National Inventory Report

Greenhouse Gas Sources and Sinks in the Republic of Moldova 1990-2016

Submission to the United Nations Framework Convention on Climate Change

Chișinău, 2018

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Coordinators:	Valentina Tapis, State Secretary, Ministry of Agriculture, Regional Development and Environment Suzanne Lekoyiet, Programme Manager, United Nations Environment Programme
Authors:	Summary – Marius Taranu Capitolul 1 – Marius Taranu Capitolul 2 – Marius Taranu Capitolul 3 – Elena Bicova, Irina Vasiliev, Tatiana Kirillova, Larisa Moraru, Serghei Burtev Capitolul 4 – Marius Taranu, Anatolie Tarita, Vladimir Brega Capitolul 5 – Sergiu Cosman, Lilia Taranu Capitolul 6 – Ion Talmaci, Aliona Miron, Victor Sfecla, Tamara Leah Capitolul 7 – Tatiana Tugui, Natalia Efros Capitolul 8 – Marius Taranu
Project Team:	Vasile Scorpan, Manager Aliona Solomon, Administrative and Financial Assistant
Internet Version:	This document is available at: <http://www.clima.md>
Comments:	Comments on this document can be addressed to: Vasile Scorpan, Manager, Climate Change Office, Ministry of Agriculture, Regional Development and Environment Mitropolit Dosoftei St., 156A, of. 37, MD 2004, Chisinau, Republic of Moldova, tel./fax: +373 22 232247, E-mail: <clima@clima.md>

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Ministry of Agriculture, Regional Development and Environment
Address:
Constantin Tanase St., #9,
MD 2005, Chisinau, Republic of Moldova
Tel.: +373 22 200547
Fax: +373 22 226858
E-mail: <madrm@madrm.gov.md>
Website: http://www.madrm.gov.md

United Nations Environment Programme (UN Environment)
Address:
United Nations Avenue, Gigiri
P.O. Box 30552, 00100, Nairobi, Kenya
Tel.: +254 (0) 20 762 1234
Fax: +254 (0) 20 762 3718
E-mail: <unepinfo@un.org>
Website: https://www.unenvironment.org/

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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 report to the Conference of the Parties (COP) data on emissions (by types of sources) and sinks (by types of storage) of all greenhouse gases (GHG) that do not fall under the Montreal Protocol.

This Report has been developed within the "Republic of Moldova: Enabling Activities for the Preparation of the Second Biennial Update Report under the United Nations Framework Convention on Climate Change" Project, implemented by the Ministry of Agriculture, Regional Development and Environment (MARDE) and United Nations Environment Programme (UNEP), with financial support of the Global Environment Facility (GEF), from February 2017 through January 2019.

The National Inventory Report reflects the efforts made by the National Inventory Team during 2017-2018, including previous results obtained under the UNDP-GEF Regional Project "Capacity Building for Improving the Quality of Greenhouse Gas National Inventories (Central Europe and CIS countries)", that ended with the National Inventory Report of the Republic of Moldova: 1990-2002 (unpublished); based on the results obtained under the UNDP-GEF Project "Republic of Moldova: Enabling Activities for the Preparation of the First National Communication under the United Nations Framework Convention on Climate Change" that ended with the preparation of the national inventory for the period from 1990 through 1998, included in the First National Communication of the Republic of Moldova (submitted to UNFCCC on November 13, 2000); based on the results obtained under the UNEP-GEF Project "Republic of Moldova: Enabling Activities for the preparation of the Second National Communication under the United Nations Framework Convention on Climate Change", that ended with the National Inventory Report:1990-2005, Greenhouse Gas Sources and Sinks in the Republic of Moldova (submitted to UNFCCC on January 27, 2010); based on the results obtained under the "Republic of Moldova: Enabling Activities for the preparation of the Third National Communication under the United Nations Framework Convention on Climate Change", that ended with the National Inventory Report:1990-2010, Greenhouse Gas Sources and Sinks in the Republic of Moldova (submitted to UNFCCC on November 21, 2013); based on the results obtained under the "Republic of Moldova: Enabling Activities for the preparation of the First Biennial Update Report and the Fourth National Communication under the United Nations Framework Convention on Climate Change" Project, that ended with the First Biennial Update Report of the Republic of Moldova under the United Nations Framework Convention on Climate Change, the National Inventory Report of the Republic of Moldova: 1990-2013, Greenhouse Gas Sources and Sinks in the Republic of Moldova and the Report on the National GHG Inventory System in the Republic of Moldova (submitted to UNFCCC on April 5, 2016), as well as the National Inventory Report of the Republic of Moldova: 1990-2015, Greenhouse Gas Sources and Sinks in the Republic of Moldova (submitted to UNFCCC on December 29, 2017) and the Fourth National Communication of the Republic of Moldova under the United Nations Framework Convention on Climate Change (submitted to UNFCCC on February 9, 2018).

Besides the inventory results, the Report contains additional relevant data, as well as the analysis of recent trends in GHG emissions and sinks in the Republic of Moldova, the analysis of the key categories, additional sectoral data used in inventory, data regarding the activities related to inventory quality control and uncertainty management.

The United Nations Framework Convention on Climate Change 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 used to compare the performances of the Parties of UNFCCC.

The Convention also obliges its Parties to the continuous improvement of the quality of national inventories. Through the series of initiatives that 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 publication of the first national inventory for the period from 1990 through 1998, an impressive number of persons in the Republic of Moldova expressed interest for the climate change phenomenon, and particularly, for greenhouse gas emissions. Though this interest generated numerous research activities, only a limited number were focused on the process of quantitative evaluation of emissions and development of national emission factors.

Despite the fact that there will always be emissions evaluation associated uncertainties, the monitoring process will continue, both in the Republic of Moldova, and internationally, in view of improving the quality of inventory and reducing the greenhouse gas associated uncertainties.

Un independent intern peer review of the quality of the national inventory of the Republic of Moldova for 1990-2016 time periods was made in October 2018 by relevant national experts, previously not involved in the national inventory compilation activities, representing public universities and research and development institutes.

The findings of this peer review allowed to identify the priority areas, both in view of improving the quality of activity data, as well as methodological approaches and emission factors used in the assessment of emissions (by types of sources) and sinks (by types of removals) within the greenhouse gas national inventory of the Republic of Moldova.

Valentina TAPIS,
State Secretary,
Ministry of Agriculture, Regional Development and Environment of the Republic of Moldova

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This chapter would be incomplete, without thanks to PhD Vasile Scorpan, the Project Manager of UNEP-GEF Project "Republic of Moldova: Enabling Activities for the Preparation of the Second Biennial Update Report under the United Nations Framework Convention on Climate Change" for his continuous involvement during project implementation, in the successful implementation of the activities stipulated in the Terms of Reference of the National Inventory Team.

LIST OF ACRONYMS, ABBREVIATIONS AND UNITS

ABS	Acrilonitril Butadien Stiren
AEZ	Agro-Ecological Zones
Al	Aluminium
Al_2O_3	Aluminium oxide
$\text{Area}_{(T)}$	Total annual area harvested of crop *T*
$\text{Area burnt}_{(T)}$	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)
B	Billion
B_0	Maximum methane producing capacity
BEF_I	Biomass expansion factor for conversion of annual net increment to aboveground tree biomass increment
BOD	Biochemical Oxygen Demand
BOF	Basic Oxygen Furnaces
BUR	Biennial Update Report
BW	Average live body weight of animal
c	Flight cycle: cruise
^{0}C	Celsius degrees
C	Carbon
C_a	Animal Feeding Situation Coefficient
CA	Honrbeam species (Carpinus ssp.)
$CaCO_3$	Limestone
$CaCO_3 \bullet MgCO_3$	Dolomite
CaO	Lime
$CaO \bullet MgO$	Dolomite lime
$CBrCIF_2$	Halon 1211
$CBrCIF_3$	Halon 1301
CCl_3F	CFC-11
CCl_2F_2	CFC-12
CCl_2CClF_2	CF-113
CCl_4	Carbon Tetrachloride
C_f	Burning coefficient (used to keep account of incomplete burning related aspects)
CF	Carbon fraction in biomass
CF_4	Perfluoromethane
C_2F_6	Perfluoroethane
C_3F_8	Perfluoropropan
C_4F_{10}	Perfluorobutan
$c\text{-}C_4F_8$	Perfluorociclobutan
C_5F_{12}	Perfluoropentan
C_6F_{14}	Perfluorohexan
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
CHP	Combined Heat and Power Plant
$CF_3CHFCHFCF_2CF_3$	HFC-43-10mee
CIS	Commonwealth of Independent States
CKD	Cement Kiln Dust
CO	Carbon monoxide
CO_2	Carbon dioxide
$CO(NH_2)_2$	Urea (carbamide)
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	Centimeter
cm^2	Square centimeter
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	Dekaliter
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 Balances
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
Fe_2O_3	Iron oxide
FG	Volume of fuel wood gathering
FNC	First National Communication
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
GCM	Global Climate Models
GDP	Gross Domestic Product
g.e.c.	Grams coal equivalent
GE	Gross Energy
GEF	Global Environment Facility
Gg	Gigagram
GHG	Greenhouse Gas
GPG	Good Practice Guidance
GSTI	Gas-Steam Turbine Installations
GWP	Global Warming Potential
H	Annually extracted volume, round wood
ha	Hectare
HDP	High Density Polyethylene
HFC	Hydrofluorocarbons
hl	Hectoliter
HNO_3	Nitric acid
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
J.S.C.	Joint Stock Company
k	Methane generation rate constant
kg	Kilogram
KCA	Key Category Analysis

km	Kilometer
km^2	Square kilometer
kPa	Kilopascal
kt	kiloton
kW	Kilowatt
kWh	Kilowatt-hour
l	Liter
L	Level
$L_{felling}$	Annual carbon loss due to commercial felling
L_0	Methane Generation Potential
LBDR	Left Bank of Dniester River
LDP	Low Density Polyethylene
LDLP	Low Density Linear Polyethylene
LEDS	Low Emission Development Strategy
LULUCF	Land Use, Land Use Change and Forest
Ltd.	Limited Liability Company
LTO	Cycle: Landing/Take Off
m	Meter
m^2	Square meter
m^3	Cubic meter
MARDE	Ministry of Agriculture, Regional Development and Environment
MCF	Methane Correction Factor
MD	Moldova
ME	Municipal Enterprise
MgO	Magnesia
mg	Miligram
mil.	Million
MJ	Megajoule
MMS	Manure Management Systems
mm	Millimeters
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 Wastes
Mt	Megatons = 10^6 tons
MTTP	Moldovan Thermal Power Plant in Dnestrovsk
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_2	Molecular nitrogen
$N_{AG\,(T)}$	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
NF_3	Nitrogen trifluoride
$N_{MMS\ Avb}$	Amount of managed manure nitrogen available for application to managed soils
Na_2CO_3	Natron
NA	Non Applicable
Nex	Nitrogen excretion rate

NAMA	National Appropriate Mitigation Actions
NaOH	Sodium Hydroxide (caustic soda)
NBS	National Bureau of Statistics
NC	National Communications
NC4	Fourth 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
NH_3	Ammonia
NH_4^+	Ammonium
NH_4NO_3	Ammonia Nitrate
$NH_4H_2PO_4$	Monoammonium phosphate
$(NH_4)_2HPO_4$	Diammonium phosphate
NIR	National Inventory Report
NMVOC	Non methane volatile organic compounds
NO	Not Occuring
NO_x	Nitrogen Oxides
NO_3^-	Nitrate
N_2O	Nitrous oxide
N_2O_{ATD}	Indirect emissions of N_2O 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 emissions of N_2O
N_2O_{IND}	Indirect emissions of N_2O
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 dung 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
ODP	Ozone-Depleting Potential
ODS	Ozone-Depleting Substances
OHF	Open hearth furnace
ON	Organic nitrogen
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.*)
PARE	Public Association of Refrigerating Engineers in the Republic of Moldova
P_{EQ}	Population equivalent number
P.	Page
PFC	Perfluorocarbons
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.)*
RBDR	Right Bank of Dniester River
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
SEI	State Ecological Inspectorate
SF_6	Sulphur hexafluoride
SHS	State Hydrometeorological Service
SiO_2	Silicon oxide
SM	Emissions from sludge treatment
SN	Synthetic Nitrogen Fertilizers
SNC	Second National Communication
SO_2	Sulphur dioxide
SOE	State Owned Enterprise
SS_{ix}	Fraction of anaerobically treated sludge
σ	Standard Error
t	Ton
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
TNC	Third National Communication
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 Program
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
WB	World Bank
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

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 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 emission trends"*.

The main mechanism for making this information available is National Communications (NC). 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, during 1998 to 2000, under the *UNDP-GEF Project "Enabling Activities for the preparation of the First National Communication under the UNFCCC"*, Republic of Moldova developed its FNC to UNFCCC, submitted to the COP 6 (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, during 2005-2009 time period, under the *UNEP-GEF Project "Enabling Activities for the preparation of the Second National Communication under the UNFCCC"*, Republic of Moldova developed its SNC under the UNFCCC (2010); within 2010-2013 – the Third National Communication under the UNFCCC (2014), while from 2014 to 2017, the Fourth National Communication under the UNFCCC (2018).

With reference to UNFCCC implementation instruments it should be noted that the COP 3 (Kyoto, 1997) adopted the Kyoto Protocol, representing an instrument setting binding targets for the Parties under Convention, by committing industrialized countries and economies in transition (37 industrialized countries and the European Union) included in Annex I to Convention, to reduce total emissions of direct GHG by at least 5 per cent, against 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, known as the *Copenhagen Accord*, reaffirms development issues in the context of climate change, inclusive 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 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 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, during 2010-2012, it was drawn the *Low Emissions Development Strategy of the Republic of Moldova until 2020*, 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", Chapter "Environment Protection" (2011-2014) and the provisions of chapter "Climate Change" of the European Union 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 prioritized 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 wide 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 encourages developing countries to prepare Low Emission Development Strategies for sustainable development and to undertake National Appropriate Mitigation Actions. The Cancun Agreements highlights 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 national communications for the countries non-Annex I (Decision 1/CP.16). In line with this, the non-Annex I Parties should prepare and submit to the UNFCCC Secretariat *National Communications* every four years and *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 and 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 emissions trends, key categories, activity data, emissions 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 that took place in Durban in 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 De-

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

cision). 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 should be submitted to the Secretariat at every two years as a stand-alone report or as a summary of the National Communications, where their reporting years coincides.

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, 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 BURs content 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 BUR submission to the Secretariat.

As for the First Biennial Update Report of the RM under the UNFCCC, its technical assessment by the TTE took place between 19 and 23 of September 2016, with the evaluation report being published on the Secretariat of the UNFCCC web page on February 20, 2017[2]. The FSV among Parties on the BUR1s content and the results of technical analysis was carried out during the 3rd FSV seminar, organized by the UNFCCC Secretariat on 15 May 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 to the Kyoto Protocol; adds a revised list of greenhouse gases to be reported; and a series of amendments to several articles of the Kyoto Protocol regarding the first 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, the developed countries should reduce their greenhouse gas emissions by at least 18 per cent compared to 1990 levels. By 28 September 2018[4], 117 countries had ratified the Doha Amendment to the KP, most of which are non-Annex I Parties to the UNFCCC and the KP.

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 in 2015, in Paris. It is expected that the new climate agreement will establish a new commitment period (1st of January 2021 – 31st of December 2030) for reducing the GHG emissions. Also, COP 19 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 Climate Agreement 2015.

The COP 20 took place in Lima (2014). The Parties agreed over *Lima Call for Climate Action* and were repeatedly invited to communicate to the Secretariat their intended nationally determined contributions, in order to facilitate clarity, transparency and understanding. The INDC may include, as appro-

[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>, while the video recording of the presentation and the interventions from the Parties are available on: <https://www.youtube.com/playlist?list=PL-m2oy1bnLzpmdRpG2pTBzUeOH3qrXlZt
[4] <https://unfccc.int/process/the-kyoto-protocol/the-doha-amendment>

priate, inter alia: (i) quantifiable information on the reference point; (ii) time frames and/or 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) how the Party considers that its national circumstances, and how it contributes towards achieving the objective of the Convention as set out in its Article 2.

According to *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 request to the Secretariat was to prepare by 1st of November 2015 a synthesis report on the aggregate effect of the INDC communicated by Parties.

The Republic of Moldova was fully committed to the UNFCCC negotiation process towards adopting at COP 21 of the Paris Agreement – 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 from 04.05.2017 for the ratification of the Paris Agreement (Official Monitor No. 162-170 from 26.05.2017)[5].

At 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 its NDC, the Republic of Moldova intends to achieve an economy-wide unconditional target of reducing its greenhouse gas emissions by 64-67 per cent below its 1990 level in 2030 and to make best efforts to reduce its emissions by 67 per cent.

The reduction commitment expressed above could be increased up to 78 per cent below 1990 level conditional to, a global agreement addressing important topics including low-cost financial resources, technology transfer, and technical cooperation, accessible to all at a scale commensurate to the challenge 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 national contribution intentionally determined of the Republic of Moldova were subsequently officially approved at national level by the Government Decision No. 1470 from 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 from 24.03.2017)[7].

Inventory Process in the Republic of Moldova

The Ministry of Agriculture, Regional Development and Environment (MARDE) 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, MARDE is in charge for implementation the international environment treaties to which the Republic of Moldova is a Part (including Rio Conventions). The representative of the Ministry of Agriculture, Regional Development and Environment is also the National Focal Point to the UNFCCC.

Within the MARDE, the Climate Change Office held the entire responsibility for National Communications, Biennial Update Reports and National Inventory Reports preparation activities.

According to Government Decision No. 549 as of 13.06.2018 on the creation, organizing and functioning of the Environment Agency[8], the latter has been recently assigned the following competencies in the field of atmospheric air protection and climate change: implementing the provisions of policy

[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] <http://lex.justice.md/index.php?action=view&view=doc&lang=1&id=375961>

documents and international environmental treaties to which the RM is a part in the field of protection of atmospheric air quality and ozone layer, GHG emissions reduction and adaptation to climate change, the elaboration and presentation to the MARDE of information on their implementation (para. 9 (2), let. c); participation to the works of the National Commission for Climate Change (para. 9 (2), let. j); ensuring the implementation of the monitoring, reporting and verification system for GHG emissions (para. 9 (2), let. k); performing the process of collecting, centralizing, validating and processing data and required information for the inventories and reports on atmospheric pollutants and GHG emissions (para. 9 (2), let. l); providing technical support to MARDE for the development of national communications and biennial update reports according to UNFCCC provisions (para. 9 (2), let. o).

The National Inventory Team within the Climate Change Office 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 related to GHG inventory preparation process.

In the process of preparing the national GHG inventory, the Climate Change Office employed a centralized approach consisting of the National Inventory Report (NIR) and the inventory itself reported by using a series of standardized Common Reporting Format (CRF) (Sectoral and Summary) Tables (according to Decision 24/CP.19[9]).

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, SF_6 and NF_3) greenhouse gases were estimated based on methodologies contained in the 2006 IPCC Guidelines, while the indirect emissions (NO_x, CO, NMVOC and SO_2) were estimated based on methodologies according to the EEA/EMEP Air Pollutant Emission Inventory Guidebook (2016).

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 results of the key categories analysis carried out following a Tier 1 methodological approach, by use of the Key Categories Analysis Tool v2.5[10], developed by the US Environment Protection Agency (US EPA), revealed: without LULUCF 14 key categories by level (L) and 16 key categories by trend (T): based on a Tier 2 approach – 13 key categories by level (L) and 13 key categories by trend (T); with LULUCF, based on the Tier 1 methodological approach – 20 key categories by level (L) and 20 key categories by trend (T), respective, based on a Tier 2 approach – 18 key categories by level (L) and 17 key categories by trend (T).

As a part of continuous efforts to develop a transparent and reliable inventory, the RM 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), 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 inventory preparation process.

Inventory quality assurance activities were supported by experts representing: Institute of Power Engineering of the Academy of Sciences of Moldova – for Sector 1 'Energy'; the Technical University of

[9] <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>.
[10] <https://19january2017snapshot.epa.gov/climatechange/national-ghg-inventory-capacity-building_.html>

Moldova – for Sector 2 'Industrial Processes and Product Use'; and Sector 3 'Agriculture'; the Forest Research and Management Institute – 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 represents, mostly, a complete register of greenhouse gas emissions. Although the NIR is intended to be comprehensive, certain sources have been excluded from the estimates presented for various reasons. Generally speaking, 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 2016, the Republic of Moldova has reduced its GHG emissions by circa 67.5 per cent (Table ES-1).

Table ES-1: Total GHG Emissions and Accompanying Variables in the Republic of Moldova within 1990-2016 periods

	1990	1995	2000	2005	2010	2011	2012	2013	2014	2015	2016
Population, million inhabitants	**4.362**	**4.348**	**4.304**	**3.940**	**3.938**	**3.931**	**3.926**	**3.924**	**3.918**	**3.885**	**3.844**
Compared to 1990, %		-0.3	-1.3	-9.7	-9.7	-9.9	-10.0	-10.0	-10.2	-10.9	-11.9
Inter-annual fluctuation, %		-0.1	-0.3	-6.9	-0.2	-0.2	-0.1	-0.1	-0.1	-0.9	-1.1
Total GHG emissions, Mt CO_2 eq.	**44.919**	**17.806**	**11.626**	**13.848**	**14.526**	**14.903**	**14.001**	**13.478**	**14.380**	**14.370**	**14.578**
Compared to 1990, %		-60.4	-74.1	-69.2	-67.7	-66.8	-68.8	-70.0	-68.0	-68.0	-67.5
Inter-annual fluctuation, %		-15.4	-7.7	2.3	0.7	2.6	-6.1	-3.7	6.7	-0.1	1.4
GHG per capita, tons per capita	**10.299**	**4.095**	**2.701**	**3.514**	**3.688**	**3.791**	**3.566**	**3.435**	**3.670**	**3.699**	**3.793**
Compared to 1990, %		-60.2	-73.8	-65.9	-64.2	-63.2	-65.4	-66.6	-64.4	-64.1	-63.2
Inter-annual fluctuation, %		-15.3	-7.4	9.8	0.9	2.8	-5.9	-3.7	6.8	0.8	2.5
GDP, billion 2010 US $	**10.133**	**3.995**	**3.524**	**4.961**	**5.812**	**6.207**	**6.163**	**6.743**	**7.066**	**7.038**	**7.327**
Compared to 1990, %		-60.6	-65.2	-51.0	-42.6	-38.7	-39.2	-33.5	-30.3	-30.5	-27.7
Inter-annual fluctuation, %		-1.4	2.1	7.5	7.1	6.8	-0.7	9.4	4.8	-0.4	4.1
GHG intensity, kg CO_2 eq./2010 US $	**4.433**	**4.457**	**3.299**	**2.791**	**2.499**	**2.401**	**2.272**	**1.999**	**2.035**	**2.042**	**1.990**
Compared to 1990, %		0.6	-25.6	-37.0	-43.6	-45.8	-48.8	-54.9	-54.1	-53.9	-55.1
Inter-annual fluctuation, %		-14.2	-9.6	-4.9	-6.0	-3.9	-5.4	-12.0	1.8	0.3	-2.6
Imported energy, million t.c.e.	**16.703**	**5.109**	**2.535**	**3.123**	**2.590**	**2.771**	**2.620**	**2.748**	**2.575**	**2.522**	**2.597**
Compared to 1990, %		-69.4	-84.8	-81.3	-84.5	-83.4	-84.3	-83.5	-84.6	-84.9	-84.5
Inter-annual fluctuation, %		11.0	-18.0	4.2	-8.2	7.0	-5.4	4.9	-6.3	-2.1	3.0
Consumed energy, million t.c.e.	**15.054**	**5.085**	**2.647**	**3.257**	**3.761**	**3.827**	**3.753**	**3.779**	**3.815**	**3.832**	**3.989**
Compared to 1990, %		-66.2	-82.4	-78.4	-75.0	-74.6	-75.1	-74.9	-74.7	-74.5	-73.5
Inter-annual fluctuation, %		9.7	-20.2	6.3	27.1	1.8	-1.9	0.7	1.0	0.4	4.1
Produced electricity, billion kWh	**15.690**	**6.168**	**3.624**	**4.225**	**6.115**	**5.785**	**5.802**	**4.491**	**5.380**	**6.050**	**5.852**
Compared to 1990, %		-60.7	-76.9	-73.1	-61.0	-63.1	-63.0	-71.4	-65.7	-61.4	-62.7
Inter-annual fluctuation, %		-25.8	-11.8	1.1	-1.3	-5.4	0.3	-22.6	19.8	12.5	-3.3
Consumed electricity, billion kWh	**11.426**	**7.022**	**4.510**	**5.838**	**5.257**	**5.416**	**5.468**	**5.795**	**5.975**	**5.455**	**5.227**
Compared to 1990, %		-38.5	-60.5	-48.9	-54.0	-52.6	-52.1	-49.3	-47.7	-52.3	-54.3
Inter-annual fluctuation, %		-3.9	-4.4	-3.1	-0.9	3.0	1.0	6.0	3.1	-8.7	-4.2
Produced heat, million Gcal	**22.212**	**9.827**	**4.986**	**5.324**	**4.600**	**4.419**	**4.273**	**4.377**	**4.064**	**3.979**	**4.125**
Compared to 1990, %		-55.8	-77.6	-76.0	-79.3	-80.1	-80.8	-80.3	-81.7	-82.1	-81.4
Inter-annual fluctuation, %		30.9	-26.0	8.2	5.4	-4.0	-3.3	2.4	-7.2	-2.1	3.7
Consumed heat, million Gcal	**20.983**	**8.796**	**4.501**	**4.765**	**3.988**	**3.952**	**3.785**	**3.861**	**3.584**	**3.473**	**3.628**
Compared to 1990, %		-58.1	-78.5	-77.3	-81.0	-81.2	-82.0	-81.6	-82.9	-83.4	-82.7
Inter-annual fluctuation, %		32.1	-23.6	8.4	4.1	-0.9	-4.2	2.0	-7.2	-3.1	4.5

References: [1] Economic Research Service US Department of Agriculture (<http://www.ers.usda.gov/data-products/international-macroeconomic-data-set.aspx>); 2Anuarele 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 RM for 1990, 1993-2016 and Statistical Yearbooks of ATULBD.

Table ES-1 reveals that the decrease in GHG emissions over the last 27 years is in full consistency with a decrease in some important economic and social indicators: the population decreased by 11.9 per cent within this time periods, the real value of GDP – by 27.7 per cent, the GHG intensity (CO_2eq/GDP) – by 55.1 per cent, electricity consumption – by 54.3 per cent, heat consumption – by 82.7 per cent, consumption of primary energy resources – by 74.3 per cent, import of energy – by 84.5 per cent.

The significant reduction of socio-economic indicators between 1990 and 2016 is a consequence of the profound transformation processes common for the transition from a centralized economy to a market economy, in particular 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 is considered one of the lowest income nations in Europe.

Even before 1991 there were some tendencies of economic decline, but the separation from the USSR considerably accelerated the process. The real GDP level was decreasing continuously during the period from 1990 to 1999 inclusively, when it fell down to as little as 34 per cent of the 1990 level. 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 has 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 has 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 (ex., from 1997 to 2016 the natural gas tariff increased 12 times; electricity tariff increased circa 4 times; gasoline, diesel and liquefied gases prices increased 2 times), in the condition when about 90-95 per cent of energy resources were imported. On the other hand, without applying cross subsidizations policies, the current energy prices have incentivized the population to take strong energy efficiency measures in the RM, which led to a significant decrease of the energy intensity, declining since 2006 with an average annual negative growth of circa 11.0 per cent.

At the same time, within 2000-2016 period, the real GDP increased by 107.9 per cent, from circa 3.5 to 7.3 billion 2010 US$, while the real GDP per capita increased by 132.8 per cent, from 819 to 1906 2010 US$.

The considerable real GDP growth achieved since 2000 seems to indicate that the economy is finally developing in the correct direction, although it should be remembered that in 2016 the real GDP reached only circa 75.8 per cent of the 1990-year level. It is worth mentioning that from 2000 to 2016, the primary energy resources consumption increased in the Republic of Moldova by 50.7 per cent; while the GHG intensity (CO_2eq/GDP) decreased during the same period by 39.7 per cent, showing the first signs of the decoupling of economic growth from the growth in greenhouse gas emissions, by 25.4 per cent within 2000-2016 periods (Figure ES-1).

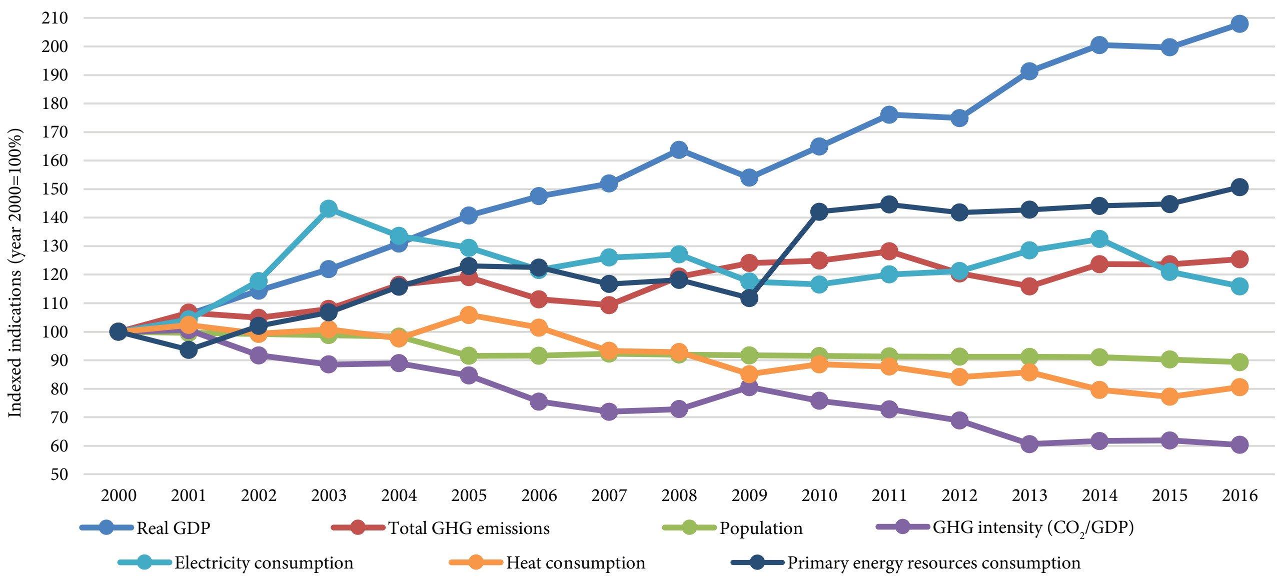


Figure ES-1: Trends in total GHG emissions and associated variables in the Republic of Moldova within 2000-2016 periods.

Table ES-2 provides data on total and net GHG emissions in the Republic of Moldova in 2016.

Table ES-2: Republic of Moldova's Total Direct GHG Emissions in 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)	**8 545.8253**	**2 835.4954**	**2 099.7464**	**175.5848**	**0.0403**	**1.1252**	**NO**	**NO**	**13 657.8174**
1. Energy	**9 032.6132**	**742.6395**	**151.9757**						**9 927.2284**
A. Fuel Combustion	9 030.9428	131.5493	63.4119						9 225.9040
1. Energy Industries	4 518.9699	2.2700	4.8207						4 526.0607
2. Manufacturing Industries and Construction	500.7010	0.4963	0.7988						501.9962
3. Transport	2 331.5969	12.0472	39.2820						2 382.9261
4. Other Sectors	1 677.5744	116.7297	18.4881						1 812.7922
5. Other	2.1005	0.0061	0.0223						2.1288
B. Fugitive Emissions from Fuels	1.6704	611.0903	88.5637						701.3244
1. Solid Fuels	NO	NO	NO						NO
2. Oil and Natural Gas	1.6704	611.0903	88.5637						701.3244
C. CO_2 Transport and Storage	NO								NO
2. Industrial Processes and Product Use	**585.1146**	**NO**	**NO**	**175.5848**	**0.0403**	**1.1252**	**NO**	**NO**	**761.8649**
A. Mineral Industry	500.5774								500.5774
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	78.6128	NO	NO						78.6128
E. Electronic Industry				NO	NO	NO	NO	NO	NO
F. Product Use as Substitutes for ODS				175.5848	NO	NO	NO	NO	175.5848
G. Other Product Manufacture and Use	0.7041	NO	NO	NO	0.0403	1.1252	NO	NO	1.8696
H. Other									
3. Agriculture	**12.2747**	**717.6111**	**1 698.5781**						**2 428.4639**
A. Enteric Fermentation		649.2698							649.2698
B. Manure Management		68.3414	372.7198						441.0611
C. Rice Cultivation		NO							NO
D. Agricultural Soils			1 325.8583						1 325.8583
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	**-1 099.6373**	**0.3568**	**179.2669**						**-920.0136**
A. Forest Land	-2 113.5468	0.3085	0.2034						-2 113.0348
B. Cropland	1 393.2356	0.0483	0.7840						1 394.0679
C. Grassland	-402.3693	NE	NE						-402.3693
D. Wetlands	-82.7917	NE	NE						-82.7917
E. Settlements	19.3071	NE	178.2795						197.5866
F. Other Land	85.6461	NE	NE						85.6461
G. Harvested Wood Products	0.8816								0.8816
H. Other	NO	NO	NO						NO
5. Waste	**15.4600**	**1 374.8879**	**69.9257**						**1 460.2737**
A. Solid Waste Disposal	NA, NO	1 115.1732							1 115.1732
B. Biological Treatment of Solid Waste		NO, NE	NO, NE						NO, NE
C. Incineration and Open Burning of Waste	15.4600	7.9023	1.6560						25.0183
D. Wastewater Treatment and Discharge		251.8125	68.2697						320.0822
E. Other	NO	NO	NO						NO
6. Other	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**
Memo Items									
International Bunkers	**313.0386**	**0.1576**	**2.9905**						**316.1867**
Aviation	313.0386	0.1576	2.9905						316.1867
Navigation	NO	NO	NO						NO
Multilateral Operations	NO	NO	NO						NO
CO_2 Emissions from Biomass	**1 561.9690**								**1 561.9690**
CO_2 Captured and Stored	NO								NO
Long-term Storage of C in waste disposal sites	NE								NO
Indirect N_2O			340.0142						340.0142
Indirect CO_2	71.4341								71.4341
Total (without LULUCF)									**14 577.8310**
Total (with LULUCF)									**13 657.8174**

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

The share of CO_2 emissions in the total direct GHG emissions was circa 66.2 per cent, CH_4 contributed with circa 19.4 per cent, N_2O emissions accounted for 13.2 per cent of the total, while the share of F-gases (HFCs, PFCs, SF_6) being totally insignificant, only circa 1.2 per cent of the total (Figure ES-2).

In 2016, in the Republic of Moldova, approximately 68.1 per cent of the total national direct GHG emissions originated from the Sector 1 'Energy'. Other relevant direct GHG sources are represented by Sector 3 'Agriculture' (16.7 per cent of the total), Sector 5 'Waste' (10.0 per cent of the total), Sector 4 'Land Use, Land-Use Change and Forestry' (-6.3 per cent of the total) and Sector 2 'Industrial Processes and Product Use' (5.2 per cent of the total) (Figure ES-3).

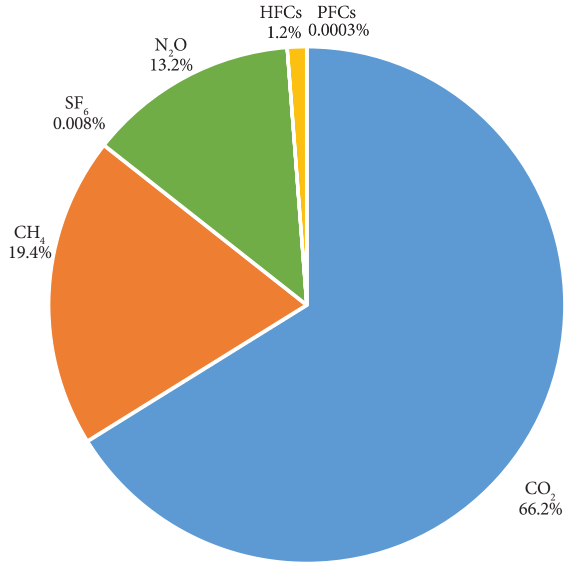


Figure ES-2: Republic of Moldova's Direct GHG Emissions by Gas in 2016.

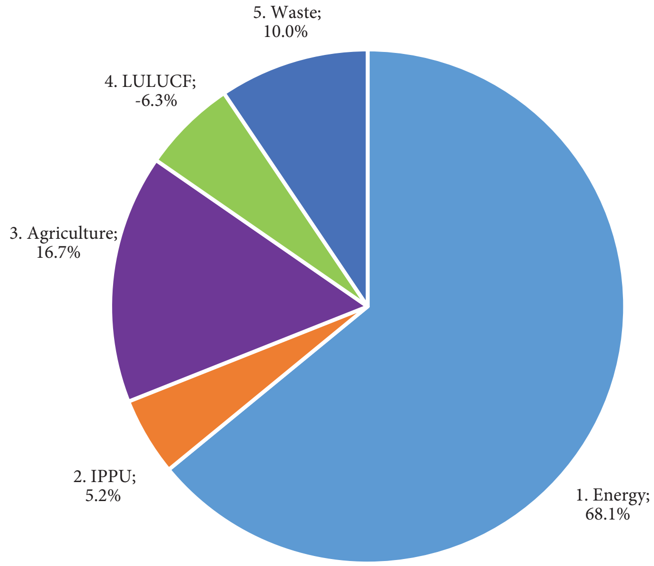


Figure ES-3: Sectoral Breakdown of the Republic of Moldova's Total GHG Emissions in 2016.

Table ES-3 shows the evolution of total direct GHG emissions and removals in the Republic of Moldova for the time series from 1990 through 2016. As it can be noted, the total national direct GHG emissions (without LULUCF) decreased during the period under review by 67.5 per cent, from 44.9 Mt CO_2 equivalent in 1990 to 14.6 Mt CO_2 equivalent in 2016 (but GHG emissions increased by circa 1.4 per cent as compared to 2015 level).

Table ES-3: Republic of Moldova's Total Direct GHG Emissions within 1990-2016 periods

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	1990	1995	2000	2005	2010	2011	2012	2013	2014	2015	2016
	CO_2 equivalent (kt)										
1. Energy	**36 610.5147**	**12 157.3676**	**7 288.8600**	**9 248.7805**	**10 194.9848**	**10 498.5364**	**10 036.1910**	**9 025.7218**	**9 656.8992**	**10 063.7869**	**9 927.2284**
A. Fuel Combustion	35 805.3520	11 474.2307	6 648.5584	8 412.7248	9 542.0407	9 758.6253	9 299.4662	8 319.8178	8 972.4391	9 409.2857	9 225.9040
1. Energy Industries	21 308.2056	7 160.4871	3 613.2428	3 760.8597	4 983.8288	4 614.9116	4 603.3054	3 686.7824	4 358.3979	4 744.8255	4 526.0607
2. Manufacturing Industries and Construction	2 212.4085	440.6772	531.7932	599.2226	443.8184	598.2152	457.4388	599.3992	468.8030	534.6373	501.9962
3. Transport	4 479.4542	1 539.2813	942.9727	1 767.1186	2 054.1180	2 164.9327	1 901.8722	2 021.7651	2 090.0531	2 203.3296	2 382.9261
4. Other Sectors	7 689.7135	2 207.2356	1 523.7452	2 259.2406	2 030.0705	2 358.9684	2 328.2713	2 007.9234	2 051.8469	1 923.5784	1 812.7922
5. Other	115.5701	126.5495	36.8044	26.2833	30.2051	21.5974	8.5786	3.9478	3.3383	2.9147	2.1288
B. Fugitive Emissions from Fuels	805.1627	683.1369	640.3016	836.0558	652.9441	739.9111	736.7247	705.9040	684.4601	654.5012	701.3244
1. Solid Fuels	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
2. Oil and Natural Gas	805.1627	683.1369	640.3016	836.0558	652.9441	739.9111	736.7247	705.9040	684.4601	654.5012	701.3244
C. CO_2 Transport and Storage	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
2. Industrial Processes and Product Use	**1 572.3005**	**450.5308**	**314.1033**	**591.9260**	**592.3056**	**695.9553**	**713.2218**	**762.6073**	**794.8503**	**784.2010**	**761.8649**
A. Mineral Industry	1 306.2407	342.6866	237.9796	440.2134	411.0616	492.3783	498.5638	551.2987	547.8150	510.8250	500.5774
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	12.8556	12.6973	7.6569	13.8464	17.2792	5.2203
D. Non-Energy Products from Fuels and Solvent Use	234.3591	76.5608	30.6392	67.8400	67.0530	72.3407	75.8897	70.9399	88.9627	86.3698	78.6128
E. Electronic Industry	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
F. Product Use as Substitutes for ODS	NO	3.9514	8.3038	40.7988	102.8657	116.5249	124.2123	130.5506	142.0853	167.8122	175.5848
G. Other Product Manufacture and Use	3.1983	1.0950	0.9118	1.1379	1.6268	1.8557	1.8588	2.1611	2.1409	1.9148	1.8696
H. Other	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
3. Agriculture	**5 220.5740**	**3 602.9153**	**2 480.8483**	**2 578.3718**	**2 255.0151**	**2 207.9339**	**1 760.0998**	**2 252.5504**	**2 492.3149**	**2 091.1781**	**2 428.4639**
A. Enteric Fermentation	2 190.6944	1 620.7325	1 085.6403	926.4666	712.5704	671.0063	632.8347	643.3105	680.9618	653.4004	649.2698
B. Manure Management	1 611.7134	939.2484	553.2408	557.5205	503.1437	461.3574	425.8809	401.7558	440.1394	426.9623	441.0611
C. Rice Cultivation	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
D. Agricultural Soils	1 417.5842	1 042.8737	841.5274	1 094.2109	1 037.5567	1 071.8950	695.7934	1 203.3001	1 361.0079	999.5751	1 325.8583
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	3.6752	5.5908	4.1840	10.2058	11.2402	12.2747
I. Other Carbon-Containing Fertilizers	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO,NE
J. Other	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
4. LULUCF	**-1 527.5846**	**-1 868.9465**	**-1 880.6877**	**-1 410.9177**	**-961.9499**	**-908.0226**	**-939.5632**	**-802.7329**	**-453.6371**	**-902.1771**	**-920.0136**
A. Forest Land	-2 563.0889	-2 045.0615	-2 307.4358	-2 409.4945	-2 484.0285	-2 390.3914	-2 292.8969	-2 140.5328	-2 134.6291	-2 158.4241	-2 113.0348
B. Cropland	2 521.8498	1 489.1801	1 468.9958	1 530.1956	1 538.8733	1 493.3618	1 496.7899	1 409.0609	1 446.5623	1 393.2012	1 394.0679
C. Grassland	-1 205.6938	-1 601.1004	-1 291.9495	-1 058.1239	-691.9874	-638.1726	-562.7510	-360.1740	-341.1085	-418.4569	-402.3693
D. Wetlands	-555.3798	-469.4389	-328.4245	-187.4101	-46.3958	-75.3129	-15.4700	-106.0998	-139.7535	-82.7917	-82.7917

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	1990	1995	2000	2005	2010	2011	2012	2013	2014	2015	2016
	CO_2 equivalent (kt)										
E. Settlements	244.5446	350.3734	393.7945	338.5239	302.9075	313.1448	243.7754	229.6814	220.6246	228.2398	197.5866
F. Other Land	152.3638	401.1281	178.5246	416.5012	441.4824	393.7285	114.1449	103.4500	436.6463	86.8192	85.6461
G. Harvested Wood Products	-122.1804	5.9727	5.8073	-41.1098	-22.8014	-4.3808	76.8444	61.8814	58.0208	49.2353	0.8816
H. Other	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
5. Waste	**1 515.3675**	**1 594.7260**	**1 541.7515**	**1 428.7535**	**1 483.2997**	**1 500.9112**	**1 491.1032**	**1 437.5505**	**1 436.0537**	**1 431.2923**	**1 460.2737**
A. Solid Waste Disposal	1 046.7277	1 209.1757	1 169.5330	1 064.3081	1 137.8491	1 155.0806	1 143.6162	1 084.7685	1 083.0800	1 087.1715	1 115.1732
B. Biological Treatment of Solid Waste	NO, NE	NO, NE	NO, NE	NO, NE	NO, NE	NO, NE	NO, NE	NO, NE	NO, NE	NO, NE	NO, NE
C. Incineration and Open Burning of Waste	27.7249	27.7458	27.5796	25.6447	25.6241	25.7171	25.6814	25.6468	25.5716	25.3128	25.0183
D. Wastewater Treatment and Discharge	440.9149	357.8046	344.6389	338.8006	319.8265	320.1134	321.8055	327.1351	327.4022	318.8081	320.0822
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	**218.9336**	**42.4672**	**66.9765**	**68.4023**	**83.5573**	**96.4069**	**108.7812**	**131.8213**	**156.0913**	**220.6372**	**316.1867**
Aviation	218.9336	42.4672	66.9765	68.4023	83.5573	96.4069	108.7812	131.8213	156.0913	220.6372	316.1867
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**	**384.6400**	**403.3840**	**429.2796**	**1 314.4896**	**1 439.5226**	**1 561.9690**
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	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Indirect N_2O	585.1195	360.0057	255.1670	306.3316	289.6907	289.5234	217.0970	308.0323	351.5434	273.9260	340.0142
Indirect CO_2	207.3247	65.3743	26.5388	60.5990	60.0215	65.1556	69.6839	64.7797	82.6825	79.5560	71.4341
Total (without LULUCF)	**44 918.7567**	**17 805.5396**	**11 625.5631**	**13 847.8319**	**14 525.6052**	**14 903.3367**	**14 000.6158**	**13 478.4300**	**14 380.1181**	**14 370.4582**	**14 577.8310**
Total (with LULUCF)	**43 391.1722**	**15 936.5931**	**9 744.8755**	**12 436.9142**	**13 563.6553**	**13 995.3141**	**13 061.0526**	**12 675.6971**	**13 926.4810**	**13 468.2811**	**13 657.8174**

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

To be noted that during the period under review, the GHG emissions from Sector 1 ‘Energy’ have decreased by circa 72.9 per cent (in 2016, decreased by another 1.4 per cent as compared to 2015), emissions from Sector 2 ‘Industrial Processes and Product Use’ decreased by circa 51.5 per cent (in 2016, a decrease by 2.8 per cent occurred compared to 2015 year level), emissions from Sector 3 ‘Agriculture’ decreased by 53.5 per cent (in 2016, the respective emissions increased by 16.1 per cent compared to 2015), net removals in Sector 4 ‘LULUCF’ decreased by 39.8 per cent (in 2016, an increase by 2.0 per cent occurred compared to 2015 year level), respectively, emissions from Waste Sector decreased by 3.6 per cent (in 2016, an increase by 2.0 per cent occurred compared to 2015 year level).

The most significant reduction of direct GHG emissions by source categories during the period under review took place in: 4G ‘Harvested Wood Products’ (-100.7 per cent), 1A5 ‘Other’ (-98.2 per cent), 2C ‘Metal Industry’ (-81.7 per cent), 1A1 ‘Energy Industries’ (-78.8 per cent), 1A2 ‘Manufacturing Industries and Construction’ (-77.3 per cent), 1A4 ‘Other Sectors’ (-76.4 per cent), 3B ‘Manure Management’ (-72.6 per cent), 3A ‘Enteric Fermentation’ (-70.4 per cent) 4C ‘Grassland’ (-66.6 per cent), 2D ‘Non-Energy Products from Fuels and Solvent Use’ (-66.5 per cent), 2A ‘Mineral Industry’ (-61.7 per cent), 1A3 ‘Transport’ (-46.8 per cent), 4B ‘Cropland’ (-44.7 per cent), 4F ‘Other Land’ (-43.8 per cent) and 5D ‘Wastewater Treatment and Discharge’ (-27.4 per cent).

Between 2015 and 2016, total direct GHG emissions increased by circa 1.4 per cent due to the increase of emissions from the following categories: 3D ‘Agricultural Soils” (+32.6 per cent), 3H ‘Urea Application’ (+9.2 per cent), 1A3 ‘Transport’ (+8.2 per cent), 1B2 ‘Fugitive Emissions from Fuels’ (+7.2 per cent), 2F ‘Product Use as Substitutes for ODS’ (+4.6 per cent), 3B ‘Manure Management’ (+3.3 per cent) and 5A ‘Solid Waste Disposal’ (+2.6 per cent).

Indirect GHG Emission Trends

Though not considered greenhouse gases, photochemically active gases like carbon monoxide (CO), nitrogen oxides (NO_x) and non-methane volatile organic compounds (NMVOC), have an indirect global warming effect. These gases are considered as ozone precursors influencing the formation and destruction of tropospheric and stratospheric ozone. In particular, they are 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: NOx, CO, NMVOC and SO_2. Between 1990 and 2016, total NOx emissions decreased by 74.7 per cent: from 94.85 kt in 1990 to 24.04 kt in 2016, total CO emissions decreased by 68.1 per cent: from

279.82 kt in 1990 to 89.23 kt in 2016, NMVOC emissions decreased by 62.6 per cent: from 141.41 kt in 1990 to 52.86 kt in 2016, while SO_2 emissions decreased by 92.3 per cent: from 157.10 kt in 1990 to 12.03 kt in 2016 (Figure ES-4).

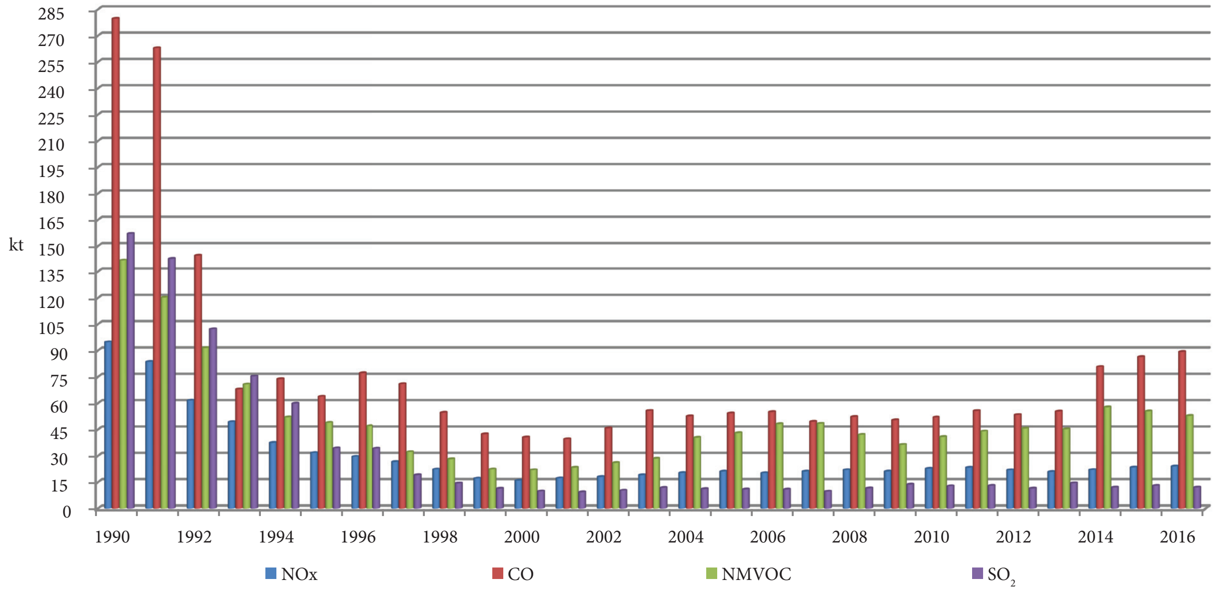


Figure ES-4: National Indirect GHG Emissions in the RM within 1990-2016 periods.

1. INTRODUCTION

1.1. Climate Change Phenomena

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 that alters the composition of the global atmosphere and which is in addition 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 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 modification 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 mean state of weather in a certain region of the world persisting 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, speed of the wind and such phenomenon as fog, frost, hoarfrost, hail and other. Climate change refer to long term changes in weather patterns caused by natural phenomena (astronomic: solar activity, influence of some planets etc.; geological-geophysical: change of the Earth's axis angle, change of the Earth orbit and other; geographical: changes in the active surface structure - volcanic eruptions, massive landslides), as well as phenomena of anthropogenic nature (induced by humans), such as pollution of terrestrial atmosphere (change of the global atmosphere composition by generation of GHG).

In conformity with the Fifth Assessment Report (AR5) of the Intergovernmental Panel on Climate Change (IPCC, 2013), it is expected that the climate change phenomenon will have different impact in different regions of the world. In comparison with the reference period 1986-2005, it is expected that by the end of XXI century (2081-2100) the average global air surface temperature will increase by circa 0.3-1.7°C according to RCP2.6, respectively by 1.1-2.6°C according to RCP4.5, by circa 1.4-3.1°C according to RCP6.0 and by 2.6-4.8°C according to RCP8.5. By contrast, between 1880 and 2012, the average global air surface temperature increased by 0.85°C, while within the 1986-2005 time periods, the respective temperature was by 0.61°C higher (with a margin of 0.55-0.67°C) in comparison to the preindustrial era (1850-1900).

To be noted that between 1901 and 2010, the sea level raised by 0.19 m while the ocean acidity has increased by 26%. Simultaneously, between 1979 and 2012, the ice surface of the Arctic Ocean decreased by 3.5-4.1 per cent/per decade. Towards the end of the XXI century, due to the pace of global warming, it is expected that the ocean acidity will increase by 15-17 per cent according to RCP2.6, by 38-41 per cent according to RCP4.5, by 58-62 per cent according to RCP6.0, respectively by 100-109 per cent according to RCP8.5. Compared to the reference period 1986-2005, the overall volume of glaciers will reduce by the end of the XXI century by 15-55 per cent according to RCP2.6, respectively by 35-85 per cent according to RCP8.5. The sea level will likely continue to increase by circa 0.26-0.55 m according to RCP2.6, respectively by 0.45-0.82 m according to RCP8.5.

Also, by the end of the XXI century it is expected to grow the frequency of natural disasters (floods, droughts, heat waves, hurricanes, tornados, etc.). 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 surface, and warming it. Long-wave radiation (infrared rays) emitted by the surface of the Earth is captured by these gases and partially send back to the Earth surface. As a consequence, the average atmospheric temperature is by 33°C warmer than it could have been in the absence of the greenhouse effect. Basically, this phenomenon makes life on Earth possible.

1.1.2. Climate Change in the Republic of Moldova

In the Republic of Moldova, climate data, specifically changes in temperature and precipitation have been measured since the end of XIX century and continue today via the hydro-meteorological monitoring network managed by the State Hydrometeorological Service.

The character of observed changes to the Republic of Moldova's climate was identified through the trends and variability of individual climatic variables. The average annual temperature and precipitation data recorded at Chisinau meteorological station, for which there are available the longest series of instrumental observation, have been studied and compared beginning with 1887 for temperature and since 1891 for precipitation. The results indicate a growing trend during the observation periods, with the average annual temperature increasing by 1.2°C (Figure 1-1), while the average annual precipitation values, respectively, by 55.6 mm (Figure 1-2).

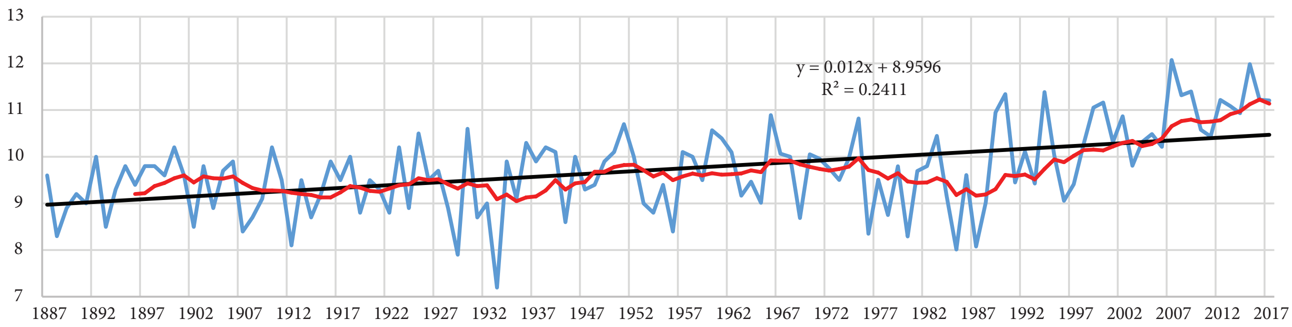


Figure 1-1: Trends of annual average air temperature change (°C) for 1887-2017: blue (actual course trend), black solid line (linear trend secular course) and red line (10 year moving average trend) at the meteorological station Chisinau, Central part of the Republic of Moldova.

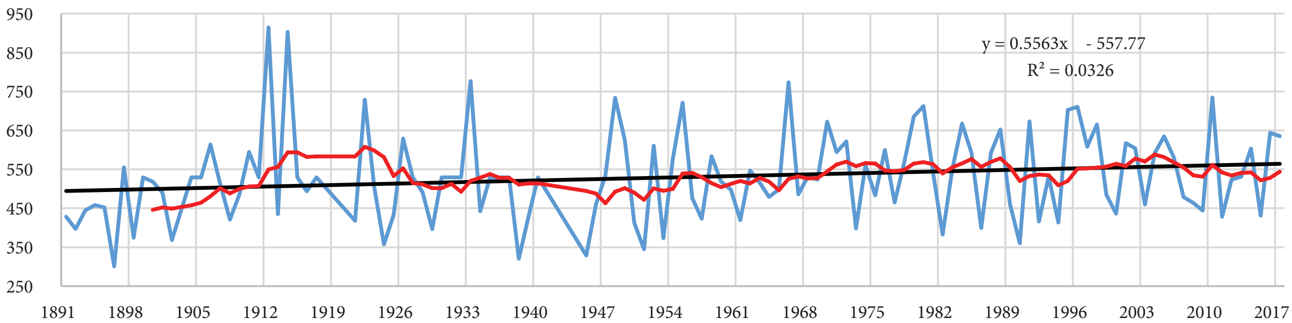


Figure 1-2: Trends of annual average precipitation (mm) for 1891-2017: blue (actual course trend), black solid line (linear trend secular course) and red line (10 year moving average trend) at the meteorological station Chisinau, Central part of the Republic of Moldova.

The Republic of Moldova has experienced an increased number of extreme weather events, such as droughts and floods. An analysis of national climate data revealed that the frequency of droughts in the Republic of Moldova in a 10-year time span is 1-2 droughts in the Northern part of the country; 2-3 droughts in the Central part and 5-6 droughts in the South. Their frequency is increasing, especially over the last decades. During the 1990-2016 timespan, 12 years were marked by droughts, which reduced significantly the crop yields. In 1990, 1992 and 2003, droughts continued during the entire vegetation period (April-September). The disastrous droughts of 2007 and 2012 affected over 70 per cent of the territory of the country, being the most severe droughts in the entire instrumental record period.

Floods also affect the Republic of Moldova on a recurring basis. In the past 70 years, 10 major floods on the great rivers of the Republic of Moldova - Dniester and Prut were reported, and three of those occurred already in XXI century (2006, 2008 and 2010). Large floods on the smaller rivers of the country are also quite common.

The socio-economic costs of climate change related to natural disasters such as droughts and floods are significant. Both their intensity and frequency are expected to further increase as a result of climate change. During 1984-2006, the Republic of Moldova's average annual economic losses due to natural disasters were about US$ 61 million. The 2007 and 2012 droughts alone caused losses estimated at about US$ 1.0 and 0.4 billion, respectively. The 2008 floods have cost the country about US$ 120 million, and the total damage and losses produced by 2010 floods were estimated at approximately US$ 42 million.

The patterns of future temperature and precipitation conditions were computed for the Republic of Moldova from the global climate model output gathered as part of the Coupled Model Intercomparison Project Phase 5 (CMIP5). Twenty-one global coupled atmosphere ocean general circulation models (GCMs) were implied in this exercise, the projections being made under the Representative Concentration Pathway (RCP) scenarios RCP 2.6, RCP 4.5, and RCP 8.5 available in the IPCC AR5 (2013).

The future climatic changes were assessed over the three Agro-Ecological Zones (AEZs) (North, Centre and South) of the Republic of Moldova for the near term (2016–2035), midterm (2046–2065) and long term (2081–2100) given relative to the reference period (1986–2005).

It was revealed that for temperature, the ensemble average changes consistently have the same sign across scenarios and their magnitude increase from the low RCP 2.6 radiative forcing pathway to the high RCP 4.5 and RCP 8.5, as moving into the later decades of the 21st century. The CMIP5 projections reveal warming in all seasons for the three AEZs, while precipitation projections are more variable across scenarios, sub-regions and seasons.

Annual changes for temperatures are very homogeneous over the three AEZs. The rate of warming is higher under RCP 8.5 scenario +4.6°C; medium +2.4°C under RCP 4.5; and smaller +1.3°C under the RCP 2.6 scenario by 2100. The ensemble, driven by RCP 8.5 emission scenario, estimates that the three AEZs will experience the most significant warming during summer from +5.9°C in North up to +6.1°C in South by 2100. The pattern of change derived from the ensemble RCP 2.6 models is quite similar, but the magnitude of change is lower from +1.3 to +1.5°C. The warming would be higher during winter up to +4.6°C in North, in the Centre and South temperature rise will be lower up to +4.2°C according to the RCP 8.5 scenario. The RCP 2.6 scenario reveals less intense warming over the three AEZs, from +1.2 to +1.4°C.

The ensemble projections from the RCP 8.5 forcing scenario show that the three AEZs would exhibit a general annual decrease in precipitation varying from -9.9 per cent in North to -13.4 per cent in South. Controversially, according to RCP 2.6 scenario moderate increase in precipitation from +3.1 per cent in North to +5.1 per cent in South by 2100 is projected. Winters have been estimated to be wetter in the Republic of Moldova by the end of the 21st century. The ensemble projections show the largest increase in precipitation from +4.0 per cent (RCP2.6) to +11.8 per cent (RCP8.5) in winter over Northern and the lowest one from +3.0 per cent (RCP2.6) to +7.4 per cent (RCP8.5) in Central parts of the country by 2100. The precipitation decrease will be more extended in the three AEZs during summer; the greatest rainfall reduction from -13.2 per cent (RCP4.5) to -25.1 per cent (RCP8.5), is projected in Centre and the lowest one from -7.4 per cent (RCP4.5) to -18.1 per cent (RCP8.5) in the North of the Republic of Moldova.

1.1.3. Greenhouse Gases

The most important greenhouse gas in atmosphere is water vapors (H_2O), responsible for approximately 2/3 of the total greenhouse effect. The content of water in atmosphere is not directly influenced by anthropogenic activities, but rather is determined by the cycle of water in nature, expressed in a simpler way, as the difference between evaporation and precipitations.

