, NO	NA	0.3170	
2. Unmanaged waste disposal sites	NA, NO	30.6501		NA, NO	NA	0.7611	
3. Uncategorized waste disposal sites	NO	NO		NO	NO	NO	
B. Biological treatment of solid waste		**0.0230**	**0.0014**	**NO, NE**	**0.0032**	**NO, NE**	
1. Composting		0.0230	0.0014	NO	0.0032	NO	
2. Anaerobic digestion at biogas facilities		NE	NE	NE	NE	NE	
C. Incineration and open burning of waste	**14.8621**	**0.3039**	**0.0053**	**0.1481**	**2.5759**	**0.0572**	**0.0054**
1. Waste incineration	NO	NO	NO	NO	NO	NO	NO
2. Open burning of waste	14.8621	0.3039	0.0053	0.1481	2.5759	0.0572	0.0054
D. Wastewater treatment and discharge		**12.1502**	**0.2238**	**NA, IE**	**NA, IE**	**0.0103**	
1. Domestic wastewater		12.1502	0.2238	NA	NA	0.0103	
2. Industrial wastewater		IE	IE	IE	IE	IE	
3. Other		NA	NA	NA	NA	NA	
E. Other	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**
Memo item:							
Long-term storage of C in waste disposal sites	NE						
Annual change in total long-term C storage	NE						
Annual change in total long-term C storage in HWP waste	NE						

2005

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2	CH_4	N_2O	NO_x	CO	NMVOC	SO_2
	(kt)						
5. Total Waste	**14.4670**	**56.0368**	**0.2118**	**0.1442**	**2.5098**	**1.2975**	**0.0053**
A. Solid waste disposal	**NA, NO**	**43.7444**		**NA, NO**	**NA, NO**	**1.2315**	
1. Managed waste disposal sites	NA, NO	12.3797		NA, NO	NA	0.3485	
2. Unmanaged waste disposal sites	NA, NO	31.3648		NA, NO	NA	0.8830	
3. Uncategorized waste disposal sites	NO	NO		NO	NO	NO	
B. Biological treatment of solid waste		**0.0241**	**0.0014**	**NO, NE**	**0.0034**	**NO, NE**	
1. Composting		0.0241	0.0014	NO	0.0034	NO	
2. Anaerobic digestion at biogas facilities		NE	NE	NE	NE	NE	
C. Incineration and open burning of waste	**14.4670**	**0.2957**	**0.0052**	**0.1442**	**2.5064**	**0.0556**	**0.0053**
1. Waste incineration	NO	NO	NO	NO	NO	NO	NO
2. Open burning of waste	14.4670	0.2957	0.0052	0.1442	2.5064	0.0556	0.0053
D. Wastewater treatment and discharge		**11.9725**	**0.2051**	**NA, IE**	**NA, IE**	**0.0103**	
1. Domestic wastewater		11.9725	0.2051	NA	NA	0.0103	
2. Industrial wastewater		IE	IE	IE	IE	IE	
3. Other		NA	NA	NA	NA	NA	
E. Other	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**
Memo item:							
Long-term storage of C in waste disposal sites	NE						
Annual change in total long-term C storage	NE						
Annual change in total long-term C storage in HWP waste	NE						

2006

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2	CH_4	N_2O	NO_x	CO	NMVOC	SO_2
	(kt)						
5. Total Waste	**14.1260**	**55.4319**	**0.2180**	**0.1408**	**2.4509**	**1.3840**	**0.0051**
A. Solid waste disposal	**NA, NO**	**43.5887**		**NA, NO**	**NA, NO**	**1.3194**	
1. Managed waste disposal sites	NA, NO	11.8561		NA, NO	NA	0.3589	
2. Unmanaged waste disposal sites	NA, NO	31.7326		NA, NO	NA	0.9605	
3. Uncategorized waste disposal sites	NO	NO		NO	NO	NO	
B. Biological treatment of solid waste		**0.0261**	**0.0016**	**NO, NE**	**0.0037**	**NO, NE**	
1. Composting		0.0261	0.0016	NO	0.0037	NO	
2. Anaerobic digestion at biogas facilities		NE	NE	NE	NE	NE	
C. Incineration and open burning of waste	**14.1260**	**0.2888**	**0.0051**	**0.1408**	**2.4472**	**0.0543**	**0.0051**
1. Waste incineration	NO	NO	NO	NO	NO	NO	NO
2. Open burning of waste	14.1260	0.2888	0.0051	0.1408	2.4472	0.0543	0.0051
D. Wastewater treatment and discharge		**11.5283**	**0.2114**	**NA, IE**	**NA, IE**	**0.0103**	
1. Domestic wastewater		11.5283	0.2114	NA	NA	0.0103	
2. Industrial wastewater		IE	IE	IE	IE	IE	
3. Other		NA	NA	NA	NA	NA	
E. Other	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**
Memo item:							
Long-term storage of C in waste disposal sites	NE						
Annual change in total long-term C storage	NE						
Annual change in total long-term C storage in HWP waste	NE						

2007

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2	CH_4	N_2O	NO_x	CO	NMVOC	SO_2
	(kt)						
5. Total Waste	**13.7672**	**55.1286**	**0.2031**	**0.1372**	**2.3898**	**1.5403**	**0.0050**
A. Solid waste disposal	**NA, NO**	**43.6535**		**NA, NO**	**NA, NO**	**1.4772**	
1. Managed waste disposal sites	NA, NO	13.4453		NA, NO	NA	0.4550	
2. Unmanaged waste disposal sites	NA, NO	30.2082		NA, NO	NA	1.0222	
3. Uncategorized waste disposal sites	NO	NO		NO	NO	NO	
B. Biological treatment of solid waste		**0.0339**	**0.0020**	**NO, NE**	**0.0047**	**NO, NE**	
1. Composting		0.0339	0.0020	NO	0.0047	NO	
2. Anaerobic digestion at biogas facilities		NE	NE	NE	NE	NE	
C. Incineration and open burning of waste	**13.7672**	**0.2814**	**0.0049**	**0.1372**	**2.3851**	**0.0529**	**0.0050**
1. Waste incineration	NO	NO	NO	NO	NO	NO	NO
2. Open burning of waste	13.7672	0.2814	0.0049	0.1372	2.3851	0.0529	0.0050
D. Wastewater treatment and discharge		**11.1599**	**0.1961**	**NA, IE**	**NA, IE**	**0.0102**	
1. Domestic wastewater		11.1599	0.1961	NA	NA	0.0102	
2. Industrial wastewater		IE	IE	IE	IE	IE	
3. Other		NA	NA	NA	NA	NA	
E. Other	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**
Memo item:							
Long-term storage of C in waste disposal sites	NE						
Annual change in total long-term C storage	NE						
Annual change in total long-term C storage in HWP waste	NE						

2008

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2	CH_4	N_2O	NO_x	CO	NMVOC	SO_2
	(kt)						
5. Total Waste	**13.4533**	**55.9096**	**0.1871**	**0.1339**	**2.3308**	**1.6676**	**0.0049**
A. Solid waste disposal	**NA, NO**	**44.3767**		**NA, NO**	**NA, NO**	**1.6057**	
1. Managed waste disposal sites	NA, NO	14.9993		NA, NO	NA	0.5427	
2. Unmanaged waste disposal sites	NA, NO	29.3774		NA, NO	NA	1.0630	
3. Uncategorized waste disposal sites	NO	NO		NO	NO	NO	
B. Biological treatment of solid waste		**0.0401**	**0.0024**	**NO, NE**	**0.0056**	**NO, NE**	
1. Composting		0.0401	0.0024	NO	0.0056	NO	
2. Anaerobic digestion at biogas facilities		NE	NE	NE	NE	NE	
C. Incineration and open burning of waste	**13.4533**	**0.2748**	**0.0048**	**0.1339**	**2.3252**	**0.0517**	**0.0049**
1. Waste incineration	NO	NO	NO	NO	NO	NO	NO
2. Open burning of waste	13.4533	0.2748	0.0048	0.1339	2.3252	0.0517	0.0049
D. Wastewater treatment and discharge		**11.2179**	**0.1799**	**NA, IE**	**NA, IE**	**0.0102**	
1. Domestic wastewater		11.2179	0.1799	NA	NA	0.0102	
2. Industrial wastewater		IE	IE	IE	IE	IE	
3. Other		NA	NA	NA	NA	NA	
E. Other	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**
Memo item:							
Long-term storage of C in waste disposal sites	NE						
Annual change in total long-term C storage	NE						
Annual change in total long-term C storage in HWP waste	NE						

2009

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2	CH_4	N_2O	NO_x	CO	NMVOC	SO_2
	(kt)						
5. Total Waste	**13.1613**	**56.3507**	**0.1909**	**0.1308**	**2.2748**	**2.0892**	**0.0048**
A. Solid waste disposal	**NA, NO**	**45.5616**		**NA, NO**	**NA, NO**	**2.0285**	
1. Managed waste disposal sites	NA, NO	16.3111		NA, NO	NA	0.7262	
2. Unmanaged waste disposal sites	NA, NO	29.2506		NA, NO	NA	1.3023	
3. Uncategorized waste disposal sites	NO	NO		NO	NO	NO	
B. Biological treatment of solid waste		**0.0446**	**0.0027**	**NO, NE**	**0.0062**	**NO, NE**	
1. Composting		0.0446	0.0027	NO	0.0062	NO	
2. Anaerobic digestion at biogas facilities		NE	NE	NE	NE	NE	
C. Incineration and open burning of waste	**13.1613**	**0.2686**	**0.0047**	**0.1308**	**2.2685**	**0.0505**	**0.0048**
1. Waste incineration	NO	NO	NO	NO	NO	NO	NO
2. Open burning of waste	13.1613	0.2686	0.0047	0.1308	2.2685	0.0505	0.0048
D. Wastewater treatment and discharge		**10.4759**	**0.1835**	**NA, IE**	**NA, IE**	**0.0102**	
1. Domestic wastewater		10.4759	0.1835	NA	NA	0.0102	
2. Industrial wastewater		IE	IE	IE	IE	IE	
3. Other		NA	NA	NA	NA	NA	
E. Other	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**
Memo item:							
Long-term storage of C in waste disposal sites	NE						
Annual change in total long-term C storage	NE						
Annual change in total long-term C storage in HWP waste	NE						

2010

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2	CH_4	N_2O	NO_x	CO	NMVOC	SO_2
	(kt)						
5. Total Waste	**12.8663**	**57.3406**	**0.1848**	**0.1277**	**2.2175**	**2.3831**	**0.0048**
A. Solid waste disposal	**NA, NO**	**46.4268**		**NA, NO**	**NA, NO**	**2.3236**	
1. Managed waste disposal sites	NA, NO	18.1065		NA, NO	NA	0.9062	
2. Unmanaged waste disposal sites	NA, NO	28.3204		NA, NO	NA	1.4174	
3. Uncategorized waste disposal sites	NO	NO		NO	NO	NO	
B. Biological treatment of solid waste		**0.0430**	**0.0026**	**NO, NE**	**0.0060**	**NO, NE**	
1. Composting		0.0430	0.0026	NO	0.0060	NO	
2. Anaerobic digestion at biogas facilities		NE	NE	NE	NE	NE	
C. Incineration and open burning of waste	**12.8663**	**0.2624**	**0.0046**	**0.1277**	**2.2115**	**0.0492**	**0.0048**
1. Waste incineration	NO	NO	NO	NO	NO	NO	NO
2. Open burning of waste	12.8663	0.2624	0.0046	0.1277	2.2115	0.0492	0.0048
D. Wastewater treatment and discharge		**10.6084**	**0.1776**	**NA, IE**	**NA, IE**	**0.0102**	
1. Domestic wastewater		10.6084	0.1776	NA	NA	0.0102	
2. Industrial wastewater		IE	IE	IE	IE	IE	
3. Other		NA	NA	NA	NA	NA	
E. Other	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**
Memo item:							
Long-term storage of C in waste disposal sites	NE						
Annual change in total long-term C storage	NE						
Annual change in total long-term C storage in HWP waste	NE						

2011

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2	CH_4	N_2O	NO_x	CO	NMVOC	SO_2
	(kt)						
5. Total Waste	**12.5793**	**57.7015**	**0.1856**	**0.1246**	**2.1602**	**2.1659**	**0.0047**
A. Solid waste disposal	**NA, NO**	**47.0716**		**NA, NO**	**NA, NO**	**2.1076**	
1. Managed waste disposal sites	NA, NO	18.8757		NA, NO	NA	0.8452	
2. Unmanaged waste disposal sites	NA, NO	28.1959		NA, NO	NA	1.2625	
3. Uncategorized waste disposal sites	NO	NO		NO	NO	NO	
B. Biological treatment of solid waste		**0.0437**	**0.0026**	**NO, NE**	**0.0061**	**NO, NE**	
1. Composting		0.0437	0.0026	NO	0.0061	NO	
2. Anaerobic digestion at biogas facilities		NE	NE	NE	NE	NE	
C. Incineration and open burning of waste	**12.5793**	**0.2562**	**0.0045**	**0.1246**	**2.1541**	**0.0480**	**0.0047**
1. Waste incineration	NO	NO	NO	NO	NO	NO	NO
2. Open burning of waste	12.5793	0.2562	0.0045	0.1246	2.1541	0.0480	0.0047
D. Wastewater treatment and discharge		**10.3301**	**0.1785**	**NA, IE**	**NA, IE**	**0.0102**	
1. Domestic wastewater		10.3301	0.1785	NA	NA	0.0102	
2. Industrial wastewater		IE	IE	IE	IE	IE	
3. Other		NA	NA	NA	NA	NA	
E. Other	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**
Memo item:							
Long-term storage of C in waste disposal sites	NE						
Annual change in total long-term C storage	NE						
Annual change in total long-term C storage in HWP waste	NE						

2012

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2	CH_4	N_2O	NO_x	CO	NMVOC	SO_2
	(kt)						
5. Total Waste	**12.2708**	**57.0474**	**0.1870**	**0.1214**	**2.1026**	**1.9934**	**0.0046**
A. Solid waste disposal	**NA, NO**	**46.5498**		**NA, NO**	**NA, NO**	**1.9364**	
1. Managed waste disposal sites	NA, NO	18.6199		NA, NO	NA	0.7746	
2. Unmanaged waste disposal sites	NA, NO	27.9299		NA, NO	NA	1.1619	
3. Uncategorized waste disposal sites	NO	NO		NO	NO	NO	
B. Biological treatment of solid waste		**0.0447**	**0.0027**	**NO, NE**	**0.0063**	**NO, NE**	
1. Composting		0.0447	0.0027	NO	0.0063	NO	
2. Anaerobic digestion at biogas facilities		NE	NE	NE	NE	NE	
C. Incineration and open burning of waste	**12.2708**	**0.2498**	**0.0044**	**0.1214**	**2.0963**	**0.0468**	**0.0046**
1. Waste incineration	NO	NO	NO	NO	NO	NO	NO
2. Open burning of waste	12.2708	0.2498	0.0044	0.1214	2.0963	0.0468	0.0046
D. Wastewater treatment and discharge		**10.2031**	**0.1799**	**NA, IE**	**NA, IE**	**0.0101**	
1. Domestic wastewater		10.2031	0.1799	NA	NA	0.0101	
2. Industrial wastewater		IE	IE	IE	IE	IE	
3. Other		NA	NA	NA	NA	NA	
E. Other	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**
Memo item:							
Long-term storage of C in waste disposal sites	NE						
Annual change in total long-term C storage	NE						
Annual change in total long-term C storage in HWP waste	NE						

2013

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2	CH_4	N_2O	NO_x	CO	NMVOC	SO_2
	(kt)						
5. Total Waste	**11.9033**	**54.7019**	**0.1879**	**0.1179**	**2.0438**	**2.0204**	**0.0045**
A. Solid waste disposal	**NA, NO**	**44.1567**		**NA, NO**	**NA, NO**	**1.9649**	
1. Managed waste disposal sites	NA, NO	16.6912		NA, NO	NA	0.7427	
2. Unmanaged waste disposal sites	NA, NO	27.4654		NA, NO	NA	1.2222	
3. Uncategorized waste disposal sites	NO	NO		NO	NO	NO	
B. Biological treatment of solid waste		**0.0486**	**0.0029**	**NO, NE**	**0.0068**	**NO, NE**	
1. Composting		0.0486	0.0029	NO	0.0068	NO	
2. Anaerobic digestion at biogas facilities		NE	NE	NE	NE	NE	
C. Incineration and open burning of waste	**11.9033**	**0.2424**	**0.0043**	**0.1179**	**2.0370**	**0.0454**	**0.0045**
1. Waste incineration	NO	NO	NO	NO	NO	NO	NO
2. Open burning of waste	11.9033	0.2424	0.0043	0.1179	2.0370	0.0454	0.0045
D. Wastewater treatment and discharge		**10.2543**	**0.1807**	**NA, IE**	**NA, IE**	**0.0101**	
1. Domestic wastewater		10.2543	0.1807	NA	NA	0.0101	
2. Industrial wastewater		IE	IE	IE	IE	IE	
3. Other		NA	NA	NA	NA	NA	
E. Other	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**
Memo item:							
Long-term storage of C in waste disposal sites	NE						
Annual change in total long-term C storage	NE						
Annual change in total long-term C storage in HWP waste	NE						

2014

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2	CH_4	N_2O	NO_x	CO	NMVOC	SO_2
	(kt)						
5. Total Waste	**11.5371**	**54.2712**	**0.1860**	**0.1144**	**1.9861**	**1.9951**	**0.0043**
A. Solid waste disposal	**NA, NO**	**44.0518**		**NA, NO**	**NA, NO**	**1.9411**	
1. Managed waste disposal sites	NA, NO	15.9908		NA, NO	NA	0.7046	
2. Unmanaged waste disposal sites	NA, NO	28.0610		NA, NO	NA	1.2365	
3. Uncategorized waste disposal sites	NO	NO		NO	NO	NO	
B. Biological treatment of solid waste		**0.0508**	**0.0030**	**NO, NE**	**0.0071**	**NO, NE**	
1. Composting		0.0508	0.0030	NO	0.0071	NO	
2. Anaerobic digestion at biogas facilities		NE	NE	NE	NE	NE	
C. Incineration and open burning of waste	**11.5371**	**0.2351**	**0.0041**	**0.1144**	**1.9790**	**0.0441**	**0.0043**
1. Waste incineration	NO	NO	NO	NO	NO	NO	NO
2. Open burning of waste	11.5371	0.2351	0.0041	0.1144	1.9790	0.0441	0.0043
D. Wastewater treatment and discharge		**9.9335**	**0.1788**	**NA, IE**	**NA, IE**	**0.0100**	
1. Domestic wastewater		9.9335	0.1788	NA	NA	0.0100	
2. Industrial wastewater		IE	IE	IE	IE	IE	
3. Other		NA	NA	NA	NA	NA	
E. Other	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**
Memo item:							
Long-term storage of C in waste disposal sites	NE						
Annual change in total long-term C storage	NE						
Annual change in total long-term C storage in HWP waste	NE						

2015

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2	CH_4	N_2O	NO_x	CO	NMVOC	SO_2
	(kt)						
5. Total Waste	**13.3135**	**54.1360**	**0.1897**	**0.1326**	**2.3124**	**2.1675**	**0.0049**
A. Solid waste disposal	**NA, NO**	**44.1799**		**NA, NO**	**NA, NO**	**2.1063**	
1. Managed waste disposal sites	NA, NO	17.2743		NA, NO	NA	0.8236	
2. Unmanaged waste disposal sites	NA, NO	26.9056		NA, NO	NA	1.2827	
3. Uncategorized waste disposal sites	NO	NO		NO	NO	NO	
B. Biological treatment of solid waste		**0.0508**	**0.0030**	**NO, NE**	**0.0071**	**NO, NE**	
1. Composting		0.0508	0.0030	NO	0.0071	NO	
2. Anaerobic digestion at biogas facilities		NE	NE	NE	NE	NE	
C. Incineration and open burning of waste	**13.3135**	**0.2721**	**0.0048**	**0.1326**	**2.3053**	**0.0512**	**0.0049**
1. Waste incineration	NO	NO	NO	NO	NO	NO	NO
2. Open burning of waste	13.3135	0.2721	0.0048	0.1326	2.3053	0.0512	0.0049
D. Wastewater treatment and discharge		**9.6331**	**0.1819**	**NA, IE**	**NA, IE**	**0.0100**	
1. Domestic wastewater		9.6331	0.1819	NA	NA	0.0100	
2. Industrial wastewater		IE	IE	IE	IE	IE	
3. Other		NA	NA	NA	NA	NA	
E. Other	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**
Memo item:							
Long-term storage of C in waste disposal sites	NE						
Annual change in total long-term C storage	NE						
Annual change in total long-term C storage in HWP waste	NE						

2016

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2	CH_4	N_2O	NO_x	CO	NMVOC	SO_2
	(kt)						
5. Total Waste	**13.0346**	**55.1867**	**0.1918**	**0.1301**	**2.2716**	**2.2928**	**0.0047**
A. Solid waste disposal	**NA, NO**	**45.2784**		**NA, NO**	**NA, NO**	**2.2326**	
1. Managed waste disposal sites	NA, NO	17.8786		NA, NO	NA	0.8816	
2. Unmanaged waste disposal sites	NA, NO	27.3999		NA, NO	NA	1.3510	
3. Uncategorized waste disposal sites	NO	NO		NO	NO	NO	
B. Biological treatment of solid waste		**0.0505**	**0.0030**	**NO, NE**	**0.0071**	**NO, NE**	
1. Composting		0.0505	0.0030	NO	0.0071	NO	
2. Anaerobic digestion at biogas facilities		NE	NE	NE	NE	NE	
C. Incineration and open burning of waste	**13.0346**	**0.2667**	**0.0047**	**0.1301**	**2.2645**	**0.0502**	**0.0047**
1. Waste incineration	NO	NO	NO	NO	NO	NO	NO
2. Open burning of waste	13.0346	0.2667	0.0047	0.1301	2.2645	0.0502	0.0047
D. Wastewater treatment and discharge		**9.5911**	**0.1841**	**NA, IE**	**NA, IE**	**0.0100**	
1. Domestic wastewater		9.5911	0.1841	NA	NA	0.0100	
2. Industrial wastewater		IE	IE	IE	IE	IE	
3. Other		NA	NA	NA	NA	NA	
E. Other	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**
Memo item:							
Long-term storage of C in waste disposal sites	NE						
Annual change in total long-term C storage	NE						
Annual change in total long-term C storage in HWP waste	NE						

2017

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2	CH_4	N_2O	NO_x	CO	NMVOC	SO_2
	(kt)						
5. Total Waste	**14.6448**	**58.6255**	**0.1985**	**0.1465**	**2.5663**	**2.3021**	**0.0052**
A. Solid waste disposal	**NA, NO**	**48.8363**		**NA, NO**	**NA, NO**	**2.2355**	
1. Managed waste disposal sites	NA, NO	17.5000		NA, NO	NA	0.8011	
2. Unmanaged waste disposal sites	NA, NO	31.3363		NA, NO	NA	1.4344	
3. Uncategorized waste disposal sites	NO	NO		NO	NO	NO	
B. Biological treatment of solid waste		**0.0578**	**0.0035**	**NO, NE**	**0.0081**	**NO, NE**	
1. Composting		0.0578	0.0035	NO	0.0081	NO	
2. Anaerobic digestion at biogas facilities		NE	NE	NE	NE	NE	
C. Incineration and open burning of waste	**14.6448**	**0.3001**	**0.0053**	**0.1465**	**2.5582**	**0.0566**	**0.0052**
1. Waste incineration	NO	NO	NO	NO	NO	NO	NO
2. Open burning of waste	14.6448	0.3001	0.0053	0.1465	2.5582	0.0566	0.0052
D. Wastewater treatment and discharge		**9.4312**	**0.1897**	**NA, IE**	**NA, IE**	**0.0100**	
1. Domestic wastewater		9.4312	0.1897	NA	NA	0.0100	
2. Industrial wastewater		IE	IE	IE	IE	IE	
3. Other		NA	NA	NA	NA	NA	
E. Other	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**
Memo item:							
Long-term storage of C in waste disposal sites	NE						
Annual change in total long-term C storage	NE						
Annual change in total long-term C storage in HWP waste	NE						

2018

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2	CH_4	N_2O	NO_x	CO	NMVOC	SO_2
	(kt)						
5. Total Waste	**14.2880**	**59.2080**	**0.2038**	**0.1432**	**2.5112**	**2.0943**	**0.0051**
A. Solid waste disposal	**NA, NO**	**49.2990**		**NA, NO**	**NA, NO**	**2.0288**	
1. Managed waste disposal sites	NA, NO	19.7881		NA, NO	NA	0.8143	
2. Unmanaged waste disposal sites	NA, NO	29.5109		NA, NO	NA	1.2145	
3. Uncategorized waste disposal sites	NO	NO		NO	NO	NO	
B. Biological treatment of solid waste		**0.0521**	**0.0031**	**NO, NE**	**0.0073**	**NO, NE**	
1. Composting		0.0521	0.0031	NO	0.0073	NO	
2. Anaerobic digestion at biogas facilities		NE	NE	NE	NE	NE	
C. Incineration and open burning of waste	**14.2880**	**0.2931**	**0.0051**	**0.1432**	**2.5039**	**0.0553**	**0.0051**
1. Waste incineration	NO	NO	NO	NO	NO	NO	NO
2. Open burning of waste	14.2880	0.2931	0.0051	0.1432	2.5039	0.0553	0.0051
D. Wastewater treatment and discharge		**9.5637**	**0.1955**	**NA, IE**	**NA, IE**	**0.0102**	
1. Domestic wastewater		9.5637	0.1955	NA	NA	0.0102	
2. Industrial wastewater		IE	IE	IE	IE	IE	
3. Other		NA	NA	NA	NA	NA	
E. Other	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**
Memo item:							
Long-term storage of C in waste disposal sites	NE						
Annual change in total long-term C storage	NE						
Annual change in total long-term C storage in HWP waste	NE						

2019

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2	CH_4	N_2O	NO_x	CO	NMVOC	SO_2
	(kt)						
5. Total Waste	**13.9352**	**59.4236**	**0.2045**	**0.1400**	**2.4607**	**2.4008**	**0.0049**
A. Solid waste disposal	**NA, NO**	**49.5684**		**NA, NO**	**NA, NO**	**2.3365**	
1. Managed waste disposal sites	NA, NO	19.6101		NA, NO	NA	0.9243	
2. Unmanaged waste disposal sites	NA, NO	29.9583		NA, NO	NA	1.4121	
3. Uncategorized waste disposal sites	NO	NO		NO	NO	NO	
B. Biological treatment of solid waste		**0.0522**	**0.0031**	**NO, NE**	**0.0073**	**NO, NE**	
1. Composting		0.0522	0.0031	NO	0.0073	NO	
2. Anaerobic digestion at biogas facilities		NE	NE	NE	NE	NE	
C. Incineration and open burning of waste	**13.9352**	**0.2863**	**0.0050**	**0.1400**	**2.4534**	**0.0541**	**0.0049**
1. Waste incineration	NO	NO	NO	NO	NO	NO	NO
2. Open burning of waste	13.9352	0.2863	0.0050	0.1400	2.4534	0.0541	0.0049
D. Wastewater treatment and discharge		**9.5168**	**0.1963**	**NA, IE**	**NA, IE**	**0.0102**	
1. Domestic wastewater		9.5168	0.1963	NA	NA	0.0102	
2. Industrial wastewater		IE	IE	IE	IE	IE	
3. Other		NA	NA	NA	NA	NA	
E. Other	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**
Memo item:							
Long-term storage of C in waste disposal sites	NE						
Annual change in total long-term C storage	NE						
Annual change in total long-term C storage in HWP waste	NE						

2020

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2	CH_4	N_2O	NO_x	CO	NMVOC	SO_2
	(kt)						
5. Total Waste	**13.7583**	**59.6743**	**0.2046**	**0.1379**	**2.4190**	**2.1869**	**0.0049**
A. Solid waste disposal	**NA, NO**	**49.8473**		**NA, NO**	**NA, NO**	**2.1235**	
1. Managed waste disposal sites	NA, NO	18.2056		NA, NO	NA	0.7756	
2. Unmanaged waste disposal sites	NA, NO	31.6417		NA, NO	NA	1.3479	
3. Uncategorized waste disposal sites	NO	NO		NO	NO	NO	
B. Biological treatment of solid waste		**0.0567**	**0.0034**	**NO, NE**	**0.0079**	**NO, NE**	
1. Composting		0.0567	0.0034	NO	0.0079	NO	
2. Anaerobic digestion at biogas facilities		NE	NE	NE	NE	NE	
C. Incineration and open burning of waste	**13.7583**	**0.2823**	**0.0050**	**0.1379**	**2.4110**	**0.0533**	**0.0049**
1. Waste incineration	NO	NO	NO	NO	NO	NO	NO
2. Open burning of waste	13.7583	0.2823	0.0050	0.1379	2.4110	0.0533	0.0049
D. Wastewater treatment and discharge		**9.4880**	**0.1963**	**NA, IE**	**NA, IE**	**0.0101**	
1. Domestic wastewater		9.4880	0.1963	NA	NA	0.0101	
2. Industrial wastewater		IE	IE	IE	IE	IE	
3. Other		NA	NA	NA	NA	NA	
E. Other	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**
Memo item:							
Long-term storage of C in waste disposal sites	NE						
Annual change in total long-term C storage	NE						
Annual change in total long-term C storage in HWP waste	NE						

Annex 6-6. Summary Reports on GHG Emissions in the Republic of Moldova within 1990-2020

1990

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	Net CO_2 emissions / removals	CH_4	N_2O	HFCs	PFCs	Unspecified mix of HFCs and PFCs	SF_6	NF_3	NO_x	CO	NMVOC	SO_2
	(kt)			(kt CO_2 equivalent)					(kt)			
Total national emissions and removals	**35,191.3877**	**216.0563**	**10.0609**	**NO**	**NO**	**NO**	**NO**	**NO**	**95.6471**	**282.3156**	**141.5732**	**150.1134**
1. Energy	**35,401.1029**	**49.8489**	**1.1597**						**91.6413**	**270.6568**	**31.9022**	**148.7237**
A. Fuel combustion Reference approach	35,187.6578											
Sectoral approach	35,400.4397	13.4191	1.1597						91.6413	270.6568	31.2464	148.7237
1. Energy industries	21,300.2929	0.4913	0.1734						39.4664	7.2099	0.6297	102.3606
2. Manufacturing industries and construction	1,915.6706	0.0698	0.0146						8.9397	3.4622	0.8735	2.6760
3. Transport	4,698.2416	1.3467	0.3582						20.8774	70.8644	9.0718	0.7843
4. Other sectors	7,372.2624	11.5005	0.6092						21.5980	188.2917	20.5488	42.5973
5. Other	113.9722	0.0109	0.0044						0.7597	0.8286	0.1226	0.3055
B. Fugitive emissions from fuels	0.6632	36.4298	0.0000						NO	NO	0.6558	NO
1. Solid fuels	NO	NO	NO						NO	NO	NO	NO
2. Oil and natural gas and other emissions from energy production	0.6632	36.4298	0.0000						NO	NO	0.6558	NO
C. CO_2 Transport and storage	NO											
2. Industrial processes and product use	**1,605.2224**	**NO**	**0.0001**	**NO**	**NO**	**NO**	**NO**	**NO**	**3.7596**	**5.4932**	**106.5516**	**1.3845**
A. Mineral industry	1,338.9600								3.6040	3.4372	0.0340	1.3202
B. Chemical industry	NO	NO	NO						NO	NO	0.0650	NO
C. Metal industry	28.5023	NO	NO	NO	NO	NO	NO	NO	0.0925	1.2102	0.0370	0.0427
D. Non-energy products from fuels and solvent use	234.3591	NO	NO						0.0434	0.2441	92.7937	0.0216
E. Electronic industry				NO	NO	NO	NO	NO				
F. Product uses as substitutes for ODS				NO	NO	NO	NO	NO				
G. Other product manufacture and use	3.4010	NO	0.0001	NO	NO	NO	NO	NO	0.0197	0.6017	1.5459	NO
H. Other									NO	NO	12.0760	NO
3. Agriculture	**0.5820**	**107.3809**	**8.0256**						**NO**	**NO**	**NE, NO**	
A. Enteric fermentation		87.5771										
B. Manure management		19.8038	3.0192								NO	
C. Rice cultivation		NO										
D. Agricultural soils			5.0064									
E. Prescribed burning of savannas		NO	NO						NO	NO	NO	
F. Field burning of agricultural residues		IE	IE						IE	IE	IE	
G. Liming	NO											
H. Urea application	0.5820											
I. Other carbon-containing fertilizers	NO, NE											
J. Other	NO	NO	NO						**NO**	**NO**	**NO**	
4. Land use, land-use change and forestry	**-1,830.4863**	**0.1061**	**0.5717**						**0.0959**	**3.5227**	**NO, NE**	
A. Forest land	-2,563.4328	0.0083	0.0005						0.0053	0.1887	NO, NE	
B. Cropland	2,379.0886	0.0978	0.0025						0.0906	3.3340	NO	
C. Grassland	-1,205.6938	NE	NE						NE	NE	NE	
D. Wetlands	-555.3798	NE	NE						NE	NE	NE	
E. Settlements	84.7480	NO, NE	0.5687						NO, NE	NO, NE	NO, NE	
F. Other land	152.3638	NE	NE						NE	NE	NE	
G. Harvested wood products	-122.1804											
H. Other	NE	NE	NE						NE	NE	NE	

5. Waste	**14.9667**	**58.7204**	**0.3038**						**0.1503**	**2.6430**	**3.1194**	**0.0052**
A. Solid waste disposal	NA, NO	44.2399							NA, NO	NA, NO	3.0203	
B. Biological treatment of solid waste		0.0544	0.0033						NO, NE	0.0076	NO, NE	
C. Incineration and open burning of waste	14.9667	0.3075	0.0054						0.1503	2.6354	0.0581	0.0052
D. Wastewater treatment and discharge		14.1186	0.2951						NA, IE	NA, IE	0.0410	
E. Other	NO	NO	NO						NO	NO	NO	
6. Other	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**
Memo items:												
International bunkers	**193.4599**	**0.0153**	**0.0063**						**0.7651**	**0.5859**	**0.2298**	**0.0613**
Aviation	193.4599	0.0153	0.0063						0.7651	0.5859	0.2298	0.0613
Navigation	NO	NO	NO						NO	NO	NO	NO
Multilateral operations	**NO**	**NO**	**NO**						**NO**	**NO**	**NO**	**NO**
CO_2 emissions from biomass	232.8093											
CO_2 captured	NO											
Long-term storage of C in waste disposal sites	NE											
Indirect N_2O			**2.5613**									
Indirect CO_2	**207.5471**											

1991

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	Net CO_2 emissions / removals	CH_4	N_2O	HFCs	PFCs	Unspecified mix of HFCs and PFCs	SF_6	NF_3	NO_x	CO	NMVOC	SO_2
	(kt)			(kt CO_2 equivalent)					(kt)			
Total national emissions and removals	**28,417.2047**	**202.2024**	**9.3152**	**NO**	**NO**	**NO**	**NO**	**NO**	**78.5102**	**206.9674**	**114.3401**	**124.4509**
1. Energy	**29,898.2495**	**44.1221**	**0.8637**						**74.8304**	**196.1625**	**23.1980**	**123.1468**
A. Fuel combustion Reference approach	29,735.5050											
Sectoral approach	29,897.6098	9.6597	0.8637						74.8304	196.1625	22.5794	123.1468
1. Energy industries	18,927.0336	0.4230	0.1562						35.0660	6.4107	0.5515	90.5225
2. Manufacturing industries and construction	1,283.0799	0.0487	0.0095						6.4952	1.7418	0.5459	1.2222
3. Transport	3,656.1040	1.0343	0.2931						16.6517	53.9238	6.9484	0.6152
4. Other sectors	5,925.0237	8.1465	0.4014						15.9595	133.4692	14.4481	30.5092
5. Other	106.3685	0.0072	0.0034						0.6579	0.6170	0.0855	0.2778
B. Fugitive emissions from fuels	0.6397	34.4624	0.0000						NO	NO	0.6186	NO
1. Solid fuels	NO	NO	NO						NO	NO	NO	NO
2. Oil and natural gas and other emissions from energy production	0.6397	34.4624	0.0000						NO	NO	0.6186	NO
C. CO_2 Transport and storage	NO											
2. Industrial processes and product use	**1,411.2739**	**NO**	**0.0001**	**NO**	**NO**	**NO**	**NO**	**NO**	**3.4408**	**4.9046**	**87.8865**	**1.2988**
A. Mineral industry	1,190.1632								3.3045	3.0431	0.0316	1.2438
B. Chemical industry	NO	NO	NO						NO	NO	0.0544	NO
C. Metal industry	24.7297	NO	NO	NO	NO	NO	NO	NO	0.0803	1.0502	0.0323	0.0371
D. Non-energy products from fuels and solvent use	193.3185	NO	NO						0.0361	0.2030	76.2635	0.0180
E. Electronic industry				NO	NO	NO	NO	NO				
F. Product uses as substitutes for ODS				NO	NO	NO	NO	NO				
G. Other product manufacture and use	3.0625	NO	0.0001	NO	NO	NO	NO	NO	0.0199	0.6083	1.3920	NO
H. Other									NO	NO	10.1126	NO
3. Agriculture	**0.5226**	**97.7579**	**7.5533**						**NO**	**NO**	**NE, NO**	
A. Enteric fermentation		81.1547										
B. Manure management		16.6032	2.7389									
C. Rice cultivation		NO										
D. Agricultural soils			4.8144									

E. Prescribed burning of savannas		NO	NO						NO	NO	NO	
F. Field burning of agricultural residues		IE	IE						IE	IE	IE	
G. Liming	NO											
H. Urea application	0.5226											
I. Other carbon-containing fertilizers	NO, NE											
J. Other	NO	NO	NO						NO	NO	NO	
4. Land use, land-use change and forestry	**-2,907.8407**	**0.0960**	**0.6171**						**0.0885**	**3.2552**	**NO, NE**	
A. Forest land	-2,343.3131	0.0014	0.0001						0.0009	0.0316	NO, NE	
B. Cropland	1,248.7850	0.0946	0.0025						0.0876	3.2236	NO	
C. Grassland	-1,414.3167	NE	NE						NE	NE	NE	
D. Wetlands	-526.4627	NE	NE						NE	NE	NE	
E. Settlements	88.7139	NO, NE	0.6145						NO, NE	NO, NE	NO, NE	
F. Other land	152.3638	NE	NE						NE	NE	NE	
G. Harvested wood products	-113.6108											
H. Other	NE	NE	NE						NE	NE	NE	
5. Waste	**14.9994**	**60.2264**	**0.2811**						**0.1506**	**2.6451**	**3.2557**	**0.0053**
A. Solid waste disposal	NA, NO	46.1999							NA, NO	NA, NO	3.1602	
B. Biological treatment of solid waste		0.0551	0.0033						NO, NE	0.0077	NO, NE	
C. Incineration and open burning of waste	14.9994	0.3080	0.0054						0.1506	2.6374	0.0582	0.0053
D. Wastewater treatment and discharge		13.6633	0.2724						NA, IE	NA, IE	0.0373	
E. Other	NO	NO	NO						NO	NO	NO	
6. Other	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**
Memo items:												
International bunkers	**147.3846**	**0.0117**	**0.0048**						**0.5829**	**0.4464**	**0.2298**	**0.0467**
Aviation	147.3846	0.0117	0.0048						0.5829	0.4464	0.2298	0.0467
Navigation	NO	NO	NO						NO	NO	NO	NO
Multilateral operations	**NO**	**NO**	**NO**						**NO**	**NO**	**NO**	**NO**
CO_2 emissions from biomass	201.2009											
CO_2 captured	NO											
Long-term storage of C in waste disposal sites	NE											
Indirect N_2O			**2.3400**									
Indirect CO_2	**170.8422**											

1992

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	Net CO_2 emissions / removals	CH_4	N_2O	HFCs	PFCs	Unspecified mix of HFCs and PFCs	SF_6	NF_3	NO_x	CO	NMVOC	SO_2
	(kt)			(kt CO_2 equivalent)			(kt)					
Total national emissions and removals	**21,825.6502**	**192.5536**	**7.9980**	NO	NO	NO	NO	NO	**58.5843**	**133.6331**	**90.3583**	**91.8546**
1. Energy	**23,310.7327**	**37.1762**	**0.6030**						**56.4998**	**124.6003**	**15.0948**	**91.1666**
A. Fuel combustion Reference approach	23,190.8152											
Sectoral approach	23,310.1924	6.0510	0.6030						56.4998	124.6003	14.5354	91.1666
1. Energy industries	15,660.9863	0.3579	0.1219						28.7536	5.5760	0.4762	71.2477
2. Manufacturing industries and construction	932.0767	0.0351	0.0069						4.5687	1.3199	0.4056	0.9295
3. Transport	2,615.2237	0.7228	0.2234						12.5061	37.2521	4.8651	0.4462
4. Other sectors	4,024.1583	4.9306	0.2486						10.1939	80.1095	8.7371	18.3826
5. Other	77.7474	0.0046	0.0023						0.4776	0.3429	0.0514	0.1606
B. Fugitive emissions from fuels	0.5403	31.1252	0.0000						NO	NO	0.5594	NO
1. Solid fuels	NO	NO	NO						NO	NO	NO	NO
2. Oil and natural gas and other emissions from energy production	0.5403	31.1252	0.0000						NO	NO	0.5594	NO