Carbon dioxide (CO_2) has a 30 per cent share in the greenhouse effect, while methane (CH_4), nitrous oxide (N_2O) and ozone (O_3) taken together account for 3 per cent. 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 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 GHG are considered to be natural components of the air, their presence in atmosphere is strongly affected by anthropogenic activities. Increased concentrations of GHG in atmosphere (caused by emissions of anthropogenic origin) contribute to strengthening of greenhouse effect thus leading to additional warming of the atmosphere. The GHG concentration in atmosphere is determined by the difference between GHG emissions and removals. It has been stated with certainty that GHG concentration in atmosphere have increased significantly in comparison with pre-industrial level. Thus, from 1750 to the end of 2017, the concentration of CO_2 increased by circa 145 per cent, concentration of CH_4 – by 257 per cent, while N_2O concentration – by circa 122 per cent[11] (Table 1-1). To a great extent these trends can be attributed to human activities — in particular, to fossil fuels combustion and continuous deforestation of forest lands.

Table 1-1: Tropospheric Concentration (in the Northern Hemisphere), Concentration Change Rate and Direct GHG Lifetime in Atmosphere

Greenhouse Gases	Preindustrial tropospheric concentration (1850-1900)	Recent tropospheric concentration (end of 2017)	GWP (100-yr time horizon) (IPCC, 2013)	Tropospheric lifetime (years)	Increased radiative forcing[13] (W/m^2)
Concentration in parts per million (ppm)					
Carbon dioxide (CO_2)	280	405.5	1	~ 100-300	2.013
Concentration in parts per billion (ppb)					
Methane (CH_4)	722	1859	28	12.4	0.509
Nitrous oxide (N_2O)	270	329.9	265	121	0.195
Tropospheric ozone (O_3)	237	337	n.a.	hours-days	0.400
Concentration in parts per trillion (ppt)					
CFC-11 (CCl_3F)	zero	232	4660	45	0.057
CFC-12 (CCl_2F_2)	zero	516	10200	100	0.163
CF-113 (CCl_2CClF_2)	zero	72	5820	85	0.022
HCFC-22 ($CHClF_2$)	zero	233	1760	11.9	0.049
HCFC-141b (CH_3CCl_2F)	zero	24	782	9.2	0.0039
HCFC-142b (CH_3CClF_2)	zero	22	1980	17.2	0.0041
Halon 1211 ($CBrClF_2$)	zero	3.6	1750	16	0.0010
Halon 1301 ($CBrClF_3$)	zero	3.3	6290	65	0.0010
HFC-134a (CH_2FCF_3)	zero	84	1300	13.4	0.0134
Carbon tetrachloride (CCl_4)	zero	82	1730	26	0.0140
Sulphur hexafluoride (SF_6)	zero	8.6	23500	3200	0.0049

By the end of 2016, globally, the amount of annual emissions of carbon dioxide represented circa 36.8 Gigatons (Gt)[13], which in the past 45 years has increased more than significantly (by circa 5 times). The most important sources of carbon dioxide emissions are fossil fuel combustion, deforestation and industrial processes (for example, cement production). The carbon dioxide lifetime in atmosphere varies between 100 and 300 years. It can be removed from atmosphere through a complex set of natural sinks mechanisms. Also, it is considered that circa 40 per cent of the emitted carbon dioxide can be absorbed by oceans. Photosynthesis, in particular 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.

Concentration of methane in atmosphere is affected in proportion of circa 60 per cent 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 atmosphere is circa 12.4 years. The annual accumulation rate of CH_4 in atmosphere is about 40 and 60 Mt, from which

[11] <http://cdiac.ornl.gov/pns/current_ghg.html>, <https://public.wmo.int/en/media/press-release/greenhouse-gas-levels-atmosphere-reach-new-record>
[12] The "radiative forcing" term refers to the amount of any given GHG heat-trapping potential and it is measured in power units (watt) per surface units (m^2).
[13] <https://www.carbonbrief.org/analysis-global-co2-emissions-set-to-rise-2-percent-in-2017-following-three-year-plateau>

approximately 11.5 per cent are generated from anthropogenic activities (in 2010, the global methane emissions represented circa 6.885 Mt and it is anticipated that, by 2020, will increase to 7.904 Mt[14]).

It has been stated that circa 40 per cent of the atmospheric N_2O is of anthropogenic origin[15], coming from use of synthetic nitrogen fertilizer, soil cultivation, animal breeding (manure management), wastewater handling, adipic acid and nitric acid production, fossil fuels combustion, waste incineration and biomass burning. The other 60 per cent of the atmospheric N_2O comes from the soil and denitrification of water in anaerobic conditions. N_2O breaks down photochemically in atmosphere. Global annual N_2O emissions from anthropogenic activities are estimated at circa 9Mt[16].

PFCs (perfluorocarbons), HFCs (hydrofluorocarbons) and SF_6 (sulphur hexafluoride) are GHG of anthropogenic origin. HFCs are preponderantly used to replace ozone depleting chemical substances, but it is also emitted in the process of HCFC-22 production. PFCs and SF_6 are emitted in various industrial processes, including aluminum and magnesia production, production of semiconductors, in transmission and distribution of electric power, etc. All these gases have a long lifetime in atmosphere and are characterized by a considerable infrared radiation absorption capacity, so that in the future it might 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 effects occur 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 policy-makers to compare the ability of each GHG to trap heat in the atmosphere.

By definition, a GWP is the time-integrated change in radiative forcing due to the instantaneous release of 1 kg of gas expressed relative to the radiative forcing 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 radiative gas (i.e., GHG) might have on troposphere.

The GWP of a GHG considers both the instantaneous radiative forcing due to an incremental concentration 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 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[17]

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

[14] <https://www.globalmethane.org/documents/analysis_fs_en.pdf>
[15] <https://www.wmo.int/pages/mediacentre/press_releases/pr_1002_en.html>.
[16] <http://edgar.jrc.ec.europa.eu/part_N2O.php#1overview>, <http://edgar.jrc.ec.europa.eu/ingos/JRC-INGOS-report.pdf>
[17] <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
Perfluorcarbons (PFC)						
Perfluoromethane	CF_4	50000	6500	5700	7390	6630
Perfluoroethane	C_2F_6	10000	9200	11900	12200	11100
Perfluoropropane	C_3F_8	2600	7000	8600	8830	8900
Perfluorobuthane	C_4F_{10}	2600	7000	8600	8860	9200
Perfluoropenthane	C_5F_{12}	4100	7500	8900	9160	8550
Perfluorohexane	C_6F_{14}	3100	7400	9000	9300	7910

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

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 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 conformity with the respective Guidelines, during 1998 to 2000, under the *UNDP-GEF Project "Enabling Activities for the preparation of the First National Communication under the UNFCCC"*, Republic of Moldova developed its FNC to UNFCCC, submitted to the COP 6 (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, during 2005-2009 time period, under the *UNEP-GEF Project "Enabling Activities for the preparation of the Second National Communication under the UNFCCC"*, Republic of Moldova developed its SNC under the UNFCCC (2010), within 2010-2013 period – the Third National Communication under the UNFCCC (2014), while from 2014 to 2017, the Fourth National Communication under the UNFCCC (2018).

With reference to UNFCCC implementation instruments it should be noted that the COP 3 (Kyoto, 1997) adopted the Kyoto Protocol, representing an instrument setting binding targets for the Parties under Convention, by committing industrialized countries and economies in transition (in total, 37 industrialized countries and the European Union) included in Annex I to Convention, to reduce total emissions of direct GHG by at least 5 per cent, against 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 Miti-*

gation 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, known as the *Copenhagen Accord*, reaffirms development issues in the context of climate change, inclusive 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 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 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, during 2010-2012, it was drawn the *Low Emissions Development Strategy of the Republic of Moldova until 2020*, 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 prioritized 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 wide 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[18].

The COP 16 held in Cancun in December 2010, adopted the *Cancun Agreements*, which encourages developing countries to prepare Low Emission Development Strategies for sustainable development and to undertake National Appropriate Mitigation Actions. The Cancun Agreements highlights 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 national communications for the countries non-Annex I (Decision 1/CP.16). In line with this, the non-Annex I Parties should prepare and submit to the UNFCCC Secretariat *National Communications (NCs)* every four years and *Biennial Update Reports (BUR)* every two year. The inventory section of the BUR 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

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

sources or removals of carbon dioxide through sequestration, including information on emissions trends, key categories, activity data, emissions 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 that took place in Durban in 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 at every two years as a stand-alone report or as a summary of the National Communications, where their reporting years coincides.

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) consisting of two steps: (i) the technical analysis of BURs and (ii) a facilitative sharing of views among Parties on BURs content 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 BUR submission to the Secretariat.

As for the First Biennial Update Report of the RM under the UNFCCC, its technical analysis by the technical expert team took place between 19 and 23 of September 2016, with the summary report being published by the Secretariat on the UNFCCC web page on February 20, 2017[19]. 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, organized by the UNFCCC Secretariat on 15th of May 2017 in Bonn, Germany[20].

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; and a series of amendments to several articles of the Kyoto Protocol regarding the first 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, the developed countries should reduce their greenhouse gas emissions by at least 18 per cent compared to 1990 levels. By 28 September 2018[21], 117 countries had ratified the Doha Amendment to the KP, most of which are non-Annex I Parties to the UNFCCC and the KP.

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 in 2015, in Paris. The new climate agreement establishes a new commitment period (1st of January 2021 – 31st of December 2030) for reducing the GHG emissions. Also, COP 19 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 Climate Agreement 2015.

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

[20] The conclusions of the 3rd FSV workshop 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 workshop 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>, while the video recording of the presentation and the interventions from the Parties are available on: <https://www.youtube.com/playlist?list=PL-m2oy1bnLzpmdRpG2pTBzUeOH3qrXlZt>

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

The COP 20 took place in Lima (2014). The Parties agreed over *Lima Call for Climate Action* and were repeatedly invited to communicate to the Secretariat their intended nationally determined contributions, in order to facilitate clarity, transparency and understanding. The INDC may include, as appropriate, inter alia: (i) quantifiable information on the reference point; (ii) time frames and/or 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) how the Party considers that its national circumstances, and how it contributes towards achieving the objective of the Convention as set out in its Article 2. According to *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 request to the Secretariat was to prepare by 1st of November 2015 a synthesis report on the aggregate effect of the INDC communicated by Parties.

The Republic of Moldova was fully committed to the UNFCCC negotiation process towards adopting at COP 21 the Paris Agreement – 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 RM in New York on September 21, 2016, and was subsequently ratified by the Parliament through Law No. 78 from 04.05.2017 for the ratification of the Paris Agreement (Official Monitor No. 162-170 from 26.05.2017)[22].

At 25th of September 2015, the RM communicated its Intended Nationally Determined Contribution (INDC)[23] 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 an economy-wide unconditional target of reducing its greenhouse gas emissions by 64-67 per cent below its 1990 level in 2030 and to make best efforts to reduce its emissions by 67 per cent. The reduction commitment expressed above could be increased up to 78 per cent below 1990 level conditional to, a global agreement addressing important topics including low-cost financial resources, technology transfer, and technical cooperation, accessible to all at a scale commensurate to the challenge 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 national contribution intentionally determined of the Republic of Moldova were subsequently officially approved at national level by the Government Decision No. 1470 from 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 from 24.03.2017)[24].

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

The Republic of Moldova historic contribution to global warming is low. In 2016, the country contributed with circa 14.6 Mt CO_2 equivalent (without LULUCF) and 13.7 Mt CO_2 equivalent (with LULUCF), representing less than 0.04 per cent of total global GHG emissions.

Total and net emissions per capita, respectively, were less than half of the global average (3.8 t CO_2 equivalent per capita compared to 6.4 t CO_2 equivalent per capita, respectively 3.6 t CO_2 equivalent per capita compared to 6.8 t CO_2 equivalent per capita).

Also, the RM's share in global GHG emissions recorded since 1990 is low, under 0.05 per cent (without LULUCF) and less than 0.04 per cent (with LULUCF).

For example, within 1990-2015 time series, the total national GHG emissions (without LULUCF) decreased by circa 68.0 per cent, which is much more than in most industrialized countries and economies in transition included in Annex I to Convention (Figure 1-3).

[22] <http://lex.justice.md/index.php?action=view&view=doc&lang=1&id=370323>
[23] <http://www4.unfccc.int/submissions/INDC/Published%20Documents/Republic%20of%20Moldova/1/INDC_Republic_of_Moldova_25.09.2015.pdf>.
[24] <http://lex.justice.md/index.php?action=view&view=doc&lang=1&id=369528>

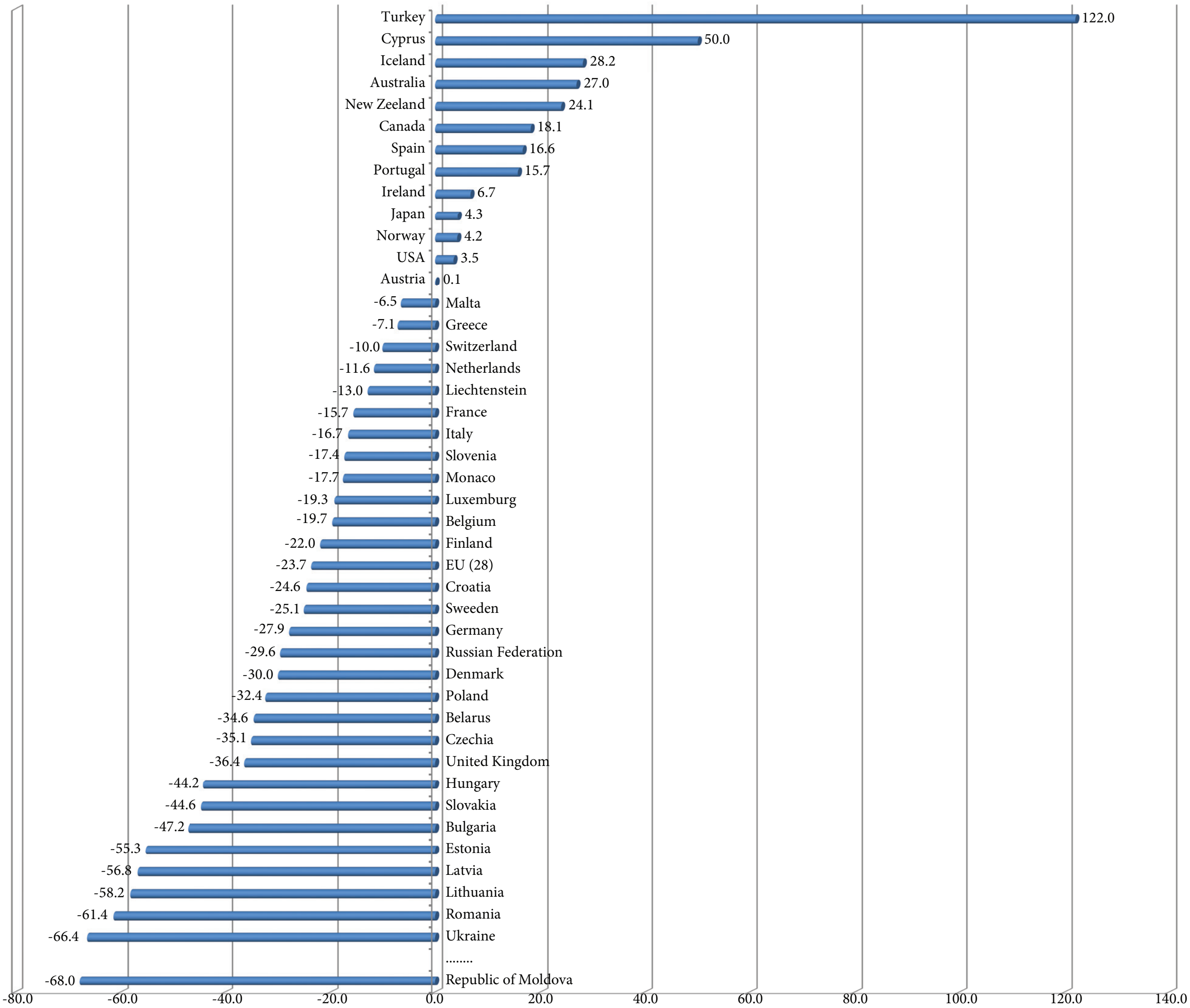


Figure 1-3: Total GHG Emissions from the Republic of Moldova (without LULUCF) and Annex I Parties to the Convention in 2015[25] (% compared to 1990).

1.2. Institutional and Legal Arrangements for Inventory Preparation

1.2.1. National Inventory System

The Ministry of Agriculture, Regional Development and Environment (MARDE) of the Republic of Moldova is the state authority responsible for development and promotion of policies and strategies addressing agriculture, food production and food safety, regional and rural development, use of territory, environment protection, climate change and natural resources. On behalf of the Government of Republic of Moldova, MARDE is in charge for implementation of international environment treaties to which the Republic of Moldova is a Part (including Rio Conventions). The representative of the MARDE is also the UNFCCC National Focal Point.

In view of implementing and accomplishing the UNFCCC provisions, as well as mechanisms and provisions of Kyoto Protocol, based on Order No. 21 as of February 11, 2004, the Climate Change Office (CCO) was established under the Ministry of Ecology, Constructions and Territory Development of the Republic of Moldova (reorganized initially into Ministry of Environment and Natural Resources, and later into Ministry of Agriculture, Regional Development and Environment).

The main tasks of the CCO are: (a) providing logistical support to the Government, central and local public administration authorities, non-government and academic organizations, in activities implemented and promoted by the RM under the UNFCCC and Kyoto Protocol; and (b) implementing climate change related projects and programs providing for such activities as: *GHG emissions evaluations and national inventory reports preparation*; development and implementation of GHG emissions mitigation

[25] <http://unfccc.int/resource/docs/2017/sbi/eng/18.pdf >

activities; development and implementation of measures aimed to adapt to climate change; assessment of the climate change impact on biological and socio-economic components; cooperation, promotion and implementation of activities and projects under the Clean Development Mechanism (CDM) of the Kyoto Protocol; implementation and facilitation of activities aimed at building awareness and information among civil society, relevant experts and decision makers in climate change related issues.

In the above context, it is worth noting that the Climate Change Office was and remains fully responsible for activities related to the preparation of National Communications, and starting with 2014, of the Biennial Update Reports of the Republic of Moldova under the UNFCCC.

The role of CCO is also specified within the Government Decision No. 141 dated 24.02.2014 on creating the energy statistical system. Thus, Chapter 2.1, Para. 3(h) notes that the Climate Change Office is responsible for developing national inventories of direct (CO_2, CH_4, N_2O, HFC, PFC and SF_6) and indirect greenhouse gases (NO_x, CO, NMVOC and SO_2), originated from six sectors (Energy, Industrial Processes, Solvents and Other Products Use, Agriculture, LULUCF and Waste).

At the same time, it should be noted that according to Government Decision No. 549 as of 13.06.2018 on the creation, organizing and functioning of the Environment Agency[26], the latter has been recently assigned the following competencies in the field of *atmospheric air protection and climate change*: implementing the provisions of policy documents and international environmental treaties to which the RM is a part in the field of protection of atmospheric air quality and ozone layer, *GHG emissions reduction and adaptation to climate change*, the elaboration and presentation to the MARDE of information on their implementation (para 9 (2), let. c); participation to the works of the *National Commission for Climate Change* (para 9 (2), let. j); ensuring the implementation of the *monitoring, reporting and verification system for GHG emissions* (para 9 (2), let. k); performing the *process of collecting, centralizing, validating and processing data and required information for the inventories and reports on atmospheric pollutants and GHG emissions* (para 9 (2), let. l); providing technical support to MARDE for the development of *national communications* and *biennial update reports* according to UNFCCC provisions (para 9 (2), let. o).

The National Inventory System (NIS) includes all institutional and legal arrangements associated with the national greenhouse gas inventory preparation and reporting process on the national and international level, National Inventory Reports, Biennial Update Reports and National Communications. This process implies preliminary planning and preparation activities such as for example, defining specific responsibilities within the inventory preparation process - such responsibilities are described in section 1.2.2 'Institutional and Legal Arrangements', while Section 1.3 'Process for Inventory Preparation' provides more details about the inventory preparation process.

1.2.2. Institutional and Legal Arrangements

Within the MARDE, the Climate Change Office (CCO) is totally responsible for the activities related to preparation of National Communications (NCs), Biennial Update Reports (BURs), National Inventory Reports (NIRs) and National GHG Emission Inventory Reports. Figure 1-4 reveals the responsibilities and arrangements for the National Inventory System (NIS) of the RM.

Within the CCO the National Inventory Team (NIT) is responsible for estimating emissions by source categories and removals by categories of sinks, Key Categories Analysis (KCA), Quality Assurance (QA) and Quality Control (QC) procedures, uncertainties assessment, documentation, reporting and archiving of data related to GHG inventory, BURs and NCs preparation process.

Below is a brief description of functional responsibilities of the participants in the process:

- The Coordinator / Compiler of the National GHG Inventory is responsible for the inventory preparation process coordination, including supervision of estimating emissions by individual categories of sources and removals by individual categories of sinks, KCA, uncertainty analysis interpretation, QA&QC activities coordination, documentation and archiving the data used in the inventory preparation process, synthesis of sectoral reports - serving as basis for the NIR compilation, respectively Chapter 2 "GHG National Inventory" from the BURs and NCs;

[26] <http://lex.justice.md/index.php?action=view&view=doc&lang=1&id=375961>

- The national experts (hired on a contract basis) are responsible for estimating emissions by individual categories of sources and removals by individual categories of sinks 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 activity data (AD) collection, application of decision trees in terms of selecting suitable assessment methods and EFs, estimating emission uncertainties by individual categories of sources, as well as for taking correction measures as a response to QA&QC activities.

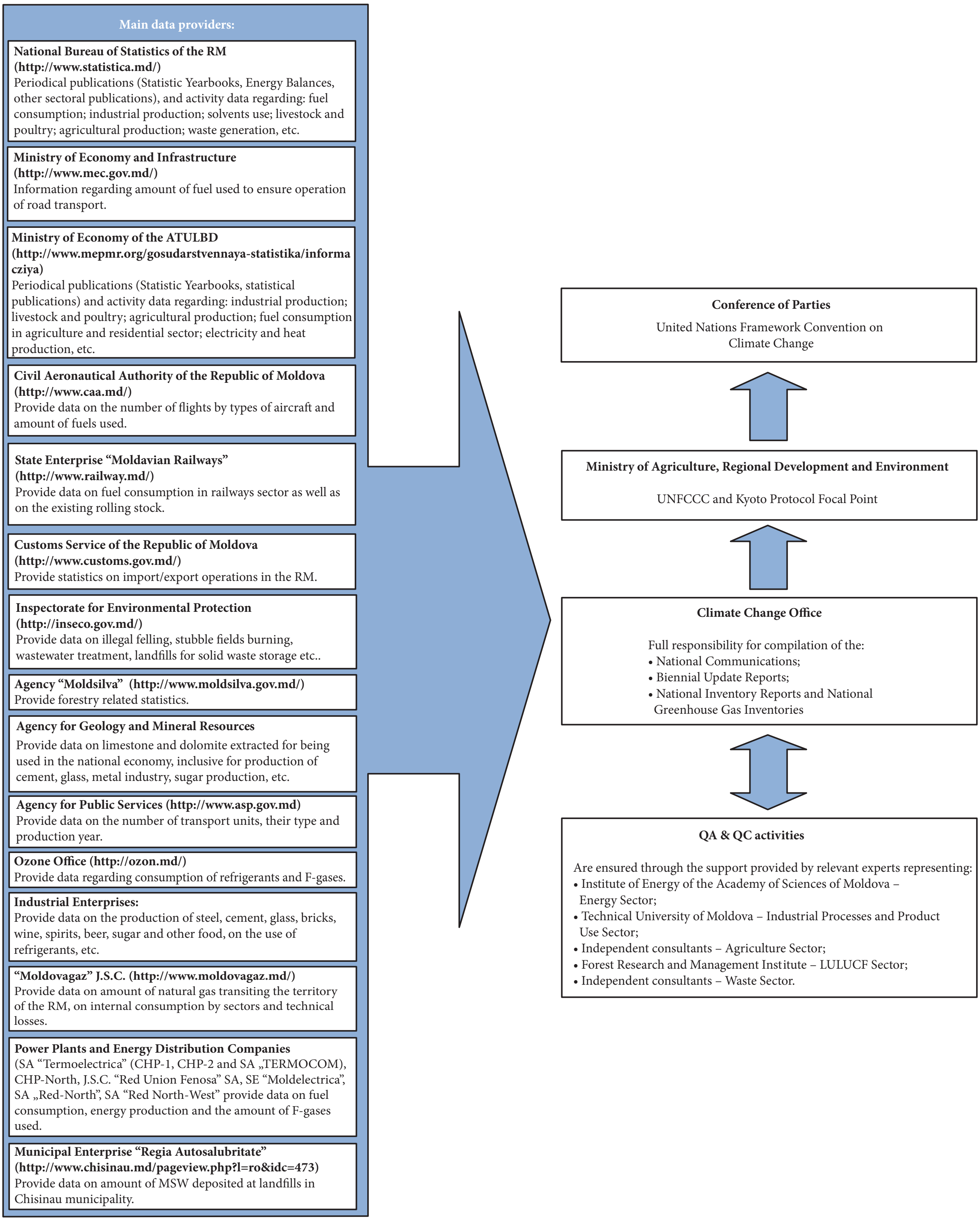


Figure 1-4: Institutional arrangements under the National Inventory System of the Republic Moldova.

The AD needed for developing the national GHG inventories are available in the Statistical Yearbooks (SY), Energy Balances (EBs) sectoral statistic publications, as well as in the on-line database of 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 the Moldova, while since 1993 only for the right bank of Dniester (without Transnistria, further referred as Administrative Territorial Units on the Left Bank of Dniester). The statistical data for the left bank of Dniester are collected from the Statistical Yearbooks of the ATULBD[27] and other relevant sectorial statistical publications developed and published by the State Statistical Service beside the Ministry of Economy of the ATULBD[28].

Additional statistical data may be provided at request, in conformity with provisions of the Law No. 93 as of 26.05.2017 on "Official Statistics".

Thus, according to Article 23, item (1), (2) and (6): „the official statistics authorities must disseminate statistical data to users in the terms specified in the statistical works programme and calendar", „the dissemination of the statistical data provided in the statistical works programme to all categories of users will be free of charge and under equal conditions of access in terms of volume, quality and terms", and „it may be disseminated data collected from legal persons or from individual entrepreneurs regarding the economic situation or the environment, if it is necessary to inform the society about the major issues and the statistical works programme foresees its dissemination"; Article 24, items (1) and (2): „the dissemination of official statistical data shall be carried out in compliance with the fundamental principles of official statistics, in particular with regard to the protection of statistical confidentiality and the guarantee of equal access in accordance with the principle of impartiality", respectively „the dissemination of official statistical data shall be carried out by the central authority in the field of statistics and by other providers of official statistics within their activity fields", and Article 25, items (1) and (2): „providers of official statistics have the right to disseminate for a certain payment statistical data produced outside the statistical works programme, through additional special processing, at the request of users", respectively "central statistical authority and its territorial subdivisions are authorized to perform, on a contractual basis, at the request of internal or external beneficiaries, research and special statistical works, including publications, which are not covered by the statistical works programme".

Other relevant activity data is collected from various data providers, based on the provisions of the Law on Access to Information, adopted by the Decision of the Parliament No. 982-XIV as of 11.05.2000, inclusively from:

- Ministry of Economy and Infrastructure (has recently taken over the responsibilities of the former Ministry of Transport and Road Infrastructure): information on the amount of fuel used to ensure operation of road transport;
- Agency for Public Services: information on the number of transport units registered, their type and production year;
- State Enterprise "Moldavian Railways": information of fuel used for rail transport, as well as on the rolling stock used by the enterprise;
- Naval Agency of the RM and State-Owned Enterprises „Ungheni River Port" and „Bacul Molovata": information on the amount of fuel used to ensure operation of naval transport;
- Civil Aeronautical Authority: information on the amount of fuels used in air transportation (civil and international aviation) and the number of flights by type of aircrafts;
- Ministry of Defense: information on the amount of fuels used for military transportation;
- Ministry of Health, Labor and Social Protection and Medicines and Medical Devices Agency: information on the use of N_2O for anesthesia purposes as well as the use of medicines which contains aerosols (specifically on HFCs);
- Land Relations and Cadaster Agency: information on land use by categories type;
- Agency "Moldsilva": information on forestry related statistics;

[27] CCO of the MoEN has copies of the Statistical Yearbooks of ATULBD for the years of 2000-2017, covering the statistical data for the 1990 year and 1995-2016 periods.
[28] Ministry of Economy of the ATULBD: <http://www.mepmr.org/gosudarstvennaya-statistika/informacziya>

- Inspectorate for Environmental Protection: information on illegal felling and stubble fields burning;
- Customs Service: statistics on import/export operations in the Republic of Moldova;
- Agency for Geology and Mineral Resources: information on limestone and dolomite extraction and use;
- Ozone Office by the MARDE: information on import/export of freons in bulk and type of freons used in the imported refrigeration and air-conditioning equipment;
- State-Owned Enterprise State Roads Administration: information on the amount of asphalt produced and used in the country;
- Municipal Enterprise "Regia Autosalubritate": information on landfill storage of solid household waste generated in Chisinau municipality;
- "Moldovagaz" J.S.C.: information on the amount of natural gas transited through the territory of the Republic of Moldova, on the consumption of natural gas in the national economy by sector, as well as on technical losses;
- Power Plants ("TERMOELECTRICA" J.S.C. in Chisinau [CHP-1 J.S.C., CHP-2 J.S.C. and "TERMOCOM" J.S.C.], CHP-North J.S.C. in Balti: information on the amount of fuel used for electricity and heat production;
- enterprises specialized in transportation and distribution of electricity (S.O.E. "Moldelectrica", I.C.S. "RED UNION FENOSA" J.S.C, "Red-North" J.S.C., "Red North-West" J.S.C.): information on the amount of PFCs and SF_6 used in electrical equipment;
- industrial enterprises ("Lafarge Cement (Moldova)" J.S.C., "Macon" J.S.C., Glass Factory No. 1 in Chisinau, "Glass-Container" Company in Chisinau, etc.): information on the amount of fuel used, industrial output and amount of mineral resources used.

It should be mentioned that the Article 1 of the *Law on Access to Information* regulates the relationships between information providers and individual / legal entity in the process of ensuring and implementing the constitutional right of access to information; principles, conditions, ways and manner of accomplishing access to official data owned by information providers; aspects of access to and protection of personal information within the scope of access to such data; rights of data solicitants, including petitioners of personal data; obligations of information providers in the process of ensuring access to official information; ways to protect the right to access to information.

Article 4 (1) stipulates that "anyone, under this law's conditions, has the right to look for, receive and make public official information". According to Article 6 (1), "official information are deemed to be all information owned and available to information providers, developed, selected, processed, consolidated and/or adopted by authorities or official persons or made available to them by other legal entities". This Article is a review of information bearing documents as stipulated by the provisions of this law. Article 7 refers to cases of limited access to official information. Rights of data solicitants are reflected in Article 10, while Article 11 refers to the obligations of information provider.

According to Article 13 (1), ways of access to information are the following: hearing of information which can be provided verbally; document review on the premises of the institution; issuing a copy of the requested document or information; issuing a copy of the document, information translated into a different language than the language of the original, for an additional charge; sending by mail (including e-mail) of a copy of the document, information, a copy of the translated document, information into a different language, at the solicitant's request, for a charge. Article 13(2) stipulate that extracts from registers, documents, information, as per solicitant's request, can be made available to the solicitant in a reasonable and acceptable to the solicitant form.

Article 16 of the Law refers to the requirements that have to be met to ensure access to information: the requested information or documents shall be made available to the solicitant from the moment it becomes available for issuing, but not later than 15 working days from the date the application for access to information is registered; the leadership of the public institution may extend the term of providing the information, or document by 5 working days if: (1) the request refers to a very big volume of information requiring their selection; (2) additional consultations are needed to satisfy the request. The solicitant will be informed about any extension of the information delivery term and about the reasons for such extension 5 days prior to the expiry of the initial term. The Law also refers to cases when access to information is denied, to payments for official information provision, to modalities of protecting the right for access to information and prosecution in court of information providers' actions.

Also, a series of laws contain provisions pertaining to wide public to environment protection related information. So, Article 29 (3) of the *Law on Natural Resources*, adopted by the Parliament Decision No. 1102-XIII as of 06.02.1997, stipulates that „*Government, local public administration authorities, state bodies assigned with natural resources management and environment protection, as well as businesses, shall make public valid and accessible information regarding natural resources use and environment protection activities*".

Article 23 of the *Forestry Code*, adopted by the Parliament Decision No. 887 as of 21.06.1996, stipulates that "*citizens and NGOs are entitled to receive information from the state forestry authorities and environment protection bodies about forestry and hunting resources, planned and accomplished conservation measures and use of such resources*".

The *Regulation regarding trading and regulated use of halogenated hydrocarbons that deplete the ozone layer*, approved by the *Law No. 852-XV as of 14.02.2002*, stipulates the procedure of presenting by the MoEN of information regarding production, import, export, trading and use (recycled and reclaimed quantities of controlled substances) of halogenated hydrocarbons that deplete the ozone layer, regulated by Montreal Protocol.

1.3. Process for Inventory Preparation

The Climate Change Office adopted a centralized approach to the process of preparing the national inventory comprising the NIR and standard estimation and reporting tables as approved by Decision 24/CP.19 (see Annex 6). The National Inventory preparation process is outlined in Figure 1-5.

The GHG Inventory Coordinator is responsible for compiling the estimations and ensuring consistency and quality of the inventory by producing the NIR and Chapters 2 "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 competences about individual features of source / sink categories.

The national experts, under direct guidance of the GHG Inventory Coordinator / Compiler, decide, by applying decision trees, on employing the best estimation methodology, and collect AD needed for emissions estimation. 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. If a new source/sink category was to be assessed, or a higher tier methodology had to be used, then the GHG Inventory Coordinator with the national experts would decide on which assessment methodology to use, collect most reasonable AD and EFs, calculate GHG emissions, assess uncertainties, ensured implementation of verification, QA/QC procedures acting on behalf of research and academic institutions, ministries and subordinated institutions, central administrative authorities and/or 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 provided the bibliography used.

The GHG Inventory Coordinator / Compiler is responsible for collecting and reviewing these materials, used in drafting the NIR sectoral chapters (Chapter 3 "Energy", Chapter 4 "Industrial Processes and Product Use", Chapter 5 "Agriculture", Chapter 6 "LULUCF", Chapter 7 "Waste"). The GHG Inventory 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.

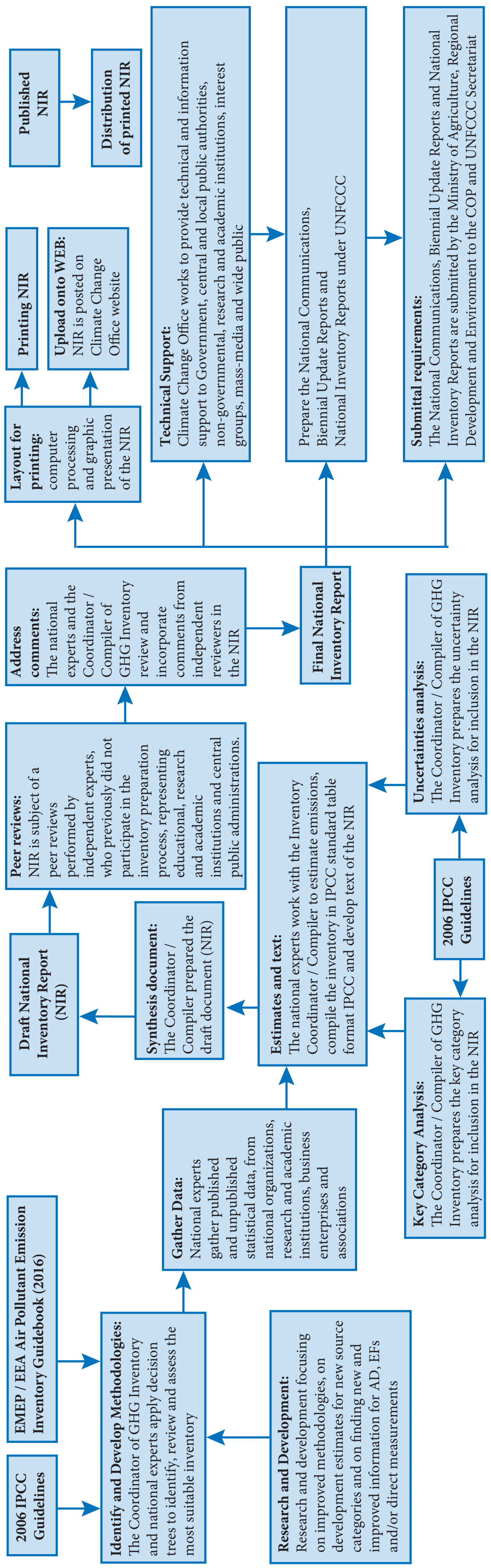


Figure 1-5: Inventory Process in the Republic of Moldova.

The NIR is produced in compliance with the general structure of the National Inventory Reports (NIR), as was established in the Decision 24/CP.19. In addition to NIR, the Common Reporting Format (CRF) tables are filled-in (see Annex 6). The GHG Inventory Coordinator / Compiler has the task to monitor the process of producing the CRF Sectoral and Summary Reporting Tables, to ensure the consistency of results. The national experts accomplished the uncertainties analysis, as well as verification and QA/QC activities, in close cooperation with the GHG Inventory Coordinator / Compiler.

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 region)*", 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 from relevant experts in the areas of major interest comments on quality of the work done, in particular on relevance of methodological approaches, EFs and AD used. The received comments are reviewed and estimations and explanatory notes to them are corrected.

Following the final review, after the incorporation of comments received in the process of peer reviews, the Climate Change Office prepares the MS Word final version of the National Inventory Report, which is then sent for approval to the MARDE. When the Report is approved, the final version is electronically processed, printed and published. Once published, the National Inventory Report, the Biennial Update Reports and/or the National Communications are submitted by the MARDE to the Secretariat, in conformity with international commitments of the RM under 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 Emission Factors Used for Inventory Preparation Process in 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 Fertilizers	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	NO	NO	NO	NO						
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 registered in the Republic of Moldova so far) greenhouse gases were estimated based on methodologies contained in the 2006 IPCC Guidelines, while the indirect emissions (NO_x, CO, NMVOC and SO_2) were estimated based on methodologies according to the EEA/EMEP Air Pollutant Emission Inventory Guidebook (2016).

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 categories of sources 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. Comprehensive bottom-up inventory is neither practicable nor possible at the present time, although for some sectors, estimates are derived from individual source specific data.

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 Dniester River (Transnistria), Energy Balances etc.) and international statistical publications (UN FAO on-line database), publications of academic, research and development institutions (Institute of Pedology, Agrochemistry and Soil Protection "Nicolae Dimo" 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 Economy and Infrastructure; MARDE; Ministry of Defense; Ministry of Health, Labor and Social Protection), AD provided by administrative authorities subordinated to ministries (Environment Agency, Inspectorate for Environmental Protection, Customs Service; Agency „Moldsilva", State Hydrometeorological Service, Agency for Geology and Mineral Resources), data from central administrative authorities (National Bureau of Statistics, Agency for Land Relations and Cadaster, Public Services Agency, Naval Agency, Civil Aeronautical Authority, Medicines and Medical Devices Agency, National Food Safety Agency), data obtained from enterprises and businesses associations (State Enterprise "Moldavian Railways", "Moldovagaz" J.S.C., "Lafarge Cement (Moldova)" J.S.C., "Macon" J.S.C., "Glass Plant No.1" J.S.C., "Glass Container Company" J.S.C., M.E. "Cristal-Flor" J.S.C., etc.).

1.5. Key Categories

According to 2006 IPCC Guidance, it is good practice to identify key categories, as it helps prioritize efforts and improve the overall quality of the national inventory.

A "key category" is defined as a "*source or sink category, that is prioritized within the national inventory system because its estimate has a significant influence on a country's total inventory of 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, 1990-2016, without LULUCF: based on the Tier 1 approach – 14 key categories by level (L) and 16 key categories by trend (T): based on a Tier 2 approach – 13 key categories by level (L) and 13 key categories by trend (T); with LULUCF: based on the Tier 1 approach – 20 key categories by level (L) and 20 key categories by trend (T), respective, based on a Tier 2 approach – 18 key categories by level (L) and 17 key categories by trend (T).

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

Table 1-4: Summary Overview of the Republic of Moldova's Key Categories for 1990-2016, Based on a 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	CO_2	X	X	X	X	X	X	X	X
1A2	Manufacturing Industries and Construction	CO_2	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			
1A4	Other Sectors	CO_2	X	X	X	X	X	X	X	X
1A4	Other Sectors	CH_4	X		X		X		X	
1B2	Fugitive Emissions from Oil and Natural Gas	CH_4	X	X	X	X	X	X	X	X
2A1	Cement Production	CO_2	X	X			X	X		
2A2	Lime Production	CO_2		X						
2F1	Product Uses as Substitutes for ODS – Refrigeration and Air Conditioning	HFC		X		X				X
2F2	Product Uses as Substitutes for ODS – Foam Blowing	HFC	X	X	X	X	X	X		X
3A	Enteric Fermentation	CH_4	X	X	X		X		X	
3B	Manure Management	CH_4	X	X	X	X	X	X	X	
3Ba	Direct N_2O Emissions from Manure Management	N_2O	X		X	X	X		X	
3Bb	Indirect N_2O Emissions from Manure Management	N_2O			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 Land Remaining Forest Land	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
4B2	Land Converted to Cropland	CO_2					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	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
5Da	Wastewater Treatment and Discharge – Domestic Wastewater	CH_4	X	X	X	X	X	X	X	X
5Da	Wastewater Treatment and Discharge – Domestic Wastewater	N_2O				X				

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

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 CO_2 equivalent units, estimated by using the GWP; (2) a category should be identified for each gas emitted by the sources and sinks, since the methods, emission factors, and related uncertainties differ for each gas; (3) source and sink categories that use the same emission factors based on common assumptions were aggregated before analysis.

Key categories were identified from two perspectives: (1) the first analysis the emission contribution that each category makes to the national total; and (2) the second perspective analysis the trend of emission contributions from each category to identify where the greatest absolute changes (either increases or reductions) have taken place over a given time.

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

The Key Category Analysis (see Annex 1) was carried out using the Key Category Calculation Tool developed by the United States Environment Protection Agency (US EPA v2.5).

1.6. Quality Assurance and Quality Control

Following the recommendations from 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 "*Quality Assurance and Quality Control Plan*" include detailed specific procedures (Figure 1-9) 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 inventory preparation process.

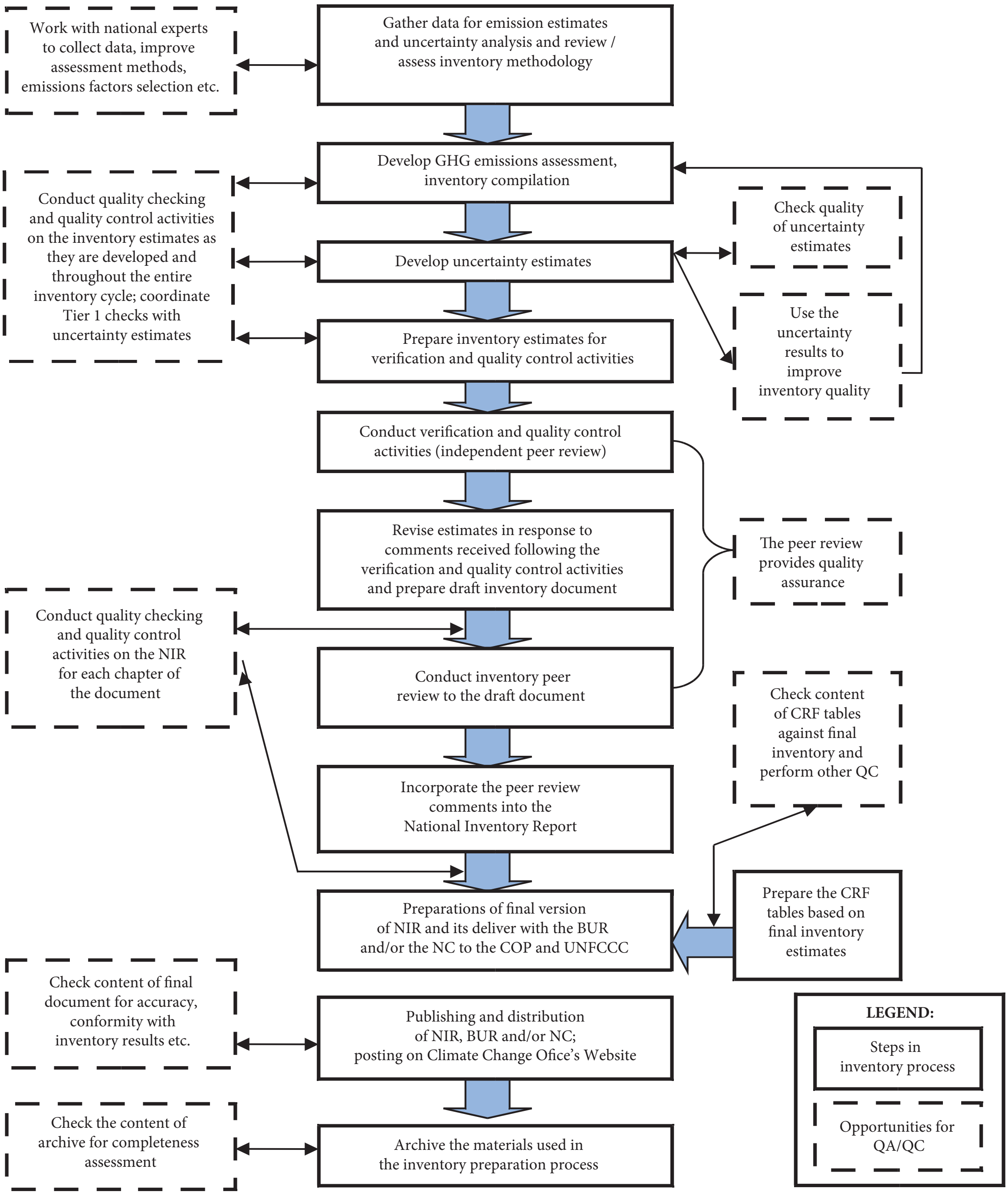


Figure 1-6: The Role of QA/QC Activities in the Inventory Preparing Process.

It is well known that inventory development implies huge amounts 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 Team has a sufficiently transparent documentation allowing to fully reproducing 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 & emission factors 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 emission factors estimation methods selection; (4) samples of GHG emissions estimation process (in Excel format); (5) uncertainties analysis 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 Climate Change Office holds all documentation used for its compilation.

Summing up, one can assert that transparency and credibility of a 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, by continuous integration of QA/QC activities, the Republic of Moldova ensures a better-quality inventory.

1.7. Uncertainty Assessment

Uncertainty estimates are 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 RM's National Inventory Team calculates the emission estimates with the highest possible accuracy, uncertainties are associated to a varying degree with the development of emission estimates for any inventory.

Some of current estimates, such as those for CO_2 emissions from fossil fuels 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 sources and sinks of GHG emissions are not available at this time (for example, GHG emissions from source category 5B "Biological Treatment of Solid Waste").
- *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 exam-

ple, the accuracy of current emission factors applied to CH_4 fugitive emissions from oil and natural gas, emissions of CO_2 from solvents and other products, indirect N_2O emissions from manure management and indirect N_2O emissions from agricultural soils etc., is highly uncertain etc.).

- *Collecting more detailed activity data.* Although methodologies for estimating emissions for some sources exist, problems arise in obtaining activity data at a level of detail in which aggregate emission factor can be applied, in particular 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 (±7.27 per cent level uncertainty and, respectively ±2.23 per cent trend uncertainty) are shown in Table 1-5, as well as in the Annex 5.

Table 1-5: Estimated Overall National Inventory Quantitative Uncertainty

	CO_2	CH_4	N_2O	Total
Level Uncertainty	±6.20	±22.26	±26.21	±7.27
Trend Uncertainty	±1.70	±11.78	±14.66	±2.23

Emissions evaluated under the RM's National GHG Inventory reflect current best estimates; in some cases, however, estimates are based on approximate methodologies, assumptions, and incomplete data. As new information become available in the future, the RM's inventory team will continue to improve, revise and recalculate its GHG emission estimates.

1.8. Completeness Assessment

Republic of Moldova's National GHG Inventory is, mostly, a complete inventory of the following direct GHG – CO_2, CH_4, N_2O, HFC, PFC and SF_6. The national inventory includes also the indirect GHGs 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 being determined by lack of activity data needed to estimate certain emissions and removals, such as: emissions of HFCs from source categories 2F3 "Fire Protection", 2F5 "Solvents" and 2F6 "Other Applications"; CH_4 emissions from source category 5B "Biological Treatment of Solid Waste".

As part of the inventory improvement plan, during the future inventory activities, the inventory team will continue the 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 2016, the total direct greenhouse gas emissions dynamic expressed in CO_2 equivalent, revealed a decreasing trend in the Republic of Moldova, reducing by circa 67.5 per cent: from 44.9 Mt CO_2 equivalent in 1990 to 14.6 Mt CO_2 equivalent in 2016 (Figure 2-1).

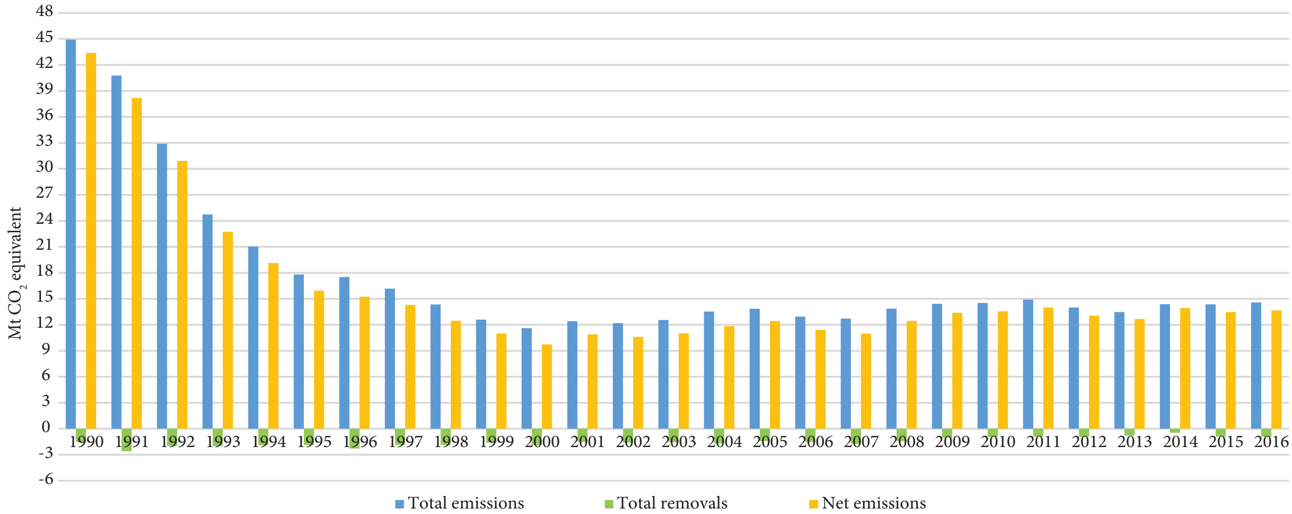


Figure 2-1: Greenhouse Gas Emission and Removals Trends in the Republic of Moldova within 1990-2016 time series.

The most significant direct GHG emissions reductions have been registered under the following source categories: 4G "Harvested Wood Products" (-100.7 per cent), 1A5 „Other" (-98.2 per cent), 2C „Metal Industry" (-81.7 per cent), 1A1 „Energy Industry" (-78.8 per cent), 1A2 „Manufacturing Industries and Construction" (-77.3 per cent), 1A4 „Other Sectors" (-76.4 per cent), 3B „Manure Management" (-72.6 per cent), 3A „Enteric Fermentation" (-70.4 per cent) 4C „Grassland" (-66.6 per cent), 2D „Non-Energy Products from Fuels and Solvent Use" (-66.5 per cent), 2A „Mineral Industry" (-61.7 per cent), 1A3 „Transport" (-46.8 per cent), 4B „Cropland" (-44.7 per cent), 4F „Other Land" (-43.8 per cent) and 5D „Wastewater Treatment and Discharge" (-27.4 per cent).

Between 2015 and 2016, total direct GHG emissions increased by circa 1.4 per cent due to increased emissions from the following source categories: 3D „Agricultural Soils" (+32.6 per cent), 3H „Urea Application" (+9.2 per cent), 1A3 „Transport" (+8.2 per cent), 1B2 „Fugitive Emissions from Oil and Natural Gas" (+7.2 per cent), 2F „Product Uses as Substitutes for ODS" (+4.6 per cent), 3B „Manure Management" (+3.3 per cent) and 5A „Solid Waste Disposal" (+2.6 per cent).

2.2. Emission Trends by Gas

Within 1990-2016 time periods, the total CO_2 emissions (without LULUCF) decreased by circa 73.8 per cent (from 36.9 Mt in 1990 to 9.6 Mt in 2016). CH_4 and N_2O decreased by circa 44.1 per cent (from 5.1 Mt CO_2 equivalent in 1990 to 2.8 Mt CO_2 equivalent in 2016), respectively by 35.5 per cent (from 3.0 Mt CO_2 equivalent in 1990 to 1.9 Mt CO_2 equivalent in 2016) (Table 2-1).

Table 2-1: Direct GHG Emissions in the Republic of Moldova within 1990-2016, Mt CO_2 equivalent

	1990	1991	1992	1993	1994	1995	1996	1997	1998
CO_2 (without LULUCF)	36.8708	32.9724	25.8671	18.0917	14.9511	11.8367	11.6817	10.6765	9.1782
CO_2 (with LULUCF)	35.1701	30.1962	23.6888	15.8652	12.8119	9.7140	9.1348	8.5282	7.0007
CH_4 (without LULUCF)	5.0725	5.0001	4.7216	4.3607	4.2749	4.0442	3.9842	3.5956	3.4538
CH_4 (with LULUCF)	5.0752	5.0025	4.7238	4.3636	4.2766	4.0464	3.9857	3.5983	3.4563
N_2O (without LULUCF)	2.9754	2.8038	2.3118	2.2884	1.8122	1.9207	1.8522	1.8911	1.7134
N_2O (with LULUCF)	3.1458	2.9877	2.5164	2.5110	2.0487	2.1722	2.1144	2.1633	1.9978
HFCs	NO	NO	NO	NO	NO	0.0040	0.0043	0.0051	0.0061
PFCs	NO	NO	NO	NO	NO	NO	NO	NO	NO
SF_6	NO	NO	NO	NO	NO	NO	NO	NO	NO
Total (without LULUCF)	**44.9188**	**40.7762**	**32.9006**	**24.7408**	**21.0382**	**17.8055**	**17.5224**	**16.1683**	**14.3515**
Total (with LULUCF)	**43.3912**	**38.1864**	**30.9290**	**22.7398**	**19.1372**	**15.9366**	**15.2393**	**14.2949**	**12.4608**

	1999	2000	2001	2002	2003	2004	2005	2006	2007
CO_2 (without LULUCF)	7.6797	6.9073	7.5065	7.1902	7.8726	8.6153	8.8852	8.1810	8.6850
CO_2 (with LULUCF)	5.7861	4.7293	5.6925	5.2897	6.0450	6.6226	7.1875	6.3674	6.6783
CH_4 (without LULUCF)	3.3443	3.2629	3.2477	3.3012	3.2065	3.1722	3.1798	3.0564	2.8926
CH_4 (with LULUCF)	3.3467	3.2639	3.2490	3.3015	3.2065	3.1724	3.1801	3.0567	2.8941
N_2O (without LULUCF)	1.5605	1.4471	1.6378	1.6912	1.4503	1.7227	1.7419	1.6553	1.0642
N_2O (with LULUCF)	1.8544	1.7434	1.9343	1.9881	1.7446	2.0129	2.0285	1.9379	1.3423
HFCs	0.0068	0.0083	0.0105	0.0145	0.0208	0.0292	0.0408	0.0536	0.0678
PFCs	NO	NO	NO	NO	NO	NO	NO	0.0000	0.0000
SF_6	NO	NO	NO	NO	0.0000	0.0000	0.0001	0.0003	0.0004
Total (without LULUCF)	**12.5913**	**11.6256**	**12.4024**	**12.1971**	**12.5502**	**13.5394**	**13.8478**	**12.9467**	**12.7101**
Total (with LULUCF)	**10.9940**	**9.7449**	**10.8863**	**10.5938**	**11.0170**	**11.8371**	**12.4369**	**11.4159**	**10.9829**

	2008	2009	2010	2011	2012	2013	2014	2015	2016
CO_2 (without LULUCF)	9.2429	9.6332	9.9495	10.2529	9.8055	8.8651	9.4851	9.8737	9.6455
CO_2 (with LULUCF)	7.5496	8.3344	8.7292	9.0928	8.6313	7.8442	8.8289	8.7806	8.5458
CH_4 (without LULUCF)	2.8743	2.8064	2.8209	2.8784	2.8205	2.7464	2.8143	2.7589	2.8351
CH_4 (with LULUCF)	2.8751	2.8067	2.8210	2.8786	2.8217	2.7472	2.8144	2.7596	2.8355
N_2O (without LULUCF)	1.6695	1.8905	1.6517	1.6547	1.2496	1.7354	1.9375	1.5688	1.9205
N_2O (with LULUCF)	1.9415	2.1558	1.9099	1.9067	1.4830	1.9527	2.1399	1.7591	2.0997
HFCs	0.0821	0.0914	0.1029	0.1165	0.1242	0.1306	0.1421	0.1678	0.1756
PFCs	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
SF_6	0.0005	0.0006	0.0007	0.0007	0.0008	0.0010	0.0011	0.0011	0.0011
Total (without LULUCF)	**13.8693**	**14.4220**	**14.5256**	**14.9033**	**14.0006**	**13.4784**	**14.3801**	**14.3705**	**14.5778**
Total (with LULUCF)	**12.4489**	**13.3888**	**13.5637**	**13.9953**	**13.0611**	**12.6757**	**13.9265**	**13.4683**	**13.6578**

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

HFCs, PFCs and SF_6 emissions have been recorded beginning with 1995, considered as a starting year for monitoring F-gases (no NF_3 emissions were recorded so far in the Republic of Moldova). Evolution of these emissions denotes a steady trend towards increase 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 reveals the variation of direct GHG emissions share by gas in the structure of total national emissions in 1990 and 2016.

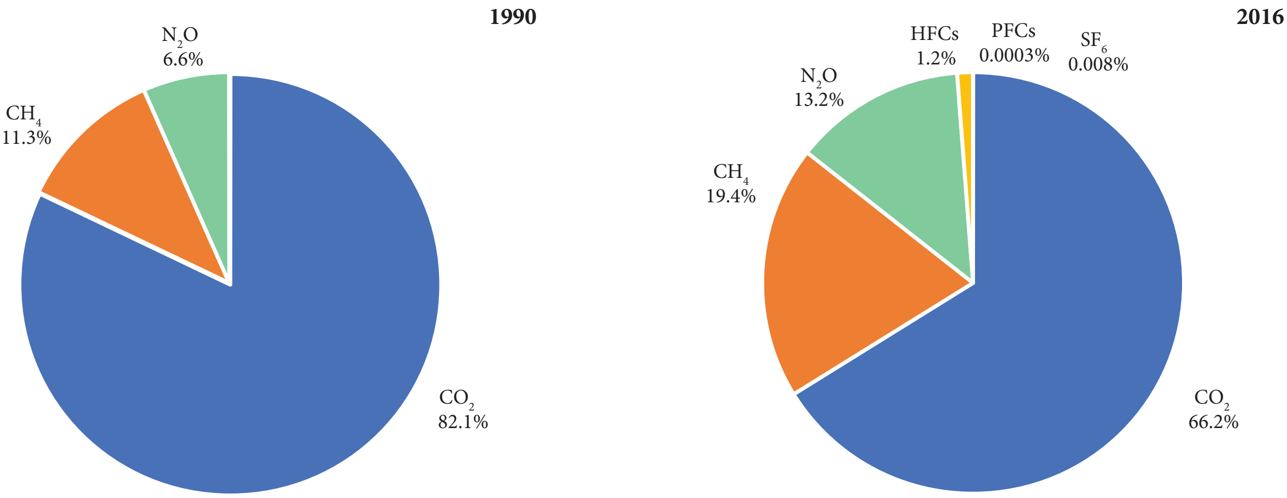


Figure 2-2: Direct GHGs share in the structure of total GHG emissions in the Republic of Moldova in 1990 and 2016 years.

In 2016, the source categories having the biggest share in the total dioxide of carbon emissions in the Republic of Moldova were: 1A1 "Energy Industries" (52.9 per cent of the total), 1A3 „Transport" (27.3 per cent of the total), 4A „Forest Land" (-24.7 per cent of the total), 1A4 „Other Sectors" (19.6 per cent of the total), 4B „Cropland" (16.3 per cent of the total), 1A2 „Manufacturing Industries and Constructions" (5.9 per cent of the total), 2A „Mineral Industry" (5.9 per cent of the total) and 4C „Grassland" (-4.7 per cent of the total) (Figure 2-3).

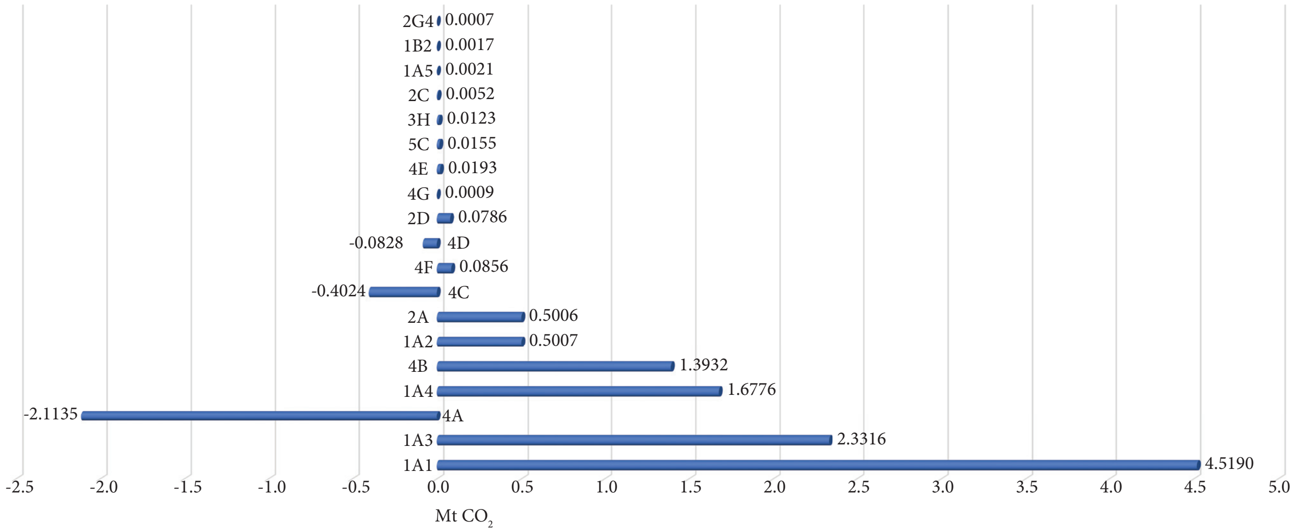


Figure 2-3: Source Categories of CO_2 in the Republic of Moldova in 2016.