C. CO_2 Transport and storage	NO											
2. Industrial processes and product use	**822.4617**	**NO**	**0.0001**	**NO**	**NO**	**NO**	**NO**	**NO**	**1.8526**	**3.4045**	**72.1808**	**0.6827**
A. Mineral industry	641.7935								1.7257	1.6459	0.0166	0.6316
B. Chemical industry	NO	NO	NO						NO	NO	0.0238	NO
C. Metal industry	23.9922	NO	NO	NO	NO	NO	NO	NO	0.0780	1.0194	0.0314	0.0360
D. Non-energy products from fuels and solvent use	154.2628	NO	NO						0.0304	0.1706	62.9651	0.0151
E. Electronic industry				NO	NO	NO	NO	NO				
F. Product uses as substitutes for ODS				NO	NO	NO	NO	NO				
G. Other product manufacture and use	2.4132	NO	0.0001	NO	NO	NO	NO	NO	0.0186	0.5686	1.0969	NO
H. Other									NO	NO	8.0471	NO
3. Agriculture	**0.3905**	**94.7961**	**6.4497**						**NO**	**NO**	**NE, NO**	
A. Enteric fermentation		79.8715										
B. Manure management		14.9247	2.4263								NO	
C. Rice cultivation		NO										
D. Agricultural soils			4.0234									
E. Prescribed burning of savannas		NO	NO						NO	NO	NO	
F. Field burning of agricultural residues		IE	IE						IE	IE	IE	
G. Liming	NO											
H. Urea application	0.3905											
I. Other carbon-containing fertilizers	NO, NE											
J. Other	NO	NO	NO						NO	NO	NO	
4. Land use, land-use change and forestry	**-2,322.9822**	**0.0879**	**0.6868**						**0.0809**	**2.9777**	**NO, NE**	
A. Forest land	-2,184.2404	0.0015	0.0001						0.0010	0.0346	NO, NE	
B. Cropland	1,174.1876	0.0864	0.0022						0.0800	2.9431	NO	
C. Grassland	-1,428.4835	NE	NE						NE	NE	NE	
D. Wetlands	-595.5455	NE	NE						NE	NE	NE	
E. Settlements	386.6196	NO, NE	0.6844						NO, NE	NO, NE	NO, NE	
F. Other land	418.7786	NE	NE						NE	NE	NE	
G. Harvested wood products	-94.2986											
H. Other	NE	NE	NE						NE	NE	NE	
5. Waste	**15.0476**	**60.4934**	**0.2585**						**0.1510**	**2.6506**	**3.0827**	**0.0053**
A. Solid waste disposal	NA, NE	47.8234							NA, NO	NA, NO	2.9908	
B. Biological treatment of solid waste		0.0575	0.0035						NO, NE	0.0081	NO, NE	
C. Incineration and open burning of waste	15.0476	0.3089	0.0054						0.1510	2.6425	0.0584	0.0053
D. Wastewater treatment and discharge		12.3036	0.2496						NA, IE	NA, IE	0.0335	
E. Other	NO	NO	NO						NO	NO	NO	
6. Other	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**
Memo items:												
International bunkers	**108.5369**	**0.0086**	**0.0036**						**0.4293**	**0.3287**	**0.2298**	**0.0344**
Aviation	108.5369	0.0086	0.0036						0.4293	0.3287	0.2298	0.0344
Navigation	NO	NO	NO						NO	NO	NO	NO
Multilateral operations	**NO**	**NO**	**NO**						**NO**	**NO**	**NO**	**NO**
CO_2 emissions from biomass	169.5924											
CO_2 captured	NO											
Long-term storage of C in waste disposal sites	NE											
Indirect N_2O			**2.0019**									
Indirect CO_2	**140.9363**											

1993

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	Net CO_2 emissions / removals	CH_4	N_2O	HFCs	PFCs	Unspecified mix of HFCs and PFCs	SF_6	NF_3	NO_x	CO	NMVOC	SO_2
	(kt)			(kt CO_2 equivalent)					(kt)			
Total national emissions and removals	**15,729.0875**	**179.5984**	**6.8796**	**NO**	**NO**	**NO**	**NO**	**NO**	**46.6890**	**70.9477**	**71.4281**	**72.3744**
1. Energy	**17,340.7506**	**30.5682**	**0.5000**						**44.6713**	**61.0487**	**8.2416**	**71.7032**
A. Fuel combustion Reference approach	17,279.5411											
Sectoral approach	17,340.2918	2.5952	0.5000						44.6713	61.0487	7.7383	71.7032
1. Energy industries	12,640.6006	0.2823	0.1058						23.6435	4.2355	0.3687	62.2743
2. Manufacturing industries and construction	617.5604	0.0229	0.0045						2.8651	0.9464	0.2784	0.6753
3. Transport	1,854.7578	0.4928	0.1808						9.9160	24.6271	3.3175	0.3241
4. Other sectors	2,133.9212	1.7913	0.2065						7.7876	30.6143	3.6883	8.0858
5. Other	93.4518	0.0058	0.0024						0.4591	0.6253	0.0853	0.3437
B. Fugitive emissions from fuels	0.4587	27.9730	0.0000						NO	NO	0.5033	NO
1. Solid fuels	NO	NO	NO						NO	NO	NO	NO
2. Oil and natural gas and other emissions from energy production	0.4587	27.9730	0.0000						NO	NO	0.5033	NO
C. CO_2 Transport and storage	NO											
2. Industrial processes and product use	**737.8604**	**NO**	**0.0001**	**NO**	**NO**	**NO**	**NO**	**NO**	**1.7577**	**3.2411**	**60.2824**	**0.6658**
A. Mineral industry	587.5786								1.6352	1.4853	0.0144	0.6172
B. Chemical industry	NO	NO	NO						NO	NO	0.0199	NO
C. Metal industry	24.4250	NO	NO	NO	NO	NO	NO	NO	0.0794	1.0383	0.0315	0.0366
D. Non-energy products from fuels and solvent use	123.8759	NO	NO						0.0241	0.1356	50.1008	0.0120
E. Electronic industry				NO	NO	NO	NO	NO				
F. Product uses as substitutes for ODS				NO	NO	NO	NO	NO				
G. Other product manufacture and use	1.9809	NO	0.0001	NO	NO	NO	NO	NO	0.0190	0.5819	0.9004	NO
H. Other									NO	NO	9.2154	NO
3. Agriculture	**0.1276**	**85.9140**	**5.3914**						**NO**	**NO**	**NE, NO**	
A. Enteric fermentation		74.9162										
B. Manure management		10.9978	2.0341								NO	
C. Rice cultivation		NO										
D. Agricultural soils			3.3572									
E. Prescribed burning of savannas		NO	NO						NO	NO	NO	
F. Field burning of agricultural residues		IE	IE						IE	IE	IE	
G. Liming	NO											
H. Urea application	0.1276											
I. Other carbon-containing fertilizers	NO, NE											
J. Other	NO	NO	NO						NO	NO	NO	
4. Land use, land-use change and forestry	**-2,364.6959**	**0.1179**	**0.7469**						**0.1091**	**4.0151**	**NO, NE**	
A. Forest land	-2,193.5115	0.0001	0.0000						0.0001	0.0024	NO, NE	
B. Cropland	1,442.9960	0.1178	0.0031						0.1090	4.0127	NO	
C. Grassland	-1,303.5202	NE	NE						NE	NE	NE	
D. Wetlands	-525.8447	NE	NE						NE	NE	NE	
E. Settlements	114.6181	NO, NE	0.7438						NO, NE	NO, NE	NO, NE	
F. Other land	164.0168	NE	NE						NE	NE	NE	
G. Harvested wood products	-63.4504											
H. Other	NE	NE	NE						NE	NE	NE	
5. Waste	**15.0447**	**62.9983**	**0.2413**						**0.1508**	**2.6428**	**2.9041**	**0.0053**

A. Solid waste disposal	NA, NO	50.2619							NA, NO	NA, NO	2.8159	
B. Biological treatment of solid waste		0.0288	0.0017						NO, NE	0.0040	NO, NE	
C. Incineration and open burning of waste	15.0447	0.3087	0.0054						0.1508	2.6388	0.0583	0.0053
D. Wastewater treatment and discharge		12.3989	0.2341						NA, IE	NA, IE	0.0299	
E. Other	NO	NO	NO						NO	NO	NO	
6. Other	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**
Memo items:												
International bunkers	**55.2342**	**0.0044**	**0.0018**						**0.2184**	**0.1673**	**0.2298**	**0.0175**
Aviation	55.2342	0.0044	0.0018						0.2184	0.1673	0.2298	0.0175
Navigation	NO	NO	NO						NO	NO	NO	NO
Multilateral operations	**NO**	**NO**	**NO**						**NO**	**NO**	**NO**	**NO**
CO_2 emissions from biomass	143.2360											
CO_2 captured	NO											
Long-term storage of C in waste disposal sites	NE											
Indirect N_2O			**1.6120**									
Indirect CO_2	**112.2027**											

1994

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	Net CO_2 emissions / removals	CH_4	N_2O	HFCs	PFCs	Unspecified mix of HFCs and PFCs	SF_6	NF_3	NO_x	CO	NMVOC	SO_2
	(kt)			(kt CO_2 equivalent)			(kt)					
Total national emissions and removals	**12,752.1034**	**175.9101**	**6.1638**	**NO**	**NO**	**NO**	**NO**	**NO**	**36.6632**	**76.2586**	**52.6015**	**57.4117**
1. Energy	**14,491.6621**	**30.0466**	**0.4536**						**35.0613**	**68.5397**	**8.8760**	**56.8740**
A. Fuel combustion Reference approach	14,457.3119											
Sectoral approach	14,491.2336	3.0879	0.4536						35.0613	68.5397	8.3910	56.8740
1. Energy industries	9,961.8515	0.1888	0.0872						18.8108	3.5570	0.2847	47.1207
2. Manufacturing industries and construction	737.3282	0.0147	0.0023						1.2545	0.7747	0.3253	0.4083
3. Transport	1,612.9419	0.4373	0.1096						6.0604	22.3481	2.8670	0.2180
4. Other sectors	2,090.7472	2.4402	0.2529						8.6031	41.2528	4.8276	8.8679
5. Other	88.3648	0.0069	0.0016						0.3325	0.6071	0.0863	0.2592
B. Fugitive emissions from fuels	0.4285	26.9587	0.0000						NO	NO	0.4850	NO
1. Solid fuels	NO	NO	NO						NO	NO	NO	NO
2. Oil and natural gas and other emissions from energy production	0.4285	26.9587	0.0000						NO	NO	0.4850	NO
C. CO_2 Transport and storage	NO											
2. Industrial processes and product use	**556.5852**	**NO**	**0.0001**	**NO**	**NO**	**NO**	**NO**	**NO**	**1.3900**	**2.8404**	**40.9265**	**0.5323**
A. Mineral industry	445.3398								1.2757	1.1521	0.0116	0.4870
B. Chemical industry	NO	NO	NO						NO	NO	0.0074	NO
C. Metal industry	25.3289	NO	NO	NO	NO	NO	NO	NO	0.0824	1.0774	0.0322	0.0380
D. Non-energy products from fuels and solvent use	84.4738	NO	NO						0.0146	0.0820	32.7972	0.0073
E. Electronic industry				NO	NO	NO	NO	NO				
F. Product uses as substitutes for ODS				NO	NO	NO	NO	NO				
G. Other product manufacture and use	1.4426	NO	0.0001	NO	NO	NO	NO	NO	0.0173	0.5290	0.6557	NO
H. Other									NO	NO	7.4223	NO
3. Agriculture	**0.0537**	**83.5225**	**4.6821**						**NO**	**NO**	**NE, NO**	
A. Enteric fermentation		72.9133										
B. Manure management		10.6093	1.9658								NO	
C. Rice cultivation		NO										

D. Agricultural soils			2.7164									
E. Prescribed burning of savannas		NO	NO						NO	NO	NO	
F. Field burning of agricultural residues		IE	IE						IE	IE	IE	
G. Liming	NO											
H. Urea application	0.0537											
I. Other carbon-containing fertilizers	NO, NE											
J. Other	NO	NO	NO						NO	NO	NO	
4. Land use, land-use change and forestry	**-2,311.2923**	**0.0662**	**0.7938**						**0.0606**	**2.2302**	**NO, NE**	
A. Forest land	-2,108.0022	0.0023	0.0001						0.0015	0.0526	NO, NE	
B. Cropland	1,206.3850	0.0639	0.0017						0.0592	2.1776	NO	
C. Grassland	-1,577.3332	NE	NE						NE	NE	NE	
D. Wetlands	-497.6418	NE	NE						NE	NE	NE	
E. Settlements	130.4883	NO, NE	0.7920						NO, NE	NO, NE	NO, NE	
F. Other land	549.4579	NE	NE						NE	NE	NE	
G. Harvested wood products	-14.6464											
H. Other	NE	NE	NE						NE	NE	NE	
5. Waste	**15.0947**	**62.2747**	**0.2343**						**0.1512**	**2.6482**	**2.7991**	**0.0054**
A. Solid waste disposal	NA, NO	50.3641							NA, NO	NA, NO	2.7135	
B. Biological treatment of solid waste		0.0268	0.0016						NO, NE	0.0038	NO, NE	
C. Incineration and open burning of waste	15.0947	0.3096	0.0054						0.1512	2.6445	0.0584	0.0054
D. Wastewater treatment and discharge		11.5741	0.2272						NA, IE	NA, IE	0.0272	
E. Other	NO	NO	NO						NO	NO	NO	
6. Other	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**
Memo items:												
International bunkers	**30.8414**	**0.0024**	**0.0010**						**0.1220**	**0.0934**	**0.2298**	**0.0098**
Aviation	30.8414	0.0024	0.0010						0.1220	0.0934	0.2298	0.0098
Navigation	NO	NO	NO						NO	NO	NO	NO
Multilateral operations	**NO**	**NO**	**NO**						**NO**	**NO**	**NO**	**NO**
CO_2 emissions from biomass	157.4600											
CO_2 captured	NO											
Long-term storage of C in waste disposal sites	NE											
Indirect N_2O			**1.4426**									
Indirect CO_2	**73.5965**											

1995

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	Net CO_2 emissions / removals	CH_4	N_2O	HFCs	PFCs	Unspecified mix of HFCs and PFCs	SF_6	NF_3	NO_x	CO	NMVOC	SO_2
	(kt)			(kt CO_2 equivalent)			(kt)					
Total national emissions and removals	**9,662.2364**	**166.5976**	**6.0382**	**1.0298**	**NO**	**NO**	**NO**	**NO**	**30.9295**	**66.5108**	**48.1949**	**31.8008**
1. Energy	**11,476.3176**	**31.4701**	**0.4305**						**29.4895**	**58.2503**	**7.3134**	**31.3056**
A. Fuel combustion Reference approach	11,441.9565											
Sectoral approach	11,475.8783	1.9344	0.4305						29.4895	58.2503	6.7793	31.3056
1. Energy industries	7,174.0286	0.1370	0.0502						12.9854	3.1484	0.2369	25.5949
2. Manufacturing industries and construction	386.3466	0.0080	0.0015						0.6898	0.5732	0.1809	0.3808
3. Transport	1,617.6947	0.4447	0.1058						6.1549	23.3801	2.9715	0.2340

4. Other sectors	2,172.1646	1.3343	0.2708						9.1456	30.5187	3.2884	4.8320
5. Other	125.6438	0.0104	0.0022						0.5138	0.6299	0.1015	0.2639
B. Fugitive emissions from fuels	0.4393	29.5357	0.0000						NO	NO	0.5341	NO
1. Solid fuels	NO	NO	NO						NO	NO	NO	NO
2. Oil and natural gas and other emissions from energy production	0.4393	29.5357	0.0000						NO	NO	0.5341	NO
C. CO_2 Transport and storage	NO											
2. Industrial processes and product use	**455.6262**	**NO**	**0.0000**	**1.0298**	**NO**	**NO**	**NO**	**NO**	**1.2059**	**2.5644**	**39.1321**	**0.4898**
A. Mineral industry	351.6610								1.0921	0.9044	0.0090	0.4438
B. Chemical industry	NO	NO	NO						NO	NO	0.0060	NO
C. Metal industry	26.2369	NO	NO	NO	NO	NO	NO	NO	0.0854	1.1166	0.0327	0.0394
D. Non-energy products from fuels and solvent use	76.5607	NO	NO						0.0132	0.0740	29.2180	0.0065
E. Electronic industry				NO	NO	NO	NO	NO				
F. Product uses as substitutes for ODS				1.0298	NO	NO	NO	NO				
G. Other product manufacture and use	1.1676	NO	0.0000	NO	NO	NO	NO	NO	0.0153	0.4695	0.5307	NO
H. Other									NO	NO	9.3357	NO
3. Agriculture	**0.0607**	**72.9745**	**4.5267**						**NO**	**NO**	**NE, NO**	
A. Enteric fermentation		64.7235										
B. Manure management		8.2510	1.8043								NO	
C. Rice cultivation		NO										
D. Agricultural soils			2.7223									
E. Prescribed burning of savannas		NO	NO						NO	NO	NO	
F. Field burning of agricultural residues		IE	IE						IE	IE	IE	
G. Liming	NO											
H. Urea application	0.0607											
I. Other carbon-containing fertilizers	NO, NE											
J. Other	NO	NO	NO						NO	NO	NO	
4. Land use, land-use change and forestry	**-2,284.8659**	**0.0896**	**0.8440**						**0.0829**	**3.0510**	**NO, NE**	
A. Forest land	-2,045.0670	0.0001	0.0000						0.0001	0.0030	NO, NE	
B. Cropland	1,316.7230	0.0895	0.0023						0.0828	3.0480	NO	
C. Grassland	-1,601.1004	NE	NE						NE	NE	NE	
D. Wetlands	-469.4389	NE	NE						NE	NE	NE	
E. Settlements	106.9167	NO, NE	0.8417						NO, NE	NO, NE	NO, NE	
F. Other land	401.1281	NE	NE						NE	NE	NE	
G. Harvested wood products	5.9727											
H. Other	NE	NE	NE						NE	NE	NE	
5. Waste	**15.0979**	**62.0635**	**0.2370**						**0.1512**	**2.6451**	**1.7494**	**0.0054**
A. Solid waste disposal	NA, NO	50.2429							NA, NO	NA, NO	1.6703	
B. Biological treatment of solid waste		0.0253	0.0015						NO, NE	0.0035	NO, NE	

C. Incineration and open burning of waste	15.0979	0.3096	0.0054						0.1512	2.6416	0.0584	0.0054
D. Wastewater treatment and discharge		11.4857	0.2301						NA, IE	NA, IE	0.0207	
E. Other	NO	NO	NO						NO	NO	NO	
6. Other	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**
Memo items:												
International bunkers	**41.9508**	**0.0066**	**0.0014**						**0.1676**	**0.1539**	**0.2298**	**0.0133**
Aviation	41.9508	0.0066	0.0014						0.1676	0.1539	0.2298	0.0133
Navigation	NO	NO	NO						NO	NO	NO	NO
Multilateral operations	**NO**	**NO**	**NO**						**NO**	**NO**	**NO**	**NO**
CO_2 emissions from biomass	230.0480											
CO_2 captured	NO											
Long-term storage of C in waste disposal sites	NE											
Indirect N_2O			**1.3586**									
Indirect CO_2	**65.4471**											

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GREENHOUSE GAS SOURCE AND SINK CATEGORIES	Net CO_2 emissions / removals	CH_4	N_2O	HFCs	PFCs	Unspecified mix of HFCs and PFCs	SF_6	NF_3	NO_x	CO	NMVOC	SO_2
	(kt)			(kt CO_2 equivalent)					(kt)			
Total national emissions and removals	**9,069.7634**	**164.6708**	**5.9658**	**1.6593**	**NO**	**NO**	**NO**	**NO**	**28.9453**	**78.7361**	**46.5154**	**31.9788**
1. Energy	**11,379.8429**	**35.3011**	**0.3745**						**27.6843**	**71.3532**	**8.7724**	**31.5576**
A. Fuel combustion Reference approach	11,323.8388											
Sectoral approach	11,379.3471	2.9694	0.3745						27.6843	71.3532	8.1891	31.5576
1. Energy industries	7,107.0544	0.1353	0.0469						12.7474	3.2595	0.2422	23.4411
2. Manufacturing industries and construction	326.3785	0.0070	0.0016						0.6523	0.6498	0.1616	0.4916
3. Transport	1,578.3769	0.4312	0.1009						5.9472	22.3021	2.8506	0.2207
4. Other sectors	2,285.6997	2.3850	0.2228						7.8951	44.6759	4.8360	7.2025
5. Other	81.8376	0.0109	0.0023						0.4423	0.4659	0.0987	0.2016
B. Fugitive emissions from fuels	0.4958	32.3317	0.0000						NO	NO	0.5834	NO
1. Solid fuels	NO	NO	NO						NO	NO	NO	NO
2. Oil and natural gas and other emissions from energy production	0.4958	32.3317	0.0000						NO	NO	0.5834	NO
C. CO_2 Transport and storage	NO											
2. Industrial processes and product use	**415.2620**	**NO**	**0.0000**	**1.6593**	**NO**	**NO**	**NO**	**NO**	**1.0530**	**2.6496**	**36.1550**	**0.4158**
A. Mineral industry	316.3598								0.9331	0.8037	0.0070	0.3697
B. Chemical industry	NO	NO	NO						NO	NO	0.0085	NO
C. Metal industry	26.7261	NO	NO	NO	NO	NO	NO	NO	0.0870	1.1375	0.0332	0.0401
D. Non-energy products from fuels and solvent use	71.0712	NO	NO						0.0119	0.0671	27.0276	0.0059
E. Electronic industry				NO	NO	NO	NO	NO				
F. Product uses as substitutes for ODS				1.6593	NO	NO	NO	NO				
G. Other product manufacture and use	1.1050	NO	0.0000	NO	NO	NO	NO	NO	0.0210	0.6414	0.5023	NO
H. Other									NO	NO	8.5764	NO
3. Agriculture	**0.0911**	**67.1693**	**4.4776**						**NO**	**NO**	**NE, NO**	
A. Enteric fermentation		59.6750										
B. Manure management		7.4943	1.8962								NO	

C. Rice cultivation		NO										
D. Agricultural soils			2.5815								
E. Prescribed burning of savannas		NO	NO						NO	NO	NO	
F. Field burning of agricultural residues		IE	IE						IE	IE	IE	
G. Liming	NO											
H. Urea application	0.0911											
I. Other carbon-containing fertilizers	NO, NE											
J. Other	NO	NO	NO						NO	NO	NO	
4. Land use, land-use change and forestry	**-2,740.5286**	**0.0616**	**0.8801**						**0.0569**	**2.0916**	**NO, NE**	
A. Forest land	-2,190.4337	0.0008	0.0000						0.0005	0.0176	NO, NE	
B. Cropland	1,118.5241	0.0609	0.0016						0.0564	2.0740	NO	
C. Grassland	-1,548.0826	NE	NE						NE	NE	NE	
D. Wetlands	-441.2360	NE	NE						NE	NE	NE	
E. Settlements	101.5910	NO, NE	0.8784						NO, NE	NO, NE	NO, NE	
F. Other land	217.3293	NE	NE						NE	NE	NE	
G. Harvested wood products	1.7792											
H. Other	NE	NE	NE						NE	NE	NE	
5. Waste	**15.0960**	**62.1388**	**0.2336**						**0.1511**	**2.6417**	**1.5880**	**0.0054**
A. Solid waste disposal	NA, NO	50.4732							NA, NO	NA, NO	1.5088	
B. Biological treatment of solid waste		0.0261	0.0016						NO, NE	0.0036	NO, NE	
C. Incineration and open burning of waste	15.0960	0.3094	0.0054						0.1511	2.6380	0.0584	0.0054
D. Wastewater treatment and discharge		11.3300	0.2266						NA, IE	NA, IE	0.0208	
E. Other	NO	NO	NO						NO	NO	NO	
6. Other	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**
Memo items:												
International bunkers	**56.7300**	**0.0048**	**0.0018**						**0.2197**	**0.1539**	**0.0822**	**0.0180**
Aviation	56.7300	0.0048	0.0018						0.2197	0.1539	0.0822	0.0180
Navigation	NO	NO	NO						NO	NO	NO	NO
Multilateral operations	**NO**	**NO**	**NO**						**NO**	**NO**	**NO**	**NO**
CO_2 emissions from biomass	294.0280											
CO_2 captured	NO											
Long-term storage of C in waste disposal sites	NE											
Indirect N_2O			**1.3705**									
Indirect CO_2	**60.5658**											

1997

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	Net CO_2 emissions / removals	CH_4	N_2O	HFCs	PFCs	Unspecified mix of HFCs and PFCs	SF_6	NF_3	NO_x	CO	NMVOC	SO_2
	(kt)			(kt CO_2 equivalent)					(kt)			
Total national emissions and removals	**8,353.2467**	**149.0115**	**5.4829**	**2.3137**	**NO**	**NO**	**NO**	**NO**	**26.0436**	**73.9422**	**31.7581**	**16.7550**
1. Energy	**10,275.2096**	**29.7284**	**0.3430**						**24.5339**	**64.6496**	**7.9555**	**16.2511**
A. Fuel combustion Reference approach	10,209.9604											
Sectoral approach	10,274.7201	2.3177	0.3429						24.5339	64.6496	7.4670	16.2511
1. Energy industries	5,615.6123	0.1108	0.0244						9.5174	3.1362	0.2233	10.5370
2. Manufacturing industries and construction	563.8972	0.0145	0.0023						0.9216	0.7564	0.2860	0.4152
3. Transport	1,516.0213	0.4009	0.0976						5.9219	24.4735	3.0625	0.2299
4. Other sectors	2,502.5306	1.7835	0.2165						7.8855	35.7839	3.8166	4.8638
5. Other	76.6587	0.0081	0.0020						0.2875	0.4997	0.0785	0.2051

B. Fugitive emissions from fuels	0.4895	27.4107	0.0000						NO	NO	0.4886	NO
1. Solid fuels	NO	NO	NO						NO	NO	NO	NO
2. Oil and natural gas and other emissions from energy production	0.4895	27.4107	0.0000						NO	NO	0.4886	NO
C. CO_2 Transport and storage	NO											
2. Industrial processes and product use	**452.4924**	**NO**	**0.0000**	**2.3137**	**NO**	**NO**	**NO**	**NO**	**1.2598**	**3.0011**	**22.3412**	**0.4985**
A. Mineral industry	377.0608								1.1298	0.9721	0.0097	0.4479
B. Chemical industry	NO	NO	NO						NO	NO	0.0068	NO
C. Metal industry	32.3806	NO	NO	NO	NO	NO	NO	NO	0.1054	1.3781	0.0401	0.0486
D. Non-energy products from fuels and solvent use	42.0528	NO	NO						0.0040	0.0227	14.1331	0.0020
E. Electronic industry				NO	NO	NO	NO	NO				
F. Product uses as substitutes for ODS				2.3137	NO	NO	NO	NO				
G. Other product manufacture and use	0.9982	NO	0.0000	NO	NO	NO	NO	NO	0.0205	0.6281	0.4537	NO
H. Other									NO	NO	7.6977	NO
3. Agriculture	**1.0992**	**57.3905**	**3.9889**						**NO**	**NO**	**NE, NO**	
A. Enteric fermentation		51.3040										
B. Manure management		6.0866	1.4681								NO	
C. Rice cultivation		NO										
D. Agricultural soils			2.5208									
E. Prescribed burning of savannas		NO	NO						NO	NO	NO	
F. Field burning of agricultural residues		IE	IE						IE	IE	IE	
G. Liming	NO											
H. Urea application	1.0992											
I. Other carbon-containing fertilizers	NO, NE											
J. Other	NO	NO	NO						NO	NO	NO	
4. Land use, land-use change and forestry	**-2,390.6002**	**0.1075**	**0.9134**						**0.0995**	**3.6610**	**NO, NE**	
A. Forest land	-2,232.2854	0.0002	0.0000						0.0001	0.0053	NO, NE	
B. Cropland	1,385.7903	0.1073	0.0028						0.0993	3.6556	NO	
C. Grassland	-1,400.8607	NE	NE						NE	NE	NE	
D. Wetlands	-413.0332	NE	NE						NE	NE	NE	
E. Settlements	100.7954	NO, NE	0.9106						NO, NE	NO, NE	NO, NE	
F. Other land	188.2363	NE	NE						NE	NE	NE	
G. Harvested wood products	-19.2429											
H. Other	NE	NE	NE						NE	NE	NE	
5. Waste	**15.0456**	**61.7851**	**0.2376**						**0.1505**	**2.6305**	**1.4614**	**0.0054**
A. Solid waste disposal	NA, NO	49.8661							NA, NO	NA, NO	1.3847	
B. Biological treatment of solid waste		0.0245	0.0015						NO, NE	0.0034	NO, NE	
C. Incineration and open burning of waste	15.0456	0.3083	0.0054						0.1505	2.6271	0.0581	0.0054
D. Wastewater treatment and discharge		11.5861	0.2307						NA, IE	NA, IE	0.0186	
E. Other	NO	NO	NO						NO	NO	NO	
6. Other	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**
Memo items:												
International bunkers	**66.1918**	**0.0054**	**0.0021**						**0.2640**	**0.1777**	**0.0937**	**0.0210**
Aviation	66.1918	0.0054	0.0021						0.2640	0.1777	0.0937	0.0210
Navigation	NO	NO	NO						NO	NO	NO	NO
Multilateral operations	**NO**	**NO**	**NO**						**NO**	**NO**	**NO**	**NO**
CO_2 emissions from biomass	291.1280											
CO_2 captured	NO											
Long-term storage of C in waste disposal sites	NE											
Indirect N_2O			**1.1651**									

Indirect CO_2	32.0911											

1998

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	Net CO_2 emissions / removals	CH_4	N_2O	HFCs	PFCs	Unspecified mix of HFCs and PFCs	SF_6	NF_3	NO_x	CO	NMVOC	SO_2
	(kt)			(kt CO_2 equivalent)					(kt)			
Total national emissions and removals	**6,859.2972**	**143.4887**	**5.2662**	**3.1372**	**NO**	**NO**	**NO**	**NO**	**21.8827**	**57.7109**	**27.7926**	**12.4820**
1. Energy	**8,891.0345**	**27.2535**	**0.2672**						**20.5268**	**49.2098**	**6.4073**	**12.0120**
A. Fuel combustion Reference approach	8,838.1605											
Sectoral approach	8,890.5850	1.7122	0.2672						20.5268	49.2098	5.9514	12.0120
1. Energy industries	4,836.6106	0.0962	0.0190						8.1103	2.7791	0.1972	7.9288
2. Manufacturing industries and construction	539.2845	0.0149	0.0022						0.8912	0.6944	0.2954	0.3171
3. Transport	1,363.1855	0.4034	0.0827						4.9702	21.3567	2.6620	0.1945
4. Other sectors	2,078.6760	1.1889	0.1612						6.1632	23.7935	2.6926	3.3628
5. Other	72.8283	0.0088	0.0021						0.3919	0.5862	0.1041	0.2088
B. Fugitive emissions from fuels	0.4495	25.5413	0.0000						NO	NO	0.4559	NO
1. Solid fuels	NO	NO	NO						NO	NO	NO	NO
2. Oil and natural gas and other emissions from energy production	0.4495	25.5413	0.0000						NO	NO	0.4559	NO
C. CO_2 Transport and storage	NO											
2. Industrial processes and product use	**375.5168**	**NO**	**0.0000**	**3.1372**	**NO**	**NO**	**NO**	**NO**	**1.1142**	**2.5238**	**19.9607**	**0.4646**
A. Mineral industry	308.4801								1.0014	0.7878	0.0079	0.4198
B. Chemical industry	NO	NO	NO						NO	NO	0.0066	NO
C. Metal industry	28.6822	NO	NO	NO	NO	NO	NO	NO	0.0934	1.2208	0.0371	0.0431
D. Non-energy products from fuels and solvent use	37.6084	NO	NO						0.0033	0.0185	13.2678	0.0016
E. Electronic industry				NO	NO	NO	NO	NO				
F. Product uses as substitutes for ODS				3.1372	NO	NO	NO	NO				
G. Other product manufacture and use	0.7460	NO	0.0000	NO	NO	NO	NO	NO	0.0162	0.4967	0.3391	NO
H. Other									NO	NO	6.3022	NO
3. Agriculture	**0.2721**	**55.4273**	**3.8036**						**NO**	**NO**	**NE, NO**	
A. Enteric fermentation		49.8079										
B. Manure management		5.6194	1.3749								NO	
C. Rice cultivation		NO										
D. Agricultural soils			2.4288									
E. Prescribed burning of savannas		NO	NO						NO	NO	NO	
F. Field burning of agricultural residues		IE	IE						IE	IE	IE	
G. Liming	NO											
H. Urea application	0.2721											
I. Other carbon-containing fertilizers	NO, NE											
J. Other	NO	NO	NO						NO	NO	NO	
4. Land use, land-use change and forestry	**-2,422.6056**	**0.0989**	**0.9542**						**0.0909**	**3.3430**	**NO, NE**	
A. Forest land	-2,288.4857	0.0023	0.0001						0.0015	0.0529	NO, NE	
B. Cropland	1,412.0577	0.0966	0.0025						0.0894	3.2900	NO	
C. Grassland	-1,436.2698	NE	NE						NE	NE	NE	
D. Wetlands	-384.8303	NE	NE						NE	NE	NE	
E. Settlements	99.0440	NO, NE	0.9516						NO, NE	NO, NE	NO, NE	
F. Other land	185.0077	NE	NE						NE	NE	NE	
G. Harvested wood products	-9.1293											
H. Other	NE	NE	NE						NE	NE	NE	

5. Waste	**15.0794**	**60.7090**	**0.2412**						**0.1508**	**2.6344**	**1.4245**	**0.0054**
A. Solid waste disposal	NA, NO	49.2046							NA, NO	NA, NO	1.3509	
B. Biological treatment of solid waste		0.0248	0.0015						NO, NE	0.0035	NO, NE	
C. Incineration and open burning of waste	15.0794	0.3089	0.0054						0.1508	2.6310	0.0582	0.0054
D. Wastewater treatment and discharge		11.1707	0.2342						NA, IE	NA, IE	0.0155	
E. Other	NO	NO	NO						NO	NO	NO	
6. Other	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**
Memo items:												
International bunkers	**53.5923**	**0.0041**	**0.0017**						**0.2144**	**0.1439**	**0.0721**	**0.0170**
Aviation	53.5923	0.0041	0.0017						0.2144	0.1439	0.0721	0.0170
Navigation	NO	NO	NO						NO	NO	NO	NO
Multilateral operations	**NO**	**NO**	**NO**						**NO**	**NO**	**NO**	**NO**
CO_2 emissions from biomass	269.0120											
CO_2 captured	NO											
Long-term storage of C in waste disposal sites	NE											
Indirect N_2O			**1.0962**									
Indirect CO_2	**29.9352**											

1999

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	Net CO_2 emissions / removals	CH_4	N_2O	HFCs	PFCs	Unspecified mix of HFCs and PFCs	SF_6	NF_3	NO_x	CO	NMVOC	SO_2
	(kt)			(kt CO_2 equivalent)			(kt)					
Total national emissions and removals	**5,126.5807**	**138.4872**	**4.8700**	**4.0002**	**NO**	**NO**	**NO**	**NO**	**16.0323**	**42.4130**	**23.4240**	**5.9010**
1. Energy	**6,913.7785**	**26.8852**	**0.1824**						**14.8145**	**37.0134**	**5.0420**	**5.4970**
A. Fuel combustion Reference approach	6,851.6906											
Sectoral approach	6,913.3665	1.5525	0.1824						14.8145	37.0134	4.5862	5.4970
1. Energy industries	3,660.2540	0.0727	0.0088						5.8881	2.3787	0.1638	2.1288
2. Manufacturing industries and construction	483.9580	0.0108	0.0016						0.7410	0.5239	0.2274	0.2536
3. Transport	910.5958	0.2475	0.0514						3.3339	12.5288	1.5798	0.1366
4. Other sectors	1,809.4024	1.2151	0.1190						4.7057	21.2190	2.5511	2.8154
5. Other	49.1563	0.0065	0.0016						0.1458	0.3630	0.0640	0.1625
B. Fugitive emissions from fuels	0.4121	25.3327	0.0000						NO	NO	0.4558	NO
1. Solid fuels	NO	NO	NO						NO	NO	NO	NO
2. Oil and natural gas and other emissions from energy production	0.4121	25.3327	0.0000						NO	NO	0.4558	NO
C. CO_2 Transport and storage	NO											
2. Industrial processes and product use	**338.2305**	**NO**	**0.0000**	**4.0002**	**NO**	**NO**	**NO**	**NO**	**0.9796**	**2.6451**	**17.0520**	**0.3987**
A. Mineral industry	271.7103								0.8542	0.6973	0.0076	0.3494
B. Chemical industry	NO	NO	NO						NO	NO	0.0050	NO
C. Metal industry	31.7942	NO	NO	NO	NO	NO	NO	NO	0.1035	1.3533	0.0408	0.0478
D. Non-energy products from fuels and solvent use	34.0839	NO	NO						0.0031	0.0172	12.7587	0.0015
E. Electronic industry				NO	NO	NO	NO	NO				
F. Product uses as substitutes for ODS				4.0002	NO	NO	NO	NO				
G. Other product manufacture and use	0.6421	NO	0.0000	NO	NO	NO	NO	NO	0.0189	0.5773	0.2919	NO
H. Other									NO	NO	3.9481	NO
3. Agriculture	**0.0034**	**50.9665**	**3.4655**						**NO**	**NO**	**NE, NO**	
A. Enteric fermentation		46.0727										
B. Manure management		4.8938	1.2401								NO	
C. Rice cultivation		NO										
D. Agricultural soils			2.2253									

E. Prescribed burning of savannas		NO	NO						NO	NO	NO	
F. Field burning of agricultural residues		IE	IE						IE	IE	IE	
G. Liming	NO											
H. Urea application	0.0034											
I. Other carbon-containing fertilizers	NO, NE											
J. Other	NO	NO	NO						NO	NO	NO	
4. Land use, land-use change and forestry	**-2,140.4389**	**0.0956**	**0.9861**						**0.0880**	**0.1265**	**NO, NE**	
A. Forest land	-2,336.8468	0.0017	0.0001						0.0011	0.0396	NO, NE	
B. Cropland	1,430.7993	0.0938	0.0024						0.0869	0.0869	NO	
C. Grassland	-1,433.2865	NE	NE						NE	NE	NE	
D. Wetlands	-356.6274	NE	NE						NE	NE	NE	
E. Settlements	111.8259	NO, NE	0.9836						NO, NE	NO, NE	NO, NE	
F. Other land	425.1554	NE	NE						NE	NE	NE	
G. Harvested wood products	18.5414											
H. Other	NE	NE	NE						NE	NE	NE	
5. Waste	**15.0071**	**60.5398**	**0.2360**						**0.1502**	**2.6281**	**1.3300**	**0.0053**
A. Solid waste disposal	NA, NO	49.3861							NA, NO	NA, NO	1.2600	
B. Biological treatment of solid waste		0.0232	0.0014						NO, NE	0.0033	NO, NE	
C. Incineration and open burning of waste	15.0071	0.3077	0.0054						0.1502	2.6248	0.0581	0.0053
D. Wastewater treatment and discharge		10.8228	0.2292						NA, IE	NA, IE	0.0119	
E. Other	NO	NO	NO						NO	NO	NO	
6. Other	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**
Memo items:												
International bunkers	**63.0390**	**0.0040**	**0.0020**						**0.2517**	**0.1574**	**0.0796**	**0.0200**
Aviation	63.0390	0.0040	0.0020						0.2517	0.1574	0.0796	0.0200
Navigation	NO	NO	NO						NO	NO	NO	NO
Multilateral operations	**NO**	**NO**	**NO**						**NO**	**NO**	**NO**	**NO**
CO_2 emissions from biomass	266.1120											
CO_2 captured	NO											
Long-term storage of C in waste disposal sites	NE											
Indirect N_2O			**0.9864**									
Indirect CO_2	**28.7113**											

2000

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	Net CO_2 emissions / removals	CH_4	N_2O	HFCs	PFCs	Unspecified mix of HFCs and PFCs	SF_6	NF_3	NO_x	CO	NMVOC	SO_2
	(kt)			(kt CO_2 equivalent)					(kt)			
Total national emissions and removals	**4,095.3870**	**134.8915**	**4.5993**	**5.1199**	**NO**	**NO**	**NO**	**NO**	**14.8344**	**41.2335**	**22.9213**	**4.5137**
1. Energy	**6,189.8822**	**28.1005**	**0.1627**						**13.5115**	**34.6241**	**4.9241**	**3.9685**
A. Fuel combustion Reference approach	6,127.8139											
Sectoral approach	6,189.4898	1.5357	0.1627						13.5115	34.6241	4.4422	3.9685
1. Energy industries	3,155.7517	0.0610	0.0069						5.0439	2.1204	0.1437	0.9753
2. Manufacturing industries and construction	520.9679	0.0098	0.0014						0.7914	0.4871	0.2261	0.2274
3. Transport	982.2638	0.2519	0.0574						3.7206	12.4426	1.5683	0.1582
4. Other sectors	1,494.1182	1.2084	0.0960						3.8246	19.3419	2.4620	2.4553
5. Other	36.3881	0.0046	0.0010						0.1311	0.2320	0.0421	0.1523
B. Fugitive emissions from fuels	0.3924	26.5648	0.0000						NO	NO	0.4819	NO
1. Solid fuels	NO	NO	NO						NO	NO	NO	NO
2. Oil and natural gas and other emissions from energy production	0.3924	26.5648	0.0000						NO	NO	0.4819	NO