In 2016, the source categories having the biggest share in the total methane emissions in the Republic of Moldova were: 5A "Solid Waste Disposal" (39.3 per cent of the total), 3A „Enteric Fermentation" (22.9 per cent of the total), 1B2 „Fugitive Emissions from Oil and Natural Gas" (21.6 per cent of the total), 5D „Wastewater Treatment and Discharge" (8.9 per cent of the total), 1A4 „Other Sectors" (4.1 per cent of the total) and 3B „Manure Management" (2.4 per cent of the total) (Figure 2-4).

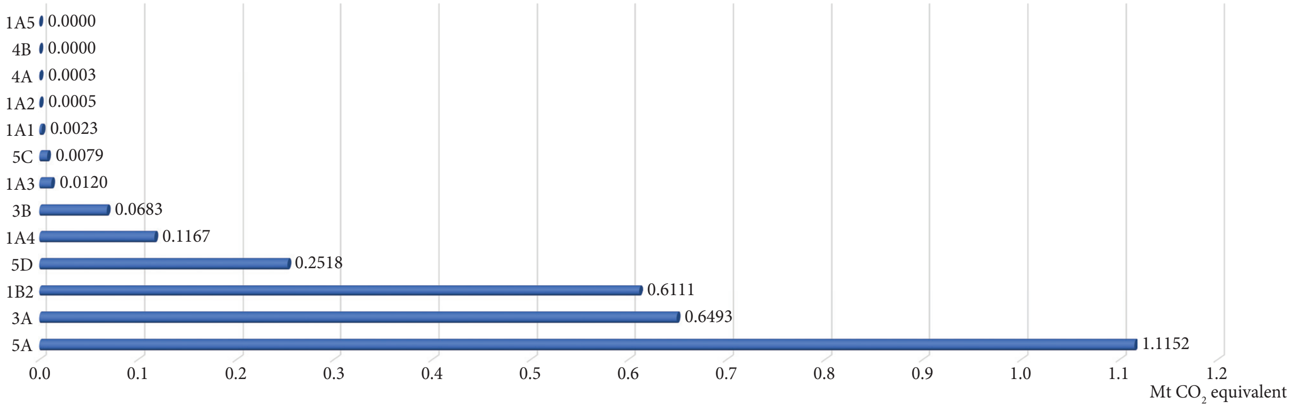


Figure 2-4: Source Categories of CH_4 in the Republic of Moldova in 2016.

In 2016, the source categories having the biggest share in the total nitrous oxide emissions in the Republic of Moldova were: 3D "Agricultural Soils" (63.1 per cent of the total), 3B „Manure Management" (17.8 per cent of the total), 4E „Settlements" (8.5 per cent of the total), 1B2 „Fugitive Emissions from Oil and Natural Gas" (4.2 per cent of the total), 5D „Wastewater Treatment and Discharge" (3.3 per cent of the total), 1A3 „Transport" (1.9 per cent of the total) and 1A4 „Other Sectors" (0.9 per cent of the total) (Figure 2-5).

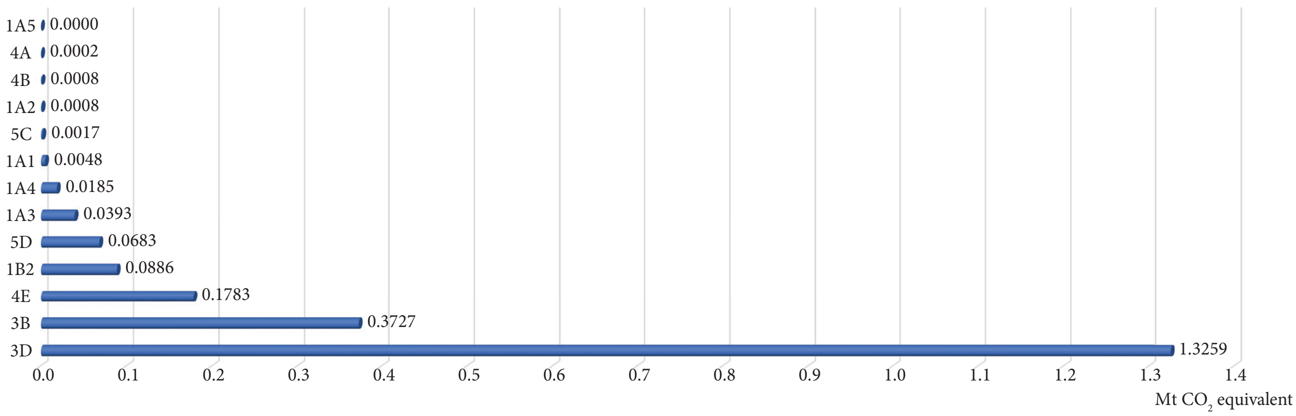


Figure 2-5: Source Categories of N_2O in the Republic of Moldova in 2016.

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 LULUCF Sector is somewhat different from other sectors: positive figures indicate that this sector is a net source of emissions, while negative figures state that the sector is a net sink of CO_2 removals.

Within 1990-2016 time series, total GHG emissions in the Republic of Moldova tended to decrease, thus emissions under Sector 1 ‘Energy’ decreased by circa 72.9 per cent, under Sector 2 ‘Industrial Processes and Product Use’ – by circa 51.5 per cent, under Sector 3 ‘Agriculture’ – by 53.5 per cent, under Sector 4 ‘LULUCF’ – by 39.8 per cent, while under Sector 5 ‘Waste Sector’ – by 3.6 per cent (Table 2-2).

Table 2-2: Direct Greenhouse Gas Emissions in the RM by Sector within 1990-2016, Mt CO_2 equivalent

	1990	1991	1992	1993	1994	1995	1996	1997	1998
1. Energy	36.6105	32.9696	26.1405	18.1730	15.1473	12.1574	12.1291	10.9364	9.4505
2. Industrial Processes and Product Use	1.5723	1.3947	0.8089	0.7249	0.5488	0.4505	0.4097	0.4514	0.3771
3. Agriculture	5.2206	4.8628	4.4000	4.2297	3.7460	3.6029	3.3846	3.1852	2.9525
4. LULUCF	-1.5276	-2.5899	-1.9715	-2.0010	-1.9010	-1.8689	-2.2831	-1.8735	-1.8907
5. Waste	1.5154	1.5491	1.5512	1.6132	1.5962	1.5947	1.5990	1.5953	1.5714
	1999	2000	2001	2002	2003	2004	2005	2006	2007
1. Energy	7.9883	7.2889	7.8927	7.5977	8.2968	9.0248	9.2488	8.3586	8.6524
2. Industrial Processes and Product Use	0.3410	0.3141	0.3190	0.3723	0.4065	0.4854	0.5919	0.7020	0.9616
3. Agriculture	2.6962	2.4808	2.6761	2.7449	2.3999	2.5926	2.5784	2.4664	1.6768
4. LULUCF	-1.5973	-1.8807	-1.5162	-1.6033	-1.5332	-1.7023	-1.4109	-1.5308	-1.7272
5. Waste	1.5658	1.5418	1.5146	1.4823	1.4471	1.4366	1.4288	1.4196	1.4194
	2008	2009	2010	2011	2012	2013	2014	2015	2016
1. Energy	9.1322	9.9117	10.1950	10.4985	10.0362	9.0257	9.6569	10.0638	9.9272
2. Industrial Processes and Product Use	1.0553	0.5558	0.5923	0.6960	0.7132	0.7626	0.7949	0.7842	0.7619
3. Agriculture	2.2434	2.5018	2.2550	2.2079	1.7601	2.2526	2.4923	2.0912	2.4285
4. LULUCF	-1.4205	-1.0332	-0.9619	-0.9080	-0.9396	-0.8027	-0.4536	-0.9022	-0.9200
5. Waste	1.4385	1.4527	1.4833	1.5009	1.4911	1.4376	1.4361	1.4313	1.4603

Sector 1 ‘Energy’ is the most important source of total national direct GHG emissions, its share varying over the time series from 1990 through 2016 from 81.5 per cent and 68.1 per cent. Other relevant sources are represented by Sector 3 ‘Agriculture’, Sector 5 ‘Waste’ and Sector 2 ‘IPPU’ (Figure 2-6). During the entire period under review, the Sector 4 ‘LULUCF’ represented a net source of carbon removals. With the decrease of national direct GHG emissions, the importance of this sector in the structure of net GHG emissions at the national level increased: in 1990 the removals represented circa 3.4 per cent of the total national GHG emissions, while in 2016 it represented already circa 6.3 per cent of the total.

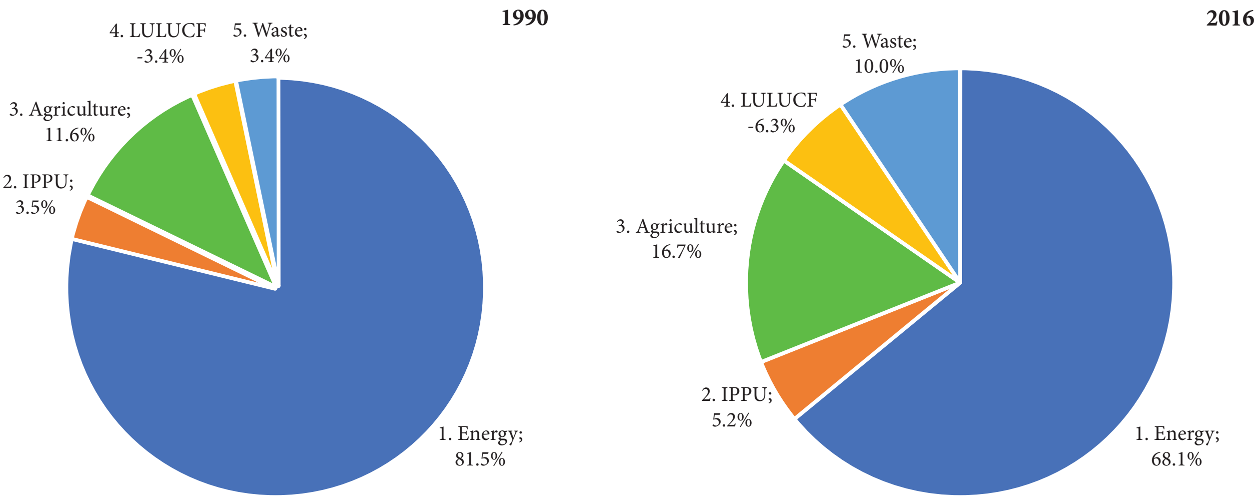


Figure 2-6: Sectoral Breakdown of the Republic of Moldova’s total GHG Emissions in 1990 and 2016.

2.3.1. Energy Sector

Energy-related activities are by far the largest source of GHG emissions in the Republic of Moldova. The Sector 1 'Energy' includes emissions of all GHGs from fuel combustion (stationary and mobile combustion) for the primary purpose of delivering energy (93 per cent of total emissions per sector in 2016), as well as fugitive releases defined as intentional or unintentional releases of GHGs from the production, processing, transmission, storage, and delivery of fossil oil and natural gas (7 per cent of total emissions per sector in 2016) (Figure 2-7, Table 2-3).

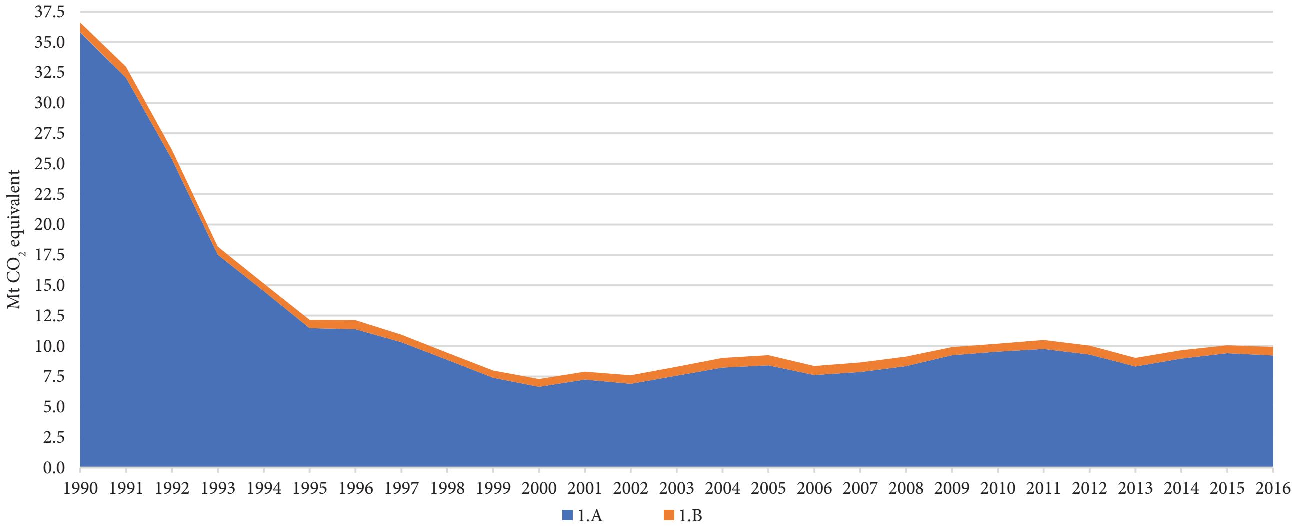


Figure 2-7: GHG Emissions from Sector 1 'Energy' in the RM within 1990-2016 periods.

Overall, these emissions accounted, in 2016 circa 68.1 per of total Republic of Moldova's direct GHG emissions. Between 1990 and 2016, total GHG emissions from Sector 1 'Energy' decreased by circa 72.9 per cent: from 36.6 Mt CO_2 equivalent in 1990 to 9.9 Mt CO_2 equivalent in 2016.

Table 2-3: GHG Emissions from Sector 1 'Energy' within 1990-2016 periods, Mt CO_2 equivalent

	1990	1995	2000	2005	2010	2011	2012	2013	2014	2015	2016
1. Energy	**36.6105**	**12.1574**	**7.2889**	**9.2488**	**10.1950**	**10.4985**	**10.0362**	**9.0257**	**9.6569**	**10.0638**	**9.9272**
1A. Fuel Combustion	**35.8054**	**11.4742**	**6.6486**	**8.4127**	**9.5420**	**9.7586**	**9.2995**	**8.3198**	**8.9724**	**9.4093**	**9.2259**
1A.1. Energy Industries	21.3082	7.1605	3.6132	3.7609	4.9838	4.6149	4.6033	3.6868	4.3584	4.7448	4.5261
1A.2. Manufacturing Industries and Construction	2.2124	0.4407	0.5318	0.5992	0.4438	0.5982	0.4574	0.5994	0.4688	0.5346	0.5020
1A.3. Transport	4.4795	1.5393	0.9430	1.7671	2.0541	2.1649	1.9019	2.0218	2.0901	2.2033	2.3829
1A.4. Other Sectors	7.6897	2.2072	1.5237	2.2592	2.0301	2.3590	2.3283	2.0079	2.0518	1.9236	1.8128
1A.5. Other	0.1156	0.1265	0.0368	0.0263	0.0302	0.0216	0.0086	0.0039	0.0033	0.0029	0.0021
1B. Fugitive Emissions from Fuels	**0.8052**	**0.6831**	**0.6403**	**0.8361**	**0.6529**	**0.7399**	**0.7367**	**0.7059**	**0.6845**	**0.6545**	**0.7013**
1B.1. Solid Fuels	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
1B.2. Oil and Natural Gas	0.8052	0.6831	0.6403	0.8361	0.6529	0.7399	0.7367	0.7059	0.6845	0.6545	0.7013
1C. CO_2 Transport and Storage	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**

Abbreviations: NO – Not Occurring.

The 1A1 "Energy Industries" contribute more than any other category to the Republic of Moldova's emissions under Sector 1 'Energy', accounting for circa 45.6 per cent of the total per sector in 2016 (58.2 per cent in 1990). Other relevant categories are represented by 1A3 "Transport" accounting for circa 24.0 per cent of the total per sector (12.2 per cent in 1990), 1A4 "Other Sectors", accounting for 18.3 per cent of the total (21.0 per cent in 1990) and 1A2 "Manufacturing Industries and Construction" accounting for circa 5.1 per cent of the total (6.0 per cent in 1990) (Figure 2-8).

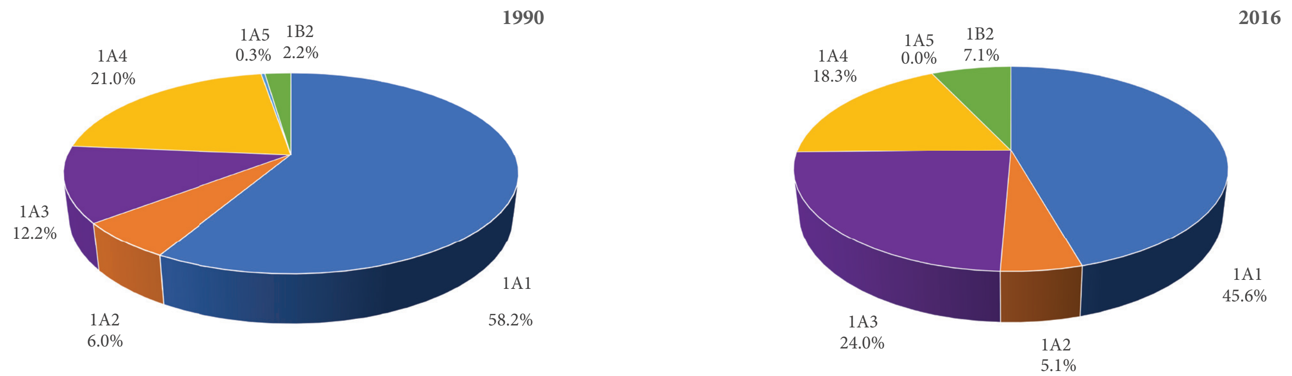


Figure 2-8: Energy Sector Greenhouse Gas Sources in the Republic of Moldova in 1990 and 2016.

2.3.2. Industrial Processes and Product Use Sector

The Sector 2 'IPPU' represents an important GHG emission source in the Republic of Moldova that includes emissions generated by non-energy industrial activities. In 2016, this sector accounted for circa 5.2 per cent of the total national GHG emissions (3.5 per cent in 1990). During 1990-2016 time periods, total sectoral GHG emissions decreased by 51.5 per cent: from 1.57 Mt CO_2 equivalent in 1990 to 0.76 Mt CO_2 equivalent in 2016 (Figure 2-9).

Between 2008 and 2009, the respective emissions decreased by 47.3 per cent as a consequence of the economic crises that significantly affected the industrial sector in the Republic of Moldova. Subsequently, in 2010-2014 time series, direct sectoral GHG emissions tended to increase slowly, in particular due to the increase in cement, lime, glass, steel production, as well as due to the increased use of F-gases. Between 2015 and 2016, total GHG emissions from this sector decreased by 2.8 per cent (Table 2-4).

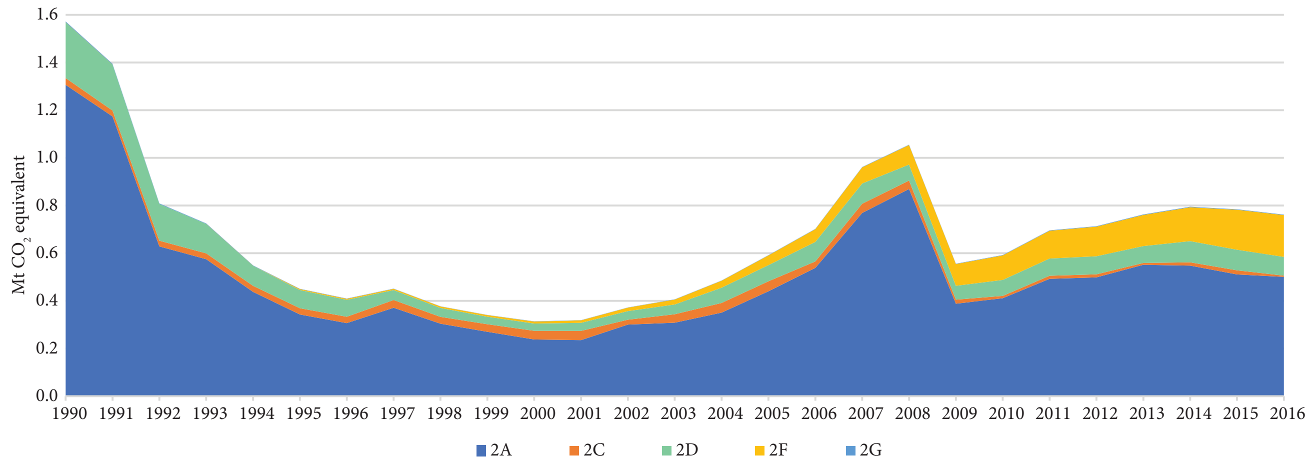


Figure 2-9: Total GHG Emissions from Sector 2 'IPPU' in the RM within 1990-2016 periods.

Table 2-4: Direct GHG Emissions from Sector 2 'IPPU' within 1990-2016, Mt CO_2 equivalent

	1990	1995	2000	2005	2010	2011	2012	2013	2014	2015	2016
2. Industrial Processes and Product Use	**1.5723**	**0.4505**	**0.3141**	**0.5919**	**0.5923**	**0.6960**	**0.7132**	**0.7626**	**0.7949**	**0.7842**	**0.7619**
A. Mineral Industry	1.3062	0.3427	0.2380	0.4402	0.4111	0.4924	0.4986	0.5513	0.5478	0.5108	0.5006
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	0.0129	0.0127	0.0077	0.0138	0.0173	0.0052
D. Non-Energy Products from Fuels and Solvent Use	0.2344	0.0766	0.0306	0.0678	0.0671	0.0723	0.0759	0.0709	0.0890	0.0864	0.0786
E. Electronic Industry	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
F. Product Uses as Substitutes for ODS	NO	0.0040	0.0083	0.0408	0.1029	0.1165	0.1242	0.1306	0.1421	0.1678	0.1756
G. Other Product Manufacture and Use	0.0032	0.0011	0.0009	0.0011	0.0016	0.0019	0.0019	0.0022	0.0021	0.0019	0.0019
H. Other	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

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

The most important source of emission in this sector is represented by 2A1 "Cement Production", with a share of circa 57.0 per cent of the total sectoral emissions in 2016 (61.8 per cent in 1990). Other relevant sources in 2016 were represented by 2F2 "Foam Blowing Agents" with a share of 13.8 per cent of the total, 2D3 "Solvent Use" - 9.3 per cent of the total (13.0 per cent in 1990), 2F1 „Refrigeration and Air Conditioning" - circa 9.3 per cent of the total, 2A3 „Glass Production" - 4.0 per cent of the total (1.6 per cent in 1990), 2A2 „Lime Production" - 2.8 per cent of the total (14.8 per cent in 1990), 2A4 „Other Process Uses of Carbonates" - 2.0 per cent of the total (4.9 per cent in 1990) and 2C1 „Iron and Steel Production" - 0.7 per cent of the total (1.8 per cent in 1990) (Figure 2-10).

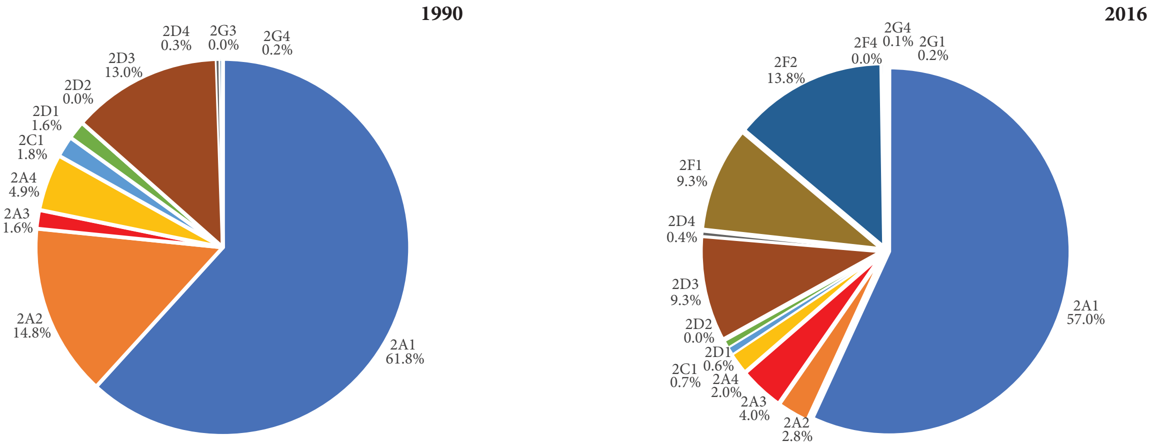


Figure 2-10: Breakdown of IPPU's GHG Emissions by Category in the RM in 1990 and 2016.

2.3.3. Agriculture Sector

The Sector 3 'Agriculture' represents an important source of direct GHG emissions in the Republic of Moldova: CH_4 emissions, in particular 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 registered emissions 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 Sector 4 'LULUCF', under the category 4B "Cropland".

In 2016, Sector 3 'Agriculture' accounted for circa 16.7 per cent of the total national direct GHG emissions (11.6 per cent in 1990). Between 1990 and 2016, total GHG emissions originated from this sector decreased by circa 53.5 per cent: from 5.22 Mt CO_2 equivalent in 1990 to 2.43 Mt CO_2 equivalent in 2016 (Table 2-5), in particular, due to a sharp drop in such indicators as: domestic livestock and poultry population, amounts of synthetic nitrogen and organic fertilizers applied to soils, amounts of agricultural crop residues returned to soils, carbon losses from mineral soils and changes of tillage practices.

Table 2-5: Direct GHG Emissions from Sector 3 'Agriculture' within 1990-2016, Mt CO_2 equivalent

	1990	1995	2000	2005	2010	2011	2012	2013	2014	2015	2016
3. Agriculture	**5.2206**	**3.6029**	**2.4808**	**2.5784**	**2.2550**	**2.2079**	**1.7601**	**2.2526**	**2.4923**	**2.0912**	**2.4285**
A. Enteric Fermentation	2.1907	1.6207	1.0856	0.9265	0.7126	0.6710	0.6328	0.6433	0.6810	0.6534	0.6493
B. Manure Management	1.6117	0.9392	0.5532	0.5575	0.5031	0.4614	0.4259	0.4018	0.4401	0.4270	0.4411
C. Rice Cultivation	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
D. Agricultural Soils	1.4176	1.0429	0.8415	1.0942	1.0376	1.0719	0.6958	1.2033	1.3610	0.9996	1.3259
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	0.0037	0.0056	0.0042	0.0102	0.0112	0.0123
I. Other Carbon-Containing Fertilizers	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 2015 and 2016, direct GHG emissions from Sector 3 'Agriculture' increased by circa 16.1 per cent (Figure 2-11), in particular as a result of the increasing use of synthetic nitrogen fertilizers.

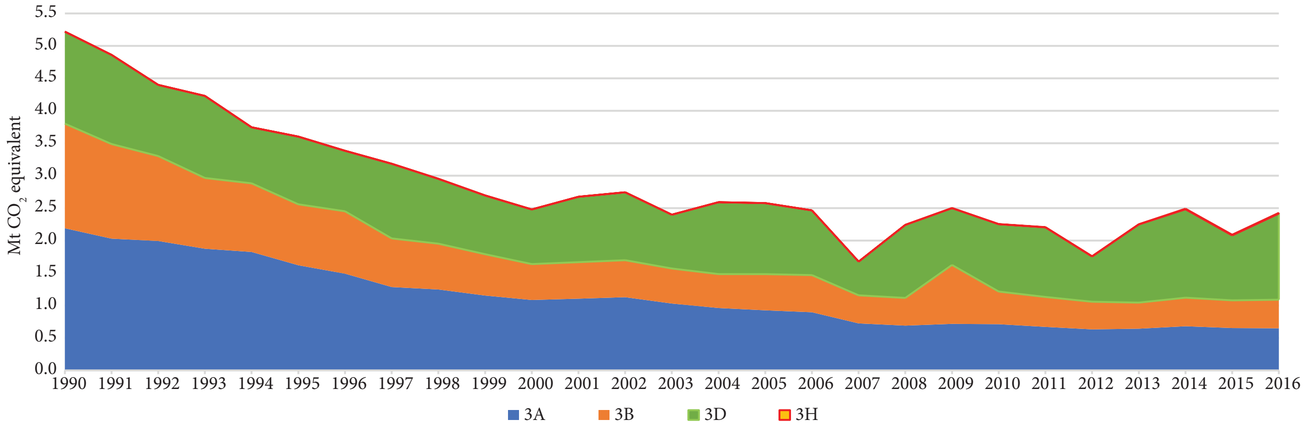


Figure 2-11: Total Direct GHG Emissions from Sector 3 'Agriculture' in the Republic of Moldova within 1990-2016 periods.

In 2016, the largest source of emission was 3D "Agricultural Soils", accounting for circa 54.6 per cent of the total per sector (27.0 per cent in 1990). Other relevant sources are represented by 3A "Enteric Fermentation" accounting for 26.7 per cent of the total (42.0 per cent in 1990) and 3B "Manure Management" accounting for circa 18.2 per cent of the total (30.9 per cent in 1990). The share of 3H "Urea Application" category is insignificant at the sectoral level (Figure 2-12).

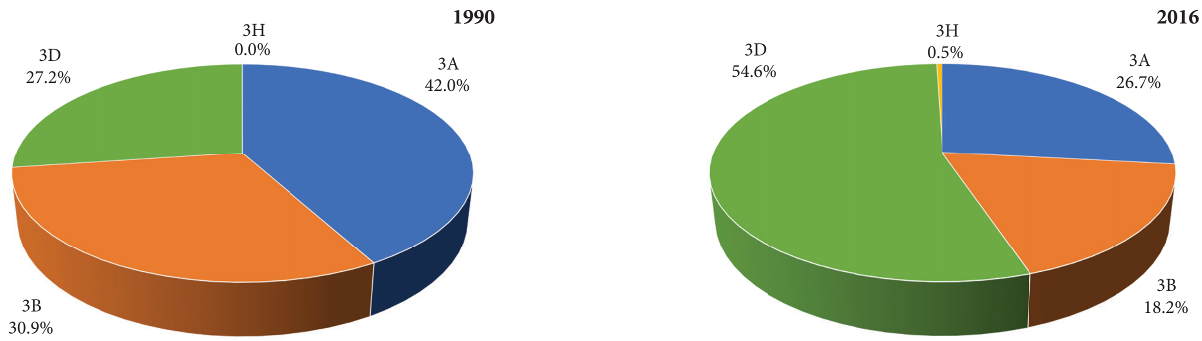


Figure 2-12: Breakdown of Agriculture Sector GHG Emissions by Category in 1990 and 2016.

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

Between 1990 and 2016, the Sector 4 'LULUCF' represented a sink of net carbon removals. Within the respective period, net CO_2 removals registered a decreasing trend, reducing by circa 39.8 per cent, from -1.53 Mt CO_2 equivalent recorded in 1990 to -0.92 Mt CO_2 equivalent in 2016 (Table 2-6, Figure 2-13).

Table 2-6: Emissions and Removals in Sector 4 'LULUCF' within 1990-2016 periods, Mt CO_2 eq.

	1990	1995	2000	2005	2010	2011	2012	2013	2014	2015	2016
4. LULUCF	**-1.5276**	**-1.8689**	**-1.8807**	**-1.4109**	**-0.9619**	**-0.9080**	**-0.9396**	**-0.8027**	**-0.4536**	**-0.9022**	**-0.9200**
A. Forest Land	-2.5631	-2.0451	-2.3074	-2.4095	-2.4840	-2.3904	-2.2929	-2.1405	-2.1346	-2.1584	-2.1130
B. Cropland	2.5218	1.4892	1.4690	1.5302	1.5389	1.4934	1.4968	1.4091	1.4466	1.3932	1.3941
C. Grassland	-1.2057	-1.6011	-1.2919	-1.0581	-0.6920	-0.6382	-0.5628	-0.3602	-0.3411	-0.4185	-0.4024
D. Wetlands	-0.5554	-0.4694	-0.3284	-0.1874	-0.0464	-0.0753	-0.0155	-0.1061	-0.1398	-0.0828	-0.0828
E. Settlements	0.2445	0.3504	0.3938	0.3385	0.3029	0.3131	0.2438	0.2297	0.2206	0.2282	0.1976
F. Other Land	0.1524	0.4011	0.1785	0.4165	0.4415	0.3937	0.1141	0.1035	0.4366	0.0868	0.0856
G. Harvested Wood Products	-0.1222	0.0060	0.0058	-0.0411	-0.0228	-0.0044	0.0768	0.0619	0.0580	0.0492	0.0009
H. Other	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO

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

This situation can be explained, in particular, due to changes in the use and management of agricultural soils (category 4B), that contributed to the substantial decrease of organic carbon from the agricultural soils[29], thus changing the humus balance from a positive one to a negative and/or profoundly negative balance. This process was also influenced by some changes in the maintenance and use of forests (category 4A), authorized increased amounts of harvested wood, substantial increase of illegal felling, increased conversion of forest land into cropland etc.

[29] The 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 the simultaneous mineralization (biochemical decomposition) of nitrogen.

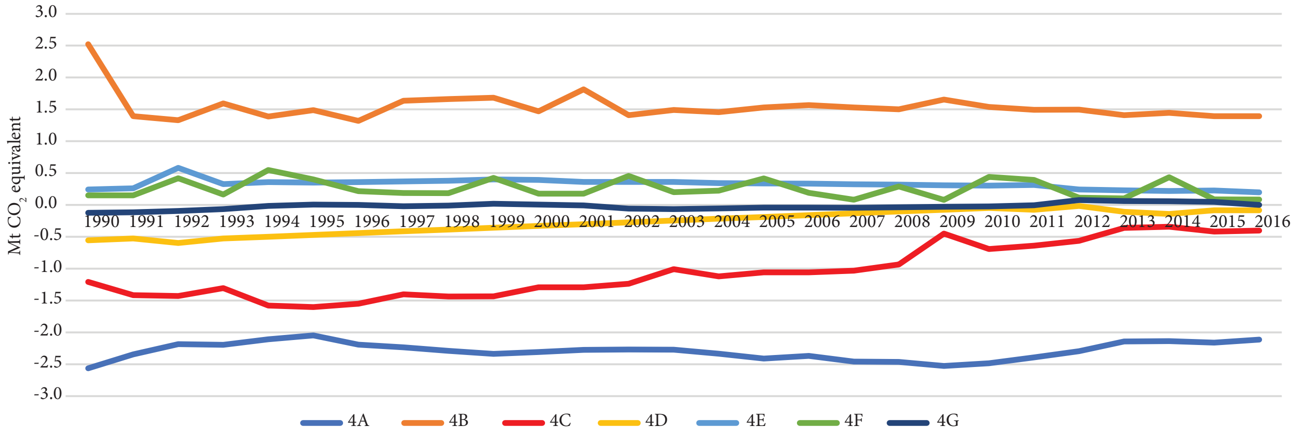


Figure 2-13: Direct GHG Emissions/Removals in Sector 4 'LULUCF' by Source/Sink Categories.

In the Republic of Moldova, in 2016, the largest source of carbon removals under Sector 4 'LULUCF' was 4A „Forest Land" (forests, protective forests) accounting for 49.4 per cent (34.8 per cent in 1990), followed by 4C „Grassland" accounting for circa 9.4 per cent of the total (16.4 per cent in 1990) and 4D „Wetlands" accounting for circa 1.9 per cent of the total (7.5 per cent in 1990). Category 4B „Cropland" represents a net source of emissions under Sector 4 'LULUCF', accounting for 32.6 per cent of the total net removals/emissions within the respective sector (34.2 per cent in 1990) (Figure 2-14).

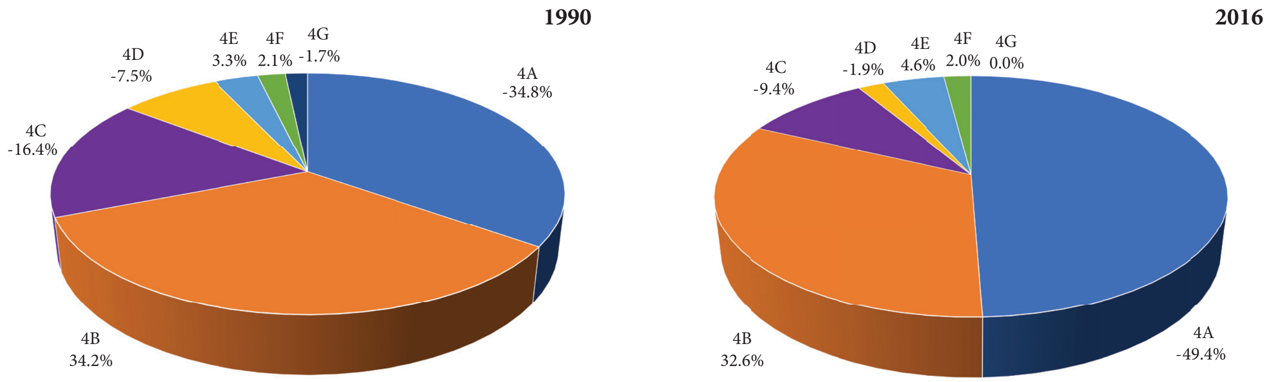


Figure 2-14: Breakdown of GHG Emissions and Removals by Source and Sink Categories in Sector 4 'LULUCF' in 1990 and 2016.

2.3.5. Waste Sector

Sector 5 'Waste' is an important source of GHG emissions in the Republic of Moldova, including CO_2 emissions from "Incineration and Open Burning of Waste" (category 5C), methane emissions from "Solid Waste Disposal" (category 5A), "Incineration and Open Burning of Waste" (category 5C) and "Wastewater Treatment and Discharge" (category 5D), respectively N_2O emissions from "Incineration and Open Burning of Waste" (category 5C) and "Wastewater Treatment and Discharge" (human manure) (category 5D). At the moment, in RM there are no any emissions registered in 5B "Biological Treatment of Solid Waste" and 5E "Other" categories.

In 2016, Sector 5 'Waste' accounted for circa 10.0 per cent of the total national direct GHG emissions (3.4 per cent in 1990). Within 1990-2016 time periods, total GHG emissions from this sector decreased by circa 3.6 per cent: from 1.52 Mt CO_2 equivalent in 1990 to 1.46 Mt CO_2 equivalent in 2016 (Table 2-7). Between 2015 and 2016, direct GHG emissions from this sector increased by circa 2.0 per cent.

Table 2-7: GHG Emissions from Sector 5 'Waste' within 1990-2016 periods, Mt CO_2 equivalent

	1990	1995	2000	2005	2010	2011	2012	2013	2014	2015	2016
5. Waste	**1.5154**	**1.5947**	**1.5418**	**1.4288**	**1.4833**	**1.5009**	**1.4911**	**1.4376**	**1.4361**	**1.4313**	**1.4603**
A. Solid Waste Disposal	1.0467	1.2092	1.1695	1.0643	1.1378	1.1551	1.1436	1.0848	1.0831	1.0872	1.1152
B. Biological Treatment of Solid Waste	NO, NE	NO, NE	NO, NE	NO, NE	NO, NE	NO, NE	NO, NE	NO, NE	NO, NE	NO, NE	NO, NE
C. Incineration and Open Burning of Waste	0.0277	0.0277	0.0276	0.0256	0.0256	0.0257	0.0257	0.0256	0.0256	0.0253	0.0250
D. Wastewater Treatment and Discharge	0.4409	0.3578	0.3446	0.3388	0.3198	0.3201	0.3218	0.3271	0.3274	0.3188	0.3201
E. Other	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO

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

Reduction of total GHG emissions from the Sector 5 'Waste', in particular until 2000, could be explained by the economic decline that occurred in the Republic of Moldova during the respective period, by a significant drop in the wellbeing of population, and respectively, capacity to generate wastes. At the same time, starting with 2006, there has been a slight growing trend of direct GHG emissions from the Sector 5 'Waste' (Figure 2-15).

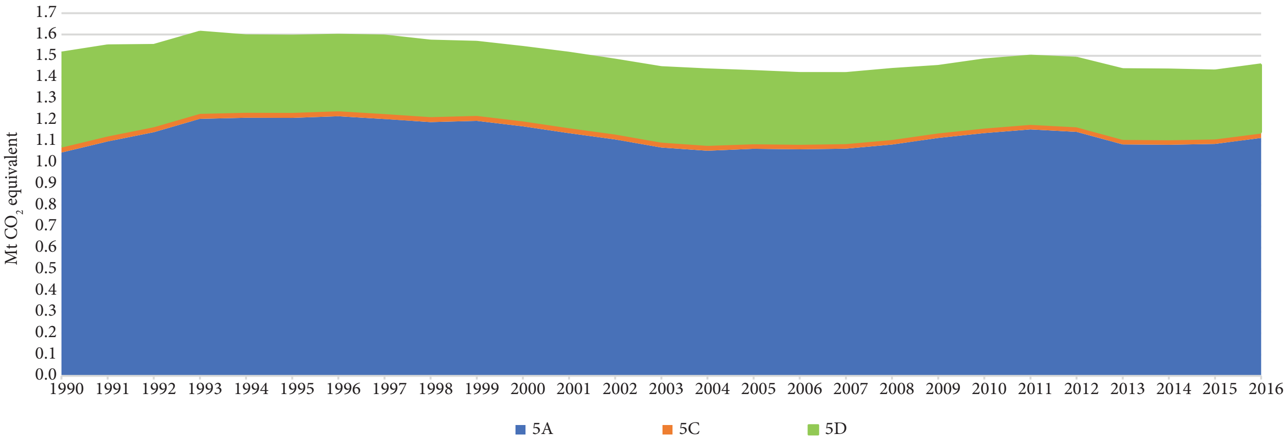


Figure 2-15: Total Waste Sector GHG Emissions Trends in the RM within 1990-2016 periods.

In 2016, the largest source of GHG emissions within the Sector 5 'Waste' was 5A "Solid Waste Disposal", accounting for circa 76.4 per cent of the total sectoral emissions (69.1 per cent in 1990), followed by 5D "Wastewater Treatment and Discharge", accounting for circa 21.9 per cent of the total (29.1 per cent in 1990), respectively from category 5C "Incineration and Open Burning of Waste", with a share of circa 1.7 per cent of the total (1.8 per cent in 1990) (Fig. 2-16).

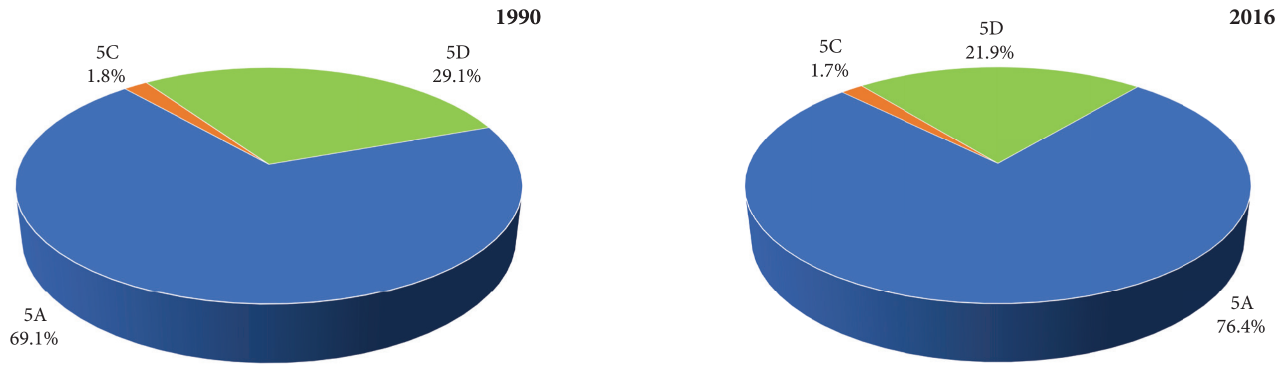


Figure 2-16: Breakdown of Waste Sector GHG Emissions by Category in the RM in 1990 and 2016.

2.4. Emission Trends for Ozone and Aerosol Precursors

Though not considered greenhouse gases, photochemically active gases like carbon monoxide (CO), nitrogen oxides (NO_x) and non-methane volatile organic compounds (NMVOC), have an indirect global warming effect. These gases are considered as ozone precursors influencing the formation and destruction of tropospheric and stratospheric ozone. In particular, they are emitted from transportation, fossil fuel combustion, 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: NOx, CO, NMVOC and SO_2.

Between 1990 and 2016, total nitrogen oxides emissions decreased by circa 74.7 per cent: from 94.85 kt in 1990 to 24.04 kt in 2016, total carbon monoxide emissions decreased by circa 68.1 per cent: from 279.82 kt in 1990, to 89.30 kt in 2016, non-methane volatile organic compounds emissions decreased by circa 62.6 per cent: from 141.41 kt in 1990 to 52.86 kt in 2016, while sulphur dioxide emissions decreased by circa 92.3 per cent: from 157.10 kt in 1990 to 12.03 kt in 2016 (Table 2-8).

Table 2-8: Ozone and Aerosol Precursors (NO_x, CO and NMVOC) and SO_2 Emission Trends in the RM within 1990-2016 periods, kt

	1990	1991	1992	1993	1994	1995	1996	1997	1998
NO_x	94.8503	83.6784	61.5984	49.3910	37.5579	31.7755	29.6012	26.5722	22.3525
CO	279.8219	262.9974	144.6734	67.9779	73.8756	63.8267	77.1933	71.0192	54.7183
NMVOC	141.4089	120.3062	91.5110	70.7995	52.0801	48.9688	47.0827	32.2721	28.2124
SO_2	157.0987	142.3319	102.2872	75.3756	59.9048	34.4348	34.2863	19.0834	14.3869
	1999	2000	2001	2002	2003	2004	2005	2006	2007
NO_x	17.2357	15.9945	17.3397	18.1234	19.0540	20.3723	21.1615	20.2740	21.1621
CO	42.4575	40.5859	39.6065	45.7546	55.7082	52.6429	54.3501	55.0501	49.5847
NMVOC	22.3883	21.9813	23.3836	26.0647	28.5055	40.4511	43.0595	48.1839	48.3704
SO_2	11.4081	9.8641	9.3435	10.3207	11.8437	11.1920	10.9930	10.9383	9.7668
	2008	2009	2010	2011	2012	2013	2014	2015	2016
NO_x	22.0226	21.1854	22.8056	23.3555	21.9438	20.9647	22.0749	23.4640	24.0397
CO	52.3105	50.4097	52.0155	55.6497	53.3805	55.3389	80.7555	86.4182	89.2990
NMVOC	42.1097	36.3792	40.8325	44.0445	45.6689	45.2815	57.7562	55.4304	52.8600
SO_2	11.5680	13.7619	12.8153	13.0829	11.4909	14.5122	12.0378	13.0690	12.0308

In 2016, the source categories having the biggest share in the total nitrogen oxides emissions in the RM were: 1A3 "Transport" (40.6 per cent of the total), 1A1 „Energy Industries" (29.9 per cent of the total), 1A4 „Other Sectors" (18.5 per cent of the total), 2A „Mineral Industry" (6.6 per cent of the total) and 1A2 „Manufacturing Industries and Constructions" (3.5 per cent of the total) (Figure 2-17).

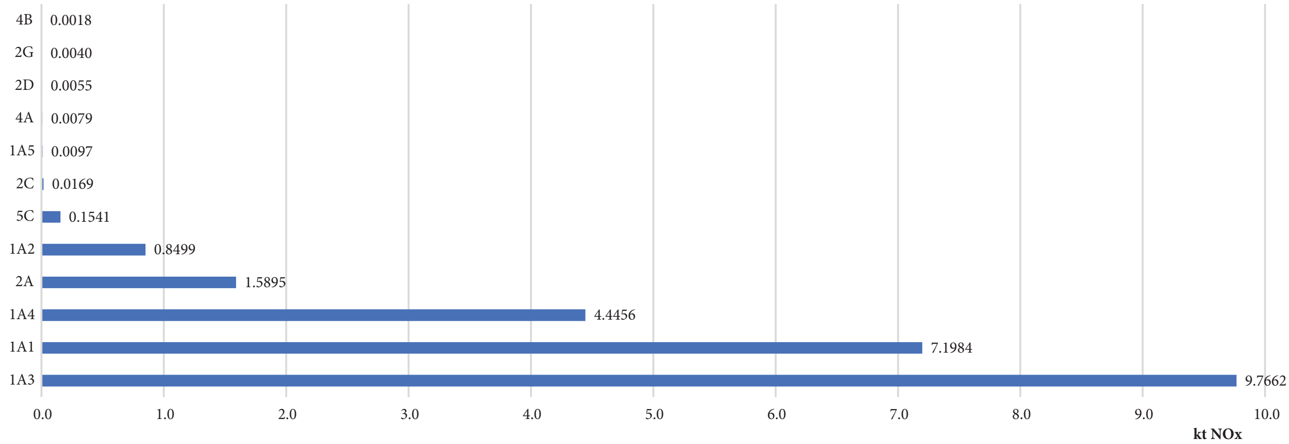


Figure 2-17: Source Categories of NO_x in the Republic of Moldova in 2016.

In 2016, the source categories having the biggest share in the total carbon monoxide emissions in the RM were: 1A4 „Other Sectors" (68.9 per cent of the total), 1A3 „Transport" (21.4 per cent of the total), 1A1 „Energy Industries" (3.1 per cent of the total), 5C „Incineration and Open Burning of Waste" (3.0 per cent of the total), 1A2 „Manufacturing Industries and Constructions" (1.4 per cent of the total) and 2A „Mineral Industry" (1.4 per cent of the total) (Figure 2-18).

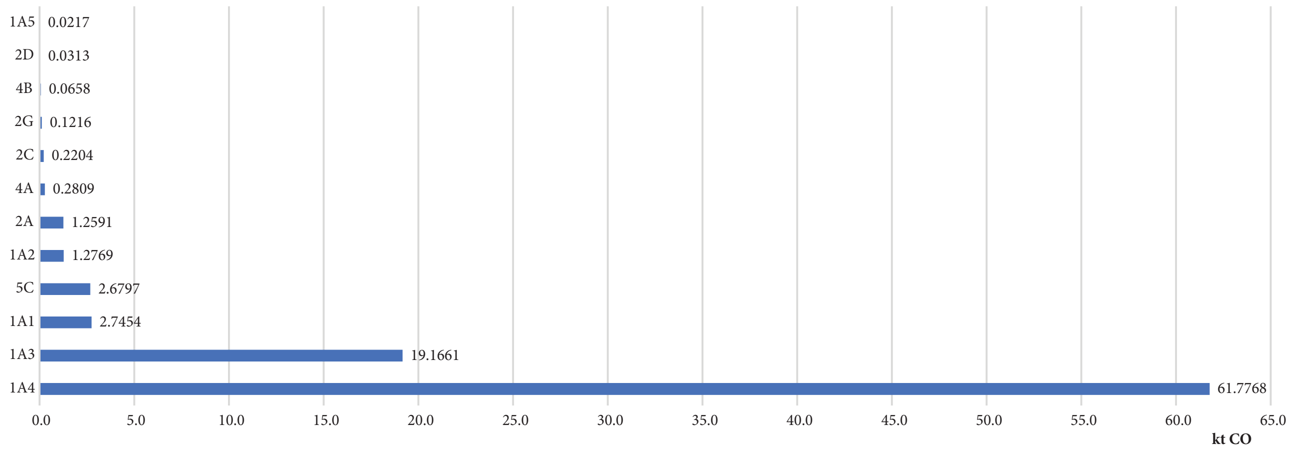


Figure 2-18: Source Categories of CO in the Republic of Moldova in 2016.

In 2016, the source categories having the biggest share in the total non-methane volatile organic compounds emissions in the RM were: 2D "Non-Energy Products from Fuels and Solvent Use" (61.2 per cent of the total), 1A4 „Other Sectors” (17.4 per cent of the total), 2H „Other” (food and alcoholic beverages) (9.8 per cent of the total), 1A3 „Transport” (4.8 per cent of the total), 5A „Solid Waste Disposal” (3.8 per cent of the total), 1B2 „Fugitive Emissions from Oil and Natural Gas” (1.3 per cent of the total), 2G „Other Product Manufacture and Use” (0.6 per cent of the total) and 1A2 „Manufacturing Industries and Constructions” (0.5 per cent of the total) (Figure 2-19).

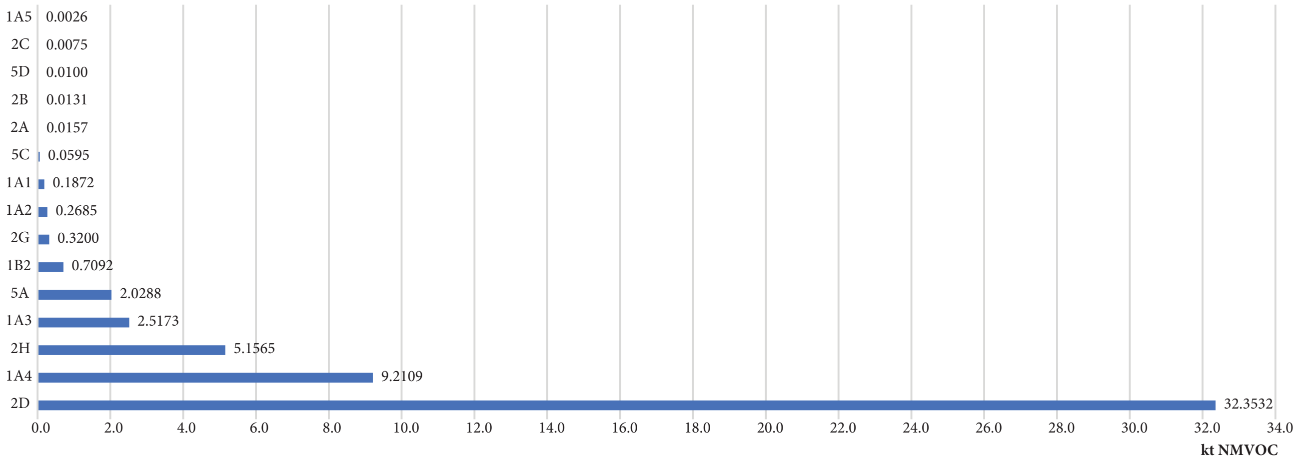


Figure 2-19: Source Categories of NMVOC in the Republic of Moldova in 2016.

In 2016, the source categories having the biggest share in the total sulphur dioxide emissions in the RM were: 1A1 „Energy Industries” (36.0 per cent of the total), 1A3 „Transport” (30.0 per cent of the total), 1A4 „Other Sectors” (19.7 per cent of the total), 1A2 „Manufacturing Industries and Constructions” (8.6 per cent of the total) and 2A „Mineral Industry” (5.5 per cent of the total) (Figure 2-20).

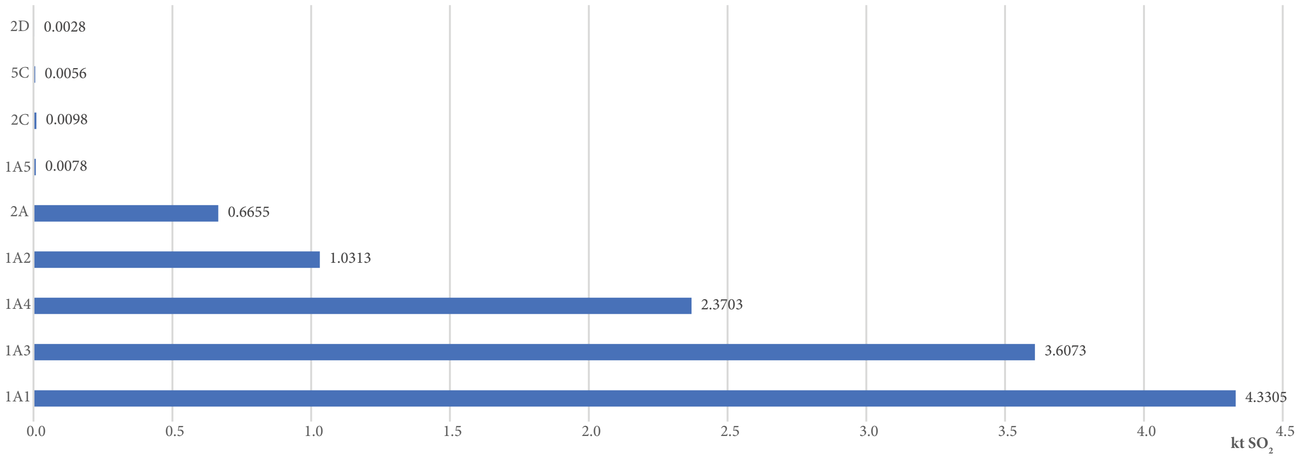


Figure 2-20: Source Categories of SO_2 in the Republic of Moldova in 2016.

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 includes the 2006 IPCC Guidelines for National Greenhouse Gas Inventories (IPCC, 2006) (in particular, for estimating direct GHG emissions) and EMEP/EEA Air Pollutant Emission Inventory Guidebook (2016) (in particular, for estimating non-CO_2 emissions).

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

1. „Energy"

1A „Fuel Combustion Activities"

- 1A1 „Energy Industries" (1A1a 'Main Activity Electricity and Heat Production', 1A1b 'Petroleum Refining', 1A1c 'Manufacture of Solid Fuels and Other Energy Industries');
- 1A2 „Manufacturing Industries and Construction" (12 industries);
- 1A3 „Transport" (1A3a 'Civil Aviation', 1A3b 'Road Transportation', 1A3c 'Railways', 1A3d 'Water-borne Navigation', 1A3e 'Other Transportation');
- 1A4 „Other Sectors" (1A4a 'Commercial/Institutional', 1A4b 'Residential', 1A4c 'Agriculture/Forestry/Fishing');
- 1A5 „Other" (1A5a 'Stationary' and 1A5b 'Mobile').

1B „Fugitive Emissions from Fuels"

- 1B2 „Fugitive Emissions from Oil and Natural Gas Systems".

„Memo items"

- „International Bunkers";
- „CO_2 Emissions from Biomass".

A brief overview, methodological issues, uncertainties assessment and times-series consistency, QA/QC and verification, recalculations made and planned improvements are described for each source category in this sector. GHG emissions in the Sector 1 'Energy' result from fuel combustion for power generation (electricity and heat), industrial production (in energy purposes), transportation needs, from residential, agriculture, forestry, fishing sectors, as well as for other needs and works in energy sector.

3.1.1. Summary of Emission Trends

Between 1990 and 2016, the total GHG emissions from the Sector 1 'Energy' tended to lower values, decreasing by 72.9 per cent (Table 3-1, Figure 3-1).

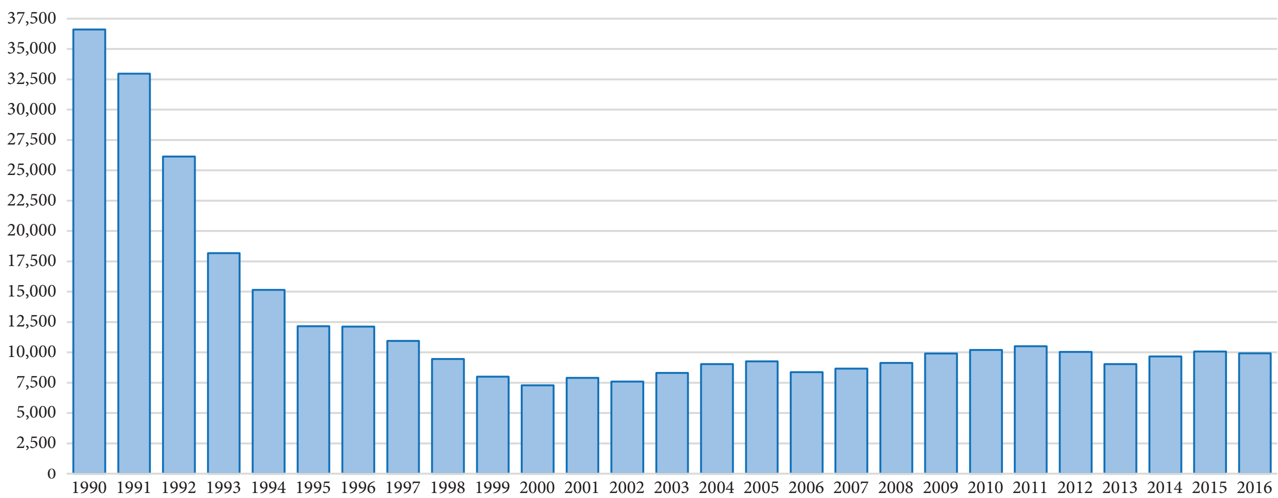


Figure 3-1: Total direct GHG emissions from Sector 1 'Energy' in the Republic of Moldova within 1990-2016 periods, kt CO_2 equivalent.

Table 3-1: Total direct GHG emissions from Sector 1 'Energy' in the Republic of Moldova within 1990-2016 periods

	1990	1991	1992	1993	1994	1995	1996	1997	1998
1. Energy, kt CO_2 equivalent	36 610.5147	32 969.6160	26 140.5321	18 173.0006	15 147.2796	12 157.3676	12 129.1119	10 936.4422	9 450.4879
in %, as compared to 1990	100.0	90.1	71.4	49.6	41.4	33.2	33.1	29.9	25.8
	1999	2000	2001	2002	2003	2004	2005	2006	2007
1. Energy, kt CO_2 equivalent	7 988.3492	7 288.8600	7 892.7224	7 597.6642	8 296.7792	9 024.8391	9 248.7805	8 358.5998	8 652.3541
in %, as compared to 1990	21.8	19.9	21.6	20.8	22.7	24.7	25.3	22.8	23.6
	2008	2009	2010	2011	2012	2013	2014	2015	2016
1. Energy, kt CO_2 equivalent	9 132.1640	9 911.6978	10 194.9848	10 498.5364	10 036.1910	9 025.7218	9 656.8992	10 063.7869	9 927.2284
in %, as compared to 1990	24.9	27.1	27.8	28.7	27.4	24.7	26.4	27.5	27.1

Between 1990 and 2016, the total GHG emissions from the Sector 1 'Energy' for the Left Bank of Dniester River (LBDR) decreased by circa 64.7 per cent (Table 3-2).

Table 3-2: Total direct GHG emissions from Sector 1 'Energy' on the LBDR within 1990-2016 periods

	1990	1991	1992	1993	1994	1995	1996	1997	1998
1. Energy, kt CO_2 equivalent	12 055.8770	10 788.5136	9 158.9726	7 903.2606	8 032.5279	5 489.6608	5 186.4769	4 413.9024	3 756.7699
in %, as compared to 1990	100.0	89.5	76.0	65.6	66.6	45.5	43.0	36.6	31.2
	1999	2000	2001	2002	2003	2004	2005	2006	2007
1. Energy, kt CO_2 equivalent	3 497.3621	3 332.9457	3 641.3192	2 925.4765	3 084.7470	3 397.2252	3 313.3311	2 591.2419	3 016.1376
in %, as compared to 1990	29.0	27.6	30.2	24.3	25.6	28.2	27.5	21.5	25.0
	2008	2009	2010	2011	2012	2013	2014	2015	2016
1. Energy, kt CO_2 equivalent	3 183.7413	4 216.5388	4 444.5966	4 479.8841	4 534.0195	3 380.3344	4 247.6710	4 440.3597	4 253.1125
in %, as compared to 1990	26.4	35.0	36.9	37.2	37.6	28.0	35.2	36.8	35.3

Within 1990-2016 time series, the total GHG emissions from the Sector 1 'Energy' for the Right Bank of Dniester River (RBDR) decreased by circa 76.9 per cent (Table 3-1, Figure 3-1).

Table 3-3: Total direct GHG emissions from Sector 1 'Energy' on the RBDR within 1990-2016 periods

	1990	1991	1992	1993	1994	1995	1996	1997	1998
1. Energy, kt CO_2 equivalent	24 554.6378	22 181.1024	16 981.5596	10 269.7400	7 114.2482	6 667.7068	6 942.6350	6 522.5399	5 693.7180
in %, as compared to 1990	100.0	90.3	69.2	41.8	29.0	27.2	28.3	26.6	23.2
	1999	2000	2001	2002	2003	2004	2005	2006	2007
1. Energy, kt CO_2 equivalent	4 490.9871	3 955.9143	4 251.4032	4 672.1877	5 212.0322	5 627.6139	5 935.4494	5 767.3579	5 636.2165
in %, as compared to 1990	18.3	16.1	17.3	19.0	21.2	22.9	24.2	23.5	23.0
	2008	2009	2010	2011	2012	2013	2014	2015	2016
1. Energy, kt CO_2 equivalent	5 948.4228	5 695.1590	5 750.3882	6 018.6523	5 502.1714	5 645.3873	5 409.2282	5 623.4271	5 674.1159
in %, as compared to 1990	24.2	23.2	23.4	24.5	22.4	23.0	22.0	22.9	23.1

Compared to the reference year (1990), by 2016 direct GHG emissions on the LBDR decreased significantly (with the exception of methane emissions, which increased by circa 14.5 times), thus CO_2 emissions achieved just 34.6 per cent of the 1990 level, N_2O – 22.5 per cent, while total direct GHG emissions expressed in CO_2 equivalent – 35.3 per cent of the reference year level (Table 3-4).

Table 3-4: Direct GHG emissions from Sector 1 'Energy' on the LBDR within 1990-2016 periods

	Direct GHG emissions, kt CO_2 equivalent				% of the total			in %, as compared to 1990			
	CO_2	CH_4	N_2O	Total	CO_2	CH_4	N_2O	CO_2	CH_4	N_2O	Total
1990	12 011.9413	5.9861	37.9496	12 055.8770	99.64	0.05	0.31	100.0	100.0	100.0	100.0
1991	10 749.2216	4.9692	34.3228	10 788.5136	99.64	0.05	0.32	89.5	83.0	90.4	89.5
1992	9 128.0965	4.4279	26.4482	9 158.9726	99.66	0.05	0.29	76.0	74.0	69.7	76.0
1993	7 866.1732	5.3184	31.7691	7 903.2606	99.53	0.07	0.40	65.5	88.8	83.7	65.6
1994	7 923.7645	81.6157	27.1477	8 032.5279	98.65	1.02	0.34	66.0	1363.4	71.5	66.6
1995	5 412.9440	60.1441	16.5728	5 489.6608	98.60	1.10	0.30	45.1	1004.7	43.7	45.5
1996	5 101.7110	69.5321	15.2338	5 186.4769	98.37	1.34	0.29	42.5	1161.6	40.1	43.0
1997	4 327.2116	77.3410	9.3498	4 413.9024	98.04	1.75	0.21	36.0	1292.0	24.6	36.6
1998	3 679.0813	70.3809	7.3077	3 756.7699	97.93	1.87	0.19	30.6	1175.7	19.3	31.2
1999	3 422.1701	69.4257	5.7663	3 497.3621	97.85	1.99	0.16	28.5	1159.8	15.2	29.0
2000	3 261.1630	66.1652	5.6175	3 332.9457	97.85	1.99	0.17	27.1	1105.3	14.8	27.6
2001	3 561.5387	73.9630	5.8175	3 641.3192	97.81	2.03	0.16	29.6	1235.6	15.3	30.2
2002	2 862.5129	56.3904	6.5731	2 925.4765	97.85	1.93	0.22	23.8	942.0	17.3	24.3
2003	3 017.4733	60.8905	6.3832	3 084.7470	97.82	1.97	0.21	25.1	1017.2	16.8	25.6
2004	3 322.6731	68.0950	6.4572	3 397.2252	97.81	2.00	0.19	27.7	1137.6	17.0	28.2
2005	3 239.7777	66.8510	6.7024	3 313.3311	97.78	2.02	0.20	27.0	1116.8	17.7	27.5
2006	2 533.9791	50.7298	6.5331	2 591.2419	97.79	1.96	0.25	21.1	847.5	17.2	21.5
2007	2 948.5807	60.6748	6.8821	3 016.1376	97.76	2.01	0.23	24.5	1013.6	18.1	25.0
2008	3 111.9504	64.9368	6.8540	3 183.7413	97.75	2.04	0.22	25.9	1084.8	18.1	26.4
2009	4 125.4275	83.0493	8.0620	4 216.5388	97.84	1.97	0.19	34.3	1387.4	21.2	35.0

	Direct GHG emissions, kt CO_2 equivalent				% of the total			in %, as compared to 1990			
	CO_2	CH_4	N_2O	Total	CO_2	CH_4	N_2O	CO_2	CH_4	N_2O	Total
2010	4 346.5492	89.6702	8.3772	4 444.5966	97.79	2.02	0.19	36.2	1498.0	22.1	36.9
2011	4 377.8688	94.1286	7.8867	4 479.8841	97.72	2.10	0.18	36.4	1572.5	20.8	37.2
2012	4 432.3304	94.0190	7.6702	4 534.0195	97.76	2.07	0.17	36.9	1570.6	20.2	37.6
2013	3 307.9480	65.0733	7.3131	3 380.3344	97.86	1.93	0.22	27.5	1087.1	19.3	28.0
2014	4 155.3017	84.3649	8.0044	4 247.6710	97.83	1.99	0.19	34.6	1409.3	21.1	35.2
2015	4 343.8420	88.1529	8.3649	4 440.3597	97.83	1.99	0.19	36.2	1472.6	22.0	36.8
2016	4 157.9132	86.6513	8.5480	4 253.1125	97.76	2.04	0.20	34.6	1447.5	22.5	35.3

Compared to the reference year (1990), by 2016 direct GHG emissions on the RBDR significantly: CO_2 emissions represented 20.9 per cent of the 1990 level, CH_4 – 67.5 per cent, N_2O – 45.8 per cent, while total direct GHG emissions expressed in CO_2 equivalent – 23.1 per cent (Table 3-5).

Table 3-5: Direct GHG emissions from Sector 1 'Energy' on the RBDR within 1990-2016 periods

	Direct GHG emissions, kt CO_2 equivalent				% of the total			in %, as compared to 1990			
	CO_2	CH_4	N_2O	Total	CO_2	CH_4	N_2O	CO_2	CH_4	N_2O	Total
1990	23 268.8502	972.2965	313.4911	24 554.6378	94.76	3.96	1.28	100.0	100.0	100.0	100.0
1991	20 810.8750	1 100.3689	269.8585	22 181.1024	93.82	4.96	1.22	89.4	113.2	86.1	90.3
1992	15 912.6304	891.7163	177.2129	16 981.5596	93.71	5.25	1.04	68.4	91.7	56.5	69.2
1993	9 483.4331	680.5556	105.7513	10 269.7400	92.34	6.63	1.03	40.8	70.0	33.7	41.8
1994	6 460.8796	593.1544	60.2141	7 114.2482	90.82	8.34	0.85	27.8	61.0	19.2	29.0
1995	5 960.0164	649.8410	57.8494	6 667.7068	89.39	9.75	0.87	25.6	66.8	18.5	27.2
1996	6 157.4296	723.5990	61.6064	6 942.6350	88.69	10.42	0.89	26.5	74.4	19.7	28.3
1997	5 884.8428	573.3909	64.3061	6 522.5399	90.22	8.79	0.99	25.3	59.0	20.5	26.6
1998	5 110.6754	525.5767	57.4659	5 693.7180	89.76	9.23	1.01	22.0	54.1	18.3	23.2
1999	3 906.3224	529.7540	54.9107	4 490.9871	86.98	11.80	1.22	16.8	54.5	17.5	18.3
2000	3 322.8581	573.1220	59.9341	3 955.9143	84.00	14.49	1.52	14.3	58.9	19.1	16.1
2001	3 619.2066	557.1143	75.0823	4 251.4032	85.13	13.10	1.77	15.6	57.3	24.0	17.3
2002	3 952.9120	635.3463	83.9294	4 672.1877	84.61	13.60	1.80	17.0	65.3	26.8	19.0
2003	4 452.3822	672.5129	87.1371	5 212.0322	85.43	12.90	1.67	19.1	69.2	27.8	21.2
2004	4 819.2035	715.7405	92.6698	5 627.6139	85.63	12.72	1.65	20.7	73.6	29.6	22.9
2005	5 078.3645	760.6730	96.4118	5 935.4494	85.56	12.82	1.62	21.8	78.2	30.8	24.2
2006	4 982.9485	689.5264	94.8830	5 767.3579	86.40	11.96	1.65	21.4	70.9	30.3	23.5
2007	4 826.8492	710.9712	98.3961	5 636.2165	85.64	12.61	1.75	20.7	73.1	31.4	23.0
2008	5 141.5298	704.5728	102.3201	5 948.4228	86.44	11.84	1.72	22.1	72.5	32.6	24.2
2009	5 027.4480	564.9423	102.7687	5 695.1590	88.28	9.92	1.80	21.6	58.1	32.8	23.2
2010	5 096.6362	543.6994	110.0526	5 750.3882	88.63	9.46	1.91	21.9	55.9	35.1	23.4
2011	5 276.8010	624.3018	117.5495	6 018.6523	87.67	10.37	1.95	22.7	64.2	37.5	24.5
2012	4 763.4789	617.4520	121.2405	5 502.1714	86.57	11.22	2.20	20.5	63.5	38.7	22.4
2013	4 906.0574	617.1071	122.2229	5 645.3873	86.90	10.93	2.17	21.1	63.5	39.0	23.0
2014	4 652.1730	625.7389	131.3164	5 409.2282	86.00	11.57	2.43	20.0	64.4	41.9	22.0
2015	4 887.7511	600.6826	134.9934	5 623.4271	86.92	10.68	2.40	21.0	61.8	43.1	22.9
2016	4 874.7001	655.9882	143.4276	5 674.1159	85.91	11.56	2.53	20.9	67.5	45.8	23.1

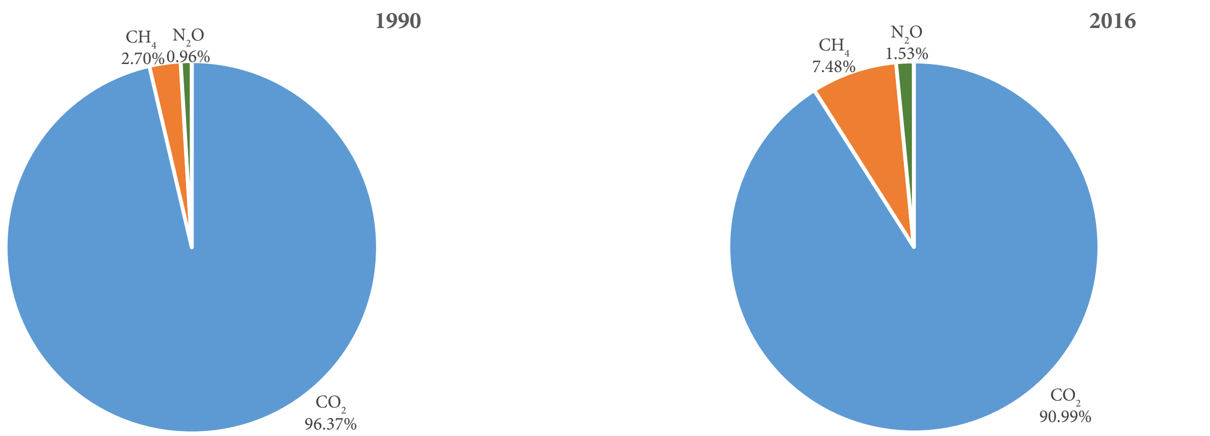


Figure 3-2: The share of direct GHG emissions from Sector 1 'Energy' in the total direct GHG emissions in 1990 and 2016, in % from the total.

Compared to the reference year (1990), by 2016 direct GHG emissions in the Republic of Moldova decreased significantly: CO_2 emissions represented circa 25.6 per cent of the 1990 level, CH_4 – 75.9 per cent, N_2O – 43.2 per cent, while direct GHG emissions expressed in CO_2 equivalent – 27.1 per cent (Table 3-6).

Table 3-6: Direct GHG emissions from Sector 1 'Energy' in the RM within 1990-2016 periods

	Direct GHG emissions, kt CO_2 equivalent				% of the total			in %, as compared to 1990			
	CO_2	CH_4	N_2O	Total	CO_2	CH_4	N_2O	CO_2	CH_4	N_2O	Total
1990	35 280.7915	978.2826	351.4407	36 610.5147	96.37	2.67	0.96	100.0	100.0	100.0	100.0
1991	31 560.0966	1 105.3381	304.1812	32 969.6160	95.72	3.35	0.92	89.5	113.0	86.6	90.1
1992	25 040.7269	896.1442	203.6611	26 140.5321	95.79	3.43	0.78	71.0	91.6	58.0	71.4
1993	17 349.6063	685.8740	137.5203	18 173.0006	95.47	3.77	0.76	49.2	70.1	39.1	49.6
1994	14 385.1477	674.7702	87.3618	15 147.2796	94.97	4.45	0.58	40.8	69.0	24.9	41.4
1995	11 372.9604	709.9851	74.4222	12 157.3676	93.55	5.84	0.61	32.2	72.6	21.2	33.2
1996	11 259.1406	793.1311	76.8402	12 129.1119	92.83	6.54	0.63	31.9	81.1	21.9	33.1
1997	10 212.0544	650.7319	73.6559	10 936.4422	93.38	5.95	0.67	28.9	66.5	21.0	29.9
1998	8 789.7567	595.9576	64.7736	9 450.4879	93.01	6.31	0.69	24.9	60.9	18.4	25.8
1999	7 328.4925	599.1797	60.6770	7 988.3492	91.74	7.50	0.76	20.8	61.2	17.3	21.8
2000	6 584.0211	639.2872	65.5517	7 288.8600	90.33	8.77	0.90	18.7	65.3	18.7	19.9
2001	7 180.7453	631.0773	80.8998	7 892.7224	90.98	8.00	1.02	20.4	64.5	23.0	21.6
2002	6 815.4249	691.7368	90.5025	7 597.6642	89.70	9.10	1.19	19.3	70.7	25.8	20.8
2003	7 469.8555	733.4034	93.5203	8 296.7792	90.03	8.84	1.13	21.2	75.0	26.6	22.7
2004	8 141.8766	783.8355	99.1270	9 024.8391	90.22	8.69	1.10	23.1	80.1	28.2	24.7
2005	8 318.1422	827.5240	103.1143	9 248.7805	89.94	8.95	1.11	23.6	84.6	29.3	25.3
2006	7 516.9276	740.2563	101.4160	8 358.5998	89.93	8.86	1.21	21.3	75.7	28.9	22.8
2007	7 775.4299	771.6460	105.2782	8 652.3541	89.86	8.92	1.22	22.0	78.9	30.0	23.6
2008	8 253.4802	769.5097	109.1741	9 132.1640	90.38	8.43	1.20	23.4	78.7	31.1	24.9
2009	9 152.8755	647.9916	110.8307	9 911.6978	92.34	6.54	1.12	25.9	66.2	31.5	27.1
2010	9 443.1854	633.3696	118.4299	10 194.9848	92.63	6.21	1.16	26.8	64.7	33.7	27.8
2011	9 654.6698	718.4304	125.4362	10 498.5364	91.96	6.84	1.19	27.4	73.4	35.7	28.7
2012	9 195.8094	711.4709	128.9107	10 036.1910	91.63	7.09	1.28	26.1	72.7	36.7	27.4
2013	8 214.0054	682.1804	129.5360	9 025.7218	91.01	7.56	1.44	23.3	69.7	36.9	24.7
2014	8 807.4746	710.1038	139.3208	9 656.8992	91.20	7.35	1.44	25.0	72.6	39.6	26.4
2015	9 231.5931	688.8354	143.3583	10 063.7869	91.73	6.84	1.42	26.2	70.4	40.8	27.5
2016	9 032.6132	742.6395	151.9757	9 927.2284	90.99	7.48	1.53	25.6	75.9	43.2	27.1

Compared to the reference year (1990), by 2016 GHG emissions on the LBDR decreased significantly (with the exception of methane emissions, which increased by circa 14.5 times, CO emissions which increased by 1.6 times and NMVOC emissions which increased by 2.2 times): CO_2 emissions represented circa 34.6 per cent of the 1990 level, N_2O – 22.5 per cent, NO_x – 31.8 per cent, and SO_2 – 5.7 per cent (Table 3-7).

Table 3-7: GHG emissions from Sector 1 'Energy' on the LBDR within 1990-2016 periods

	GHG emissions, kt							in %, as 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	12 011.9413	0.2394	0.1273	23.6914	2.9969	0.2826	74.3101	100.0	100.0	100.0	100.0	100.0	100.0	100.0
1991	10 749.2216	0.1988	0.1152	21.2647	2.7810	0.2507	65.5646	89.5	83.0	90.4	89.8	92.8	88.7	88.2
1992	9 128.0965	0.1771	0.0888	17.6545	2.7125	0.2357	50.5167	76.0	74.0	69.7	74.5	90.5	83.4	68.0
1993	7 866.1732	0.2127	0.1066	17.6270	6.0203	0.7556	46.7354	65.5	88.8	83.7	74.4	200.9	267.4	62.9
1994	7 923.7645	3.2646	0.0911	16.5407	6.1577	0.9199	39.9846	66.0	1363.4	71.5	69.8	205.5	325.5	53.8
1995	5 412.9440	2.4058	0.0556	11.7514	13.6815	1.0106	19.4117	45.1	1004.7	43.7	49.6	456.5	357.6	26.1
1996	5 101.7110	2.7813	0.0511	10.8965	10.5505	0.8746	17.6861	42.5	1161.6	40.1	46.0	352.0	309.5	23.8
1997	4 327.2116	3.0936	0.0314	8.7311	13.2869	1.0747	6.4521	36.0	1292.0	24.6	36.9	443.4	380.3	8.7
1998	3 679.0813	2.8152	0.0245	7.1817	9.9376	0.8840	4.6998	30.6	1175.7	19.3	30.3	331.6	312.8	6.3
1999	3 422.1701	2.7770	0.0193	6.4327	6.3065	0.6380	4.4347	28.5	1159.8	15.2	27.2	210.4	225.8	6.0
2000	3 261.1630	2.6466	0.0189	6.1126	5.1349	0.5910	4.2178	27.1	1105.3	14.8	25.8	171.3	209.1	5.7
2001	3 561.5387	2.9585	0.0195	6.6313	5.4472	0.6510	4.0465	29.6	1235.6	15.3	28.0	181.8	230.4	5.4
2002	2 862.5129	2.2556	0.0221	5.7219	5.1300	0.6454	3.8947	23.8	942.0	17.3	24.2	171.2	228.4	5.2
2003	3 017.4733	2.4356	0.0214	5.7724	5.6283	0.6925	3.7322	25.1	1017.2	16.8	24.4	187.8	245.1	5.0
2004	3 322.6731	2.7238	0.0217	6.2485	5.3784	0.7887	3.5339	27.7	1137.6	17.0	26.4	179.5	279.1	4.8
2005	3 239.7777	2.6740	0.0225	6.1739	5.2595	0.7783	3.3531	27.0	1116.8	17.7	26.1	175.5	275.4	4.5
2006	2 533.9791	2.0292	0.0219	5.0694	4.5073	0.7119	3.1803	21.1	847.5	17.2	21.4	150.4	251.9	4.3
2007	2 948.5807	2.4270	0.0231	5.7146	4.7031	0.7081	3.0230	24.5	1013.6	18.1	24.1	156.9	250.6	4.1
2008	3 111.9504	2.5975	0.0230	5.9517	4.8554	0.7411	2.8984	25.9	1084.8	18.1	25.1	162.0	262.3	3.9
2009	4 125.4275	3.3220	0.0271	7.6541	5.7987	0.7349	5.5092	34.3	1387.4	21.2	32.3	193.5	260.1	7.4
2010	4 346.5492	3.5868	0.0281	8.1774	6.0951	0.7704	4.9595	36.2	1498.0	22.1	34.5	203.4	272.6	6.7
2011	4 377.8688	3.7651	0.0265	8.0621	6.1288	0.9127	4.0628	36.4	1572.5	20.8	34.0	204.5	323.0	5.5
2012	4 432.3304	3.7608	0.0257	8.0734	5.5338	0.8370	3.9940	36.9	1570.6	20.2	34.1	184.7	296.2	5.4
2013	3 307.9480	2.6029	0.0245	6.4251	4.8478	0.6706	4.4228	27.5	1087.1	19.3	27.1	161.8	237.3	6.0
2014	4 155.3017	3.3746	0.0269	7.5883	5.3416	0.7347	4.4811	34.6	1409.3	21.1	32.0	178.2	260.0	6.0
2015	4 343.8420	3.5261	0.0281	8.0215	5.5461	0.6948	4.4532	36.2	1472.6	22.0	33.9	185.1	245.9	6.0
2016	4 157.9132	3.4661	0.0287	7.5409	4.7389	0.6313	4.2303	34.6	1447.5	22.5	31.8	158.1	223.4	5.7

Compared to the reference year (1990), by 2016 GHG emissions on the RBDR decreased significantly: CO_2 emissions represented circa 20.9 per cent of the 1990 level, CH_4 – 67.5 per cent, N_2O – 45.8 per cent, NO_x – 21.9 per cent, CO – 30.0 per cent, NMVOC – 39.3 per cent, and SO_2 – 8.8 per cent (Table 3-8).

Table 3-8: GHG emissions from Sector 1 'Energy' on the RBDR within 1990-2016 periods

	GHG emissions, kt							in %, as 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	23 268.8502	38.8919	1.0520	67.3492	267.7298	31.2131	80.9681	100.0	100.0	100.0	100.0	100.0	100.0	100.0
1991	20 810.8750	44.0148	0.9056	58.8907	251.9827	29.0408	75.2877	89.4	113.2	86.1	87.4	94.1	93.0	93.0
1992	15 912.6304	35.6687	0.5947	41.9844	135.3230	16.0545	50.9580	68.4	91.7	56.5	62.3	50.5	51.4	62.9
1993	9 483.4331	27.2222	0.3549	29.9009	55.5536	7.5691	27.8814	40.8	70.0	33.7	44.4	20.7	24.2	34.4
1994	6 460.8796	23.7262	0.2021	19.5092	61.8372	7.8943	19.3879	27.8	61.0	19.2	29.0	23.1	25.3	23.9
1995	5 960.0164	25.9936	0.1941	18.7135	44.5650	6.2622	14.5470	25.6	66.8	18.5	27.8	16.6	20.1	18.0
1996	6 157.4296	28.9440	0.2067	17.5408	60.9864	7.8409	16.1954	26.5	74.4	19.7	26.0	22.8	25.1	20.0
1997	5 884.8428	22.9356	0.2158	16.4685	51.7256	6.8875	12.1446	25.3	59.0	20.5	24.5	19.3	22.1	15.0
1998	5 110.6754	21.0231	0.1928	13.9446	39.2482	5.4677	9.2392	22.0	54.1	18.3	20.7	14.7	17.5	11.4
1999	3 906.3224	21.1902	0.1843	9.6916	30.5103	4.3495	6.5868	16.8	54.5	17.5	14.4	11.4	13.9	8.1
2000	3 322.8581	22.9249	0.2011	8.6471	29.7148	4.2882	5.1431	14.3	58.9	19.1	12.8	11.1	13.7	6.4
2001	3 619.2066	22.2846	0.2520	9.5130	28.3175	4.1376	4.8210	15.6	57.3	24.0	14.1	10.6	13.3	6.0
2002	3 952.9120	25.4139	0.2816	11.0641	35.6138	5.2264	5.8871	17.0	65.3	26.8	16.4	13.3	16.7	7.3
2003	4 452.3822	26.9005	0.2924	11.9073	44.3706	6.3374	7.5691	19.1	69.2	27.8	17.7	16.6	20.3	9.3
2004	4 819.2035	28.6296	0.3110	12.6019	41.1928	6.2676	7.0477	20.7	73.6	29.6	18.7	15.4	20.1	8.7
2005	5 078.3645	30.4269	0.3235	13.2038	42.9480	6.4111	6.9250	21.8	78.2	30.8	19.6	16.0	20.5	8.6
2006	4 982.9485	27.5811	0.3184	13.2731	44.8225	6.6115	7.0097	21.4	70.9	30.3	19.7	16.7	21.2	8.7
2007	4 826.8492	28.4388	0.3302	12.9734	38.0165	6.0002	5.8383	20.7	73.1	31.4	19.3	14.2	19.2	7.2
2008	5 141.5298	28.1829	0.3434	13.3964	40.5334	6.5475	7.7191	22.1	72.5	32.6	19.9	15.1	21.0	9.5
2009	5 027.4480	22.5977	0.3449	12.1238	39.7573	6.4032	7.7348	21.6	58.1	32.8	18.0	14.8	20.5	9.6
2010	5 096.6362	21.7480	0.3693	13.1350	41.2235	6.2957	7.2885	21.9	55.9	35.1	19.5	15.4	20.2	9.0
2011	5 276.8010	24.9721	0.3945	13.4937	44.4087	6.8440	8.3193	22.7	64.2	37.5	20.0	16.6	21.9	10.3
2012	4 763.4789	24.6981	0.4068	12.1473	42.8627	6.6190	6.8524	20.5	63.5	38.7	18.0	16.0	21.2	8.5
2013	4 906.0574	24.6843	0.4101	12.6462	45.7023	6.8508	9.3694	21.1	63.5	39.0	18.8	17.1	21.9	11.6
2014	4 652.1730	25.0296	0.4407	12.5939	70.4333	10.7661	6.8351	20.0	64.4	41.9	18.7	26.3	34.5	8.4
2015	4 887.7511	24.0273	0.4530	13.5973	75.9428	11.4760	7.8926	21.0	61.8	43.1	20.2	28.4	36.8	9.7
2016	4 874.7001	26.2395	0.4813	14.7289	80.2276	12.2557	7.1082	20.9	67.5	45.8	21.9	30.0	39.3	8.8

Compared to the reference year (1990), by 2016 GHG emissions in the Republic of Moldova decreased significantly: CO_2 emissions represented circa 25.6 per cent of the 1990 level, CH_4 – 75.9 per cent, N_2O – 43.2 per cent, NO_x – 24.5 per cent, CO – 31.3 per cent, NMVOC – 40.7 per cent, and SO_2 –7.3 per cent (Table 3-9).

Table 3-9: GHG emissions from Sector 1 'Energy' in the RM within 1990-2016 periods

	GHG emissions, kt							in %, as 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	35 280.7915	39.1313	1.1793	91.0406	271.4048	31.6819	155.7638	100.0	100.0	100.0	100.0	100.0	100.0	100.0
1991	31 560.0966	44.2135	1.0207	80.1554	255.1241	29.4152	141.0744	89.5	113.0	86.6	88.0	94.0	92.8	90.6
1992	25 040.7269	35.8458	0.6834	59.6389	138.2917	16.3771	101.6319	71.0	91.6	58.0	65.5	51.0	51.7	65.2
1993	17 349.6063	27.4350	0.4615	47.5279	61.7648	8.3876	74.7382	49.2	70.1	39.1	52.2	22.8	26.5	48.0
1994	14 385.1477	26.9908	0.2932	36.0499	68.0468	8.8374	59.3963	40.8	69.0	24.9	39.6	25.1	27.9	38.1
1995	11 372.9604	28.3994	0.2497	30.4649	58.2794	7.2884	33.9768	32.2	72.6	21.2	33.5	21.5	23.0	21.8
1996	11 259.1406	31.7252	0.2579	28.4374	71.5642	8.7276	33.8981	31.9	81.1	21.9	31.2	26.4	27.5	21.8
1997	10 212.0544	26.0293	0.2472	25.1996	65.0399	7.9743	18.6133	28.9	66.5	21.0	27.7	24.0	25.2	11.9
1998	8 789.7567	23.8383	0.2174	21.1263	49.2086	6.3618	13.9529	24.9	60.9	18.4	23.2	18.1	20.1	9.0
1999	7 328.4925	23.9672	0.2036	16.1243	36.8298	4.9938	11.0284	20.8	61.2	17.3	17.7	13.6	15.8	7.1
2000	6 584.0211	25.5715	0.2200	14.7597	34.8619	4.8848	9.3678	18.7	65.3	18.7	16.2	12.8	15.4	6.0
2001	7 180.7453	25.2431	0.2715	16.1444	33.7768	4.7942	8.8744	20.4	64.5	23.0	17.7	12.4	15.1	5.7
2002	6 815.4249	27.6695	0.3037	16.7861	40.7569	5.8776	9.7897	19.3	70.7	25.8	18.4	15.0	18.6	6.3
2003	7 469.8555	29.3361	0.3138	17.6796	50.0082	7.0341	11.3068	21.2	75.0	26.6	19.4	18.4	22.2	7.3
2004	8 141.8766	31.3534	0.3326	18.8504	46.5982	7.0666	10.5973	23.1	80.1	28.2	20.7	17.2	22.3	6.8
2005	8 318.1422	33.1010	0.3460	19.3776	48.2340	7.2002	10.2932	23.6	84.6	29.3	21.3	17.8	22.7	6.6
2006	7 516.9276	29.6103	0.3403	18.3425	49.3605	7.3353	10.2098	21.3	75.7	28.9	20.1	18.2	23.2	6.6
2007	7 775.4299	30.8658	0.3533	18.6880	42.7530	6.7207	8.8827	22.0	78.9	30.0	20.5	15.8	21.2	5.7
2008	8 253.4802	30.7804	0.3664	19.3481	45.4277	7.3059	10.6366	23.4	78.7	31.1	21.3	16.7	23.1	6.8
2009	9 152.8755	25.9197	0.3719	19.7779	45.5750	7.1466	13.2555	25.9	66.2	31.5	21.7	16.8	22.6	8.5
2010	9 443.1854	25.3348	0.3974	21.3124	47.3547	7.0824	12.2631	26.8	64.7	33.7	23.4	17.4	22.4	7.9

	GHG emissions, kt							in %, as 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
2011	9 654.6698	28.7372	0.4209	21.5558	50.5851	7.7791	12.3977	27.4	73.4	35.7	23.7	18.6	24.6	8.0
2012	9 195.8094	28.4588	0.4326	20.2207	48.4470	7.4794	10.8629	26.1	72.7	36.7	22.2	17.9	23.6	7.0
2013	8 214.0054	27.2872	0.4347	19.0713	50.5789	7.5356	13.8040	23.3	69.7	36.9	20.9	18.6	23.8	8.9
2014	8 807.4746	28.4042	0.4675	20.1823	75.8060	11.5158	11.3285	25.0	72.6	39.6	22.2	27.9	36.3	7.3
2015	9 231.5931	27.5534	0.4811	21.6188	81.5147	12.1824	12.3574	26.2	70.4	40.8	23.7	30.0	38.5	7.9
2016	9 032.6132	29.7056	0.5100	22.2698	84.9869	12.8957	11.3492	25.6	75.9	43.2	24.5	31.3	40.7	7.3

On the LBDR, the decreasing trend of GHG emissions was also characteristic between 1990 and 2016 at source category level within the Sector 1 'Energy' (Table 3-10).

Table 3-10: Breakdown of the direct GHG emissions from the Sector 1 'Energy' by category for the LBDR within 1990-2016 periods

	Direct GHG emissions, kt CO_2 equivalent						
	1A1	1A2	1A3	1A4	1A5	1B2	Total
1990	12 055.8770	NA	NA	NA	NA	NA	12 055.8770
1991	10 788.5136	NA	NA	NA	NA	NA	10 788.5136
1992	9 158.9726	NA	NA	NA	NA	NA	9 158.9726
1993	7 664.1268	NA	239.1338	NA	NA	NA	7 903.2606
1994	7 225.7163	516.0355	213.6154	NA	NA	77.1607	8 032.5279
1995	4 556.6485	134.5331	214.1718	528.6992	NA	55.6082	5 489.6608
1996	4 427.7577	97.7485	195.1026	400.3718	NA	65.4963	5 186.4769
1997	3 066.7963	284.1853	201.9252	788.4369	NA	72.5587	4 413.9024
1998	2 551.0606	274.4619	169.9197	695.0824	NA	66.2453	3 756.7699
1999	2 431.1217	255.1699	104.9790	640.0040	NA	66.0875	3 497.3621
2000	2 413.8789	269.8615	106.5080	479.4779	NA	63.2194	3 332.9457
2001	2 684.4051	327.0008	113.2257	445.7840	NA	70.9037	3 641.3192
2002	2 056.6433	137.5158	153.7549	524.3046	NA	53.2578	2 925.4765
2003	2 167.3262	148.6904	181.9074	529.3037	NA	57.5193	3 084.7470
2004	2 258.9404	135.5299	171.5281	767.0017	NA	64.2250	3 397.2252
2005	2 203.6292	193.3789	178.9995	674.1582	NA	63.1653	3 313.3311
2006	1 501.6238	252.9022	180.6068	608.5694	NA	47.5397	2 591.2419
2007	1 998.6691	439.4848	195.6427	324.5331	NA	57.8079	3 016.1376
2008	2 108.4320	475.8142	199.4060	333.0594	5.0595	61.9702	3 183.7413
2009	3 368.9061	233.4945	190.4183	342.1677	2.8561	78.6962	4 216.5388
2010	3 487.7994	216.6024	221.1527	431.5281	2.6849	84.8291	4 444.5966
2011	3 153.2765	235.0456	220.2314	780.6427	1.6502	89.0377	4 479.8841
2012	3 210.4679	258.1861	203.1343	771.2513	1.5726	89.4073	4 534.0195
2013	2 308.7469	213.2529	220.5422	575.1384	1.5578	61.0962	3 380.3344
2014	3 070.6532	250.6579	259.9359	585.6746	0.9116	79.8377	4 247.6710
2015	3 455.5985	210.7155	261.7464	427.6069	1.0848	83.6077	4 440.3597
2016	3 361.9174	233.7171	275.0515	298.8147	0.9060	82.7058	4 253.1125

Between 1990 and 2016, the decreasing trend of GHG emissions was also characteristic to all source categories within the Sector 1 'Energy' on the RBDR (Table 3-11).

Table 3-11: Breakdown of the direct GHG emissions from the Sector 1 'Energy' by category for the RBDR within 1990-2016 periods

	Direct GHG emissions, kt CO_2 equivalent							the share of each category, % from the total					
	1A1	1A2	1A3	1A4	1A5	1B2	Total	1A1	1A2	1A3	1A4	1A5	1B2
1990	9 252.3287	2 212.4085	4 479.4542	7 689.7135	115.5701	805.1627	24 554.6378	37.7	9.0	18.2	31.3	0.5	3.3
1991	8 141.5911	1 490.7200	3 405.6396	8 128.9575	107.5724	906.6216	22 181.1024	36.7	6.7	15.4	36.6	0.5	4.1
1992	6 495.0934	1 068.3480	2 399.6485	6 164.6672	78.5337	775.2688	16 981.5596	38.2	6.3	14.1	36.3	0.5	4.6
1993	4 975.9484	684.9689	1 523.7669	2 325.4332	94.3265	665.2960	10 269.7400	48.5	6.7	14.8	22.6	0.9	6.5
1994	2 733.6281	276.0456	1 313.7909	2 160.4012	89.0194	541.3629	7 114.2482	38.4	3.9	18.5	30.4	1.3	7.6
1995	2 603.8385	306.1441	1 325.1095	1 678.5364	126.5495	627.5288	6 667.7068	39.1	4.6	19.9	25.2	1.9	9.4
1996	2 663.8585	272.5615	1 295.5778	1 949.2727	82.8034	678.5611	6 942.6350	38.4	3.9	18.7	28.1	1.2	9.8
1997	2 526.5904	305.4690	1 307.7926	1 757.0688	77.4557	548.1633	6 522.5399	38.7	4.7	20.1	26.9	1.2	8.4
1998	2 263.4031	293.5483	1 137.1320	1 410.5849	73.6783	515.3714	5 693.7180	39.8	5.2	20.0	24.8	1.3	9.1
1999	1 709.2839	233.9424	771.1627	1 197.5783	49.8010	529.2188	4 490.9871	38.1	5.2	17.2	26.7	1.1	11.8
2000	1 199.3639	261.9317	836.4647	1 044.2674	36.8044	577.0822	3 955.9143	30.3	6.6	21.1	26.4	0.9	14.6
2001	1 423.4437	285.5369	906.6771	1 014.0758	43.8813	577.7884	4 251.4032	33.5	6.7	21.3	23.9	1.0	13.6
2002	1 296.8365	287.6032	1 141.8682	1 257.6701	40.1303	648.0794	4 672.1877	27.8	6.2	24.4	26.9	0.9	13.9
2003	1 269.2979	304.5154	1 330.5646	1 602.7125	28.8076	676.1341	5 212.0322	24.4	5.8	25.5	30.8	0.6	13.0

	Direct GHG emissions, kt CO_2 equivalent							the share of each category, % from the total					
	1A1	1A2	1A3	1A4	1A5	1B2	Total	1A1	1A2	1A3	1A4	1A5	1B2
2004	1 472.5026	330.3559	1 537.3307	1 529.9007	28.0207	729.5032	5 627.6139	26.2	5.9	27.3	27.2	0.5	13.0
2005	1 557.2305	405.8436	1 588.1191	1 585.0823	26.2833	772.8905	5 935.4494	26.2	6.8	26.8	26.7	0.4	13.0
2006	1 467.0151	409.3535	1 515.1910	1 643.2294	39.4920	693.0769	5 767.3579	25.4	7.1	26.3	28.5	0.7	12.0
2007	1 490.1025	385.3095	1 608.0748	1 378.3136	45.1203	729.2958	5 636.2165	26.4	6.8	28.5	24.5	0.8	12.9
2008	1 669.2354	434.0411	1 696.0944	1 381.3632	44.1742	723.5146	5 948.4228	28.1	7.3	28.5	23.2	0.7	12.2
2009	1 666.5853	282.8573	1 623.2163	1 524.0366	10.5966	587.8670	5 695.1590	29.3	5.0	28.5	26.8	0.2	10.3
2010	1 496.0294	227.2159	1 832.9653	1 598.5425	27.5201	568.1149	5 750.3882	26.0	4.0	31.9	27.8	0.5	9.9
2011	1 461.6352	363.1696	1 944.7013	1 578.3257	19.9471	650.8734	6 018.6523	24.3	6.0	32.3	26.2	0.3	10.8
2012	1 392.8374	199.2526	1 698.7379	1 557.0200	7.0060	647.3175	5 502.1714	25.3	3.6	30.9	28.3	0.1	11.8
2013	1 378.0355	386.1463	1 801.2229	1 432.7850	2.3899	644.8078	5 645.3873	24.4	6.8	31.9	25.4	0.0	11.4
2014	1 287.7447	218.1451	1 830.1171	1 466.1722	2.4267	604.6224	5 409.2282	23.8	4.0	33.8	27.1	0.0	11.2
2015	1 289.2271	323.9218	1 941.5832	1 495.9715	1.8300	570.8936	5 623.4271	22.9	5.8	34.5	26.6	0.0	10.2
2016	1 164.1433	268.2791	2 107.8747	1 513.9774	1.2228	618.6186	5 674.1159	20.5	4.7	37.1	26.7	0.0	10.9

Table 3-12, Figures 3-3 and 3.4 present the evolution of GHG emissions by source categories under the Sector 1 'Energy' in the Republic of Moldova within 1990-2016, respectively the share of each category from the sectoral total.

Table 3-12: Breakdown of the Republic of Moldova's Sector 1 'Energy' direct GHG emissions by category within 1990-2016 periods

	Direct GHG emissions, kt CO_2 equivalent							the share of each category, % from the sectoral total					
	1A1	1A2	1A3	1A4	1A5	1B2	Total	1A1	1A2	1A3	1A4	1A5	1B2
1990	21 308.2056	2 212.4085	4 479.4542	7 689.7135	115.5701	805.1627	36 610.5147	58.2	6.0	12.2	21.0	0.3	2.2
1991	18 930.1047	1 490.7200	3 405.6396	8 128.9575	107.5724	906.6216	32 969.6160	57.4	4.5	10.3	24.7	0.3	2.7
1992	15 654.0659	1 068.3480	2 399.6485	6 164.6672	78.5337	775.2688	26 140.5321	59.9	4.1	9.2	23.6	0.3	3.0
1993	12 640.0753	684.9689	1 762.9007	2 325.4332	94.3265	665.2960	18 173.0006	69.6	3.8	9.7	12.8	0.5	3.7
1994	9 959.3444	792.5847	1 527.4063	2 160.4012	89.0194	618.5236	15 147.2796	65.8	5.2	10.1	14.3	0.6	4.1
1995	7 160.4871	440.6772	1 539.2813	2 207.2356	126.5495	683.1369	12 157.3676	58.9	3.6	12.7	18.2	1.0	5.6
1996	7 091.6162	370.3100	1 490.6804	2 349.6445	82.8034	744.0574	12 129.1119	58.5	3.1	12.3	19.4	0.7	6.1
1997	5 593.3867	589.6544	1 509.7178	2 545.5057	77.4557	620.7220	10 936.4422	51.1	5.4	13.8	23.3	0.7	5.7
1998	4 814.4638	568.0101	1 307.0517	2 105.6673	73.6783	581.6167	9 450.4879	50.9	6.0	13.8	22.3	0.8	6.2
1999	4 140.4056	489.1123	876.1417	1 837.5824	49.8010	595.3063	7 988.3492	51.8	6.1	11.0	23.0	0.6	7.5
2000	3 613.2428	531.7932	942.9727	1 523.7452	36.8044	640.3016	7 288.8600	49.6	7.3	12.9	20.9	0.5	8.8
2001	4 107.8487	612.5378	1 019.9028	1 459.8599	43.8813	648.6921	7 892.7224	52.0	7.8	12.9	18.5	0.6	8.2
2002	3 353.4798	425.1190	1 295.6232	1 781.9747	40.1303	701.3372	7 597.6642	44.1	5.6	17.1	23.5	0.5	9.2
2003	3 436.6241	453.2059	1 512.4719	2 132.0162	28.8076	733.6534	8 296.7792	41.4	5.5	18.2	25.7	0.3	8.8
2004	3 731.4430	465.8858	1 708.8588	2 296.9025	28.0207	793.7282	9 024.8391	41.3	5.2	18.9	25.5	0.3	8.8
2005	3 760.8597	599.2226	1 767.1186	2 259.2406	26.2833	836.0558	9 248.7805	40.7	6.5	19.1	24.4	0.3	9.0
2006	2 968.6389	662.2557	1 695.7978	2 251.7988	39.4920	740.6166	8 358.5998	35.5	7.9	20.3	26.9	0.5	8.9
2007	3 488.7717	824.7942	1 803.7175	1 702.8467	45.1203	787.1037	8 652.3541	40.3	9.5	20.8	19.7	0.5	9.1
2008	3 777.6673	909.8553	1 895.5003	1 714.4226	49.2337	785.4848	9 132.1640	41.4	10.0	20.8	18.8	0.5	8.6
2009	5 035.4915	516.3518	1 813.6345	1 866.2043	13.4527	666.5631	9 911.6978	50.8	5.2	18.3	18.8	0.1	6.7
2010	4 983.8288	443.8184	2 054.1180	2 030.0705	30.2051	652.9441	10 194.9848	48.9	4.4	20.1	19.9	0.3	6.4
2011	4 614.9116	598.2152	2 164.9327	2 358.9684	21.5974	739.9111	10 498.5364	44.0	5.7	20.6	22.5	0.2	7.0
2012	4 603.3054	457.4388	1 901.8722	2 328.2713	8.5786	736.7247	10 036.1910	45.9	4.6	19.0	23.2	0.1	7.3
2013	3 686.7824	599.3992	2 021.7651	2 007.9234	3.9478	705.9040	9 025.7218	40.8	6.6	22.4	22.2	0.0	7.8
2014	4 358.3979	468.8030	2 090.0531	2 051.8469	3.3383	684.4601	9 656.8992	45.1	4.9	21.6	21.2	0.0	7.1
2015	4 744.8255	534.6373	2 203.3296	1 923.5784	2.9147	654.5012	10 063.7869	47.1	5.3	21.9	19.1	0.0	6.5
2016	4 526.0607	501.9962	2 382.9261	1 812.7922	2.1288	701.3244	9 927.2284	45.6	5.1	24.0	18.3	0.0	7.1

Within the Sector 1 'Energy', the source category with the largest share in the national direct GHG emissions is 1A1 'Energy Industries', varying over the review period from a maximum of 69.6 per cent (1993) to a minimum of 35.5 per cent (2006). Other major emissions sources within the Sector 1 'Energy' are represented by 1A4 'Other Sectors', with a share varying from a maximum of 26.9 per cent (2006) to a minimum of 12.8 per cent (1995); 1A3 'Transport', with a share varying from a maximum of 24.0 per cent (2016) to a minimum of 9.2 per cent (1992); 1A2 'Manufacturing Industries and Construction', with a share varying from a maximum of 10.0 per cent (2008) to a minimum of 3.1 per cent (1996); 1B2 'Fugitive Emissions from Oil and Natural Gas', with a share varying from a maximum of 9.2 per cent (2002) to a minimum of 2.2 per cent (1990).

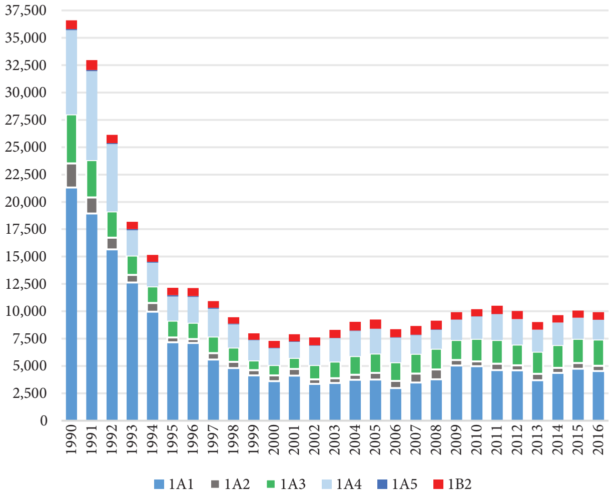


Figure 3-3: Breakdown of the Republic of Moldova's Sector 1 'Energy' direct GHG emissions by category within 1990-2016 periods.

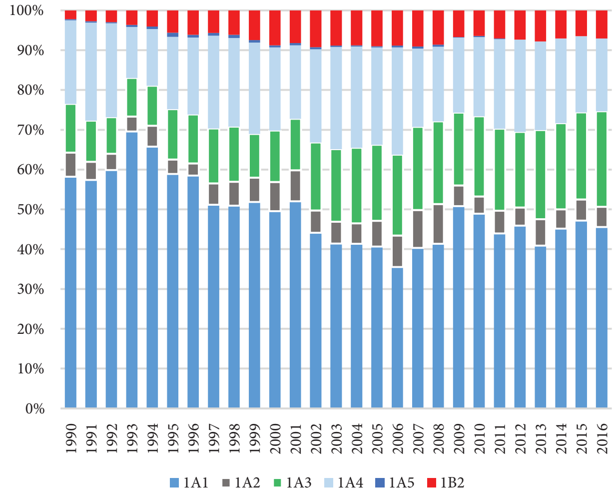


Figure 3-4: The share of different source categories in the structure of total direct GHG emissions from Sector 1 'Energy' within 1990-2016 periods, % from the total.

Compared to 1990, by 2016 the share of certain categories increased in the structure of total sectoral direct GHG emissions: 1A3 "Transport" (from 12.2 per cent to 24.0 per cent) and 1B2 „Fugitive Emissions from Oil and Natural Gas" (from 2.2 per cent to 7.1 per cent) (Table 3-12, Figure 3-5).

To be noted that the share of GHG emissions originated from the sub-sector 'Stationary Combustion' for the left bank of Dniester River from sources like 1A1, 1A2, 1A4 and 1A5 significantly varied during the reference period, from a maximum of 97.3 per cent of the total sub-sectoral GHG emissions in 1994 to a minimum of 92.3 per cent in 2013. Respectively, the share of GHG emissions originated from sub-sector 'Mobile Combustion', from sources like 1A3, 1A4 and 1A5, varied from a minimum of 2.7 per cent of the total in 1994, up to a maximum of 7.7 per cent in 2013 (Table 3-13).

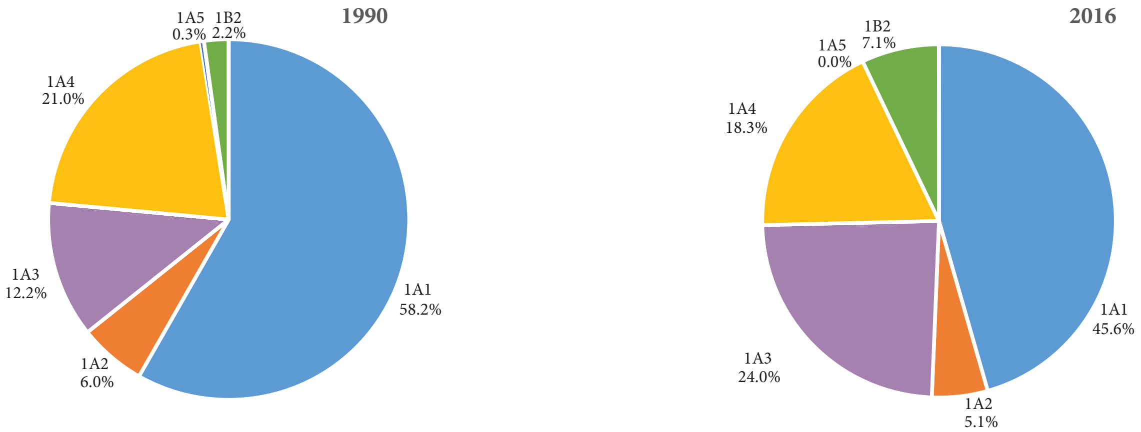


Figure 3-5: The share of different source categories in the structure of total direct GHG emissions from Sector 1 'Energy' in 1990 and 2016, % from the total.

Table 3-13: GHG emissions from 'Stationary Combustion' and 'Mobile Combustion' within the Sector 1 'Energy' for the LBDR

	Direct GHG emissions, kt CO_2 equivalent			in % from the total		in %, as compared to 1990	
	Stationary	Mobile	Total	Stationary	Mobile	Stationary	Mobile
1990	12 055.8770	NA	12 055.8770	100.0	NA	100.0	NA
1991	10 788.5136	NA	10 788.5136	100.0	NA	89.5	NA
1992	9 158.9726	NA	9 158.9726	100.0	NA	76.0	NA
1993	7 664.1268	239.1338	7 903.2606	97.0	3.0	63.6	100.0
1994	7 741.7518	213.6154	7 955.3672	97.3	2.7	64.2	89.3
1995	5 105.4801	328.5726	5 434.0527	94.0	6.0	42.3	137.4
1996	4 839.2645	281.7161	5 120.9806	94.5	5.5	40.1	117.8
1997	4 021.7528	319.5909	4 341.3437	92.6	7.4	33.4	133.6
1998	3 432.8955	257.6291	3 690.5246	93.0	7.0	28.5	107.7

	Direct GHG emissions, kt CO_2 equivalent			in % from the total		in %, as compared to 1990	
	Stationary	Mobile	Total	Stationary	Mobile	Stationary	Mobile
1999	3 252.2361	179.0386	3 431.2747	94.8	5.2	27.0	74.9
2000	3 111.7152	158.0112	3 269.7263	95.2	4.8	25.8	66.1
2001	3 406.5175	163.8980	3 570.4156	95.4	4.6	28.3	68.5
2002	2 679.3422	192.8765	2 872.2187	93.3	6.7	22.2	80.7
2003	2 816.9429	210.2848	3 027.2277	93.1	6.9	23.4	87.9
2004	3 137.0966	195.9036	3 333.0002	94.1	5.9	26.0	81.9
2005	3 053.9092	196.2567	3 250.1659	94.0	6.0	25.3	82.1
2006	2 348.5874	195.1148	2 543.7022	92.3	7.7	19.5	81.6
2007	2 752.1743	206.1554	2 958.3297	93.0	7.0	22.8	86.2
2008	2 912.9437	208.8273	3 121.7710	93.3	6.7	24.2	87.3
2009	3 935.0267	202.8160	4 137.8427	95.1	4.9	32.6	84.8
2010	4 113.1476	246.6198	4 359.7675	94.3	5.7	34.1	103.1
2011	4 142.2293	248.6170	4 390.8464	94.3	5.7	34.4	104.0
2012	4 210.2990	234.3132	4 444.6123	94.7	5.3	34.9	98.0
2013	3 062.8281	256.4102	3 319.2383	92.3	7.7	25.4	107.2
2014	3 873.2146	294.6186	4 167.8332	92.9	7.1	32.1	123.2
2015	4 062.2362	294.5158	4 356.7521	93.2	6.8	33.7	123.2
2016	3 895.3552	275.0515	4 170.4067	93.4	6.6	32.3	115.0

The share of GHG emissions originated from the sub-sector 'Stationary Combustion' on the RBDR significantly varied during the reference period, from a maximum of 80.9 per cent of the total sub-sectoral GHG emissions in 1992 to a minimum of 54.2 per cent in 2016. Respectively, the share of GHG emissions originated from sub-sector 'Mobile Combustion' varied from a minimum of 19.1 per cent of the total in 1992 up to a maximum of 45.8 per cent in 2016 (Table 3-14).

Table 3-14: GHG emissions from 'Stationary Combustion' and 'Mobile Combustion' within the Sector 1 'Energy' for the RBDR

	Direct GHG emissions, kt CO_2 equivalent			in % from the total		in %, as compared to 1990	
	Stationary	Mobile	Total	Stationary	Mobile	Stationary	Mobile
1990	17 800.8881	5 948.5869	23 749.4751	75.0	25.0	100.0	100.0
1991	16 789.0743	4 485.4064	21 274.4807	78.9	21.1	94.3	75.4
1992	13 104.4132	3 101.8776	16 206.2907	80.9	19.1	73.6	52.1
1993	7 419.1771	2 185.2669	9 604.4439	77.2	22.8	41.7	36.7
1994	4 629.3861	1 943.4991	6 572.8853	70.4	29.6	26.0	32.7
1995	4 114.5514	1 925.6266	6 040.1780	68.1	31.9	23.1	32.4
1996	4 481.9534	1 782.1206	6 264.0739	71.6	28.4	25.2	30.0
1997	4 213.7568	1 760.6198	5 974.3765	70.5	29.5	23.7	29.6
1998	3 709.1994	1 469.1472	5 178.3466	71.6	28.4	20.8	24.7
1999	2 965.2657	996.5026	3 961.7682	74.8	25.2	16.7	16.8
2000	2 367.0066	1 011.8254	3 378.8320	70.1	29.9	13.3	17.0
2001	2 592.5802	1 081.0346	3 673.6148	70.6	29.4	14.6	18.2
2002	2 661.1976	1 362.9107	4 024.1083	66.1	33.9	14.9	22.9
2003	2 998.6172	1 537.2809	4 535.8981	66.1	33.9	16.8	25.8
2004	3 167.5012	1 730.6095	4 898.1107	64.7	35.3	17.8	29.1
2005	3 398.9396	1 763.6192	5 162.5589	65.8	34.2	19.1	29.6
2006	3 380.1710	1 694.1100	5 074.2810	66.6	33.4	19.0	28.5
2007	3 130.7183	1 776.2025	4 906.9208	63.8	36.2	17.6	29.9
2008	3 370.1007	1 854.8075	5 224.9082	64.5	35.5	18.9	31.2
2009	3 358.0571	1 749.2349	5 107.2920	65.8	34.2	18.9	29.4
2010	3 220.3957	1 961.8776	5 182.2733	62.1	37.9	18.1	33.0
2011	3 300.2855	2 067.4934	5 367.7789	61.5	38.5	18.5	34.8
2012	3 042.6281	1 812.2259	4 854.8540	62.7	37.3	17.1	30.5
2013	3 077.2650	1 923.3146	5 000.5796	61.5	38.5	17.3	32.3
2014	2 813.3273	1 991.2785	4 804.6058	58.6	41.4	15.8	33.5
2015	2 930.0009	2 122.5327	5 052.5336	58.0	42.0	16.5	35.7
2016	2 742.4028	2 313.0945	5 055.4973	54.2	45.8	15.4	38.9

The share of GHG emissions originated from the sub-sector 'Stationary Combustion', from sources like 1A1, 1A2, 1A4 and 1A5 varied during the reference period, from 87.8 per cent of the total in 1992 to a minimum of 71.9 per cent in 2016.

Respectively, the share of GHG emissions originated from sub-sector 'Mobile Combustion', from sources like 1A3, 1A4 and 1A5, varied from a minimum of 12.2 per cent of the total in 1992 to a maximum of 28.1 per cent in 2016 (Table 3-15, Figure 3-6).

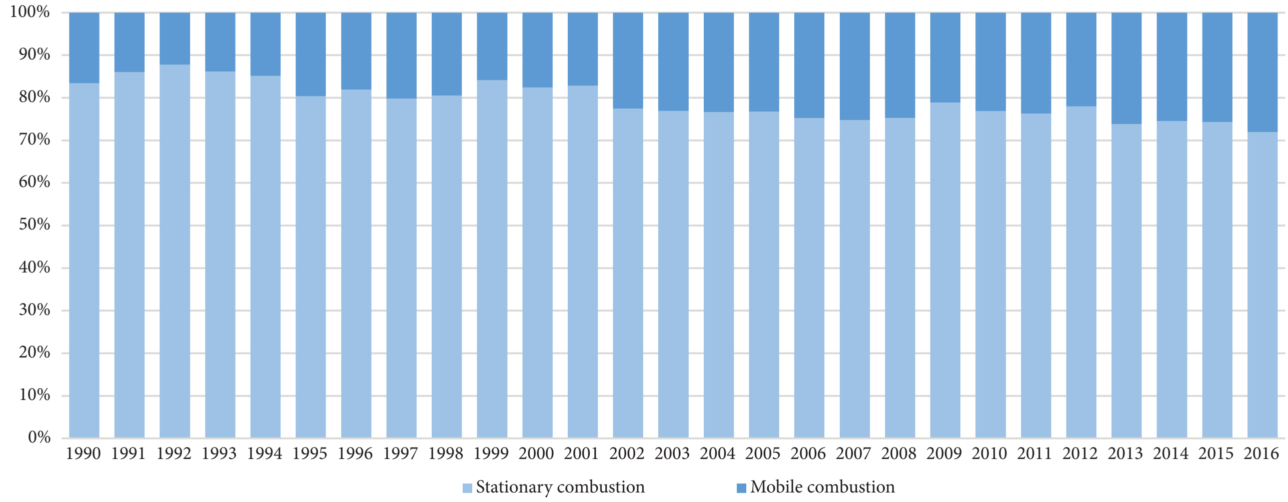


Figure 3-6: The share of direct GHG emissions from 'Stationary Combustion' and 'Mobile Combustion' within the Sector 1 'Energy' in the RM, % from the total within sub-sector 1A.

Table 3-15: GHG emissions from 'Stationary Combustion' and 'Mobile Combustion' within the Sector 1 'Energy' in the Republic of Moldova

	Direct GHG emissions kt CO_2 equivalent			in % from the total		in %, as compared to 1990	
	Stationary	Mobile	Total	Stationary	Mobile	Stationary	Mobile
1990	29 856.7651	5 948.5869	35 805.3520	83.4	16.6	100.0	100.0
1991	27 577.5879	4 485.4064	32 062.9943	86.0	14.0	92.4	75.4
1992	22 263.3857	3 101.8776	25 365.2633	87.8	12.2	74.6	52.1
1993	15 083.3039	2 424.4007	17 507.7046	86.2	13.8	50.5	40.8
1994	12 371.1380	2 157.1145	14 528.2525	85.2	14.8	41.4	36.3
1995	9 220.0315	2 254.1992	11 474.2307	80.4	19.6	30.9	37.9
1996	9 321.2179	2 063.8367	11 385.0545	81.9	18.1	31.2	34.7
1997	8 235.5095	2 080.2107	10 315.7202	79.8	20.2	27.6	35.0
1998	7 142.0949	1 726.7764	8 868.8713	80.5	19.5	23.9	29.0
1999	6 217.5018	1 175.5411	7 393.0429	84.1	15.9	20.8	19.8
2000	5 478.7218	1 169.8366	6 648.5584	82.4	17.6	18.4	19.7
2001	5 999.0977	1 244.9326	7 244.0303	82.8	17.2	20.1	20.9
2002	5 340.5398	1 555.7872	6 896.3270	77.4	22.6	17.9	26.2
2003	5 815.5601	1 747.5657	7 563.1258	76.9	23.1	19.5	29.4
2004	6 304.5979	1 926.5130	8 231.1109	76.6	23.4	21.1	32.4
2005	6 452.8489	1 959.8759	8 412.7248	76.7	23.3	21.6	32.9
2006	5 728.7584	1 889.2248	7 617.9832	75.2	24.8	19.2	31.8
2007	5 882.8926	1 982.3578	7 865.2504	74.8	25.2	19.7	33.3
2008	6 283.0445	2 063.6348	8 346.6792	75.3	24.7	21.0	34.7
2009	7 293.0838	1 952.0509	9 245.1347	78.9	21.1	24.4	32.8
2010	7 333.5433	2 208.4974	9 542.0407	76.9	23.1	24.6	37.1
2011	7 442.5149	2 316.1104	9 758.6253	76.3	23.7	24.9	38.9
2012	7 252.9271	2 046.5391	9 299.4662	78.0	22.0	24.3	34.4
2013	6 140.0931	2 179.7247	8 319.8178	73.8	26.2	20.6	36.6
2014	6 686.5419	2 285.8971	8 972.4391	74.5	25.5	22.4	38.4
2015	6 992.2371	2 417.0486	9 409.2857	74.3	25.7	23.4	40.6
2016	6 637.7580	2 588.1460	9 225.9040	71.9	28.1	22.2	43.5

In the structure of the total GHG emissions originated from the Sector 1 'Energy' on the LBDR, the share of fugitive emissions from sub-sector 1B 'Fugitive Emissions' was insignificant compared to the share of GHG emissions originated from 1A 'Fuel Combustion Activities' (Table 3-16).