C. CO_2 Transport and storage	NO											
2. Industrial processes and product use	**310.6441**	**NO**	**0.0000**	**5.1199**	**NO**	**NO**	**NO**	**NO**	**1.1392**	**2.7463**	**16.6714**	**0.5399**
A. Mineral industry	240.7803								0.9987	0.5762	0.0068	0.4842
B. Chemical industry	NO	NO	NO						NO	NO	0.0073	NO
C. Metal industry	36.2689	NO	NO	NO	NO	NO	NO	NO	0.1181	1.5438	0.0462	0.0545
D. Non-energy products from fuels and solvent use	32.6395	NO	NO						0.0025	0.0139	12.5638	0.0012
E. Electronic industry				NO	NO	NO	NO	NO				
F. Product uses as substitutes for ODS				5.1199	NO	NO	NO	NO				
G. Other product manufacture and use	0.9554	NO	0.0000	NO	NO	NO	NO	NO	0.0200	0.6124	0.4343	NO
H. Other									NO	NO	3.6129	NO
3. Agriculture	**0.4397**	**47.2751**	**3.2009**						**NO**	**NO**	**NE, NO**	
A. Enteric fermentation		43.4313										
B. Manure management		3.8438	1.0833								NO	
C. Rice cultivation		NO										
D. Agricultural soils			2.1176									
E. Prescribed burning of savannas		NO	NO						NO	NO	NO	
F. Field burning of agricultural residues		IE	IE						IE	IE	IE	
G. Liming	NO											
H. Urea application	0.4397											
I. Other carbon-containing fertilizers	NO, NE											
J. Other	NO	NO	NO						NO	NO	NO	
4. Land use, land-use change and forestry	**-2,420.5755**	**0.0365**	**0.9944**						**0.0338**	**1.2427**	**NO, NE**	
A. Forest land	-2,307.4384	0.0001	0.0000						0.0000	0.0014	NO, NE	
B. Cropland	1,222.7282	0.0364	0.0009						0.0337	1.2413	NO	
C. Grassland	-1,291.9495	NE	NE						NE	NE	NE	
D. Wetlands	-328.4245	NE	NE						NE	NE	NE	
E. Settlements	100.1768	NO, NE	0.9934						NO, NE	NO, NE	NO, NE	
F. Other land	178.5246	NE	NE						NE	NE	NE	
G. Harvested wood products	5.8073											
H. Other	NE	NE	NE						NE	NE	NE	
5. Waste	**14.9965**	**59.4794**	**0.2413**						**0.1500**	**2.6204**	**1.3258**	**0.0054**
A. Solid waste disposal	NA, NO	48.2815							NA, NO	NA, NO	1.2568	
B. Biological treatment of solid waste		0.0210	0.0013						NO, NE	0.0029	NO, NE	
C. Incineration and open burning of waste	14.9965	0.3073	0.0054						0.1500	2.6175	0.0579	0.0054
D. Wastewater treatment and discharge		10.8697	0.2346						NA, IE	NA, IE	0.0111	
E. Other	NO	NO	NO						NO	NO	NO	
6. Other	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**
Memo items:												
International bunkers	**63.0779**	**0.0043**	**0.0020**						**0.2591**	**0.1688**	**0.0773**	**0.0200**
Aviation	63.0779	0.0043	0.0020						0.2591	0.1688	0.0773	0.0200
Navigation	NO	NO	NO						NO	NO	NO	NO
Multilateral operations	**NO**	**NO**	**NO**						**NO**	**NO**	**NO**	**NO**
CO_2 emissions from biomass	272.3720											
CO_2 captured	NO											
Long-term storage of C in waste disposal sites	NE											
Indirect N_2O			**0.8910**									
Indirect CO_2	**28.5957**											

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	Net CO_2 emissions / removals	CH_4	N_2O	HFCs	PFCs	Unspecified mix of HFCs and PFCs	SF_6	NF_3	NO_x	CO	NMVOC	SO_2
	(kt)			(kt CO_2 equivalent)					(kt)			
Total national emissions and removals	**5,082.6367**	**134.4106**	**4.8566**	**6.8681**	**NO**	**NO**	**NO**	**NO**	**16.2102**	**40.6409**	**24.4817**	**3.9943**
1. Energy	**6,819.3643**	**28.0333**	**0.1673**						**14.9244**	**33.4823**	**4.8324**	**3.4823**
A. Fuel combustion Reference approach	6,769.5962											
Sectoral approach	6,818.9369	1.4121	0.1673						14.9244	33.4823	4.3519	3.4823
1. Energy industries	3,677.7189	0.0726	0.0080						5.8773	2.5004	0.1689	0.8801
2. Manufacturing industries and construction	601.9346	0.0123	0.0019						1.1500	0.5744	0.2598	0.2566
3. Transport	1,061.7864	0.2667	0.0634						3.9981	13.3140	1.6688	0.1332
4. Other sectors	1,434.1009	1.0554	0.0928						3.7425	16.7367	2.1939	2.1063
5. Other	43.3961	0.0050	0.0012						0.1565	0.3569	0.0605	0.1061
B. Fugitive emissions from fuels	0.4274	26.6212	0.0000						NO	NO	0.4805	NO
1. Solid fuels	NO	NO	NO						NO	NO	NO	NO
2. Oil and natural gas and other emissions from energy production	0.4274	26.6212	0.0000						NO	NO	0.4805	NO
C. CO_2 Transport and storage	NO											
2. Industrial processes and product use	**312.9423**	**NO**	**0.0000**	**6.8681**	**NO**	**NO**	**NO**	**NO**	**1.0901**	**2.8557**	**18.4464**	**0.5066**
A. Mineral industry	237.0750								0.9409	0.5713	0.0068	0.4470
B. Chemical industry	NO	NO	NO						NO	NO	0.0080	NO
C. Metal industry	38.6274	NO	NO	NO	NO	NO	NO	NO	0.1257	1.6441	0.0500	0.0580
D. Non-energy products from fuels and solvent use	36.4195	NO	NO						0.0031	0.0174	14.0195	0.0015
E. Electronic industry				NO	NO	NO	NO	NO				
F. Product uses as substitutes for ODS				6.8681	NO	NO	NO	NO				
G. Other product manufacture and use	0.8204	NO	0.0000	NO	NO	NO	NO	NO	0.0203	0.6229	0.3729	NO
H. Other									NO	NO	3.9893	NO
3. Agriculture	**0.1496**	**47.9939**	**3.4503**						**NO**	**NO**	**NE, NO**	
A. Enteric fermentation		44.1309										
B. Manure management		3.8630	1.1030								NO	
C. Rice cultivation		NO										
D. Agricultural soils			2.3473									
E. Prescribed burning of savannas		NO	NO						NO	NO	NO	
F. Field burning of agricultural residues		IE	IE						IE	IE	IE	
G. Liming	NO											
H. Urea application	0.1496											
I. Other carbon-containing fertilizers	NO, NE											
J. Other	NO	NO	NO						NO	NO	NO	
4. Land use, land-use change and forestry	**-2,064.7883**	**0.0508**	**0.9951**						**0.0459**	**1.6868**	**NO, NE**	
A. Forest land	-2,273.7027	0.0039	0.0002						0.0025	0.0896	NO, NE	
B. Cropland	1,560.4352	0.0469	0.0012						0.0434	1.5972	NO	
C. Grassland	-1,290.6541	NE	NE						NE	NE	NE	
D. Wetlands	-300.2217	NE	NE						NE	NE	NE	
E. Settlements	67.0898	NO, NE	0.9937						NO, NE	NO, NE	NO, NE	
F. Other land	178.5246	NE	NE						NE	NE	NE	
G. Harvested wood products	-6.2594											
H. Other	NE	NE	NE						NE	NE	NE	
5. Waste	**14.9689**	**58.3326**	**0.2438**						**0.1497**	**2.6161**	**1.2028**	**0.0054**
A. Solid waste disposal	NA, NO	46.9170							NA, NO	NA, NO	1.1343	
B. Biological treatment of solid waste		0.0190	0.0011						NO, NE	0.0027	NO, NE	

C. Incineration and open burning of waste	14.9689	0.3067	0.0054						0.1497	2.6134	0.0578	0.0054
D. Wastewater treatment and discharge		11.0899	0.2373						NA, IE	NA, IE	0.0106	
E. Other	NO	NO	NO						NO	NO	NO	
6. Other	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**
Memo items:												
International bunkers	**50.4863**	**0.0039**	**0.0016**						**0.1936**	**0.1468**	**0.0630**	**0.0160**
Aviation	50.4863	0.0039	0.0016						0.1936	0.1468	0.0630	0.0160
Navigation	NO	NO	NO						NO	NO	NO	NO
Multilateral operations	**NO**	**NO**	**NO**						**NO**	**NO**	**NO**	**NO**
CO_2 emissions from biomass	282.2280											
CO_2 captured	NO											
Long-term storage of C in waste disposal sites	NE											
Indirect N_2O			**0.9449**									
Indirect CO_2	**31.6632**											

2002

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	Net CO_2 emissions / removals	CH_4	N_2O	HFCs	PFCs	Unspecified mix of HFCs and PFCs	SF_6	NF_3	NO_x	CO	NMVOC	SO_2
	(kt)			(kt CO_2 equivalent)					(kt)			
Total national emissions and removals	**4,762.9045**	**136.9677**	**5.0563**	**9.1227**	**NO**	**NO**	**NO**	**NO**	**16.8987**	**45.7399**	**26.8842**	**4.8222**
1. Energy	**6,538.3068**	**30.1374**	**0.2146**						**15.5363**	**40.7317**	**5.9151**	**4.2675**
A. Fuel combustion Reference approach	6,479.3085											
Sectoral approach	6,537.9006	1.7746	0.2146						15.5363	40.7317	5.3987	4.2675
1. Energy industries	2,933.2101	0.0614	0.0069						4.6959	2.0055	0.1356	0.6884
2. Manufacturing industries and construction	411.7767	0.0077	0.0011						0.6019	0.4089	0.1809	0.2019
3. Transport	1,405.6363	0.3418	0.0947						5.6192	17.2878	2.2088	0.1735
4. Other sectors	1,747.8245	1.3555	0.1103						4.4782	20.7434	2.8052	3.0494
5. Other	39.4529	0.0083	0.0016						0.1411	0.2860	0.0683	0.1543
B. Fugitive emissions from fuels	0.4062	28.3628	0.0000						NO	NO	0.5164	NO
1. Solid fuels	NO	NO	NO						NO	NO	NO	NO
2. Oil and natural gas and other emissions from energy production	0.4062	28.3628	0.0000						NO	NO	0.5164	NO
C. CO_2 Transport and storage	NO											
2. Industrial processes and product use	**361.1500**	**NO**	**0.0000**	**9.1227**	**NO**	**NO**	**NO**	**NO**	**1.2039**	**2.0646**	**19.7692**	**0.5494**
A. Mineral industry	301.4884								1.1197	0.7266	0.0084	0.5172
B. Chemical industry	NO	NO	NO						NO	NO	0.0104	NO
C. Metal industry	20.5030	NO	NO	NO	NO	NO	NO	NO	0.0667	0.8725	0.0263	0.0308
D. Non-energy products from fuels and solvent use	38.3743	NO	NO						0.0027	0.0153	14.8206	0.0013
E. Electronic industry				NO	NO	NO	NO	NO				
F. Product uses as substitutes for ODS				9.1227	NO	NO	NO	NO				
G. Other product manufacture and use	0.7843	NO	0.0000	NO	NO	NO	NO	NO	0.0147	0.4503	0.3565	NO
H. Other									NO	NO	4.5471	NO
3. Agriculture	**0.0470**	**49.0432**	**3.5951**						**NO**	**NO**	**NE, NO**	
A. Enteric fermentation		45.0244										
B. Manure management		4.0188	1.1134								NO	
C. Rice cultivation		NO										
D. Agricultural soils			2.4816									
E. Prescribed burning of savannas		NO	NO						NO	NO	NO	
F. Field burning of agricultural residues		IE	IE						IE	IE	IE	

G. Liming	NO											
H. Urea application	0.0470											
I. Other carbon-containing fertilizers	NO, NE											
J. Other	NO	NO	NO						NO	NO	NO	
4. Land use, land-use change and forestry	**-2,151.5395**	**0.0106**	**0.9965**						**0.0092**	**0.3385**	**NO, NE**	
A. Forest land	-2,267.6159	0.0021	0.0001						0.0013	0.0481	NO, NE	
B. Cropland	1,156.5876	0.0085	0.0002						0.0079	0.2904	NO	
C. Grassland	-1,235.1380	NE	NE						NE	NE	NE	
D. Wetlands	-272.0188	NE	NE						NE	NE	NE	
E. Settlements	67.0898	NO, NE	0.9961						NO, NE	NO, NE	NO, NE	
F. Other land	456.2431	NE	NE						NE	NE	NE	
G. Harvested wood products	-56.6873											
H. Other	NE	NE	NE						NE	NE	NE	
5. Waste	**14.9402**	**57.7765**	**0.2500**						**0.1493**	**2.6051**	**1.1999**	**0.0054**
A. Solid waste disposal	NA, NO	45.6713							NA, NO	NA, NO	1.1318	
B. Biological treatment of solid waste		0.0209	0.0013						NO, NE	0.0029	NO, NE	
C. Incineration and open burning of waste	14.9402	0.3059	0.0054						0.1493	2.6022	0.0576	0.0054
D. Wastewater treatment and discharge		11.7785	0.2434						NA, IE	NA, IE	0.0104	
E. Other	NO	NO	NO						NO	NO	NO	
6. Other	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**
Memo items:												
International bunkers	**59.9541**	**0.0036**	**0.0020**						**0.2413**	**0.1619**	**0.0653**	**0.0190**
Aviation	59.9541	0.0036	0.0020						0.2413	0.1619	0.0653	0.0190
Navigation	NO	NO	NO						NO	NO	NO	NO
Multilateral operations	**NO**	**NO**	**NO**						**NO**	**NO**	**NO**	**NO**
CO_2 emissions from biomass	322.0800											
CO_2 captured	NO											
Long-term storage of C in waste disposal sites	NE											
Indirect N_2O			**0.9828**									
Indirect CO_2	**33.3896**											

2003

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	Net CO_2 emissions / removals	CH_4	N_2O	HFCs	PFCs	Unspecified mix of HFCs and PFCs	SF_6	NF_3	NO_x	CO	NMVOC	SO_2
	(kt)			(kt CO_2 equivalent)					(kt)			
Total national emissions and removals	**5,501.9182**	**133.3682**	**4.6000**	**12.1632**	**NO**	**NO**	**0.0000**	**NO**	**17.9406**	**55.2708**	**27.8119**	**6.3270**
1. Energy	**7,179.5364**	**32.0059**	**0.2087**						**16.5078**	**49.7946**	**7.0723**	**5.7398**
A. Fuel combustion Reference approach	7,144.5381											
Sectoral approach	7,178.4599	2.2674	0.2087						16.5078	49.7946	6.4898	5.7398
1. Energy industries	3,036.7432	0.0626	0.0069						4.8529	2.0895	0.1407	0.5251
2. Manufacturing industries and construction	439.9447	0.0083	0.0011						0.6706	0.3922	0.1897	0.1716
3. Transport	1,588.6955	0.4003	0.0912						6.1096	20.6504	2.5992	0.2110
4. Other sectors	2,084.6537	1.7920	0.1085						4.7321	26.3815	3.5078	4.7236
5. Other	28.4228	0.0043	0.0009						0.1427	0.2811	0.0524	0.1085
B. Fugitive emissions from fuels	1.0765	29.7385	0.0000						NO	NO	0.5825	NO
1. Solid fuels	NO	NO	NO						NO	NO	NO	NO
2. Oil and natural gas and other emissions from energy production	1.0765	29.7385	0.0000						NO	NO	0.5825	NO

C. CO_2 Transport and storage	NO											
2. Industrial processes and product use	**386.3885**	**NO**	**0.0000**	**12.1632**	**NO**	**NO**	**0.0000**	**NO**	**1.2824**	**2.8260**	**19.6528**	**0.5819**
A. Mineral industry	309.0730								1.1464	0.7495	0.0092	0.5274
B. Chemical industry	NO	NO	NO						NO	NO	0.0123	NO
C. Metal industry	35.4283	NO	NO	NO	NO	NO	NO	NO	0.1153	1.5074	0.0456	0.0532
D. Non-energy products from fuels and solvent use	40.9252	NO	NO						0.0026	0.0145	14.8735	0.0013
E. Electronic industry				NO	NO	NO	NO	NO				
F. Product uses as substitutes for ODS				12.1632	NO	NO	NO	NO				
G. Other product manufacture and use	0.9620	NO	0.0000	NO	NO	NO	0.0000	NO	0.0181	0.5545	0.4373	NO
H. Other									NO	NO	4.2749	NO
3. Agriculture	**0.2381**	**44.8709**	**3.1618**						**NO**	**NO**	**NE, NO**	
A. Enteric fermentation		41.1415										
B. Manure management		3.7294	1.0567								NO	
C. Rice cultivation		NO										
D. Agricultural soils			2.1051									
E. Prescribed burning of savannas		NO	NO						NO	NO	NO	
F. Field burning of agricultural residues		IE	IE						IE	IE	IE	
G. Liming	NO											
H. Urea application	0.2381											
I. Other carbon-containing fertilizers	NO, NE											
J. Other	NO	NO	NO						NO	NO	NO	
4. Land use, land-use change and forestry	**-2,079.1549**	**0.0024**	**0.9877**						**0.0016**	**0.0573**	**NO, NE**	
A. Forest land	-2,270.1176	0.0023	0.0001						0.0015	0.0526	NO, NE	
B. Cropland	1,237.5523	0.0001	0.0000						0.0001	0.0046	NO	
C. Grassland	-1,007.1842	NE	NE						NE	NE	NE	
D. Wetlands	-243.8159	NE	NE						NE	NE	NE	
E. Settlements	67.8615	NO, NE	0.9876						NO, NE	NO, NE	NO, NE	
F. Other land	201.6619	NE	NE						NE	NE	NE	
G. Harvested wood products	-65.1129											
H. Other	NE	NE	NE						NE	NE	NE	
5. Waste	**14.9100**	**56.4890**	**0.2418**						**0.1488**	**2.5930**	**1.0868**	**0.0054**
A. Solid waste disposal	NA, NO	44.0789							NA, NO	NA, NO	1.0191	
B. Biological treatment of solid waste		0.0219	0.0013						NO, NE	0.0031	NO, NE	
C. Incineration and open burning of waste	14.9100	0.3050	0.0054						0.1488	2.5899	0.0574	0.0054
D. Wastewater treatment and discharge		12.0831	0.2351						NA, IE	NA, IE	0.0103	
E. Other	NO	NO	NO						NO	NO	NO	
6. Other	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**
Memo items:												
International bunkers	**34.7676**	**0.0035**	**0.0012**						**0.1317**	**0.1223**	**0.0403**	**0.0110**
Aviation	34.7676	0.0035	0.0012						0.1317	0.1223	0.0403	0.0110
Navigation	NO	NO	NO						NO	NO	NO	NO
Multilateral operations	**NO**	**NO**	**NO**						**NO**	**NO**	**NO**	**NO**
CO_2 emissions from biomass	373.5760											
CO_2 captured	NO											
Long-term storage of C in waste disposal sites	NE											
Indirect N_2O			**0.8836**									
Indirect CO_2	**33.6837**											

2004

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	Net CO_2 emissions / removals	CH_4	N_2O	HFCs	PFCs	Unspecified mix of HFCs and PFCs	SF_6	NF_3	NO_x	CO	NMVOC	SO_2
	(kt)			(kt CO_2 equivalent)					(kt)			
Total national emissions and removals	**5,853.5527**	**131.9612**	**4.8205**	**16.0027**	**NO**	**NO**	**0.0000**	**NO**	**19.3032**	**52.6872**	**39.4607**	**5.4764**
1. Energy	**7,630.4387**	**34.1013**	**0.2113**						**17.7126**	**46.7598**	**7.1333**	**4.8271**
A. Fuel combustion Reference approach	7,595.3946											
Sectoral approach	7,629.3163	1.9771	0.2113						17.7126	46.7598	6.2260	4.8271
1. Energy industries	3,107.0816	0.0639	0.0071						4.9649	2.1435	0.1442	0.4804
2. Manufacturing industries and construction	448.3884	0.0097	0.0014						0.7048	0.4457	0.2047	0.2034
3. Transport	1,786.1813	0.4311	0.1062						7.1263	22.4044	2.8401	0.2464
4. Other sectors	2,260.0278	1.4692	0.0957						4.7005	21.4786	2.9899	3.8578
5. Other	27.6373	0.0031	0.0010						4.7005	21.4786	2.9899	3.8578
B. Fugitive emissions from fuels	1.1223	32.1242	0.0000						NO	NO	0.9073	NO
1. Solid fuels	NO	NO	NO						NO	NO	NO	NO
2. Oil and natural gas and other emissions from energy production	1.1223	32.1242	0.0000						NO	NO	0.9073	NO
C. CO_2 Transport and storage	NO											
2. Industrial processes and product use	**456.1463**	**NO**	**0.0001**	**16.0027**	**NO**	**NO**	**0.0000**	**NO**	**1.4368**	**3.2083**	**31.1819**	**0.6438**
A. Mineral industry	350.4572								1.2780	0.8629	0.0106	0.5790
B. Chemical industry	NO	NO	NO						NO	NO	0.0129	NO
C. Metal industry	40.5084	NO	NO	NO	NO	NO	NO	NO	0.1318	1.7236	0.0522	0.0608
D. Non-energy products from fuels and solvent use	64.1303	NO	NO						0.0082	0.0459	25.3328	0.0041
E. Electronic industry				NO	NO	NO	NO	NO				
F. Product uses as substitutes for ODS				16.0027	NO	NO	NO	NO				
G. Other product manufacture and use	1.0504	NO	0.0001	NO	NO	NO	0.0000	NO	0.0188	0.5759	0.4774	NO
H. Other									NO	NO	5.2960	NO
3. Agriculture	**0.3669**	**41.9611**	**3.4051**						**NO**	**NO**	**NE, NO**	
A. Enteric fermentation		38.4568										
B. Manure management		3.5042	1.0264								NO	
C. Rice cultivation		NO										
D. Agricultural soils			2.3786									
E. Prescribed burning of savannas		NO	NO						NO	NO	NO	
F. Field burning of agricultural residues		IE	IE						IE	IE	IE	
G. Liming	NO											
H. Urea application	0.3669											
I. Other carbon-containing fertilizers	NO, NE											
J. Other	NO	NO	NO						NO	NO	NO	
4. Land use, land-use change and forestry	**-2,248.2613**	**0.0080**	**0.9736**						**0.0057**	**0.1401**	**NO, NE**	
A. Forest land	-2,334.7768	0.0061	0.0003						0.0039	0.1383	NO, NE	
B. Cropland	1,198.5883	0.0020	0.0001						0.0018	0.0018	NO	
C. Grassland	-1,120.4767	NE	NE						NE	NE	NE	
D. Wetlands	-215.6130	NE	NE						NE	NE	NE	
E. Settlements	53.6737	NO, NE	0.9732						NO, NE	NO, NE	NO, NE	
F. Other land	223.8177	NE	NE						NE	NE	NE	
G. Harvested wood products	-53.4745											
H. Other	NE	NE	NE						NE	NE	NE	
5. Waste	**14.8621**	**55.8907**	**0.2305**						**0.1481**	**2.5791**	**1.1456**	**0.0054**
A. Solid waste disposal	NA, NO	43.4137							NA, NO	NA, NO	1.0781	
B. Biological treatment of solid waste		0.0230	0.0014						NO, NE	0.0032	NO, NE	

C. Incineration and open burning of waste	14.8621	0.3039	0.0053						0.1481	2.5759	0.0572	0.0054
D. Wastewater treatment and discharge		12.1502	0.2238						NA, IE	NA, IE	0.0103	
E. Other	NO	NO	NO						NO	NO	NO	
6. Other	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**
Memo items:												
International bunkers	**34.7903**	**0.0035**	**0.0012**						**0.1283**	**0.1296**	**0.0344**	**0.0110**
Aviation	34.7903	0.0035	0.0012						0.1283	0.1296	0.0344	0.0110
Navigation	NO	NO	NO						NO	NO	NO	NO
Multilateral operations	**NO**	**NO**	**NO**						**NO**	**NO**	**NO**	**NO**
CO_2 emissions from biomass	307.6800											
CO_2 captured	NO											
Long-term storage of C in waste disposal sites	NE											
Indirect N_2O			**0.9226**									
Indirect CO_2	**56.7824**											

2005

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	Net CO_2 emissions / removals	CH_4	N_2O	HFCs	PFCs	Unspecified mix of HFCs and PFCs	SF_6	NF_3	NO_x	CO	NMVOC	SO_2
	(kt)			(kt CO_2 equivalent)			(kt)					
Total national emissions and removals	**6,484.7979**	**132.6848**	**4.8969**	**22.5106**	**NO**	**NO**	**0.0000**	**NO**	**19.9710**	**54.7851**	**42.1519**	**5.1861**
1. Energy	**7,873.9844**	**35.9818**	**0.2113**						**18.0996**	**48.4438**	**7.2370**	**4.4251**
A. Fuel combustion Reference approach	7,835.8382											
Sectoral approach	7,872.8438	2.0747	0.2113						18.0996	48.4438	6.4175	4.4251
1. Energy industries	3,229.4503	0.0660	0.0072						5.1572	2.2318	0.1500	0.4400
2. Manufacturing industries and construction	576.6569	0.0113	0.0015						0.8627	0.4875	0.2515	0.1899
3. Transport	1,821.7199	0.4397	0.1150						7.5129	22.8675	2.9169	0.0452
4. Other sectors	2,219.0765	1.5553	0.0866						4.3367	22.7299	3.0691	3.7081
5. Other	25.9403	0.0024	0.0010						0.2301	0.1272	0.0300	0.0418
B. Fugitive emissions from fuels	1.1406	33.9070	0.0000						NO	NO	0.8196	NO
1. Solid fuels	NO	NO	NO						NO	NO	NO	NO
2. Oil and natural gas and other emissions from energy production	1.1406	33.9070	0.0000						NO	NO	0.8196	NO
C. CO_2 Transport and storage	NO											
2. Industrial processes and product use	**550.4807**	**NO**	**0.0001**	**22.5106**	**NO**	**NO**	**0.0000**	**NO**	**1.7183**	**3.4998**	**33.6173**	**0.7558**
A. Mineral industry	439.1892								1.5556	1.1045	0.0135	0.6890
B. Chemical industry	NO	NO	NO						NO	NO	0.0149	NO
C. Metal industry	41.9358	NO	NO	NO	NO	NO	NO	NO	0.1364	1.7839	0.0545	0.0630
D. Non-energy products from fuels and solvent use	68.1910	NO	NO						0.0077	0.0431	27.2264	0.0038
E. Electronic industry				NO	NO	NO	NO	NO				
F. Product uses as substitutes for ODS				22.5106	NO	NO	NO	NO				
G. Other product manufacture and use	1.1646	NO	0.0001	NO	NO	NO	0.0000	NO	0.0186	0.5683	0.5294	NO
H. Other									NO	NO	5.7786	NO
3. Agriculture	**0.1739**	**40.6563**	**3.5122**						**NO**	**NO**	**NE, NO**	
A. Enteric fermentation		36.9611										
B. Manure management		3.6952	1.1022								NO	
C. Rice cultivation		NO										
D. Agricultural soils			2.4100									
E. Prescribed burning of savannas		NO	NO						NO	NO	NO	
F. Field burning of agricultural residues		IE	IE						IE	IE	IE	

G. Liming	NO											
H. Urea application	0.1739											
I. Other carbon-containing fertilizers	NO, NE											
J. Other	NO	NO	NO						NO	NO	NO	
4. Land use, land-use change and forestry	**-1,954.3081**	**0.0099**	**0.9615**						**0.0090**	**0.3317**	**NO, NE**	
A. Forest land	-2,409.5185	0.0006	0.0000						0.0004	0.0132	NO, NE	
B. Cropland	1,271.6794	0.0093	0.0002						0.0087	0.3185	NO	
C. Grassland	-1,058.1239	NE	NE						NE	NE	NE	
D. Wetlands	-187.4101	NE	NE						NE	NE	NE	
E. Settlements	53.6737	NO, NE	0.9613						NO, NE	NO, NE	NO, NE	
F. Other land	416.5012	NE	NE						NE	NE	NE	
G. Harvested wood products	-41.1098											
H. Other	NE	NE	NE						NE	NE	NE	
5. Waste	**14.4670**	**56.0368**	**0.2118**						**0.1442**	**2.5098**	**1.2975**	**0.0053**
A. Solid waste disposal	NA, NO	43.7444							NA, NO	NA, NO	1.2315	
B. Biological treatment of solid waste		0.0241	0.0014						NO, NE	0.0034	NO, NE	
C. Incineration and open burning of waste	14.4670	0.2957	0.0052						0.1442	2.5064	0.0556	0.0053
D. Wastewater treatment and discharge		11.9725	0.2051						NA, IE	NA, IE	0.0103	
E. Other	NO	NO	NO						NO	NO	NO	
6. Other	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**
Memo items:												
International bunkers	**37.9260**	**0.0035**	**0.0013**						**0.1433**	**0.1362**	**0.0373**	**0.0120**
Aviation	37.9260	0.0035	0.0013						0.1433	0.1362	0.0373	0.0120
Navigation	NO	NO	NO						NO	NO	NO	NO
Multilateral operations	**NO**	**NO**	**NO**						**NO**	**NO**	**NO**	**NO**
CO_2 emissions from biomass	307.3920											
CO_2 captured	NO											
Long-term storage of C in waste disposal sites	NE											
Indirect N_2O			**0.9665**									
Indirect CO_2	**61.0627**											

2006

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	Net CO_2 emissions / removals	CH_4	N_2O	HFCs	PFCs	Unspecified mix of HFCs and PFCs	SF_6	NF_3	NO_x	CO	NMVOC	SO_2
	(kt)			(kt CO_2 equivalent)			(kt)					
Total national emissions and removals	**5,697.7447**	**127.1264**	**4.7940**	**33.2493**	**0.0231**	**NO**	**0.0000**	**NO**	**19.0350**	**55.2438**	**47.5410**	**5.3328**
1. Energy	**7,114.2233**	**32.1351**	**0.2164**						**17.0365**	**49.3930**	**7.3505**	**4.5538**
A. Fuel combustion Reference approach	7,075.9753											
Sectoral approach	7,112.9809	2.2706	0.2164						17.0365	49.3930	6.6436	4.5538
1. Energy industries	2,492.9310	0.0517	0.0057						3.9840	1.7263	0.1160	0.3339
2. Manufacturing industries and construction	635.2427	0.0119	0.0015						0.9501	0.4873	0.2692	0.1695
3. Transport	1,742.1028	0.4060	0.1198						7.4749	21.0274	2.7125	0.0436
4. Other sectors	2,203.6648	1.7981	0.0881						4.2950	25.7482	3.4823	3.8856
5. Other	39.0397	0.0029	0.0013						0.3325	0.4037	0.0635	0.1212
B. Fugitive emissions from fuels	1.2424	29.8644	0.0000						NO	NO	0.7069	NO
1. Solid fuels	NO	NO	NO						NO	NO	NO	NO
2. Oil and natural gas and other emissions from energy production	1.2424	29.8644	0.0000						NO	NO	0.7069	NO

C. CO_2 Transport and storage	NO											
2. Industrial processes and product use	**645.4865**	**NO**	**0.0001**	**33.2493**	**0.0231**	**NO**	**0.0000**	**NO**	**1.8503**	**3.1294**	**38.8065**	**0.7739**
A. Mineral industry	535.4220								1.7321	1.3597	0.0165	0.7272
B. Chemical industry	NO	NO	NO						NO	NO	0.0130	NO
C. Metal industry	27.0182	NO	NO	NO	NO	NO	NO	NO	0.0879	1.1492	0.0355	0.0406
D. Non-energy products from fuels and solvent use	81.9807	NO	NO						0.0124	0.0697	33.2258	0.0062
E. Electronic industry				NO	NO	NO	NO	NO				
F. Product uses as substitutes for ODS				33.2493	NO	NO	NO	NO				
G. Other product manufacture and use	1.0655	NO	0.0001	NO	0.0231	NO	0.0000	NO	0.0180	0.5508	0.4843	NO
H. Other									NO	NO	5.0313	NO
3. Agriculture	**0.1460**	**39.5494**	**3.4111**						**NO**	**NO**	**NE, NO**	
A. Enteric fermentation		35.7523										
B. Manure management		3.7971	1.1361								NO	
C. Rice cultivation		NO										
D. Agricultural soils			2.2750									
E. Prescribed burning of savannas		NO	NO						NO	NO	NO	
F. Field burning of agricultural residues		IE	IE						IE	IE	IE	
G. Liming	NO											
H. Urea application	0.1460											
I. Other carbon-containing fertilizers	NO, NE											
J. Other	NO	NO	NO						NO	NO	NO	
4. Land use, land-use change and forestry	**-2,076.2371**	**0.0100**	**0.9483**						**0.0075**	**0.2706**	**NO, NE**	
A. Forest land	-2,366.5168	0.0063	0.0003						0.0040	0.1427	NO, NE	
B. Cropland	1,303.2724	0.0038	0.0001						0.0035	0.1279	NO	
C. Grassland	-1,056.3692	NE	NE						NE	NE	NE	
D. Wetlands	-159.2073	NE	NE						NE	NE	NE	
E. Settlements	53.6737	NO, NE	0.9479						NO, NE	NO, NE	NO, NE	
F. Other land	189.4964	NE	NE						NE	NE	NE	
G. Harvested wood products	-40.5864											
H. Other	NE	NE	NE						NE	NE	NE	
5. Waste	**14.1260**	**55.4319**	**0.2180**						**0.1408**	**2.4509**	**1.3840**	**0.0051**
A. Solid waste disposal	NA, NO	43.5887							NA, NO	NA, NO	1.3194	
B. Biological treatment of solid waste		0.0261	0.0016						NO, NE	0.0037	NO, NE	
C. Incineration and open burning of waste	14.1260	0.2888	0.0051						0.1408	2.4472	0.0543	0.0051
D. Wastewater treatment and discharge		11.5283	0.2114						NA, IE	NA, IE	0.0103	
E. Other	NO	NO	NO						NO	NO	NO	
6. Other	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**
Memo items:												
International bunkers	**37.9241**	**0.0039**	**0.0013**						**0.1428**	**0.1424**	**0.0397**	**0.0120**
Aviation	37.9241	0.0039	0.0013						0.1428	0.1424	0.0397	0.0120
Navigation	NO	NO	NO						NO	NO	NO	NO
Multilateral operations	**NO**	**NO**	**NO**						**NO**	**NO**	**NO**	**NO**
CO_2 emissions from biomass	361.4360											
CO_2 captured	NO											
Long-term storage of C in waste disposal sites	NE											
Indirect N_2O			**0.9556**									
Indirect CO_2	**74.1622**											

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	Net CO_2 emissions / removals	CH_4	N_2O	HFCs	PFCs	Unspecified mix of HFCs and PFCs	SF_6	NF_3	NO_x	CO	NMVOC	SO_2
	(kt)			(kt CO_2 equivalent)					(kt)			
Total national emissions and removals	**5,888.6802**	**120.3744**	**4.1482**	**44.7872**	**0.0231**	**NO**	**0.0000**	**NO**	**20.0202**	**51.1171**	**47.4475**	**4.0330**
1. Energy	**7,251.2550**	**33.6430**	**0.2092**						**17.4545**	**42.9555**	**6.7550**	**3.1042**
A. Fuel combustion Reference approach	7,206.8061											
Sectoral approach	7,249.9793	1.8066	0.2092						17.4545	42.9555	5.8517	3.1042
1. Energy industries	2,890.4481	0.0592	0.0063						4.6122	2.0151	0.1350	0.2113
2. Manufacturing industries and construction	801.5026	0.0149	0.0017						1.1306	0.5048	0.3350	0.0989
3. Transport	1,846.7731	0.4274	0.1253						7.9312	21.7418	2.8091	0.0462
4. Other sectors	1,666.7458	1.3012	0.0741						3.3949	18.3862	2.5173	2.6494
5. Other	44.5097	0.0039	0.0017						0.3855	0.3075	0.0552	0.0983
B. Fugitive emissions from fuels	1.2757	31.8364	0.0000						NO	NO	0.9033	NO
1. Solid fuels	NO	NO	NO						NO	NO	NO	NO
2. Oil and natural gas and other emissions from energy production	1.2757	31.8364	0.0000						NO	NO	0.9033	NO
C. CO_2 Transport and storage	NO											
2. Industrial processes and product use	**892.1071**	**NO**	**NO**	**44.7872**	**0.0231**	**NO**	**0.0000**	**NO**	**2.3881**	**4.3206**	**39.1522**	**0.9238**
A. Mineral industry	767.6859								2.2296	1.9983	0.0245	0.8593
B. Chemical industry	NO	NO	NO						NO	NO	0.0139	NO
C. Metal industry	38.6127	NO	NO	NO	NO	NO	NO	NO	0.1256	1.6426	0.0508	0.0580
D. Non-energy products from fuels and solvent use	84.7433	NO	NO						0.0130	0.0732	34.9915	0.0065
E. Electronic industry				NO	NO	NO	NO	NO				
F. Product uses as substitutes for ODS				44.7872	NO	NO	NO	NO				
G. Other product manufacture and use	1.0652	NO	NO	NO	0.0231	NO	0.0000	NO	0.0198	0.6066	0.4842	NO
H. Other									NO	NO	3.5873	NO
3. Agriculture	**0.2631**	**31.5420**	**2.8030**						**NO**	**NO**	**NE, NO**	
A. Enteric fermentation		28.8838										
B. Manure management		2.6582	0.8615								NO	
C. Rice cultivation		NO										
D. Agricultural soils			1.9415									
E. Prescribed burning of savannas		NO	NO						NO	NO	NO	
F. Field burning of agricultural residues		IE	IE						IE	IE	IE	
G. Liming	NO											
H. Urea application	0.2631											
I. Other carbon-containing fertilizers	NO, NE											
J. Other	NO	NO	NO						NO	NO	NO	
4. Land use, land-use change and forestry	**-2,268.7122**	**0.0607**	**0.9330**						**0.0405**	**1.4511**	**NO, NE**	
A. Forest land	-2,460.3855	0.0546	0.0030						0.0349	1.2432	NO, NE	
B. Cropland	1,266.1250	0.0061	0.0002						0.0056	0.2079	NO	
C. Grassland	-1,031.2350	NE	NE						NE	NE	NE	
D. Wetlands	-131.0044	NE	NE						NE	NE	NE	
E. Settlements	49.2742	NO, NE	0.9298						NO, NE	NO, NE	NO, NE	
F. Other land	83.1072	NE	NE						NE	NE	NE	
G. Harvested wood products	-44.5936											
H. Other	NE	NE	NE						NE	NE	NE	
5. Waste	**13.7672**	**55.1286**	**0.2031**						**0.1372**	**2.3898**	**1.5403**	**0.0050**
A. Solid waste disposal	NA, NO	43.6535							NA, NO	NA, NO	1.4772	
B. Biological treatment of solid waste		0.0339	0.0020						NO, NE	0.0047	NO, NE	

C. Incineration and open burning of waste	13.7672	0.2814	0.0049						0.1372	2.3851	0.0529	0.0050
D. Wastewater treatment and discharge		11.1599	0.1961						NA, IE	NA, IE	0.0102	
E. Other	NO	NO	NO						NO	NO	NO	
6. Other	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**
Memo items:												
International bunkers	**44.2052**	**0.0027**	**0.0015**						**0.1782**	**0.1296**	**0.0393**	**0.0140**
Aviation	44.2052	0.0027	0.0015						0.1782	0.1296	0.0393	0.0140
Navigation	NO	NO	NO						NO	NO	NO	NO
Multilateral operations	**NO**	**NO**	**NO**						**NO**	**NO**	**NO**	**NO**
CO_2 emissions from biomass	304.6560											
CO_2 captured	NO											
Long-term storage of C in waste disposal sites	NE											
Indirect N_2O			**0.7714**									
Indirect CO_2	**78.0464**											