Table 3-16: Direct GHG emissions from 1A 'Fuel Combustion Activities' and 1B 'Fugitive Emissions from Fuels' sub-sectors under the Sector 1 'Energy' for the LBDR within 1990-2016 periods

	Direct GHG emissions, kt CO_2 equivalent			in % from the total		in %, as compared to 1990		
	1A Fuel Combustion	1B Fugitive Emissions	1. Energy	1A Fuel Combustion	1B Fugitive Emissions	1A Fuel Combustion	1B Fugitive Emissions	1. Energy
1990	12 055.8770	NA	12 055.8770	100.0	NA	100.0	NA	100.0
1991	10 788.5136	NA	10 788.5136	100.0	NA	89.5	NA	89.5
1992	9 158.9726	NA	9 158.9726	100.0	NA	76.0	NA	76.0
1993	7 903.2606	NA	7 903.2606	100.0	NA	65.6	NA	65.6
1994	7 955.3672	77.1607	8 032.5279	99.0	1.0	66.0	100.0	66.6
1995	5 434.0527	55.6082	5 489.6608	99.0	1.0	45.1	72.1	45.5

	Direct GHG emissions, kt CO_2 equivalent			in % from the total		in %, as compared to 1990		
	1A Fuel Combustion	1B Fugitive Emissions	1. Energy	1A Fuel Combustion	1B Fugitive Emissions	1A Fuel Combustion	1B Fugitive Emissions	1. Energy
1996	5 120.9806	65.4963	5 186.4769	98.7	1.3	42.5	84.9	43.0
1997	4 341.3437	72.5587	4 413.9024	98.4	1.6	36.0	94.0	36.6
1998	3 690.5246	66.2453	3 756.7699	98.2	1.8	30.6	85.9	31.2
1999	3 431.2747	66.0875	3 497.3621	98.1	1.9	28.5	85.6	29.0
2000	3 269.7263	63.2194	3 332.9457	98.1	1.9	27.1	81.9	27.6
2001	3 570.4156	70.9037	3 641.3192	98.1	1.9	29.6	91.9	30.2
2002	2 872.2187	53.2578	2 925.4765	98.2	1.8	23.8	69.0	24.3
2003	3 027.2277	57.5193	3 084.7470	98.1	1.9	25.1	74.5	25.6
2004	3 333.0002	64.2250	3 397.2252	98.1	1.9	27.6	83.2	28.2
2005	3 250.1659	63.1653	3 313.3311	98.1	1.9	27.0	81.9	27.5
2006	2 543.7022	47.5397	2 591.2419	98.2	1.8	21.1	61.6	21.5
2007	2 958.3297	57.8079	3 016.1376	98.1	1.9	24.5	74.9	25.0
2008	3 121.7710	61.9702	3 183.7413	98.1	1.9	25.9	80.3	26.4
2009	4 137.8427	78.6962	4 216.5388	98.1	1.9	34.3	102.0	35.0
2010	4 359.7675	84.8291	4 444.5966	98.1	1.9	36.2	109.9	36.9
2011	4 390.8464	89.0377	4 479.8841	98.0	2.0	36.4	115.4	37.2
2012	4 444.6123	89.4073	4 534.0195	98.0	2.0	36.9	115.9	37.6
2013	3 319.2383	61.0962	3 380.3344	98.2	1.8	27.5	79.2	28.0
2014	4 167.8332	79.8377	4 247.6710	98.1	1.9	34.6	103.5	35.2
2015	4 356.7521	83.6077	4 440.3597	98.1	1.9	36.1	108.4	36.8
2016	4 170.4067	82.7058	4 253.1125	98.1	1.9	34.6	107.2	35.3

In the structure of the total GHG emissions originated from the Sector 1 'Energy' on the RBDR, the share of fugitive emissions from sub-sector 1B tended to grow from a minimum of 3.3 per cent in 1990 to maximum of 14.6 per cent in 2000. Respectively, the share of GHG emissions originated from the sub-sector 1A 'Fuel Combustion Activities' varied from a minimum of 85.4 per cent in 2000 up to a maximum of 96.7 per cent in 1990 (Table 3-17).

Table 3-17: Direct GHG emissions from 1A 'Fuel Combustion Activities' and 1B 'Fugitive Emissions from Fuels' sub-sectors under the Sector 1 'Energy' for the RBDR within 1990-2016 periods

	Direct GHG emissions, kt CO_2 equivalent			in % from the total		in %, as compared to 1990		
	1A Fuel Combustion	1B Fugitive Emissions	1. Energy	1A Fuel Combustion	1B Fugitive Emissions	1A Fuel Combustion	1B Fugitive Emissions	1. Energy
1990	23 749.4751	805.1627	24 554.6378	96.7	3.3	100.0	100.0	100.0
1991	21 274.4807	906.6216	22 181.1024	95.9	4.1	89.6	112.6	90.3
1992	16 206.2907	775.2688	16 981.5596	95.4	4.6	68.2	96.3	69.2
1993	9 604.4439	665.2960	10 269.7400	93.5	6.5	40.4	82.6	41.8
1994	6 572.8853	541.3629	7 114.2482	92.4	7.6	27.7	67.2	29.0
1995	6 040.1780	627.5288	6 667.7068	90.6	9.4	25.4	77.9	27.2
1996	6 264.0739	678.5611	6 942.6350	90.2	9.8	26.4	84.3	28.3
1997	5 974.3765	548.1633	6 522.5399	91.6	8.4	25.2	68.1	26.6
1998	5 178.3466	515.3714	5 693.7180	90.9	9.1	21.8	64.0	23.2
1999	3 961.7682	529.2188	4 490.9871	88.2	11.8	16.7	65.7	18.3
2000	3 378.8320	577.0822	3 955.9143	85.4	14.6	14.2	71.7	16.1
2001	3 673.6148	577.7884	4 251.4032	86.4	13.6	15.5	71.8	17.3
2002	4 024.1083	648.0794	4 672.1877	86.1	13.9	16.9	80.5	19.0
2003	4 535.8981	676.1341	5 212.0322	87.0	13.0	19.1	84.0	21.2
2004	4 898.1107	729.5032	5 627.6139	87.0	13.0	20.6	90.6	22.9
2005	5 162.5589	772.8905	5 935.4494	87.0	13.0	21.7	96.0	24.2
2006	5 074.2810	693.0769	5 767.3579	88.0	12.0	21.4	86.1	23.5
2007	4 906.9208	729.2958	5 636.2165	87.1	12.9	20.7	90.6	23.0
2008	5 224.9082	723.5146	5 948.4228	87.8	12.2	22.0	89.9	24.2
2009	5 107.2920	587.8670	5 695.1590	89.7	10.3	21.5	73.0	23.2
2010	5 182.2733	568.1149	5 750.3882	90.1	9.9	21.8	70.6	23.4
2011	5 367.7789	650.8734	6 018.6523	89.2	10.8	22.6	80.8	24.5
2012	4 854.8540	647.3175	5 502.1714	88.2	11.8	20.4	80.4	22.4
2013	5 000.5796	644.8078	5 645.3873	88.6	11.4	21.1	80.1	23.0
2014	4 804.6058	604.6224	5 409.2282	88.8	11.2	20.2	75.1	22.0
2015	5 052.5336	570.8936	5 623.4271	89.8	10.2	21.3	70.9	22.9
2016	5 055.4973	618.6186	5 674.1159	89.1	10.9	21.3	76.8	23.1

The share of fugitive emissions – sub-sector 1B 'Fugitive Emissions from Fuels' in the structure of the total GHG emissions originated from the Sector 1 'Energy', tended to grow from a minimum of 2.2 per cent in 1990 to maximum of 9.2 per cent in 2002. Respectively, the share of GHG emissions from the sub-sector 1A 'Fuel Combustion Activities' decreased from a maximum of 97.8 per cent in 1990 to a minimum of 90.8 per cent in 2002 (Table 3-18, Figure 3-7).

Table 3-18: Direct GHG emissions from 1A 'Fuel Combustion Activities' and 1B 'Fugitive Emissions from Fuels' under the Sector 1 'Energy' of the RM within 1990-2016 periods

	Direct GHG emissions, kt CO_2 equivalent			in % from the total		in %, as compared to 1990		
	1A Fuel Combustion	1B Fugitive Emissions	1. Energy	1A Fuel Combustion	1B Fugitive Emissions	1A Fuel Combustion	1B Fugitive Emissions	1. Energy
1990	35 805.3520	805.1627	36 610.5147	97.8	2.2	100.0	100.0	100.0
1991	32 062.9943	906.6216	32 969.6160	97.3	2.7	89.5	112.6	90.1
1992	25 365.2633	775.2688	26 140.5321	97.0	3.0	70.8	96.3	71.4
1993	17 507.7046	665.2960	18 173.0006	96.3	3.7	48.9	82.6	49.6
1994	14 528.7561	618.5236	15 147.2796	95.9	4.1	40.6	76.8	41.4
1995	11 474.2307	683.1369	12 157.3676	94.4	5.6	32.0	84.8	33.2
1996	11 385.0545	744.0574	12 129.1119	93.9	6.1	31.8	92.4	33.1
1997	10 315.7202	620.7220	10 936.4422	94.3	5.7	28.8	77.1	29.9
1998	8 868.8713	581.6167	9 450.4879	93.8	6.2	24.8	72.2	25.8
1999	7 393.0429	595.3063	7 988.3492	92.5	7.5	20.6	73.9	21.8
2000	6 648.5584	640.3016	7 288.8600	91.2	8.8	18.6	79.5	19.9
2001	7 244.0303	648.6921	7 892.7224	91.8	8.2	20.2	80.6	21.6
2002	6 896.3270	701.3372	7 597.6642	90.8	9.2	19.3	87.1	20.8
2003	7 563.1258	733.6534	8 296.7792	91.2	8.8	21.1	91.1	22.7
2004	8 231.1109	793.7282	9 024.8391	91.2	8.8	23.0	98.6	24.7
2005	8 412.7248	836.0558	9 248.7805	91.0	9.0	23.5	103.8	25.3
2006	7 617.9832	740.6166	8 358.5998	91.1	8.9	21.3	92.0	22.8
2007	7 865.2504	787.1037	8 652.3541	90.9	9.1	22.0	97.8	23.6
2008	8 346.6792	785.4848	9 132.1640	91.4	8.6	23.3	97.6	24.9
2009	9 245.1347	666.5631	9 911.6978	93.3	6.7	25.8	82.8	27.1
2010	9 542.0407	652.9441	10 194.9848	93.6	6.4	26.6	81.1	27.8
2011	9 758.6253	739.9111	10 498.5364	93.0	7.0	27.3	91.9	28.7
2012	9 299.4662	736.7247	10 036.1910	92.7	7.3	26.0	91.5	27.4
2013	8 319.8178	705.9040	9 025.7218	92.2	7.8	23.2	87.7	24.7
2014	8 972.4391	684.4601	9 656.8992	92.9	7.1	25.1	85.0	26.4
2015	9 409.2857	654.5012	10 063.7869	93.5	6.5	26.3	81.3	27.5
2016	9 225.9040	701.3244	9 927.2284	92.9	7.1	25.8	87.1	27.1

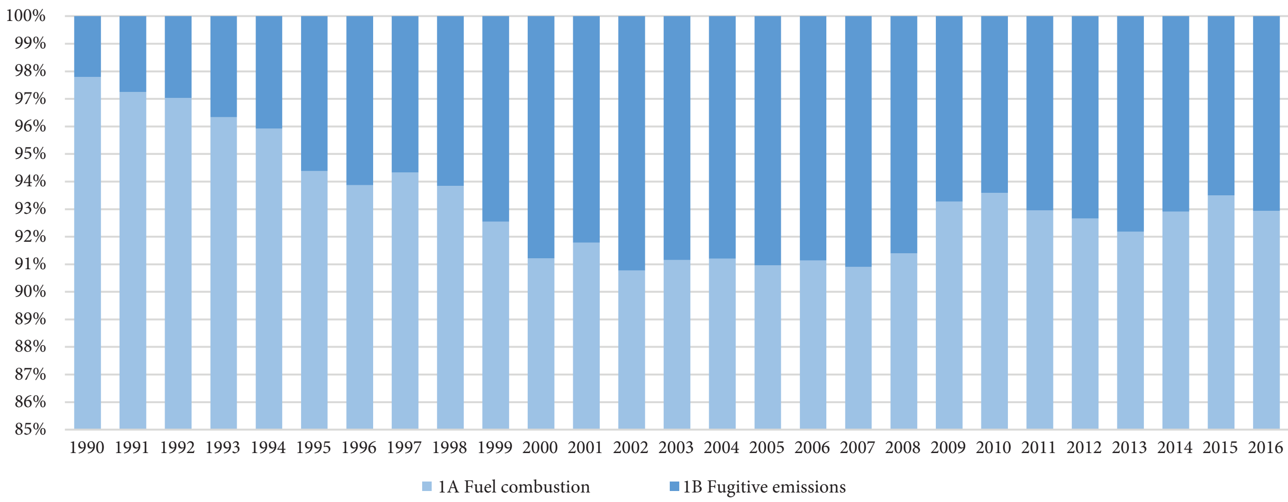


Figure 3-7: The share of direct GHG emissions from 1A 'Fuel Combustion Activities' and 1B 'Fugitive Emissions from Fuels' sub-sectors within 1990-2016 periods, % from the total.

3.1.2. Key Categories

The results of key category analysis (with LULUCF) carried out following a Tier 1 approach are provided in Chapter 1.5 of this Report. Table 3-19 provides information on identified key categories (by level and trend assessment) within the Sector 1 'Energy' of the Republic of Moldova.

Table 3-19: Key categories identified within the Sector 1 'Energy'

IPCC Categories	GHG	Source Categories	Key Categories
1.A.1	CO_2	CO_2 Emissions from Energy Industries	Yes (L, T)
1.A.1	CH_4	CH_4 Emissions from Energy Industries	No
1.A.1	N_2O	N_2O Emissions from Energy Industries	No
1.A.2	CO_2	CO_2 Emissions from Manufacturing Industry and Construction	Yes (L, T)
1.A.2	CH_4	CH_4 Emissions from Manufacturing Industry and Construction	No
1.A.2	N_2O	N_2O Emissions from Manufacturing Industry and Construction	No
1.A.3a	CO_2	CO_2 Emissions from Domestic Aviation	No
1.A.3a	CH_4	CH_4 Emissions from Domestic Aviation	No
1.A.3a	N_2O	N_2O Emissions from Domestic Aviation	No
1.A.3b	CO_2	CO_2 Emissions from Road Transportation	Yes (L, T)
1.A.3b	CH_4	CH_4 Emissions from Road Transportation	No
1.A.3b	N_2O	N_2O Emissions from Road Transportation	No
1.A.3c	CO_2	CO_2 Emissions from Railways	Yes (L, T)
1.A.3c	CH_4	CH_4 Emissions from Railways	No
1.A.3c	N_2O	N_2O Emissions from Railways	No
1.A.3d	CO_2	CO_2 Emissions from Domestic Navigation	No
1.A.3d	CH_4	CH_4 Emissions from Domestic Navigation	No
1.A.3d	N_2O	N_2O Emissions from Domestic Navigation	No
1.A.3e	CO_2	CO_2 Emissions from Pipeline Transport	No
1.A.3e	CH_4	CH_4 Emissions from Pipeline Transport	No
1.A.3e	N_2O	N_2O Emissions from Pipeline Transport	No
1.A.4	CO_2	CO_2 Emissions from Other Sectors	Yes (L, T)
1.A.4	CH_4	CH_4 Emissions from Other Sectors	Yes (L)
1.A.4	N_2O	N_2O Emissions from Other Sectors	No
1.A.5	CO_2	CO_2 Emissions from Other	No
1.A.5	CH_4	CH_4 Emissions from Other	No
1.A.5	N_2O	N_2O Emissions from Other	No
1.B.2	CO_2	CO_2 Fugitive Emissions from Oil and Natural Gas	No
1.B.2	CH_4	CH_4 Fugitive Emissions from Oil and Natural Gas	Yes (L, T)
1.B.2	N_2O	N_2O Fugitive Emissions from Oil and Natural Gas	No

3.1.3. Methodological Issues

Under the Sector 1 'Energy' there were estimated GHG emissions originated from 5 source categories under sub-sector 1A 'Fuel Combustion Activities' (1A1, 1A2, 1A3, 1A4 and 1A5), 1 source category under subsector 1B 'Fugitive Emissions from Fuels' (1B2) and 2 source categories under Memo Items ('International Aviation', and 'CO_2 Emissions from Biomass'). GHG emissions originated from the Sector 1 'Energy' were estimated following a Tier 1 approach, for all source categories, except 'International Bunkers: Aviation', for which was applied a Tier 2 methodology (Table 3-20).

Table 3-20: Summary of 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 (Domestic Aviation, Road Transportation, Railways, Domestic 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 were used country specific annual average net caloric values, thus emissions from the combustion of this particular type of fuel were estimated using a Tier 2 approach. During the current inventory cycle, GHG emissions from 1A3b 'Road Transportation' were estimated applying a Tier 3 approach (the COPERT 4.9 model program was tested), but this change was possible only for 2014-2016 time series (due to lacking AD, it was impossible so far to extend the calculations for a longer period of time).

The basic equations used to estimate GHG emissions under the Sector 1 'Energy' are described below:

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

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 1990, 1993-2016 years (the Energy Balances for 2016 is presented in Annex 2) and Statistical Yearbooks, including those of ATULBD (activity data regarding fuel consumption on the territory on the Left Bank of the Dniester River are available in Annex 3-1).

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 are the Energy Balances of the RM, provided annually by the National Bureau of Statistics (NBS). At the same time, it is useful the information provided directly by enterprises in the field of energy, transport, by different ministries and agencies. The legal base for data requests is assured by the Law No. 93 as of 26.05.2017 on Official Statistics, as well as Law No. 982 as of 11.05.2000 on access to information (for the Public Services Agency, an additional contract was signed between the parts regarding services providing). The list of organizations that provide primary data for the Sector 1 'Energy' is presented below:

1. National Bureau of Statistics, Direction for Industry, Energy and Construction Statistics;
2. J.S.C. "Termoelectrica" (subdivisions "CHP-1", "CHP-2" and "Termoservice");
3. J.S.C. "CHP-North";
4. Ministry of Economy and Infrastructure of the Republic of Moldova;
5. Ministry of Defense of the Republic of Moldova, Service for Ecology and Environment Protection;
6. Customs Service of the Republic of Moldova;
7. Public Services Agency (the successor of S.E "Centre for State Information Resources "Register");
8. Civil Aeronautical Authority;
9. "Moldavian Railways" State Owned Enterprises;
10. "Moldovagaz" J.S.C;
11. Inspectorate for Environmental Protection (information on the characteristics of the technological processes for oil and natural gas extraction, based on data provided by Company "Valiexchimp J.S.C.");
12. Institute of Power Engineering of the Academy of Sciences of Moldova.

To be noted that the Energy Balance for 1990 year ensured geographical coverage of the whole country, while the Energy Balances for the time series from 1993 through 2016 covered only the territory on the right bank of the Dniester River (in the 1991-1992 years 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 a MS DOS format, and only since 2015 these were generated and provided to users in a MS Excel form, which facilitates the data analyze and use process. The estimation of GHG emissions was based on country specific values (Table 3-21).

Table 3-21: Emission factors and other relevant parameters used to estimate GHG emissions from the Sector 1 'Energy' in the Republic of Moldova

Fuel Type	Net Calorific Value (CS Values), TJ/kt		Net Calorific Value, TJ/kt		Emission factors, t C/TJ		Fraction of carbon oxidized	
	Ranges according to the NBS	Value used	IPCC, 1997	IPCC, 2006	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 Ukrainian Coal Basins	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
Brown Coal Briquettes	17.75	17.75		20.7	25.8	26.6	0.98	1
Coking Coal	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 Type	Net Calorific Value (CS Values), TJ/kt		Net Calorific Value, TJ/kt		Emission factors, t C/TJ		Fraction of carbon oxidized	
	Ranges according to the NBS	Value used	IPCC, 1997	IPCC, 2006	IPCC, 1997	IPCC, 2006	IPCC, 1997	IPCC, 2006
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
Fuel Wood	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-EB "Energy Balance", approved through Order No. 88 from 03.10.2012 of the National Bureau of Statistics of the RM (<http://www.statistica.md/public/files/Formulare_statistice/2013/industrie_energetica/1_BE.pdf>

In the Statistical Report No. 1-BE "Energy Balance", respectively in the "Instructions for drafting the Statistical Report No. 1-BE" average caloric values are available for converting quantitative indicators for fuel from natural units to coal equivalent units (Table 3-22).

Table 3-22: The method of calculating the average caloric values based on the instructions for drafting the Statistical Report No. 1-BE "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
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
Fuel Wood	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: http://www.statistica.md/

Table 3-23 presents country specific data pertaining to annual average net caloric values for natural gas imported and consumed in the RM, which are periodically provided by J.S.C. "Moldovagaz" through official letters. Unlike the previous inventory cycles, when a multiannual average net caloric value for natural gas imported and consumed was used, the current inventory used annual average net caloric values according to the information received from by J.S.C. "Moldovagaz" (Table 3-23).

Table 3-23: AD on annual average Net Caloric Values for natural gas imported in the Republic of Moldova within 1990-2016 periods

		1990	1991	1992	1993	1994	1995	1996	1997	1998
BUR2	kcal/m³	7980	7980	7980	7980	7980	7980	7980	7980	7970
	TJ/mil. m³	33.40	33.40	33.40	33.40	33.40	33.40	33.40	33.40	33.36
NC4		33.86	33.86	33.86	33.86	33.86	33.86	33.86	33.86	33.86
Difference	%	-1.3	-1.3	-1.3	-1.3	-1.3	-1.3	-1.3	-1.3	-1.5
		1999	2000	2001	2002	2003	2004	2005	2006	2007
BUR2	kcal/m³	7976	7978	7972	7992	8007	8019	8026	8035	8038
	TJ/mil. m³	33.39	33.40	33.37	33.45	33.52	33.57	33.60	33.63	33.65
NC4		33.86	33.86	33.86	33.86	33.86	33.86	33.86	33.86	33.86
Difference	%	-1.4	-1.4	-1.4	-1.2	-1.0	-0.9	-0.8	-0.7	-0.6
		2008	2009	2010	2011	2012	2013	2014	2015	2016
BUR2	kcal/m³	8041	8074	8071	8081	8107	8137	8175	8246	8237
	TJ/mil. m³	33.66	33.80	33.79	33.83	33.94	34.06	34.22	34.52	34.48
NC4		33.86	33.86	33.86	33.86	33.86	33.86	33.86	33.86	33.86
Difference	%	-0.6	-0.2	-0.2	-0.1	0.2	0.6	1.1	1.9	1.8

Source: J.S.C. „Moldovagaz". **Abbreviations:** NC4 – Fourth National Communication of the RM under the UNFCCC (2018); BUR2 – Second Biennial Update Report of the RM under the UNFCCC (2019).

The tables below present category sources under the Sector 1 'Energy' for which statistical data regarding the territory on the left bank of Dniester River are available (Tables 3-24 and 3-25).

Table 3-24: Category sources under the Sector 1 'Energy' for which statistical data regarding the territory on the LBDR are available, compared to the RBDR

Source Category	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, 2008-2016; natural gas: 1990-2016
1A1aii Heat and Power Generation	*	NO	Not Occurring
1A1aiii Heat Plants	*	*	Coal, residual fuel oil:1990-1998, 2008-2016; natural gas: 1994-2016
1A1b Petroleum Refining	*	NO	Not Occurring
1A1c Manufacture of Solid Fuels and Other Energy Industries	*	NO	Not Occurring
1A2. Manufacturing Industries and Construction	*	*	**Natural gas: 1994-2016; Coal, residual fuel oil: 2008-2016; LPG: 2011-2016**
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: 2009-2016
c. Railways	*	*	
d. Water-borne Navigation	*	NO	Not Occurring
e. Other Transportation	*	NO	Not Occurring
e i. Pipeline Transport	*	NO	Not Occurring
e ii Off-road Transport	NA	NA	
e iii Fishing (mobile combustion)	NO	NO	Not Occurring
1A4. Other Sectors	*	*	

Source Category	RBDR	LBDR	Statistical data for the LBDR, by fuels and the period for which data are available
a. Commercial / Institutional	*	*	Natural gas: 1999-2016, LPG: 2011-2016; Coal, residual fuel oil: 2008-2016
b. Residential	*	*	Natural gas, LPG: 1995-2016; fuel wood: 2008-2016
c. Agriculture / Forestry / Fishing	*	*	
c i. Stationary	*	*	Coal, residual fuel oil: 2008-2016
c ii. Mobile	*	*	Gasoline, diesel oil: 1995-2016
1A5. Other	*	*	
a. Stationary	*	*	Coal, residual fuel oil: 2008-2016
b. Mobile	*	NO	Not Occurring
1B. Fugitive Emissions from Fuels	*	*	
1B1. Solid Fuels	NO	NO	Not Occurring
a. Coal mining and handling	NO	NO	Not Occurring
b. Solid Fuel Transformation	NO	NO	Not Occurring
c. Other	NO	NO	Not Occurring
1B2. Oil, Natural Gas and Fugitive Emissions from Energy Production	*	*	
a. Oil	*	NO	Not Occurring
b. Natural Gas	*	*	
c. Venting and Flaring	*	*	
d. Other	NO	NO	Not Occurring
1C. CO_2 Transport and Storage	**NO**	**NO**	
1. CO_2 Transport	NO	NO	Not Occurring
2. CO_2 Transport Injection and Storage	NO	NO	Not Occurring
3. Other	NO	NO	Not Occurring
Memo Items: (1)	*	**NO**	
International Bunkers	*	NO	Not Occurring
International Aviation	*	NO	Not Occurring
International Maritime Navigation	NO	NO	Not Occurring
Multilateral Operations	NO	NO	Not Occurring
CO_2 Emissions from Biomass	*	*	**Fuel Wood: 2008-2016**
CO_2 Capture	NO	NO	Not Occurring
For storage at national level	NO	NO	Not Occurring
For storage in other countries	NO	NO	Not Occurring

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

Table 3-25: GHG emissions on the LBDR by source category and fuel type

	Statistical Data for the LBDR, By Source Category and Fuel							
	1A1	1A2	1A3	1A4a	1A4b	1A4c	1A5	1B2
Coal	*	*	NO	*	NA	*	*	NO
Residual Fuel Oil	*	*	NO	*	NA	NA	NA	NO
Natural Gas	*	*	*	*	*	*	NA	*
LPG	NO	*	*	*	*	NA	NA	*
Fuel Wood	NA	NA	NO	NA	*	NA	NA	NO
Diesel Oil	NA	NA	NA	NA	NA	*	NA	NO
Gasoline	NO	NA	NA	NA	NA	*	NA	NO
Lubricants	NO	NA	NA	NO	NA	*	NA	NO

Abbreviations: NA – Not Available, NO – Not Occurring.

3.1.4. Uncertainties Assessment and Time-Series Consistency

The uncertainty analysis of the GHG emissions from the Sector 1 'Energy' (by source categories) 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 sectoral emissions were estimated at circa 4.46 per cent. The uncertainties introduced in trend in sectoral emissions were estimated at circa 1.26 per cent.

In view of ensuring time-series consistency of the results, the same approach was used for the entire period under review.

3.1.5. Quality Assurance and Quality Control

The 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;
- the sectoral database was updated and improved;
- in connection 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 estimation sheets;
- to confirm the final results obtained, control verifications are performed on the calculation formulas;
- the AD are available only in natural units for 1990-1992 time series – for the entire country, while for the LBDR – for the entire reference period; to ensure greater consistency, it was achieved the conversion of natural units into energy units (TJ) by using the same caloric values;
- 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[30]);
- 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;
- 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 "Moldovagaz" SA, while data on coal and residual fuel oil was identified in the periodical statistical publications produced by the State Service for Statistical Analysis attached to the Ministry of Economic Development of ATULBD;
- for recalculations, the causes and tables with results were described and compared to the previous inventory;
- as far as possible, the recommendations of the international expert who carried out the inventory quality expertise in the previous inventory cycle were applied within the First Biennial Update Report of the Republic of Moldova under the UNFCCC (2016) (<http://clima.md/doc.php?l=en&idc=82&id=3852>), including:
  - the estimation of GHG emissions from fossil fuel combustion within the Sector 1 'Energy' uses AD both in natural units (kt / million m^3) and in energy units (TJ);
  - for natural gas were used annual averages of net caloric values;
- for 1A2 category, AD needed to estimate GHG emissions from 12 industries on the LBDR were assessed indirectly;
- for 1A3b category, GHG emissions for 2014-2016 time series were estimated for the first time using a Tier 3 approach (by using COPERT 4.9 program);
- for 1991-1992 time series, AD needed to estimate GHG emissions from most of the source categories under Sector 1 'Energy' were restored, including by applying the interpolation method;
- for category 'International Aviation' (Memo Items) the beginning of the time series (1990-1994) were restored using the partial overlapping method;
- for 1A3b and 1A3c categories, for the territory on the LBDR, the gaps in the time series of AD (fuel consumption) were restored through indirect methods;
- mechanical errors related to entering activity data were eliminated, in most cases the respective errors were associated with line routing and incomplete summary;
- the structure and content of sectoral database were improved, currently having a hierarchical structure;

[30] <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 database for the Sector 1 'Energy' was changed according to the CRF tables used by Annex I countries (Decision 24/CP.19);
- for each source category where problems were identified regarding collecting AD, an additional verification of the AD sources was carried out, respectively the AD rows were updated;
- for some source categories (for example 1A3c), the EBs of the RM included AD on fuel consumption presented in natural units with null values, while within the sections where data is provided in energy units (TJ), the numeric information is included; in such situations in the current inventory cycle, those fuels are considered in the inventory, unlike to the previous;
- the current inventory cycle includes more fuels and source categories, compared to the previous one.

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 Energy Sector.

The main causes of these recalculations are:

- annual average net caloric values were used for natural gas consumption;
- in order to estimate indirect GHG emissions, methodological approaches and default EFs available in the EMEP/EEA Air Pollutant Inventory Guidebook (2016) were applied;
- GHG emissions from 2 new source categories (1A1b and 1A1c) under the Sector 1 'Energy' were estimated for the first time;
- for 1A2 'Manufacturing Industries and Construction' for the first time, GHG emissions were estimated separately for 12 industries (for the RBDR and LBDR);
- for 1991-1992, the AD needed to estimate GHG emissions from most of the categories under the Sector 1 'Energy' were restored, including by applying the interpolation method;
- for the 'International Aviation' (Memo Items), the partial overlapping method was used to restore the beginning of the time series (1990-1994);
- for 1A3b and 1A3c categories, the AD gaps on fuel consumption for the territory on the LBDR were filled by using indirect methods;
- a series of mechanical errors from the manual data entry of AD were eliminated;
- for each category AD pertaining to fuel consumption were updated, while for those subcategories included for the first time, AD were collected from the official reference sources.

In comparison with the results included into the NC4 of the RM under the UNFCCC (2018), these recalculations resulted in an increase of direct GHG emissions within 1990-1993, 1995, 1998-2015, varying from a minimum increase by 0.2 per cent in 1998 up to a maximum of circa 22.3 per cent in 1992, respectively in an insignificant decrease in 1994 and 1996-1997 (Table 3-26).

Table 3-26: Recalculated GHG emissions under the Sector 1 'Energy' for 1990-2015 periods, included into the NC4 of the RM under the UNFCCC (2018), kt CO_2 equivalent

	1990	1991	1992	1993	1994	1995	1996	1997	1998
NC4	34 630.7793	30 780.3222	21 369.9464	16 133.0168	15 151.0645	11 885.4927	12 188.6923	10 947.6494	9 426.9800
BUR2	36 610.5147	32 969.6160	26 140.5321	18 173.0006	15 147.2796	12 157.3676	12 129.1119	10 936.4422	9 450.4879
Difference, %	5.7	7.1	22.3	12.6	0.0	2.3	-0.5	-0.1	0.2
	1999	2000	2001	2002	2003	2004	2005	2006	2007
NC4	7 472.5074	6 787.8110	7 388.0471	7 132.3183	7 849.9958	8 363.7142	8 681.7347	7 853.2835	8 024.5058
BUR2	7 988.3492	7 288.8600	7 892.7224	7 597.6642	8 296.7792	9 024.8391	9 248.7805	8 358.5998	8 652.3541
Difference, %	6.9	7.4	6.8	6.5	5.7	7.9	6.5	6.4	7.8
	2008	2009	2010	2011	2012	2013	2014	2015	2016
NC4	8 613.9630	9 302.2915	9 828.7136	9 996.1204	9 654.5298	8 563.2692	9 344.7215	9 504.9423	
BUR2	9 132.1640	9 911.6978	10 194.9848	10 498.5364	10 036.1910	9 025.7218	9 656.8992	10 063.7869	9 927.2284
Difference, %	6.0	6.6	3.7	5.0	4.0	5.4	3.3	5.9	

Abbreviations: NC4 – Fourth National Communication (2018); BUR2 – Second Biennial Update Report of the RM under UNFCCC (2019).

Total direct GHG emissions for 2016 were estimated for the first time. Between 1990 and 2016, total direct GHG emissions within the Sector 1 'Energy' decreased by circa 72.9 per cent.

3.1.7. Assessment of Completeness

Under the current inventory cycle within the Sector 1 'Energy' there were estimated direct GHG emissions originated from 8 source categories (Table 3-27). As no coal mining exists in the country, respectively no GHG emissions from the category 1B1 'Fugitive Emissions from Coal Mining and Handling' were registered.

Table 3-27: Assessment of completeness under the Sector 1 'Energy'

IPCC Category	Source Categories	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 categories level within the 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 the 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
- 1A1c Manufacture of Solid Fuels and Other Energy Industries

Between 1990 and 2016, GHG emissions from category 1A1 'Energy Industries' tended to decrease to 21.2 per cent of the reference year 1990 level (Table 3-28).

Table 3-28: GHG emissions from category 1A1 'Energy Industries' in the Republic of Moldova within 1990-2016 periods

	1990	1991	1992	1993	1994	1995	1996	1997	1998
1A1, kt CO_2 equivalent	21 308.2056	18 930.1047	15 654.0659	12 640.0753	9 959.3444	7 160.4871	7 091.6162	5 593.3867	4 814.4638
%, as compared to 1990	100.0	88.8	73.5	59.3	46.7	33.6	33.3	26.2	22.6
	1999	2000	2001	2002	2003	2004	2005	2006	2007
1A1, kt CO_2 equivalent	3 637.4006	3 132.4649	3 649.2979	2 917.1561	3 022.5275	3 339.5735	3 391.2173	2 621.2236	3 163.5834
%, as compared to 1990	17.1	14.7	17.1	13.7	14.2	15.7	15.9	12.3	14.8
	2008	2009	2010	2011	2012	2013	2014	2015	2016
1A1, kt CO_2 equivalent	3 777.6673	5 035.4915	4 983.8288	4 614.9116	4 603.3054	3 686.7824	4 358.3979	4 744.8255	4 526.0607
%, as compared to 1990	17.7	23.6	23.4	21.7	21.6	17.3	20.5	22.3	21.2

Total direct GHG emissions from 1A1 'Energy Industries' category decreased from circa 21,308.2 kt CO_2 equivalent in 1990 to circa 4,526.1 kt CO_2 equivalent in 2016 (Table 3-29). CO_2 has the largest share in the total structure of direct GHG emissions.

Table 3-29: Direct GHG emissions from category 1A1 'Energy Industries' in the Republic of Moldova within 1990-2016 periods

	Direct GHG emissions, kt CO_2 equivalent				the share from the total, %			in %, as compared to 1990			
	CO_2	CH_4	N_2O	Total	CO_2	CH_4	N_2O	CO_2	CH_4	N_2O	Total
1990	21 244.3119	12.2564	51.6374	21 308.2056	99.70	0.06	0.24	100.0	100.0	100.0	100.0
1991	18 873.0209	10.5503	46.5335	18 930.1047	99.70	0.06	0.25	88.8	86.1	90.1	88.8
1992	15 608.8471	8.9238	36.2950	15 654.0659	99.71	0.06	0.23	73.5	72.8	70.3	73.5
1993	12 601.5386	7.0406	31.4960	12 640.0753	99.70	0.06	0.25	59.3	57.4	61.0	59.3
1994	9 928.6683	4.7059	25.9702	9 959.3444	99.69	0.05	0.26	46.7	38.4	50.3	46.7
1995	7 142.1394	3.4107	14.9369	7 160.4871	99.74	0.05	0.21	33.6	27.8	28.9	33.6
1996	7 074.2917	3.3675	13.9569	7 091.6162	99.76	0.05	0.20	33.3	27.5	27.0	33.3
1997	5 583.3634	2.7548	7.2685	5 593.3867	99.82	0.05	0.13	26.3	22.5	14.1	26.2
1998	4 806.4261	2.3913	5.6464	4 814.4638	99.83	0.05	0.12	22.6	19.5	10.9	22.6
1999	3 632.9960	1.8044	2.6002	3 637.4006	99.88	0.05	0.07	17.1	14.7	5.0	17.1
2000	3 128.9143	1.5129	2.0377	3 132.4649	99.89	0.05	0.07	14.7	12.3	3.9	14.7
2001	3 645.1203	1.8009	2.3767	3 649.2979	99.89	0.05	0.07	17.2	14.7	4.6	17.1
2002	2 913.5901	1.5255	2.0405	2 917.1561	99.88	0.05	0.07	13.7	12.4	4.0	13.7
2003	3 018.9122	1.5570	2.0584	3 022.5275	99.88	0.05	0.07	14.2	12.7	4.0	14.2
2004	3 335.7987	1.6164	2.1584	3 339.5735	99.89	0.05	0.06	15.7	13.2	4.2	15.7
2005	3 387.3293	1.6720	2.2161	3 391.2173	99.89	0.05	0.07	15.9	13.6	4.3	15.9
2006	2 618.1732	1.3104	1.7401	2 621.2236	99.88	0.05	0.07	12.3	10.7	3.4	12.3
2007	3 160.0537	1.5252	2.0046	3 163.5834	99.89	0.05	0.06	14.9	12.4	3.9	14.8
2008	3 772.1690	1.8041	3.6942	3 777.6673	99.85	0.05	0.10	17.8	14.7	7.2	17.7
2009	5 027.2977	2.3988	5.7949	5 035.4915	99.84	0.05	0.12	23.7	19.6	11.2	23.6
2010	4 975.7812	2.4944	5.5531	4 983.8288	99.84	0.05	0.11	23.4	20.4	10.8	23.4
2011	4 607.9596	2.2274	4.7247	4 614.9116	99.85	0.05	0.10	21.7	18.2	9.1	21.7
2012	4 596.6508	2.1209	4.5338	4 603.3054	99.86	0.05	0.10	21.6	17.3	8.8	21.6
2013	3 680.5879	1.7543	4.4402	3 686.7824	99.83	0.05	0.12	17.3	14.3	8.6	17.3
2014	4 351.4775	2.1402	4.7802	4 358.3979	99.84	0.05	0.11	20.5	17.5	9.3	20.5
2015	4 737.5409	2.3193	4.9653	4 744.8255	99.85	0.05	0.10	22.3	18.9	9.6	22.3
2016	4 518.9699	2.2700	4.8207	4 526.0607	99.84	0.05	0.11	21.3	18.5	9.3	21.2

Further is presented the dynamic of direct GHG emissions from category 1A1 'Energy Industries' in the Republic of Moldova between 1990 and 2016, separately for the RBDR and LBDR (Figure 3-8, Table 3-30).

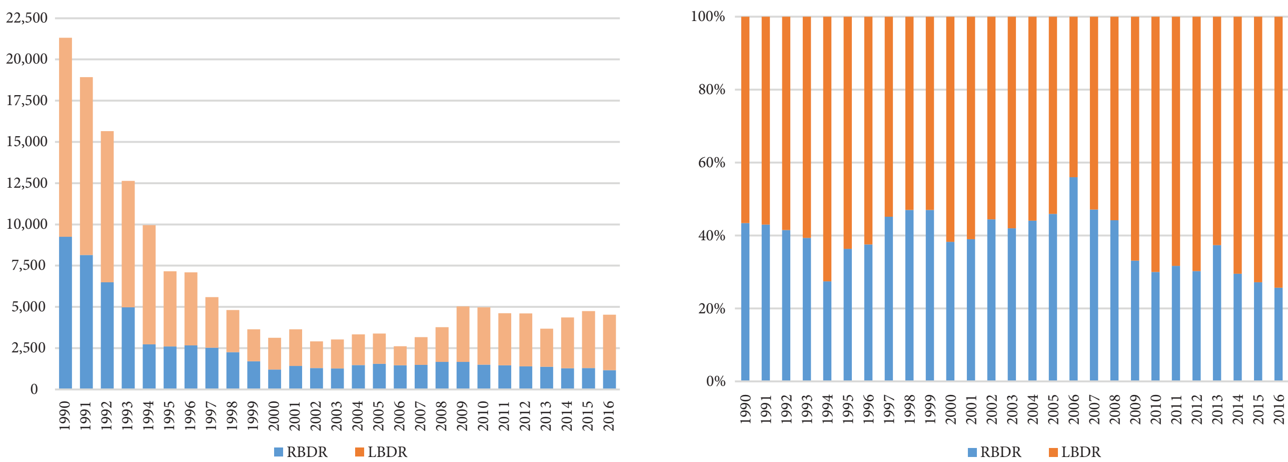


Figure 3-8: Direct GHG emissions from category 1A1 'Energy Industries' in the Republic of Moldova within 1990-2016 periods, presented separately for the RBDR and the LBDR.

In 1990, circa 43.4 per cent of the total direct GHG emissions under this category originated on the RBDR, while 56.6 per cent, respectively, on the LBDR. By 2016, the share of the RBDR decreased by 25.7 per cent of the total, while the share of the LBDR increased up to 74.3 per cent of the total.

Table 3-30: Direct GHG emissions from category 1A1 'Energy Industries' in the Republic of Moldova within 1990-2016 periods, presented separately for the RBDR and the LBDR

	Direct GHG emissions, kt CO_2 equivalent			the share from the total, %		in %, as compared to 1990		
	RBDR	LBDR	RM	RBDR	LBDR	RBDR	LBDR	RM
1990	9 252.3287	12 055.8770	21 308.2056	43.4	56.6	100.0	100.0	100.0
1991	8 141.5911	10 788.5136	18 930.1047	43.0	57.0	88.0	89.5	88.8
1992	6 495.0934	9 158.9726	15 654.0659	41.5	58.5	70.2	76.0	73.5

	Direct GHG emissions, kt CO_2 equivalent			the share from the total, %		in %, as compared to 1990		
	RBDR	LBDR	RM	RBDR	LBDR	RBDR	LBDR	RM
1993	4 975.9484	7 664.1268	12 640.0753	39.4	60.6	53.8	63.6	59.3
1994	2 733.6281	7 225.7163	9 959.3444	27.4	72.6	29.5	59.9	46.7
1995	2 603.8385	4 556.6485	7 160.4871	36.4	63.6	28.1	37.8	33.6
1996	2 663.8585	4 427.7577	7 091.6162	37.6	62.4	28.8	36.7	33.3
1997	2 526.5904	3 066.7963	5 593.3867	45.2	54.8	27.3	25.4	26.2
1998	2 263.4031	2 551.0606	4 814.4638	47.0	53.0	24.5	21.2	22.6
1999	1 709.2839	1 928.1167	3 637.4006	47.0	53.0	18.5	16.0	17.1
2000	1 199.3639	1 933.1010	3 132.4649	38.3	61.7	13.0	16.0	14.7
2001	1 423.4437	2 225.8542	3 649.2979	39.0	61.0	15.4	18.5	17.1
2002	1 296.8365	1 620.3196	2 917.1561	44.5	55.5	14.0	13.4	13.7
2003	1 269.2979	1 753.2296	3 022.5275	42.0	58.0	13.7	14.5	14.2
2004	1 472.5026	1 867.0709	3 339.5735	44.1	55.9	15.9	15.5	15.7
2005	1 557.2305	1 833.9868	3 391.2173	45.9	54.1	16.8	15.2	15.9
2006	1 467.0151	1 154.2085	2 621.2236	56.0	44.0	15.9	9.6	12.3
2007	1 490.1025	1 673.4809	3 163.5834	47.1	52.9	16.1	13.9	14.8
2008	1 669.2354	2 108.4320	3 777.6673	44.2	55.8	18.0	17.5	17.7
2009	1 666.5853	3 368.9061	5 035.4915	33.1	66.9	18.0	27.9	23.6
2010	1 496.0294	3 487.7994	4 983.8288	30.0	70.0	16.2	28.9	23.4
2011	1 461.6352	3 153.2765	4 614.9116	31.7	68.3	15.8	26.2	21.7
2012	1 392.8374	3 210.4679	4 603.3054	30.3	69.7	15.1	26.6	21.6
2013	1 378.0355	2 308.7469	3 686.7824	37.4	62.6	14.9	19.2	17.3
2014	1 287.7447	3 070.6532	4 358.3979	29.5	70.5	13.9	25.5	20.5
2015	1 289.2271	3 455.5985	4 744.8255	27.2	72.8	13.9	28.7	22.3
2016	1 164.1433	3 361.9174	4 526.0607	25.7	74.3	12.6	27.9	21.2

Table 3-31 presents the evolution of GHG emissions under category 1A1 'Energy Industries' by sources (1A1a, 1A1b and 1A1c), separately for the territory on the RBDR and LBDR. GHG emissions from 1A1b and 1A1c were estimated for the first time in the current inventory cycle. The contribution of these sources to the total emissions under this category is relatively low.

Table 3-31: Direct GHG emissions from category 1A1 'Energy Industries', by sources and regions, within 1990-2016 periods

	RBDR				LBDR				Republic of Moldova			
	1A1a	1A1b	1A1c	1A1	1A1a	1A1b	1A1c	1A1	1A1a	1A1b	1A1c	1A1
1990	9 252.3287	NO	NO	9 252.3287	12 055.8770	NO	NO	12 055.8770	21 308.2056	NO	NO	21 308.2056
1991	8 141.5911	NO	NO	8 141.5911	10 788.5136	NO	NO	10 788.5136	18 930.1047	NO	NO	18 930.1047
1992	6 495.0934	NO	NO	6 495.0934	9 158.9726	NO	NO	9 158.9726	15 654.0659	NO	NO	15 654.0659
1993	4 975.9484	NO	NO	4 975.9484	7 664.1268	NO	NO	7 664.1268	12 640.0753	NO	NO	12 640.0753
1994	2 733.6281	NO	NO	2 733.6281	7 225.7163	NO	NO	7 225.7163	9 959.3444	NO	NO	9 959.3444
1995	2 603.8385	NO	NO	2 603.8385	4 556.6485	NO	NO	4 556.6485	7 160.4871	NO	NO	7 160.4871
1996	2 663.8585	NO	NO	2 663.8585	4 427.7577	NO	NO	4 427.7577	7 091.6162	NO	NO	7 091.6162
1997	2 526.5904	NO	NO	2 526.5904	3 066.7963	NO	NO	3 066.7963	5 593.3867	NO	NO	5 593.3867
1998	2 263.4031	NO	NO	2 263.4031	2 551.0606	NO	NO	2 551.0606	4 814.4638	NO	NO	4 814.4638
1999	1 709.2839	NO	NO	1 709.2839	1 928.1167	NO	NO	1 928.1167	3 637.4006	NO	NO	3 637.4006
2000	1 199.3639	NO	NO	1 199.3639	1 933.1010	NO	NO	1 933.1010	3 132.4649	NO	NO	3 132.4649
2001	1 423.4437	NO	NO	1 423.4437	2 225.8542	NO	NO	2 225.8542	3 649.2979	NO	NO	3 649.2979
2002	1 296.8365	NO	NO	1 296.8365	1 620.3196	NO	NO	1 620.3196	2 917.1561	NO	NO	2 917.1561
2003	1 269.2203	0.0777	NO	1 269.2979	1 753.2296	NO	NO	1 753.2296	3 022.4499	0.0777	NO	3 022.5275
2004	1 227.4488	245.0539	NO	1 472.5026	1 867.0709	NO	NO	1 867.0709	3 094.5196	245.0539	NO	3 339.5735
2005	1 384.9055	172.3250	NO	1 557.2305	1 833.9868	NO	NO	1 833.9868	3 218.8923	172.3250	NO	3 391.2173
2006	1 333.9740	133.0411	NO	1 467.0151	1 154.2085	NO	NO	1 154.2085	2 488.1825	133.0411	NO	2 621.2236
2007	1 209.7470	280.3555	NO	1 490.1025	1 673.4809	NO	NO	1 673.4809	2 883.2279	280.3555	NO	3 163.5834
2008	1 178.3906	490.8448	NO	1 669.2354	2 108.4320	NO	NO	2 108.4320	3 286.8226	490.8448	NO	3 777.6673
2009	1 086.5397	580.0456	NO	1 666.5853	3 368.9061	NO	NO	3 368.9061	4 455.4458	580.0456	NO	5 035.4915
2010	1 106.0579	389.9715	NO	1 496.0294	3 487.7994	NO	NO	3 487.7994	4 593.8573	389.9715	NO	4 983.8288
2011	1 034.0727	427.5625	NO	1 461.6352	3 153.2765	NO	NO	3 153.2765	4 187.3492	427.5625	NO	4 614.9116
2012	994.0602	395.8148	2.9625	1 392.8374	3 210.4679	NO	NO	3 210.4679	4 204.5281	395.8148	2.9625	4 603.3054
2013	1 020.9561	353.5472	3.5322	1 378.0355	2 308.7469	NO	NO	2 308.7469	3 329.7030	353.5472	3.5322	3 686.7824
2014	981.1304	302.7403	3.8740	1 287.7447	3 070.6532	NO	NO	3 070.6532	4 051.7835	302.7403	3.8740	4 358.3979
2015	889.4800	391.5433	8.2038	1 289.2271	3 455.5985	NO	NO	3 455.5985	4 345.0784	391.5433	8.2038	4 744.8255
2016	918.2598	239.1610	6.7226	1 164.1433	3 361.9174	NO	NO	3 361.9174	4 280.1772	239.1610	6.7226	4 526.0607

Table 3-32 presents the evolution of direct and indirect GHG emissions from category 1A1 'Energy Industries', separately for the territory on the RBDR and LBDR.

Table 3-32: Direct and indirect GHG emissions from category 1A1 'Energy Industries' within 1990-2016 periods for the RBDR and the LBDR, kt

	RBDR							LBDR						
	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	9232.3706	0.2508	0.0459	15.6862	4.1741	0.3446	28.0503	12011.9413	0.2394	0.1273	23.6914	2.9969	0.2826	74.3101
1991	8123.7993	0.2232	0.0410	13.7157	3.5921	0.2983	24.9577	10749.2216	0.1988	0.1152	21.2647	2.7810	0.2507	65.5646
1992	6480.7507	0.1798	0.0330	11.0164	2.8272	0.2381	20.7307	9128.0965	0.1771	0.0888	17.6545	2.7125	0.2357	50.5167
1993	4965.1278	0.1347	0.0250	8.5289	2.2359	0.1863	15.8188	7636.4108	0.1469	0.0807	15.0527	1.9724	0.1807	46.4553
1994	2727.9063	0.0745	0.0130	4.6303	1.3313	0.1064	7.3875	7200.7620	0.1138	0.0742	14.1279	2.2026	0.1767	39.7330
1995	2598.6421	0.0692	0.0116	4.3832	1.2900	0.1022	6.6457	4543.4973	0.0673	0.0385	8.5516	1.8362	0.1332	18.9491
1996	2658.8029	0.0685	0.0112	4.4636	1.3744	0.1066	6.1385	4415.4888	0.0662	0.0356	8.2319	1.8623	0.1340	17.3025
1997	2522.3226	0.0602	0.0093	4.1829	1.4044	0.1046	4.5244	3061.0408	0.0500	0.0151	5.2834	1.7094	0.1173	6.0124
1998	2259.8075	0.0517	0.0077	3.7281	1.2944	0.0949	3.5775	2546.6186	0.0440	0.0112	4.3343	1.4637	0.1009	4.3512
1999	1706.7609	0.0378	0.0053	2.7890	1.0207	0.0732	2.1190	1926.2351	0.0343	0.0034	3.0559	1.3391	0.0893	0.0096
2000	1197.6997	0.0261	0.0034	1.9375	0.7592	0.0529	0.9655	1931.2146	0.0344	0.0034	3.0638	1.3426	0.0895	0.0097
2001	1421.4382	0.0324	0.0040	2.2978	0.9319	0.0644	0.8688	2223.6821	0.0396	0.0040	3.5278	1.5459	0.1031	0.0111
2002	1294.8517	0.0322	0.0040	2.0967	0.8665	0.0596	0.6802	1618.7384	0.0289	0.0029	2.5681	1.1253	0.0750	0.0081
2003	1267.3935	0.0311	0.0038	2.0459	0.8594	0.0587	0.5167	1751.5187	0.0312	0.0031	2.7787	1.2176	0.0812	0.0088
2004	1470.5499	0.0314	0.0039	2.0276	0.8406	0.0577	0.6364	1865.2488	0.0332	0.0033	2.9591	1.2967	0.0864	0.0093
2005	1555.1322	0.0342	0.0042	2.2773	0.9538	0.0652	0.5961	1832.1971	0.0327	0.0033	2.9067	1.2737	0.0849	0.0092
2006	1465.0910	0.0319	0.0038	2.1800	0.9234	0.0628	0.4573	1153.0822	0.0206	0.0021	1.8293	0.8016	0.0534	0.0058
2007	1488.2059	0.0312	0.0037	2.0288	0.8557	0.0584	0.4798	1671.8478	0.0298	0.0030	2.6523	1.1622	0.0775	0.0084
2008	1666.9627	0.0362	0.0046	2.0500	0.8451	0.0585	0.7605	2105.2063	0.0360	0.0078	3.5187	1.2841	0.0872	2.5687
2009	1664.0482	0.0387	0.0053	1.9844	0.7697	0.0549	1.2824	3363.2495	0.0572	0.0142	5.6970	1.9721	0.1350	5.2238
2010	1493.4653	0.0399	0.0053	1.9565	0.7897	0.0556	0.9961	3482.3159	0.0598	0.0134	5.8411	2.0985	0.1431	4.5983
2011	1459.4262	0.0347	0.0045	1.8241	0.7391	0.0518	0.8516	3148.5334	0.0544	0.0114	5.2483	1.9304	0.1313	3.6876
2012	1390.9587	0.0296	0.0038	1.7533	0.7036	0.0491	0.8143	3205.6921	0.0553	0.0114	5.3362	1.9747	0.1341	3.6277
2013	1375.9261	0.0315	0.0044	1.8276	0.7108	0.0500	1.0977	2304.6618	0.0387	0.0105	3.9367	1.3206	0.0906	4.0251
2014	1285.6416	0.0332	0.0043	1.7574	0.7146	0.0501	0.8059	3065.8359	0.0525	0.0118	5.1419	1.8506	0.1260	4.0120
2015	1287.1201	0.0334	0.0043	1.6240	0.6738	0.0471	0.6637	3450.4208	0.0594	0.0124	5.7494	2.1198	0.1440	3.9851
2016	1162.0584	0.0331	0.0042	1.6092	0.6776	0.0469	0.5279	3356.9115	0.0577	0.0120	5.5892	2.0678	0.1403	3.8025

Compared to 1990, by 2016, the level of GHG emissions from this category on the RBDR reached: for CO_2 circa 12.6 per cent of the reference year level, for CH_4 – 13.2 per cent, N_2O – 9.2 per cent, NO_x – 10.3 per cent, CO – 16.2 per cent, NMVOC – 13.6 per cent and SO_2 – 1.9 per cent; while on the LBDR: CO_2 – circa 27.9 per cent of the reference year level, for CH_4 – 24.1 per cent, N_2O – 9.4 per cent, NO_x – 23.6 per cent, CO – 69.0 per cent, NMVOC – 49.7 per cent and SO_2 – 5.1 per cent (Table 3-33).

Table 3-33: GHG emissions from category 1A1 'Energy Industries' within 1990-2016 periods, presented separately for the RBDR and the LBDR, in % compared to 1990

	RBDR, in % as compared to 1990							LBDR, in % as 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	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
1991	88.0	89.0	89.2	87.4	86.1	86.6	89.0	89.5	83.0	90.4	89.8	92.8	88.7	88.2
1992	70.2	71.7	71.9	70.2	67.7	69.1	73.9	76.0	74.0	69.7	74.5	90.5	83.4	68.0
1993	53.8	53.7	54.5	54.4	53.6	54.1	56.4	63.6	61.4	63.4	63.5	65.8	63.9	62.5
1994	29.5	29.7	28.2	29.5	31.9	30.9	26.3	59.9	47.5	58.3	59.6	73.5	62.5	53.5
1995	28.1	27.6	25.3	27.9	30.9	29.7	23.7	37.8	28.1	30.2	36.1	61.3	47.1	25.5
1996	28.8	27.3	24.4	28.5	32.9	30.9	21.9	36.8	27.6	28.0	34.7	62.1	47.4	23.3
1997	27.3	24.0	20.2	26.7	33.6	30.3	16.1	25.5	20.9	11.9	22.3	57.0	41.5	8.1
1998	24.5	20.6	16.8	23.8	31.0	27.5	12.8	21.2	18.4	8.8	18.3	48.8	35.7	5.9
1999	18.5	15.1	11.5	17.8	24.5	21.3	7.6	16.0	14.3	2.7	12.9	44.7	31.6	0.0
2000	13.0	10.4	7.4	12.4	18.2	15.4	3.4	16.1	14.4	2.7	12.9	44.8	31.7	0.0
2001	15.4	12.9	8.7	14.6	22.3	18.7	3.1	18.5	16.6	3.1	14.9	51.6	36.5	0.0
2002	14.0	12.8	8.6	13.4	20.8	17.3	2.4	13.5	12.1	2.3	10.8	37.5	26.5	0.0
2003	13.7	12.4	8.2	13.0	20.6	17.0	1.8	14.6	13.0	2.5	11.7	40.6	28.7	0.0
2004	15.9	12.5	8.5	12.9	20.1	16.8	2.3	15.5	13.9	2.6	12.5	43.3	30.6	0.0
2005	16.8	13.6	9.1	14.5	22.8	18.9	2.1	15.3	13.6	2.6	12.3	42.5	30.1	0.0
2006	15.9	12.7	8.2	13.9	22.1	18.2	1.6	9.6	8.6	1.6	7.7	26.7	18.9	0.0
2007	16.1	12.4	8.2	12.9	20.5	17.0	1.7	13.9	12.4	2.3	11.2	38.8	27.4	0.0
2008	18.1	14.4	10.0	13.1	20.2	17.0	2.7	17.5	15.0	6.1	14.9	42.8	30.9	3.5
2009	18.0	15.4	11.5	12.7	18.4	15.9	4.6	28.0	23.9	11.1	24.0	65.8	47.8	7.0
2010	16.2	15.9	11.4	12.5	18.9	16.2	3.6	29.0	25.0	10.5	24.7	70.0	50.6	6.2
2011	15.8	13.8	9.8	11.6	17.7	15.0	3.0	26.2	22.7	8.9	22.2	64.4	46.4	5.0
2012	15.1	11.8	8.3	11.2	16.9	14.3	2.9	26.7	23.1	8.9	22.5	65.9	47.4	4.9
2013	14.9	12.5	9.7	11.7	17.0	14.5	3.9	19.2	16.2	8.2	16.6	44.1	32.1	5.4

	RBDR, in % as compared to 1990							LBDR, in % as 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
2014	13.9	13.2	9.3	11.2	17.1	14.5	2.9	25.5	21.9	9.2	21.7	61.8	44.6	5.4
2015	13.9	13.3	9.3	10.4	16.1	13.7	2.4	28.7	24.8	9.7	24.3	70.7	51.0	5.4
2016	12.6	13.2	9.2	10.3	16.2	13.6	1.9	27.9	24.1	9.4	23.6	69.0	49.7	5.1

By 2016, the level of GHG emissions from this category in the RM reached: for CO_2 circa 21.3 per cent of the reference year level, for CH_4 – 18.5 per cent, N_2O – 9.3 per cent, NO_x – 18.3 per cent, CO – 38.3 per cent, NMVOC – 29.9 per cent and SO_2 – 4.2 per cent (Table 3-34).

Table 3-34: Direct and indirect GHG emissions from category 1A1 'Energy Industries' in the Republic of Moldova, within 1990-2016 periods

	1A1, kt							1A1, in % as 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	21 244.3119	0.4903	0.1733	39.3776	7.1710	0.6271	102.3604	100.0	100.0	100.0	100.0	100.0	100.0	100.0
1991	18 873.0209	0.4220	0.1562	34.9804	6.3731	0.5490	90.5222	88.8	86.1	90.1	88.8	88.9	87.5	88.4
1992	15 608.8471	0.3570	0.1218	28.6709	5.5397	0.4738	71.2475	73.5	72.8	70.3	72.8	77.3	75.5	69.6
1993	12 601.5386	0.2816	0.1057	23.5816	4.2083	0.3669	62.2741	59.3	57.4	61.0	59.9	58.7	58.5	60.8
1994	9 928.6683	0.1882	0.0871	18.7582	3.5339	0.2831	47.1205	46.7	38.4	50.3	47.6	49.3	45.1	46.0
1995	7 142.1394	0.1364	0.0501	12.9349	3.1262	0.2355	25.5947	33.6	27.8	28.9	32.8	43.6	37.5	25.0
1996	7 074.2917	0.1347	0.0468	12.6955	3.2367	0.2406	23.4410	33.3	27.5	27.0	32.2	45.1	38.4	22.9
1997	5 583.3634	0.1102	0.0244	9.4662	3.1137	0.2218	10.5369	26.3	22.5	14.1	24.0	43.4	35.4	10.3
1998	4 806.4261	0.0957	0.0189	8.0624	2.7581	0.1958	7.9287	22.6	19.5	10.9	20.5	38.5	31.2	7.7
1999	3 632.9960	0.0722	0.0087	5.8449	2.3598	0.1625	2.1287	17.1	14.7	5.0	14.8	32.9	25.9	2.1
2000	3 128.9143	0.0605	0.0068	5.0013	2.1017	0.1424	0.9751	14.7	12.3	3.9	12.7	29.3	22.7	1.0
2001	3 645.1203	0.0720	0.0080	5.8256	2.4777	0.1674	0.8799	17.2	14.7	4.6	14.8	34.6	26.7	0.9
2002	2 913.5901	0.0610	0.0068	4.6647	1.9918	0.1347	0.6883	13.7	12.4	4.0	11.8	27.8	21.5	0.7
2003	3 018.9122	0.0623	0.0069	4.8246	2.0770	0.1399	0.5255	14.2	12.7	4.0	12.3	29.0	22.3	0.5
2004	3 335.7987	0.0647	0.0072	4.9867	2.1373	0.1442	0.6457	15.7	13.2	4.2	12.7	29.8	23.0	0.6
2005	3 387.3293	0.0669	0.0074	5.1840	2.2275	0.1501	0.6052	15.9	13.6	4.3	13.2	31.1	23.9	0.6
2006	2 618.1732	0.0524	0.0058	4.0093	1.7250	0.1163	0.4631	12.3	10.7	3.4	10.2	24.1	18.5	0.5
2007	3 160.0537	0.0610	0.0067	4.6811	2.0180	0.1359	0.4882	14.9	12.4	3.9	11.9	28.1	21.7	0.5
2008	3 772.1690	0.0722	0.0124	5.5687	2.1292	0.1458	3.3292	17.8	14.7	7.2	14.1	29.7	23.2	3.3
2009	5 027.2977	0.0960	0.0194	7.6814	2.7418	0.1899	6.5062	23.7	19.6	11.2	19.5	38.2	30.3	6.4
2010	4 975.7812	0.0998	0.0186	7.7976	2.8882	0.1987	5.5945	23.4	20.4	10.8	19.8	40.3	31.7	5.5
2011	4 607.9596	0.0891	0.0159	7.0725	2.6695	0.1831	4.5393	21.7	18.2	9.1	18.0	37.2	29.2	4.4
2012	4 596.6508	0.0848	0.0152	7.0895	2.6782	0.1832	4.4420	21.6	17.3	8.8	18.0	37.3	29.2	4.3
2013	3 680.5879	0.0702	0.0149	5.7643	2.0314	0.1406	5.1228	17.3	14.3	8.6	14.6	28.3	22.4	5.0
2014	4 351.4775	0.0856	0.0160	6.8994	2.5652	0.1761	4.8179	20.5	17.5	9.3	17.5	35.8	28.1	4.7
2015	4 737.5409	0.0928	0.0167	7.3734	2.7936	0.1911	4.6488	22.3	18.9	9.6	18.7	39.0	30.5	4.5
2016	4 518.9699	0.0908	0.0162	7.1984	2.7454	0.1872	4.3305	21.3	18.5	9.3	18.3	38.3	29.9	4.2

1A1a Main Activity Electricity and Heat Production

The 1A1a 'Main Activity Electricity and Heat Production' is disaggregated into three other emissions sources: 1A1ai 'Electricity Generation', 1A1aii 'Combined Heat and Power Generation' and 1A1aiii 'Heat Plants'. Between 1990 and 2016, total direct GHG emissions from 1A1a 'Main Activity Electricity and Heat Production' decreased from circa 21,308 kt CO_2 equivalent to circa 4,280 kt CO_2 equivalent (Table 3-35).