2008

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	Net CO_2 emissions / removals	CH_4	N_2O	HFCs	PFCs	Unspecified mix of HFCs and PFCs	SF_6	NF_3	NO_x	CO	NMVOC	SO_2
	(kt)			(kt CO_2 equivalent)					(kt)			
Total national emissions and removals	**6,574.2719**	**119.6418**	**4.4739**	**57.3610**	**0.0288**	**NO**	**0.0000**	**NO**	**20.8656**	**53.3534**	**41.0502**	**5.6386**
1. Energy	**7,548.6755**	**33.5536**	**0.2128**						**18.1364**	**45.6619**	**7.3512**	**4.6736**
A. Fuel combustion Reference approach	7,504.2095											
Sectoral approach	7,547.3826	1.8613	0.2127						18.1364	45.6619	6.1704	4.6736
1. Energy industries	2,990.8419	0.0652	0.0072						4.7865	2.0898	0.1404	0.3057
2. Manufacturing industries and construction	885.5633	0.0154	0.0045						1.3642	2.2677	0.4690	1.8477
3. Transport	1,949.9802	0.4511	0.1272						8.2916	22.7260	2.9400	0.0485
4. Other sectors	1,677.3708	1.3260	0.0723						3.3719	18.2724	2.5708	2.3550
5. Other	43.6263	0.0036	0.0015						0.3223	0.3060	0.0503	0.1167
B. Fugitive emissions from fuels	1.2929	31.6922	0.0000						NO	NO	1.1807	NO
1. Solid fuels	NO	NO	NO						NO	NO	NO	NO
2. Oil and natural gas and other emissions from energy production	1.2929	31.6922	0.0000						NO	NO	1.1807	NO
C. CO_2 Transport and storage	NO											
2. Industrial processes and product use	**967.6859**	**NO**	**NO**	**57.3610**	**0.0288**	**NO**	**0.0000**	**NO**	**2.5679**	**4.3540**	**32.0314**	**0.9601**
A. Mineral industry	864.4658								2.4282	2.2832	0.0278	0.9032
B. Chemical industry	NO	NO	NO						NO	NO	0.0122	NO
C. Metal industry	35.4118	NO	NO	NO	NO	NO	NO	NO	0.1152	1.5064	0.0465	0.0532
D. Non-energy products from fuels and solvent use	66.7047	NO	NO						0.0075	0.0427	26.5891	0.0037
E. Electronic industry				NO	NO	NO	NO	NO				
F. Product uses as substitutes for ODS				57.3610	NO	NO	NO	NO				
G. Other product manufacture and use	1.1036	NO	NO	NO	0.0288	NO	0.0000	NO	0.0170	0.5217	0.5016	NO
H. Other									NO	NO	4.8542	NO
3. Agriculture	**0.8505**	**30.1478**	**3.1612**						**NO**	**NO**	**NE, NO**	
A. Enteric fermentation		27.5714										
B. Manure management		2.5764	0.8529								NO	
C. Rice cultivation		NO										
D. Agricultural soils			2.3083									
E. Prescribed burning of savannas		NO	NO						NO	NO	NO	
F. Field burning of agricultural residues		IE	IE						IE	IE	IE	

G. Liming	NO											
H. Urea application	0.8505											
I. Other carbon-containing fertilizers	NO, NE											
J. Other	NO	NO	NO						NO	NO	NO	
4. Land use, land-use change and forestry	**-1,956.3934**	**0.0308**	**0.9128**						**0.0274**	**1.0067**	**NO, NE**	
A. Forest land	-2,462.7874	0.0038	0.0002						0.0024	0.0864	NO, NE	
B. Cropland	1,236.6745	0.0270	0.0007						0.0250	0.9203	NO	
C. Grassland	-932.1498	NE	NE						NE	NE	NE	
D. Wetlands	-102.8015	NE	NE						NE	NE	NE	
E. Settlements	49.2742	NO, NE	0.9119						NO, NE	NO, NE	NO, NE	
F. Other land	291.0044	NE	NE						NE	NE	NE	
G. Harvested wood products	-35.6078											
H. Other	NE	NE	NE						NE	NE	NE	
5. Waste	**13.4533**	**55.9096**	**0.1871**						**0.1339**	**2.3308**	**1.6676**	**0.0049**
A. Solid waste disposal	NA, NO	44.3767							NA, NO	NA, NO	1.6057	
B. Biological treatment of solid waste		0.0401	0.0024						NO, NE	0.0056	NO, NE	
C. Incineration and open burning of waste	13.4533	0.2748	0.0048						0.1339	2.3252	0.0517	0.0049
D. Wastewater treatment and discharge		11.2179	0.1799						NA, IE	NA, IE	0.0102	
E. Other	NO	NO	NO						NO	NO	NO	
6. Other	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**
Memo items:												
International bunkers	**44.1680**	**0.0016**	**0.0014**						**0.1855**	**0.1080**	**0.0365**	**0.0140**
Aviation	44.1680	0.0016	0.0014						0.1855	0.1080	0.0365	0.0140
Navigation	NO	NO	NO						NO	NO	NO	NO
Multilateral operations	**NO**	**NO**	**NO**						**NO**	**NO**	**NO**	**NO**
CO_2 emissions from biomass	352.4520											
CO_2 captured	NO											
Long-term storage of C in waste disposal sites	NE											
Indirect N_2O			**0.8405**									
Indirect CO_2	**59.5995**											

2009

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	Net CO_2 emissions / removals	CH_4	N_2O	HFCs	PFCs	Unspecified mix of HFCs and PFCs	SF_6	NF_3	NO_x	CO	NMVOC	SO_2
	(kt)			(kt CO_2 equivalent)			(kt)					
Total national emissions and removals	**7,009.2673**	**116.7794**	**4.4226**	**67.4790**	**0.0288**	**NO**	**0.0000**	**NO**	**19.4651**	**50.9631**	**35.9526**	**5.2233**
1. Energy	**8,093.8632**	**28.9540**	**0.1933**						**18.0332**	**45.9932**	**7.2201**	**4.6938**
A. Fuel combustion Reference approach	8,049.3971											
Sectoral approach	8,092.5702	1.9828	0.1933						18.0332	45.9932	6.0503	4.6938
1. Energy industries	3,835.5110	0.0831	0.0092						6.1430	2.6585	0.1791	0.6150
2. Manufacturing industries and construction	501.9635	0.0080	0.0030						0.7725	1.6620	0.2842	1.4375
3. Transport	1,919.6624	0.4575	0.1112						7.5165	22.6058	2.8767	0.0046
4. Other sectors	1,824.9424	1.4331	0.0696						3.4994	18.9129	2.6852	2.6186
5. Other	10.4909	0.0011	0.0003						0.1018	0.1540	0.0251	0.0182
B. Fugitive emissions from fuels	1.2930	26.9712	0.0000						NO	NO	1.1698	NO
1. Solid fuels	NO	NO	NO						NO	NO	NO	NO
2. Oil and natural gas and other emissions from energy production	1.2930	26.9712	0.0000						NO	NO	1.1698	NO

C. CO_2 Transport and storage	NO											
2. Industrial processes and product use	**462.2951**	**NO**	**NO**	**67.4790**	**0.0288**	**NO**	**0.0000**	**NO**	**1.2921**	**2.3712**	**26.6433**	**0.5246**
A. Mineral industry	386.8478								1.2106	0.9874	0.0123	0.4962
B. Chemical industry	NO	NO	NO						NO	NO	0.0100	NO
C. Metal industry	17.0619	NO	NO	NO	NO	NO	NO	NO	0.0555	0.7255	0.0227	0.0256
D. Non-energy products from fuels and solvent use	57.5805	NO	NO						0.0056	0.0316	22.9783	0.0028
E. Electronic industry				NO	NO	NO	NO	NO				
F. Product uses as substitutes for ODS				67.4790	NO	NO	NO	NO				
G. Other product manufacture and use	0.8048	NO	NO	NO	0.0288	NO	0.0000	NO	0.0205	0.6267	0.3658	NO
H. Other									NO	NO	3.2541	NO
3. Agriculture	**0.5864**	**31.4621**	**3.1480**						**NO**	**NO**	**NE, NO**	
A. Enteric fermentation		28.5438										
B. Manure management		2.9183	0.9659								NO	
C. Rice cultivation		NO										
D. Agricultural soils			2.1821									
E. Prescribed burning of savannas		NO	NO						NO	NO	NO	
F. Field burning of agricultural residues		IE	IE						IE	IE	IE	
G. Liming	NO											
H. Urea application	0.5864											
I. Other carbon-containing fertilizers	NO, NE											
J. Other	NO	NO	NO						NO	NO	NO	
4. Land use, land-use change and forestry	**-1,560.6386**	**0.0126**	**0.8904**						**0.0090**	**0.3239**	**NO, NE**	
A. Forest land	-2,526.0659	0.0093	0.0005						0.0059	0.2108	NO, NE	
B. Cropland	1,390.6850	0.0033	0.0001						0.0031	0.1130	NO	
C. Grassland	-447.6932	NE	NE						NE	NE	NE	
D. Wetlands	-74.5986	NE	NE						NE	NE	NE	
E. Settlements	45.5694	NO, NE	0.8898						NO, NE	NO, NE	NO, NE	
F. Other land	79.9357	NE	NE						NE	NE	NE	
G. Harvested wood products	-28.4708											
H. Other	NE	NE	NE						NE	NE	NE	
5. Waste	**13.1613**	**56.3507**	**0.1909**						**0.1308**	**2.2748**	**2.0892**	**0.0048**
A. Solid waste disposal	NA, NO	45.5616							NA, NO	NA, NO	2.0285	
B. Biological treatment of solid waste		0.0446	0.0027						NO, NE	0.0062	NO, NE	
C. Incineration and open burning of waste	13.1613	0.2686	0.0047						0.1308	2.2685	0.0505	0.0048
D. Wastewater treatment and discharge		10.4759	0.1835						NA, IE	NA, IE	0.0102	
E. Other	NO	NO	NO						NO	NO	NO	
6. Other	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**
Memo items:												
International bunkers	**44.1719**	**0.0017**	**0.0014**						**0.1878**	**0.1094**	**0.0380**	**0.0140**
Aviation	44.1719	0.0017	0.0014						0.1878	0.1094	0.0380	0.0140
Navigation	NO	NO	NO						NO	NO	NO	NO
Multilateral operations	**NO**	**NO**	**NO**						**NO**	**NO**	**NO**	**NO**
CO_2 emissions from biomass	362.1000											
CO_2 captured	NO											
Long-term storage of C in waste disposal sites	NE											
Indirect N_2O			**0.8652**									
Indirect CO_2	**51.3571**											

2010

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	Net CO_2 emissions / removals	CH_4	N_2O	HFCs	PFCs	Unspecified mix of HFCs and PFCs	SF_6	NF_3	NO_x	CO	NMVOC	SO_2
	(kt)			(kt CO_2 equivalent)					(kt)			
Total national emissions and removals	**7,729.4961**	**117.4269**	**4.6666**	**78.1507**	**0.0403**	**NO**	**0.0000**	**NO**	**21.4739**	**53.2513**	**40.8386**	**5.3806**
1. Energy	**8,719.0513**	**28.5855**	**0.2105**						**19.9684**	**48.6806**	**7.2606**	**4.8053**
A. Fuel combustion Reference approach	8,677.6661											
Sectoral approach	8,717.7555	2.1371	0.2105						19.9684	48.6806	6.3424	4.8053
1. Energy industries	4,047.8107	0.0891	0.0098						6.4814	2.8196	0.1898	0.5281
2. Manufacturing industries and construction	516.1412	0.0094	0.0030						0.8397	1.5071	0.2868	1.2574
3. Transport	2,140.5138	0.4708	0.1225						8.7584	22.2774	2.8861	0.0052
4. Other sectors	1,985.9921	1.5654	0.0746						3.7644	21.8247	2.9363	2.9155
5. Other	27.2976	0.0023	0.0006						0.1245	0.2519	0.0434	0.0991
B. Fugitive emissions from fuels	1.2958	26.4485	0.0000						NO	NO	0.9181	NO
1. Solid fuels	NO	NO	NO						NO	NO	NO	NO
2. Oil and natural gas and other emissions from energy production	1.2958	26.4485	0.0000						NO	NO	0.9181	NO
C. CO_2 Transport and storage	NO											
2. Industrial processes and product use	**482.3543**	**NO**	**NO**	**78.1507**	**0.0403**	**NO**	**0.0000**	**NO**	**1.3736**	**2.2003**	**31.1949**	**0.5705**
A. Mineral industry	405.3915								1.3115	1.0242	0.0127	0.5525
B. Chemical industry	NO	NO	NO						NO	NO	0.0143	NO
C. Metal industry	9.6985	NO	NO	NO	NO	NO	NO	NO	0.0315	0.4121	0.0128	0.0145
D. Non-energy products from fuels and solvent use	66.2398	NO	NO						0.0069	0.0392	26.4907	0.0034
E. Electronic industry				NO	NO	NO	NO	NO				
F. Product uses as substitutes for ODS				78.1507	NO	NO	NO	NO				
G. Other product manufacture and use	1.0245	NO	NO	NO	0.0403	NO	0.0000	NO	0.0237	0.7247	0.4657	NO
H. Other									NO	NO	4.1987	NO
3. Agriculture	**1.7443**	**31.4952**	**3.4048**						**NO**	**NO**	**NE, NO**	
A. Enteric fermentation		28.3270										
B. Manure management		3.1682	1.0080								NO	
C. Rice cultivation		NO										
D. Agricultural soils			2.3968									
E. Prescribed burning of savannas		NO	NO						NO	NO	NO	
F. Field burning of agricultural residues		IE	IE						IE	IE	IE	
G. Liming	NO											
H. Urea application	1.7443											
I. Other carbon-containing fertilizers	NO, NE											
J. Other	NO	NO	NO						NO	NO	NO	
4. Land use, land-use change and forestry	**-1,486.5202**	**0.0056**	**0.8665**						**0.0042**	**0.1529**	**NO, NE**	
A. Forest land	-2,484.1627	0.0032	0.0002						0.0021	0.0737	NO, NE	
B. Cropland	1,271.7754	0.0023	0.0001						0.0022	0.0792	NO	
C. Grassland	-691.9874	NE	NE						NE	NE	NE	
D. Wetlands	-46.3958	NE	NE						NE	NE	NE	
E. Settlements	45.5694	NO, NE	0.8663						NO, NE	NO, NE	NO, NE	
F. Other land	441.4824	NE	NE						NE	NE	NE	
G. Harvested wood products	-22.8014											
H. Other	NE	NE	NE						NE	NE	NE	
5. Waste	**12.8663**	**57.3406**	**0.1848**						**0.1277**	**2.2175**	**2.3831**	**0.0048**
A. Solid waste disposal	NA, NO	46.4268							NA, NO	NA, NO	2.3236	
B. Biological treatment of solid waste		0.0430	0.0026						NO, NE	0.0060	NO, NE	

C. Incineration and open burning of waste	12.8663	0.2624	0.0046						0.1277	2.2115	0.0492	0.0048
D. Wastewater treatment and discharge		10.6084	0.1776						NA, IE	NA, IE	0.0102	
E. Other	NO	NO	NO						NO	NO	NO	
6. Other	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**
Memo items:												
International bunkers	**41.0593**	**0.0026**	**0.0014**						**0.1667**	**0.1218**	**0.0377**	**0.0130**
Aviation	41.0593	0.0026	0.0014						0.1667	0.1218	0.0377	0.0130
Navigation	NO	NO	NO						NO	NO	NO	NO
Multilateral operations	**NO**	**NO**	**NO**						**NO**	**NO**	**NO**	**NO**
CO_2 emissions from biomass	341.0480											
CO_2 captured	NO											
Long-term storage of C in waste disposal sites	NE											
Indirect N_2O			**0.9310**									
Indirect CO_2	**59.3041**											

2011

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	Net CO_2 emissions / removals	CH_4	N_2O	HFCs	PFCs	Unspecified mix of HFCs and PFCs	SF_6	NF_3	NO_x	CO	NMVOC	SO_2
	(kt)			(kt CO_2 equivalent)			(kt)					
Total national emissions and removals	**8,094.7768**	**119.2316**	**4.5853**	**90.5042**	**0.0403**	**NO**	**0.0000**	**NO**	**22.1003**	**56.0110**	**43.5601**	**5.5088**
1. Energy	**8,926.8957**	**31.8482**	**0.2164**						**20.3098**	**51.1208**	**7.8715**	**4.8128**
A. Fuel combustion Reference approach	8,885.4717											
Sectoral approach	8,925.5610	2.2550	0.2164						20.3098	51.1208	6.8151	4.8128
1. Energy industries	3,746.1444	0.0799	0.0087						5.9885	2.6096	0.1753	0.3978
2. Manufacturing industries and construction	576.1765	0.0107	0.0036						0.9067	1.8629	0.3338	1.5810
3. Transport	2,272.6744	0.4687	0.1281						9.1192	22.9464	2.9620	0.0056
4. Other sectors	2,310.7777	1.6944	0.0756						4.1423	23.3551	3.2990	2.7405
5. Other	19.7881	0.0013	0.0004						0.1531	0.3469	0.0449	0.0879
B. Fugitive emissions from fuels	1.3347	29.5932	0.0000						NO	NO	1.0564	NO
1. Solid fuels	NO	NO	NO						NO	NO	NO	NO
2. Oil and natural gas and other emissions from energy production	1.3347	29.5932	0.0000						NO	NO	1.0564	NO
C. CO_2 Transport and storage	NO											
2. Industrial processes and product use	**573.6077**	**NO**	**NO**	**90.5042**	**0.0403**	**NO**	**0.0000**	**NO**	**1.6612**	**2.5605**	**33.5228**	**0.6913**
A. Mineral industry	488.1986								1.5879	1.2450	0.0156	0.6681
B. Chemical industry	NO	NO	NO						NO	NO	0.0157	NO
C. Metal industry	12.8556	NO	NO	NO	NO	NO	NO	NO	0.0418	0.5465	0.0169	0.0193
D. Non-energy products from fuels and solvent use	71.3244	NO	NO						0.0078	0.0443	28.6400	0.0039
E. Electronic industry				NO	NO	NO	NO	NO				
F. Product uses as substitutes for ODS				90.5042	NO	NO	NO	NO				
G. Other product manufacture and use	1.2291	NO	NO	NO	0.0403	NO	0.0000	NO	0.0237	0.7248	0.5587	NO
H. Other									NO	NO	4.2760	NO
3. Agriculture	**3.6752**	**29.6755**	**3.3378**						**NO**	**NO**	**NE, NO**	
A. Enteric fermentation		26.6765										
B. Manure management		2.9990	0.9189								NO	
C. Rice cultivation		NO										
D. Agricultural soils			2.4190									
E. Prescribed burning of savannas		NO	NO						NO	NO	NO	
F. Field burning of agricultural residues		IE	IE						IE	IE	IE	

G. Liming	NO											
H. Urea application	3.6752											
I. Other carbon-containing fertilizers	NO, NE											
J. Other	NO	NO	NO						NO	NO	NO	
4. Land use, land-use change and forestry	**-1,421.9811**	**0.0064**	**0.8455**						**0.0047**	**0.1694**	**NO, NE**	
A. Forest land	-2,390.5712	0.0043	0.0002						0.0028	0.0987	NO, NE	
B. Cropland	1,230.6841	0.0021	0.0001						0.0019	0.0707	NO	
C. Grassland	-638.1726	NE	NE						NE	NE	NE	
D. Wetlands	-75.3129	NE	NE						NE	NE	NE	
E. Settlements	62.0438	NO, NE	0.8452						NO, NE	NO, NE	NO, NE	
F. Other land	393.7285	NE	NE						NE	NE	NE	
G. Harvested wood products	-4.3808											
H. Other	NE	NE	NE						NE	NE	NE	
5. Waste	**12.5793**	**57.7015**	**0.1856**						**0.1246**	**2.1602**	**2.1659**	**0.0047**
A. Solid waste disposal	NA, NO	47.0716							NA, NO	NA, NO	2.1076	
B. Biological treatment of solid waste		0.0437	0.0026						NO, NE	0.0061	NO, NE	
C. Incineration and open burning of waste	12.5793	0.2562	0.0045						0.1246	2.1541	0.0480	0.0047
D. Wastewater treatment and discharge		10.3301	0.1785						NA, IE	NA, IE	0.0102	
E. Other	NO	NO	NO						NO	NO	NO	
6. Other	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**
Memo items:												
International bunkers	41.0082	0.0028	0.0013						0.1611	0.1246	0.0496	0.0130
Aviation	41.0082	0.0028	0.0013						0.1611	0.1246	0.0496	0.0130
Navigation	NO	NO	NO						NO	NO	NO	NO
Multilateral operations	**NO**	**NO**	**NO**						**NO**	**NO**	**NO**	**NO**
CO_2 emissions from biomass	384.6400											
CO_2 captured	NO											
Long-term storage of C in waste disposal sites	NE											
Indirect N_2O			**0.8990**									
Indirect CO_2	**64.2370**											

2012

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	Net CO_2 emissions / removals	CH_4	N_2O	HFCs	PFCs	Unspecified mix of HFCs and PFCs	SF_6	NF_3	NO_x	CO	NMVOC	SO_2
	(kt)			(kt CO_2 equivalent)			(kt)					
Total national emissions and removals	**7,780.7180**	**116.6790**	**4.3276**	**100.4768**	**0.0403**	**NO**	**0.0000**	**NO**	**20.9436**	**55.4622**	**44.8404**	**5.5982**
1. Energy	**8,614.8544**	**31.6092**	**0.2019**						**19.2239**	**49.8924**	**7.6602**	**4.9700**
A. Fuel combustion Reference approach	8,567.2666											
Sectoral approach	8,613.5235	2.4176	0.2019						19.2239	49.8924	6.6913	4.9700
1. Energy industries	3,803.4077	0.0755	0.0086						6.0853	2.6153	0.1756	0.6665
2. Manufacturing industries and construction	539.1478	0.0106	0.0030						0.8256	1.4506	0.3009	1.1715
3. Transport	1,992.5651	0.4049	0.1152						8.2265	19.3038	2.5284	0.0048
4. Other sectors	2,271.4679	1.9260	0.0750						4.0329	26.3885	3.6707	3.1225
5. Other	6.9350	0.0006	0.0002						0.0536	0.1342	0.0157	0.0047
B. Fugitive emissions from fuels	1.3309	29.1916	0.0000						NO	NO	0.9690	NO
1. Solid fuels	NO	NO	NO						NO	NO	NO	NO
2. Oil and natural gas and other emissions from energy production	1.3309	29.1916	0.0000						NO	NO	0.9690	NO

C. CO_2 Transport and storage	NO											
2. Industrial processes and product use	**581.6659**	**NO**	**NO**	**100.4768**	**0.0403**	**NO**	**0.0000**	**NO**	**1.5683**	**2.4006**	**35.1868**	**0.6236**
A. Mineral industry	493.1587								1.5008	1.2782	0.0159	0.6001
B. Chemical industry	NO	NO	NO						NO	NO	0.0150	NO
C. Metal industry	12.6973	NO	NO	NO	NO	NO	NO	NO	0.0413	0.5398	0.0171	0.0191
D. Non-energy products from fuels and solvent use	74.6523	NO	NO						0.0088	0.0500	30.6212	0.0044
E. Electronic industry				NO	NO	NO	NO	NO				
F. Product uses as substitutes for ODS				100.4768	NO	NO	NO	NO				
G. Other product manufacture and use	1.1575	NO	NO	NO	0.0403	NO	0.0000	NO	0.0174	0.5326	0.5261	NO
H. Other									NO	NO	3.9915	NO
3. Agriculture	**5.5908**	**27.9757**	**3.1555**						**NO**	**NO**	**NE, NO**	
A. Enteric fermentation		25.2109										
B. Manure management		2.7648	0.8439								NO	
C. Rice cultivation		NO										
D. Agricultural soils			2.3116									
E. Prescribed burning of savannas		NO	NO						NO	NO	NO	
F. Field burning of agricultural residues		IE	IE						IE	IE	IE	
G. Liming	NO											
H. Urea application	5.5908											
I. Other carbon-containing fertilizers	NO, NE											
J. Other	NO	NO	NO						NO	NO	NO	
4. Land use, land-use change and forestry	**-1,433.6639**	**0.0467**	**0.7833**						**0.0299**	**1.0665**	**NO, NE**	
A. Forest land	-2,294.8221	0.0464	0.0026						0.0296	1.0564	NO, NE	
B. Cropland	1,236.5016	0.0003	0.0000						0.0003	0.0101	NO	
C. Grassland	-562.7510	NE	NE						NE	NE	NE	
D. Wetlands	-15.4700	NE	NE						NE	NE	NE	
E. Settlements	11.8882	NO, NE	0.7807						NO, NE	NO, NE	NO, NE	
F. Other land	114.1449	NE	NE						NE	NE	NE	
G. Harvested wood products	76.8444											
H. Other	NE	NE	NE						NE	NE	NE	
5. Waste	**12.2708**	**57.0474**	**0.1870**						**0.1214**	**2.1026**	**1.9934**	**0.0046**
A. Solid waste disposal	NA, NO	46.5498							NA, NO	NA, NO	1.9364	
B. Biological treatment of solid waste		0.0447	0.0027						NO, NE	0.0063	NO, NE	
C. Incineration and open burning of waste	12.2708	0.2498	0.0044						0.1214	2.0963	0.0468	0.0046
D. Wastewater treatment and discharge		10.2031	0.1799						NA, IE	NA, IE	0.0101	
E. Other	NO	NO	NO						NO	NO	NO	
6. Other	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**
Memo items:												
International bunkers	**47.3142**	**0.0028**	**0.0015**						**0.1806**	**0.1322**	**0.0558**	**0.0150**
Aviation	47.3142	0.0028	0.0015						0.1806	0.1322	0.0558	0.0150
Navigation	NO	NO	NO						NO	NO	NO	NO
Multilateral operations	**NO**	**NO**	**NO**						**NO**	**NO**	**NO**	**NO**
CO_2 emissions from biomass	403.3840											
CO_2 captured	NO											
Long-term storage of C in waste disposal sites	NE											
Indirect N_2O			**0.8550**									
Indirect CO_2	**68.5241**											

2013

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	Net CO_2 emissions / removals	CH_4	N_2O	HFCs	PFCs	Unspecified mix of HFCs and PFCs	SF_6	NF_3	NO_x	CO	NMVOC	SO_2
	(kt)			(kt CO_2 equivalent)					(kt)			
Total national emissions and removals	**7,577.6937**	**112.5614**	**4.7193**	**109.0841**	**0.0403**	**NO**	**0.0000**	**NO**	**21.2300**	**55.9651**	**43.8719**	**13.1659**
1. Energy	**8,227.6443**	**29.7144**	**0.2194**						**19.3494**	**50.9262**	**7.6008**	**12.4523**
A. Fuel combustion Reference approach	8,185.8950											
Sectoral approach	8,225.9844	2.4705	0.2194						19.3494	50.9262	6.7020	12.4523
1. Energy industries	3,596.7176	0.0677	0.0188						6.2249	2.0253	0.1397	7.1268
2. Manufacturing industries and construction	577.6855	0.0097	0.0042						0.8830	2.3030	0.3557	2.0352
3. Transport	2,101.2934	0.4086	0.1153						8.4230	18.8125	2.4595	0.0049
4. Other sectors	1,947.9381	1.9842	0.0809						3.7783	27.7557	3.7434	3.2852
5. Other	2.3497	0.0003	0.0001						0.0403	0.0297	0.0037	0.0003
B. Fugitive emissions from fuels	1.6599	27.2439	0.0000						NO	NO	0.8989	NO
1. Solid fuels	NO	NO	NO						NO	NO	NO	NO
2. Oil and natural gas and other emissions from energy production	1.6599	27.2439	0.0000						NO	NO	0.8989	NO
C. CO_2 Transport and storage	NO											
2. Industrial processes and product use	**623.1087**	**NO**	**NO**	**109.0841**	**0.0403**	**NO**	**0.0000**	**NO**	**1.7397**	**2.1714**	**34.2507**	**0.7091**
A. Mineral industry	544.8742								1.6927	1.3902	0.0172	0.6929
B. Chemical industry	NO	NO	NO						NO	NO	0.0159	NO
C. Metal industry	7.6569	NO	NO	NO	NO	NO	NO	NO	0.0249	0.3250	0.0100	0.0115
D. Non-energy products from fuels and solvent use	69.4810	NO	NO						0.0088	0.0501	28.2397	0.0044
E. Electronic industry				NO	NO	NO	NO	NO				
F. Product uses as substitutes for ODS				109.0841	NO	NO	NO	NO				
G. Other product manufacture and use	1.0965	NO	NO	NO	0.0403	NO	0.0000	NO	0.0133	0.4062	0.4984	0.0003
H. Other									NO	NO	5.4694	NO
3. Agriculture	**4.1840**	**28.1102**	**3.5830**						**NO**	**NO**	**NE, NO**	
A. Enteric fermentation		25.3945										
B. Manure management		2.7156	0.7857								NO	
C. Rice cultivation		NO										
D. Agricultural soils			2.7973									
E. Prescribed burning of savannas		NO	NO						NO	NO	NO	
F. Field burning of agricultural residues		IE	IE						IE	IE	IE	
G. Liming	NO											
H. Urea application	4.1840											
I. Other carbon-containing fertilizers	NO, NE											
J. Other	NO	NO	NO						NO	NO	NO	
4. Land use, land-use change and forestry	**-1,289.1465**	**0.0349**	**0.7290**						**0.0230**	**0.8236**	**NO, NE**	
A. Forest land	-2,141.8702	0.0322	0.0018						0.0206	0.7339	NO, NE	
B. Cropland	1,139.9149	0.0026	0.0001						0.0024	0.0898	NO	
C. Grassland	-360.1740	NE	NE						NE	NE	NE	
D. Wetlands	-106.0998	NE	NE						NE	NE	NE	
E. Settlements	13.7512	NO, NE	0.7272						NO, NE	NO, NE	NO, NE	
F. Other land	103.4500	NE	NE						NE	NE	NE	
G. Harvested wood products	61.8814											
H. Other	NE	NE	NE						NE	NE	NE	
5. Waste	**11.9033**	**54.7019**	**0.1879**						**0.1179**	**2.0438**	**2.0204**	**0.0045**
A. Solid waste disposal	NA, NO	44.1567							NA, NO	NA, NO	1.9649	
B. Biological treatment of solid waste		0.0486	0.0029						NO, NE	0.0068	NO, NE	

C. Incineration and open burning of waste	11.9033	0.2424	0.0043						0.1179	2.0370	0.0454	0.0045
D. Wastewater treatment and discharge		10.2543	0.1807						NA, IE	NA, IE	0.0101	
E. Other	NO	NO	NO						NO	NO	NO	
6. Other	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**
Memo items:												
International bunkers	**41.0717**	**0.0046**	**0.0013**						**0.1592**	**0.1584**	**0.0571**	**0.0130**
Aviation	41.0717	0.0046	0.0013						0.1592	0.1584	0.0571	0.0130
Navigation	NO	NO	NO						NO	NO	NO	NO
Multilateral operations	**NO**	**NO**	**NO**						**NO**	**NO**	**NO**	**NO**
CO_2 emissions from biomass	429.2796											
CO_2 captured	NO											
Long-term storage of C in waste disposal sites	NE											
Indirect N_2O			**0.9257**									
Indirect CO_2	**63.2239**											

2014

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	Net CO_2 emissions / removals	CH_4	N_2O	HFCs	PFCs	Unspecified mix of HFCs and PFCs	SF_6	NF_3	NO_x	CO	NMVOC	SO_2
	(kt)			(kt CO_2 equivalent)					(kt)			
Total national emissions and removals	**7,945.4252**	**114.4810**	**5.2731**	**122.9816**	**0.0403**	**NO**	**0.0000**	**NO**	**20.9724**	**82.3162**	**56.3396**	**5.3742**
1. Energy	**8,214.8567**	**31.2848**	**0.2441**						**19.1555**	**77.8236**	**11.7283**	**4.6819**
A. Fuel combustion Reference approach	8,160.7414											
Sectoral approach	8,213.1659	4.5778	0.2441						19.1555	77.8236	10.9231	4.6819
1. Energy industries	3,555.9756	0.0750	0.0082						5.6971	2.4781	0.1664	0.4068
2. Manufacturing industries and construction	563.8971	0.0099	0.0036						0.8995	1.9366	0.3298	1.6679
3. Transport	2,140.5508	0.4056	0.1070						8.0152	18.5701	2.4006	0.0049
4. Other sectors	1,927.7357	4.0868	0.1247						4.4921	54.5828	8.0026	2.4012
5. Other	25.0067	0.0006	0.0005						0.0516	0.2560	0.0237	0.2011
B. Fugitive emissions from fuels	1.6908	26.7070	0.0000						NO	NO	0.8052	NO
1. Solid fuels	NO	NO	NO						NO	NO	NO	NO
2. Oil and natural gas and other emissions from energy production	1.6908	26.7070	0.0000						NO	NO	0.8052	NO
C. CO_2 Transport and storage	NO											
2. Industrial processes and product use	**636.1602**	**NO**	**NO**	**122.9816**	**0.0403**	**NO**	**0.0000**	**NO**	**1.6990**	**2.3772**	**42.6162**	**0.6880**
A. Mineral industry	533.8710								1.6295	1.3602	0.0167	0.6601
B. Chemical industry	NO	NO	NO						NO	NO	0.0166	NO
C. Metal industry	13.8464	NO	NO	NO	NO	NO	NO	NO	0.0450	0.5882	0.0186	0.0208
D. Non-energy products from fuels and solvent use	87.2367	NO	NO						0.0128	0.0723	36.3007	0.0064
E. Electronic industry				NO	NO	NO	NO	NO				
F. Product uses as substitutes for ODS				122.9816	NO	NO	NO	NO				
G. Other product manufacture and use	1.2062	NO	NO	NO	0.0403	NO	0.0000	NO	0.0117	0.3565	0.5483	0.0007
H. Other									NO	NO	5.7153	NO
3. Agriculture	**10.2058**	**28.9203**	**4.1636**						**NO**	**NO**	**NE, NO**	
A. Enteric fermentation		26.1032										
B. Manure management		2.8171	0.8671								NO	
C. Rice cultivation		NO										
D. Agricultural soils			3.2966									
E. Prescribed burning of savannas		NO	NO						NO	NO	NO	
F. Field burning of agricultural residues		IE	IE						IE	IE	IE	

G. Liming	NO											
H. Urea application	10.2058											
I. Other carbon-containing fertilizers	NO, NE											
J. Other	NO	NO	NO						NO	NO	NO	
4. Land use, land-use change and forestry	**-927.3346**	**0.0047**	**0.6794**						**0.0036**	**0.1293**	**NO, NE**	
A. Forest land	-2,134.7390	0.0027	0.0001						0.0017	0.0603	NO, NE	
B. Cropland	1,174.6145	0.0020	0.0001						0.0019	0.0690	NO	
C. Grassland	-341.1085	NE	NE						NE	NE	NE	
D. Wetlands	-139.7535	NE	NE						NE	NE	NE	
E. Settlements	18.9848	NO, NE	0.6792						NO, NE	NO, NE	NO, NE	
F. Other land	436.6463	NE	NE						NE	NE	NE	
G. Harvested wood products	58.0208											
H. Other	NE	NE	NE						NE	NE	NE	
5. Waste	**11.5371**	**54.2712**	**0.1860**						**0.1144**	**1.9861**	**1.9951**	**0.0043**
A. Solid waste disposal	NA, NO	44.0518							NA, NO	NA, NO	1.9411	
B. Biological treatment of solid waste		0.0508	0.0030						NO, NE	0.0071	NO, NE	
C. Incineration and open burning of waste	11.5371	0.2351	0.0041						0.1144	1.9790	0.0441	0.0043
D. Wastewater treatment and discharge		9.9335	0.1788						NA, IE	NA, IE	0.0100	
E. Other	NO	NO	NO						NO	NO	NO	
6. Other	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**
Memo items:												
International bunkers	**53.6855**	**0.0034**	**0.0018**						**0.2110**	**0.1599**	**0.0553**	**0.0170**
Aviation	53.6855	0.0034	0.0018						0.2110	0.1599	0.0553	0.0170
Navigation	NO	NO	NO						NO	NO	NO	NO
Multilateral operations	**NO**	**NO**	**NO**						**NO**	**NO**	**NO**	**NO**
CO_2 emissions from biomass	1,314.4896											
CO_2 captured	NO											
Long-term storage of C in waste disposal sites	NE											
Indirect N_2O			**1.0793**									
Indirect CO_2	**81.0677**											

2015

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	Net CO_2 emissions / removals	CH_4	N_2O	HFCs	PFCs	Unspecified mix of HFCs and PFCs	SF_6	NF_3	NO_x	CO	NMVOC	SO_2
	(kt)			(kt CO_2 equivalent)					(kt)			
Total national emissions and removals	**7,536.3186**	**112.5958**	**4.4226**	**157.0394**	**0.0403**	**NO**	**0.0000**	**NO**	**21.8835**	**87.3129**	**54.1274**	**4.8979**
1. Energy	**8,277.6210**	**30.5108**	**0.2660**						**20.0982**	**81.9714**	**12.2797**	**4.2232**
A. Fuel combustion Reference approach	8,220.4351											
Sectoral approach	8,275.9434	4.8476	0.2660						20.0982	81.9714	11.5338	4.2232
1. Energy industries	3,684.4508	0.0658	0.0067						5.8503	2.5548	0.1705	0.1072
2. Manufacturing industries and construction	517.0989	0.0100	0.0035						0.7978	1.8079	0.3136	1.5442
3. Transport	2,261.4456	0.4285	0.1197						8.8431	19.1901	2.5021	0.0051
4. Other sectors	1,790.2120	4.3428	0.1357						4.5595	58.1877	8.5261	2.3805
5. Other	22.7360	0.0005	0.0004						0.0475	0.2309	0.0216	0.1861
B. Fugitive emissions from fuels	1.6776	25.6632	0.0000						NO	NO	0.7458	NO
1. Solid fuels	NO	NO	NO						NO	NO	NO	NO
2. Oil and natural gas and other emissions from energy production	1.6776	25.6632	0.0000						NO	NO	0.7458	NO

C. CO_2 Transport and storage	NO											
2. Industrial processes and product use	**606.9922**	**NO**	**NO**	**157.0394**	**0.0403**	**NO**	**0.0000**	**NO**	**1.6355**	**2.4169**	**39.6803**	**0.6699**
A. Mineral industry	504.2041								1.5589	1.2767	0.0159	0.6393
B. Chemical industry	NO	NO	NO						NO	NO	0.0119	NO
C. Metal industry	17.2792	NO	NO	NO	NO	NO	NO	NO	0.0561	0.7340	0.0221	0.0259
D. Non-energy products from fuels and solvent use	84.5691	NO	NO						0.0089	0.0501	34.9703	0.0044
E. Electronic industry				NO	NO	NO	NO	NO				
F. Product uses as substitutes for ODS				157.0394	NO	NO	NO	NO				
G. Other product manufacture and use	0.9397	NO	NO	NO	0.0403	NO	0.0000	NO	0.0116	0.3561	0.4271	0.0003
H. Other									NO	NO	4.2329	NO
3. Agriculture	**11.2402**	**27.9230**	**3.3285**						**NO**	**NO**	**NE, NO**	
A. Enteric fermentation		25.1684										
B. Manure management		2.7546	0.8386								NO	
C. Rice cultivation		NO										
D. Agricultural soils			2.4899									
E. Prescribed burning of savannas		NO	NO						NO	NO	NO	
F. Field burning of agricultural residues		IE	IE						IE	IE	IE	
G. Liming	NO											
H. Urea application	11.2402											
I. Other carbon-containing fertilizers	NO, NE											
J. Other	NO	NO	NO						NO	NO	NO	
4. Land use, land-use change and forestry	**-1,372.8484**	**0.0261**	**0.6385**						**0.0171**	**0.6122**	**NO, NE**	
A. Forest land	-2,159.4439	0.0246	0.0014						0.0157	0.5596	NO, NE	
B. Cropland	1,112.6279	0.0015	0.0000						0.0014	0.0526	NO	
C. Grassland	-418.4569	NE	NE						NE	NE	NE	
D. Wetlands	-82.7917	NE	NE						NE	NE	NE	
E. Settlements	39.1617	NO, NE	0.6371						NO, NE	NO, NE	NO, NE	
F. Other land	86.8192	NE	NE						NE	NE	NE	
G. Harvested wood products	49.2353											
H. Other	NE	NE	NE						NE	NE	NE	
5. Waste	**13.3135**	**54.1360**	**0.1897**						**0.1326**	**2.3124**	**2.1675**	**0.0049**
A. Solid waste disposal	NA, NO	44.1799							NA, NO	NA, NO	2.1063	
B. Biological treatment of solid waste		0.0508	0.0030						NO, NE	0.0071	NO, NE	
C. Incineration and open burning of waste	13.3135	0.2721	0.0048						0.1326	2.3053	0.0512	0.0049
D. Wastewater treatment and discharge		9.6331	0.1819						NA, IE	NA, IE	0.0100	
E. Other	NO	NO	NO						NO	NO	NO	
6. Other	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**
Memo items:												
International bunkers	**56.8077**	**0.0056**	**0.0018**						**0.2255**	**0.1841**	**0.0817**	**0.0180**
Aviation	56.8077	0.0056	0.0018						0.2255	0.1841	0.0817	0.0180
Navigation	NO	NO	NO						NO	NO	NO	NO
Multilateral operations	**NO**	**NO**	**NO**						**NO**	**NO**	**NO**	**NO**
CO_2 emissions from biomass	1,428.4386											
CO_2 captured	NO											
Long-term storage of C in waste disposal sites	NE											
Indirect N_2O			**0.8886**									
Indirect CO_2	**77.8743**											