Table 3-35: Direct GHG emissions from 1A1a 'Main Activity Electricity and Heat Production' in the Republic of Moldova within 1990-2016 periods, kt CO_2 equivalent

	1990	1991	1992	1993	1994	1995	1996	1997	1998
1A1a, kt CO_2 eq.	21 308.2056	18 946.2276	15 676.6204	12 640.0753	9 959.3444	7 160.4871	7 091.6162	5 593.3867	4 814.4638
in %, as compared to 1990	100.0	88.9	73.6	59.3	46.7	33.6	33.3	26.2	22.6
	1999	2000	2001	2002	2003	2004	2005	2006	2007
1A1a, kt CO_2 eq.	3 637.4006	3 132.4649	3 649.2979	2 917.1561	3 022.4499	3 094.5196	3 218.8923	2 488.1825	2 883.2279
in %, as compared to 1990	17.1	14.7	17.1	13.7	14.2	14.5	15.1	11.7	13.5
	2008	2009	2010	2011	2012	2013	2014	2015	2016
1A1a, kt CO_2 eq.	3 286.8226	4 455.4458	4 593.8573	4 187.3492	4 204.5281	3 329.7030	4 051.7835	4 345.0784	4 280.1772
in %, as compared to 1990	15.4	20.9	21.6	19.7	19.7	15.6	19.0	20.4	20.1

Regarding the contribution of each region to the total emissions under the respective source category, the share of the RBDR decreased from 43.4 per cent of the national total in 1990 to 21.5 per cent of the total in 2016, while, at the same time, the share of the LBDR increased within 1990-2016 from 56.6 per cent of the national total in 1990 up to 78.5 per cent of the total in 2016 (Table 3-36).

Table 3-36: Direct GHG emissions from 1A1a 'Main Activity Electricity and Heat Production' within 1990-2016 periods, presented separately for the RBDR and the LBDR

	1990	1991	1992	1993	1994	1995	1996	1997	1998
RBDR, kt CO_2 eq.	9 252.3287	8 157.7140	6 517.6479	4 975.9484	2 733.6281	2 603.8385	2 663.8585	2 526.5904	2 263.4031
LBDR, kt CO_2 eq.	12 055.8770	10 788.5136	9 158.9726	7 664.1268	7 225.7163	4 556.6485	4 427.7577	3 066.7963	2 551.0606
RM, kt CO_2 eq.	**21 308.2056**	**18 946.2276**	**15 676.6204**	**12 640.0753**	**9 959.3444**	**7 160.4871**	**7 091.6162**	**5 593.3867**	**4 814.4638**
RBDR, in % of the total	43.4	43.1	41.6	39.4	27.4	36.4	37.6	45.2	47.0
LBDR, in % of the total	56.6	56.9	58.4	60.6	72.6	63.6	62.4	54.8	53.0
	1999	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**
RBDR, kt CO_2 eq.	1 709.2839	1 199.3639	1 423.4437	1 296.8365	1 269.2203	1 227.4488	1 384.9055	1 333.9740	1 209.7470
LBDR, kt CO_2 eq.	1 928.1167	1 933.1010	2 225.8542	1 620.3196	1 753.2296	1 867.0709	1 833.9868	1 154.2085	1 673.4809
RM, kt CO_2 eq.	**3 637.4006**	**3 132.4649**	**3 649.2979**	**2 917.1561**	**3 022.4499**	**3 094.5196**	**3 218.8923**	**2 488.1825**	**2 883.2279**
RBDR, in % of the total	47.0	38.3	39.0	44.5	42.0	39.7	43.0	53.6	42.0
LBDR, in % of the total	53.0	61.7	61.0	55.5	58.0	60.3	57.0	46.4	58.0
	2008	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**
RBDR, kt CO_2 eq.	1 178.3906	1 086.5397	1 106.0579	1 034.0727	994.0602	1 020.9561	981.1304	889.4800	918.2598
LBDR, kt CO_2 eq.	2 108.4320	3 368.9061	3 487.7994	3 153.2765	3 210.4679	2 308.7469	3 070.6532	3 455.5985	3 361.9174
RM, kt CO_2 eq.	**3 286.8226**	**4 455.4458**	**4 593.8573**	**4 187.3492**	**4 204.5281**	**3 329.7030**	**4 051.7835**	**4 345.0784**	**4 280.1772**
RBDR, in % of the total	35.9	24.4	24.1	24.7	23.6	30.7	24.2	20.5	21.5
LBDR, in % of the total	64.1	75.6	75.9	75.3	76.4	69.3	75.8	79.5	78.5

CO_2 had the largest share in the total structure of direct GHG emissions from 1A1a 'Main Activity Electricity and Heat Production' within 1990-2016 periods (Table 3-37).

Table 3-37: Direct GHG Emissions from 1A1a 'Main Activity Electricity and Heat Production' in the RM within 1990-2016 periods and the share of each gas in the total structure of GHG emissions

	1A1a, kt CO_2 equivalent				in % of the total			in %, as compared to 1990			
	CO_2	CH_4	N_2O	Total	CO_2	CH_4	N_2O	CO_2	CH_4	N_2O	Total
1990	21 244.3119	12.2564	51.6374	21 308.2056	99.70	0.06	0.24	100.0	100.0	100.0	100.0
1991	18 888.9604	10.6062	46.6611	18 946.2276	99.70	0.06	0.25	88.9	86.5	90.4	88.9
1992	15 631.1968	8.9793	36.4443	15 676.6204	99.71	0.06	0.23	73.6	73.3	70.6	73.6
1993	12 601.5386	7.0406	31.4960	12 640.0753	99.70	0.06	0.25	59.3	57.4	61.0	59.3
1994	9 928.6683	4.7059	25.9702	9 959.3444	99.69	0.05	0.26	46.7	38.4	50.3	46.7
1995	7 142.1394	3.4107	14.9369	7 160.4871	99.74	0.05	0.21	33.6	27.8	28.9	33.6
1996	7 074.2917	3.3675	13.9569	7 091.6162	99.76	0.05	0.20	33.3	27.5	27.0	33.3
1997	5 583.3634	2.7548	7.2685	5 593.3867	99.82	0.05	0.13	26.3	22.5	14.1	26.2
1998	4 806.4261	2.3913	5.6464	4 814.4638	99.83	0.05	0.12	22.6	19.5	10.9	22.6
1999	3 632.9960	1.8044	2.6002	3 637.4006	99.88	0.05	0.07	17.1	14.7	5.0	17.1
2000	3 128.9143	1.5129	2.0377	3 132.4649	99.89	0.05	0.07	14.7	12.3	3.9	14.7
2001	3 645.1203	1.8009	2.3767	3 649.2979	99.89	0.05	0.07	17.2	14.7	4.6	17.1
2002	2 913.5901	1.5255	2.0405	2 917.1561	99.88	0.05	0.07	13.7	12.4	4.0	13.7
2003	3 018.8348	1.5569	2.0582	3 022.4499	99.88	0.05	0.07	14.2	12.7	4.0	14.2
2004	3 090.8301	1.5912	2.0983	3 094.5196	99.88	0.05	0.07	14.5	13.0	4.1	14.5
2005	3 215.0987	1.6441	2.1496	3 218.8923	99.88	0.05	0.07	15.1	13.4	4.2	15.1
2006	2 485.2006	1.2901	1.6918	2 488.1825	99.88	0.05	0.07	11.7	10.5	3.3	11.7
2007	2 879.8680	1.4750	1.8850	2 883.2279	99.88	0.05	0.07	13.6	12.0	3.7	13.5
2008	3 281.6019	1.7221	3.4986	3 286.8226	99.84	0.05	0.11	15.4	14.1	6.8	15.4
2009	4 447.6480	2.2818	5.5160	4 455.4458	99.82	0.05	0.12	20.9	18.6	10.7	20.9
2010	4 586.0896	2.4117	5.3559	4 593.8573	99.83	0.05	0.12	21.6	19.7	10.4	21.6
2011	4 180.6692	2.1470	4.5330	4 187.3492	99.84	0.05	0.11	19.7	17.5	8.8	19.7
2012	4 198.2060	2.0180	4.3041	4 204.5281	99.85	0.05	0.10	19.8	16.5	8.3	19.7
2013	3 323.8598	1.6451	4.1981	3 329.7030	99.82	0.05	0.13	15.6	13.4	8.1	15.6
2014	4 045.1883	2.0381	4.5571	4 051.7835	99.84	0.05	0.11	19.0	16.6	8.8	19.0
2015	4 338.1788	2.1929	4.7068	4 345.0784	99.84	0.05	0.11	20.4	17.9	9.1	20.4
2016	4 273.3730	2.1749	4.6292	4 280.1772	99.84	0.05	0.11	20.1	17.7	9.0	20.1

Table 3-38 presents direct GHG emissions from 1A1a 'Main Activity Electricity and Heat Production' by sources and regions within 1990-2016 time series.

Table 3-38: Direct GHG emissions from 1A1a 'Main Activity Electricity and Heat Production' by sources and regions within 1990-2016 periods, kt CO_2 equivalent

	RBDR				LBDR				Republic of Moldova			
	1A1ai	1A1aii	1A1aiii	1A1a	1A1ai	1A1aii	1A1aiii	1A1a	1A1ai	1A1aii	1A1aiii	1A1a
1990	NO	1 945.2826	7 307.0460	9 252.3287	11 748.9846	NO	306.8924	12 055.8770	11 748.9846	1 945.2826	7 613.9384	21 308.2056
1991	NO	2 165.3414	5 992.3726	8 157.7140	10 481.5704	NO	306.9432	10 788.5136	10 481.5704	2 165.3414	6 299.3159	18 946.2276
1992	NO	1 839.9486	4 677.6993	6 517.6479	8 831.9107	NO	327.0619	9 158.9726	8 831.9107	1 839.9486	5 004.7611	15 676.6204
1993	NO	1 576.0806	3 399.8678	4 975.9484	7 451.0877	NO	213.0391	7 664.1268	7 451.0877	1 576.0806	3 612.9070	12 640.0753

	RBDR				LBDR				Republic of Moldova			
	1A1ai	1A1aii	1A1aiii	1A1a	1A1ai	1A1aii	1A1aiii	1A1a	1A1ai	1A1aii	1A1aiii	1A1a
1994	NO	342.9810	2 390.6470	2 733.6281	6 723.0928	NO	502.6235	7 225.7163	6 723.0928	342.9810	2 893.2705	9 959.3444
1995	NO	313.4214	2 290.4172	2 603.8385	4 277.2763	NO	279.3723	4 556.6485	4 277.2763	313.4214	2 569.7894	7 160.4871
1996	NO	444.7600	2 219.0985	2 663.8585	4 334.5299	NO	93.2278	4 427.7577	4 334.5299	444.7600	2 312.3262	7 091.6162
1997	NO	516.0840	2 010.5064	2 526.5904	2 788.9888	NO	277.8076	3 066.7963	2 788.9888	516.0840	2 288.3139	5 593.3867
1998	NO	358.2230	1 905.1801	2 263.4031	2 130.0380	NO	421.0227	2 551.0606	2 130.0380	358.2230	2 326.2028	4 814.4638
1999	NO	361.2374	1 348.0465	1 709.2839	1 577.1410	NO	350.9757	1 928.1167	1 577.1410	361.2374	1 699.0222	3 637.4006
2000	NO	385.9338	813.4300	1 199.3639	1 441.0117	NO	492.0894	1 933.1010	1 441.0117	385.9338	1 305.5194	3 132.4649
2001	NO	583.8622	839.5815	1 423.4437	1 756.6221	NO	469.2321	2 225.8542	1 756.6221	583.8622	1 308.8136	3 649.2979
2002	NO	492.8533	803.9832	1 296.8365	1 351.2996	NO	269.0200	1 620.3196	1 351.2996	492.8533	1 073.0032	2 917.1561
2003	NO	451.2426	817.9776	1 269.2203	1 423.2874	NO	329.9422	1 753.2296	1 423.2874	451.2426	1 147.9198	3 022.4499
2004	NO	474.5035	752.9453	1 227.4488	1 580.9312	NO	286.1397	1 867.0709	1 580.9312	474.5035	1 039.0849	3 094.5196
2005	NO	544.2083	840.6972	1 384.9055	1 519.4867	NO	314.5002	1 833.9868	1 519.4867	544.2083	1 155.1973	3 218.8923
2006	NO	525.0423	808.9317	1 333.9740	811.0246	NO	343.1839	1 154.2085	811.0246	525.0423	1 152.1156	2 488.1825
2007	NO	512.8196	696.9274	1 209.7470	1 358.5105	NO	314.9704	1 673.4809	1 358.5105	512.8196	1 011.8978	2 883.2279
2008	NO	461.3959	716.9947	1 178.3906	1 751.1937	NO	357.2383	2 108.4320	1 751.1937	461.3959	1 074.2330	3 286.8226
2009	NO	447.9544	638.5853	1 086.5397	3 025.1952	NO	343.7109	3 368.9061	3 025.1952	447.9544	982.2962	4 455.4458
2010	2.8100	422.8277	680.4201	1 103.2479	3 088.4385	NO	399.3609	3 487.7994	3 091.2485	422.8277	1 079.7811	4 593.8573
2011	2.0370	399.0442	632.9915	1 032.0357	2 756.6500	NO	396.6265	3 153.2765	2 758.6870	399.0442	1 029.6180	4 187.3492
2012	1.1696	381.4285	611.4621	992.8906	2 823.4276	NO	387.0403	3 210.4679	2 824.5972	381.4285	998.5024	4 204.5281
2013	2.4617	360.4067	658.0877	1 018.4943	1 918.3616	NO	390.3853	2 308.7469	1 920.8234	360.4067	1 048.4729	3 329.7030
2014	2.9461	356.5547	621.6296	978.1843	2 709.1912	NO	361.4620	3 070.6532	2 712.1372	356.5547	983.0916	4 051.7835
2015	0.5030	709.5544	179.4226	888.9769	3 085.3760	NO	370.2225	3 455.5985	3 085.8790	709.5544	549.6451	4 345.0784
2016	0.6511	723.1269	194.4818	917.6087	2 990.1627	NO	371.7546	3 361.9174	2 990.8138	723.1269	566.2365	4 280.1772

The table below presents the share of direct GHG emissions for the respective source category by sources and regions between 1990 and 2016 (Table 3-39).

Table 3-39: The share of direct GHG emissions from 1A1a 'Main Activity Electricity and Heat Production' by sources and regions in the Republic of Moldova within 1990-2016 periods, %

	RBDR			LBDR			Republic of Moldova		
	1A1ai	1A1aii	1A1aiii	1A1ai	1A1aii	1A1aiii	1A1ai	1A1aii	1A1aiii
1990	NO	21.0	79.0	97.5	NO	2.5	55.1	9.1	35.7
1991	NO	26.5	73.5	97.2	NO	2.8	55.3	11.4	33.2
1992	NO	28.2	71.8	96.4	NO	3.6	56.3	11.7	31.9
1993	NO	31.7	68.3	97.2	NO	2.8	58.9	12.5	28.6
1994	NO	12.5	87.5	93.0	NO	7.0	67.5	3.4	29.1
1995	NO	12.0	88.0	93.9	NO	6.1	59.7	4.4	35.9
1996	NO	16.7	83.3	97.9	NO	2.1	61.1	6.3	32.6
1997	NO	20.4	79.6	90.9	NO	9.1	49.9	9.2	40.9
1998	NO	15.8	84.2	83.5	NO	16.5	44.2	7.4	48.3
1999	NO	21.1	78.9	81.8	NO	18.2	43.4	9.9	46.7
2000	NO	32.2	67.8	74.5	NO	25.5	46.0	12.3	41.7
2001	NO	41.0	59.0	78.9	NO	21.1	48.1	16.0	35.9
2002	NO	38.0	62.0	83.4	NO	16.6	46.3	16.9	36.8
2003	NO	35.6	64.4	81.2	NO	18.8	47.1	14.9	38.0
2004	NO	38.7	61.3	84.7	NO	15.3	51.1	15.3	33.6
2005	NO	39.3	60.7	82.9	NO	17.1	47.2	16.9	35.9
2006	NO	39.4	60.6	70.3	NO	29.7	32.6	21.1	46.3
2007	NO	42.4	57.6	81.2	NO	18.8	47.1	17.8	35.1
2008	NO	39.2	60.8	83.1	NO	16.9	53.3	14.0	32.7
2009	NO	41.2	58.8	89.8	NO	10.2	67.9	10.1	22.0
2010	0.3	38.3	61.7	88.5	NO	11.5	67.3	9.2	23.5
2011	0.2	38.7	61.3	87.4	NO	12.6	65.9	9.5	24.6
2012	0.1	38.4	61.6	87.9	NO	12.1	67.2	9.1	23.7
2013	0.2	35.4	64.6	83.1	NO	16.9	57.7	10.8	31.5
2014	0.3	36.5	63.5	88.2	NO	11.8	66.9	8.8	24.3
2015	0.1	79.8	20.2	89.3	NO	10.7	71.0	16.3	12.6
2016	0.1	78.8	21.2	88.9	NO	11.1	69.9	16.9	13.2

Table 3-40 shows the evolution of direct GHG emissions from source category 1A1a 'Main Activity Electricity and Heat Production' between 1990 and 2016 for the territory on the RBDR and LBDR, respectively the share of each region in the structure of total emissions under this source category.

Table 3-40: Direct GHG emissions from 1A1a 'Main Activity Electricity and Heat Production' by regions within 1990-2016 and the share of each region in the structure of total emissions

	1A1a, kt CO_2 equivalent			in % of the total		in %, as compared with 1990		
	RBDR	LBDR	RM	RBDR	LBDR	RBDR	LBDR	RM
1990	9 252.3287	12 055.8770	21 308.2056	43.4	56.6	100.0	100.0	100.0
1991	8 157.7140	10 788.5136	18 946.2276	43.1	56.9	88.2	89.5	88.9
1992	6 517.6479	9 158.9726	15 676.6204	41.6	58.4	70.4	76.0	73.6
1993	4 975.9484	7 664.1268	12 640.0753	39.4	60.6	53.8	63.6	59.3
1994	2 733.6281	7 225.7163	9 959.3444	27.4	72.6	29.5	59.9	46.7
1995	2 603.8385	4 556.6485	7 160.4871	36.4	63.6	28.1	37.8	33.6
1996	2 663.8585	4 427.7577	7 091.6162	37.6	62.4	28.8	36.7	33.3
1997	2 526.5904	3 066.7963	5 593.3867	45.2	54.8	27.3	25.4	26.2
1998	2 263.4031	2 551.0606	4 814.4638	47.0	53.0	24.5	21.2	22.6
1999	1 709.2839	1 928.1167	3 637.4006	47.0	53.0	18.5	16.0	17.1
2000	1 199.3639	1 933.1010	3 132.4649	38.3	61.7	13.0	16.0	14.7
2001	1 423.4437	2 225.8542	3 649.2979	39.0	61.0	15.4	18.5	17.1
2002	1 296.8365	1 620.3196	2 917.1561	44.5	55.5	14.0	13.4	13.7
2003	1 269.2203	1 753.2296	3 022.4499	42.0	58.0	13.7	14.5	14.2
2004	1 227.4488	1 867.0709	3 094.5196	39.7	60.3	13.3	15.5	14.5
2005	1 384.9055	1 833.9868	3 218.8923	43.0	57.0	15.0	15.2	15.1
2006	1 333.9740	1 154.2085	2 488.1825	53.6	46.4	14.4	9.6	11.7
2007	1 209.7470	1 673.4809	2 883.2279	42.0	58.0	13.1	13.9	13.5
2008	1 178.3906	2 108.4320	3 286.8226	35.9	64.1	12.7	17.5	15.4
2009	1 086.5397	3 368.9061	4 455.4458	24.4	75.6	11.7	27.9	20.9
2010	1 103.2479	3 487.7994	4 593.8573	24.0	75.9	11.9	28.9	21.6
2011	1 032.0357	3 153.2765	4 187.3492	24.6	75.3	11.2	26.2	19.7
2012	992.8906	3 210.4679	4 204.5281	23.6	76.4	10.7	26.6	19.7
2013	1 018.4943	2 308.7469	3 329.7030	30.6	69.3	11.0	19.2	15.6
2014	978.1843	3 070.6532	4 051.7835	24.1	75.8	10.6	25.5	19.0
2015	888.9769	3 455.5985	4 345.0784	20.5	79.5	9.6	28.7	20.4
2016	917.6087	3 361.9174	4 280.1772	21.4	78.5	9.9	27.9	20.1

1A1ai Electricity Generation

In the Republic of Moldova electricity generation capacity include: 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; CHP-2 Chisinau, with an installed capacity of 240 MW and 1,200 Gcal/h heat capacity, built between 1976-1980; CHP-1 Chisinau, with an installed capacity of 66 MW and 254 Gcal/h heat capacity, built between 1951-1961; CHP-North Balti, with an installed capacity of 24 MW and 200 Gcal/h heat capacity built in during 1956-1970; other power plants, including CHP owned by sugar plants with an installed capacity of 97.5 MW operating on natural gas and residual fuel oil, built during 1956-1981. In recent years, renewable energy sources of small power are being developed. Their total capacity in 2015 represented 5 MW of electric power, while in 2016 – circa 6.9 MW.

The power transmission system operator 'Moldelectrica' SOE manages the internal transport network on the right bank of the Dniester River, including 5,977.5 km transmission lines of 400, 330, 110 kV, and 25,877.4 km radial lines of 35 and 6-10 kV.

Data on fuel consumption for electricity generation on the RBDR are available for 2010-2016 time series in the Energy Balances of the RM (Table 3-41).

Table 3-41: AD on fuel consumption for electricity generation on the RBDR within 2010-2016 periods, TJ

Fuels	2010	2011	2012	2013	2014	2015	2016
Residual Fuel Oil	21	19	10	10	9	NO	NO
Natural Gas	21	10	7	30	40	1	1
Diesel	NO	NO	NO	NO	NO	6	8
Biogas	NO	NO	NO	10	18	14	2
Total	42	29	17	50	67	21	11

Sources: Energy Balances of the RM for 2016.

The Moldavian Thermal Power Plant (MTPP) in Dnestrovsk has an installed capacity of 2520 MW, it is 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 (in service since 1973-1974) 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). Electricity generation during 1990-2016 at MTPP decreased by circa 67 per cent (Table 3-42).

Table 3-42: Electricity generation at MTPP within 1990-2016, million kWh

	1990	1991	1992	1993	1994	1995	1996	1997	1998
Electricity Generation	13 569	11 223	9 468	8 626	6 836	4 747	4 560	3 629	3 296
	1999	2000	2001	2002	2003	2004	2005	2006	2007
Electricity Generation	2 687	2 463	3 366	2 942	2 793	2 891	2 701	1 374	2 489
	2008	2009	2010	2011	2012	2013	2014	2015	2016
Electricity Generation	2 631	4 863	4 619	4 255	4 375	3 044	3 893	4 610	4 468

Source: S.O.E. "Moldelectrica".

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 increased from circa 1,206.6 million m^3 (1990) up to 1,312.0 million m^3 (2016). Between 1994 and 2016, consumption of other two types of fuel (residual fuel oil and coal) varied significantly.

To be noted that official statistical data on residual fuel oil and coal consumption within the MTTP are available only for 1994-1998 and 2008-2016. AD are published in natural values; in order to convert in 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 – annual net calorific value in TJ/million.m^3, according to information provided by J.S.C. „Moldovagaz" (Table 3-43).

Table 3-43: Fuel consumption for electricity generation at the MTPP from Dnestrovsk within 1994-2016 periods

	Bituminous Coal, kt	Residual Fuel Oil, kt	Natural Gas, mill. m^3	Bituminous Coal, TJ	Residual Fuel Oil, TJ	Natural Gas, TJ
1990	2 541	1 070	1 207	64 643	43 010	40 306
1991	2 419	758	1 207	61 539	30 484	40 312
1992	1 760	693	1 286	44 774	27 855	42 955
1993	1 647	608	838	41 900	24 422	27 979
1994	1 687	228	1 030	42 907	9 166	34 406
1995	883	26	1 098	22 461	1 049	36 691
1996	806	24	1 232	20 513	949	41 147
1997	282	6	1 113	7 171	243	37 189
1998	182	27	857	4 641	1 082	28 578
1999	NA, NO	NA, NO	841	NA, NO	NA, NO	28 086
2000	NA, NO	NA, NO	768	NA, NO	NA, NO	25 661
2001	NA, NO	NA, NO	937	NA, NO	NA, NO	31 282
2002	NA, NO	NA, NO	719	NA, NO	NA, NO	24 064
2003	NA, NO	NA, NO	756	NA, NO	NA, NO	25 346
2004	NA, NO	NA, NO	839	NA, NO	NA, NO	28 153
2005	NA, NO	NA, NO	805	NA, NO	NA, NO	27 059
2006	NA, NO	NA, NO	429	NA, NO	NA, NO	14 443
2007	NA, NO	NA, NO	719	NA, NO	NA, NO	24 192
2008	115	8	766	2 937	306	25 790
2009	231	20	1 267	5 874	795	42 829
2010	201	20	1 339	5 116	785	45 252
2011	161	16	1 220	4 087	652	41 269
2012	160	14	1 256	4 070	558	42 617
2013	314	2	754	7 986	74	25 693
2014	2	1	1 163	57	47	39 785
2015	2	1	1 348	51	56	46 530
2016	8	2	1 312	191	82	45 238

Source: for natural gas –„Moldovagaz"; for residual fuel oil and coal – Statistical Yearbooks of the ATULBD; for coal and residual fuel oil – for 1990-1998 time series: NC1 of the RM under UNFCCC (2000), for 2013-2016 time series: MTPP from Dnestrovsk Press Releases (<www.moldgres.com>).

The table below presents data regarding fuel consumption for public electricity generation on the RBDR and LBDR between 1990-2016 time periods (Table 3-44).

Table 3-44: Fuel consumption for electricity generation for RBDR and LBDR within 1990-2016 periods, TJ

	RBDR				LBDR		
	Residual Fuel Oil	Natural Gas	Diesel	Biogas	Bituminous Coal	Residual Fuel Oil	Natural Gas
1990	NO	NO	NO	NO	64 643	43 010	40 306
1991	NO	NO	NO	NO	61 539	30 484	40 312
1992	NO	NO	NO	NO	44 774	27 855	42 955
1993	NO	NO	NO	NO	41 900	24 422	27 979
1994	NO	NO	NO	NO	42 907	9 166	34 406
1995	NO	NO	NO	NO	22 461	1 049	36 691

	RBDR				LBDR		
	Residual Fuel Oil	Natural Gas	Diesel	Biogas	Bituminous Coal	Residual Fuel Oil	Natural Gas
1996	NO	NO	NO	NO	20 513	949	41 147
1997	NO	NO	NO	NO	7 171	243	37 189
1998	NO	NO	NO	NO	4 641	1 082	28 578
1999	NO	NO	NO	NO	NA, NO	NA, NO	28 086
2000	NO	NO	NO	NO	NA, NO	NA, NO	25 661
2001	NO	NO	NO	NO	NA, NO	NA, NO	31 282
2002	NO	NO	NO	NO	NA, NO	NA, NO	24 064
2003	NO	NO	NO	NO	NA, NO	NA, NO	25 346
2004	NO	NO	NO	NO	NA, NO	NA, NO	28 153
2005	NO	NO	NO	NO	NA, NO	NA, NO	27 059
2006	NO	NO	NO	NO	NA, NO	NA, NO	14 443
2007	NO	NO	NO	NO	NA, NO	NA, NO	24 192
2008	NO	NO	NO	NO	2 937	306	25 790
2009	NO	NO	NO	NO	5 874	795	42 829
2010	21	21	NO	NO	5 116	785	45 252
2011	19	10	NO	NO	4 087	652	41 269
2012	10	7	NO	NO	4 070	558	42 617
2013	10	30	NO	10	7 986	74	25 693
2014	9	40	NO	18	72	60	39 785
2015	NO	1	6	14	51	56	46 530
2016	NO	1	8	2	191	82	45 238

Table 3-45 and Figure 3-9 show data on fuel consumption (in TJ) for electricity generation, by type, within source category 1A1ai Electricity Generation, respectively the share (in %) in the structure of total fuel consumption.

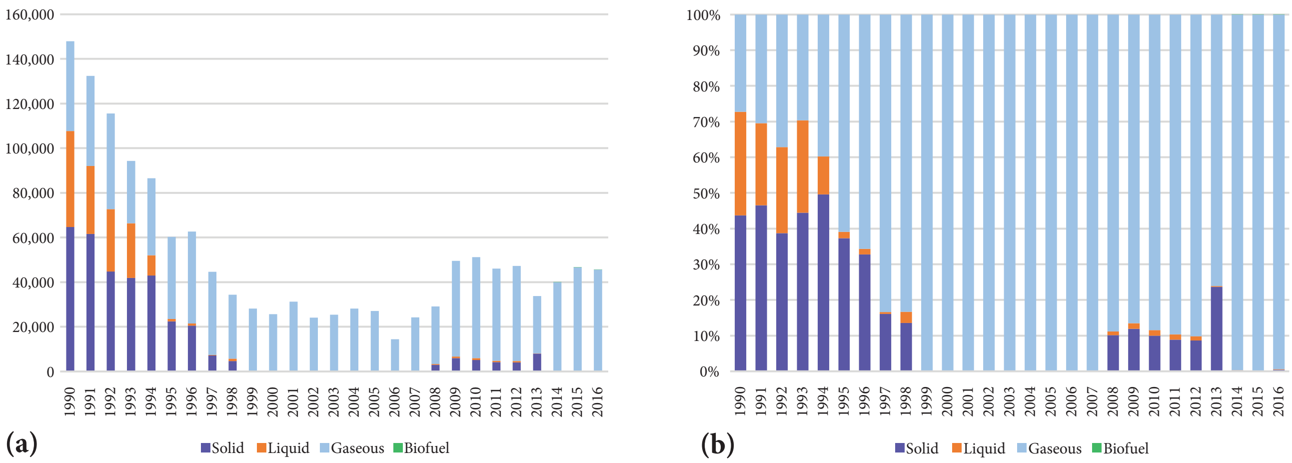


Figure 3-9: Fuel consumption within 1A1ai 'Electricity Generation', where: (a) Fuel consumption by type of fuel, TJ; and (b) Fuel consumption by type of fuel, in % of the total.

Table 3-45: Fuel consumption within the 1A1ai 'Electricity Generation' by type of fuel (TJ) and the share in the structure of total consumption (in % from total)

	Fuel consumption, TJ					in % from the total			
	Solid	Liquid	Gaseous	Biofuels	Total	Solid	Liquid	Gaseous	Biofuels
1990	64 643	43 010	40 306	NO	147 959	43.7	29.1	27.2	NO
1991	61 539	30 484	40 312	NO	132 335	46.5	23.0	30.5	NO
1992	44 774	27 855	42 955	NO	115 584	38.7	24.1	37.2	NO
1993	41 900	24 422	27 979	NO	94 301	44.4	25.9	29.7	NO
1994	42 907	9 166	34 406	NO	86 479	49.6	10.6	39.8	NO
1995	22 461	1 049	36 691	NO	60 201	37.3	1.7	60.9	NO
1996	20 513	949	41 147	NO	62 609	32.8	1.5	65.7	NO
1997	7 171	243	37 189	NO	44 603	16.1	0.5	83.4	NO
1998	4 641	1 082	28 578	NO	34 301	13.5	3.2	83.3	NO
1999	NA, NO	NA, NO	28 086	NO	28 086	NA, NO	NA, NO	100.0	NO
2000	NA, NO	NA, NO	25 661	NO	25 661	NA, NO	NA, NO	100.0	NO
2001	NA, NO	NA, NO	31 282	NO	31 282	NA, NO	NA, NO	100.0	NO
2002	NA, NO	NA, NO	24 064	NO	24 064	NA, NO	NA, NO	100.0	NO
2003	NA, NO	NA, NO	25 346	NO	25 346	NA, NO	NA, NO	100.0	NO
2004	NA, NO	NA, NO	28 153	NO	28 153	NA, NO	NA, NO	100.0	NO
2005	NA, NO	NA, NO	27 059	NO	27 059	NA, NO	NA, NO	100.0	NO

	Fuel consumption, TJ					in % from the total			
	Solid	Liquid	Gaseous	Biofuels	Total	Solid	Liquid	Gaseous	Biofuels
2006	NA, NO	NA, NO	14 443	NO	14 443	NA, NO	NA, NO	100.0	NO
2007	NA, NO	NA, NO	24 192	NO	24 192	NA, NO	NA, NO	100.0	NO
2008	2 937	306	25 790	NO	29 033	10.1	1.1	88.8	NO
2009	5 874	795	42 829	NO	49 497	11.9	1.6	86.5	NO
2010	5 116	806	45 273	NO	51 195	10.0	1.6	88.4	NO
2011	4 087	671	41 279	NO	46 037	8.9	1.5	89.7	NO
2012	4 070	568	42 624	NO	47 262	8.6	1.2	90.2	NO
2013	7 986	84	25 723	10	33 803	23.6	0.2	76.1	0.03
2014	57	56	39 825	18	39 956	0.1	0.1	99.7	0.05
2015	51	62	46 531	14	46 658	0.1	0.1	99.7	0.03
2016	191	90	45 239	2	45 522	0.4	0.2	99.4	0.00

1A1aii Combined Heat and Power Generation

On the RBDR there are 3 Combined Heat and Power (CHP) Plants: in Chisinau municipality the CHP-1 and the CHP-2, and in Balti municipality: the CHP-North. Also, there are some small power plants with cogeneration at sugar plants. Total production of electricity on the RBDR decreased from approximately 1.697 billion kWh in 1990 to about 898 billion kWh in 2016 (Table 3-46).

Table 3-46: Electricity generation, import and consumption on the RBDR**,** within 2003-2016 periods, million kWh

	2003	2004	2005	2006	2007	2008	2009
Generation	975	952	1 127	1 080	1 051	985	970
Import	1 757	1 836	1 600	2 881	2 931	2 961	2 941
Consumption	3 570	3 455	3 686	3 871	4 030	4 065	3 979
	2010	2011	2012	2013	2014	2015	2016
Generation	972	933	890	849	889	864	898
Import	2 662	3 142	3 279	3 244	3 341	3 360	3 347
Consumption	4 106	4 161	4 211	4 236	4 305	4 305	4 245

Source: S.O.E. "Moldelectrica".

In the context of increasing trend of electricity consumption in the last period, 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 in Chisinau, respectively CHP-North in Balti) is presented in Table 3-47.

Table 3-47: Fuel consumption, electricity and heat generation at the CHPs in the Republic of Moldova within 1990-2016 periods

		1990	1991	1992	1993	1994	1995	1996	1997	1998
CHP-1	Residual Fuel Oil, kt	13.4	26.1	14.2	14.0	6.2	4.7	8.5	3.7	4.6
	Natural Gas, millions m^3	271.2	290.0	245.8	184.2	161.0	137.6	118.6	113.4	135.2
	Electricity, millions kWh	207.5	207.0	196.3	150.2	136.5	106.4	114.6	93.2	138.6
	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	1 045.9
CHP-2	Residual Fuel Oil, kt	76.4	135.9	164.9	120.4	53.1	57.3	67.5	49.9	34.3
	Natural Gas, millions m^3	486.1	419.0	337.1	318.4	315.2	270.7	323.2	386.5	313.5
	Electricity, millions kWh	1 150.0	951.4	923.4	883.4	751.2	670.9	838.8	896.2	723.3
	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	1 296.0
CHP-North	Residual Fuel Oil, kt	40.0	35.0	31.9	19.6	3.8	8.1	1.4	1.1	6.8
	Natural Gas, millions m^3	15.7	87.6	136.3	102.0	98.5	86.9	107.2	93.6	70.1
	Electricity, millions kWh	121.0	100.0	102.0	75.0	87.0	81.0	100.0	96.0	75.0
	Heat, thousands Gcal	1 360.0	1 450.0	1 144.0	834.0	625.0	596.0	642.0	500.0	416.0
		1999	2000	2001	2002	2003	2004	2005	2006	2007
CHP-1	Residual Fuel Oil, kt	4.1	1.2	0.4	0.0	0.1	0.1	0.9	0.0	0.0
	Natural Gas, millions m^3	73.0	65.2	82.3	85.7	81.3	76.3	84.8	83.5	81.1
	Electricity, millions kWh	115.0	100.8	138.5	142.1	138.8	136.5	154.9	148.0	151.9
	Heat, thousands Gcal	448.3	387.4	408.8	386.3	405.9	335.6	375.6	378.8	329.1
CHP-2	Residual Fuel Oil, kt	22.3	3.7	3.1	1.2	1.9	0.0	2.9	0.0	0.0
	Natural Gas, millions m^3	312.2	267.4	365.1	313.0	286.0	278.9	326.8	316.3	308.5
	Electricity, millions kWh	801.0	658.1	942.2	804.7	741.9	714.3	854.4	818.4	805.4
	Heat, thousands Gcal	1 286.5	947.0	1 068.4	1 069.2	1 018.6	885.7	1 198.1	1 204.2	1 159.3
CHP-North	Residual Fuel Oil, kt	10.1	0.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Natural Gas, millions m^3	39.3	25.0	40.5	38.0	44.6	41.6	44.3	44.4	38.0
	Electricity, millions kWh	50.7	27.3	44.4	40.6	52.5	57.7	67.8	74.7	67.7
	Heat, thousands Gcal	247.0	125.7	206.1	198.5	246.0	229.6	232.6	222.7	193.5

		2008	2009	2010	2011	2012	2013	2014	2015	2016
CHP-1	Residual Fuel Oil, kt	0.0	1.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Natural Gas, millions m^3	78.3	70.0	51.2	40.3	33.8	33.1	35.9	25.6	24.5
	Electricity, millions kWh	140.3	135.6	94.9	70.2	56.7	59.5	67.4	47.2	43.9
	Heat, thousands Gcal	319.6	271.9	245.4	203.5	184.6	170.9	167.8	195.3	186.0
CHP-2	Residual Fuel Oil, kt	0.0	9.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Natural Gas, millions m^3	294.8	284.6	304.2	295.3	288.9	267.2	268.7	274.7	275.6
	Electricity, millions kWh	755.3	754.6	782.4	765.2	742.9	649.8	702.3	731.6	708.3
	Heat, thousands Gcal	1 153.8	1 126.8	1 193.4	1 166.0	1 135.7	1 047.5	1 049.7	1 095.8	2 101.3
CHP-North	Residual Fuel Oil, kt	0.0	0.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Natural Gas, millions m^3	37.8	38.0	41.5	39.1	38.9	33.5	34.4	36.0	37.1
	Electricity, millions kWh	67.4	66.5	70.0	69.9	66.3	60.2	61.5	66.6	67.5
	Heat, thousands Gcal	199.1	205.8	227.5	225.9	227.7	253.9	259.9	275.5	285.2

Source: "Termoelectrica" through Official Letter No. 79/3114 dated 26.05.2016 answer to Letter No. 512/2016-05-01 dated 10.05.2016, includes information for 2015; Subdivision "Termoservice" of J.S.C. "CHP-2" through Official Letter No. 79/823 dated 19.02.2015, answer to Letter No. 497/2015-01-11 dated 31.01.2015, includes information for 2010-2014; CHP-1 through Official Letter No. 01-11/6-56 dated 22.02.2011 answer to Letter No. 03-07/175 dated 02.02.2011, includes information for 2000-2010; Official Letter No. 01-11/6-10 dated 13.01.2014 answer to Letter No. 320/2014-01-01 dated 03.01.2014, includes information for 2011-2012; Official Letter No. 18/215 din 16.02.2015 answer to Letter No. 408/2015-01-10 din 31.01.2015, includes information for 2010-2014; CHP-2 through Official Letter No. 43/195 dated 14.02.2011 answer to Letter No. 03-07/175 dated 02.02.2011, includes information for 2000-2010; Official Letter No. 18/37 dated 13.01.2014 answer to Letter No. 320/2014-01-01 dated 03.01.2014, includes information for 2011-2012; Official Letter No. 18/188 dated 10.02.2015 answer to Letter No. 408/2015-01-10 dated 31.01.2015, includes information for 2010-2014; CHP-North through Official Letter No. 04/14-119 dated 28.02.2011 answer to Letter No. 03-07/175 dated 02.02.2011, includes information for 2000-2010; Official Letter No. 04-14/34 dated 22.01.2014 answer to Letter No. 320/2014-01-01 dated 03.01.2014, includes information for 2011-2012; Official Letter No. 04-14/71 dated 06.02.2015 answer to Letter No. 497/2015-01-11 dated 31.01.2015, includes information for 2010-2014; Official Letter No. 04-14/316 dated 17.05.2016 answer to Letter No. 512/2016-05-01 dated 10.05.2016, includes information for 2015; Official Letter No.79/68 dated 18.01.2018 answer to Letter dated 22.12.2017.

More information on fuel consumption from the CHPs in the RM is presented in Table 3-48.

Table 3-48: Fuel consumption by type of fuels at the CHP plants in the Republic of Moldova within 1990-2016 periods, TJ

	1990	1991	1992	1993	1994	1995	1996	1997	1998
Anthracite	NO	NO	NO	129	NO	NO	NO	NO	NO
Diesel	43	2127	1276	12	NO	29	29	29	29
Residual Fuel Oil	5215	7918	8482	6189	1086	1144	1350	1144	851
Natural Gas	27374	24795	19346	19265	4606	3961	6015	7570	5164
	1999	2000	2001	2002	2003	2004	2005	2006	2007
Diesel	59	29	29	NO	NO	11	21	17	12
Residual Fuel Oil	352	147	235	88	88	61	116	35	14
Natural Gas	5868	6631	10034	8655	7914	8351	9503	9279	9097
	2008	2009	2010	2011	2012	2013	2014	2015	2016
Anthracite	NO	NO	NO	NO	NO	NO	NO	NO	5
Diesel	16	18	20	19	10	10	9	NO	NO
Residual Fuel Oil	40	309	105	94	58	57	64	262	476
Natural Gas	8140	7526	7358	6951	6699	6326	6249	12273	12210
Biogas	NO	NO	NO	NO	NO	29	79	387	359

Note: for 1990-1993 time series, these AD represent aggregated data on fuel consumption within 1A1ai and 1A1aiii subcategories; 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 1993-2016, AD in energy units were taken directly from the Energy Balances of the RM.

Information on fuel consumption by type of fuels (solid, liquid, gaseous and biofuels) at the CHPs in the Republic of Moldova is presented in Table 3-49.

Table 3-49: Fuel consumption by type of fuel at the CHPs in the Republic of Moldova within 1990-2016 periods, TJ

	1990	1991	1992	1993	1994	1995	1996	1997	1998
Solid Fuels	NO	NO	NO	129	NO	NO	NO	NO	NO
Liquid fuels	5257	10045	9759	6201	1086	1173	1379	1173	880
Gaseous fuels	27374	24795	19346	19265	4606	3961	6015	7570	5164
	1999	2000	2001	2002	2003	2004	2005	2006	2007
Liquid fuels	411	176	264	88	88	72	137	52	26
Gaseous fuels	5868	6631	10034	8655	7914	8351	9503	9279	9097
	2008	2009	2010	2011	2012	2013	2014	2015	2016
Solid Fuels	NO	NO	NO	NO	NO	NO	NO	NO	5
Liquid fuels	56	327	125	113	68	67	73	262	476
Gaseous fuels	8140	7526	7358	6951	6699	6326	6249	12273	12210
Biofuels	NO	NO	NO	NO	NO	29	79	387	359

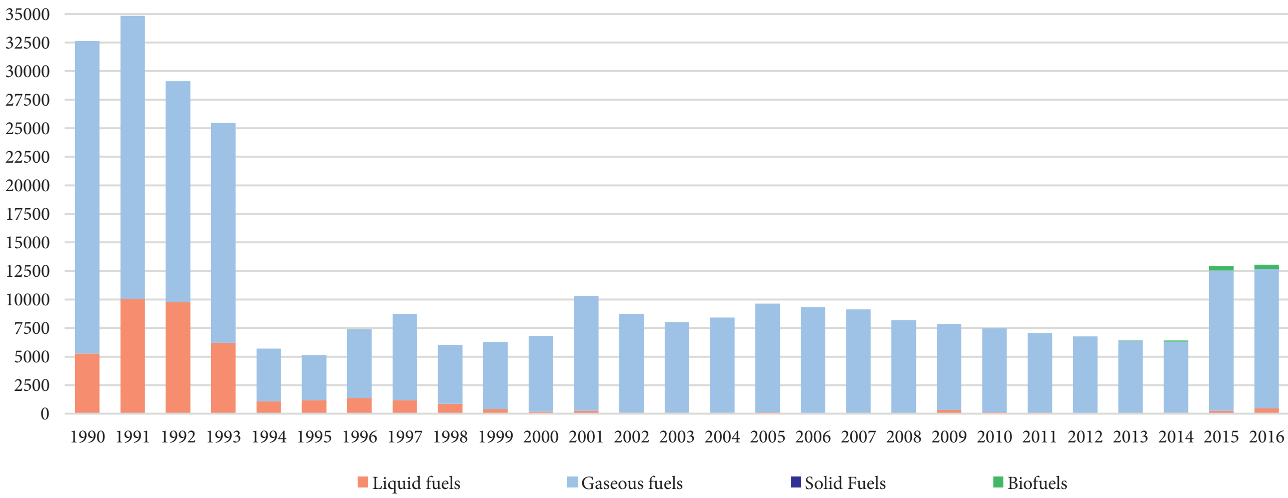


Figure 3-10: Fuel consumption by type of fuels at the CHPs in the Republic of Moldova within 1990-2016 periods, TJ.

1A1aiii Heat Plants

There are many heat plants (HPs) in the Republic of Moldova, mainly operating on natural gases and residual fuel oil, less on coal and biomass. The amount of fuel consumption is accounted in the Energy Balances of the Republic of Moldova. AD on fuel consumption for heat generation on the left bank of Dniester River are provided by JSC "Moldovagaz" (Table 3-50). These were considered as the difference between total fuel consumption in the energy sector of the LBDR and fuel consumption at the MTTP. AD are available in natural units (million m^3), being converted in energy units (TJ) by applying the average annual conversion factor (in TJ/million m^3).

Table 3-50: Natural Gas Consumption for Heat Production on the LBDR within 1990-2016 periods

	1990	1991	1992	1993	1994	1995	1996	1997	1998
Natural Gas, million m^3	164	164	174	114	268	149	50	148	225
Net caloric value, TJ/million.m^3	33.40	33.40	33.40	33.40	33.40	33.40	33.40	33.40	33.36
Natural Gas, TJ	5 465	5 466	5 824	3 794	8 951	4 975	1 660	4 947	7 498
	1999	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**
Natural Gas, million m^3	187	262	250	143	175	152	167	182	167
Net caloric value, TJ/million.m^3	33.39	33.40	33.37	33.45	33.52	33.57	33.60	33.63	33.65
Natural Gas, TJ	6 250	8 763	8 356	4 791	5 876	5 096	5 601	6 111	5 609
	2008	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**
Natural Gas, million m^3	189	181	211	209	203	204	188	191	192
Net caloric value, TJ/million.m^3	33.66	33.80	33.79	33.83	33.94	34.06	34.22	34.52	34.48
Natural Gas, TJ	6 362	6 121	7 112	7 063	6 892	6 952	6 437	6 593	6 620

AD on fuel consumption (inclusive in energy units) for heat generation on the RBDR are available in the Energy Balances of the RM within a separate rubric named "Heat Production". The table below presents aggregated AD on fuel consumption for heat production in the RM (Table 3-51).

Table 3-51: Fuel consumption for heat production in the RM within 1990-2016 periods, TJ

	1990	1991	1992	1993	1994	1995	1996	1997	1998
Anthracite	NO	NO	NO	373	176	117	29	29	29
Brown Coal (lignite)	35	NO	NO	202	59	29	29	29	29
Other types of Bituminous Coal	3384	2732	2081	1418	675	441	499	411	323
Diesel	2595	1811	1028	244	293	323	205	147	59
Kerosene for Oven	43	NO	NO	100	59	NO	29	29	59
Residual Fuel Oil	45426	37564	29703	21841	12176	11208	10034	7130	5663
Natural Gas	63433	52920	42765	30221	32658	28828	26042	29857	32789
Liquefied Petroleum Gases	46	NO	NO	35	NO	NO	NO	NO	NO
Fuel Wood	9	NO	NO	6	NO	NO	NO	NO	NO
Wood Waste	59	NO	NO	50	147	88	NO	59	29
Agricultural Residues	NO	NO	NO	NO	NO	NO	88	NO	NO

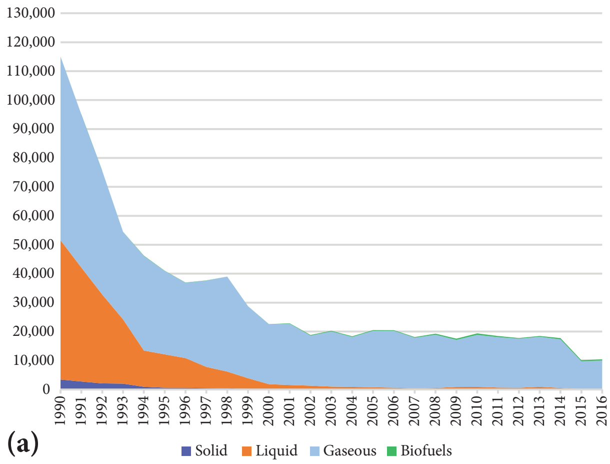
	1999	2000	2001	2002	2003	2004	2005	2006	2007
Anthracite	NO	NO	NO	59	59	59	81	44	39
Other types of Bituminous Coal	176	117	88	29	58	78	42	56	26
Diesel	29	59	29	59	88	75	73	42	21
Kerosene for Oven	59	59	29	29	29	15	NO	NO	NO
Residual Fuel Oil	3609	1584	1350	1115	733	637	523	439	268
Natural Gas	24852	20704	21178	17290	19065	17255	19520	19665	17496
Liquefied Petroleum Gases	NO	NO	29	NO	NO	5	9	8	4
Fuel Wood	NO	NO	NO	NO	NO	3	3	2	NO
Wood Waste	29	59	147	NO	29	16	16	1	1
Agricultural Residues	NO	NO	NO	235	205	226	226	214	239
	2008	2009	2010	2011	2012	2013	2014	2015	2016
Anthracite	71	113	91	61	67	264	52	59	57
Other types of Bituminous Coal	28	9	5	8	7	64	28	11	12
Diesel	22	31	28	19	18	33	20	9	10
Kerosene for Oven	NO	3	NO	NO	NO	NO	NO	NO	NO
Residual Fuel Oil	372	679	745	544	460	528	408	8	33
Other Oil Products	NO	NO	NO	NO	17	1	NO	1	1
Natural Gas	18398	16272	17974	17422	16961	17314	16765	9628	9889
Liquefied Petroleum Gases	3	7	1	1	NO	NO	NO	NO	NO
Fuel Wood	1	1	2	1	1	37	29	8	15
Wood Waste	1	2	2	1	3	3	5	7	2
Agricultural Residues	373	435	514	399	226	229	321	341	290
Pellets and briquettes from vegetable waste	NO	NO	NO	NO	NO	NO	NO	33	85
Biogas	NO	NO	NO	NO	NO	7	99	NO	NO

Table 3-52 presents fuel consumption by type for heat production in the Republic of Moldova within 1990-2016 time series.

Table 3-52: Fuel consumption by type of fuel for heat production in the RM within 1990-2016 periods

	Fuel consumption by type of fuel, TJ					in %, as compared to 1990				
	Solid	Liquid	Gaseous	Biofuels	Total	Solid	Liquid	Gaseous	Biofuels	Total
1990	3 419	48 110	63 433	68	115 030	100.0	100.0	100.0	100.0	100.0
1991	2 732	39 376	52 920	NA	95 028	79.9	81.8	83.4	NA	82.6
1992	2 081	30 730	42 765	NA	75 576	60.9	63.9	67.4	NA	65.7
1993	1 993	22 220	30 221	56	54 490	58.3	46.2	47.6	82.4	47.4
1994	910	12 528	32 658	147	46 243	26.6	26.0	51.5	216.2	40.2
1995	587	11 531	28 828	88	41 034	17.2	24.0	45.4	129.4	35.7
1996	557	10 268	26 042	88	36 955	16.3	21.3	41.1	129.4	32.1
1997	469	7 306	29 857	59	37 691	13.7	15.2	47.1	86.8	32.8
1998	381	5 781	32 789	29	38 980	11.1	12.0	51.7	42.6	33.9
1999	176	3 697	24 852	29	28 754	5.1	7.7	39.2	42.6	25.0
2000	117	1 702	20 704	59	22 582	3.4	3.5	32.6	86.8	19.6
2001	88	1 437	21 178	147	22 850	2.6	3.0	33.4	216.2	19.9
2002	88	1 203	17 290	235	18 816	2.6	2.5	27.3	345.6	16.4
2003	117	850	19 065	234	20 266	3.4	1.8	30.1	344.1	17.6
2004	137	732	17 255	245	18 369	4.0	1.5	27.2	360.3	16.0
2005	123	605	19 520	245	20 493	3.6	1.3	30.8	360.3	17.8
2006	100	489	19 665	217	20 471	2.9	1.0	31.0	319.1	17.8
2007	65	293	17 496	240	18 094	1.9	0.6	27.6	352.9	15.7
2008	99	397	18 398	375	19 269	2.9	0.8	29.0	551.5	16.8
2009	122	720	16 272	438	17 552	3.6	1.5	25.7	644.1	15.3
2010	96	774	17 974	518	19 362	2.8	1.6	28.3	761.8	16.8
2011	69	564	17 422	401	18 456	2.0	1.2	27.5	589.7	16.0
2012	74	495	16 961	230	17 760	2.2	1.0	26.7	338.2	15.4
2013	328	562	17 314	276	18 480	9.6	1.2	27.3	405.9	16.1
2014	80	428	16 765	454	17 727	2.3	0.9	26.4	667.6	15.4
2015	70	18	9 628	389	10 105	2.0	0.0	15.2	572.1	8.8
2016	69	44	9 889	392	10 394	2.0	0.1	15.6	576.5	9.0

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



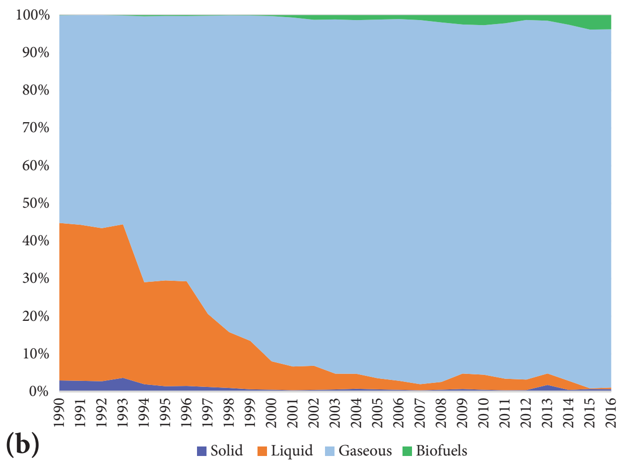


Figure 3-11: Fuel consumption within 1A1aiii Heat Plants, where: (a) Fuel consumption by type of fuel, TJ; and (b) Fuel consumption by type of fuel, in % of the total.

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

Fuel consumption in all sources included under 1A1a 'Main Activity Electricity and Heat Production', as well as the share of each source are presented in Table 3-53.

Table 3-53: Fuel consumption (TJ) by sources within 1A1a 'Main Activity Electricity and Heat Production' and the share of sources (%) in the structure of total emissions within 1990-2016

	Fuel consumption by sources, TJ				the share, % of the total		
	1A1ai	1A1aii	1A1aiii	1A1a	1A1ai	1A1aii	1A1aiii
1990	147 959	32 631	115 030	295 620	50.1	11.0	38.9
1991	132 335	34 839	95 028	262 203	50.5	13.3	36.2
1992	115 584	29 105	75 576	220 264	52.5	13.2	34.3
1993	94 301	25 595	54 490	174 386	54.1	14.7	31.2
1994	86 479	5 692	46 243	138 414	62.5	4.1	33.4
1995	60 201	5 134	41 034	106 369	56.6	4.8	38.6
1996	62 609	7 394	36 955	106 958	58.5	6.9	34.6
1997	44 603	8 743	37 691	91 037	49.0	9.6	41.4
1998	34 301	6 044	38 980	79 325	43.2	7.6	49.1
1999	28 086	6 279	28 754	63 119	44.5	9.9	45.6
2000	25 661	6 807	22 582	55 050	46.6	12.4	41.0
2001	31 282	10 298	22 850	64 430	48.6	16.0	35.5
2002	24 064	8 743	18 816	51 623	46.6	16.9	36.4
2003	25 346	8 002	20 266	53 614	47.3	14.9	37.8
2004	28 153	8 423	18 369	54 945	51.2	15.3	33.4
2005	27 059	9 640	20 493	57 192	47.3	16.9	35.8
2006	14 443	9 331	20 471	44 245	32.6	21.1	46.3
2007	24 192	9 123	18 094	51 409	47.1	17.7	35.2
2008	29 033	8 196	19 269	56 498	51.4	14.5	34.1
2009	49 497	7 853	17 552	74 902	66.1	10.5	23.4
2010	51 195	7 483	19 362	78 040	65.6	9.6	24.8
2011	46 037	7 064	18 456	71 557	64.3	9.9	25.8
2012	47 262	6 767	17 760	71 789	65.8	9.4	24.7
2013	33 803	6 422	18 480	58 705	57.6	10.9	31.5
2014	39 956	6 401	17 727	64 084	62.3	10.0	27.7
2015	46 658	12 922	10 105	69 685	67.0	18.5	14.5
2016	45 522	13 050	10 394	68 966	66.0	18.9	15.1

Fuel consumption by sources under the 1A1a 'Electricity and Heat Production'

The evolution of fuel consumption by sources under 1A1a „Public Electricity and Heat Production" within 1990-2016 periods is presented in Table 3-54 and Figure 3-12.

Table 3-54: Fuel consumption under 1A1a 'Main Activity Electricity and Heat Production' in the RM, breakdown by fuel type, 1990-2016

	Fuel consumption, TJ					the share, % from the total				in %, as compared to 1990				
	Coal	Petro-leum products	Natural gases	Biofuels	Total	Coal	Petro-leum products	Natural gases	Biofuels	Coal	Petro-leum products	Natural gases	Biofuels	Total
1990	68 062	96 377	131 112	68	295 620	23.0	32.6	44.4	0.0	100.0	100.0	100.0	100.0	100.0
1991	64 272	79 904	118 027	NA	262 203	24.5	30.5	45.0	NA	94.4	82.9	90.0	NA	88.7
1992	46 855	68 344	105 065	NA	220 264	21.3	31.0	47.7	NA	68.8	70.9	80.1	NA	74.5
1993	44 022	52 843	77 465	56	174 386	25.2	30.3	44.4	0.0	64.7	54.8	59.1	82.4	59.0
1994	43 817	22 780	71 670	147	138 414	31.7	16.5	51.8	0.1	64.4	23.6	54.7	216.2	46.8
1995	23 048	13 753	69 480	88	106 369	21.7	12.9	65.3	0.1	33.9	14.3	53.0	129.4	36.0
1996	21 070	12 596	73 205	88	106 959	19.7	11.8	68.4	0.1	31.0	13.1	55.8	129.4	36.2
1997	7 640	8 722	74 616	59	91 037	8.4	9.6	82.0	0.1	11.2	9.0	56.9	86.8	30.8
1998	5 022	7 743	66 531	29	79 325	6.3	9.8	83.9	0.0	7.4	8.0	50.7	42.6	26.8
1999	176	4 108	58 806	29	63 119	0.3	6.5	93.2	0.0	0.3	4.3	44.9	42.6	21.4
2000	117	1 878	52 997	59	55 051	0.2	3.4	96.3	0.1	0.2	1.9	40.4	86.8	18.6
2001	88	1 701	62 494	147	64 430	0.1	2.6	97.0	0.2	0.1	1.8	47.7	216.2	21.8
2002	88	1 291	50 009	235	51 623	0.2	2.5	96.9	0.5	0.1	1.3	38.1	345.6	17.5
2003	117	938	52 324	234	53 613	0.2	1.7	97.6	0.4	0.2	1.0	39.9	344.1	18.1
2004	137	804	53 759	245	54 945	0.2	1.5	97.8	0.4	0.2	0.8	41.0	360.3	18.6
2005	123	742	56 081	245	57 191	0.2	1.3	98.1	0.4	0.2	0.8	42.8	360.3	19.3
2006	100	541	43 387	217	44 245	0.2	1.2	98.1	0.5	0.1	0.6	33.1	319.1	15.0
2007	65	319	50 785	240	51 409	0.1	0.6	98.8	0.5	0.1	0.3	38.7	352.9	17.4
2008	3 036	759	52 328	375	56 497	5.4	1.3	92.6	0.7	4.5	0.8	39.9	551.5	19.1
2009	5 996	1 842	66 626	438	74 902	8.0	2.5	89.0	0.6	8.8	1.9	50.8	644.1	25.3
2010	5 212	1 705	70 605	518	78 039	6.7	2.2	90.5	0.7	7.7	1.8	53.9	761.8	26.4
2011	4 156	1 348	65 652	401	71 557	5.8	1.9	91.7	0.6	6.1	1.4	50.1	589.7	24.2
2012	4 144	1 131	66 284	230	71 789	5.8	1.6	92.3	0.3	6.1	1.2	50.6	338.2	24.3
2013	8 314	713	49 363	315	58 705	14.2	1.2	84.1	0.5	12.2	0.7	37.6	463.2	19.9
2014	137	557	62 839	551	64 084	0.2	0.9	98.1	0.9	0.2	0.6	47.9	810.3	21.7
2015	121	342	68 432	790	69 685	0.2	0.5	98.2	1.1	0.2	0.4	52.2	1161.8	23.6
2016	265	610	67 338	753	68 966	0.4	0.9	97.6	1.1	0.4	0.6	51.4	1107.4	23.3

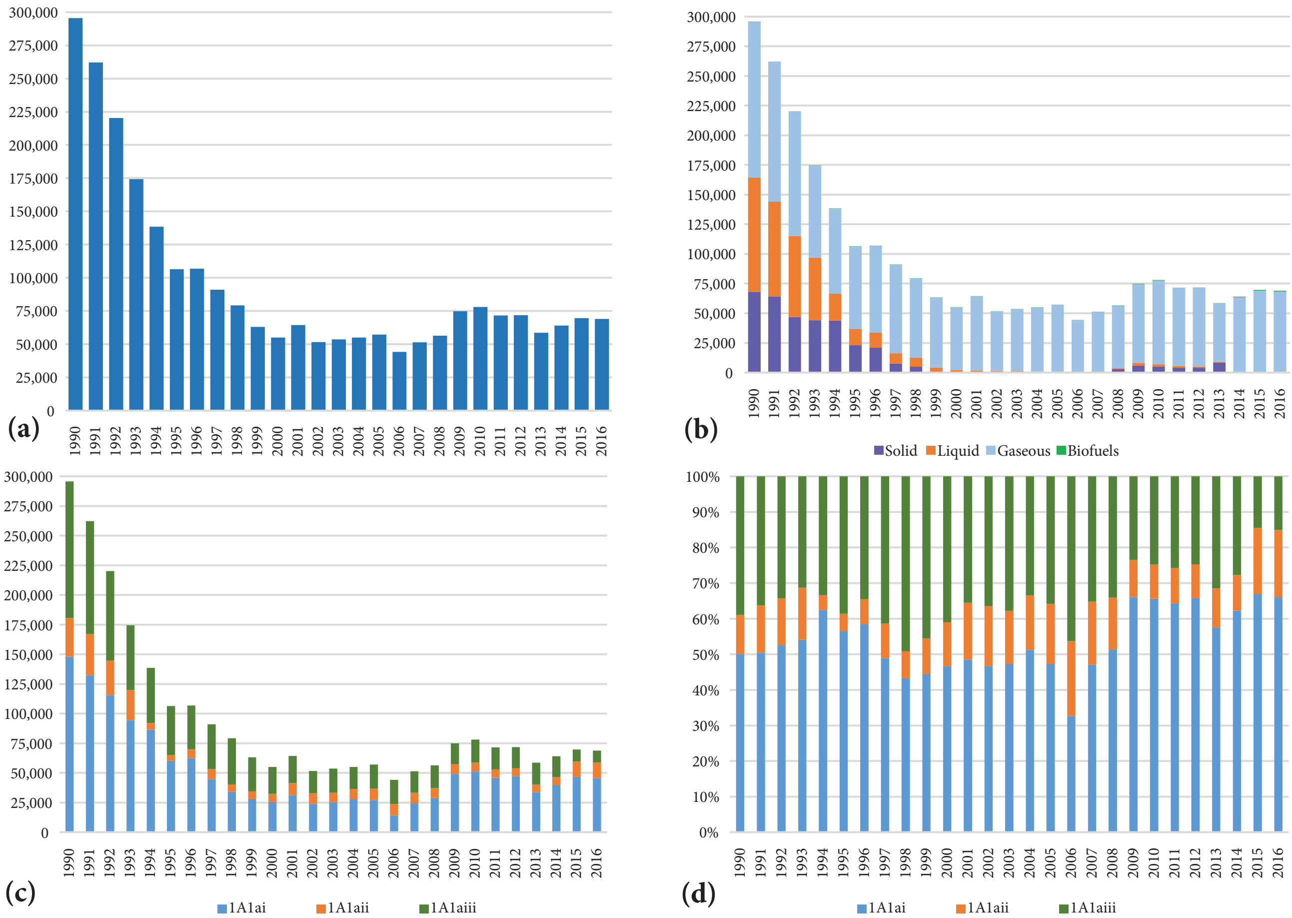


Figure 3-12: Fuel consumption by sources and fuel types within 1A1a 'Main Activity Electricity and Heat Production' in the RM within 1990-2016, when: (a) total fuel consumption within 1A1a, TJ; (b) total fuel consumption by fuel type within 1A1a, TJ; (c) total fuel consumption by sources within 1A1a, TJ; (d) total fuel consumption by sources within 1A1a, % from the total.

During the respective period, the share of solid fuels (coal) decreased from 23.0 per cent to 0.4 per cent; the share of liquid fuels (petroleum products) dropped from 32.6 per cent to circa 0.8 per cent; the share of gaseous fuels (natural gases) increased from 44.4 per cent to 97.6 per cent; while the share of biofuels increased from 0.02 per cent to 1.09 per cent of the total (biofuels consumption recorded a significant growth, in particular between 2000 and 2016, from circa 59 TJ to 753 TJ). In total, in 2016, fuel consumption within this category represented only circa 23.3 per cent of the reference year level (1990).

Trend of GHG emission 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 2016 are presented in Figure 3-13.

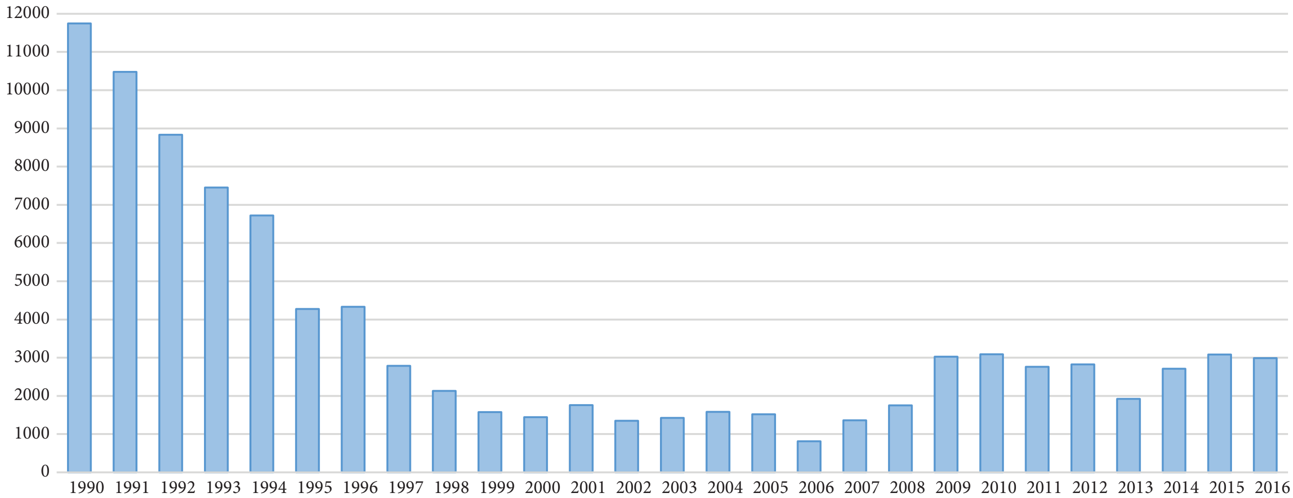


Figure 3-13: Direct GHG emissions from 1A1ai 'Electricity Generation' in the Republic of Moldova within 1990-2016 periods.

During the respective period, GHG emissions from this source category presented a decreasing trend, accounting in 2016 only circa 25.5 per cent of the reference year level (Table 3-55).

Table 3-55: Direct GHG emissions from 1A1ai 'Electricity Generation' in the Republic of Moldova within 1990-2016 periods

	1990	1991	1992	1993	1994	1995	1996	1997	1998
1A1ai, RBDR, kt CO_2 eq.	NO	NO	NO	NO	NO	NO	NO	NO	NO
1A1ai, LBDR, kt CO_2 eq.	11 748.9846	10 481.5704	8 831.9107	7 451.0877	6 723.0928	4 277.2763	4 334.5299	2 788.9888	2 130.0380
1A1ai, RM, kt CO_2 eq.	**11 748.9846**	**10 481.5704**	**8 831.9107**	**7 451.0877**	**6 723.0928**	**4 277.2763**	**4 334.5299**	**2 788.9888**	**2 130.0380**
in %, as compared to 1990	100.0	89.2	75.2	63.4	57.2	36.4	36.9	23.7	18.1
	1999	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**
1A1ai, RBDR, kt CO_2 eq.	NO	NO	NO	NO	NO	NO	NO	NO	NO
1A1ai, LBDR, kt CO_2 eq.	1 577.1410	1 441.0117	1 756.6221	1 351.2996	1 423.2874	1 580.9312	1 519.4867	811.0246	1 358.5105
1A1ai, RM, kt CO_2 eq.	**1 577.1410**	**1 441.0117**	**1 756.6221**	**1 351.2996**	**1 423.2874**	**1 580.9312**	**1 519.4867**	**811.0246**	**1 358.5105**
in %, as compared to 1990	13.4	12.3	15.0	11.5	12.1	13.5	12.9	6.9	11.6
	2008	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**
1A1ai, RBDR, kt CO_2 eq.	NO	NO	2.8100	2.0370	1.1696	2.4617	2.9461	0.5030	0.6511
1A1ai, LBDR, kt CO_2 eq.	1 751.1937	3 025.1952	3 088.4385	2 756.6500	2 823.4276	1 918.3616	2 709.1912	3 085.3760	2 990.1627
1A1ai, RM, kt CO_2 eq.	**1 751.1937**	**3 025.1952**	**3 091.2485**	**2 758.6870**	**2 824.5972**	**1 920.8234**	**2 712.1372**	**3 085.8790**	**2 990.8138**
in %, as compared to 1990	14.9	25.7	26.3	23.5	24.0	16.3	23.1	26.3	25.5

Between 1990 and 2016, the largest share in the structure of total direct GHG emissions was represented by CO_2 (Table 3-56).

Table 3-56: Direct GHG emissions from 1A1ai 'Electricity Generation' in the RM within 1990-2016 periods and the share of each gas in the total structure at category level

	1A1 ai, kt CO_2 equivalent				% from the total		
	CO_2	CH_4	N_2O	Total	CO_2	CH_4	N_2O
1990	11 705.3484	5.8495	37.7867	11 748.9846	99.63	0.05	0.32
1991	10 442.5779	4.8326	34.1599	10 481.5704	99.63	0.05	0.33
1992	8 801.3538	4.2823	26.2746	8 831.9107	99.65	0.05	0.30

	1A1 ai, kt CO_2 equivalent				% from the total		
	CO_2	CH_4	N_2O	Total	CO_2	CH_4	N_2O
1993	7 423.5796	3.5786	23.9295	7 451.0877	99.63	0.05	0.32
1994	6 698.6290	2.6203	21.8436	6 723.0928	99.64	0.04	0.32
1995	4 264.3977	1.5575	11.3211	4 277.2763	99.70	0.04	0.26
1996	4 322.3520	1.6127	10.5652	4 334.5299	99.72	0.04	0.24
1997	2 783.5044	1.1273	4.3571	2 788.9888	99.80	0.04	0.16
1998	2 126.0068	0.9116	3.1195	2 130.0380	99.81	0.04	0.15
1999	1 575.6019	0.7021	0.8370	1 577.1410	99.90	0.04	0.05
2000	1 439.6054	0.6415	0.7647	1 441.0117	99.90	0.04	0.05
2001	1 754.9079	0.7820	0.9322	1 756.6221	99.90	0.04	0.05
2002	1 349.9809	0.6016	0.7171	1 351.2996	99.90	0.04	0.05
2003	1 421.8985	0.6336	0.7553	1 423.2874	99.90	0.04	0.05
2004	1 579.3884	0.7038	0.8390	1 580.9312	99.90	0.04	0.05
2005	1 518.0038	0.6765	0.8064	1 519.4867	99.90	0.04	0.05
2006	810.2331	0.3611	0.4304	811.0246	99.90	0.04	0.05
2007	1 357.1848	0.6048	0.7209	1 358.5105	99.90	0.04	0.05
2008	1 748.3166	0.7411	2.1360	1 751.1937	99.84	0.04	0.12
2009	3 019.8740	1.2772	4.0440	3 025.1952	99.82	0.04	0.13
2010	3 086.1482	1.3201	3.7801	3 091.2485	99.84	0.04	0.12
2011	2 754.3255	1.1845	3.1769	2 758.6870	99.84	0.04	0.12
2012	2 820.1961	1.2099	3.1912	2 824.5972	99.84	0.04	0.11
2013	1 917.1144	0.7960	2.9129	1 920.8234	99.81	0.04	0.15
2014	2 707.6673	1.1525	3.3175	2 712.1372	99.84	0.04	0.12
2015	3 081.0603	1.3212	3.4976	3 085.8790	99.84	0.04	0.11
2016	2 986.1686	1.2786	3.3666	2 990.8138	99.84	0.04	0.11

Table 3-57 presents direct GHG emissions from 1A1ai 'Electricity Generation' by regions within 1990-2016 periods.

Table 3-57: Direct GHG emissions from 1A1ai 'Electricity Generation' by regions within 1990-2016 periods, kt CO_2 equivalent

	RBDR				LBDR			
	CO_2	CH_4	N_2O	Total	CO_2	CH_4	N_2O	Total
1990	NO	NO	NO	NO	11 705.3484	5.8495	37.7867	11 748.9846
1991	NO	NO	NO	NO	10 442.5779	4.8326	34.1599	10 481.5704
1992	NO	NO	NO	NO	8 801.3538	4.2823	26.2746	8 831.9107
1993	NO	NO	NO	NO	7 423.5796	3.5786	23.9295	7 451.0877
1994	NO	NO	NO	NO	6 698.6290	2.6203	21.8436	6 723.0928
1995	NO	NO	NO	NO	4 264.3977	1.5575	11.3211	4 277.2763
1996	NO	NO	NO	NO	4 322.3520	1.6127	10.5652	4 334.5299
1997	NO	NO	NO	NO	2 783.5044	1.1273	4.3571	2 788.9888
1998	NO	NO	NO	NO	2 126.0068	0.9116	3.1195	2 130.0380
1999	NO	NO	NO	NO	2 076.2420	0.8892	3.0148	2 080.1460
2000	NO	NO	NO	NO	1 918.1185	0.8185	2.8525	1 921.7896
2001	NO	NO	NO	NO	2 211.2940	0.9490	2.9300	2 215.1729
2002	NO	NO	NO	NO	1 784.2400	0.7584	2.6248	1 787.6233
2003	NO	NO	NO	NO	1 834.0307	0.7804	2.5730	1 837.3840
2004	NO	NO	NO	NO	1 969.3936	0.8405	2.5666	1 972.8007
2005	NO	NO	NO	NO	1 885.8821	0.8031	2.4439	1 889.1291
2006	NO	NO	NO	NO	1 155.9844	0.4776	1.9779	1 158.4399
2007	NO	NO	NO	NO	1 680.8091	0.7112	2.1784	1 683.6987
2008	NO	NO	NO	NO	1 748.3166	0.7411	2.1360	1 751.1937
2009	NO	NO	NO	NO	3 019.8740	1.2772	4.0440	3 025.1952
2010	2.8035	0.0021	0.0044	2.8100	3 083.3447	1.3180	3.7757	3 088.4385
2011	2.0316	0.0017	0.0037	2.0370	2 752.2939	1.1828	3.1732	2 756.6500
2012	1.1667	0.0009	0.0020	1.1696	2 819.0294	1.2090	3.1892	2 823.4276
2013	2.4570	0.0018	0.0030	2.4617	1 914.6574	0.7943	2.9099	1 918.3616
2014	2.9406	0.0021	0.0033	2.9461	2 704.7267	1.1504	3.3141	2 709.1912
2015	0.5007	0.0008	0.0015	0.5030	3 080.5596	1.3203	3.4961	3 085.3760
2016	0.6489	0.0007	0.0015	0.6511	2 985.5197	1.2779	3.3651	2 990.1627

Table 3-58 presents direct and indirect GHG emissions from the respective source category between 1990 and 2016.

Table 3-58: Direct and indirect GHG emissions from 1A1ai 'Electricity Generation' in the Republic of Moldova within 1990-2016 periods

	1A1ai, kt							in %, as 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	11 705.3484	0.2340	0.1268	23.2050	2.7838	0.2684	74.3086	100.0	100.0	100.0	100.0	100.0	100.0	100.0
1991	10 442.5779	0.1933	0.1146	20.7782	2.5679	0.2365	65.5630	89.2	82.6	90.4	89.5	92.2	88.1	88.2
1992	8 801.3538	0.1713	0.0882	17.1362	2.4854	0.2205	50.5151	75.2	73.2	69.5	73.8	89.3	82.2	68.0
1993	7 423.5796	0.1431	0.0803	14.7151	1.8245	0.1708	46.4542	63.4	61.2	63.3	63.4	65.5	63.7	62.5
1994	6 698.6290	0.1048	0.0733	13.3313	1.8535	0.1534	39.7305	57.2	44.8	57.8	57.4	66.6	57.2	53.5
1995	4 264.3977	0.0623	0.0380	8.1089	1.6422	0.1203	18.9477	36.4	26.6	30.0	34.9	59.0	44.8	25.5
1996	4 322.3520	0.0645	0.0355	8.0841	1.7975	0.1297	17.3020	36.9	27.6	28.0	34.8	64.6	48.3	23.3
1997	2 783.5044	0.0451	0.0146	4.8431	1.5164	0.1044	6.0110	23.8	19.3	11.5	20.9	54.5	38.9	8.1
1998	2 126.0068	0.0365	0.0105	3.6670	1.1713	0.0814	4.3491	18.2	15.6	8.3	15.8	42.1	30.3	5.9
1999	1 575.6019	0.0281	0.0028	2.4996	1.0953	0.0730	0.0079	13.5	12.0	2.2	10.8	39.3	27.2	0.0
2000	1 439.6054	0.0257	0.0026	2.2839	1.0008	0.0667	0.0072	12.3	11.0	2.0	9.8	36.0	24.9	0.0
2001	1 754.9079	0.0313	0.0031	2.7841	1.2200	0.0813	0.0088	15.0	13.4	2.5	12.0	43.8	30.3	0.0
2002	1 349.9809	0.0241	0.0024	2.1417	0.9385	0.0626	0.0068	11.5	10.3	1.9	9.2	33.7	23.3	0.0
2003	1 421.8985	0.0253	0.0025	2.2558	0.9885	0.0659	0.0071	12.1	10.8	2.0	9.7	35.5	24.6	0.0
2004	1 579.3884	0.0282	0.0028	2.5056	1.0980	0.0732	0.0079	13.5	12.0	2.2	10.8	39.4	27.3	0.0
2005	1 518.0038	0.0271	0.0027	2.4082	1.0553	0.0704	0.0076	13.0	11.6	2.1	10.4	37.9	26.2	0.0
2006	810.2331	0.0144	0.0014	1.2854	0.5633	0.0376	0.0041	6.9	6.2	1.1	5.5	20.2	14.0	0.0
2007	1 357.1848	0.0242	0.0024	2.1531	0.9435	0.0629	0.0068	11.6	10.3	1.9	9.3	33.9	23.4	0.0
2008	1 748.3166	0.0296	0.0072	2.9525	1.0360	0.0707	2.5669	14.9	12.7	5.7	12.7	37.2	26.3	3.5
2009	3 019.8740	0.0511	0.0136	5.1523	1.7334	0.1191	5.2221	25.8	21.8	10.7	22.2	62.3	44.4	7.0
2010	3 086.1482	0.0528	0.0127	5.2130	1.8223	0.1247	4.6067	26.4	22.6	10.0	22.5	65.5	46.5	6.2
2011	2 754.3255	0.0474	0.0107	4.6233	1.6556	0.1130	3.6951	23.5	20.2	8.4	19.9	59.5	42.1	5.0
2012	2 820.1961	0.0484	0.0107	4.7248	1.7063	0.1162	3.6307	24.1	20.7	8.4	20.4	61.3	43.3	4.9
2013	1 917.1144	0.0318	0.0098	3.3230	1.0512	0.0727	4.0281	16.4	13.6	7.7	14.3	37.8	27.1	5.4
2014	2 707.6673	0.0461	0.0111	4.5755	1.6020	0.1094	4.0146	23.1	19.7	8.8	19.7	57.5	40.8	5.4
2015	3 081.0603	0.0528	0.0117	5.1643	1.8634	0.1269	3.9835	26.3	22.6	9.3	22.3	66.9	47.3	5.4
2016	2 986.1686	0.0511	0.0113	5.0008	1.8099	0.1231	3.8010	25.5	21.9	8.9	21.6	65.0	45.9	5.1

1A1aii Combined Heat and Power Generation

Direct GHG emissions from 1A1aii 'Combined Heat and Power Generation' in the RM between 1990 and 2016 is presented in Figure 3-14.

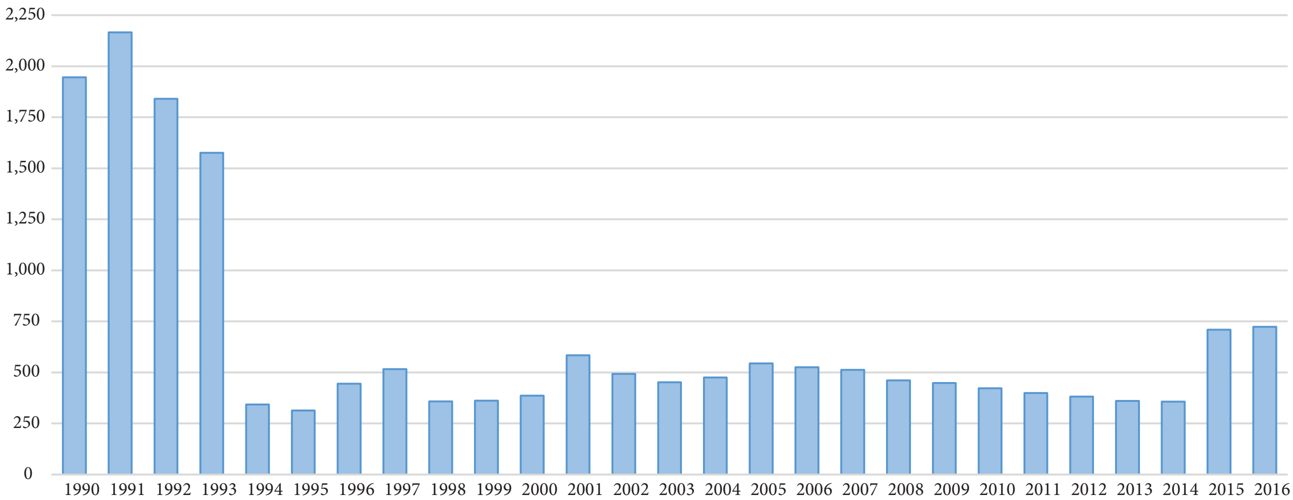


Figure 3-14: Direct GHG emissions from 1A1aii 'Combined Heat and Power Generation' in the Republic of Moldova within 1990-2016 periods.

During the respective period, GHG emissions from this source presented a significant decrease, accounting in 2016 only circa 37.2 per cent of the reference year level (Table 3-59).

Table 3-59: Direct GHG emissions from 1A1aii 'Combined Heat and Power Generation' in the Republic of Moldova within 1990-2016 periods

	1990	1991	1992	1993	1994	1995	1996	1997	1998
1A1aii, kt CO_2 eq.	1 945.2826	2 165.3414	1 839.9486	1 576.0806	342.9810	313.4214	444.7600	516.0840	358.2230
in %, as compared to 1990	100.0	111.3	94.6	81.0	17.6	16.1	22.9	26.5	18.4
	1999	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**
1A1aii, kt CO_2 eq.	361.2374	385.9338	583.8622	492.8533	451.2426	474.5035	544.2083	525.0423	512.8196
in %, as compared to 1990	18.6	19.8	30.0	25.3	23.2	24.4	28.0	27.0	26.4

	2008	2009	2010	2011	2012	2013	2014	2015	2016
1A1aii, kt CO_2 eq.	461.3959	447.9544	422.8277	399.0442	381.4285	360.4067	356.5547	709.5544	723.1269
in %, as compared to 1990	23.7	23.0	21.7	20.5	19.6	18.5	18.3	36.5	37.2

Table 3-60 presents direct GHG emissions from the respective source between 1990 and 2016, 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 reference year level.

Table 3-60: Direct GHG emissions from 1A1aii 'Combined Heat and Power Generation' in the RM within 1990-2016 periods and the share of each gas in the total structure at category level

	Direct GHG emissions, kt CO_2 equivalent				the share from the total, %			in %, as compared to 1990		
	CO_2	CH_4	N_2O	Total	CO_2	CH_4	N_2O	CO_2	CH_4	N_2O
1990	1 942.4482	1.0786	1.7558	1 945.2826	99.85	0.06	0.09	100.0	100.0	100.0
1991	2 161.4332	1.3732	2.5349	2 165.3414	99.82	0.06	0.12	111.3	127.3	144.4
1992	1 836.4117	1.2155	2.3214	1 839.9486	99.81	0.07	0.13	94.5	112.7	132.2
1993	1 573.3901	0.9499	1.7406	1 576.0806	99.83	0.06	0.11	81.0	88.1	99.1
1994	342.4530	0.1966	0.3314	342.9810	99.85	0.06	0.10	17.6	18.2	18.9
1995	312.9066	0.1870	0.3278	313.4214	99.84	0.06	0.10	16.1	17.3	18.7
1996	444.0804	0.2538	0.4258	444.7600	99.85	0.06	0.10	22.9	23.5	24.3
1997	515.3715	0.2772	0.4353	516.0840	99.86	0.05	0.08	26.5	25.7	24.8
1998	357.7167	0.1951	0.3112	358.2230	99.86	0.05	0.09	18.4	18.1	17.7
1999	360.8115	0.1775	0.2484	361.2374	99.88	0.05	0.07	18.6	16.5	14.1
2000	385.5258	0.1790	0.2291	385.9338	99.89	0.05	0.06	19.8	16.6	13.0
2001	583.2453	0.2707	0.3462	583.8622	99.89	0.05	0.06	30.0	25.1	19.7
2002	492.3567	0.2230	0.2737	492.8533	99.90	0.05	0.06	25.3	20.7	15.6
2003	450.7866	0.2045	0.2516	451.2426	99.90	0.05	0.06	23.2	19.0	14.3
2004	474.0276	0.2142	0.2617	474.5035	99.90	0.05	0.06	24.4	19.9	14.9
2005	543.6528	0.2479	0.3077	544.2083	99.90	0.05	0.06	28.0	23.0	17.5
2006	524.5206	0.2359	0.2858	525.0423	99.90	0.04	0.05	27.0	21.9	16.3
2007	512.3145	0.2294	0.2757	512.8196	99.90	0.04	0.05	26.4	21.3	15.7
2008	460.9356	0.2077	0.2526	461.3959	99.90	0.05	0.05	23.7	19.3	14.4
2009	447.4590	0.2127	0.2827	447.9544	99.89	0.05	0.06	23.0	19.7	16.1
2010	422.3928	0.1933	0.2416	422.8277	99.90	0.05	0.06	21.7	17.9	13.8
2011	398.6346	0.1823	0.2273	399.0442	99.90	0.05	0.06	20.5	16.9	12.9
2012	381.0441	0.1726	0.2118	381.4285	99.90	0.05	0.06	19.6	16.0	12.1
2013	360.0414	0.1639	0.2014	360.4067	99.90	0.05	0.06	18.5	15.2	11.5
2014	356.1894	0.1637	0.2016	356.5547	99.90	0.05	0.06	18.3	15.2	11.5
2015	708.7941	0.3362	0.4241	709.5544	99.89	0.05	0.06	36.5	31.2	24.2
2016	722.3149	0.3501	0.4619	723.1269	99.89	0.05	0.06	37.2	32.5	26.3

Direct and indirect GHG emissions from 1A1aii 'Combined Heat and Power Generation' in the Republic of Moldova within 1990-2016 periods are presented in Table 3-61. During the respective period, GHG emissions from this source decreased significantly, representing in 2016: for CO_2 emissions only 37.2 per cent of the 1990 level, for CH_4 – 32.5 per cent, N_2O – 26.3 per cent, NO_x – 37.3 per cent, CO – 43.4 per cent, NMVOC – 40.6 per cent and SO_2 – 9.4 per cent.

Table 3-61: Direct and indirect GHG emissions from 1A1aii 'Combined Heat and Power Generation' in the Republic of Moldova within 1990-2016 periods

	GHG emissions, kt							in %, as 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	1 942.4482	0.0431	0.0059	3.1795	1.1470	0.0832	2.5910	100.0	100.0	100.0	100.0	100.0	100.0	100.0
1991	2 161.4332	0.0549	0.0085	3.4693	1.1210	0.0844	4.0253	111.3	127.3	144.4	109.1	97.7	101.4	155.4
1992	1 836.4117	0.0486	0.0078	3.0092	0.9032	0.0708	4.2636	94.5	112.7	132.2	94.6	78.7	85.1	164.6
1993	1 573.3901	0.0380	0.0058	2.6212	0.8461	0.0645	3.1755	81.0	88.1	99.1	82.4	73.8	77.5	122.6
1994	342.4530	0.0079	0.0011	0.5641	0.1960	0.0145	0.5389	17.6	18.2	18.9	17.7	17.1	17.4	20.8
1995	312.9066	0.0075	0.0011	0.5169	0.1722	0.0130	0.5687	16.1	17.3	18.7	16.3	15.0	15.6	22.0
1996	444.0804	0.0102	0.0014	0.7289	0.2554	0.0188	0.6713	22.9	23.5	24.3	22.9	22.3	22.6	25.9
1997	515.3715	0.0111	0.0015	0.8381	0.3130	0.0223	0.5698	26.5	25.7	24.8	26.4	27.3	26.8	22.0
1998	357.7167	0.0078	0.0010	0.5823	0.2147	0.0154	0.4240	18.4	18.1	17.7	18.3	18.7	18.5	16.4
1999	360.8115	0.0071	0.0008	0.5761	0.2351	0.0161	0.1786	18.6	16.5	14.1	18.1	20.5	19.4	6.9
2000	385.5258	0.0072	0.0008	0.6129	0.2613	0.0176	0.0760	19.8	16.6	13.0	19.3	22.8	21.2	2.9
2001	583.2453	0.0108	0.0012	0.9283	0.3953	0.0267	0.1205	30.0	25.1	19.7	29.2	34.5	32.0	4.7
2002	492.3567	0.0089	0.0009	0.7828	0.3389	0.0227	0.0460	25.3	20.7	15.6	24.6	29.5	27.3	1.8
2003	450.7866	0.0082	0.0008	0.7168	0.3100	0.0208	0.0458	23.2	19.0	14.3	22.5	27.0	25.0	1.8

	GHG emissions, kt							in %, as 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
2004	474.0276	0.0086	0.0009	0.7526	0.3268	0.0219	0.0331	24.4	19.9	14.9	23.7	28.5	26.3	1.3
2005	543.6528	0.0099	0.0010	0.8636	0.3727	0.0250	0.0611	28.0	23.0	17.5	27.2	32.5	30.0	2.4
2006	524.5206	0.0094	0.0010	0.8319	0.3627	0.0242	0.0207	27.0	21.9	16.3	26.2	31.6	29.1	0.8
2007	512.3145	0.0092	0.0009	0.8124	0.3552	0.0237	0.0100	26.4	21.3	15.7	25.6	31.0	28.5	0.4
2008	460.9356	0.0083	0.0008	0.7312	0.3183	0.0213	0.0228	23.7	19.3	14.4	23.0	27.8	25.6	0.9
2009	447.4590	0.0085	0.0009	0.7149	0.2985	0.0203	0.1559	23.0	19.7	16.1	22.5	26.0	24.4	6.0
2010	422.3928	0.0077	0.0008	0.6711	0.2889	0.0194	0.0550	21.7	17.9	13.8	21.1	25.2	23.3	2.1
2011	398.6346	0.0073	0.0008	0.6332	0.2728	0.0183	0.0494	20.5	16.9	12.9	19.9	23.8	22.0	1.9
2012	381.0441	0.0069	0.0007	0.6051	0.2623	0.0176	0.0311	19.6	16.0	12.1	19.0	22.9	21.1	1.2
2013	360.0414	0.0066	0.0007	0.5743	0.2489	0.0167	0.0305	18.5	15.2	11.5	18.1	21.7	20.0	1.2
2014	356.1894	0.0065	0.0007	0.5729	0.2479	0.0166	0.0339	18.3	15.2	11.5	18.0	21.6	20.0	1.3
2015	708.7941	0.0134	0.0014	1.1639	0.4977	0.0335	0.1332	36.5	31.2	24.2	36.6	43.4	40.3	5.1
2016	722.3149	0.0140	0.0016	1.1873	0.4974	0.0338	0.2433	37.2	32.5	26.3	37.3	43.4	40.6	9.4

1A1aiii Heat Plants

Direct GHG emissions from 1A1aiii 'Heat Plants' in the RM between 1990 and 2016 are presented in Figure 3-15. During the respective period, GHG emissions from this source recorded a significant decrease, representing in 2016 only circa 7.4 per cent of the reference year level (Table 3-62).

Table 3-62: Direct GHG emissions from 1A1aiii 'Heat Plants' in the Republic of Moldova within 1990-2016 periods

	1990	1991	1992	1993	1994	1995	1996	1997	1998
1A1aiii, kt CO_2 eq.	7 613.9384	6 299.3159	5 004.7611	3 612.9070	2 893.2705	2 569.7894	2 312.3262	2 288.3139	2 326.2028
in %, as compared to 1990	100.0	82.7	65.7	47.5	38.0	33.8	30.4	30.1	30.6
	1999	2000	2001	2002	2003	2004	2005	2006	2007
1A1aiii, kt CO_2 eq.	1 699.0222	1 305.5194	1 308.8136	1 073.0032	1 147.9198	1 039.0849	1 155.1973	1 152.1156	1 011.8978
in %, as compared to 1990	22.3	17.1	17.2	14.1	15.1	13.6	15.2	15.1	13.3
	2008	2009	2010	2011	2012	2013	2014	2015	2016
1A1aiii, kt CO_2 eq.	1 074.2330	982.2962	1 079.7811	1 029.6180	998.5024	1 048.4729	983.0916	549.6451	566.2365
in %, as compared to 1990	14.1	12.9	14.2	13.5	13.1	13.8	12.9	7.2	7.4

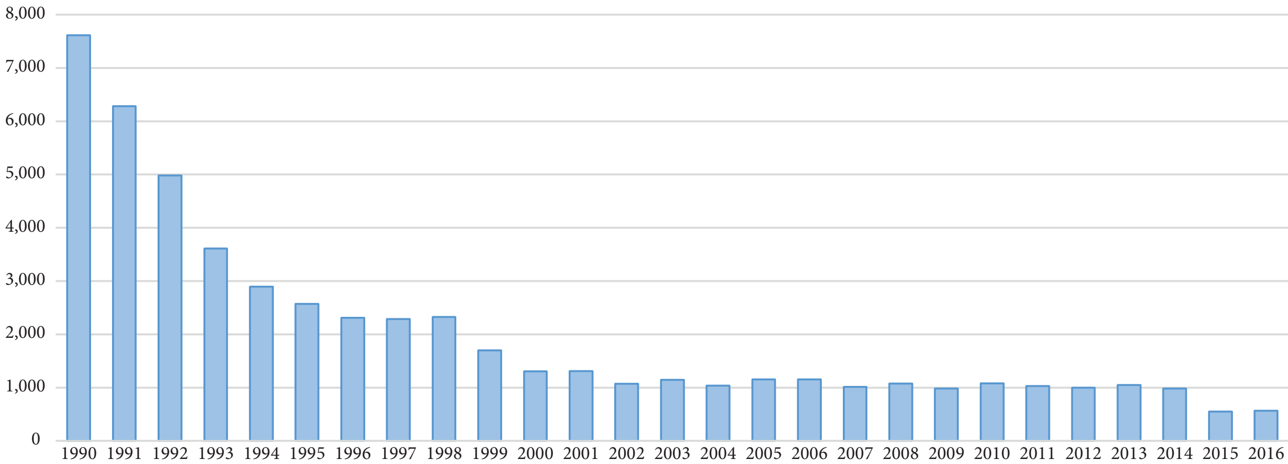


Figure 3-15: Direct GHG emissions from 1A1aiii 'Heat Plants' in the RM within 1990-2016 periods.

Direct and indirect GHG emissions from 1A1aiii 'Heat Plants' in the Republic of Moldova within 1990-2016 periods are presented in Table 3-63. During the respective period, GHG emissions from this source decreased significantly, representing in 2016: for CO_2 emissions only 7.4 per cent of the 1990 level, for CH_4 – 10.3 per cent, N_2O – 6.6 per cent, NO_x – 7.2 per cent, CO – 13.0 per cent, NMVOC – 10.4 per cent and SO_2 – 0.3 per cent.

Table 3-63: Direct and indirect GHG emissions from 1A1aiii 'Heat Plants' in the Republic of Moldova within 1990-2016 periods

	GHG emissions, kt							in %, as 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	7 596.5153	0.2131	0.0406	12.9930	3.2402	0.2756	25.4608	100.0	100.0	100.0	100.0	100.0	100.0	100.0
1991	6 284.9492	0.1760	0.0334	10.7675	2.6934	0.2289	21.0869	82.7	82.6	82.4	82.9	83.1	83.1	82.8
1992	4 993.4314	0.1393	0.0263	8.5737	2.1605	0.1832	16.7130	65.7	65.3	64.9	66.0	66.7	66.5	65.6

	GHG emissions, kt							in %, as 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
1993	3 604.5689	0.1005	0.0196	6.2453	1.5377	0.1317	12.6444	47.5	47.1	48.2	48.1	47.5	47.8	49.7
1994	2 887.5863	0.0756	0.0127	4.8627	1.4844	0.1152	6.8512	38.0	35.5	31.4	37.4	45.8	41.8	26.9
1995	2 564.8351	0.0666	0.0110	4.3091	1.3118	0.1022	6.0783	33.8	31.3	27.2	33.2	40.5	37.1	23.9
1996	2 307.8593	0.0600	0.0100	3.8824	1.1837	0.0922	5.4677	30.4	28.2	24.5	29.9	36.5	33.5	21.5
1997	2 284.4876	0.0540	0.0083	3.7851	1.2843	0.0951	3.9561	30.1	25.3	20.5	29.1	39.6	34.5	15.5
1998	2 322.7026	0.0514	0.0074	3.8131	1.3721	0.0990	3.1556	30.6	24.1	18.3	29.3	42.3	35.9	12.4
1999	1 696.5826	0.0370	0.0051	2.7692	1.0293	0.0734	1.9422	22.3	17.4	12.5	21.3	31.8	26.6	7.6
2000	1 303.7830	0.0277	0.0035	2.1045	0.8396	0.0581	0.8920	17.2	13.0	8.6	16.2	25.9	21.1	3.5
2001	1 306.9671	0.0299	0.0037	2.1132	0.8624	0.0595	0.7507	17.2	14.0	9.1	16.3	26.6	21.6	2.9
2002	1 071.2525	0.0280	0.0035	1.7403	0.7145	0.0494	0.6356	14.1	13.2	8.7	13.4	22.1	17.9	2.5
2003	1 146.1497	0.0288	0.0035	1.8518	0.7786	0.0532	0.4721	15.1	13.5	8.7	14.3	24.0	19.3	1.9
2004	1 037.4141	0.0269	0.0033	1.6809	0.7074	0.0483	0.4393	13.7	12.6	8.2	12.9	21.8	17.5	1.7
2005	1 153.4420	0.0288	0.0035	1.8626	0.7938	0.0539	0.3713	15.2	13.5	8.6	14.3	24.5	19.6	1.5
2006	1 150.4468	0.0277	0.0033	1.8545	0.7950	0.0539	0.3091	15.1	13.0	8.1	14.3	24.5	19.6	1.2
2007	1 010.3687	0.0256	0.0030	1.6299	0.7091	0.0480	0.1944	13.3	12.0	7.3	12.5	21.9	17.4	0.8
2008	1 072.3496	0.0309	0.0037	1.7430	0.7582	0.0516	0.2756	14.1	14.5	9.2	13.4	23.4	18.7	1.1
2009	980.3150	0.0317	0.0040	1.6084	0.6862	0.0472	0.4470	12.9	14.9	9.8	12.4	21.2	17.1	1.8
2010	1 077.5486	0.0359	0.0045	1.7694	0.7602	0.0524	0.4594	14.2	16.9	11.0	13.6	23.5	19.0	1.8
2011	1 027.7090	0.0312	0.0038	1.6760	0.7247	0.0496	0.3360	13.5	14.6	9.3	12.9	22.4	18.0	1.3
2012	996.9657	0.0254	0.0030	1.6113	0.6904	0.0469	0.2973	13.1	11.9	7.5	12.4	21.3	17.0	1.2
2013	1 046.7039	0.0274	0.0036	1.7091	0.7111	0.0486	0.5397	13.8	12.9	9.0	13.2	21.9	17.6	2.1
2014	981.3317	0.0289	0.0035	1.6056	0.6968	0.0475	0.2771	12.9	13.5	8.6	12.4	21.5	17.2	1.1
2015	548.3244	0.0214	0.0026	0.9048	0.4114	0.0280	0.0687	7.2	10.1	6.5	7.0	12.7	10.2	0.3
2016	564.8896	0.0219	0.0027	0.9317	0.4222	0.0287	0.0804	7.4	10.3	6.6	7.2	13.0	10.4	0.3

Direct and indirect GHG emissions under 1A1aiii 'Heat Plants' by regions between 1990 and 2016 are presented in Table 3-64.

Table 3-64: Direct GHG emissions from 1A1aiii 'Heat Plants' in the Republic of Moldova by Regions, within 1990-2016 periods

	RBDR							LBDR						
	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	7 289.9224	0.2077	0.0400	12.5066	3.0271	0.2614	25.4593	306.5929	0.0055	0.0005	0.4864	0.2131	0.0142	0.0015
1991	5 978.3055	0.1705	0.0329	10.2810	2.4802	0.2147	21.0853	306.6437	0.0055	0.0005	0.4865	0.2132	0.0142	0.0015
1992	4 666.6887	0.1334	0.0258	8.0553	1.9334	0.1681	16.7114	326.7427	0.0058	0.0006	0.5184	0.2271	0.0151	0.0016
1993	3 391.7377	0.0967	0.0192	5.9076	1.3898	0.1218	12.6433	212.8312	0.0038	0.0004	0.3376	0.1480	0.0099	0.0011
1994	2 385.4533	0.0666	0.0118	4.0661	1.1353	0.0919	6.8487	502.1330	0.0090	0.0009	0.7966	0.3491	0.0233	0.0025
1995	2 285.7355	0.0617	0.0105	3.8664	1.1178	0.0893	6.0769	279.0996	0.0050	0.0005	0.4428	0.1940	0.0129	0.0014
1996	2 214.7225	0.0584	0.0098	3.7347	1.1190	0.0879	5.4672	93.1368	0.0017	0.0002	0.1478	0.0647	0.0043	0.0005
1997	2 006.9511	0.0491	0.0078	3.3448	1.0914	0.0822	3.9547	277.5365	0.0049	0.0005	0.4403	0.1929	0.0129	0.0014
1998	1 902.0908	0.0439	0.0067	3.1458	1.0797	0.0795	3.1535	420.6118	0.0075	0.0007	0.6673	0.2924	0.0195	0.0021
1999	1 345.9494	0.0307	0.0045	2.2129	0.7855	0.0571	1.9404	350.6332	0.0063	0.0006	0.5563	0.2438	0.0163	0.0018
2000	812.1739	0.0189	0.0026	1.3246	0.4979	0.0353	0.8895	491.6091	0.0088	0.0009	0.7799	0.3418	0.0228	0.0025
2001	838.1929	0.0216	0.0028	1.3695	0.5365	0.0377	0.7483	468.7742	0.0084	0.0008	0.7437	0.3259	0.0217	0.0023
2002	802.4950	0.0232	0.0030	1.3139	0.5276	0.0369	0.6342	268.7575	0.0048	0.0005	0.4264	0.1868	0.0125	0.0013
2003	816.5295	0.0229	0.0029	1.3289	0.5494	0.0379	0.4704	329.6202	0.0059	0.0006	0.5229	0.2291	0.0153	0.0017
2004	751.5537	0.0218	0.0028	1.2274	0.5087	0.0351	0.4379	285.8604	0.0051	0.0005	0.4535	0.1987	0.0132	0.0014
2005	839.2488	0.0232	0.0029	1.3642	0.5754	0.0394	0.3697	314.1932	0.0056	0.0006	0.4985	0.2184	0.0146	0.0016
2006	807.5978	0.0216	0.0027	1.3106	0.5566	0.0380	0.3074	342.8490	0.0061	0.0006	0.5439	0.2383	0.0159	0.0017
2007	695.7057	0.0200	0.0024	1.1307	0.4903	0.0334	0.1929	314.6630	0.0056	0.0006	0.4992	0.2187	0.0146	0.0016
2008	715.4600	0.0246	0.0031	1.1768	0.5101	0.0350	0.2738	356.8896	0.0064	0.0006	0.5662	0.2481	0.0165	0.0018
2009	636.9395	0.0256	0.0034	1.0637	0.4474	0.0313	0.4453	343.3755	0.0061	0.0006	0.5447	0.2387	0.0159	0.0017
2010	678.5774	0.0288	0.0038	1.1364	0.4828	0.0339	0.4574	398.9712	0.0071	0.0007	0.6329	0.2774	0.0185	0.0020
2011	631.4696	0.0241	0.0031	1.0474	0.4493	0.0312	0.3340	396.2394	0.0071	0.0007	0.6286	0.2755	0.0184	0.0020
2012	610.3031	0.0185	0.0023	0.9978	0.4215	0.0290	0.2953	386.6626	0.0069	0.0007	0.6134	0.2688	0.0179	0.0019
2013	656.6996	0.0205	0.0029	1.0904	0.4400	0.0305	0.5377	390.0043	0.0070	0.0007	0.6187	0.2711	0.0181	0.0020
2014	620.2224	0.0224	0.0028	1.0327	0.4458	0.0307	0.2753	361.1093	0.0064	0.0006	0.5729	0.2510	0.0167	0.0018
2015	178.4632	0.0148	0.0020	0.3180	0.1543	0.0108	0.0669	369.8612	0.0066	0.0007	0.5868	0.2571	0.0171	0.0019
2016	193.4977	0.0152	0.0020	0.3425	0.1640	0.0115	0.0786	371.3919	0.0066	0.0007	0.5892	0.2582	0.0172	0.0019

Table 3-65 presents direct GHG emissions from the respective source between 1990 and 2016, 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 reference year level.

Table 3-65: Direct GHG emissions from 1A1aiii 'Heat Plants' in the RM within 1990-2016 periods and the share of each gas in the total structure at category level

	Direct GHG emissions, kt CO_2 equivalent				the share from the total, %			in %, as compared to 1990		
	CO_2	CH_4	N_2O	Total	CO_2	CH_4	N_2O	CO_2	CH_4	N_2O
1990	7 596.5153	5.3283	12.0949	7 613.9384	99.77	0.07	0.16	100.0	100.0	100.0
1991	6 284.9492	4.4004	9.9663	6 299.3159	99.77	0.07	0.16	82.7	82.6	82.4
1992	4 993.4314	3.4814	7.8483	5 004.7611	99.77	0.07	0.16	65.7	65.3	64.9
1993	3 604.5689	2.5121	5.8259	3 612.9070	99.77	0.07	0.16	47.5	47.1	48.2
1994	2 887.5863	1.8890	3.7952	2 893.2705	99.80	0.07	0.13	38.0	35.5	31.4
1995	2 564.8351	1.6662	3.2881	2 569.7894	99.81	0.06	0.13	33.8	31.3	27.2
1996	2 307.8593	1.5011	2.9659	2 312.3262	99.81	0.06	0.13	30.4	28.2	24.5
1997	2 284.4876	1.3504	2.4760	2 288.3139	99.83	0.06	0.11	30.1	25.3	20.5
1998	2 322.7026	1.2846	2.2156	2 326.2028	99.85	0.06	0.10	30.6	24.1	18.3
1999	1 696.5826	0.9247	1.5149	1 699.0222	99.86	0.05	0.09	22.3	17.4	12.5
2000	1 303.7830	0.6924	1.0439	1 305.5194	99.87	0.05	0.08	17.2	13.0	8.6
2001	1 306.9671	0.7482	1.0983	1 308.8136	99.86	0.06	0.08	17.2	14.0	9.1
2002	1 071.2525	0.7009	1.0498	1 073.0032	99.84	0.07	0.10	14.1	13.2	8.7
2003	1 146.1497	0.7188	1.0513	1 147.9198	99.85	0.06	0.09	15.1	13.5	8.7
2004	1 037.4141	0.6732	0.9976	1 039.0849	99.84	0.06	0.10	13.7	12.6	8.2
2005	1 153.4420	0.7197	1.0355	1 155.1973	99.85	0.06	0.09	15.2	13.5	8.6
2006	1 150.4468	0.6932	0.9756	1 152.1156	99.86	0.06	0.08	15.1	13.0	8.1
2007	1 010.3687	0.6408	0.8883	1 011.8978	99.85	0.06	0.09	13.3	12.0	7.3
2008	1 072.3496	0.7733	1.1100	1 074.2330	99.82	0.07	0.10	14.1	14.5	9.2
2009	980.3150	0.7920	1.1892	982.2962	99.80	0.08	0.12	12.9	14.9	9.8
2010	1 077.5486	0.8982	1.3342	1 079.7811	99.79	0.08	0.12	14.2	16.9	11.0
2011	1 027.7090	0.7803	1.1287	1 029.6180	99.81	0.08	0.11	13.5	14.6	9.3
2012	996.9657	0.6355	0.9012	998.5024	99.85	0.06	0.09	13.1	11.9	7.5
2013	1 046.7039	0.6851	1.0839	1 048.4729	99.83	0.07	0.10	13.8	12.9	9.0
2014	981.3317	0.7219	1.0380	983.0916	99.82	0.07	0.11	12.9	13.5	8.6
2015	548.3244	0.5355	0.7851	549.6451	99.76	0.10	0.14	7.2	10.1	6.5
2016	564.8896	0.5463	0.8007	566.2365	99.76	0.10	0.14	7.4	10.3	6.6

1A1b 'Petroleum Refining'

GHG emissions from source category 1A1b 'Petroleum Refining' were estimated within the Sector 1 'Energy' for the first time in the current inventory cycle. The AD for 2003-2016 time series are available in the EBs of the RM in energy units (TJ) for 5 types of fuel: petroleum, gasoline, diesel, residual fuel oil, other petroleum products and other hydrocarbons (Table 3-66, Figure 3-16).

Table 3-66: The AD for source category 1A1b 'Petroleum Refining', TJ

	Production type	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Primary	Petroleum	NA	334	219	171	349	620	701	465	526	473	404	341	483	286
Secondary	Diesel oil	NO	NO	36	8	121	171	203	162	155	137	52	29	23	264
	Residual fuel oil	1	NO	111	89	199	301	656	476	386	488	646	650	448	101
	Other petroleum products	NO	2	NO	NO	NO	NO	NO	NO	NO	NO	38	NO	12	24
	Lubricants	1	11	57	26	3	4	NO	193	216	141	31	5	NO	2
	Other hydrocarbons	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	1
	Gasoline	NO	NO	NO	NO	NO	2	NO	NO	NO	13	7	1	NO	2
	Fuel for oven	NO	NO	6	2	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
	Engine fuels	NO	NO	NO	NO	NO	NO	NO	NO	5	NO	NO	NO	NO	NO

The Energy Balances of the RM for 2015 and 2016 were published for the first time in a MS Excel format. The needed information is available within Chapter „Transformation", categories „Petroleum installations" and „Petrol Refineries".

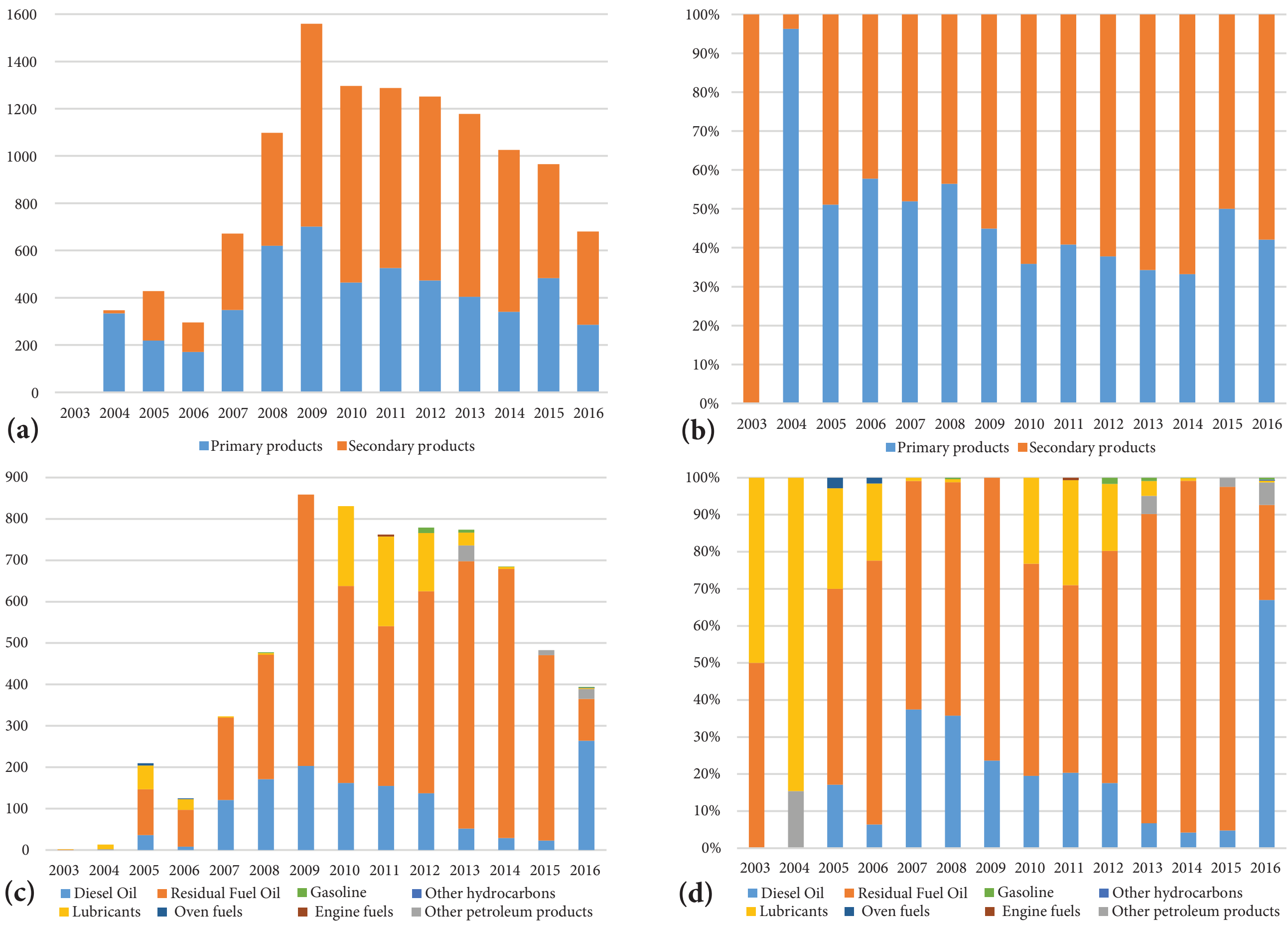


Figure 3-16: Primary and secondary petroleum products under source category 1A1b 'Petroleum Refining' in the Republic of Moldova within 2003-2016 periods, when: (a) production of primary and secondary petroleum products within 20003-2016, TJ; (b) production of primary and secondary products within 2003-2016, % of the total; (c) production of secondary petroleum products within 2003-2016, TJ; (d) production of secondary petroleum products within 2003-2016, % of the total.

In the Republic of Moldova there are two operational companies in this sector: the first („Valiexchimp" LTD) is involved in oil extraction on the oil fields near Valeni village, Cahul district, and the second one (Arnaut Petrol J.S.C.) owns an oil refinery with a small capacity in the city of Comrat (ATU Gagauzia). The values of direct GHG emissions were taken from the 2006 IPCC Guidelines, while for indirect GHG emissions – from the 2016 EMEP/EEA Guidebook (Table 3-67).

Table 3-67: 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
Engine fuels	74 100	3	0.6	65	16.2	0.8	46.5
Sources of reference:	2006 IPCC Guidelines			2016 EMEP/EEA Guidebook			

Direct GHG emissions from this category between 2003 and 2016 are presented in Table 3-68.

Table 3-68: Direct GHG emissions from source category 1A1b 'Petroleum Refining' in the Republic of Moldova within 2003-2016 periods

	2003	2004	2005	2006	2007	2008	2009
1A1b, kt CO_2 equivalent	0.0777	245.0539	172.3250	133.0411	280.3555	490.8448	580.0456
	2010	2011	2012	2013	2014	2015	2016
1A1b, kt CO_2 equivalent	389.9715	427.5625	395.8148	353.5472	302.7403	391.5433	239.1610

Table 3-69 shows direct and indirect GHG emissions under 1A1b 'Petroleum Refining' source category from 2003 through 2016.

Table 3-69: GHG emissions from source category 1A1b 'Petroleum Refining' in the Republic of Moldova within 2003-2016 periods, kt

	CO_2	CH_4	N_2O	NO_x	CO	NMVOC	SO_2
2003	0.0774	0.0000	0.0000	0.0001	0.0000	0.0000	0.0005
2004	244.9686	0.0010	0.0002	0.0476	0.0051	0.0008	0.1654
2005	172.2306	0.0011	0.0002	0.0496	0.0057	0.0008	0.1653
2006	132.9726	0.0008	0.0002	0.0376	0.0041	0.0006	0.1292
2007	280.1857	0.0020	0.0004	0.0857	0.0102	0.0014	0.2769
2008	490.5671	0.0033	0.0007	0.1420	0.0167	0.0023	0.4639
2009	579.6497	0.0047	0.0009	0.2059	0.0238	0.0033	0.6812
2010	389.6916	0.0033	0.0007	0.1442	0.0168	0.0023	0.4733
2011	427.2904	0.0032	0.0006	0.1399	0.0164	0.0022	0.4589
2012	395.5328	0.0033	0.0007	0.1462	0.0169	0.0023	0.4827
2013	353.2561	0.0034	0.0007	0.1554	0.0174	0.0025	0.5243
2014	302.4812	0.0031	0.0006	0.1427	0.0155	0.0023	0.4919
2015	391.2981	0.0029	0.0006	0.1345	0.0146	0.0022	0.4625
2016	238.9889	0.0020	0.0004	0.0739	0.0106	0.0011	0.2051

Direct GHG emissions from the respective source category between 2003 and 2016 as well as the share of each gas in the total structure at category level are presented in Table 3-70.

Table 3-70: Direct GHG emissions from source category 1A1b 'Petroleum Refining' in the RM within 2003-2016 periods and the share of each gas in the total structure at category level

	GHG emissions, kt CO_2 equivalent				the share of gas in the total structure of emissions, %		
	CO_2	CH_4	N_2O	Total	CO_2	CH_4	N_2O
2003	0.0774	0.0001	0.0002	0.0777	99.67	0.10	0.23
2004	244.9686	0.0252	0.0601	245.0539	99.97	0.01	0.02
2005	172.2306	0.0279	0.0665	172.3250	99.95	0.02	0.04
2006	132.9726	0.0203	0.0483	133.0411	99.95	0.02	0.04
2007	280.1857	0.0502	0.1196	280.3555	99.94	0.02	0.04
2008	490.5671	0.0821	0.1956	490.8448	99.94	0.02	0.04
2009	579.6497	0.1170	0.2789	580.0456	99.93	0.02	0.05
2010	389.6916	0.0827	0.1972	389.9715	99.93	0.02	0.05
2011	427.2904	0.0804	0.1917	427.5625	99.94	0.02	0.04
2012	395.5328	0.0833	0.1986	395.8148	99.93	0.02	0.05
2013	353.2561	0.0860	0.2051	353.5472	99.92	0.02	0.06
2014	302.4812	0.0766	0.1826	302.7403	99.91	0.03	0.06
2015	391.2981	0.0725	0.1727	391.5433	99.94	0.02	0.04
2016	238.9889	0.0509	0.1212	239.1610	99.93	0.02	0.05

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

The source category 1A1c 'Manufacture of Solid Fuels and Other Energy Industries' includes two sources (1A1ci 'Manufacture of Solid Fuels' and 1A1cii 'Other Energy Industries') and was first considered within the Sector 1 'Energy' in the current inventory cycle. The Energy Balances for 2012-2016 time series represent the primary sources of reference for the AD used (production of charcoal, in energy units) (Table 3-71).

Table 3-71: AD available in the energy units of the RM for 2012-2016 time periods, considered under the source category 1A1c 'Manufacture of Solid Fuels and Other Energy Industries'

	2012	2013	2014	2015	2016
Charcoal, TJ	26	31	34	72	59

Additionally, the Statistical Reports 'PRODMOLD' for 2006-2015 time series were consulted for comparison (production of charcoal, in natural units) (Table 3-72). In order to convert AD from tones to TJ, a conversion factor equivalent to 29.5 TJ/kt of charcoal was used (2006 IPCC Guidelines, Volume 2, Chapter 1, Table 1.2, page 1.21). Since there were detected significant differences for available AD and considering that in recent Statistical Reports 'PRODMOLD' the statistical data regarding the production of charcoal is no longer available, GHG emissions from the respective category were estimated using AD from the Energy Balances of the RM.

Table 3-72: AD available in the Statistical Reports 'PRODMOLD' for 2006-2015 time series

	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Charcoal, t	54.0	145.4	278.4	221.9	381.7	555.1	566.6	483.4	351. 4	481.6
Charcoal, TJ	1.593	4.289	8.213	6.545	11.259	16.376	16.713	14.260	10.365	14.206

The values of EFs for direct GHG emissions were taken from the 2006 IPCC Guidelines, while for indirect GHG emissions – from the 2016 EMEP/EEA Guidebook (Table 3-73).

Table 3-73: EFs used to estimate GHG emissions from source category 1A1c 'Manufacture of Solid Fuels and Other Energy Industries', kg/TJ

Fuel	Emission Factors, kg/TJ						
	CO_2	CH_4	N_2O	NO_x	CO	NMVOC	SO_2
Fuel Wood	112 000	30	4	81	90	7.31	10.8
Sources of references:	2006 IPCC Guidelines			2016 EMEP/EEA Guidebook, Category 1.A.1 Energy Industries, Table 3-7.			

Direct and indirect GHG emissions from the respective source category for 2012-2016 time series are presented in Table 3-74.