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	Net CO_2 emissions / removals	CH_4	N_2O	HFCs	PFCs	Unspecified mix of HFCs and PFCs	SF_6	NF_3	NO_x	CO	NMVOC	SO_2
	(kt)			(kt CO_2 equivalent)					(kt)			
Total national emissions and removals	**7,841.2042**	**115.3513**	**4.8650**	**166.7099**	**0.0403**	**NO**	**0.0000**	**NO**	**22.5896**	**90.1410**	**55.4061**	**4.0432**
1. Energy	**8,353.8926**	**32.7079**	**0.2853**						**20.9516**	**85.7020**	**12.9977**	**3.4387**
A. Fuel combustion Reference approach	8,253.5211											
Sectoral approach	8,352.2025	5.2344	0.2853						20.9516	85.7020	12.2579	3.4387
1. Energy industries	3,644.8751	0.0657	0.0069						5.7964	2.5196	0.1682	0.2330
2. Manufacturing industries and construction	488.6172	0.0092	0.0026						0.7463	1.2679	0.2653	1.0227
3. Transport	2,428.3642	0.4966	0.1370						9.8296	19.6407	2.5824	0.0054
4. Other sectors	1,767.4874	4.6624	0.1384						4.5317	62.0479	9.2199	1.9853
5. Other	22.8586	0.0005	0.0004						0.0476	0.2260	0.0221	0.1923
B. Fugitive emissions from fuels	1.6900	27.4735	0.0000						NO	NO	0.7398	NO
1. Solid fuels	NO	NO	NO						NO	NO	NO	NO
2. Oil and natural gas and other emissions from energy production	1.6900	27.4735	0.0000						NO	NO	0.7398	NO
C. CO_2 Transport and storage	NO											
2. Industrial processes and product use	**579.1078**	**NO**	**NO**	**166.7099**	**0.0403**	**NO**	**0.0000**	**NO**	**1.4983**	**1.8206**	**40.1156**	**0.5998**
A. Mineral industry	488.0182								1.4633	1.2375	0.0154	0.5879
B. Chemical industry	NO	NO	NO						NO	NO	0.0131	NO
C. Metal industry	5.2203	NO	NO	NO	NO	NO	NO	NO	0.0169	0.2204	0.0075	0.0078
D. Non-energy products from fuels and solvent use	84.8044	NO	NO						0.0076	0.0429	34.9327	0.0038
E. Electronic industry				NO	NO	NO	NO	NO				
F. Product uses as substitutes for ODS				166.7099	NO	NO	NO	NO				
G. Other product manufacture and use	1.0649	NO	NO	NO	0.0403	NO	0.0000	NO	0.0105	0.3198	0.4841	0.0003
H. Other									NO	NO	4.6628	NO
3. Agriculture	**12.2747**	**27.4424**	**3.7863**						**NO**	**NO**	**NE, NO**	
A. Enteric fermentation		24.8801										
B. Manure management		2.5622	0.8631								NO	
C. Rice cultivation		NO										
D. Agricultural soils			2.9232									
E. Prescribed burning of savannas		NO	NO						NO	NO	NO	
F. Field burning of agricultural residues		IE	IE						IE	IE	IE	
G. Liming	NO											
H. Urea application	12.2747											
I. Other carbon-containing fertilizers	NO, NE											
J. Other	NO	NO	NO						NO	NO	NO	
4. Land use, land-use change and forestry	**-1,117.1054**	**0.0143**	**0.6016**						**0.0097**	**0.3467**	**NO, NE**	
A. Forest land	-2,115.7622	0.0123	0.0007						0.0079	0.2809	NO, NE	
B. Cropland	1,111.9941	0.0019	0.0001						0.0018	0.0658	NO	
C. Grassland	-402.3693	NE	NE						NE	NE	NE	
D. Wetlands	-82.7917	NE	NE						NE	NE	NE	
E. Settlements	19.3071	NO, NE	0.6008						NO, NE	NO, NE	NO, NE	
F. Other land	351.6349	NE	NE						NE	NE	NE	
G. Harvested wood products	0.8816											
H. Other	NE	NE	NE						NE	NE	NE	
5. Waste	**13.0346**	**55.1867**	**0.1918**						**0.1301**	**2.2716**	**2.2928**	**0.0047**
A. Solid waste disposal	NA, NO	45.2784							NA, NO	NA, NO	2.2326	
B. Biological treatment of solid waste		0.0505	0.0030						NO, NE	0.0071	NO, NE	

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	Net CO_2 emissions / removals	CH_4	N_2O	HFCs	PFCs	Unspecified mix of HFCs and PFCs	SF_6	NF_3	NO_x	CO	NMVOC	SO_2
	(kt)			(kt CO_2 equivalent)					(kt)			
C. Incineration and open burning of waste	13.0346	0.2667	0.0047						0.1301	2.2645	0.0502	0.0047
D. Wastewater treatment and discharge		9.5911	0.1841						NA, IE	NA, IE	0.0100	
E. Other	NO	NO	NO						NO	NO	NO	
6. Other	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**
Memo items:												
International bunkers	**100.9698**	**0.0062**	**0.0033**						0.4139	0.2665	0.1113	0.0320
Aviation	100.9698	0.0062	0.0033						0.4139	0.2665	0.1113	0.0320
Navigation	NO	NO	NO						NO	NO	NO	NO
Multilateral operations	**NO**	**NO**	**NO**						**NO**	**NO**	**NO**	**NO**
CO_2 emissions from biomass	1,603.1890											
CO_2 captured	NO											
Long-term storage of C in waste disposal sites	NE											
Indirect N_2O			**0.9869**									
Indirect CO_2	**77.9170**											

2017

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	Net CO_2 emissions / removals	CH_4	N_2O	HFCs	PFCs	Unspecified mix of HFCs and PFCs	SF_6	NF_3	NO_x	CO	NMVOC	SO_2
	(kt)			(kt CO_2 equivalent)					(kt)			
Total national emissions and removals	**7,402.2253**	**119.9717**	**5.1810**	**185.8945**	**0.0403**	**NO**	**0.0000**	**NO**	**22.9324**	**113.1404**	**64.7482**	**4.9513**
1. Energy	**7,934.3500**	**35.6745**	**0.3312**						**21.2407**	**107.7886**	**16.2093**	**4.3204**
A. Fuel combustion Reference approach	7,787.7356											
Sectoral approach	7,932.6739	6.9284	0.3312						21.2407	107.7886	15.4842	4.3204
1. Energy industries	2,996.5052	0.0543	0.0055						4.7627	2.0849	0.1391	0.0472
2. Manufacturing industries and construction	501.6022	0.0128	0.0029						0.9406	1.3692	0.2706	1.1299
3. Transport	2,451.2471	0.4838	0.1350						9.7868	19.0444	2.5083	0.0054
4. Other sectors	1,960.6971	6.3772	0.1874						5.7093	85.0674	12.5450	2.9370
5. Other	22.6223	0.0002	0.0004						0.0414	0.2226	0.0212	0.2009
B. Fugitive emissions from fuels	1.6760	28.7461	0.0000						NO	NO	0.7251	NO
1. Solid fuels	NO	NO	NO						NO	NO	NO	NO
2. Oil and natural gas and other emissions from energy production	1.6760	28.7461	0.0000						NO	NO	0.7251	NO
C. CO_2 Transport and storage	NO											
2. Industrial processes and product use	**592.6872**	**NO**	**NO**	**185.8945**	**0.0403**	**NO**	**0.0000**	**NO**	**1.5316**	**2.2987**	**46.2368**	**0.6257**
A. Mineral industry	475.6060								1.4527	1.2025	0.0146	0.5922
B. Chemical industry	NO	NO	NO						NO	NO	0.0123	NO
C. Metal industry	18.8842	NO	NO	NO	NO	NO	NO	NO	0.0613	0.8019	0.0249	0.0283
D. Non-energy products from fuels and solvent use	97.0212	NO	NO						0.0097	0.0547	40.4418	0.0048
E. Electronic industry				NO	NO	NO	NO	NO				
F. Product uses as substitutes for ODS				185.8945	NO	NO	NO	NO				
G. Other product manufacture and use	1.1757	NO	NO	NO	0.0403	NO	0.0000	NO	0.0078	0.2396	0.5344	0.0003
H. Other									NO	NO	5.2088	NO
3. Agriculture	**26.2081**	**25.6519**	**4.0746**						**NO**	**NO**	**NE, NO**	
A. Enteric fermentation		23.1354										
B. Manure management		2.5165	0.8177								NO	
C. Rice cultivation		NO										
D. Agricultural soils			3.2570									
E. Prescribed burning of savannas		NO	NO						NO	NO	NO	

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	Net CO_2 emissions / removals	CH_4	N_2O	HFCs	PFCs	Unspecified mix of HFCs and PFCs	SF_6	NF_3	NO_x	CO	NMVOC	SO_2
	(kt)			(kt CO_2 equivalent)					(kt)			
F. Field burning of agricultural residues		IE	IE						IE	IE	IE	
G. Liming	NO											
H. Urea application	26.2081											
I. Other carbon-containing fertilizers	NO, NE											
J. Other	NO	NO	NO						NO	NO	NO	
4. Land use, land-use change and forestry	**-1,165.6648**	**0.0199**	**0.5767**						**0.0136**	**0.4867**	**NO, NE**	
A. Forest land	-2,016.4373	0.0170	0.0009						0.0109	0.3878	NO, NE	
B. Cropland	1,089.5602	0.0029	0.0001						0.0027	0.0990	NO	
C. Grassland	-384.0392	NE	NE						NE	NE	NE	
D. Wetlands	-82.8162	NE	NE						NE	NE	NE	
E. Settlements	77.3098	NO, NE	0.5757						NO, NE	NO, NE	NO, NE	
F. Other land	218.2055	NE	NE						NE	NE	NE	
G. Harvested wood products	-67.4476											
H. Other	NE											
5. Waste	**14.6448**	**58.6255**	**0.1985**						**0.1465**	**2.5663**	**2.3021**	**0.0052**
A. Solid waste disposal	NA, NO	48.8363							NA, NO	NA, NO	2.2355	
B. Biological treatment of solid waste		0.0578	0.0035						NO, NE	0.0081	NO, NE	
C. Incineration and open burning of waste	14.6448	0.3001	0.0053						0.1465	2.5582	0.0566	0.0052
D. Wastewater treatment and discharge		9.4312	0.1897						NA, IE	NA, IE	0.0100	
E. Other	NO	NO	NO						NO	NO	NO	
6. Other	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**
Memo items:												
International bunkers	**148.2788**	**0.0058**	**0.0048**						**0.5821**	**0.3478**	**0.1423**	**0.0470**
Aviation	148.2788	0.0058	0.0048						0.5821	0.3478	0.1423	0.0470
Navigation	NO	NO	NO						NO	NO	NO	NO
Multilateral operations	**NO**	**NO**	**NO**						**NO**	**NO**	**NO**	**NO**
CO_2 emissions from biomass	2,122.7228											
CO_2 captured	NO											
Long-term storage of C in waste disposal sites	NE											
Indirect N_2O			**1.0411**									
Indirect CO_2	**90.1477**											

2018

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	Net CO_2 emissions / removals	CH_4	N_2O	HFCs	PFCs	Unspecified mix of HFCs and PFCs	SF_6	NF_3	NO_x	CO	NMVOC	SO_2
	(kt)			(kt CO_2 equivalent)					(kt)			
Total national emissions and removals	**8,165.9880**	**119.7841**	**5.2421**	**198.8877**	**0.0403**	**NO**	**0.0001**	**NO**	**24.8089**	**162.1584**	**95.9239**	**4.4461**
1. Energy	**8,350.5473**	**37.7167**	**0.3805**						**22.6342**	**156.7217**	**23.6900**	**3.5780**
A. Fuel combustion Reference approach	8,182.3371											
Sectoral approach	8,348.8621	10.6064	0.3805						22.6342	156.7217	22.9976	3.5780
1. Energy industries	3,255.3655	0.0593	0.0060						5.1810	2.2679	0.1513	0.0570
2. Manufacturing industries and construction	594.3248	0.0144	0.0031						1.2726	1.2408	0.2948	0.9561
3. Transport	2,529.5773	0.5024	0.1334						9.7840	19.8910	2.5892	0.0056
4. Other sectors	1,946.2502	10.0301	0.2376						6.3540	133.0922	19.9404	2.3520
5. Other	23.3443	0.0002	0.0004						0.0427	0.2297	0.0219	0.2073
B. Fugitive emissions from fuels	1.6852	27.1103	0.0000						NO	NO	0.6924	NO
1. Solid fuels	NO	NO	NO						NO	NO	NO	NO

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	Net CO_2 emissions / removals	CH_4	N_2O	HFCs	PFCs	Unspecified mix of HFCs and PFCs	SF_6	NF_3	NO_x	CO	NMVOC	SO_2
	(kt)			(kt CO_2 equivalent)					(kt)			
2. Oil and natural gas and other emissions from energy production	1.6852	27.1103	0.0000						NO	NO	0.6924	NO
C. CO_2 Transport and storage	NO											
2. Industrial processes and product use	**764.3984**	**NO**	**NO**	**198.8877**	**0.0403**	**NO**	**0.0001**	**NO**	**2.0269**	**2.7602**	**70.1396**	**0.8631**
A. Mineral industry	591.9454								1.9255	1.4894	0.0186	0.8185
B. Chemical industry	NO	NO	NO						NO	NO	0.0155	NO
C. Metal industry	20.2133	NO	NO	NO	NO	NO	NO	NO	0.0657	0.8586	0.0267	0.0303
D. Non-energy products from fuels and solvent use	151.1809	NO	NO						0.0273	0.1534	64.9072	0.0136
E. Electronic industry				NO	NO	NO	NO	NO				
F. Product uses as substitutes for ODS				198.8877	NO	NO	NO	NO				
G. Other product manufacture and use	1.0589	NO	NO	NO	0.0403	NO	0.0001	NO	0.0085	0.2587	0.4813	0.0007
H. Other									NO	NO	4.6903	NO
3. Agriculture	**43.3624**	**22.8526**	**4.1028**						**NO**	**NO**	**NE, NO**	
A. Enteric fermentation		20.6594										
B. Manure management		2.1932	0.7210								NO	
C. Rice cultivation		NO										
D. Agricultural soils			3.3818									
E. Prescribed burning of savannas		NO	NO						NO	NO	NO	
F. Field burning of agricultural residues		IE	IE						IE	IE	IE	
G. Liming	NO											
H. Urea application	43.3624											
I. Other carbon-containing fertilizers	NO, NE											
J. Other	NO	NO	NO						NO	NO	NO	
4. Land use, land-use change and forestry	**-1,006.6081**	**0.0068**	**0.5550**						**0.0046**	**0.1654**	**NO, NE**	
A. Forest land	-1,969.3582	0.0059	0.0003						0.0037	0.1334	NO, NE	
B. Cropland	1,206.3949	0.0009	0.0000						0.0009	0.0321	NO	
C. Grassland	-440.1513	NE	NE						NE	NE	NE	
D. Wetlands	-82.8253	NE	NE						NE	NE	NE	
E. Settlements	21.6217	NO, NE	0.5546						NO, NE	NO, NE	NO, NE	
F. Other land	321.2138	NE	NE						NE	NE	NE	
G. Harvested wood products	-63.5037											
H. Other	NE	NE	NE						NE	NE	NE	
5. Waste	**14.2880**	**59.2080**	**0.2038**						**0.1432**	**2.5112**	**2.0943**	**0.0051**
A. Solid waste disposal	NA, NO	49.2990							NA, NO	NA, NO	2.0288	
B. Biological treatment of solid waste		0.0521	0.0031						NO, NE	0.0073	NO, NE	
C. Incineration and open burning of waste	14.2880	0.2931	0.0051						0.1432	2.5039	0.0553	0.0051
D. Wastewater treatment and discharge		9.5637	0.1955						NA, IE	NA, IE	0.0102	
E. Other	NO	NO	NO						NO	NO	NO	
6. Other	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**
Memo items:												
International bunkers	**170.4060**	**0.0071**	**0.0058**						0.6507	0.5113	0.1537	0.0540
Aviation	170.4060	0.0071	0.0058						0.6507	0.5113	0.1537	0.0540
Navigation	NO	NO	NO						NO	NO	NO	NO
Multilateral operations	**NO**	**NO**	**NO**						**NO**	**NO**	**NO**	**NO**
CO_2 emissions from biomass	3,583.0567											
CO_2 captured	NO											
Long-term storage of C in waste disposal sites	NE											
Indirect N_2O			**1.0303**									
Indirect CO_2	**143.8546**											

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	Net CO_2 emissions / removals	CH_4	N_2O	HFCs	PFCs	Unspecified mix of HFCs and PFCs	SF_6	NF_3	NO_x	CO	NMVOC	SO_2
	(kt)			(kt CO_2 equivalent)			(kt)					
Total national emissions and removals	**9,242.8298**	**107.2865**	**5.3796**	**235.5397**	**0.0403**	**NO**	**0.0001**	**NO**	**25.0345**	**147.0344**	**90.1994**	**5.2165**
1. Energy	**8,583.6814**	**28.1492**	**0.3826**						**23.0076**	**141.6541**	**21.1796**	**4.4562**
A. Fuel combustion Reference approach	8,434.0311											
Sectoral approach	8,582.0532	9.3467	0.3826						23.0076	141.6541	20.6437	4.4562
1. Energy industries	3,124.4150	0.0562	0.0057						4.9700	2.1753	0.1451	0.0468
2. Manufacturing industries and construction	717.7258	0.0298	0.0052						1.2740	1.5229	0.4796	0.9216
3. Transport	2,611.5525	0.4983	0.1390						10.1388	20.5687	2.6841	0.0058
4. Other sectors	2,105.4970	8.7623	0.2323						6.5829	117.1622	17.3135	3.2791
5. Other	22.8629	0.0002	0.0004						0.0418	0.2250	0.0215	0.2030
B. Fugitive emissions from fuels	1.6282	18.8024	0.0000						NO	NO	0.5359	NO
1. Solid fuels	NO	NO	NO						NO	NO	NO	NO
2. Oil and natural gas and other emissions from energy production	1.6282	18.8024	0.0000						NO	NO	0.5359	NO
C. CO_2 Transport and storage	NO											
2. Industrial processes and product use	**754.2055**	**NO**	**NO**	**235.5397**	**0.0403**	**NO**	**0.0001**	**NO**	**1.8762**	**2.5375**	**66.6190**	**0.7554**
A. Mineral industry	593.6612								1.7986	1.5265	0.0187	0.7216
B. Chemical industry	NO	NO	NO						NO	NO	0.0170	NO
C. Metal industry	15.7926	NO	NO	NO	NO	NO	NO	NO	0.0513	0.6704	0.0209	0.0237
D. Non-energy products from fuels and solvent use	143.6217	NO	NO						0.0186	0.1047	61.3608	0.0093
E. Electronic industry				NO	NO	NO	NO	NO				
F. Product uses as substitutes for ODS				235.5397	NO	NO	NO	NO				
G. Other product manufacture and use	1.1299	NO	NO	NO	0.0403	NO	0.0001	NO	0.0077	0.2360	0.5136	0.0008
H. Other									NO	NO	4.6880	NO
3. Agriculture	**39.6306**	**19.6977**	**4.2505**						**NO**	**NO**	**NE, NO**	
A. Enteric fermentation		17.6379										
B. Manure management		2.0599	0.6536								NO	
C. Rice cultivation		NO										
D. Agricultural soils			3.5969									
E. Prescribed burning of savannas		NO	NO						NO	NO	NO	
F. Field burning of agricultural residues		IE	IE						IE	IE	IE	
G. Liming	NO											
H. Urea application	39.6306											
I. Other carbon-containing fertilizers	NO, NE											
J. Other	NO	NO	NO						NO	NO	NO	
4. Land use, land-use change and forestry	**-148.6229**	**0.0160**	**0.5421**						**0.0107**	**0.3821**	**NO, NE**	
A. Forest land	-1,950.6476	0.0143	0.0008						0.0091	0.3254	NO, NE	
B. Cropland	1,507.3962	0.0017	0.0000						0.0015	0.0568	NO	
C. Grassland	-293.2923	NE	NE						NE	NE	NE	
D. Wetlands	-82.8099	NE	NE						NE	NE	NE	
E. Settlements	116.5030	NO, NE	0.5412						NO, NE	NO, NE	NO, NE	
F. Other land	611.7881	NE	NE						NE	NE	NE	
G. Harvested wood products	-57.5604											
H. Other	NE	NE	NE						NE	NE	NE	
5. Waste	**13.9352**	**59.4236**	**0.2045**						**0.1400**	**2.4607**	**2.4008**	**0.0049**

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	Net CO_2 emissions / removals	CH_4	N_2O	HFCs	PFCs	Unspecified mix of HFCs and PFCs	SF_6	NF_3	NO_x	CO	NMVOC	SO_2
	(kt)			(kt CO_2 equivalent)					(kt)			
A. Solid waste disposal	NA, NO	49.5684							NA, NO	NA, NO	2.3365	
B. Biological treatment of solid waste		0.0522	0.0031						NO, NE	0.0073	NO, NE	
C. Incineration and open burning of waste	13.9352	0.2863	0.0050						0.1400	2.4534	0.0541	0.0049
D. Wastewater treatment and discharge		9.5168	0.1963						NA, IE	NA, IE	0.0102	
E. Other	NO	NO	NO						NO	NO	NO	
6. Other	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**
Memo items:												
International bunkers	**151.5015**	**0.0055**	**0.0051**						**0.6236**	**0.4162**	**0.1199**	**0.0480**
Aviation	151.5015	0.0055	0.0051						0.6236	0.4162	0.1199	0.0480
Navigation	NO	NO	NO						NO	NO	NO	NO
Multilateral operations	**NO**	**NO**	**NO**						**NO**	**NO**	**NO**	**NO**
CO_2 emissions from biomass	2,976.2234											
CO_2 captured	NO											
Long-term storage of C in waste disposal sites	NE											
Indirect N_2O			**1.0565**									
Indirect CO_2	**136.1237**											

2020

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	Net CO_2 emissions / removals	CH_4	N_2O	HFCs	PFCs	Unspecified mix of HFCs and PFCs	SF_6	NF_3	NO_x	CO	NMVOC	SO_2
	(kt)			(kt CO_2 equivalent)					(kt)			
Total national emissions and removals	**9,608.0373**	**95.7174**	**4.7326**	**245.3168**	**0.0403**	**NO**	**0.0001**	**NO**	**24.4909**	**142.0826**	**111.5648**	**4.2932**
1. Energy	**8,972.1085**	**18.6747**	**0.3722**						**22.4651**	**136.3310**	**20.4625**	**3.4896**
A. Fuel combustion Reference approach	8,933.5232											
Sectoral approach	8,970.5288	9.0656	0.3722						22.4651	136.3310	20.0607	3.4896
1. Energy industries	3,634.3761	0.0654	0.0066						5.7797	2.5315	0.1688	0.0361
2. Manufacturing industries and construction	801.4383	0.0298	0.0049						0.4409	1.4200	0.5045	0.7768
3. Transport	2,462.2411	0.4352	0.1302						9.7000	18.3931	2.4165	0.0054
4. Other sectors	2,050.0916	8.5350	0.2302						6.5036	113.7660	16.9499	2.4726
5. Other	22.3816	0.0002	0.0004						0.0409	0.2203	0.0210	0.1987
B. Fugitive emissions from fuels	1.5797	9.6091	0.0000						NO	NO	0.4018	NO
1. Solid fuels	NO	NO	NO						NO	NO	NO	NO
2. Oil and natural gas and other emissions from energy production	1.5797	9.6091	0.0000						NO	NO	0.4018	NO
C. CO_2 Transport and storage	NO											
2. Industrial processes and product use	**751.8959**	**NO**	**NO**	**245.3168**	**0.0403**	**NO**	**0.0001**	**NO**	**1.8679**	**2.6172**	**88.9154**	**0.7987**
A. Mineral industry	536.8930								1.7673	1.3540	0.0171	0.7550
B. Chemical industry	NO	NO	NO						NO	NO	0.0177	NO
C. Metal industry	18.6972	NO	NO	NO	NO	NO	NO	NO	0.0607	0.7940	0.0247	0.0280
D. Non-energy products from fuels and solvent use	195.3645	NO	NO						0.0301	0.1689	84.9204	0.0149
E. Electronic industry				NO	NO	NO	NO	NO				
F. Product uses as substitutes for ODS				245.3168	NO	NO	NO	NO				

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	Net CO_2 emissions / removals	CH_4	N_2O	HFCs	PFCs	Unspecified mix of HFCs and PFCs	SF_6	NF_3	NO_x	CO	NMVOC	SO_2
	(kt)			(kt CO_2 equivalent)					(kt)			
G. Other product manufacture and use	0.9412	NO	NO	NO	0.0403	NO	0.0001	NO	0.0098	0.3004	0.4278	0.0008
H. Other									NO	NO	3.5077	NO
3. Agriculture	**42.6156**	**17.3363**	**3.5920**						**NO**	**NO**	**NE, NO**	
A. Enteric fermentation		15.5616										
B. Manure management		1.7747	0.5584								NO	
C. Rice cultivation		NO										
D. Agricultural soils			3.0335									
E. Prescribed burning of savannas		NO	NO						NO	NO	NO	
F. Field burning of agricultural residues		IE	IE						IE	IE	IE	
G. Liming	NO											
H. Urea application	42.6156											
I. Other carbon-containing fertilizers	NO, NE											
J. Other	NO	NO	NO						NO	NO	NO	
4. Land use, land-use change and forestry	**-172.3409**	**0.0321**	**0.5638**						**0.0200**	**0.7154**	**NO, NE**	
A. Forest land	-1,887.3228	0.0289	0.0016						0.0185	0.6586	NO, NE	
B. Cropland	1,629.9020	0.0032	0.0001						0.0015	0.0568	NO	
C. Grassland	-223.1528	NE	NE						NE	NE	NE	
D. Wetlands	-82.8099	NE	NE						NE	NE	NE	
E. Settlements	27.2098	NO, NE	0.5621						NO, NE	NO, NE	NO, NE	
F. Other land	329.1445	NE	NE						NE	NE	NE	
G. Harvested wood products	34.6883											
H. Other	NE	NE	NE						NE	NE	NE	
5. Waste	**13.7583**	**59.6743**	**0.2046**						**0.1379**	**2.4190**	**2.1869**	**0.0049**
A. Solid waste disposal	NA, NO	49.8473							NA, NO	NA, NO	2.1235	
B. Biological treatment of solid waste		0.0567	0.0034						NO, NE	0.0079	NO, NE	
C. Incineration and open burning of waste	13.7583	0.2823	0.0050						0.1379	2.4110	0.0533	0.0049
D. Wastewater treatment and discharge		9.4880	0.1963						NA, IE	NA, IE	0.0101	
E. Other	NO	NO	NO						NO	NO	NO	
6. Other	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**
Memo items:												
International bunkers	**35.2495**	**0.0002**	**0.0010**						**0.1233**	**0.0493**	**0.0247**	**0.0000**
Aviation	35.2495	0.0002	0.0010						0.1233	0.0493	0.0247	0.0000
Navigation	NO	NO	NO						NO	NO	NO	NO
Multilateral operations	**NO**	**NO**	**NO**						**NO**	**NO**	**NO**	**NO**
CO_2 emissions from biomass	2,985.9162											
CO_2 captured	NO											
Long-term storage of C in waste disposal sites	NE											
Indirect N_2O			**0.9052**									
Indirect CO_2	**187.7661**											

Annex 6-7. Summary Reports for GHG Emissions in CO_2 equivalent in the Republic of Moldova within 1990-2020

1990

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2	CH_4	N_2O	HFCs	PFCs	SF_6	Unspecified mix of HFCs and PFCs	NF_3	Total
	CO_2 equivalent (kt)								
Total (net emissions)	**35,191.3877**	**5,401.4074**	**2,998.1536**	**NO**	**NO**	**NO**	**NO**	**NO**	**43,590.9487**
1. Energy	**35,401.1029**	**1,246.2222**	**345.6021**						**36,992.9272**
A. Fuel Combustion (Sectoral approach)	35,400.4397	335.4782	345.6019						36,081.5198
1. Energy Industries	21,300.2929	12.2813	51.6671						21,364.2413
2. Manufacturing Industries and Construction	1,915.6706	1.7449	4.3486						1,921.7642
3. Transport	4,698.2416	33.6681	106.7291						4,838.6388
4. Other Sectors	7,372.2624	287.5113	181.5317						7,841.3054
5. Other	113.9722	0.2726	1.3253						115.5701
B. Fugitive Emissions from Fuels	0.6632	910.7440	0.0002						911.4074
1. Solid Fuels	NO	NO	NO						NO
2. Oil and Natural Gas	0.6632	910.7440	0.0002						911.4074
C. CO_2 Transport and Storage	NO								NO
2. Industrial Processes and Product Use	**1,605.2224**	**NO**	**0.0197**	**NO**	**NO**	**NO**	**NO**	**NO**	**1,605.2421**
A. Mineral Industry	1,338.9600								1,338.9600
B. Chemical Industry	NO	NO	NO						NO
C. Metal Industry	28.5023	NO	NO	NO	NO	NO	NO	NO	28.5023
D. Non-Energy Products From Fuels and Solvent Use	234.3591	NO	NO						234.3591
E. Electronic Industry				NO	NO	NO	NO	NO	NO
F. Product Use as Substitutes for ODS				NO	NO	NO	NO	NO	NO
G. Other Product Manufacture and Use	3.4010	NO	0.0197	NO	NO	NO	NO	NO	3.4207
H. Other									
3. Agriculture	**0.5820**	**2,684.5230**	**2,391.6276**						**5,076.7326**
A. Enteric Fermentation		2,189.4276							2,189.4276
B. Manure Management		495.0955	899.7142						1,394.8097
C. Rice Cultivation		NO							NO
D. Agricultural Soils			1,491.9134						1,491.9134
E. Prescribed Burning of Savannas		NO	NO						NO
F. Field Burning of Agricultural Residues		IE	IE						IE
G. Liming	NO								NO
H. Urea Application	0.5820								0.5820
I. Other Carbon-Containing Fertilizers	NO, NE								NO, NE
J. Other	NO	NO	NO						NO
4. LULUCF	**-1,830.4863**	**2.6533**	**170.3740**						**-1,657.4590**
A. Forest Land	-2,563.4328	0.2072	0.1366						-2,563.0889
B. Cropland	2,379.0886	2.4461	0.7559						2,382.2907
C. Grassland	-1,205.6938	NE	NE						-1,205.6938
D. Wetlands	-555.3798	NE	NE						-555.3798
E. Settlements	84.7480	NO, NE	169.4814						254.2294
F. Other Land	152.3638	NE	NE						152.3638
G. Harvested Wood Products	-122.1804								-122.1804
H. Other	NE	NE	NE						NE

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2	CH_4	N_2O	HFCs	PFCs	SF_6	Unspecified mix of HFCs and PFCs	NF_3	Total
	CO_2 equivalent (kt)								
5. Waste	**14.9667**	**1,468.0088**	**90.5302**						**1,573.5058**
A. Solid Waste Disposal	NA, NO	1,105.9965							1,105.9965
B. Biological Treatment of Solid Waste		1.3597	0.9725						2.3322
C. Incineration and Open Burning of Waste	14.9667	7.6876	1.6078						24.2621
D. Wastewater Treatment and Discharge		352.9650	87.9499						440.9149
E. Other	NO	NO	NO						NO
6. Other	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	NO
Memo Items									
International Bunkers	**193.4599**	**0.3828**	**1.8920**						**195.7347**
Aviation	193.4599	0.3828	1.8920						195.7347
Navigation	NO	NO	NO						NO
Multilateral Operations	**NO**	**NO**	**NO**						**NO**
CO_2 Emissions from Biomass	232.8093								232.8093
CO_2 Captured and Stored	NO								NO
Long-term Storage of C in Waste Disposal Sites	NE								NE
Indirect N_2O			763.2533						763.2533
Indirect CO_2	207.5471								207.5471
								Total (without LULUCF)	**45,248.4076**
								Total (with LULUCF)	**43,590.9487**

1991

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2	CH_4	N_2O	HFCs	PFCs	SF_6	Unspecified mix of HFCs and PFCs	NF_3	Total
	CO_2 equivalent (kt)								
Total (net emissions)	**28,417.2047**	**5,055.0603**	**2,775.9393**	**NO**	**NO**	**NO**	**NO**	**NO**	**36,248.2042**
1. Energy	**29,898.2495**	**1,103.0527**	**257.3913**						**31,258.6935**
A. Fuel Combustion (Sectoral approach)	29,897.6098	241.4926	257.3912						30,396.4935
1. Energy Industries	18,927.0336	10.5744	46.5622						18,984.1702
2. Manufacturing Industries and Construction	1,283.0799	1.2182	2.8341						1,287.1322
3. Transport	3,656.1040	25.8572	87.3527						3,769.3140
4. Other Sectors	5,925.0237	203.6619	119.6190						6,248.3047
5. Other	106.3685	0.1809	1.0231						107.5724
B. Fugitive Emissions from Fuels	0.6397	861.5601	0.0001						862.2000
1. Solid Fuels	NO	NO	NO						NO
2. Oil and Natural Gas	0.6397	861.5601	0.0001						862.2000
C. CO_2 Transport and Storage	NO								NO
2. Industrial Processes and Product Use	**1,411.2739**	**NO**	**0.0164**	**NO**	**NO**	**NO**	**NO**	**NO**	**1,411.2903**
A. Mineral Industry	1,190.1632								1,190.1632
B. Chemical Industry	NO	NO	NO						NO
C. Metal Industry	24.7297	NO	NO	NO	NO	NO	NO	NO	24.7297
D. Non-Energy Products From Fuels and Solvent Use	193.3185	NO	NO						193.3185
E. Electronic Industry				NO	NO	NO	NO	NO	NO
F. Product Use as Substitutes for ODS				NO	NO	NO	NO	NO	NO

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2	CH_4	N_2O	HFCs	PFCs	SF_6	Unspecified mix of HFCs and PFCs	NF_3	Total
	CO_2 equivalent (kt)								
G. Other Product Manufacture and Use	3.0625	NO	0.0164	NO	NO	NO	NO	NO	3.0789
H. Other									
3. Agriculture	**0.5226**	**2,443.9487**	**2,250.8837**						**4,695.3550**
A. Enteric Fermentation		2,028.8687							2,028.8687
B. Manure Management		415.0799	816.1992						1,231.2791
C. Rice Cultivation		NO							NO
D. Agricultural Soils			1,434.6846						1,434.6846
E. Prescribed Burning of Savannas		NO	NO						NO
F. Field Burning of Agricultural Residues		IE	IE						IE
G. Liming	NO								NO
H. Urea Application	0.5226								0.5226
I. Other Carbon-Containing Fertilizers	NO, NE								NO, NE
J. Other	NO	NO	NO						NO
4. LULUCF	**-2,907.8407**	**2.3998**	**183.8820**						**-2,721.5589**
A. Forest Land	-2,343.3131	0.0347	0.0229						-2,343.2556
B. Cropland	1,248.7850	2.3651	0.7309						1,251.8810
C. Grassland	-1,414.3167	NE	NE						-1,414.3167
D. Wetlands	-526.4627	NE	NE						-526.4627
E. Settlements	88.7139	NO, NE	183.1282						271.8421
F. Other Land	152.3638	NE	NE						152.3638
G. Harvested Wood Products	-113.6108								-113.6108
H. Other	NE	NE	NE						NE
5. Waste	**14.9994**	**1,505.6591**	**83.7658**						**1,604.4244**
A. Solid Waste Disposal	NA, NO	1,154.9967							1,154.9967
B. Biological Treatment of Solid Waste		1.3779	0.9855						2.3633
C. Incineration and Open Burning of Waste	14.9994	7.7010	1.6109						24.3113
D. Wastewater Treatment and Discharge		341.5835	81.1694						422.7530
E. Other	NO	NO	NO						NO
6. Other	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	NO
Memo Items									
International Bunkers	**147.3846**	**0.2917**	**1.4414**						**149.1177**
Aviation	147.3846	0.2917	1.4414						149.1177
Navigation	NO	NO	NO						NO
Multilateral Operations	**NO**	**NO**	**NO**						**NO**
CO_2 Emissions from Biomass	201.2009								201.2009
CO_2 Captured and Stored	NO								NO
Long-term Storage of C in Waste Disposal Sites	NE								NE
Indirect N_2O			697.3100						697.3100
Indirect CO_2	170.8422								170.8422
								Total (without LULUCF)	**38,969.7631**
								Total (with LULUCF)	**36,248.2042**

1992

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2	CH_4	N_2O	HFCs	PFCs	SF_6	Unspecified mix of HFCs and PFCs	NF_3	Total
	CO_2 equivalent (kt)								
Total (net emissions)	**21,825.6502**	**4,813.8391**	**2,383.3948**	**NO**	**NO**	**NO**	**NO**	**NO**	**29,022.8842**
1. Energy	**23,310.7327**	**929.4042**	**179.7070**						**24,419.8439**
A. Fuel Combustion (Sectoral approach)	23,310.1924	151.2753	179.7069						23,641.1745
1. Energy Industries	15,660.9863	8.9470	36.3227						15,706.2560
2. Manufacturing Industries and Construction	932.0767	0.8782	2.0490						935.0040
3. Transport	2,615.2237	18.0694	66.5696						2,699.8627
4. Other Sectors	4,024.1583	123.2654	74.0944						4,221.5181
5. Other	77.7474	0.1152	0.6712						78.5337
B. Fugitive Emissions from Fuels	0.5403	778.1290	0.0001						778.6694
1. Solid Fuels	NO	NO	NO						NO
2. Oil and Natural Gas	0.5403	778.1290	0.0001						778.6694
C. CO_2 Transport and Storage	NO								NO
2. Industrial Processes and Product Use	**822.4617**	**NO**	**0.0149**	**NO**	**NO**	**NO**	**NO**	**NO**	**822.4766**
A. Mineral Industry	641.7935								641.7935
B. Chemical Industry	NO	NO	NO						NO
C. Metal Industry	23.9922	NO	NO	NO	NO	NO	NO	NO	23.9922
D. Non-Energy Products From Fuels and Solvent Use	154.2628	NO	NO						154.2628
E. Electronic Industry				NO	NO	NO	NO	NO	NO
F. Product Use as Substitutes for ODS				NO	NO	NO	NO	NO	NO
G. Other Product Manufacture and Use	2.4132	NO	0.0149	NO	NO	NO	NO	NO	2.4281
H. Other									
3. Agriculture	**0.3905**	**2,369.9032**	**1,922.0030**						**4,292.2967**
A. Enteric Fermentation		1,996.7865							1,996.7865
B. Manure Management		373.1167	723.0274						1,096.1441
C. Rice Cultivation		NO							NO
D. Agricultural Soils			1,198.9756						1,198.9756
E. Prescribed Burning of Savannas		NO	NO						NO
F. Field Burning of Agricultural Residues		IE	IE						IE
G. Liming	NO								NO
H. Urea Application	0.3905								0.3905
I. Other Carbon-Containing Fertilizers	NO, NE								NO, NE
J. Other	NO	NO	NO						NO
4. LULUCF	**-2,322.9822**	**2.1973**	**204.6518**						**-2,116.1331**
A. Forest Land	-2,184.2404	0.0380	0.0250						-2,184.1774
B. Cropland	1,174.1876	2.1593	0.6673						1,177.0143
C. Grassland	-1,428.4835	NE	NE						-1,428.4835
D. Wetlands	-595.5455	NE	NE						-595.5455
E. Settlements	386.6196	NO, NE	203.9595						590.5790
F. Other Land	418.7786	NE	NE						418.7786
G. Harvested Wood Products	-94.2986								-94.2986
H. Other	NE	NE	NE						NE
5. Waste	**15.0476**	**1,512.3344**	**77.0182**						**1,604.4001**
A. Solid Waste Disposal	NA, NE	1,195.5847							1,195.5847

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2	CH_4	N_2O	HFCs	PFCs	SF_6	Unspecified mix of HFCs and PFCs	NF_3	Total
	CO_2 equivalent (kt)								
B. Biological Treatment of Solid Waste		1.4375	1.0281						2.4656
C. Incineration and Open Burning of Waste	15.0476	7.7226	1.6157						24.3859
D. Wastewater Treatment and Discharge		307.5895	74.3744						381.9639
E. Other	NO	NO	NO						NO
6. Other	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	NO
Memo Items									
International Bunkers	**108.5369**	**0.2148**	**1.0615**						**109.8132**
Aviation	108.5369	0.2148	1.0615						109.8132
Navigation	NO	NO	NO						NO
Multilateral Operations	**NO**	**NO**	**NO**						**NO**
CO_2 Emissions from Biomass	169.5924								169.5924
CO_2 Captured and Stored	NO								NO
Long-term Storage of C in Waste Disposal Sites	NE								NE
Indirect N_2O			596.5764						596.5764
Indirect CO_2	140.9363								140.9363
								Total (without LULUCF)	**31,139.0172**
								Total (with LULUCF)	**29,022.8842**

1993

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2	CH_4	N_2O	HFCs	PFCs	SF_6	Unspecified mix of HFCs and PFCs	NF_3	Total
	CO_2 equivalent (kt)								
Total (net emissions)	**15,729.0875**	**4,489.9594**	**2,050.1170**	**NO**	**NO**	**NO**	**NO**	**NO**	**22,269.1639**
1. Energy	**17,340.7506**	**764.2042**	**149.0069**						**18,253.9617**
A. Fuel Combustion (Sectoral approach)	17,340.2918	64.8801	149.0068						17,554.1788
1. Energy Industries	12,640.6006	7.0580	31.5167						12,679.1754
2. Manufacturing Industries and Construction	617.5604	0.5733	1.3499						619.4837
3. Transport	1,854.7578	12.3208	53.8887						1,920.9673
4. Other Sectors	2,133.9212	44.7823	61.5223						2,240.2258
5. Other	93.4518	0.1456	0.7291						94.3265
B. Fugitive Emissions from Fuels	0.4587	699.3241	0.0000						699.7829
1. Solid Fuels	NO	NO	NO						NO
2. Oil and Natural Gas	0.4587	699.3241	0.0000						699.7829
C. CO_2 Transport and Storage	NO								NO
2. Industrial Processes and Product Use	**737.8604**	**NO**	**0.0179**	**NO**	**NO**	**NO**	**NO**	**NO**	**737.8783**
A. Mineral Industry	587.5786								587.5786
B. Chemical Industry	NO	NO	NO						NO
C. Metal Industry	24.4250	NO	NO	NO	NO	NO	NO	NO	24.4250
D. Non-Energy Products From Fuels and Solvent Use	123.8759	NO	NO						123.8759
E. Electronic Industry				NO	NO	NO	NO	NO	NO
F. Product Use as Substitutes for ODS				NO	NO	NO	NO	NO	NO
G. Other Product Manufacture and Use	1.9809	NO	0.0179	NO	NO	NO	NO	NO	1.9988

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2	CH_4	N_2O	HFCs	PFCs	SF_6	Unspecified mix of HFCs and PFCs	NF_3	Total
	CO_2 equivalent (kt)								
H. Other									
3. Agriculture	**0.1276**	**2,147.8512**	**1,606.6271**						**3,754.6059**
A. Enteric Fermentation		1,872.9050							1,872.9050
B. Manure Management		274.9462	606.1705						881.1167
C. Rice Cultivation		NO							NO
D. Agricultural Soils			1,000.4566						1,000.4566
E. Prescribed Burning of Savannas		NO	NO						NO
F. Field Burning of Agricultural Residues		IE	IE						IE
G. Liming	NO								NO
H. Urea Application	0.1276								0.1276
I. Other Carbon-Containing Fertilizers	NO, NE								NO, NE
J. Other	NO	NO	NO						NO
4. LULUCF	**-2,364.6959**	**2.9467**	**222.5703**						**-2,139.1788**
A. Forest Land	-2,193.5115	0.0026	0.0017						-2,193.5072
B. Cropland	1,442.9960	2.9441	0.9098						1,446.8500
C. Grassland	-1,303.5202	NE	NE						-1,303.5202
D. Wetlands	-525.8447	NE	NE						-525.8447
E. Settlements	114.6181	NO, NE	221.6588						336.2769
F. Other Land	164.0168	NE	NE						164.0168
G. Harvested Wood Products	-63.4504								-63.4504
H. Other	NE	NE	NE						NE
5. Waste	**15.0447**	**1,574.9573**	**71.8949**						**1,661.8969**
A. Solid Waste Disposal	NA, NO	1,256.5473							1,256.5473
B. Biological Treatment of Solid Waste		0.7194	0.5145						1.2339
C. Incineration and Open Burning of Waste	15.0447	7.7182	1.6150						24.3780
D. Wastewater Treatment and Discharge		309.9724	69.7653						379.7377
E. Other	NO	NO	NO						NO
6. Other	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	NO
Memo Items									
International Bunkers	**55.2342**	**0.1093**	**0.5402**						**55.8837**
Aviation	55.2342	0.1093	0.5402						55.8837
Navigation	NO	NO	NO						NO
Multilateral Operations	**NO**	**NO**	**NO**						**NO**
CO_2 Emissions from Biomass	143.2360								143.2360
CO_2 Captured and Stored	NO								NO
Long-term Storage of C in Waste Disposal Sites	NE								NE
Indirect N_2O			480.3861						480.3861
Indirect CO_2	112.2027								112.2027
								Total (without LULUCF)	**24,408.3427**
								Total (with LULUCF)	**22,269.1639**

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2	CH_4	N_2O	HFCs	PFCs	SF_6	Unspecified mix of HFCs and PFCs	NF_3	Total
	CO_2 equivalent (kt)								
Total (net emissions)	**12,752.1034**	**4,397.7513**	**1,836.8188**	**NO**	**NO**	**NO**	**NO**	**NO**	**18,986.6734**
1. Energy	**14,491.6621**	**751.1660**	**135.1676**						**15,377.9958**
A. Fuel Combustion (Sectoral approach)	14,491.2336	77.1979	135.1676						14,703.5992
1. Energy Industries	9,961.8515	4.7207	25.9879						9,992.5601
2. Manufacturing Industries and Construction	737.3282	0.3674	0.6758						738.3714
3. Transport	1,612.9419	10.9323	32.6659						1,656.5401
4. Other Sectors	2,090.7472	61.0059	75.3551						2,227.1082
5. Other	88.3648	0.1716	0.4830						89.0194
B. Fugitive Emissions from Fuels	0.4285	673.9681	0.0000						674.3966
1. Solid Fuels	NO	NO	NO						NO
2. Oil and Natural Gas	0.4285	673.9681	0.0000						674.3966
C. CO_2 Transport and Storage	NO								NO
2. Industrial Processes and Product Use	**556.5852**	**NO**	**0.0149**	**NO**	**NO**	**NO**	**NO**	**NO**	**556.6001**
A. Mineral Industry	445.3398								445.3398
B. Chemical Industry	NO	NO	NO						NO
C. Metal Industry	25.3289	NO	NO	NO	NO	NO	NO	NO	25.3289
D. Non-Energy Products From Fuels and Solvent Use	84.4738	NO	NO						84.4738
E. Electronic Industry				NO	NO	NO	NO	NO	NO
F. Product Use as Substitutes for ODS				NO	NO	NO	NO	NO	NO
G. Other Product Manufacture and Use	1.4426	NO	0.0149	NO	NO	NO	NO	NO	1.4575
H. Other									
3. Agriculture	**0.0537**	**2,088.0629**	**1,395.2768**						**3,483.3934**
A. Enteric Fermentation		1,822.8316							1,822.8316
B. Manure Management		265.2313	585.7993						851.0306
C. Rice Cultivation		NO							NO
D. Agricultural Soils			809.4775						809.4775
E. Prescribed Burning of Savannas		NO	NO						NO
F. Field Burning of Agricultural Residues		IE	IE						IE
G. Liming	NO								NO
H. Urea Application	0.0537								0.0537
I. Other Carbon-Containing Fertilizers	NO, NE								NO, NE
J. Other	NO	NO	NO						NO
4. LULUCF	**-2,311.2923**	**1.6555**	**236.5414**						**-2,073.0955**
A. Forest Land	-2,108.0022	0.0578	0.0381						-2,107.9063
B. Cropland	1,206.3850	1.5977	0.4937						1,208.4764
C. Grassland	-1,577.3332	NE	NE						-1,577.3332
D. Wetlands	-497.6418	NE	NE						-497.6418
E. Settlements	130.4883	NO, NE	236.0095						366.4978
F. Other Land	549.4579	NE	NE						549.4579
G. Harvested Wood Products	-14.6464								-14.6464
H. Other	NE	NE	NE						NE
5. Waste	**15.0947**	**1,556.8668**	**69.8180**						**1,641.7795**
A. Solid Waste Disposal	NA, NO	1,259.1024							1,259.1024

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2	CH_4	N_2O	HFCs	PFCs	SF_6	Unspecified mix of HFCs and PFCs	NF_3	Total
	CO_2 equivalent (kt)								
B. Biological Treatment of Solid Waste		0.6705	0.4796						1.1501
C. Incineration and Open Burning of Waste	15.0947	7.7410	1.6200						24.4557
D. Wastewater Treatment and Discharge		289.3528	67.7185						357.0713
E. Other	NO	NO	NO						NO
6. Other	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	NO
Memo Items									
International Bunkers	**30.8414**	**0.0610**	**0.3016**						**31.2041**
Aviation	30.8414	0.0610	0.3016						31.2041
Navigation	NO	NO	NO						NO
Multilateral Operations	**NO**	**NO**	**NO**						**NO**
CO_2 Emissions from Biomass	157.4600								157.4600
CO_2 Captured and Stored	NO								NO
Long-term Storage of C in Waste Disposal Sites	NE								NE
Indirect N_2O			429.8938						429.8938
Indirect CO_2	73.5965								73.5965
								Total (without LULUCF)	**21,059.7688**
								Total (with LULUCF)	**18,986.6734**

1995

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2	CH_4	N_2O	HFCs	PFCs	SF_6	Unspecified mix of HFCs and PFCs	NF_3	Total
	CO_2 equivalent (kt)								
Total (net emissions)	**9,662.2364**	**4,164.9407**	**1,799.3713**	**1.0298**	**NO**	**NO**	**NO**	**NO**	**15,627.5783**
1. Energy	**11,476.3176**	**786.7513**	**128.2797**						**12,391.3486**
A. Fuel Combustion (Sectoral approach)	11,475.8783	48.3601	128.2796						11,652.5180
1. Energy Industries	7,174.0286	3.4249	14.9539						7,192.4074
2. Manufacturing Industries and Construction	386.3466	0.2002	0.4498						386.9966
3. Transport	1,617.6947	11.1180	31.5296						1,660.3423
4. Other Sectors	2,172.1646	33.3580	80.6996						2,286.2222
5. Other	125.6438	0.2589	0.6468						126.5495
B. Fugitive Emissions from Fuels	0.4393	738.3913	0.0000						738.8306
1. Solid Fuels	NO	NO	NO						NO
2. Oil and Natural Gas	0.4393	738.3913	0.0000						738.8306
C. CO_2 Transport and Storage	NO								NO
2. Industrial Processes and Product Use	**455.6262**	**NO**	**0.0003**	**1.0298**	**NO**	**NO**	**NO**	**NO**	**456.6563**
A. Mineral Industry	351.6610								351.6610
B. Chemical Industry	NO	NO	NO						NO
C. Metal Industry	26.2369	NO	NO	NO	NO	NO	NO	NO	26.2369
D. Non-Energy Products From Fuels and Solvent Use	76.5607	NO	NO						76.5607
E. Electronic Industry				NO	NO	NO	NO	NO	NO
F. Product Use as Substitutes for ODS				1.0298	NO	NO	NO	NO	1.0298
G. Other Product Manufacture and Use	1.1676	NO	0.0003	NO	NO	NO	NO	NO	1.1679

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2	CH_4	N_2O	HFCs	PFCs	SF_6	Unspecified mix of HFCs and PFCs	NF_3	Total
	CO_2 equivalent (kt)								
H. Other									
3. Agriculture	**0.0607**	**1,824.3626**	**1,348.9446**						**3,173.3679**
A. Enteric Fermentation		1,618.0865							1,618.0865
B. Manure Management		206.2761	537.6941						743.9702
C. Rice Cultivation		NO							NO
D. Agricultural Soils			811.2505						811.2505
E. Prescribed Burning of Savannas		NO	NO						NO
F. Field Burning of Agricultural Residues		IE	IE						IE
G. Liming	NO								NO
H. Urea Application	0.0607								0.0607
I. Other Carbon-Containing Fertilizers	NO, NE								NO, NE
J. Other	NO	NO	NO						NO
4. LULUCF	**-2,284.8659**	**2.2396**	**251.5155**						**-2,031.1108**
A. Forest Land	-2,045.0670	0.0033	0.0022						-2,045.0615
B. Cropland	1,316.7230	2.2363	0.6911						1,319.6504
C. Grassland	-1,601.1004	NE	NE						-1,601.1004
D. Wetlands	-469.4389	NE	NE						-469.4389
E. Settlements	106.9167	NO, NE	250.8222						357.7389
F. Other Land	401.1281	NE	NE						401.1281
G. Harvested Wood Products	5.9727								5.9727
H. Other	NE	NE	NE						NO
5. Waste	**15.0979**	**1,551.5871**	**70.6313**						**1,637.3163**
A. Solid Waste Disposal	NA, NO	1,256.0725							1,256.0725
B. Biological Treatment of Solid Waste		0.6322	0.4521						1.0843
C. Incineration and Open Burning of Waste	15.0979	7.7395	1.6200						24.4574
D. Wastewater Treatment and Discharge		287.1429	68.5592						355.7021
E. Other	NO	NO	NO						NO
6. Other	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	NO
Memo Items									
International Bunkers	**41.9508**	**0.1638**	**0.4066**						**42.5212**
Aviation	41.9508	0.1638	0.4066						42.5212
Navigation	NO	NO	NO						NO
Multilateral Operations	**NO**	**NO**	**NO**						**NO**
CO_2 Emissions from Biomass	230.0480								230.0480
CO_2 Captured and Stored	NO								NO
Long-term Storage of C in Waste Disposal Sites	NE								NE
Indirect N_2O			404.8742						404.8742
Indirect CO_2	65.4471								65.4471
								Total (without LULUCF)	**17,658.6891**
								Total (with LULUCF)	**15,627.5783**

1996

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2	CH_4	N_2O	HFCs	PFCs	SF_6	Unspecified mix of HFCs and PFCs	NF_3	Total
	CO_2 equivalent (kt)								
Total (net emissions)	**9,069.7634**	**4,116.7709**	**1,777.7950**	**1.6593**	**NO**	**NO**	**NO**	**NO**	**14,965.9885**
1. Energy	**11,379.8429**	**882.5278**	**111.5900**						**12,373.9607**
A. Fuel Combustion (Sectoral approach)	11,379.3471	74.2347	111.5900						11,565.1718
1. Energy Industries	7,107.0544	3.3821	13.9743						7,124.4109
2. Manufacturing Industries and Construction	326.3785	0.1749	0.4773						327.0306
3. Transport	1,578.3769	10.7792	30.0631						1,619.2192
4. Other Sectors	2,285.6997	59.6255	66.3824						2,411.7076
5. Other	81.8376	0.2730	0.6929						82.8034
B. Fugitive Emissions from Fuels	0.4958	808.2931	0.0000						808.7889
1. Solid Fuels	NO	NO	NO						NO
2. Oil and Natural Gas	0.4958	808.2931	0.0000						808.7889
C. CO_2 Transport and Storage	NO								NO
2. Industrial Processes and Product Use	**415.2620**	**NO**	**0.0006**	**1.6593**	**NO**	**NO**	**NO**	**NO**	**416.9219**
A. Mineral Industry	316.3598								316.3598
B. Chemical Industry	NO	NO	NO						NO
C. Metal Industry	26.7261	NO	NO	NO	NO	NO	NO	NO	26.7261
D. Non-Energy Products From Fuels and Solvent Use	71.0712	NO	NO						71.0712
E. Electronic Industry				NO	NO	NO	NO	NO	NO
F. Product Use as Substitutes for ODS				1.6593	NO	NO	NO	NO	1.6593
G. Other Product Manufacture and Use	1.1050	NO	0.0006	NO	NO	NO	NO	NO	1.1056
H. Other									
3. Agriculture	**0.0911**	**1,679.2333**	**1,334.3366**						**3,013.6610**
A. Enteric Fermentation		1,491.8749							1,491.8749
B. Manure Management		187.3584	565.0636						752.4220
C. Rice Cultivation		NO							NO
D. Agricultural Soils			769.2730						769.2730
E. Prescribed Burning of Savannas		NO	NO						NO
F. Field Burning of Agricultural Residues		IE	IE						IE
G. Liming	NO								NO
H. Urea Application	0.0911								0.0911
I. Other Carbon-Containing Fertilizers	NO, NE								NO, NE
J. Other	NO	NO	NO						NO
4. LULUCF	**-2,740.5286**	**1.5410**	**262.2576**						**-2,476.7300**
A. Forest Land	-2,190.4337	0.0193	0.0127						-2,190.4016
B. Cropland	1,118.5241	1.5217	0.4703						1,120.5161
C. Grassland	-1,548.0826	NE	NE						-1,548.0826
D. Wetlands	-441.2360	NE	NE						-441.2360
E. Settlements	101.5910	NO, NE	261.7746						363.3656
F. Other Land	217.3293	NE	NE						217.3293
G. Harvested Wood Products	1.7792								1.7792
H. Other	NE	NE	NE						NE
5. Waste	**15.0960**	**1,553.4688**	**69.6101**						**1,638.1749**
A. Solid Waste Disposal	NA, NO	1,261.8303							1,261.8303

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2	CH_4	N_2O	HFCs	PFCs	SF_6	Unspecified mix of HFCs and PFCs	NF_3	Total
	CO_2 equivalent (kt)								
B. Biological Treatment of Solid Waste		0.6517	0.4661						1.1178
C. Incineration and Open Burning of Waste	15.0960	7.7356	1.6194						24.4511
D. Wastewater Treatment and Discharge		283.2511	67.5246						350.7757
E. Other	NO	NO	NO						NO
6. Other	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	NO
Memo Items									
International Bunkers	**56.7300**	**0.1196**	**0.5436**						**57.3932**
Aviation	56.7300	0.1196	0.5436						57.3932
Navigation	NO	NO	NO						NO
Multilateral Operations	**NO**	**NO**	**NO**						**NO**
CO_2 Emissions from Biomass	294.0280								294.0280
CO_2 Captured and Stored	NO								NO
Long-term Storage of C in Waste Disposal Sites	NE								NE
Indirect N_2O			408.4042						408.4042
Indirect CO_2	60.5658								60.5658
								Total (without LULUCF)	**17,442.7185**
								Total (with LULUCF)	**14,965.9885**

1997

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2	CH_4	N_2O	HFCs	PFCs	SF_6	Unspecified mix of HFCs and PFCs	NF_3	Total
	CO_2 equivalent (kt)								
Total (net emissions)	**8,353.2467**	**3,725.2871**	**1,633.8983**	**2.3137**	**NO**	**NO**	**NO**	**NO**	**13,714.7457**
1. Energy	**10,275.2096**	**743.2093**	**102.1991**						**11,120.6179**
A. Fuel Combustion (Sectoral approach)	10,274.7201	57.9425	102.1991						10,434.8617
1. Energy Industries	5,615.6123	2.7692	7.2856						5,625.6671
2. Manufacturing Industries and Construction	563.8972	0.3615	0.6913						564.9501
3. Transport	1,516.0213	10.0229	29.0956						1,555.1398
4. Other Sectors	2,502.5306	44.5872	64.5312						2,611.6491
5. Other	76.6587	0.2017	0.5953						77.4557
B. Fugitive Emissions from Fuels	0.4895	685.2668	0.0000						685.7562
1. Solid Fuels	NO	NO	NO						NO
2. Oil and Natural Gas	0.4895	685.2668	0.0000						685.7562
C. CO_2 Transport and Storage	NO								NO
2. Industrial Processes and Product Use	**452.4924**	**NO**	**0.0009**	**2.3137**	**NO**	**NO**	**NO**	**NO**	**454.8070**
A. Mineral Industry	377.0608								377.0608
B. Chemical Industry	NO	NO	NO						NO
C. Metal Industry	32.3806	NO	NO	NO	NO	NO	NO	NO	32.3806
D. Non-Energy Products From Fuels and Solvent Use	42.0528	NO	NO						42.0528
E. Electronic Industry				NO	NO	NO	NO	NO	NO
F. Product Use as Substitutes for ODS				2.3137	NO	NO	NO	NO	2.3137
G. Other Product Manufacture and Use	0.9982	NO	0.0009	NO	NO	NO	NO	NO	0.9991

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2	CH_4	N_2O	HFCs	PFCs	SF_6	Unspecified mix of HFCs and PFCs	NF_3	Total
	CO_2 equivalent (kt)								
H. Other									
3. Agriculture	**1.0992**	**1,434.7631**	**1,188.7040**						**2,624.5664**
A. Enteric Fermentation		1,282.5988							1,282.5988
B. Manure Management		152.1643	437.4938						589.6581
C. Rice Cultivation		NO							NO
D. Agricultural Soils			751.2102						751.2102
E. Prescribed Burning of Savannas		NO	NO						NO
F. Field Burning of Agricultural Residues		IE	IE						IE
G. Liming	NO								NO
H. Urea Application	1.0992								1.0992
I. Other Carbon-Containing Fertilizers	NO, NE								NO, NE
J. Other	NO	NO	NO						NO
4. LULUCF	**-2,390.6002**	**2.6880**	**272.1818**						**-2,115.7304**
A. Forest Land	-2,232.2854	0.0059	0.0039						-2,232.2757
B. Cropland	1,385.7903	2.6821	0.8289						1,389.3014
C. Grassland	-1,400.8607	NE	NE						-1,400.8607
D. Wetlands	-413.0332	NE	NE						-413.0332
E. Settlements	100.7954	NO, NE	271.3490						372.1444
F. Other Land	188.2363	NE	NE						188.2363
G. Harvested Wood Products	-19.2429								-19.2429
H. Other	NE	NE	NE						NE
5. Waste	**15.0456**	**1,544.6267**	**70.8125**						**1,630.4848**
A. Solid Waste Disposal	NA, NO	1,246.6523							1,246.6523
B. Biological Treatment of Solid Waste		0.6130	0.4384						1.0514
C. Incineration and Open Burning of Waste	15.0456	7.7079	1.6138						24.3673
D. Wastewater Treatment and Discharge		289.6535	68.7603						358.4138
E. Other	NO	NO	NO						NO
6. Other	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	NO
Memo Items									
International Bunkers	**66.1918**	**0.1341**	**0.6341**						**66.9600**
Aviation	66.1918	0.1341	0.6341						66.9600
Navigation	NO	NO	NO						NO
Multilateral Operations	**NO**	**NO**	**NO**						**NO**
CO_2 Emissions from Biomass	291.1280								291.1280
CO_2 Captured and Stored	NO								NO
Long-term Storage of C in Waste Disposal Sites	NE								NE
Indirect N_2O			347.2089						347.2089
Indirect CO_2	32.0911								32.0911
								Total (without LULUCF)	**15,830.4761**
								Total (with LULUCF)	**13,714.7457**

1998

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2	CH_4	N_2O	HFCs	PFCs	SF_6	Unspecified mix of HFCs and PFCs	NF_3	Total
	CO_2 equivalent (kt)								
Total (net emissions)	**6,859.2972**	**3,587.2172**	**1,569.3311**	**3.1372**	**NO**	**NO**	**NO**	**NO**	**12,018.9827**
1. Energy	**8,891.0345**	**681.3380**	**79.6234**						**9,651.9960**
A. Fuel Combustion (Sectoral approach)	8,890.5850	42.8057	79.6234						9,013.0141
1. Energy Industries	4,836.6106	2.4047	5.6624						4,844.6778
2. Manufacturing Industries and Construction	539.2845	0.3730	0.6669						540.3244
3. Transport	1,363.1855	10.0855	24.6358						1,397.9068
4. Other Sectors	2,078.6760	29.7213	48.0295						2,156.4269
5. Other	72.8283	0.2211	0.6289						73.6783
B. Fugitive Emissions from Fuels	0.4495	638.5324	0.0000						638.9819
1. Solid Fuels	NO	NO	NO						NO
2. Oil and Natural Gas	0.4495	638.5324	0.0000						638.9819
C. CO_2 Transport and Storage	NO								NO
2. Industrial Processes and Product Use	**375.5168**	**NO**	**0.0015**	**3.1372**	**NO**	**NO**	**NO**	**NO**	**378.6554**
A. Mineral Industry	308.4801								308.4801
B. Chemical Industry	NO	NO	NO						NO
C. Metal Industry	28.6822	NO	NO	NO	NO	NO	NO	NO	28.6822
D. Non-Energy Products From Fuels and Solvent Use	37.6084	NO	NO						37.6084
E. Electronic Industry				NO	NO	NO	NO	NO	NO
F. Product Use as Substitutes for ODS				3.1372	NO	NO	NO	NO	3.1372
G. Other Product Manufacture and Use	0.7460	NO	0.0015	NO	NO	NO	NO	NO	0.7475
H. Other									
3. Agriculture	**0.2721**	**1,385.6816**	**1,133.4851**						**2,519.4389**
A. Enteric Fermentation		1,245.1973							1,245.1973
B. Manure Management		140.4844	409.7130						550.1974
C. Rice Cultivation		NO							NO
D. Agricultural Soils			723.7721						723.7721
E. Prescribed Burning of Savannas		NO	NO						NO
F. Field Burning of Agricultural Residues		IE	IE						IE
G. Liming	NO								NO
H. Urea Application	0.2721								0.2721
I. Other Carbon-Containing Fertilizers	NO, NE								NO, NE
J. Other	NO	NO	NO						NO
4. LULUCF	**-2,422.6056**	**2.4720**	**284.3568**						**-2,135.7768**
A. Forest Land	-2,288.4857	0.0581	0.0383						-2,288.3892
B. Cropland	1,412.0577	2.4139	0.7460						1,415.2175
C. Grassland	-1,436.2698	NE	NE						-1,436.2698
D. Wetlands	-384.8303	NE	NE						-384.8303
E. Settlements	99.0440	NO, NE	283.5725						382.6164
F. Other Land	185.0077	NE	NE						185.0077
G. Harvested Wood Products	-9.1293								-9.1293
H. Other	NE	NE	NE						NE
5. Waste	**15.0794**	**1,517.7256**	**71.8643**						**1,604.6693**

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2	CH_4	N_2O	HFCs	PFCs	SF_6	Unspecified mix of HFCs and PFCs	NF_3	Total
	CO_2 equivalent (kt)								
A. Solid Waste Disposal	NA, NO	1,230.1150							1,230.1150
B. Biological Treatment of Solid Waste		0.6189	0.4427						1.0616
C. Incineration and Open Burning of Waste	15.0794	7.7234	1.6172						24.4200
D. Wastewater Treatment and Discharge		279.2682	69.8045						349.0727
E. Other	NO	NO	NO						NO
6. Other	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	NO
Memo Items									
International Bunkers	**53.5923**	**0.1025**	**0.5152**						**54.2100**
Aviation	53.5923	0.1025	0.5152						54.2100
Navigation	NO	NO	NO						NO
Multilateral Operations	**NO**	**NO**	**NO**						**NO**
CO_2 Emissions from Biomass	269.0120								269.0120
CO_2 Captured and Stored	NO								NO
Long-term Storage of C in Waste Disposal Sites	NE								NE
Indirect N_2O			326.6573						326.6573
Indirect CO_2	29.9352								29.9352
								Total (without LULUCF)	**14,154.7596**
								Total (with LULUCF)	**12,018.9827**

1999

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2	CH_4	N_2O	HFCs	PFCs	SF_6	Unspecified mix of HFCs and PFCs	NF_3	Total
	CO_2 equivalent (kt)								
Total (net emissions)	**5,126.5807**	**3,462.1792**	**1,451.2674**	**4.0002**	**NO**	**NO**	**NO**	**NO**	**10,044.0274**
1. Energy	**6,913.7785**	**672.1310**	**54.3661**						**7,640.2756**
A. Fuel Combustion (Sectoral approach)	6,913.3665	38.8130	54.3660						7,006.5455
1. Energy Industries	3,660.2540	1.8165	2.6146						3,664.6852
2. Manufacturing Industries and Construction	483.9580	0.2698	0.4735						484.7013
3. Transport	910.5958	6.1873	15.3296						932.1127
4. Other Sectors	1,809.4024	30.3769	35.4659						1,875.2453
5. Other	49.1563	0.1623	0.4823						49.8010
B. Fugitive Emissions from Fuels	0.4121	633.3180	0.0000						633.7301
1. Solid Fuels	NO	NO	NO						NO
2. Oil and Natural Gas	0.4121	633.3180	0.0000						633.7301
C. CO_2 Transport and Storage	NO								NO
2. Industrial Processes and Product Use	**338.2305**	**NO**	**0.0128**	**4.0002**	**NO**	**NO**	**NO**	**NO**	**342.2435**
A. Mineral Industry	271.7103								271.7103
B. Chemical Industry	NO	NO	NO						NO
C. Metal Industry	31.7942	NO	NO	NO	NO	NO	NO	NO	31.7942
D. Non-Energy Products From Fuels and Solvent Use	34.0839	NO	NO						34.0839
E. Electronic Industry				NO	NO	NO	NO	NO	NO
F. Product Use as Substitutes for ODS				4.0002	NO	NO	NO	NO	4.0002

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2	CH_4	N_2O	HFCs	PFCs	SF_6	Unspecified mix of HFCs and PFCs	NF_3	Total
	CO_2 equivalent (kt)								
G. Other Product Manufacture and Use	0.6421	NO	0.0128	NO	NO	NO	NO	NO	0.6549
H. Other									
3. Agriculture	**0.0034**	**1,274.1632**	**1,032.7049**						**2,306.8715**
A. Enteric Fermentation		1,151.8178							1,151.8178
B. Manure Management		122.3454	369.5596						491.9050
C. Rice Cultivation		NO							NO
D. Agricultural Soils			663.1453						663.1453
E. Prescribed Burning of Savannas		NO	NO						NO
F. Field Burning of Agricultural Residues		IE	IE						IE
G. Liming	NO								NO
H. Urea Application	0.0034								0.0034
I. Other Carbon-Containing Fertilizers	NO, NE								NO, NE
J. Other	NO	NO	NO						NO
4. LULUCF	**-2,140.4389**	**2.3889**	**293.8604**						**-1,844.1896**
A. Forest Land	-2,336.8468	0.0435	0.0287						-2,336.7747
B. Cropland	1,430.7993	2.3454	0.7248						1,433.8695
C. Grassland	-1,433.2865	NE	NE						-1,433.2865
D. Wetlands	-356.6274	NE	NE						-356.6274
E. Settlements	111.8259	NO, NE	293.1069						404.9328
F. Other Land	425.1554	NE	NE						425.1554
G. Harvested Wood Products	18.5414								18.5414
H. Other	NE	NE	NE						NE
5. Waste	**15.0071**	**1,513.4962**	**70.3233**						**1,598.8266**
A. Solid Waste Disposal	NA, NO	1,234.6535							1,234.6535
B. Biological Treatment of Solid Waste		0.5807	0.4154						0.9961
C. Incineration and Open Burning of Waste	15.0071	7.6922	1.6101						24.3095
D. Wastewater Treatment and Discharge		270.5697	68.2978						338.8674
E. Other	NO	NO	NO						NO
6. Other	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	NO
Memo Items									
International Bunkers	**63.0390**	**0.0994**	**0.6040**						**63.7425**
Aviation	63.0390	0.0994	0.6040						63.7425
Navigation	NO	NO	NO						NO
Multilateral Operations	**NO**	**NO**	**NO**						**NO**
CO_2 Emissions from Biomass	266.1120								266.1120
CO_2 Captured and Stored	NO								NO
Long-term Storage of C in Waste Disposal Sites	NE								NE
Indirect N_2O			293.9587						293.9587
Indirect CO_2	28.7113								28.7113
								Total (without LULUCF)	**11,888.2171**
								Total (with LULUCF)	**10,044.0274**

2000

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2	CH_4	N_2O	HFCs	PFCs	SF_6	Unspecified mix of HFCs and PFCs	NF_3	Total
	CO_2 equivalent (kt)								
Total (net emissions)	**4,095.3870**	**3,372.2884**	**1,370.6045**	**5.1199**	**NO**	**NO**	**NO**	**NO**	**8,843.3998**
1. Energy	**6,189.8822**	**702.5137**	**48.4842**						**6,940.8801**
A. Fuel Combustion (Sectoral approach)	6,189.4898	38.3932	48.4841						6,276.3671
1. Energy Industries	3,155.7517	1.5249	2.0520						3,159.3286
2. Manufacturing Industries and Construction	520.9679	0.2454	0.4147						521.6280
3. Transport	982.2638	6.2978	17.0960						1,005.6576
4. Other Sectors	1,494.1182	30.2106	28.6196						1,552.9485
5. Other	36.3881	0.1145	0.3018						36.8044
B. Fugitive Emissions from Fuels	0.3924	664.1205	0.0000						664.5129
1. Solid Fuels	NO	NO	NO						NO
2. Oil and Natural Gas	0.3924	664.1205	0.0000						664.5129
C. CO_2 Transport and Storage	NO								NO
2. Industrial Processes and Product Use	**310.6441**	**NO**	**0.0131**	**5.1199**	**NO**	**NO**	**NO**	**NO**	**315.7771**
A. Mineral Industry	240.7803								240.7803
B. Chemical Industry	NO	NO	NO						NO
C. Metal Industry	36.2689	NO	NO	NO	NO	NO	NO	NO	36.2689
D. Non-Energy Products From Fuels and Solvent Use	32.6395	NO	NO						32.6395
E. Electronic Industry				NO	NO	NO	NO	NO	NO
F. Product Use as Substitutes for ODS				5.1199	NO	NO	NO	NO	5.1199
G. Other Product Manufacture and Use	0.9554	NO	0.0131	NO	NO	NO	NO	NO	0.9685
H. Other									
3. Agriculture	**0.4397**	**1,181.8782**	**953.8762**						**2,136.1941**
A. Enteric Fermentation		1,085.7826							1,085.7826
B. Manure Management		96.0956	322.8297						418.9254
C. Rice Cultivation		NO							NO
D. Agricultural Soils			631.0464						631.0464
E. Prescribed Burning of Savannas		NO	NO						NO
F. Field Burning of Agricultural Residues		IE	IE						IE
G. Liming	NO								NO
H. Urea Application	0.4397								0.4397
I. Other Carbon-Containing Fertilizers	NO, NE								NO, NE
J. Other	NO	NO	NO						NO
4. LULUCF	**-2,420.5755**	**0.9123**	**296.3244**						**-2,123.3389**
A. Forest Land	-2,307.4384	0.0016	0.0010						-2,307.4358
B. Cropland	1,222.7282	0.9107	0.2814						1,223.9203
C. Grassland	-1,291.9495	NE	NE						-1,291.9495
D. Wetlands	-328.4245	NE	NE						-328.4245
E. Settlements	100.1768	NO, NE	296.0419						396.2187
F. Other Land	178.5246	NE	NE						178.5246
G. Harvested Wood Products	5.8073								5.8073
H. Other	NE	NE	NE						NE
5. Waste	**14.9965**	**1,486.9842**	**71.9066**						**1,573.8873**

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2	CH_4	N_2O	HFCs	PFCs	SF_6	Unspecified mix of HFCs and PFCs	NF_3	Total
	CO_2 equivalent (kt)								
A. Solid Waste Disposal	NA, NO	1,207.0370							1,207.0370
B. Biological Treatment of Solid Waste		0.5238	0.3746						0.8984
C. Incineration and Open Burning of Waste	14.9965	7.6818	1.6084						24.2867
D. Wastewater Treatment and Discharge		271.7416	69.9236						341.6652
E. Other	NO	NO	NO						NO
6. Other	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	NO
Memo Items									
International Bunkers	**63.0779**	**0.1086**	**0.6101**						**63.7967**
Aviation	63.0779	0.1086	0.6101						63.7967
Navigation	NO	NO	NO						NO
Multilateral Operations	**NO**	**NO**	**NO**						**NO**
CO_2 Emissions from Biomass	272.3720								272.3720
CO_2 Captured and Stored	NO								NO
Long-term Storage of C in Waste Disposal Sites	NE								NE
Indirect N_2O			265.5133						265.5133
Indirect CO_2	28.5957								28.5957
Total (without LULUCF)									**10,966.7387**
Total (with LULUCF)									**8,843.3998**

2001

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2	CH_4	N_2O	HFCs	PFCs	SF_6	Unspecified mix of HFCs and PFCs	NF_3	Total
	CO_2 equivalent (kt)								
Total (net emissions)	**5,082.6367**	**3,360.2646**	**1,447.2749**	**6.8681**	**NO**	**NO**	**NO**	**NO**	**9,897.0443**
1. Energy	**6,819.3643**	**700.8326**	**49.8664**						**7,570.0633**
A. Fuel Combustion (Sectoral approach)	6,818.9369	35.3020	49.8663						6,904.1053
1. Energy Industries	3,677.7189	1.8154	2.3940						3,681.9284
2. Manufacturing Industries and Construction	601.9346	0.3079	0.5542						602.7967
3. Transport	1,061.7864	6.6677	18.8941						1,087.3482
4. Other Sectors	1,434.1009	26.3857	27.6641						1,488.1507
5. Other	43.3961	0.1253	0.3599						43.8813
B. Fugitive Emissions from Fuels	0.4274	665.5306	0.0001						665.9580
1. Solid Fuels	NO	NO	NO						NO
2. Oil and Natural Gas	0.4274	665.5306	0.0001						665.9580
C. CO_2 Transport and Storage	NO								NO
2. Industrial Processes and Product Use	**312.9423**	**NO**	**0.0131**	**6.8681**	**NO**	**NO**	**NO**	**NO**	**319.8235**
A. Mineral Industry	237.0750								237.0750
B. Chemical Industry	NO	NO	NO						NO
C. Metal Industry	38.6274	NO	NO	NO	NO	NO	NO	NO	38.6274
D. Non-Energy Products From Fuels and Solvent Use	36.4195	NO	NO						36.4195
E. Electronic Industry				NO	NO	NO	NO	NO	NO
F. Product Use as Substitutes for ODS				6.8681	NO	NO	NO	NO	6.8681

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2	CH_4	N_2O	HFCs	PFCs	SF_6	Unspecified mix of HFCs and PFCs	NF_3	Total
	CO_2 equivalent (kt)								
G. Other Product Manufacture and Use	0.8204	NO	0.0131	NO	NO	NO	NO	NO	0.8335
H. Other									
3. Agriculture	**0.1496**	**1,199.8472**	**1,028.1989**						**2,228.1956**
A. Enteric Fermentation		1,103.2722							1,103.2722
B. Manure Management		96.5750	328.7069						425.2818
C. Rice Cultivation		NO							NO
D. Agricultural Soils			699.4920						699.4920
E. Prescribed Burning of Savannas		NO	NO						NO
F. Field Burning of Agricultural Residues		IE	IE						IE
G. Liming	NO								NO
H. Urea Application	0.1496								0.1496
I. Other Carbon-Containing Fertilizers	NO, NE								NO, NE
J. Other	NO	NO	NO						NO
4. LULUCF	**-2,064.7883**	**1.2702**	**296.5454**						**-1,766.9727**
A. Forest Land	-2,273.7027	0.0983	0.0648						-2,273.5395
B. Cropland	1,560.4352	1.1719	0.3622						1,561.9692
C. Grassland	-1,290.6541	NE	NE						-1,290.6541
D. Wetlands	-300.2217	NE	NE						-300.2217
E. Settlements	67.0898	NO, NE	296.1184						363.2082
F. Other Land	178.5246	NE	NE						178.5246
G. Harvested Wood Products	-6.2594								-6.2594
H. Other	NE	NE	NE						NE
5. Waste	**14.9689**	**1,458.3147**	**72.6511**						**1,545.9346**
A. Solid Waste Disposal	NA, NO	1,172.9240							1,172.9240
B. Biological Treatment of Solid Waste		0.4755	0.3401						0.8156
C. Incineration and Open Burning of Waste	14.9689	7.6683	1.6055						24.2427
D. Wastewater Treatment and Discharge		277.2468	70.7055						347.9523
E. Other	NO	NO	NO						NO
6. Other	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	NO
Memo Items									
International Bunkers	**50.4863**	**0.0977**	**0.4911**						**51.0751**
Aviation	50.4863	0.0977	0.4911						51.0751
Navigation	NO	NO	NO						NO
Multilateral Operations	**NO**	**NO**	**NO**						**NO**
CO_2 Emissions from Biomass	282.2280								282.2280
CO_2 Captured and Stored	NO								NO
Long-term Storage of C in Waste Disposal Sites	NE								NE
Indirect N_2O			281.5882						281.5882
Indirect CO_2	31.6632								31.6632
								Total (without LULUCF)	**11,664.0170**
								Total (with LULUCF)	**9,897.0443**

2002

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2	CH_4	N_2O	HFCs	PFCs	SF_6	Unspecified mix of HFCs and PFCs	NF_3	Total
	CO_2 equivalent (kt)								
Total (net emissions)	**4,762.9045**	**3,424.1927**	**1,506.7677**	**9.1227**	**NO**	**NO**	**NO**	**NO**	**9,702.9876**
1. Energy	**6,538.3068**	**753.4343**	**63.9628**						**7,355.7039**
A. Fuel Combustion (Sectoral approach)	6,537.9006	44.3648	63.9628						6,646.2281
1. Energy Industries	2,933.2101	1.5342	2.0510						2,936.7953
2. Manufacturing Industries and Construction	411.7767	0.1927	0.3333						412.3027
3. Transport	1,405.6363	8.5438	28.2257						1,442.4058
4. Other Sectors	1,747.8245	33.8864	32.8830						1,814.5940
5. Other	39.4529	0.2076	0.4698						40.1303
B. Fugitive Emissions from Fuels	0.4062	709.0696	0.0001						709.4758
1. Solid Fuels	NO	NO	NO						NO
2. Oil and Natural Gas	0.4062	709.0696	0.0001						709.4758
C. CO_2 Transport and Storage	NO								NO
2. Industrial Processes and Product Use	**361.1500**	**NO**	**0.0131**	**9.1227**	**NO**	**NO**	**NO**	**NO**	**370.2858**
A. Mineral Industry	301.4884								301.4884
B. Chemical Industry	NO	NO	NO						NO
C. Metal Industry	20.5030	NO	NO	NO	NO	NO	NO	NO	20.5030
D. Non-Energy Products From Fuels and Solvent Use	38.3743	NO	NO						38.3743
E. Electronic Industry				NO	NO	NO	NO	NO	NO
F. Product Use as Substitutes for ODS				9.1227	NO	NO	NO	NO	9.1227
G. Other Product Manufacture and Use	0.7843	NO	0.0131	NO	NO	NO	NO	NO	0.7974
H. Other									
3. Agriculture	**0.0470**	**1,226.0792**	**1,071.3299**						**2,297.4561**
A. Enteric Fermentation		1,125.6099							1,125.6099
B. Manure Management		100.4693	331.8054						432.2747
C. Rice Cultivation		NO							NO
D. Agricultural Soils			739.5245						739.5245
E. Prescribed Burning of Savannas		NO	NO						NO
F. Field Burning of Agricultural Residues		IE	IE						IE
G. Liming	NO								NO
H. Urea Application	0.0470								0.0470
I. Other Carbon-Containing Fertilizers	NO, NE								NO, NE
J. Other	NO	NO	NO						NO
4. LULUCF	**-2,151.5395**	**0.2659**	**296.9504**						**-1,854.3232**
A. Forest Land	-2,267.6159	0.0528	0.0348						-2,267.5283
B. Cropland	1,156.5876	0.2131	0.0658						1,156.8665
C. Grassland	-1,235.1380	NE	NE						-1,235.1380
D. Wetlands	-272.0188	NE	NE						-272.0188
E. Settlements	67.0898	NO, NE	296.8498						363.9396
F. Other Land	456.2431	NE	NE						456.2431
G. Harvested Wood Products	-56.6873								-56.6873
H. Other	NE	NE	NE						NE
5. Waste	**14.9402**	**1,444.4133**	**74.5114**						**1,533.8650**

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2	CH_4	N_2O	HFCs	PFCs	SF_6	Unspecified mix of HFCs and PFCs	NF_3	Total
	CO_2 equivalent (kt)								
A. Solid Waste Disposal	NA, NO	1,141.7814							1,141.7814
B. Biological Treatment of Solid Waste		0.5221	0.3734						0.8954
C. Incineration and Open Burning of Waste	14.9402	7.6480	1.6017						24.1900
D. Wastewater Treatment and Discharge		294.4618	72.5363						366.9981
E. Other	NO	NO	NO						NO
6. Other	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	NO
Memo Items									
International Bunkers	**59.9541**	**0.0909**	**0.5847**						**60.6297**
Aviation	59.9541	0.0909	0.5847						60.6297
Navigation	NO	NO	NO						NO
Multilateral Operations	**NO**	**NO**	**NO**						**NO**
CO_2 Emissions from Biomass	322.0800								322.0800
CO_2 Captured and Stored	NO								NO
Long-term Storage of C in Waste Disposal Sites	NE								NE
Indirect N_2O			292.8797						292.8797
Indirect CO_2	33.3896								33.3896
								Total (without LULUCF)	**11,557.3108**
								Total (with LULUCF)	**9,702.9876**

2003

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2	CH_4	N_2O	HFCs	PFCs	SF_6	Unspecified mix of HFCs and PFCs	NF_3	Total
	CO_2 equivalent (kt)								
Total (net emissions)	**5,501.9182**	**3,334.2048**	**1,370.8048**	**12.1632**	**NO**	**0.0071**	**NO**	**NO**	**10,219.0982**
1. Energy	**7,179.5364**	**800.1472**	**62.1960**						**8,041.8796**
A. Fuel Combustion (Sectoral approach)	7,178.4599	56.6853	62.1946						7,297.3398
1. Energy Industries	3,036.7432	1.5649	2.0677						3,040.3758
2. Manufacturing Industries and Construction	439.9447	0.2075	0.3419						440.4941
3. Transport	1,588.6955	10.0070	27.1817						1,625.8842
4. Other Sectors	2,084.6537	44.7997	32.3247						2,161.7781
5. Other	28.4228	0.1063	0.2785						28.8076
B. Fugitive Emissions from Fuels	1.0765	743.4618	0.0014						744.5398
1. Solid Fuels	NO	NO	NO						NO
2. Oil and Natural Gas	1.0765	743.4618	0.0014						744.5398
C. CO_2 Transport and Storage	NO								NO
2. Industrial Processes and Product Use	**386.3885**	**NO**	**0.0131**	**12.1632**	**NO**	**0.0071**	**NO**	**NO**	**398.5720**
A. Mineral Industry	309.0730								309.0730
B. Chemical Industry	NO	NO	NO						NO
C. Metal Industry	35.4283	NO	NO	NO	NO	NO	NO	NO	35.4283
D. Non-Energy Products From Fuels and Solvent Use	40.9252	NO	NO						40.9252
E. Electronic Industry				NO	NO	NO	NO	NO	NO
F. Product Use as Substitutes for ODS				12.1632	NO	NO	NO	NO	12.1632

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2	CH_4	N_2O	HFCs	PFCs	SF_6	Unspecified mix of HFCs and PFCs	NF_3	Total
	CO_2 equivalent (kt)								
G. Other Product Manufacture and Use	0.9620	NO	0.0131	NO	NO	0.0071	NO	NO	0.9823
H. Other									
3. Agriculture	**0.2381**	**1,121.7722**	**942.2106**						**2,064.2209**
A. Enteric Fermentation		1,028.5383							1,028.5383
B. Manure Management		93.2338	314.8850						408.1189
C. Rice Cultivation		NO							NO
D. Agricultural Soils			627.3256						627.3256
E. Prescribed Burning of Savannas		NO	NO						NO
F. Field Burning of Agricultural Residues		IE	IE						IE
G. Liming	NO								NO
H. Urea Application	0.2381								0.2381
I. Other Carbon-Containing Fertilizers	NO, NE								NO, NE
J. Other	NO	NO	NO						NO
4. LULUCF	**-2,079.1549**	**0.0612**	**294.3382**						**-1,784.7555**
A. Forest Land	-2,270.1176	0.0578	0.0381						-2,270.0217
B. Cropland	1,237.5523	0.0034	0.0010						1,237.5567
C. Grassland	-1,007.1842	NE	NE						-1,007.1842
D. Wetlands	-243.8159	NE	NE						-243.8159
E. Settlements	67.8615	NO, NE	294.2991						362.1605
F. Other Land	201.6619	NE	NE						201.6619
G. Harvested Wood Products	-65.1129								-65.1129
H. Other	NE	NE	NE						NE
5. Waste	**14.9100**	**1,412.2243**	**72.0468**						**1,499.1811**
A. Solid Waste Disposal	NA, NO	1,101.9715							1,101.9715
B. Biological Treatment of Solid Waste		0.5481	0.3920						0.9401
C. Incineration and Open Burning of Waste	14.9100	7.6262	1.5977						24.1339
D. Wastewater Treatment and Discharge		302.0785	70.0571						372.1356
E. Other	NO	NO	NO						NO
6. Other	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	NO
Memo Items									
International Bunkers	**34.7676**	**0.0873**	**0.3479**						**35.2028**
Aviation	34.7676	0.0873	0.3479						35.2028
Navigation	NO	NO	NO						NO
Multilateral Operations	**NO**	**NO**	**NO**						**NO**
CO_2 Emissions from Biomass	373.5760								373.5760
CO_2 Captured and Stored	NO								NO
Long-term Storage of C in Waste Disposal Sites	NE								NE
Indirect N_2O			263.3183						263.3183
Indirect CO_2	33.6837								33.6837
								Total (without LULUCF)	**12,003.8537**
								Total (with LULUCF)	**10,219.0982**

2004

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2	CH_4	N_2O	HFCs	PFCs	SF_6	Unspecified mix of HFCs and PFCs	NF_3	Total
	CO_2 equivalent (kt)								
Total (net emissions)	**5,853.5527**	**3,299.0302**	**1,436.5033**	**16.0027**	**NO**	**0.0071**	**NO**	**NO**	**10,605.0960**
1. Energy	**7,630.4387**	**852.5334**	**62.9686**						**8,545.9407**
A. Fuel Combustion (Sectoral approach)	7,629.3163	49.4274	62.9672						7,741.7109
1. Energy Industries	3,107.0816	1.5984	2.1069						3,110.7870
2. Manufacturing Industries and Construction	448.3884	0.2417	0.4102						449.0403
3. Transport	1,786.1813	10.7787	31.6402						1,828.6001
4. Other Sectors	2,260.0278	36.7303	28.5047						2,325.2628
5. Other	27.6373	0.0782	0.3052						28.0207
B. Fugitive Emissions from Fuels	1.1223	803.1060	0.0015						804.2298
1. Solid Fuels	NO	NO	NO						NO
2. Oil and Natural Gas	1.1223	803.1060	0.0015						804.2298
C. CO_2 Transport and Storage	NO								NO
2. Industrial Processes and Product Use	**456.1463**	**NO**	**0.0149**	**16.0027**	**NO**	**0.0071**	**NO**	**NO**	**472.1710**
A. Mineral Industry	350.4572								350.4572
B. Chemical Industry	NO	NO	NO						NO
C. Metal Industry	40.5084	NO	NO	NO	NO	NO	NO	NO	40.5084
D. Non-Energy Products From Fuels and Solvent Use	64.1303	NO	NO						64.1303
E. Electronic Industry				NO	NO	NO	NO	NO	NO
F. Product Use as Substitutes for ODS				16.0027	NO	NO	NO	NO	16.0027
G. Other Product Manufacture and Use	1.0504	NO	0.0149	NO	NO	0.0071	NO	NO	1.0724
H. Other									
3. Agriculture	**0.3669**	**1,049.0273**	**1,014.7057**						**2,064.0999**
A. Enteric Fermentation		961.4211							961.4211
B. Manure Management		87.6062	305.8807						393.4869
C. Rice Cultivation		NO							NO
D. Agricultural Soils			708.8250						708.8250
E. Prescribed Burning of Savannas		NO	NO						NO
F. Field Burning of Agricultural Residues		IE	IE						IE
G. Liming	NO								NO
H. Urea Application	0.3669								0.3669
I. Other Carbon-Containing Fertilizers	NO, NE								NO, NE
J. Other	NO	NO	NO						NO
4. LULUCF	**-2,248.2613**	**0.2008**	**290.1214**						**-1,957.9391**
A. Forest Land	-2,334.7768	0.1518	0.1001						-2,334.5249
B. Cropland	1,198.5883	0.0490	0.0151						1,198.6525
C. Grassland	-1,120.4767	NE	NE						-1,120.4767
D. Wetlands	-215.6130	NE	NE						-215.6130
E. Settlements	53.6737	NO, NE	290.0061						343.6798
F. Other Land	223.8177	NE	NE						223.8177
G. Harvested Wood Products	-53.4745								-53.4745
H. Other	NE	NE	NE						NE
5. Waste	**14.8621**	**1,397.2687**	**68.6927**						**1,480.8235**

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2	CH_4	N_2O	HFCs	PFCs	SF_6	Unspecified mix of HFCs and PFCs	NF_3	Total
	CO_2 equivalent (kt)								
A. Solid Waste Disposal	NA, NO	1,085.3420							1,085.3420
B. Biological Treatment of Solid Waste		0.5754	0.4116						0.9870
C. Incineration and Open Burning of Waste	14.8621	7.5964	1.5919						24.0505
D. Wastewater Treatment and Discharge		303.7548	66.6893						370.4440
E. Other	NO	NO	NO						NO
6. Other	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	NO
Memo Items									
International Bunkers	**34.7903**	**0.0863**	**0.3548**						**35.2315**
Aviation	34.7903	0.0863	0.3548						35.2315
Navigation	NO	NO	NO						NO
Multilateral Operations	**NO**	**NO**	**NO**						**NO**
CO_2 Emissions from Biomass	307.6800								307.6800
CO_2 Captured and Stored	NO								NO
Long-term Storage of C in Waste Disposal Sites	NE								NE
Indirect N_2O			274.9399						274.9399
Indirect CO_2	56.7824								56.7824
Total (without LULUCF)									**12,563.0351**
Total (with LULUCF)									**10,605.0960**

2005

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2	CH_4	N_2O	HFCs	PFCs	SF_6	Unspecified mix of HFCs and PFCs	NF_3	Total
	CO_2 equivalent (kt)								
Total (net emissions)	**6,484.7979**	**3,317.1194**	**1,459.2616**	**22.5106**	**NO**	**0.0427**	**NO**	**NO**	**11,283.7323**
1. Energy	**7,873.9844**	**899.5446**	**62.9591**						**8,836.4882**
A. Fuel Combustion (Sectoral approach)	7,872.8438	51.8685	62.9577						7,987.6700
1. Energy Industries	3,229.4503	1.6505	2.1572						3,233.2579
2. Manufacturing Industries and Construction	576.6569	0.2829	0.4447						577.3845
3. Transport	1,821.7199	10.9921	34.2799						1,866.9919
4. Other Sectors	2,219.0765	38.8835	25.7923						2,283.7523
5. Other	25.9403	0.0595	0.2836						26.2833
B. Fugitive Emissions from Fuels	1.1406	847.6761	0.0015						848.8182
1. Solid Fuels	NO	NO	NO						NO
2. Oil and Natural Gas	1.1406	847.6761	0.0015						848.8182
C. CO_2 Transport and Storage	NO								NO
2. Industrial Processes and Product Use	**550.4807**	**NO**	**0.0182**	**22.5106**	**NO**	**0.0427**	**NO**	**NO**	**573.0521**
A. Mineral Industry	439.1892								439.1892
B. Chemical Industry	NO	NO	NO						NO
C. Metal Industry	41.9358	NO	NO	NO	NO	NO	NO	NO	41.9358
D. Non-Energy Products From Fuels and Solvent Use	68.1910	NO	NO						68.1910
E. Electronic Industry				NO	NO	NO	NO	NO	NO
F. Product Use as Substitutes for ODS				22.5106	NO	NO	NO	NO	22.5106
G. Other Product Manufacture and Use	1.1646	NO	0.0182	NO	NO	0.0427	NO	NO	1.2255

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2	CH_4	N_2O	HFCs	PFCs	SF_6	Unspecified mix of HFCs and PFCs	NF_3	Total
	CO_2 equivalent (kt)								
H. Other									
3. Agriculture	**0.1739**	**1,016.4068**	**1,046.6361**						**2,063.2167**
A. Enteric Fermentation		924.0273							924.0273
B. Manure Management		92.3795	328.4623						420.8418
C. Rice Cultivation		NO							NO
D. Agricultural Soils			718.1737						718.1737
E. Prescribed Burning of Savannas		NO	NO						NO
F. Field Burning of Agricultural Residues		IE	IE						IE
G. Liming	NO								NO
H. Urea Application	0.1739								0.1739
I. Other Carbon-Containing Fertilizers	NO, NE								NO, NE
J. Other	NO	NO	NO						NO
4. LULUCF	**-1,954.3081**	**0.2482**	**286.5410**						**-1,667.5188**
A. Forest Land	-2,409.5185	0.0145	0.0096						-2,409.4945
B. Cropland	1,271.6794	0.2337	0.0722						1,271.9854
C. Grassland	-1,058.1239	NE	NE						-1,058.1239
D. Wetlands	-187.4101	NE	NE						-187.4101
E. Settlements	53.6737	NO, NE	286.4592						340.1329
F. Other Land	416.5012	NE	NE						416.5012
G. Harvested Wood Products	-41.1098								-41.1098
H. Other	NE	NE	NE						NE
5. Waste	**14.4670**	**1,400.9198**	**63.1072**						**1,478.4941**
A. Solid Waste Disposal	NA, NO	1,093.6111							1,093.6111
B. Biological Treatment of Solid Waste		0.6025	0.4309						1.0334
C. Incineration and Open Burning of Waste	14.4670	7.3936	1.5495						23.4100
D. Wastewater Treatment and Discharge		299.3127	61.1268						360.4395
E. Other	NO	NO	NO						NO
6. Other	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	NO
Memo Items									
International Bunkers	**37.9260**	**0.0872**	**0.3848**						**38.3980**
Aviation	37.9260	0.0872	0.3848						38.3980
Navigation	NO	NO	NO						NO
Multilateral Operations	**NO**	**NO**	**NO**						**NO**
CO_2 Emissions from Biomass	307.3920								307.3920
CO_2 Captured and Stored	NO								NO
Long-term Storage of C in Waste Disposal Sites	NE								NE
Indirect N_2O			288.0244						288.0244
Indirect CO_2	61.0627								61.0627
								Total (without LULUCF)	**12,951.2511**
								Total (with LULUCF)	**11,283.7323**

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2	CH_4	N_2O	HFCs	PFCs	SF_6	Unspecified mix of HFCs and PFCs	NF_3	Total
	CO_2 equivalent (kt)								
Total (net emissions)	**5,697.7447**	**3,178.1597**	**1,428.6020**	**33.2493**	**0.0231**	**0.3088**	**NO**	**NO**	**10,338.0877**
1. Energy	**7,114.2233**	**803.3765**	**64.4939**						**7,982.0936**
A. Fuel Combustion (Sectoral approach)	7,112.9809	56.7653	64.4921						7,234.2382
1. Energy Industries	2,492.9310	1.2935	1.6959						2,495.9204
2. Manufacturing Industries and Construction	635.2427	0.2973	0.4482						635.9882
3. Transport	1,742.1028	10.1498	35.7002						1,787.9528
4. Other Sectors	2,203.6648	44.9525	26.2676						2,274.8849
5. Other	39.0397	0.0722	0.3801						39.4920
B. Fugitive Emissions from Fuels	1.2424	746.6112	0.0018						747.8554
1. Solid Fuels	NO	NO	NO						NO
2. Oil and Natural Gas	1.2424	746.6112	0.0018						747.8554
C. CO_2 Transport and Storage	NO								NO
2. Industrial Processes and Product Use	**645.4865**	**NO**	**0.0176**	**33.2493**	**0.0231**	**0.3088**	**NO**	**NO**	**679.0853**
A. Mineral Industry	535.4220								535.4220
B. Chemical Industry	NO	NO	NO						NO
C. Metal Industry	27.0182	NO	NO	NO	NO	NO	NO	NO	27.0182
D. Non-Energy Products From Fuels and Solvent Use	81.9807	NO	NO						81.9807
E. Electronic Industry				NO	NO	NO	NO	NO	NO
F. Product Use as Substitutes for ODS				33.2493	NO	NO	NO	NO	33.2493
G. Other Product Manufacture and Use	1.0655	NO	0.0176	NO	0.0231	0.3088	NO	NO	1.4150
H. Other									
3. Agriculture	**0.1460**	**988.7357**	**1,016.5194**						**2,005.4012**
A. Enteric Fermentation		893.8074							893.8074
B. Manure Management		94.9283	338.5550						433.4833
C. Rice Cultivation		NO							NO
D. Agricultural Soils			677.9645						677.9645
E. Prescribed Burning of Savannas		NO	NO						NO
F. Field Burning of Agricultural Residues		IE	IE						IE
G. Liming	NO								NO
H. Urea Application	0.1460								0.1460
I. Other Carbon-Containing Fertilizers	NO, NE								NO, NE
J. Other	NO	NO	NO						NO
4. LULUCF	**-2,076.2371**	**0.2505**	**282.6021**						**-1,793.3845**
A. Forest Land	-2,366.5168	0.1567	0.1033						-2,366.2568
B. Cropland	1,303.2724	0.0938	0.0290						1,303.3953
C. Grassland	-1,056.3692	NE	NE						-1,056.3692
D. Wetlands	-159.2073	NE	NE						-159.2073
E. Settlements	53.6737	NO, NE	282.4698						336.1435
F. Other Land	189.4964	NE	NE						189.4964
G. Harvested Wood Products	-40.5864								-40.5864
H. Other	NE	NE	NE						NE
5. Waste	**14.1260**	**1,385.7969**	**64.9690**						**1,464.8920**

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2	CH_4	N_2O	HFCs	PFCs	SF_6	Unspecified mix of HFCs and PFCs	NF_3	Total
	CO_2 equivalent (kt)								
A. Solid Waste Disposal	NA, NO	1,089.7168							1,089.7168
B. Biological Treatment of Solid Waste		0.6536	0.4674						1.1210
C. Incineration and Open Burning of Waste	14.1260	7.2192	1.5130						22.8582
D. Wastewater Treatment and Discharge		288.2073	62.9886						351.1959
E. Other	NO	NO	NO						NO
6. Other	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	NO
Memo Items									
International Bunkers	**37.9241**	**0.0979**	**0.3865**						**38.4085**
Aviation	37.9241	0.0979	0.3865						38.4085
Navigation	NO	NO	NO						NO
Multilateral Operations	**NO**	**NO**	**NO**						**NO**
CO_2 Emissions from Biomass	361.4360								361.4360
CO_2 Captured and Stored	NO								NO
Long-term Storage of C in Waste Disposal Sites	NE								NE
Indirect N_2O			284.7725						284.7725
Indirect CO_2	74.1622								74.1622
								Total (without LULUCF)	**12,131.4721**
								Total (with LULUCF)	**10,338.0877**

2007

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2	CH_4	N_2O	HFCs	PFCs	SF_6	Unspecified mix of HFCs and PFCs	NF_3	Total
	CO_2 equivalent (kt)								
Total (net emissions)	**5,888.6802**	**3,009.3604**	**1,236.1758**	**44.7872**	**0.0231**	**0.4084**	**NO**	**NO**	**10,179.4350**
1. Energy	**7,251.2550**	**841.0761**	**62.3465**						**8,154.6776**
A. Fuel Combustion (Sectoral approach)	7,249.9793	45.1657	62.3447						7,357.4896
1. Energy Industries	2,890.4481	1.4797	1.8906						2,893.8184
2. Manufacturing Industries and Construction	801.5026	0.3719	0.4977						802.3722
3. Transport	1,846.7731	10.6856	37.3515						1,894.8103
4. Other Sectors	1,666.7458	32.5309	22.0918						1,721.3685
5. Other	44.5097	0.0975	0.5132						45.1203
B. Fugitive Emissions from Fuels	1.2757	795.9105	0.0018						797.1880
1. Solid Fuels	NO	NO	NO						NO
2. Oil and Natural Gas	1.2757	795.9105	0.0018						797.1880
C. CO_2 Transport and Storage	NO								NO
2. Industrial Processes and Product Use	**892.1071**	**NO**	**NO**	**44.7872**	**0.0231**	**0.4084**	**NO**	**NO**	**937.3258**
A. Mineral Industry	767.6859								767.6859
B. Chemical Industry	NO	NO	NO						NO
C. Metal Industry	38.6127	NO	NO	NO	NO	NO	NO	NO	38.6127
D. Non-Energy Products From Fuels and Solvent Use	84.7433	NO	NO						84.7433
E. Electronic Industry				NO	NO	NO	NO	NO	NO
F. Product Use as Substitutes for ODS				44.7872	NO	NO	NO	NO	44.7872
G. Other Product Manufacture and Use	1.0652	NO	NO	NO	0.0231	0.4084	NO	NO	1.4967

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2	CH_4	N_2O	HFCs	PFCs	SF_6	Unspecified mix of HFCs and PFCs	NF_3	Total
	CO_2 equivalent (kt)								
H. Other									
3. Agriculture	**0.2631**	**788.5504**	**835.2961**						**1,624.1096**
A. Enteric Fermentation		722.0955							722.0955
B. Manure Management		66.4548	256.7282						323.1831
C. Rice Cultivation		NO							NO
D. Agricultural Soils			578.5679						578.5679
E. Prescribed Burning of Savannas		NO	NO						NO
F. Field Burning of Agricultural Residues		IE	IE						IE
G. Liming	NO								NO
H. Urea Application	0.2631								0.2631
I. Other Carbon-Containing Fertilizers	NO, NE								NO, NE
J. Other	NO	NO	NO						NO
4. LULUCF	**-2,268.7122**	**1.5178**	**278.0202**						**-1,989.1742**
A. Forest Land	-2,460.3855	1.3652	0.9002						-2,458.1201
B. Cropland	1,266.1250	0.1525	0.0471						1,266.3247
C. Grassland	-1,031.2350	NE	NE						-1,031.2350
D. Wetlands	-131.0044	NE	NE						-131.0044
E. Settlements	49.2742	NO, NE	277.0728						326.3470
F. Other Land	83.1072	NE	NE						83.1072
G. Harvested Wood Products	-44.5936								-44.5936
H. Other	NE	NE	NE						NE
5. Waste	**13.7672**	**1,378.2161**	**60.5129**						**1,452.4962**
A. Solid Waste Disposal	NA, NO	1,091.3363							1,091.3363
B. Biological Treatment of Solid Waste		0.8474	0.6060						1.4534
C. Incineration and Open Burning of Waste	13.7672	7.0358	1.4745						22.2776
D. Wastewater Treatment and Discharge		278.9966	58.4323						337.4289
E. Other	NO	NO	NO						NO
6. Other	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	NO
Memo Items									
International Bunkers	**44.2052**	**0.0681**	**0.4402**						**44.7135**
Aviation	44.2052	0.0681	0.4402						44.7135
Navigation	NO	NO	NO						NO
Multilateral Operations	**NO**	**NO**	**NO**						**NO**
CO_2 Emissions from Biomass	304.6560								304.6560
CO_2 Captured and Stored	NO								NO
Long-term Storage of C in Waste Disposal Sites	NE								NE
Indirect N_2O			229.8776						229.8776
Indirect CO_2	78.0464								78.0464
								Total (without LULUCF)	**12,168.6092**
								Total (with LULUCF)	**10,179.4350**

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2	CH_4	N_2O	HFCs	PFCs	SF_6	Unspecified mix of HFCs and PFCs	NF_3	Total
	CO_2 equivalent (kt)								
Total (net emissions)	**6,574.2719**	**2,991.0447**	**1,333.2298**	**57.3610**	**0.0288**	**0.4988**	**NO**	**NO**	**10,956.4351**
1. Energy	**7,548.6755**	**838.8396**	**63.4004**						**8,450.9155**
A. Fuel Combustion (Sectoral approach)	7,547.3826	46.5335	63.3986						7,657.3147
1. Energy Industries	2,990.8419	1.6305	2.1369						2,994.6093
2. Manufacturing Industries and Construction	885.5633	0.3856	1.3337						887.2826
3. Transport	1,949.9802	11.2781	37.9126						1,999.1709
4. Other Sectors	1,677.3708	33.1490	21.5577						1,732.0776
5. Other	43.6263	0.0901	0.4578						44.1742
B. Fugitive Emissions from Fuels	1.2929	792.3061	0.0018						793.6008
1. Solid Fuels	NO	NO	NO						NO
2. Oil and Natural Gas	1.2929	792.3061	0.0018						793.6008
C. CO_2 Transport and Storage	NO								NO
2. Industrial Processes and Product Use	**967.6859**	**NO**	**NO**	**57.3610**	**0.0288**	**0.4988**	**NO**	**NO**	**1,025.5746**
A. Mineral Industry	864.4658								864.4658
B. Chemical Industry	NO	NO	NO						NO
C. Metal Industry	35.4118	NO	NO	NO	NO	NO	NO	NO	35.4118
D. Non-Energy Products From Fuels and Solvent Use	66.7047	NO	NO						66.7047
E. Electronic Industry				NO	NO	NO	NO	NO	NO
F. Product Use as Substitutes for ODS				57.3610	NO	NO	NO	NO	57.3610
G. Other Product Manufacture and Use	1.1036	NO	NO	NO	0.0288	0.4988	NO	NO	1.6312
H. Other									
3. Agriculture	**0.8505**	**753.6957**	**942.0406**						**1,696.5868**
A. Enteric Fermentation		689.2854							689.2854
B. Manure Management		64.4103	254.1676						318.5779
C. Rice Cultivation		NO							NO
D. Agricultural Soils			687.8730						687.8730
E. Prescribed Burning of Savannas		NO	NO						NO
F. Field Burning of Agricultural Residues		IE	IE						IE
G. Liming	NO								NO
H. Urea Application	0.8505								0.8505
I. Other Carbon-Containing Fertilizers	NO, NE								NO, NE
J. Other	NO	NO	NO						NO
4. LULUCF	**-1,956.3934**	**0.7701**	**272.0280**						**-1,683.5953**
A. Forest Land	-2,462.7874	0.0949	0.0626						-2,462.6300
B. Cropland	1,236.6745	0.6752	0.2087						1,237.5584
C. Grassland	-932.1498	NE	NE						-932.1498
D. Wetlands	-102.8015	NE	NE						-102.8015
E. Settlements	49.2742	NO, NE	271.7567						321.0310
F. Other Land	291.0044	NE	NE						291.0044
G. Harvested Wood Products	-35.6078								-35.6078
H. Other	NE	NE	NE						NE
5. Waste	**13.4533**	**1,397.7393**	**55.7607**						**1,466.9534**

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2	CH_4	N_2O	HFCs	PFCs	SF_6	Unspecified mix of HFCs and PFCs	NF_3	Total
	CO_2 equivalent (kt)								
A. Solid Waste Disposal	NA, NO	1,109.4186							1,109.4186
B. Biological Treatment of Solid Waste		1.0034	0.7176						1.7211
C. Incineration and Open Burning of Waste	13.4533	6.8704	1.4403						21.7640
D. Wastewater Treatment and Discharge		280.4470	53.6028						334.0498
E. Other	NO	NO	NO						NO
6. Other	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	NO
Memo Items									
International Bunkers	**44.1680**	**0.0409**	**0.4319**						**44.6408**
Aviation	44.1680	0.0409	0.4319						44.6408
Navigation	NO	NO	NO						NO
Multilateral Operations	**NO**	**NO**	**NO**						**NO**
CO_2 Emissions from Biomass	352.4520								352.4520
CO_2 Captured and Stored	NO								NO
Long-term Storage of C in Waste Disposal Sites	NE								NE
Indirect N_2O			250.4677						250.4677
Indirect CO_2	59.5995								59.5995
								Total (without LULUCF)	**12,640.0303**
								Total (with LULUCF)	**10,956.4351**

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GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2	CH_4	N_2O	HFCs	PFCs	SF_6	Unspecified mix of HFCs and PFCs	NF_3	Total
	CO_2 equivalent (kt)								
Total (net emissions)	**7,009.2673**	**2,919.4856**	**1,317.9437**	**67.4790**	**0.0288**	**0.5422**	**NO**	**NO**	**11,314.7466**
1. Energy	**8,093.8632**	**723.8504**	**57.6140**						**8,875.3276**
A. Fuel Combustion (Sectoral approach)	8,092.5702	49.5710	57.6122						8,199.7535
1. Energy Industries	3,835.5110	2.0776	2.7509						3,840.3395
2. Manufacturing Industries and Construction	501.9635	0.1994	0.9080						503.0709
3. Transport	1,919.6624	11.4379	33.1375						1,964.2378
4. Other Sectors	1,824.9424	35.8275	20.7387						1,881.5086
5. Other	10.4909	0.0286	0.0771						10.5966
B. Fugitive Emissions from Fuels	1.2930	674.2794	0.0018						675.5742
1. Solid Fuels	NO	NO	NO						NO
2. Oil and Natural Gas	1.2930	674.2794	0.0018						675.5742
C. CO_2 Transport and Storage	NO								NO
2. Industrial Processes and Product Use	**462.2951**	**NO**	**NO**	**67.4790**	**0.0288**	**0.5422**	**NO**	**NO**	**530.3451**
A. Mineral Industry	386.8478								386.8478
B. Chemical Industry	NO	NO	NO						NO
C. Metal Industry	17.0619	NO	NO	NO	NO	NO	NO	NO	17.0619
D. Non-Energy Products From Fuels and Solvent Use	57.5805	NO	NO						57.5805
E. Electronic Industry				NO	NO	NO	NO	NO	NO
F. Product Use as Substitutes for ODS				67.4790	NO	NO	NO	NO	67.4790
G. Other Product Manufacture and Use	0.8048	NO	NO	NO	0.0288	0.5422	NO	NO	1.3759

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2	CH_4	N_2O	HFCs	PFCs	SF_6	Unspecified mix of HFCs and PFCs	NF_3	Total
	CO_2 equivalent (kt)								
H. Other									
3. Agriculture	**0.5864**	**786.5526**	**938.1032**						**1,725.2422**
A. Enteric Fermentation		713.5953							713.5953
B. Manure Management		72.9573	287.8301						360.7874
C. Rice Cultivation		NO							NO
D. Agricultural Soils			650.2732						650.2732
E. Prescribed Burning of Savannas		NO	NO						NO
F. Field Burning of Agricultural Residues		IE	IE						IE
G. Liming	NO								NO
H. Urea Application	0.5864								0.5864
I. Other Carbon-Containing Fertilizers	NO, NE								NO, NE
J. Other	NO	NO	NO						NO
4. LULUCF	**-1,560.6386**	**0.3145**	**265.3313**						**-1,294.9928**
A. Forest Land	-2,526.0659	0.2315	0.1527						-2,525.6817
B. Cropland	1,390.6850	0.0829	0.0256						1,390.7936
C. Grassland	-447.6932	NE	NE						-447.6932
D. Wetlands	-74.5986	NE	NE						-74.5986
E. Settlements	45.5694	NO, NE	265.1529						310.7223
F. Other Land	79.9357	NE	NE						79.9357
G. Harvested Wood Products	-28.4708								-28.4708
H. Other	NE	NE	NE						NE
5. Waste	**13.1613**	**1,408.7682**	**56.8951**						**1,478.8246**
A. Solid Waste Disposal	NA, NO	1,139.0402							1,139.0402
B. Biological Treatment of Solid Waste		1.1143	0.7969						1.9112
C. Incineration and Open Burning of Waste	13.1613	6.7157	1.4083						21.2853
D. Wastewater Treatment and Discharge		261.8981	54.6899						316.5880
E. Other	NO	NO	NO						NO
6. Other	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	NO
Memo Items									
International Bunkers	**44.1719**	**0.0429**	**0.4319**						**44.6466**
Aviation	44.1719	0.0429	0.4319						44.6466
Navigation	NO	NO	NO						NO
Multilateral Operations	**NO**	**NO**	**NO**						**NO**
CO_2 Emissions from Biomass	362.1000								362.1000
CO_2 Captured and Stored	NO								NO
Long-term Storage of C in Waste Disposal Sites	NE								NE
Indirect N_2O			257.8427						257.8427
Indirect CO_2	51.3571								51.3571
								Total (without LULUCF)	**12,609.7395**
								Total (with LULUCF)	**11,314.7466**

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2	CH_4	N_2O	HFCs	PFCs	SF_6	Unspecified mix of HFCs and PFCs	NF_3	Total
	CO_2 equivalent (kt)								
Total (net emissions)	**7,729.4961**	**2,935.6715**	**1,390.6452**	**78.1507**	**0.0403**	**0.6616**	**NO**	**NO**	**12,134.6655**
1. Energy	**8,719.0513**	**714.6376**	**62.7337**						**9,496.4226**
A. Fuel Combustion (Sectoral approach)	8,717.7555	53.4263	62.7319						8,833.9136
1. Energy Industries	4,047.8107	2.2279	2.9322						4,052.9708
2. Manufacturing Industries and Construction	516.1412	0.2354	0.8849						517.2615
3. Transport	2,140.5138	11.7693	36.5158						2,188.7989
4. Other Sectors	1,985.9921	39.1358	22.2344						2,047.3623
5. Other	27.2976	0.0579	0.1646						27.5201
B. Fugitive Emissions from Fuels	1.2958	661.2113	0.0018						662.5090
1. Solid Fuels	NO	NO	NO						NO
2. Oil and Natural Gas	1.2958	661.2113	0.0018						662.5090
C. CO_2 Transport and Storage	NO								NO
2. Industrial Processes and Product Use	**482.3543**	**NO**	**NO**	**78.1507**	**0.0403**	**0.6616**	**NO**	**NO**	**561.2070**
A. Mineral Industry	405.3915								405.3915
B. Chemical Industry	NO	NO	NO						NO
C. Metal Industry	9.6985	NO	NO	NO	NO	NO	NO	NO	9.6985
D. Non-Energy Products From Fuels and Solvent Use	66.2398	NO	NO						66.2398
E. Electronic Industry				NO	NO	NO	NO	NO	NO
F. Product Use as Substitutes for ODS				78.1507	NO	NO	NO	NO	78.1507
G. Other Product Manufacture and Use	1.0245	NO	NO	NO	0.0403	0.6616	NO	NO	1.7265
H. Other									
3. Agriculture	**1.7443**	**787.3794**	**1,014.6236**						**1,803.7474**
A. Enteric Fermentation		708.1752							708.1752
B. Manure Management		79.2042	300.3879						379.5922
C. Rice Cultivation		NO							NO
D. Agricultural Soils			714.2357						714.2357
E. Prescribed Burning of Savannas		NO	NO						NO
F. Field Burning of Agricultural Residues		IE	IE						IE
G. Liming	NO								NO
H. Urea Application	1.7443								1.7443
I. Other Carbon-Containing Fertilizers	NO, NE								NO, NE
J. Other	NO	NO	NO						NO
4. LULUCF	**-1,486.5202**	**0.1390**	**258.2142**						**-1,228.1669**
A. Forest Land	-2,484.1627	0.0809	0.0534						-2,484.0285
B. Cropland	1,271.7754	0.0581	0.0180						1,271.8515
C. Grassland	-691.9874	NE	NE						-691.9874
D. Wetlands	-46.3958	NE	NE						-46.3958
E. Settlements	45.5694	NO, NE	258.1429						303.7123
F. Other Land	441.4824	NE	NE						441.4824
G. Harvested Wood Products	-22.8014								-22.8014
H. Other	NE	NE	NE						NE
5. Waste	**12.8663**	**1,433.5155**	**55.0736**						**1,501.4555**

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2	CH_4	N_2O	HFCs	PFCs	SF_6	Unspecified mix of HFCs and PFCs	NF_3	Total
	CO_2 equivalent (kt)								
A. Solid Waste Disposal	NA, NO	1,160.6703							1,160.6703
B. Biological Treatment of Solid Waste		1.0751	0.7689						1.8439
C. Incineration and Open Burning of Waste	12.8663	6.5595	1.3761						20.8019
D. Wastewater Treatment and Discharge		265.2106	52.9287						318.1393
E. Other	NO	NO	NO						NO
6. Other	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	NO
Memo Items									
International Bunkers	**41.0593**	**0.0648**	**0.4071**						**41.5312**
Aviation	41.0593	0.0648	0.4071						41.5312
Navigation	NO	NO	NO						NO
Multilateral Operations	**NO**	**NO**	**NO**						**NO**
CO_2 Emissions from Biomass	341.0480								341.0480
CO_2 Captured and Stored	NO								NO
Long-term Storage of C in Waste Disposal Sites	NE								NE
Indirect N_2O			277.4232						277.4232
Indirect CO_2	59.3041								59.3041
Total (without LULUCF)									**13,362.8324**
Total (with LULUCF)									**12,134.6655**

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GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2	CH_4	N_2O	HFCs	PFCs	SF_6	Unspecified mix of HFCs and PFCs	NF_3	Total
	CO_2 equivalent (kt)								
Total (net emissions)	**8,094.7768**	**2,980.7895**	**1,366.4307**	**90.5042**	**0.0403**	**0.7043**	**NO**	**NO**	**12,533.2459**
1. Energy	**8,926.8957**	**796.2043**	**64.4868**						**9,787.5868**
A. Fuel Combustion (Sectoral approach)	8,925.5610	56.3739	64.4849						9,046.4199
1. Energy Industries	3,746.1444	1.9971	2.5910						3,750.7325
2. Manufacturing Industries and Construction	576.1765	0.2663	1.0725						577.5153
3. Transport	2,272.6744	11.7183	38.1651						2,322.5577
4. Other Sectors	2,310.7777	42.3603	22.5291						2,375.6672
5. Other	19.7881	0.0318	0.1273						19.9471
B. Fugitive Emissions from Fuels	1.3347	739.8304	0.0018						741.1669
1. Solid Fuels	NO	NO	NO						NO
2. Oil and Natural Gas	1.3347	739.8304	0.0018						741.1669
C. CO_2 Transport and Storage	NO								NO
2. Industrial Processes and Product Use	**573.6077**	**NO**	**NO**	**90.5042**	**0.0403**	**0.7043**	**NO**	**NO**	**664.8566**
A. Mineral Industry	488.1986								488.1986
B. Chemical Industry	NO	NO	NO						NO
C. Metal Industry	12.8556	NO	NO	NO	NO	NO	NO	NO	12.8556
D. Non-Energy Products From Fuels and Solvent Use	71.3244	NO	NO						71.3244
E. Electronic Industry				NO	NO	NO	NO	NO	NO
F. Product Use as Substitutes for ODS				90.5042	NO	NO	NO	NO	90.5042

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2	CH_4	N_2O	HFCs	PFCs	SF_6	Unspecified mix of HFCs and PFCs	NF_3	Total
	CO_2 equivalent (kt)								
G. Other Product Manufacture and Use	1.2291	NO	NO	NO	0.0403	0.7043	NO	NO	1.9738
H. Other									
3. Agriculture	**3.6752**	**741.8863**	**994.6744**						**1,740.2358**
A. Enteric Fermentation		666.9120							666.9120
B. Manure Management		74.9743	273.8235						348.7979
C. Rice Cultivation		NO							NO
D. Agricultural Soils			720.8509						720.8509
E. Prescribed Burning of Savannas		NO	NO						NO
F. Field Burning of Agricultural Residues		IE	IE						IE
G. Liming	NO								NO
H. Urea Application	3.6752								3.6752
I. Other Carbon-Containing Fertilizers	NO, NE								NO, NE
J. Other	NO	NO	NO						NO
4. LULUCF	**-1,421.9811**	**0.1602**	**251.9575**						**-1,169.8633**
A. Forest Land	-2,390.5712	0.1083	0.0714						-2,390.3914
B. Cropland	1,230.6841	0.0519	0.0160						1,230.7520
C. Grassland	-638.1726	NE	NE						-638.1726
D. Wetlands	-75.3129	NE	NE						-75.3129
E. Settlements	62.0438	NO, NE	251.8701						313.9139
F. Other Land	393.7285	NE	NE						393.7285
G. Harvested Wood Products	-4.3808								-4.3808
H. Other	NE	NE	NE						NE
5. Waste	**12.5793**	**1,442.5387**	**55.3120**						**1,510.4300**
A. Solid Waste Disposal	NA, NO	1,176.7888							1,176.7888
B. Biological Treatment of Solid Waste		1.0916	0.7807						1.8723
C. Incineration and Open Burning of Waste	12.5793	6.4058	1.3445						20.3296
D. Wastewater Treatment and Discharge		258.2525	53.1868						311.4394
E. Other	NO	NO	NO						NO
6. Other	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	NO
Memo Items									
International Bunkers	**41.0082**	**0.0696**	**0.3921**						**41.4700**
Aviation	41.0082	0.0696	0.3921						41.4700
Navigation	NO	NO	NO						NO
Multilateral Operations	**NO**	**NO**	**NO**						**NO**
CO_2 Emissions from Biomass	384.6400								384.6400
CO_2 Captured and Stored	NO								NO
Long-term Storage of C in Waste Disposal Sites	NE								NE
Indirect N_2O			267.8954						267.8954
Indirect CO_2	64.2370								64.2370
								Total (without LULUCF)	**13,703.1092**
								Total (with LULUCF)	**12,533.2459**

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2	CH_4	N_2O	HFCs	PFCs	SF_6	Unspecified mix of HFCs and PFCs	NF_3	Total
	CO_2 equivalent (kt)								
Total (net emissions)	**7,780.7180**	**2,916.9754**	**1,289.6300**	**100.4768**	**0.0403**	**0.7646**	**NO**	**NO**	**12,088.6052**
1. Energy	**8,614.8544**	**790.2301**	**60.1561**						**9,465.2406**
A. Fuel Combustion (Sectoral approach)	8,613.5235	60.4410	60.1543						8,734.1188
1. Energy Industries	3,803.4077	1.8878	2.5499						3,807.8454
2. Manufacturing Industries and Construction	539.1478	0.2644	0.8795						540.2918
3. Transport	1,992.5651	10.1228	34.3266						2,037.0144
4. Other Sectors	2,271.4679	48.1511	22.3422						2,341.9613
5. Other	6.9350	0.0149	0.0562						7.0060
B. Fugitive Emissions from Fuels	1.3309	729.7891	0.0018						731.1218
1. Solid Fuels	NO	NO	NO						NO
2. Oil and Natural Gas	1.3309	729.7891	0.0018						731.1218
C. CO_2 Transport and Storage	NO								NO
2. Industrial Processes and Product Use	**581.6659**	**NO**	**NO**	**100.4768**	**0.0403**	**0.7646**	**NO**	**NO**	**682.9476**
A. Mineral Industry	493.1587								493.1587
B. Chemical Industry	NO	NO	NO						NO
C. Metal Industry	12.6973	NO	NO	NO	NO	NO	NO	NO	12.6973
D. Non-Energy Products From Fuels and Solvent Use	74.6523	NO	NO						74.6523
E. Electronic Industry				NO	NO	NO	NO	NO	NO
F. Product Use as Substitutes for ODS				100.4768	NO	NO	NO	NO	100.4768
G. Other Product Manufacture and Use	1.1575	NO	NO	NO	0.0403	0.7646	NO	NO	1.9625
H. Other									
3. Agriculture	**5.5908**	**699.3920**	**940.3254**						**1,645.3082**
A. Enteric Fermentation		630.2714							630.2714
B. Manure Management		69.1206	251.4705						320.5911
C. Rice Cultivation		NO							NO
D. Agricultural Soils			688.8549						688.8549
E. Prescribed Burning of Savannas		NO	NO						NO
F. Field Burning of Agricultural Residues		IE	IE						IE
G. Liming	NO								NO
H. Urea Application	5.5908								5.5908
I. Other Carbon-Containing Fertilizers	NO, NE								NO, NE
J. Other	NO	NO	NO						NO
4. LULUCF	**-1,433.6639**	**1.1675**	**233.4235**						**-1,199.0729**
A. Forest Land	-2,294.8221	1.1601	0.7650						-2,292.8970
B. Cropland	1,236.5016	0.0074	0.0023						1,236.5113
C. Grassland	-562.7510	NE	NE						-562.7510
D. Wetlands	-15.4700	NE	NE						-15.4700
E. Settlements	11.8882	NO, NE	232.6562						244.5444
F. Other Land	114.1449	NE	NE						114.1449
G. Harvested Wood Products	76.8444								76.8444
H. Other	NE	NE	NE						NE
5. Waste	**12.2708**	**1,426.1858**	**55.7250**						**1,494.1816**

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2	CH_4	N_2O	HFCs	PFCs	SF_6	Unspecified mix of HFCs and PFCs	NF_3	Total
	CO_2 equivalent (kt)								
A. Solid Waste Disposal	NA, NO	1,163.7460							1,163.7460
B. Biological Treatment of Solid Waste		1.1179	0.7996						1.9175
C. Incineration and Open Burning of Waste	12.2708	6.2443	1.3109						19.8260
D. Wastewater Treatment and Discharge		255.0776	53.6146						308.6921
E. Other	NO	NO	NO						NO
6. Other	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	NO
Memo Items									
International Bunkers	**47.3142**	**0.0701**	**0.4520**						**47.8362**
Aviation	47.3142	0.0701	0.4520						47.8362
Navigation	NO	NO	NO						NO
Multilateral Operations	**NO**	**NO**	**NO**						**NO**
CO_2 Emissions from Biomass	403.3840								403.3840
CO_2 Captured and Stored	NO								NO
Long-term Storage of C in Waste Disposal Sites	NE								NE
Indirect N_2O			254.8006						254.8006
Indirect CO_2	68.5241								68.5241
								Total (without LULUCF)	**13,287.6781**
								Total (with LULUCF)	**12,088.6052**

2013

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2	CH_4	N_2O	HFCs	PFCs	SF_6	Unspecified mix of HFCs and PFCs	NF_3	Total
	CO_2 equivalent (kt)								
Total (net emissions)	**7,577.6937**	**2,814.0342**	**1,406.3628**	**109.0841**	**0.0403**	**0.9651**	**NO**	**NO**	**11,908.1803**
1. Energy	**8,227.6443**	**742.8603**	**65.3739**						**9,035.8785**
A. Fuel Combustion (Sectoral approach)	8,225.9844	61.7621	65.3712						8,353.1176
1. Energy Industries	3,596.7176	1.6916	5.6106						3,604.0198
2. Manufacturing Industries and Construction	577.6855	0.2429	1.2450						579.1734
3. Transport	2,101.2934	10.2152	34.3692						2,145.8778
4. Other Sectors	1,947.9381	49.6054	24.1133						2,021.6567
5. Other	2.3497	0.0071	0.0332						2.3899
B. Fugitive Emissions from Fuels	1.6599	681.0982	0.0027						682.7608
1. Solid Fuels	NO	NO	NO						NO
2. Oil and Natural Gas	1.6599	681.0982	0.0027						682.7608
C. CO_2 Transport and Storage	NO								NO
2. Industrial Processes and Product Use	**623.1087**	**NO**	**NO**	**109.0841**	**0.0403**	**0.9651**	**NO**	**NO**	**733.1983**
A. Mineral Industry	544.8742								544.8742
B. Chemical Industry	NO	NO	NO						NO
C. Metal Industry	7.6569	NO	NO	NO	NO	NO	NO	NO	7.6569
D. Non-Energy Products From Fuels and Solvent Use	69.4810	NO	NO						69.4810
E. Electronic Industry				NO	NO	NO	NO	NO	NO
F. Product Use as Substitutes for ODS				109.0841	NO	NO	NO	NO	109.0841

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2	CH_4	N_2O	HFCs	PFCs	SF_6	Unspecified mix of HFCs and PFCs	NF_3	Total
	CO_2 equivalent (kt)								
G. Other Product Manufacture and Use	1.0965	NO	NO	NO	0.0403	0.9651	NO	NO	2.1020
H. Other									
3. Agriculture	**4.1840**	**702.7541**	**1,067.7368**						**1,774.6749**
A. Enteric Fermentation		634.8631							634.8631
B. Manure Management		67.8911	234.1272						302.0183
C. Rice Cultivation		NO							NO
D. Agricultural Soils			833.6096						833.6096
E. Prescribed Burning of Savannas		NO	NO						NO
F. Field Burning of Agricultural Residues		IE	IE						IE
G. Liming	NO								NO
H. Urea Application	4.1840								4.1840
I. Other Carbon-Containing Fertilizers	NO, NE								NO, NE
J. Other	NO	NO	NO						NO
4. LULUCF	**-1,289.1465**	**0.8718**	**217.2510**						**-1,071.0238**
A. Forest Land	-2,141.8702	0.8059	0.5314						-2,140.5329
B. Cropland	1,139.9149	0.0659	0.0204						1,140.0011
C. Grassland	-360.1740	NE	NE						-360.1740
D. Wetlands	-106.0998	NE	NE						-106.0998
E. Settlements	13.7512	NO, NE	216.6993						230.4505
F. Other Land	103.4500	NE	NE						103.4500
G. Harvested Wood Products	61.8814								61.8814
H. Other	NE	NE	NE						NE
5. Waste	**11.9033**	**1,367.5480**	**56.0012**						**1,435.4525**
A. Solid Waste Disposal	NA, NO	1,103.9166							1,103.9166
B. Biological Treatment of Solid Waste		1.2142	0.8684						2.0826
C. Incineration and Open Burning of Waste	11.9033	6.0604	1.2720						19.2357
D. Wastewater Treatment and Discharge		256.3568	53.8608						310.2176
E. Other	NO	NO	NO						NO
6. Other	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	NO
Memo Items									
International Bunkers	**41.0717**	**0.1149**	**0.3986**						**41.5852**
Aviation	41.0717	0.1149	0.3986						41.5852
Navigation	NO	NO	NO						NO
Multilateral Operations	**NO**	**NO**	**NO**						**NO**
CO_2 Emissions from Biomass	429.2796								429.2796
CO_2 Captured and Stored	NO								NO
Long-term Storage of C in Waste Disposal Sites	NE								NE
Indirect N_2O			275.8722						275.8722
Indirect CO_2	63.2239								63.2239
								Total (without LULUCF)	**12,979.2041**
								Total (with LULUCF)	**11,908.1803**

2014

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2	CH_4	N_2O	HFCs	PFCs	SF_6	Unspecified mix of HFCs and PFCs	NF_3	Total
	CO_2 equivalent (kt)								
Total (net emissions)	**7,945.4252**	**2,862.0254**	**1,571.3959**	**122.9816**	**0.0403**	**1.0540**	**NO**	**NO**	**12,502.9225**
1. Energy	**8,214.8567**	**782.1200**	**72.7378**						**9,069.7146**
A. Fuel Combustion (Sectoral approach)	8,213.1659	114.4451	72.7351						8,400.3462
1. Energy Industries	3,555.9756	1.8743	2.4523						3,560.3022
2. Manufacturing Industries and Construction	563.8971	0.2469	1.0866						565.2305
3. Transport	2,140.5508	10.1395	31.8915						2,182.5818
4. Other Sectors	1,927.7357	102.1699	37.1642						2,067.0698
5. Other	25.0067	0.0145	0.1406						25.1618
B. Fugitive Emissions from Fuels	1.6908	667.6749	0.0027						669.3684
1. Solid Fuels	NO	NO	NO						NO
2. Oil and Natural Gas	1.6908	667.6749	0.0027						669.3684
C. CO_2 Transport and Storage	NO								NO
2. Industrial Processes and Product Use	**636.1602**	**NO**	**NO**	**122.9816**	**0.0403**	**1.0540**	**NO**	**NO**	**760.2361**
A. Mineral Industry	533.8710								533.8710
B. Chemical Industry	NO	NO	NO						NO
C. Metal Industry	13.8464	NO	NO	NO	NO	NO	NO	NO	13.8464
D. Non-Energy Products From Fuels and Solvent Use	87.2367	NO	NO						87.2367
E. Electronic Industry				NO	NO	NO	NO	NO	NO
F. Product Use as Substitutes for ODS				122.9816	NO	NO	NO	NO	122.9816
G. Other Product Manufacture and Use	1.2062	NO	NO	NO	0.0403	1.0540	NO	NO	2.3005
H. Other									
3. Agriculture	**10.2058**	**723.0076**	**1,240.7589**						**1,973.9724**
A. Enteric Fermentation		652.5791							652.5791
B. Manure Management		70.4285	258.3833						328.8118
C. Rice Cultivation		NO							NO
D. Agricultural Soils			982.3757						982.3757
E. Prescribed Burning of Savannas		NO	NO						NO
F. Field Burning of Agricultural Residues		IE	IE						IE
G. Liming	NO								NO
H. Urea Application	10.2058								10.2058
I. Other Carbon-Containing Fertilizers	NO, NE								NO, NE
J. Other	NO	NO	NO						NO
4. LULUCF	**-927.3346**	**0.1169**	**202.4681**						**-724.7496**
A. Forest Land	-2,134.7390	0.0663	0.0437						-2,134.6291
B. Cropland	1,174.6145	0.0506	0.0156						1,174.6808
C. Grassland	-341.1085	NE	NE						-341.1085
D. Wetlands	-139.7535	NE	NE						-139.7535
E. Settlements	18.9848	NO, NE	202.4088						221.3936
F. Other Land	436.6463	NE	NE						436.6463
G. Harvested Wood Products	58.0208								58.0208
H. Other	NE	NE	NE						NE

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2	CH_4	N_2O	HFCs	PFCs	SF_6	Unspecified mix of HFCs and PFCs	NF_3	Total
	CO_2 equivalent (kt)								
5. Waste	**11.5371**	**1,356.7809**	**55.4310**						**1,423.7490**
A. Solid Waste Disposal	NA, NO	1,101.2941							1,101.2941
B. Biological Treatment of Solid Waste		1.2701	0.9084						2.1785
C. Incineration and Open Burning of Waste	11.5371	5.8782	1.2334						18.6487
D. Wastewater Treatment and Discharge		248.3385	53.2891						301.6276
E. Other	NO	NO	NO						NO
6. Other	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	NO
Memo Items									
International Bunkers	**53.6855**	**0.0852**	**0.5281**						**54.2988**
Aviation	53.6855	0.0852	0.5281						54.2988
Navigation	NO	NO	NO						NO
Multilateral Operations	**NO**	**NO**	**NO**						**NO**
CO_2 Emissions from Biomass	1,314.4896								1,314.4896
CO_2 Captured and Stored	NO								NO
Long-term Storage of C in Waste Disposal Sites	NE								NE
Indirect N_2O			321.6253						321.6253
Indirect CO_2	81.0677								81.0677
								Total (without LULUCF)	**13,227.6721**
								Total (with LULUCF)	**12,502.9225**

2015

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2	CH_4	N_2O	HFCs	PFCs	SF_6	Unspecified mix of HFCs and PFCs	NF_3	Total
	CO_2 equivalent (kt)								
Total (net emissions)	**7,536.3186**	**2,814.8962**	**1,317.9409**	**157.0394**	**0.0403**	**1.0545**	**NO**	**NO**	**11,827.2898**
1. Energy	**8,277.6210**	**762.7699**	**79.2560**						**9,119.6469**
A. Fuel Combustion (Sectoral approach)	8,275.9434	121.1893	79.2533						8,476.3861
1. Energy Industries	3,684.4508	1.6461	1.9933						3,688.0902
2. Manufacturing Industries and Construction	517.0989	0.2492	1.0346						518.3827
3. Transport	2,261.4456	10.7127	35.6676						2,307.8259
4. Other Sectors	1,790.2120	108.5694	40.4338						1,939.2152
5. Other	22.7360	0.0120	0.1241						22.8721
B. Fugitive Emissions from Fuels	1.6776	641.5805	0.0027						643.2608
1. Solid Fuels	NO	NO	NO						NO
2. Oil and Natural Gas	1.6776	641.5805	0.0027						643.2608
C. CO_2 Transport and Storage	NO								NO
2. Industrial Processes and Product Use	**606.9922**	**NO**	**NO**	**157.0394**	**0.0403**	**1.0545**	**NO**	**NO**	**765.1264**
A. Mineral Industry	504.2041								504.2041
B. Chemical Industry	NO	NO	NO						NO
C. Metal Industry	17.2792	NO	NO	NO	NO	NO	NO	NO	17.2792
D. Non-Energy Products From Fuels and Solvent Use	84.5691	NO	NO						84.5691
E. Electronic Industry				NO	NO	NO	NO	NO	NO

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2	CH_4	N_2O	HFCs	PFCs	SF_6	Unspecified mix of HFCs and PFCs	NF_3	Total
	CO_2 equivalent (kt)								
F. Product Use as Substitutes for ODS				157.0394	NO	NO	NO	NO	157.0394
G. Other Product Manufacture and Use	0.9397	NO	NO	NO	0.0403	1.0545	NO	NO	2.0346
H. Other									
3. Agriculture	**11.2402**	**698.0743**	**991.8944**						**1,701.2089**
A. Enteric Fermentation		629.2090							629.2090
B. Manure Management		68.8654	249.8959						318.7613
C. Rice Cultivation		NO							NO
D. Agricultural Soils			741.9984						741.9984
E. Prescribed Burning of Savannas		NO	NO						NO
F. Field Burning of Agricultural Residues		IE	IE						IE
G. Liming	NO								NO
H. Urea Application	11.2402								11.2402
I. Other Carbon-Containing Fertilizers	NO, NE								NO,NE
J. Other	NO	NO	NO						NO
4. LULUCF	**-1,372.8484**	**0.6531**	**190.2643**						**-1,181.9309**
A. Forest Land	-2,159.4439	0.6146	0.4052						-2,158.4241
B. Cropland	1,112.6279	0.0386	0.0119						1,112.6784
C. Grassland	-418.4569	NE	NE						-418.4569
D. Wetlands	-82.7917	NE	NE						-82.7917
E. Settlements	39.1617	NO, NE	189.8472						229.0089
F. Other Land	86.8192	NE	NE						86.8192
G. Harvested Wood Products	49.2353								49.2353
H. Other	NE	NE	NE						NE
5. Waste	**13.3135**	**1,353.3989**	**56.5261**						**1,423.2385**
A. Solid Waste Disposal	NA, NO	1,104.4973							1,104.4973
B. Biological Treatment of Solid Waste		1.2707	0.9088						2.1795
C. Incineration and Open Burning of Waste	13.3135	6.8029	1.4258						21.5422
D. Wastewater Treatment and Discharge		240.8280	54.1915						295.0195
E. Other	NO	NO	NO						NO
6. Other	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	NO
Memo Items									
International Bunkers	**56.8077**	**0.1395**	**0.5458**						**57.4930**
Aviation	56.8077	0.1395	0.5458						57.4930
Navigation	NO	NO	NO						NO
Multilateral Operations	**NO**	**NO**	**NO**						**NO**
CO_2 Emissions from Biomass	1,428.4386								1,428.4386
CO_2 Captured and Stored	NO								NO
Long-term Storage of C in Waste Disposal Sites	NE								NE
Indirect N_2O			264.8025						264.8025
Indirect CO_2	77.8743								77.8743
								Total (without LULUCF)	**13,009.2207**
								Total (with LULUCF)	**11,827.2898**

2016

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2	CH_4	N_2O	HFCs	PFCs	SF_6	Unspecified mix of HFCs and PFCs	NF_3	Total
	CO_2 equivalent (kt)								
Total (net emissions)	**7,841.2042**	**2,883.7825**	**1,449.7624**	**166.7099**	**0.0403**	**1.0829**	**NO**	**NO**	**12,342.5822**
1. Energy	**8,353.8926**	**817.6982**	**85.0259**						**9,256.6167**
A. Fuel Combustion (Sectoral approach)	8,352.2025	130.8597	85.0232						8,568.0854
1. Energy Industries	3,644.8751	1.6434	2.0586						3,648.5771
2. Manufacturing Industries and Construction	488.6172	0.2305	0.7658						489.6135
3. Transport	2,428.3642	12.4139	40.8280						2,481.6061
4. Other Sectors	1,767.4874	116.5604	41.2504						1,925.2983
5. Other	22.8586	0.0116	0.1204						22.9905
B. Fugitive Emissions from Fuels	1.6900	686.8385	0.0027						688.5313
1. Solid Fuels	NO	NO	NO						NO
2. Oil and Natural Gas	1.6900	686.8385	0.0027						688.5313
C. CO_2 Transport and Storage	NO								NO
2. Industrial Processes and Product Use	**579.1078**	**NO**	**NO**	**166.7099**	**0.0403**	**1.0829**	**NO**	**NO**	**746.9409**
A. Mineral Industry	488.0182								488.0182
B. Chemical Industry	NO	NO	NO						NO
C. Metal Industry	5.2203	NO	NO	NO	NO	NO	NO	NO	5.2203
D. Non-Energy Products From Fuels and Solvent Use	84.8044	NO	NO						84.8044
E. Electronic Industry				NO	NO	NO	NO	NO	NO
F. Product Use as Substitutes for ODS				166.7099	NO	NO	NO	NO	166.7099
G. Other Product Manufacture and Use	1.0649	NO	NO	NO	0.0403	1.0829	NO	NO	2.1882
H. Other									
3. Agriculture	**12.2747**	**686.0592**	**1,128.3179**						**1,826.6518**
A. Enteric Fermentation		622.0031							622.0031
B. Manure Management		64.0561	257.2030						321.2590
C. Rice Cultivation		NO							NO
D. Agricultural Soils			871.1149						871.1149
E. Prescribed Burning of Savannas		NO	NO						NO
F. Field Burning of Agricultural Residues		IE	IE						IE
G. Liming	NO								NO
H. Urea Application	12.2747								12.2747
I. Other Carbon-Containing Fertilizers	NO, NE								NO, NE
J. Other	NO	NO	NO						NO
4. LULUCF	**-1,117.1054**	**0.3568**	**179.2669**						**-937.4818**
A. Forest Land	-2,115.7622	0.3085	0.2034						-2,115.2503
B. Cropland	1,111.9941	0.0483	0.0149						1,112.0573
C. Grassland	-402.3693	NE	NE						-402.3693
D. Wetlands	-82.7917	NE	NE						-82.7917
E. Settlements	19.3071	NO, NE	179.0485						198.3556
F. Other Land	351.6349	NE	NE						351.6349
G. Harvested Wood Products	0.8816								0.8816
H. Other	NE	NE	NE						NE
5. Waste	**13.0346**	**1,379.6683**	**57.1517**						**1,449.8546**

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2	CH_4	N_2O	HFCs	PFCs	SF_6	Unspecified mix of HFCs and PFCs	NF_3	Total
	CO_2 equivalent (kt)								
A. Solid Waste Disposal	NA, NO	1,131.9612							1,131.9612
B. Biological Treatment of Solid Waste		1.2631	0.9034						2.1665
C. Incineration and Open Burning of Waste	13.0346	6.6672	1.3968						21.0986
D. Wastewater Treatment and Discharge		239.7768	54.8516						294.6284
E. Other	NO	NO	NO						NO
6. Other	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**
Memo Items									
International Bunkers	**100.9698**	**0.1538**	**0.9827**						**102.1063**
Aviation	100.9698	0.1538	0.9827						102.1063
Navigation	NO	NO	NO						NO
Multilateral Operations	**NO**	**NO**	**NO**						**NO**
CO_2 Emissions from Biomass	1,603.1890								1,603.1890
CO_2 Captured and Stored	NO								NO
Long-term Storage of C in Waste Disposal Sites	NE								NE
Indirect N_2O			294.1106						294.1106
Indirect CO_2	77.9170								77.9170
								Total (without LULUCF)	**13,280.0640**
								Total (with LULUCF)	**12,342.5822**

2017

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2	CH_4	N_2O	HFCs	PFCs	SF_6	Unspecified mix of HFCs and PFCs	NF_3	Total
	CO_2 equivalent (kt)								
Total (net emissions)	**7,402.2253**	**2,999.2934**	**1,543.9364**	**185.8945**	**0.0403**	**1.1145**	**NO**	**NO**	**12,132.5045**
1. Energy	**7,934.3500**	**891.8619**	**98.6939**						**8,924.9057**
A. Fuel Combustion (Sectoral approach)	7,932.6739	173.2101	98.6912						8,204.5753
1. Energy Industries	2,996.5052	1.3584	1.6362						2,999.4997
2. Manufacturing Industries and Construction	501.6022	0.3208	0.8738						502.7968
3. Transport	2,451.2471	12.0951	0.1069						2,463.4491
4. Other Sectors	1,960.6971	159.4299	55.8319						2,175.9589
5. Other	22.6223	0.0060	0.1069						22.7351
B. Fugitive Emissions from Fuels	1.6760	718.6518	0.0027						720.3305
1. Solid Fuels	NO	NO	NO						NO
2. Oil and Natural Gas	1.6760	718.6518	0.0027						720.3305
C. CO_2 Transport and Storage	NO								NO
2. Industrial Processes and Product Use	**592.6872**	**NO**	**NO**	**185.8945**	**0.0403**	**1.1145**	**NO**	**NO**	**779.7366**
A. Mineral Industry	475.6060								475.6060
B. Chemical Industry	NO	NO	NO						NO
C. Metal Industry	18.8842	NO	NO	NO	NO	NO	NO	NO	18.8842
D. Non-Energy Products From Fuels and Solvent Use	97.0212	NO	NO						97.0212
E. Electronic Industry				NO	NO	NO	NO	NO	NO
F. Product Use as Substitutes for ODS				185.8945	NO	NO	NO	NO	185.8945

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2	CH_4	N_2O	HFCs	PFCs	SF_6	Unspecified mix of HFCs and PFCs	NF_3	Total
	CO_2 equivalent (kt)								
G. Other Product Manufacture and Use	1.1757	NO	NO	NO	0.0403	1.1145	NO	NO	2.3306
H. Other									
3. Agriculture	**26.2081**	**641.2966**	**1,214.2443**						**1,881.7490**
A. Enteric Fermentation		578.3838							578.3838
B. Manure Management		62.9128	243.6701						306.5829
C. Rice Cultivation		NO							NO
D. Agricultural Soils			970.5743						970.5743
E. Prescribed Burning of Savannas		NO	NO						NO
F. Field Burning of Agricultural Residues		IE	IE						IE
G. Liming	NO								NO
H. Urea Application	26.2081								26.2081
I. Other Carbon-Containing Fertilizers	NO, NE								NO, NE
J. Other	NO	NO	NO						NO
4. LULUCF	**-1,165.6648**	**0.4984**	**171.8485**						**-993.3179**
A. Forest Land	-2,016.4373	0.4258	0.2808						-2,015.7307
B. Cropland	1,089.5602	0.0726	0.0224						1,089.6553
C. Grassland	-384.0392	NE	NE						-384.0392
D. Wetlands	-82.8162	NE	NE						-82.8162
E. Settlements	77.3098	NO, NE	171.5452						248.8550
F. Other Land	218.2055	NE	NE						218.2055
G. Harvested Wood Products	-67.4476								-67.4476
H. Other	NE	NE	NE						NE
5. Waste	**14.6448**	**1,465.6365**	**59.1497**						**1,539.4310**
A. Solid Waste Disposal	NA, NO	1,220.9072							1,220.9072
B. Biological Treatment of Solid Waste		1.4458	1.0341						2.4799
C. Incineration and Open Burning of Waste	14.6448	7.5036	1.5709						23.7193
D. Wastewater Treatment and Discharge		235.7799	56.5448						292.3246
E. Other	NO	NO	NO						NO
6. Other	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**
Memo Items									
International Bunkers	**148.2788**	**0.1454**	**1.4311**						**149.8553**
Aviation	148.2788	0.1454	1.4311						149.8553
Navigation	NO	NO	NO						NO
Multilateral Operations	**NO**	**NO**	**NO**						**NO**
CO_2 Emissions from Biomass	2,122.7228								2,122.7228
CO_2 Captured and Stored	NO								NO
Long-term Storage of C in Waste Disposal Sites	NE								NE
Indirect N_2O			310.2353						310.2353
Indirect CO_2	90.1477								90.1477
								Total (without LULUCF)	**13,125.8224**
								Total (with LULUCF)	**12,132.5045**

2018

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2	CH_4	N_2O	HFCs	PFCs	SF_6	Unspecified mix of HFCs and PFCs	NF_3	Total
	CO_2 equivalent (kt)								
Total (net emissions)	**8,165.9880**	**2,994.6014**	**1,562.1404**	**198.8877**	**0.0403**	**1.3348**	**NO**	**NO**	**12,922.9927**
1. Energy	**8,350.5473**	**942.9173**	**113.3951**						**9,406.8597**
A. Fuel Combustion (Sectoral approach)	8,348.8621	265.1588	113.3924						8,727.4133
1. Energy Industries	3,255.3655	1.4816	1.7891						3,258.6362
2. Manufacturing Industries and Construction	594.3248	0.3592	0.9341						595.6181
3. Transport	2,529.5773	12.5597	39.7569						2,581.8939
4. Other Sectors	1,946.2502	250.7521	70.8021						2,267.8044
5. Other	23.3443	0.0062	0.1103						23.4607
B. Fugitive Emissions from Fuels	1.6852	677.7585	0.0027						679.4463
1. Solid Fuels	NO	NO	NO						NO
2. Oil and Natural Gas	1.6852	677.7585	0.0027						679.4463
C. CO_2 Transport and Storage	NO								NO
2. Industrial Processes and Product Use	**764.3984**	**NO**	**NO**	**198.8877**	**0.0403**	**1.3348**	**NO**	**NO**	**964.6613**
A. Mineral Industry	591.9454								591.9454
B. Chemical Industry	NO	NO	NO						NO
C. Metal Industry	20.2133	NO	NO	NO	NO	NO	NO	NO	20.2133
D. Non-Energy Products From Fuels and Solvent Use	151.1809	NO	NO						151.1809
E. Electronic Industry				NO	NO	NO	NO	NO	NO
F. Product Use as Substitutes for ODS				198.8877	NO	NO	NO	NO	198.8877
G. Other Product Manufacture and Use	1.0589	NO	NO	NO	0.0403	1.3348	NO	NO	2.4340
H. Other									
3. Agriculture	**43.3624**	**571.3140**	**1,222.6352**						**1,837.3116**
A. Enteric Fermentation		516.4851							516.4851
B. Manure Management		54.8289	214.8667						269.6956
C. Rice Cultivation		NO							NO
D. Agricultural Soils			1,007.7685						1,007.7685
E. Prescribed Burning of Savannas		NO	NO						NO
F. Field Burning of Agricultural Residues		IE	IE						IE
G. Liming	NO								NO
H. Urea Application	43.3624								43.3624
I. Other Carbon-Containing Fertilizers	NO, NE								NO, NE
J. Other	NO	NO	NO						NO
4. LULUCF	**-1,006.6081**	**0.1700**	**165.3869**						**-841.0512**
A. Forest Land	-1,969.3582	0.1465	0.0966						-1,969.1152
B. Cropland	1,206.3949	0.0235	0.0073						1,206.4257
C. Grassland	-440.1513	NE	NE						-440.1513
D. Wetlands	-82.8253	NE	NE						-82.8253
E. Settlements	21.6217	NO, NE	165.2831						186.9048
F. Other Land	321.2138	NE	NE						321.2138
G. Harvested Wood Products	-63.5037								-63.5037
H. Other	NE	NE	NE						NE
5. Waste	**14.2880**	**1,480.2001**	**60.7231**						**1,555.2113**

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2	CH_4	N_2O	HFCs	PFCs	SF_6	Unspecified mix of HFCs and PFCs	NF_3	Total
	CO_2 equivalent (kt)								
A. Solid Waste Disposal	NA, NO	1,232.4760							1,232.4760
B. Biological Treatment of Solid Waste		1.3036	0.9324						2.2360
C. Incineration and Open Burning of Waste	14.2880	7.3280	1.5335						23.1496
D. Wastewater Treatment and Discharge		239.0924	58.2573						297.3497
E. Other	NO	NO	NO						NO
6. Other	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**
Memo Items									
International Bunkers	**170.4060**	**0.1782**	**1.7154**						**172.2996**
Aviation	170.4060	0.1782	1.7154						172.2996
Navigation	NO	NO	NO						NO
Multilateral Operations	**NO**	**NO**	**NO**						**NO**
CO_2 Emissions from Biomass	3,583.0567								3,583.0567
CO_2 Captured and Stored	NO								NO
Long-term Storage of C in Waste Disposal Sites	NE								NE
Indirect N_2O			307.0403						307.0403
Indirect CO_2	143.8546								143.8546
								Total (without LULUCF)	**13,764.0439**
								Total (with LULUCF)	**12,922.9927**

2019

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2	CH_4	N_2O	HFCs	PFCs	SF_6	Unspecified mix of HFCs and PFCs	NF_3	Total
	CO_2 equivalent (kt)								
Total (net emissions)	**9,242.8298**	**2,682.1623**	**1,603.1277**	**235.5397**	**0.0403**	**1.4373**	**NO**	**NO**	**13,765.1372**
1. Energy	**8,583.6814**	**703.7296**	**114.0050**						**9,401.4161**
A. Fuel Combustion (Sectoral approach)	8,582.0532	233.6685	114.0023						8,929.7241
1. Energy Industries	3,124.4150	1.4044	1.6884						3,127.5077
2. Manufacturing Industries and Construction	717.7258	0.7441	1.5502						720.0202
3. Transport	2,611.5525	12.4575	41.4206						2,665.4305
4. Other Sectors	2,105.4970	219.0565	69.2351						2,393.7886
5. Other	22.8629	0.0060	0.1080						22.9770
B. Fugitive Emissions from Fuels	1.6282	470.0611	0.0027						471.6920
1. Solid Fuels	NO	NO	NO						NO
2. Oil and Natural Gas	1.6282	470.0611	0.0027						471.6920
C. CO_2 Transport and Storage	NO								NO
2. Industrial Processes and Product Use	**754.2055**	**NO**	**NO**	**235.5397**	**0.0403**	**1.4373**	**NO**	**NO**	**991.2229**
A. Mineral Industry	593.6612								593.6612
B. Chemical Industry	NO	NO	NO						NO
C. Metal Industry	15.7926	NO	NO	NO	NO	NO	NO	NO	15.7926
D. Non-Energy Products From Fuels and Solvent Use	143.6217	NO	NO						143.6217
E. Electronic Industry				NO	NO	NO	NO	NO	NO
F. Product Use as Substitutes for ODS				235.5397	NO	NO	NO	NO	235.5397

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2	CH_4	N_2O	HFCs	PFCs	SF_6	Unspecified mix of HFCs and PFCs	NF_3	Total
	CO_2 equivalent (kt)								
G. Other Product Manufacture and Use	1.1299	NO	NO	NO	0.0403	1.4373	NO	NO	2.6076
H. Other									
3. Agriculture	**39.6306**	**492.4429**	**1,266.6513**						**1,798.7248**
A. Enteric Fermentation		440.9463							440.9463
B. Manure Management		51.4965	194.7808						246.2774
C. Rice Cultivation		NO							NO
D. Agricultural Soils			1,071.8704						1,071.8704
E. Prescribed Burning of Savannas		NO	NO						NO
F. Field Burning of Agricultural Residues		IE	IE						IE
G. Liming	NO								NO
H. Urea Application	39.6306								39.6306
I. Other Carbon-Containing Fertilizers	NO, NE								NO, NE
J. Other	NO	NO	NO						NO
4. LULUCF	**-148.6229**	**0.3989**	**161.5312**						**13.3072**
A. Forest Land	-1,950.6476	0.3573	0.2356						-1,950.0547
B. Cropland	1,507.3962	0.0416	0.0129						1,507.4508
C. Grassland	-293.2923	NE	NE						-293.2923
D. Wetlands	-82.8099	NE	NE						-82.8099
E. Settlements	116.5030	NO, NE	161.2828						277.7857
F. Other Land	611.7881	NE	NE						611.7881
G. Harvested Wood Products	-57.5604								-57.5604
H. Other	NE	NE	NE						NE
5. Waste	**13.9352**	**1,485.5909**	**60.9402**						**1,560.4663**
A. Solid Waste Disposal	NA, NO	1,239.2098							1,239.2098
B. Biological Treatment of Solid Waste		1.3040	0.9326						2.2366
C. Incineration and Open Burning of Waste	13.9352	7.1574	1.4970						22.5896
D. Wastewater Treatment and Discharge		237.9196	58.5106						296.4302
E. Other	NO	NO	NO						NO
6. Other	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**
Memo Items									
International Bunkers	**151.5015**	**0.1369**	**1.5333**						**153.1717**
Aviation	151.5015	0.1369	1.5333						153.1717
Navigation	NO	NO	NO						NO
Multilateral Operations	**NO**	**NO**	**NO**						**NO**
CO_2 Emissions from Biomass	2,976.2234								2,976.2234
CO_2 Captured and Stored	NO								NO
Long-term Storage of C in Waste Disposal Sites	NE								NE
Indirect N_2O			314.8264						314.8264
Indirect CO_2	136.1237								136.1237
								Total (without LULUCF)	**13,751.8300**
								Total (with LULUCF)	**13,765.1372**

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GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2	CH_4	N_2O	HFCs	PFCs	SF_6	Unspecified mix of HFCs and PFCs	NF_3	Total
	CO_2 equivalent (kt)								
Total (net emissions)	**9,608.0373**	**2,392.9342**	**1,410.3062**	**245.3168**	**0.0403**	**1.5790**	**NO**	**NO**	**13,658.2138**
1. Energy	**8,972.1085**	**466.8670**	**110.9154**						**9,549.8909**
A. Fuel Combustion (Sectoral approach)	8,970.5288	226.6395	110.9127						9,308.0809
1. Energy Industries	3,634.3761	1.6353	1.9598						3,637.9713
2. Manufacturing Industries and Construction	801.4383	0.7451	1.4657						803.6492
3. Transport	2,462.2411	10.8793	38.7861						2,511.9066
4. Other Sectors	2,050.0916	213.3738	68.5953						2,332.0606
5. Other	22.3816	0.0059	0.1058						22.4933
B. Fugitive Emissions from Fuels	1.5797	240.2276	0.0027						241.8100
1. Solid Fuels	NO	NO	NO						NO
2. Oil and Natural Gas	1.5797	240.2276	0.0027						241.8100
C. CO_2 Transport and Storage	NO								NO
2. Industrial Processes and Product Use	**751.8959**	**NO**	**NO**	**245.3168**	**0.0403**	**1.5790**	**NO**	**NO**	**998.8320**
A. Mineral Industry	536.8930								536.8930
B. Chemical Industry	NO	NO	NO						NO
C. Metal Industry	18.6972	NO	NO	NO	NO	NO	NO	NO	18.6972
D. Non-Energy Products From Fuels and Solvent Use	195.3645	NO	NO						195.3645
E. Electronic Industry				NO	NO	NO	NO	NO	NO
F. Product Use as Substitutes for ODS				245.3168	NO	NO	NO	NO	245.3168
G. Other Product Manufacture and Use	0.9412	NO	NO	NO	0.0403	1.5790	NO	NO	2.5605
H. Other									
3. Agriculture	**42.6156**	**433.4064**	**1,070.4136**						**1,546.4355**
A. Enteric Fermentation		389.0391							389.0391
B. Manure Management		44.3673	166.4175						210.7848
C. Rice Cultivation		NO							NO
D. Agricultural Soils			903.9960						903.9960
E. Prescribed Burning of Savannas		NO	NO						NO
F. Field Burning of Agricultural Residues		IE	IE						IE
G. Liming	NO								NO
H. Urea Application	42.6156								42.6156
I. Other Carbon-Containing Fertilizers	NO, NE								NO, NE
J. Other	NO	NO	NO						NO
4. LULUCF	**-172.3409**	**0.8034**	**168.0021**						**-3.5354**
A. Forest Land	-1,887.3228	0.7233	0.4769						-1,886.1227
B. Cropland	1,629.9020	0.0801	0.0248						1,630.0069
C. Grassland	-223.1528	NE	NE						-223.1528
D. Wetlands	-82.8099	NE	NE						-82.8099
E. Settlements	27.2098	NO, NE	167.5004						194.7102
F. Other Land	329.1445	NE	NE						329.1445
G. Harvested Wood Products	34.6883								34.6883
H. Other	NE	NE	NE						NE
5. Waste	**13.7583**	**1,491.8574**	**60.9751**						**1,566.5908**
A. Solid Waste Disposal	NA, NO	1,246.1821							1,246.1821

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2	CH_4	N_2O	HFCs	PFCs	SF_6	Unspecified mix of HFCs and PFCs	NF_3	Total
	CO_2 equivalent (kt)								
B. Biological Treatment of Solid Waste		1.4180	1.0142						2.4322
C. Incineration and Open Burning of Waste	13.7583	7.0563	1.4767						22.2913
D. Wastewater Treatment and Discharge		237.2010	58.4843						295.6853
E. Other	NO	NO	NO						NO
6. Other	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**
Memo Items									
International Bunkers	**35.2495**	**0.0062**	**0.2938**						**35.5495**
Aviation	35.2495	0.0062	0.2938						35.5495
Navigation	NO	NO	NO						NO
Multilateral Operations	**NO**	**NO**	**NO**						**NO**
CO_2 Emissions from Biomass	2,985.9162								2,985.9162
CO_2 Captured and Stored	NO								NO
Long-term Storage of C in Waste Disposal Sites	NE								NE
Indirect N_2O			269.7462						269.7462
Indirect CO_2	187.7661								187.7661
								Total (without LULUCF)	**13,661.7492**
								Total (with LULUCF)	**13,658.2138**