Table 3-74: GHG emissions from source category 1A1c 'Manufacture of Solid Fuels and Other Energy Industries' in the Republic of Moldova within 2012-2016 periods, kt

	CO_2	CH_4	N_2O	NO_x	CO	NMVOC	SO_2
2012	2.9120	0.0008	0.0001	0.0021	0.0023	0.0002	0.0003
2013	3.4720	0.0009	0.0001	0.0025	0.0028	0.0002	0.0003
2014	3.8080	0.0010	0.0001	0.0028	0.0031	0.0002	0.0004
2015	8.0640	0.0022	0.0003	0.0058	0.0065	0.0005	0.0008
2016	6.6080	0.0018	0.0002	0.0048	0.0053	0.0004	0.0006

Table 3-75 shows direct GHG emissions from the source category 1A1c 'Manufacture of Solid Fuels and Other Energy Industries' in the Republic of Moldova between 2012 and 2016 as well as the share of each gas in the total structure at category level.

Table 3-75: Direct GHG emissions from source category 1A1c 'Manufacture of Solid Fuels and Other Energy Industries' in the Republic of Moldova within 2012-2016 periods and the share of each gas in the total structure at source category level

	GHG emissions, kt CO_2 equivalent				the share of gas in the total structure of emissions, %		
	CO_2	CH_4	N_2O	Total	CO_2	CH_4	N_2O
2012	2.9120	0.0195	0.0310	2.9625	98.30	0.66	1.05
2013	3.4720	0.0233	0.0370	3.5322	98.30	0.66	1.05
2014	3.8080	0.0255	0.0405	3.8740	98.30	0.66	1.05
2015	8.0640	0.0540	0.0858	8.2038	98.30	0.66	1.05
2016	6.6080	0.0443	0.0703	6.7226	98.30	0.66	1.05

3.2.2. Methodological Issues and Emission Factors

GHG emissions originated from category 1A1 'Energy Industries' was estimated following a Tier 1 methodology (Table 3-76), using default emission factors. To assure the natural conversion from natural units to energy units, CS NCVs were used (see Table 3-21). The carbon oxidation fraction values used were those recommended by 2006 IPCC Guidelines.

Table 3-76: Methods, EFs and parameters used for estimating direct GHG emissions originated from 1A1 'Energy Industries' category

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

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

Default EFs available in the 2016 EMEP/EEA Guidebook were used for estimating non-CO_2 emissions (Table 3-77).

Table 3-77: Emission factors used for estimating GHG emissions originated from 1A1 'Energy Industries' category, kg/TJ

	CO_2	CH_4	N_2O	NO_x	CO	NMVOC	SO_2	Sources of references – 2016 EMEP/EEA **Guidebook**
Anthracite	98 300	1	1.5	209	8.7	1	820	Table 3.2 (solid coal)
Brown Coal (lignite)	101 000	1	1.5	247	8.7	1.4	1680	Table 3.3 (brown coal)
Other types of bituminous coal	94 600	1	1.5	209	8.7	1	820	Table 3.2 (solid coal)
Diesel	74 100	3	0.6	65	16.2	0.8	46.5	Table 3-6 (diesel oil)
Kerosene 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)
Fuel Wood	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 Residues	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, pages 2.16-2.17.			2016 EMEP/EEA Guidelines, Category 1A1 Energy Industries				

3.2.3. Uncertainties Assessment 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 the category 1A1 'Energy Industries' and they also depend on the quality of activity data available.

Uncertainties associated with EFs used to estimate CO_2 emissions from the 1A1 'Energy Industries' category, were estimated at circa ±5 per cent, while those pertaining to EFs used to estimate CH_4 and N_2O emissions reach up to ±50 per cent. At the same time, uncertainties pertaining to AD regarding fuel consumption within the Sector 1 'Energy' were estimated at circa ±5 per cent for CO_2 and CH_4 emissions, respectively ±3 per cent for N_2O emissions. Thus, combined uncertainties for this source category were estimated at ±7.1 per cent for CO_2 emissions, ±50.2 per cent for CH_4 emissions, and ±50.1 per cent for N_2O emissions (Annex 5-3.1).

In order to ensure time-series consistency of the obtained results, the same approach was used for the entire period under review, in conformity with good practices used for GHG emission inventory.

3.2.4. Quality Assurance and Quality Control

Standard verification and quality control forms and check-lists were filled in for the 1A1 'Energy Industries' category, 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 the data entry and emission estimation process related errors, verifications and quality control procedures were applied and these included:

- Verification of AD collecting and manipulation procedures, including: verifying if 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 use for each source category; verifying if the primary reference sources are correctly indicated; the accuracy of calculations for subcategories included in 1A1 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 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 source 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 and the 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;
- 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 emissions archive.

Following the recommendations included into the 2006 IPCC Guidelines, GHG emissions were estimated using AD and CS NCVs available in the 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 transition from an average NCV for a longer period of time (1990-2015) to an annual average NCV for natural gases (Table 3-23), based on the information provided by J.S.C. „Moldovagaz" for 1997-2016 time series (for 1990-1996 periods, were used annual average values characteristic to 1997);
- The AD on coal and residual fuel oil consumption at the MTPP Dnestrovsk were updated based on the information available in the NC1 of the RM under the UNFCCC (2000);
- When estimating fuel consumption for source category 1Alai 'Electricity Generation', it has been ensured that fuel consumption from renewable energy sources is not included;
- With the publication of the EBs of the RM in a MS Excel form for 2015 and 2016, it became easier to monitor and allocate fuel consumption within 1A1aii and 1A1aiii sources, thus avoiding the misallocation in other categories of the sector (for example, within 1A2);
- For years 1991 and 1992, when the EBs of the RM have not been published, the consumption values for a series of fuels (other types of coal, diesel oil, residual fuel oil, natural gas) were restored by the interpolation method;
- Within the current inventory cycle, GHG emission under the Sector 1 'Energy' were estimated for the first time, both aggregated at national level, as well as separately for the RBDR and LBDR.

In comparison with the results included into the NC4 of the RM under the UNFCCC (2018), the performed recalculations resulted in an increase of direct GHG emissions in 1990-1993, 1995 and 2004-2015, with a variation from a minimum increase by 3.7 per cent in 1995, to a maximum increase by circa 20.1 per cent in 1992, respectively a decrease in 1994 and 1996-2003, with a variation from a minimum decrease by 0.1 per cent in 1994 to a maximum decrease by circa 1.1 per cent in 1996 (Table 3-78). For 2016, direct GHG emissions from category 1A1 were estimated for the first time. Between 1990 and 2016, the respective emissions decreased by circa 78.8 per cent.

Table 3-78: Recalculation results of GHG emissions from 1A1 'Energy Industries' category included into the NC4 of the RM under the UNFCCC (2018), within 1990-2015 periods, kt CO_2 eq.

	1990	1991	1992	1993	1994	1995	1996	1997	1998
NC4	19 398.3484	17 416.5690	13 050.8621	10 770.8079	9 965.9551	6 904.3865	7 172.9335	5 625.5607	4 856.7709
BUR2	21 308.2056	18 946.2276	15 676.6204	12 640.0753	9 959.3444	7 160.4871	7 091.6162	5 593.3867	4 814.4638
Difference, %	9.8	8.8	20.1	17.4	-0.1	3.7	-1.1	-0.6	-0.9
	1999	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**
NC4	3 664.8753	3 159.3286	3 681.9284	2 936.7953	3 040.3758	3 110.7870	3 233.2579	2 495.9204	2 893.8184
BUR2	3 637.4006	3 132.4649	3 649.2979	2 917.1561	3 022.5275	3 339.5735	3 391.2173	2 621.2236	3 163.5834
Difference, %	-0.7	-0.9	-0.9	-0.7	-0.6	7.4	4.9	5.0	9.3
	2008	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**
NC4	3 297.5705	4 460.5074	4 597.5705	4 187.9640	4 197.1458	3 316.4107	4 021.5062	4 147.0729	
BUR2	3 777.6673	5 035.4915	4 983.8288	4 614.9116	4 603.3054	3 686.7824	4 358.3979	4 744.8255	4 526.0607
Difference, %	14.6	12.9	8.4	10.2	9.7	11.2	8.4	14.4	

Abbreviations: NC4 – Fourth National Communication of the RM under the UNFCCC (2018); BUR2 – Second Biennial Update Report of the RM under the UNFCCC (2019).

3.2.6. Planned Improvements

Potential improvements within the 1A1 'Energy Industries' category 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). Also, another potential improvement could be identifying additional AD sources or updating AD from official statistical publications.

3.3. Manufacturing Industries and Construction (Category 1A2)

In 2016, circa 4,775 enterprises and production units were active in the national industrial sector, including 90 in mining industry, 4,139 in manufacturing industry, respectively 78 in the electricity and heat, gas and water supply sector.

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 the Sector 2 'IPPU').

Direct GHG emissions from 1A2 "Manufacturing industries and construction' are being monitored within the following source categories (which, correspond to the ISIC Rev. 3.1[31] Registry - International Standard Industrial Classification of all Economic Activities):

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

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

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).

Between 1990 and 2016, the GHG emissions from category 1A2 'Manufacturing Industries and Construction' tended to decrease by circa 73.3 per cent: from circa 2,212.4 kt CO_2 equivalent recorded in 1990, to circa 502.0 kt CO_2 equivalent in 2016 (Table 3-79, Figure 3-17).

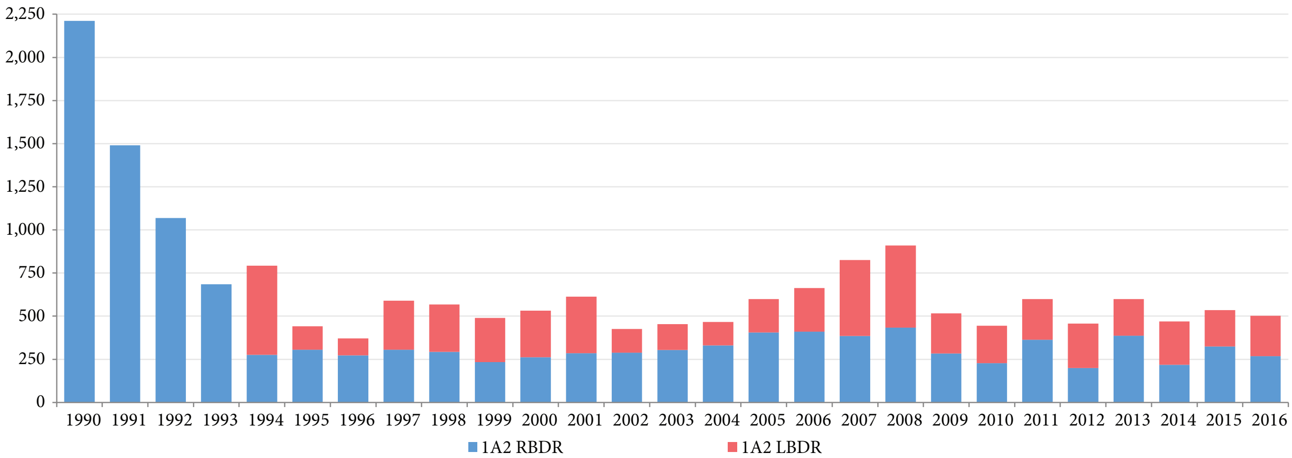


Figure 3-17: GHG emissions from 1A2 'Manufacturing Industries and Construction' category in the RM, by regions, within 1990-2016 periods, kt CO_2 equivalent.

[31] 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>).

Table 3-79: GHG emissions from 1A2 'Manufacturing Industries and Construction' category in the RM by regions, within 1990-2016 periods, kt CO_2 equivalent

	1990	1991	1992	1993	1994	1995	1996	1997	1998
1A2 RBDR	2 212.4085	1 490.7200	1 068.3480	684.9689	276.0456	306.1441	272.5615	305.4690	293.5483
1A2 LBDR	NA, IE	NA, IE	NA, IE	NA, IE	516.0355	134.5331	97.7485	284.1853	274.4619
1A2 RM	**2 212.4085**	**1 490.7200**	**1 068.3480**	**684.9689**	**792.0811**	**440.6772**	**370.3100**	**589.6544**	**568.0101**
1A2 RBDR, %	100.0	100.0	100.0	100.0	34.9	69.5	73.6	51.8	51.7
1A2 LBDR, %	NA, IE	NA, IE	NA, IE	NA, IE	65.1	30.5	26.4	48.2	48.3

	1999	2000	2001	2002	2003	2004	2005	2006	2007
1A2 RBDR	233.9424	261.9317	285.5369	287.6032	304.5154	330.3559	405.8436	409.3535	385.3095
1A2 LBDR	255.1699	269.8615	327.0008	137.5158	148.6904	135.5299	193.3789	252.9022	439.4848
1A2 RM	**489.1123**	**531.7932**	**612.5378**	**425.1190**	**453.2059**	**465.8858**	**599.2226**	**662.2557**	**824.7942**
1A2 RBDR, %	47.8	49.3	46.6	67.7	67.2	70.9	67.7	61.8	46.7
1A2 LBDR, %	52.2	50.7	53.4	32.3	32.8	29.1	32.3	38.2	53.3

	2008	2009	2010	2011	2012	2013	2014	2015	2016
1A2 RBDR	434.0411	282.8573	227.2159	363.1696	199.2526	386.1463	218.1451	323.9218	268.2791
1A2 LBDR	475.8142	233.4945	216.6024	235.0456	258.1861	213.2529	250.6579	210.7155	233.7171
1A2 RM	**909.8553**	**516.3518**	**443.8184**	**598.2152**	**457.4388**	**599.3992**	**468.8030**	**534.6373**	**501.9962**
1A2 RBDR, %	47.7	54.8	51.2	60.7	43.6	64.4	46.5	60.6	53.4
1A2 LBDR, %	52.3	45.2	48.8	39.3	56.4	35.6	53.5	39.4	46.6

Table 3-80 presents GHG emissions from the respective category between 1990 and 2016 for the RBDR, by industries.

Table 3-80: GHG emissions from 1A2 'Manufacturing Industries and Construction' category for the RBDR, by industries, within 1990-2016 periods, kt CO_2 equivalent

	1A2a	1A2b	1A2c	1A2d	1A2e	1A2f	1A2g	1A2h	1A2i	1A2j	1A2k	1A2L	1A2m	1A2
1990	138.9934	NO	19.3740	NO	261.8453	1 453.6593	NO	89.1312	11.8274	18.4009	195.6357	23.5414	NO	2 212.4085
1991	NO	NO	NO	NO	215.2412	1 044.4289	NO	73.1533	2.9113	14.0609	140.9244	NO	NO	1 490.7200
1992	NO	NO	NO	NO	168.6371	743.9243	NO	57.1928	2.6596	9.7209	86.2132	NO	NO	1 068.3480
1993	0.9693	NO	NO	NO	122.9356	443.4198	NO	42.4811	2.4079	5.5917	33.1394	0.5940	33.4302	684.9689
1994	NO	NO	NO	NO	90.7584	142.9152	NO	12.3029	2.1563	0.0563	27.8565	NO	NO	276.0456
1995	NO	NO	NO	NO	101.5121	161.4229	NO	15.3526	2.1563	NO	25.7003	NO	NO	306.1441
1996	NO	NO	NO	NO	111.5150	126.5986	NO	6.5701	2.1563	NO	25.7216	NO	NO	272.5615
1997	NO	NO	NO	NO	99.3984	171.6227	NO	6.5701	2.1563	NO	25.7216	NO	NO	305.4690
1998	NO	NO	NO	NO	104.3058	160.7568	NO	4.9416	4.3869	NO	19.1571	NO	NO	293.5483
1999	NO	NO	NO	NO	63.6167	152.8042	NO	4.9416	2.1563	NO	10.4236	NO	NO	233.9424
2000	NO	NO	NO	NO	62.0636	183.9752	NO	3.3131	2.1563	NO	10.4236	NO	NO	261.9317
2001	NO	NO	NO	NO	68.9850	200.6589	NO	3.3131	2.1563	NO	10.4236	NO	NO	285.5369
2002	NO	NO	NO	NO	52.5285	218.6612	NO	1.9014	3.1630	NO	11.3491	NO	NO	287.6032
2003	NO	NO	NO	1.6846	74.5950	216.2794	NO	1.6285	2.1563	NO	8.1716	NO	NO	304.5154
2004	0.3231	NO	0.6954	1.8531	63.6831	242.2625	NO	2.6469	4.5308	0.6317	12.0557	1.3711	0.3027	330.3559
2005	0.5385	NO	0.9089	2.1900	66.0864	312.1441	NO	2.6024	4.9089	0.9173	13.5828	1.3349	0.6294	405.8436
2006	0.6462	NO	1.4442	2.4708	63.9844	309.9482	0.5054	2.2443	7.2819	0.9293	19.1371	0.4907	0.2710	409.3535
2007	0.5385	NO	0.4575	1.9654	47.9835	304.3697	NO	2.7613	3.9787	0.8957	20.7751	0.9067	0.6773	385.3095
2008	0.3875	NO	2.2644	2.8077	53.5784	339.5374	NO	2.7485	4.5174	0.9512	18.6547	0.9665	7.6273	434.0411
2009	NO	NO	1.9014	1.9014	35.0691	220.3261	NO	1.9014	3.1630	NO	16.6934	1.9014	NO	282.8573
2010	0.3231	NO	0.2246	1.9253	48.7631	150.0413	NO	2.2282	2.9694	0.6473	18.0439	1.7392	0.3106	227.2159
2011	0.6029	NO	1.6967	4.2116	50.6684	278.1773	NO	3.3532	3.8616	1.2036	15.7450	3.4080	0.2412	363.1696
2012	NO	NO	0.7300	2.7516	56.0913	114.1392	NO	1.4955	2.8998	1.3141	18.0368	1.2806	0.5137	199.2526
2013	0.2154	NO	1.5237	NO	52.3539	303.8729	NO	1.8531	6.3201	3.7876	14.3665	1.8531	NO	386.1463
2014	NO	NO	1.6285	3.3131	62.9456	122.4369	0.0696	1.1646	6.6127	1.6596	16.6165	1.6980	NO	218.1451
2015	NO	NO	1.6283	3.0885	57.4612	240.9295	0.0019	0.5834	4.5212	0.3778	12.6569	1.9476	0.7253	323.9218
2016	NO	NO	2.2589	2.7516	64.1600	181.7491	NO	1.3784	2.4441	1.0315	10.9889	1.5166	NO	268.2791

Table 3-81 shows GHG emissions from the respective category between 1995 and 2016 for the LBDR, by industries.

Table 3-81: GHG emissions from 1A2 'Manufacturing Industries and Construction' category for the LBDR, by industries, within 1995-2016 periods, kt CO_2 equivalent

	1A2a	1A2b	1A2c	1A2d	1A2e	1A2f	1A2g	1A2h	1A2i	1A2j	1A2k	1A2L	1A2m	1A2
1995	36.8621	NO	0.1345	3.6324	26.5030	0.8072	NO	17.7584	NO	1.8835	7.6684	19.9109	19.3728	134.5331
1996	27.5651	NO	0.0977	1.9550	16.1285	0.5865	NO	10.8501	NO	0.8797	4.8874	19.5497	15.2488	97.7485
1997	100.3174	NO	0.2842	5.1153	44.3329	1.7051	NO	34.3864	NO	1.4209	13.9251	45.1855	37.5125	284.1853
1998	90.2980	NO	5.4892	4.1169	36.2290	0.8234	NO	22.7803	NO	1.3723	12.8997	62.3029	38.1502	274.4619
1999	93.3922	NO	4.8482	3.0620	31.6411	0.5103	NO	16.5860	NO	1.0207	12.2482	56.9029	34.9583	255.1699
2000	96.3406	NO	5.1274	4.8575	24.8273	1.0794	NO	22.1286	NO	1.6192	5.6671	79.6091	28.6053	269.8615
2001	116.0853	NO	4.2510	7.8480	23.2171	1.3080	NO	26.1601	NO	3.5970	7.1940	97.1192	40.2211	327.0008
2002	26.9531	NO	1.6502	0.5501	14.1641	0.5501	NO	9.2136	NO	1.7877	3.4379	40.9797	38.2294	137.5158
2003	46.5401	NO	1.7843	0.5948	19.1811	0.5948	NO	11.8952	NO	1.7843	4.1633	26.1695	35.9831	148.6904

	1A2a	1A2b	1A2c	1A2d	1A2e	1A2f	1A2g	1A2h	1A2i	1A2j	1A2k	1A2L	1A2m	1A2
2004	45.2670	NO	1.7619	0.6776	14.2306	0.2711	NO	10.9779	NO	1.3553	3.7948	24.6665	32.5272	135.5299
2005	66.1356	NO	2.5139	0.9669	19.1445	0.3868	NO	16.2438	NO	1.5470	4.0610	37.5155	44.8639	193.3789
2006	75.1119	NO	3.2877	1.5174	34.1418	0.7587	NO	23.5199	NO	1.5174	8.8516	59.1791	45.0166	252.9022
2007	204.3604	NO	4.3948	1.7579	43.9485	1.3185	NO	29.8850	NO	0.8790	39.1141	59.3304	54.4961	439.4848
2008	213.6406	NO	3.3307	1.4274	49.9605	NO	NO	29.0247	NO	0.4758	52.8154	58.0493	67.0898	475.8142
2009	74.7183	NO	1.8680	0.9340	22.6490	NO	NO	11.6747	NO	0.2335	7.4718	36.8921	77.0532	233.4945
2010	40.5047	NO	3.6822	1.0830	26.4255	NO	NO	15.8120	NO	0.2166	7.7977	47.2193	73.8614	216.6024
2011	52.8853	NO	4.2308	1.4103	28.4405	NO	NO	16.4532	NO	0.2350	9.8719	45.3638	76.1548	235.0456
2012	65.3211	NO	5.1637	0.7746	30.4660	NO	NO	17.5567	NO	0.5164	12.1347	45.9571	80.2959	258.1861
2013	31.7747	NO	5.9711	0.6398	36.6795	NO	NO	15.9940	NO	0.8530	11.5157	50.1144	59.7108	213.2529
2014	68.1790	NO	5.0132	0.5013	34.3401	NO	NO	11.0289	NO	0.7520	16.5434	33.5882	80.7119	250.6579
2015	50.7824	NO	2.9500	1.0536	25.9180	NO	NO	9.0608	NO	0.2107	10.1143	25.7073	84.9184	210.7155
2016	42.5365	NO	4.6743	0.7012	31.5518	NO	NO	10.2836	NO	0.2337	14.0230	32.9541	96.7589	233.7171

Table 3-82 presents GHG emissions under the 1A2 'Manufacturing Industries and Construction' category from the RM, between 1990 and 2016, by industries. Direct GHG emissions from the respective category within 1990-2016 time series were estimated separately for the territory on the RBDR and LBDR, as well as aggregated at national level, as presented in Table 3-83.

Table 3-82: GHG emissions from 1A2 'Manufacturing Industries and Construction' category in the RM, by industries, within 1990-2016 periods, kt CO_2 equivalent

	1A2a	1A2b	1A2c	1A2d	1A2e	1A2f	1A2g	1A2h	1A2i	1A2j	1A2k	1A2L	1A2m	1A2
1990	138.9934	NO	19.3740	NO	261.8453	1 453.6593	NO	89.1312	11.8274	18.4009	195.6357	23.5414	NO	2 212.4090
1991	NO	NO	NO	NO	215.2412	1 044.4289	NO	73.1533	2.9113	14.0609	140.9244	NO	NO	1 490.7200
1992	NO	NO	NO	NO	168.6371	743.9243	NO	57.1928	2.6596	9.7209	86.2132	NO	NO	1 068.3480
1993	0.9693	NO	NO	NO	122.9356	443.4198	NO	42.4811	2.4079	5.5917	33.1394	0.5940	33.4302	684.9689
1994	NO	NO	NO	NO	90.7584	142.9152	NO	12.3029	2.1563	0.0563	27.8565	NO	NO	792.0811
1995	36.8621	NO	0.1345	3.6324	128.0151	162.2301	NO	33.1110	2.1563	1.8835	33.3687	19.9109	19.3728	440.6772
1996	27.5651	NO	0.0977	1.9550	127.6435	127.1851	NO	17.4202	2.1563	0.8797	30.6090	19.5497	15.2488	370.3100
1997	100.3174	NO	0.2842	5.1153	143.7313	173.3278	NO	40.9565	2.1563	1.4209	39.6467	45.1855	37.5125	589.6544
1998	90.2980	NO	5.4892	4.1169	140.5348	161.5802	NO	27.7220	4.3869	1.3723	32.0568	62.3029	38.1502	568.0101
1999	93.3922	NO	4.8482	3.0620	95.2578	153.3146	NO	21.5277	2.1563	1.0207	22.6717	56.9029	34.9583	489.1123
2000	96.3406	NO	5.1274	4.8575	86.8908	185.0546	NO	25.4418	2.1563	1.6192	16.0907	79.6091	28.6053	531.7932
2001	116.0853	NO	4.2510	7.8480	92.2021	201.9670	NO	29.4732	2.1563	3.5970	17.6176	97.1192	40.2211	612.5378
2002	26.9531	NO	1.6502	0.5501	66.6926	219.2112	NO	11.1150	3.1630	1.7877	14.7870	40.9797	38.2294	425.1190
2003	46.5401	NO	1.7843	2.2794	93.7761	216.8742	NO	13.5237	2.1563	1.7843	12.3350	26.1695	35.9831	453.2059
2004	45.5901	NO	2.4572	2.5308	77.9137	242.5335	NO	13.6248	4.5308	1.9870	15.8505	26.0376	32.8298	465.8858
2005	66.6741	NO	3.4228	3.1569	85.2309	312.5308	NO	18.8463	4.9089	2.4643	17.6437	38.8504	45.4934	599.2226
2006	75.7581	NO	4.7319	3.9882	98.1262	310.7070	0.5054	25.7642	7.2819	2.4468	27.9887	59.6698	45.2876	662.2557
2007	204.8989	NO	4.8524	3.7234	91.9320	305.6881	NO	32.6463	3.9787	1.7747	59.8893	60.2371	55.1734	824.7942
2008	214.0281	NO	5.5951	4.2352	103.5389	339.5374	NO	31.7732	4.5174	1.4270	71.4701	59.0158	74.7171	909.8553
2009	74.7183	NO	3.7694	2.8354	57.7180	220.3261	NO	13.5761	3.1630	0.2335	24.1653	38.7935	77.0532	516.3518
2010	40.8277	NO	3.9069	3.0083	75.1886	150.0413	NO	18.0401	2.9694	0.8639	25.8416	48.9586	74.1720	443.8184
2011	53.4882	NO	5.9276	5.6219	79.1089	278.1773	NO	19.8064	3.8616	1.4386	25.6169	48.7718	76.3960	598.2152
2012	65.3211	NO	5.8937	3.5261	86.5573	114.1392	NO	19.0522	2.8998	1.8305	30.1716	47.2377	80.8096	457.4388
2013	31.9901	NO	7.4948	0.6398	89.0334	303.8729	NO	17.8471	6.3201	4.6406	25.8822	51.9675	59.7108	599.3992
2014	68.1790	NO	6.6416	3.8144	97.2858	122.4369	0.0696	12.1935	6.6127	2.4115	33.1599	35.2862	80.7119	468.8030
2015	50.7824	NO	4.5784	4.1421	83.3792	240.9295	0.0019	9.6442	4.5212	0.5885	22.7713	27.6549	85.6437	534.6370
2016	42.5365	NO	6.9333	3.4527	95.7118	NO	NO	11.6619	2.4441	1.2652	25.0119	34.4707	96.7589	501.9960

Table 3-83: Direct GHG emissions from 1A2 'Manufacturing Industries and Construction' category within 1990-2016, kt CO_2 equivalent

	RBDR				LBDR				Republic of Moldova			
	CO_2	CH_4	N_2O	Total	CO_2	CH_4	N_2O	Total	CO_2	CH_4	N_2O	Total
1990	2 204.8457	2.4619	5.1008	2 212.4085	NA, IE	NA, IE	NA, IE	NA, IE	2 204.8457	2.4619	5.1008	2 212.4085
1991	1 485.7792	1.5787	3.3622	1 490.7200	NA, IE	NA, IE	NA, IE	NA, IE	1 485.7792	1.5787	3.3622	1 490.7200
1992	1 064.8093	1.1404	2.3983	1 068.3480	NA, IE	NA, IE	NA, IE	NA, IE	1 064.8093	1.1404	2.3983	1 068.3480
1993	682.7002	0.7424	1.5263	684.9689	NA, IE	NA, IE	NA, IE	NA, IE	682.7002	0.7424	1.5263	684.9689
1994	275.2448	0.2780	0.5228	276.0456	515.5319	0.2297	0.2738	516.0355	790.7767	0.5077	0.7967	792.0811
1995	305.3371	0.2882	0.5188	306.1441	134.4019	0.0599	0.0714	134.5331	439.7389	0.3481	0.5902	440.6772
1996	271.7263	0.2953	0.5399	272.5615	97.6531	0.0435	0.0519	97.7485	369.3794	0.3389	0.5917	370.3100
1997	304.4514	0.3744	0.6432	305.4690	283.9080	0.1265	0.1508	284.1853	588.3594	0.5009	0.7940	589.6544
1998	292.5438	0.3699	0.6345	293.5483	274.1941	0.1222	0.1457	274.4619	566.7379	0.4921	0.7802	568.0101
1999	233.3404	0.2292	0.3729	233.9424	254.9208	0.1136	0.1354	255.1699	488.2612	0.3428	0.5083	489.1123
2000	261.4339	0.1916	0.3062	261.9317	269.5982	0.1201	0.1432	269.8615	531.0321	0.3118	0.4494	531.7932
2001	284.8872	0.2350	0.4148	285.5369	326.6817	0.1456	0.1735	327.0008	611.5689	0.3806	0.5883	612.5378
2002	287.1112	0.1945	0.2975	287.6032	137.3816	0.0612	0.0730	137.5158	424.4928	0.2557	0.3705	425.1190
2003	304.0210	0.1956	0.2989	304.5154	148.5453	0.0662	0.0789	148.6904	452.5663	0.2618	0.3778	453.2059
2004	329.7153	0.2488	0.3918	330.3559	135.3977	0.0603	0.0719	135.5299	465.1130	0.3091	0.4638	465.8858
2005	405.1763	0.2644	0.4030	405.8436	193.1902	0.0861	0.1026	193.3789	598.3665	0.3504	0.5056	599.2226

	RBDR				LBDR				Republic of Moldova			
	CO_2	CH_4	N_2O	Total	CO_2	CH_4	N_2O	Total	CO_2	CH_4	N_2O	Total
2006	408.7224	0.2494	0.3817	409.3535	252.6554	0.1126	0.1342	252.9022	661.3778	0.3620	0.5159	662.2557
2007	384.7640	0.2201	0.3254	385.3095	439.0559	0.1957	0.2332	439.4848	823.8199	0.4157	0.5586	824.7942
2008	432.2526	0.6528	1.1357	434.0411	475.3425	0.2136	0.2581	475.8142	907.5951	0.8664	1.3937	909.8553
2009	281.6130	0.4520	0.7923	282.8573	233.2603	0.1057	0.1286	233.4945	514.8733	0.5576	0.9209	516.3518
2010	226.6155	0.2233	0.3771	227.2159	216.3870	0.0975	0.1178	216.6024	443.0025	0.3208	0.4950	443.8184
2011	361.6005	0.5735	0.9956	363.1696	234.8118	0.1058	0.1279	235.0456	596.4123	0.6794	1.1236	598.2152
2012	198.7666	0.1851	0.3009	199.2526	257.9307	0.1159	0.1395	258.1861	456.6973	0.3010	0.4404	457.4388
2013	384.2876	0.6759	1.1827	386.1463	213.0414	0.0958	0.1157	213.2529	597.3290	0.7717	1.2985	599.3992
2014	217.4477	0.2572	0.4403	218.1451	250.4093	0.1127	0.1360	250.6579	467.8569	0.3698	0.5763	468.8030
2015	322.4037	0.5565	0.9616	323.9218	210.5061	0.0948	0.1147	210.7155	532.9098	0.6513	1.0762	534.6373
2016	267.2158	0.3913	0.6720	268.2791	233.4852	0.1050	0.1268	233.7171	500.7010	0.4963	0.7988	501.9962

Compared to 1990, in 2016, direct GHG emissions from 1A2 'Manufacturing Industries and Construction' category reached: for CO_2 – 22.7 per cent of the reference year level, CH_4 – 20.2 per cent, N_2O – 15.7 per cent, with the largest share in the structure of total direct GHG emissions at category level represented by CO_2 (Table 3-84).

Table 3-84: Direct GHG emissions from 1A2 'Manufacturing Industries and Construction' category within 1990-2016 periods, in % as compared to 1990 and the share of gas in the structure of total direct emissions at category level, % from the total

	the share of gas, % from the total				in %, as compared to 1990			
	CO_2	CH_4	N_2O	Total	CO_2	CH_4	N_2O	Total
1990	99.66	0.11	0.23	100.00	100.0	100.0	100.0	100.0
1991	99.67	0.11	0.23	100.00	67.4	64.1	65.9	67.4
1992	99.67	0.11	0.22	100.00	48.3	46.3	47.0	48.3
1993	99.67	0.11	0.22	100.00	31.0	30.2	29.9	31.0
1994	99.84	0.06	0.10	100.00	35.9	20.6	15.6	35.8
1995	99.79	0.08	0.13	100.00	19.9	14.1	11.6	19.9
1996	99.75	0.09	0.16	100.00	16.8	13.8	11.6	16.7
1997	99.78	0.08	0.13	100.00	26.7	20.3	15.6	26.7
1998	99.78	0.09	0.14	100.00	25.7	20.0	15.3	25.7
1999	99.83	0.07	0.10	100.00	22.1	13.9	10.0	22.1
2000	99.86	0.06	0.08	100.00	24.1	12.7	8.8	24.0
2001	99.84	0.06	0.10	100.00	27.7	15.5	11.5	27.7
2002	99.85	0.06	0.09	100.00	19.3	10.4	7.3	19.2
2003	99.86	0.06	0.08	100.00	20.5	10.6	7.4	20.5
2004	99.83	0.07	0.10	100.00	21.1	12.6	9.1	21.1
2005	99.86	0.06	0.08	100.00	27.1	14.2	9.9	27.1
2006	99.87	0.05	0.08	100.00	30.0	14.7	10.1	29.9
2007	99.88	0.05	0.07	100.00	37.4	16.9	11.0	37.3
2008	99.75	0.10	0.15	100.00	41.2	35.2	27.3	41.1
2009	99.71	0.11	0.18	100.00	23.4	22.6	18.1	23.3
2010	99.82	0.07	0.11	100.00	20.1	13.0	9.7	20.1
2011	99.70	0.11	0.19	100.00	27.1	27.6	22.0	27.0
2012	99.84	0.07	0.10	100.00	20.7	12.2	8.6	20.7
2013	99.65	0.13	0.22	100.00	27.1	31.3	25.5	27.1
2014	99.80	0.08	0.12	100.00	21.2	15.0	11.3	21.2
2015	99.68	0.12	0.20	100.00	24.2	26.5	21.1	24.2
2016	99.74	0.10	0.16	100.00	22.7	20.2	15.7	22.7

The table below presents direct and indirect GHG emissions from category 1A2 'Manufacturing Industries and Construction' in the RM between 1990 and 2016 (Table 3-85). As compared to 1990, in 2016, the GHG emissions from the respective category accounted: for CO_2 emissions – 12.1 per cent of the reference year level, CH_4 – 15.9 per cent, NO_x – 4.8 per cent, CO – 30.9 per cent, NMVOC – 17.7 per cent and SO_2 – 35.7 per cent.

Table 3-85: Direct and indirect GHG emissions from category 1A2 'Manufacturing Industries and Construction' category in the RM, within 1990-2016 periods

	1A2, kt							in %, as 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	2 204.8457	0.0985	0.0171	11.0992	3.7377	0.9764	2.8767	100.0	100.0	100.0	100.0	100.0	100.0	100.0
1991	1 485.7792	0.0631	0.0113	8.0111	1.9356	0.6185	1.3614	67.4	64.1	65.9	72.2	51.8	63.3	47.3
1992	1 064.8093	0.0456	0.0080	5.5713	1.4481	0.4536	1.0216	48.3	46.3	47.0	50.2	38.7	46.5	35.5
1993	682.7002	0.0297	0.0051	3.3714	1.0112	0.3028	0.7220	31.0	30.2	29.9	30.4	27.1	31.0	25.1
1994	275.2448	0.0111	0.0018	0.9723	0.5175	0.1297	0.3979	12.5	11.3	10.3	8.8	13.8	13.3	13.8

	1A2, kt							in %, as 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
1995	305.3371	0.0115	0.0017	0.9159	0.5550	0.1449	0.4164	13.8	11.7	10.2	8.3	14.8	14.8	14.5
1996	271.7263	0.0118	0.0018	0.8521	0.6411	0.1371	0.5207	12.3	12.0	10.6	7.7	17.2	14.0	18.1
1997	304.4514	0.0150	0.0022	0.8426	0.6463	0.1826	0.4393	13.8	15.2	12.6	7.6	17.3	18.7	15.3
1998	292.5438	0.0148	0.0021	0.8555	0.5932	0.1975	0.3441	13.3	15.0	12.4	7.7	15.9	20.2	12.0
1999	233.3404	0.0092	0.0013	0.5051	0.4038	0.1266	0.2602	10.6	9.3	7.3	4.6	10.8	13.0	9.0
2000	261.4339	0.0077	0.0010	0.5360	0.3594	0.1191	0.2338	11.9	7.8	6.0	4.8	9.6	12.2	8.1
2001	284.8872	0.0094	0.0014	0.8179	0.4166	0.1290	0.2881	12.9	9.5	8.1	7.4	11.1	13.2	10.0
2002	287.1112	0.0078	0.0010	0.5276	0.3510	0.1292	0.2102	13.0	7.9	5.8	4.8	9.4	13.2	7.3
2003	304.0210	0.0078	0.0010	0.5778	0.3282	0.1333	0.1808	13.8	7.9	5.9	5.2	8.8	13.6	6.3
2004	329.7153	0.0100	0.0013	0.6801	0.3951	0.1562	0.2164	15.0	10.1	7.7	6.1	10.6	16.0	7.5
2005	405.1763	0.0106	0.0014	0.7829	0.4096	0.1803	0.2041	18.4	10.7	7.9	7.1	11.0	18.5	7.1
2006	408.7224	0.0100	0.0013	0.8116	0.3812	0.1745	0.1854	18.5	10.1	7.5	7.3	10.2	17.9	6.4
2007	384.7640	0.0088	0.0011	0.7269	0.2995	0.1626	0.1103	17.5	8.9	6.4	6.5	8.0	16.7	3.8
2008	432.2526	0.0261	0.0038	0.8955	2.0407	0.2817	1.8553	19.6	26.5	22.3	8.1	54.6	28.9	64.5
2009	281.6130	0.0181	0.0027	0.5782	1.4832	0.1887	1.3727	12.8	18.4	15.5	5.2	39.7	19.3	47.7
2010	226.6155	0.0089	0.0013	0.5230	0.4938	0.1174	0.3808	10.3	9.1	7.4	4.7	13.2	12.0	13.2
2011	361.6005	0.0229	0.0033	0.7370	1.7574	0.2446	1.5888	16.4	23.3	19.5	6.6	47.0	25.0	55.2
2012	198.7666	0.0074	0.0010	0.4441	0.3083	0.1049	0.1880	9.0	7.5	5.9	4.0	8.2	10.7	6.5
2013	384.2876	0.0270	0.0040	0.7546	2.2071	0.2752	2.0419	17.4	27.5	23.2	6.8	59.0	28.2	71.0
2014	217.4477	0.0103	0.0015	0.4911	0.6557	0.1240	0.5483	9.9	10.4	8.6	4.4	17.5	12.7	19.1
2015	322.4037	0.0223	0.0032	0.6321	1.7138	0.2344	1.5503	14.6	22.6	18.9	5.7	45.9	24.0	53.9
2016	267.2158	0.0157	0.0023	0.5353	1.1544	0.1728	1.0263	12.1	15.9	13.2	4.8	30.9	17.7	35.7

3.3.2. Methodological Issues, Emissions Factor and Activity Data

GHG emissions originated from category 1A2 'Manufacturing Industries and Construction' was estimated following a Tier 1 methodology (Table 3-86), using default emission factors.

Table 3-86: Methods and coefficients used for assessing the direct GHG emissions originated from 1A2 'Manufacturing Industries and Construction' category

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
1A2 Manufacturing Industries and Construction	T1	CS	1	D	T1	D	T1	D

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

To assure the natural conversion from natural measure units to energy units, country specific net calorific values were used (Table 3-21). The value used for carbon oxidation fraction is recommended by 2006 IPCC Guidelines.

Default EF available in the 2016 EMEP/EEA Guidebook were used for estimating non-CO_2 emissions (Table 3-87).

Table 3-87: Emission factors used for estimating GHG emissions from category 1A2 'Manufacturing Industries and Construction', kg/TJ

Fuel category	Fuel	CO_2	CH_4	N_2O	NO_x	CO	NMVOC	SO_2
Biofuel	Fuel Wood and Wood Waste	112000	30	4	91	570	300	11
	Other types of Solid Biomass	100000	30	4	91	570	300	11
	Charcoal	112000	200	4	91	570	300	11
Liquid fuels	Aviation Gasoline	70000	3	0.6	513	66	25	47
	Motor Gasoline	69300	3	0.6	513	66	25	47
	Jet Kerosene	71500	3	0.6	513	66	25	47
	Other Kerosene	71900	3	0.6	513	66	25	47
	LPG	64200	3	0.6	513	66	25	47
	Diesel Oil	74100	3	0.6	513	66	25	47
	Residual Fuel Oil	77400	3	0.6	513	66	25	47
	Other Petroleum Products	73300	3	0.6	513	66	25	47
Gaseous fuels	Natural Gas	56100	1	0.1	74	29	23	0.67
Solid fuels	Anthracite	98300	10	1.5	173	931	88.8	900
	Other Bituminous Coal	94600	10	1.5	173	931	88.8	900
	Lignite	101000	10	1.5	173	931	88.8	900
	Brown Coal Briquettes	97500	10	1.5	173	931	88.8	900
	Coke Oven Coke and Lignite Coke	107000	10	1.5	173	931	88.8	900

Sources: for direct GHG emissions: CO_2, CH_4, N_2O – 2006 IPCC Guidelines, Volume 2, Table 2.3; for indirect GHG emissions: NOx, CO, NMVOC, SO_2 – 2016 EMEP/EEA Guidebook, Category 1.A.2, Tables 3-2, 3-3, 3-4.

The AD related to fuel consumption with energy purposes within the 1A2 'Manufacturing Industries and Construction' category were collected from the Energy Balances for 1990, 1993-2016, as well as from the statistical publications of the ATULBD.

Further, the following tables present activity data on fuel consumption within this category for the territory on the RBDR, by industries, from 1990 through 2016 (Table 3-88 – Table 3-99).

Table 3-88: Fuel consumption with energy purposes from 1A2a 'Iron and Steel' within 1990-2013 periods, TJ

	1990	1993	2004	2005	2006	2007	2008	2010	2011	2013
Coke	158	9	3	5	6	5	3	3	5	2
Natural Gas	2171	NO	NO	NO	NO	NO	NO	NO	NO	NO
LPG	NO	NO	NO	NO	NO	NO	1	NO	1	NO

Table 3-89: Fuel consumption with energy purposes from 1A2c 'Chemicals' within 1990-2016 periods, TJ

	1990	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Motor gasoline	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	1
Diesel oil	NO	NO	1	NO	NO	1	NO	NO	1	NO	NO	NO	NO	9
Residual Fuel Oil	80	1	1	NO	NO	NO	NO	NO	18	NO	18	NO	NO	NO
Other petroleum products	NO	NO	8	12	NO	NO	NO	NO	NO	NO	NO	NO	6	1
Natural Gas	234	11	3	10	7	39	34	4	4	13	2	29	21	27
LPG	NO	NO	NO	NO	1	NO	NO	NO	NO	NO	NO	NO	NO	NO
Fuel wood	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	7	NO	NO	NO
Wood waste	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	4	NO

Table 3-90: Fuel consumption with energy purposes from 1A2d 'Pulp, Paper and Print', within 2003-2016 periods, TJ

	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2014	2015	2016
Kerosene	NO	NO	NO	NO	NO	NO	NO	1	NO	NO	NO	NO	NO
Natural Gas	30	33	39	44	35	50	34	33	75	49	59	55	49

Table 3-91: Fuel consumption with energy purposes from 1A2e 'Food Processing, Beverages and Tobacco', within 1990-2016 periods, TJ

	1990	1991	1992	1993	1994	1995	1996	1997	1998
Anthracite	80	NO	NO	9	NO	NO	NO	NO	29
Lignite	NO	NO	NO	3	NO	NO	NO	NO	NO
Coke	634	NO	NO	378	323	352	381	323	264
Diesel Oil	596	NO	NO	378	381	440	381	323	147
Kerosene for oven	468	NO	NO	50	59	29	88	117	59
Residual Fuel Oil	563	NO	NO	370	235	264	264	147	205
Jet Kerosene	128	NO	NO	21	NO	NO	NO	NO	NO
Aviation gasoline	NO	NO	NO	3	NO	NO	NO	NO	NO
Gasoline	44	NO	NO	6	NO	NO	NO	NO	NO
Kerosene	647	NO	NO	188	29	NO	NO	NO	29
Natural Gas	67	NO	NO	76	29	117	235	323	352
LPG	NO	NO	NO	6	NO	NO	NO	NO	NO
Fuel wood	126	NO	NO	62	NO	29	29	29	24.64
Other types of fuel	NO	NO	NO	NO	NO	NO	NO	117	59
Pellets and Briquettes and other Waste	NO	NO	NO	NO	NO	NO	NO	NO	59
Biogas	NO	NO	NO	NO	NO	NO	NO	NO	29
Engine fuel	NO	NO	NO	NO	NO	NO	NO	NO	264

	1999	2000	2001	2002	2003	2004	2005	2006	2007
Anthracite	NO	29	29	28	29	133	167	156	77
Other Bituminous Coal	NO	NO	NO	NO	NO	NO	1	NO	NO
Coke	205	176	235	184.87	147	51	1	NO	NO
Diesel Oil	88	88	88	85	88	123	110	99	76
Kerosene for oven	117	117	117	86	29	25	16	8	4
Residual Fuel Oil	88	88	117	NO	117	140	121	122	54
Gasoline	NO	NO	NO	NO	NO	6	13	5	5
Kerosene	NO	NO	NO	NO	NO	5	10	NO	NO
Other petroleum products	NO	NO	NO	NO	NO	4	NO	NO	NO
Natural Gas	293	323	293	304.74	645	386	507	527	526
LPG	NO	NO	NO	NO	29	5	7	18	5
Fuel wood	12.32	12.32	12.32	12.32	NO	7	10	5	3
Wood Waste	NO	NO	NO	NO	NO	33	20	NO	3
Other types of fuel	59	NO	NO	NO	NO	NO	NO	NO	NO

	2008	2009	2010	2011	2012	2013	2014	2015	2016
Anthracite	78	53.4	70	78	94	78	117	56	63
Coke	2	NO	NO	NO	NO	NO	NO	NO	NO
Diesel Oil	75	43	81	75	75	85	59	17	13
Kerosene for oven	15	NO	6	4	2	NO	NO	NO	NO
Residual Fuel Oil	90	NO	6	9	6	NO	35	17	67
Gasoline	1	NO	1	1	NO	NO	1	NO	2
Natural Gas	562	474.04	565	644	710	676	705	869	909
LPG	5	NO	48	2	11	5	71	7	8
Fuel wood	2	NO	2	3	6	7	12	15	10
Wood Waste	3	NO	2	2	1	NO	NO	1	NO
Agricultural Residues	NO	NO	NO	1	1	8	NO	NO	NO
Pellets and Briquettes from Vegetable Waste	NO	NO	NO	NO	NO	NO	NO	27	18

Table 3-92: Fuel consumption with energy purposes from 1A2f 'Non-Metallic Minerals', within 1990-2016 periods, TJ

	1990	1991	1992	1993	1994	1995	1996	1997	1998
Anthracite	828	NO	NO	NO	NO	NO	29	29	29
Lignite	12	16	20	25	29	NO	NO	NO	NO
Other Bituminous Coal	NO	NO	NO	NO	NO	NO	59	30	NO
Coke	79	NO	NO	NO	NO	29	29	29	NO
Diesel Oil	383	302	221	140	59	29	NO	NO	NO
Residual Fuel Oil	13266	9994	6721	3449	176	59	59	59	59
Jet Kerosene	85	NO	NO	NO	NO	NO	NO	NO	NO
Gasoline	131	NO	NO	NO	NO	NO	NO	NO	NO
Natural Gas	5077	4351	3624	2898	2171	2699	1966	2817	2729
LPG	46	NO	NO	NO	NO	NO	NO	NO	NO
Wood Waste	29	NO	NO	NO	NO	NO	NO	NO	NO
Pellets and Briquettes from Vegetable Waste	NO	NO	NO	NO	NO	NO	NO	NO	29
Biogas	NO	NO	NO	NO	NO	NO	NO	NO	29
	1999	2000	2001	2002	2003	2004	2005	2006	2007
Anthracite	29	NO	NO	NO	NO	NO	NO	NO	NO
Other Bituminous Coal	NO	29	NO	NO	NO	14	14	NO	NO
Coke	NO	NO	NO	NO	NO	NO	NO	1	2
Diesel Oil	NO	NO	NO	NO	NO	10	14	19	17
Kerosene for oven	NO	NO	NO	NO	NO	1	5	3	3
Residual Fuel Oil	NO	NO	NO	NO	30	22	25	27	30
Gasoline	NO	NO	NO	NO	NO	NO	NO	NO	1
Natural Gas	2670	3227	2934	3893.9	3810	4242	5474	5450	5346
LPG	NO	NO	557	NO	NO	3	1	1	1
	2008	2009	2010	2011	2012	2013	2014	2015	2016
Anthracite	148	27	199	1655	60	2166	416	2	1
Other Bituminous Coal	1795	1374	NO	NO	NO	NO	NO	1646	915
Coke	NO	53	121	NO	28	2	52	NO	141
Diesel Oil	10	NO	32	10	22	NO	NO	5	14
Kerosene for oven	1	NO	3	NO	NO	NO	NO	NO	NO
Residual Fuel Oil	19	40	38	28	7	NO	NO	13	8
Gasoline	NO	NO	NO	NO	NO	NO	1	NO	NO
Natural Gas	2695	1388	1989	1983	1832	1589	1346	1469	1382
LPG	3	NO	1	1	2	NO	NO	NO	NO
Fuel wood	2	NO	NO	NO	NO	NO	NO	NO	NO

Table 3-93: Fuel consumption with energy purposes from 1A2g 'Transport Equipment', within 1990-2016 periods, TJ

	2006	2014	2015	2016
LPG	NO	NO	NO	9
Gasoline	NO	1	NO	NO
Natural Gas	9	NO	NO	1
Pellets and Briquettes from Vegetable Waste	NO	NO	1	NO

Table 3-94: Fuel consumption with energy purposes from 1A2h 'Machinery', within 1990-2016 periods, TJ

	1990	1991	1992	1993	1994	1995	1996	1997	1998
Coke	158	124	90	56	NO	NO	NO	NO	NO
Diesel Oil	128	105	82	59	29	29	NO	NO	NO
Residual Fuel Oil	40	128	217	305	88	NO	NO	NO	NO
Jet Kerosene	43	29	16	3	NO	NO	NO	NO	NO
Aviation gasoline	NO	NO	NO	6	NO	NO	NO	NO	NO
Gasoline	NO	NO	NO	6	NO	NO	NO	NO	NO
Kerosene	NO	NO	NO	3	NO	NO	NO	NO	NO
Natural Gas	1002	709	416	123	59	235	117	117	88
LPG	NO	NO	NO	3	NO	NO	NO	NO	NO
Fuel wood	9	NO	NO	NO	NO	NO	NO	NO	NO

	1999	2000	2001	2002	2003	2004	2005	2006	2007
Anthracite	NO	NO	NO	NO	NO	1	1	NO	1
Coke	NO	NO	NO	NO	NO	3	2	4	4
Diesel Oil	NO	NO	NO	NO	NO	1	1	NO	NO
Gasoline	NO	NO	NO	NO	NO	NO	1	NO	NO
Natural Gas	88	59	59	33.86	29	36	37	30	34
LPG	NO	NO	NO	NO	NO	2	1	2	5
Fuel wood	NO	NO	NO	NO	NO	NO	1	NO	NO
	2008	2009	2010	2011	2012	2013	2014	2015	2016
Coke	4	NO	2	2	2	NO	NO	1	2
Diesel Oil	2	NO	4	4	2	NO	NO	1	1
Gasoline	NO	NO	NO	NO	NO	NO	1	NO	1
Natural Gas	26	33.86	19	47	19	33	NO	6	17
LPG	11	NO	10	3	1	NO	NO	1	1
Fuel wood	NO	NO	2	NO	NO	NO	NO	NO	NO
Agricultural Residues	NO	NO	NO	4	NO	NO	NO	NO	NO
Pellets and Briquettes from Vegetable Waste	NO	NO	NO	NO	NO	NO	NO	NO	1

Table 3-95: Fuel consumption with energy purposes from 1A2i 'Mining and Quarrying', within 1990-2016 periods, TJ

	1990	1991	1992	1993	1994	1995	1996	1997	1998
Anthracite	27	NO	NO	NO	NO	NO	NO	NO	NO
Diesel Oil	43	39	36	32	29	29	29	29	59
Jet Kerosene	43	NO	NO	NO	NO	NO	NO	NO	NO
LPG	46	NO	NO	NO	NO	NO	NO	NO	NO
	1999	2000	2001	2002	2003	2004	2005	2006	2007
Diesel Oil	29	29	29	42.54	29	60	63	97	52
Gasoline	NO	NO	NO	NO	NO	1	NO	1	NO
Natural Gas	NO	NO	NO	NO	NO	NO	4	NO	2
	2008	2009	2010	2011	2012	2013	2014	2015	2016
Diesel Oil	60	42.54	39	51	39	85	88	58	31
Gasoline	NO	NO	1	1	NO	NO	1	3	2
Natural Gas	1	NO	NO	NO	NO	NO	NO	NO	NO

Table 3-96: Fuel consumption with energy purposes from 1A2j 'Wood and Wood Products', within 1990-2016 periods, TJ

	1990	1991	1992	1993	1994	1995	1996	1997	1998
Diesel Oil	86	59	32	6	NO	NO	NO	NO	NO
Residual Fuel Oil	40	41	43	44	NO	NO	NO	NO	NO
Aviation gasoline	NO	NO	NO	3	NO	NO	NO	NO	NO
Gasoline	44	30	17	3	NO	NO	NO	NO	NO
Natural Gas	100	74	47	21	NO	NO	NO	NO	NO
Wood Waste	147	120	94	67	29	NO	NO	NO	NO
	1999	2000	2001	2002	2003	2004	2005	2006	2007
Diesel Oil	NO	NO	NO	NO	NO	5	3	5	4
Residual Fuel Oil	NO	NO	NO	NO	NO	NO	1	1	2
Gasoline	NO	NO	NO	NO	NO	1	2	2	3
Natural Gas	NO	NO	NO	NO	NO	2	6	6	4
LPG	NO	NO	NO	NO	NO	1	2	NO	NO
Fuel wood	NO	NO	NO	NO	NO	1	NO	1	3
Wood Waste	NO	NO	NO	NO	NO	6	6	1	2
	2008	2009	2010	2011	2012	2013	2014	2015	2016
Diesel Oil	4	NO	1	7	2	NO	NO	1	10
Residual Fuel Oil	NO	NO	NO	NO	2	NO	NO	NO	NO
Gasoline	5	NO	2	4	6	NO	NO	4	4
Natural Gas	5	NO	7	6	9	67	29	NO	NO
Fuel wood	2	NO	7	12	10	6	NO	10	5
Wood Waste	11	NO	14	23	35	5	16	3	NO
Agricultural Residues	NO	NO	NO	NO	NO	2	NO	NO	NO

Table 3-97: Fuel consumption with energy purposes from 1A2k 'Construction', within 1990-2016 periods, TJ

	1990	1991	1992	1993	1994	1995	1996	1997	1998
Kerosene for oven	NO	NO	NO	3	NO	NO	NO	NO	NO
Residual Fuel Oil	2170	1544	919	293	264	235	205	205	147
Jet gasoline	NO	NO	NO	12	NO	NO	NO	NO	NO
Gasoline	80	90	99	109	59	59	88	88	59
Other Petroleum Products	NO	NO	NO	3	NO	NO	NO	NO	NO
Natural Gas	350	239	129	18	29	29	29	29	29
Fuel Wood	67	45	22	NO	29	29	29	29	29

	1999	2000	2001	2002	2003	2004	2005	2006	2007
Kerosene for oven	NO	NO	NO	NO	NO	1	1	1	NO
Residual Fuel Oil	88	88	88	85	88	80	124	143	174
Jet gasoline	NO	NO	NO	NO	NO	NO	NO	2	NO
Gasoline	29	29	29	40.2	NO	40	14	46	51
Natural Gas	NO	NO	NO	NO	NO	8	7	10	12
LPG	NO	NO	NO	NO	NO	NO	1	NO	NO
Fuel Wood	29	29	29	34	29	36	42	64	45
	2008	2009	2010	2011	2012	2013	2014	2015	2016
Residual Fuel Oil	171	128	111	117	148	143	117	114	116
Jet gasoline	NO	NO	17	NO	NO	NO	NO	NO	NO
Gasoline	33	NO	23	23	28	2	30	15	12
Natural Gas	14	NO	8	10	3	NO	5	7	6
Fuel Wood	29	NO	46	17	30	45	78	37	18

Table 3-98: Fuel consumption with energy purposes from 1A2l 'Textile and Leather', within 1990-2016 periods, TJ

	1990	1993	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Anthracite	187	6	NO	NO	NO	2	NO	NO	NO	NO	1	NO	NO
Diesel Oil	43	NO	7	6	3	5	1	NO	3	5	3	NO	NO
Kerosene for oven	NO	NO	3	4	2	NO	NO	NO	NO	NO	NO	NO	NO
Gasoline	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	1
Natural Gas	33	NO	11	8	2	6	9	34	27	54	17	33	29
LPG	NO	NO	NO	2	NO	NO	6	NO	NO	NO	NO	NO	NO
Fuel Wood	NO	NO	NO	NO	NO	NO	NO	NO	NO	2	1	NO	NO
Residual Fuel Oil	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	1	NO	NO

Table 3-99: Fuel consumption with energy purposes from 1A2m 'Non-specified Industry', within 1993-2016 periods, TJ

	1993	2004	2005	2006	2007	2008	2010	2011	2012	2015	2016
Fuel Wood	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	1
LPG	NO	1	3	3	2	2	1	2	1	NO	NO
Natural Gas	32	1	5	NO	7	128	3	2	8	1	73
Residual Fuel Oil	393	NO	2	1	2	4	1	NO	NO	NO	NO
Diesel Oil	15	1	NO	NO	NO	NO	NO	NO	NO	9	16
Coke	NO	1	NO	NO	NO	NO	NO	NO	NO	NO	NO
Anthracite	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	1

Table 3-100 presents AD on fuel consumption from category 1A2 'Manufacturing Industries and Construction' on the LBDR between 1994 and 2016. This information was taken from statistical publications, respectively official letters provided by 'Moldovagaz'.

Table 3-100: Fuel consumption with energy purposes from category 1A2 'Manufacturing Industries and Construction' on the LBDR, within 1994-2016 periods, TJ

	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
Natural Gas	9190	2396	1741	5061	4888	4544	4806	5823	2449	2648	2414	3444
	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	%
Other Bituminous Coal	NO	NO	2	4	3	3	2	1	2	2	2	NO
Residual Fuel Oil	NO	NO	35	23	13	12	10	15	15	15	15	NO
Natural Gas	4504	7826	8422	4120	3835	4161	4578	3774	4438	3728	4138	-55.0
LPG	NO	NO	NO	NO	NO	3	2	1	1	1	1	NO

As the AD are incomplete, in order to fill the existing gaps associated with fuel consumption, these were generated indirectly by considering the industrial production on the territory of the LBDR (Table 3-101), respectively, the share of each sector in the total structure of industrial production (Table 3-102).

Table 3-101: Industrial production on the LBDR, billion Rubles within 1995-2000 periods, respectively million Rubles within 2001-2016 periods

	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
Industrial production	29 163	181 882	326 013	387 977	745 691	2 249 352	3 171.7	2 757.8	3 518.6	5 099.6	5 960.0
	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Industrial production	4 698.8	7 208.0	9 285.6	6 829.5	7 344.6	9 356.3	10 083.4	8 833.8	10 721.7	9 067.5	8 573.3

Sources of reference: for 1995-2000 time series, the Statistical Yearbook of the ATULBD for 2000, page 93; for 2003-2006 time series, the Statistical Yearbook of the ATULBD for 2007, page 88; for 2007-2011 time series, the Statistical Yearbook of the ATULBD for 2012, page 95; for 2012-2016 time series, the Statistical Yearbook of the ATULBD for 2017, page 98.

Table 3-102: The share of industrial branches in the structure of industrial production on the LBDR, % from the total

	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
1A2a Iron and steel	27.4	28.2	35.3	32.9	36.6	35.7	35.5	19.6	31.3	33.4	34.2
1A2c Chemicals	0.1	0.1	0.1	2.0	1.9	1.9	1.3	1.2	1.2	1.3	1.3
1A2d Pulp, Paper and Print	2.7	2.0	1.8	1.5	1.2	1.8	2.4	0.4	0.4	0.5	0.5
1A2e Food Processing, beverages and Tobacco	19.7	16.5	15.6	13.2	12.4	9.2	7.1	10.3	12.9	10.5	9.9
1A2f Non-Metallic Minerals	0.6	0.6	0.6	0.3	0.2	0.4	0.4	0.4	0.4	0.2	0.2
1A2h Machinery	13.2	11.1	12.1	8.3	6.5	8.2	8.0	6.7	8.0	8.1	8.4
1a2j Wood and Wood Products	1.4	0.9	0.5	0.5	0.4	0.6	1.1	1.3	1.2	1.0	0.8
1a2k Construction	5.7	5.0	4.9	4.7	4.8	2.1	2.2	2.5	2.8	2.8	2.1
1a2l Textile and Leather	14.8	20.0	15.9	22.7	22.3	29.5	29.7	29.8	17.6	18.2	19.4
1A2m Energy industry	14.4	15.6	13.2	13.9	13.7	10.6	12.3	27.8	24.2	24.0	23.2
	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
1A2a Iron and steel	29.7	46.5	44.9	32.0	18.7	22.5	25.3	14.9	27.2	24.1	18.2
1A2c Chemicals	1.3	1.0	0.7	0.8	1.7	1.8	2.0	2.8	2.0	1.4	2.0
1A2d Pulp, Paper and Print	0.6	0.4	0.3	0.4	0.5	0.6	0.3	0.3	0.2	0.5	0.3
1A2e Food Processing, beverages and Tobacco	13.5	10.0	10.5	9.7	12.2	12.1	11.8	17.2	13.7	12.3	13.5
1A2f Non-Metallic Minerals	0.3	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1A2h Machinery	9.3	6.8	6.1	5.0	7.3	7.0	6.8	7.5	4.4	4.3	4.4
1a2j Wood and Wood Products	0.6	0.2	0.1	0.1	0.1	0.1	0.2	0.4	0.3	0.1	0.1
1a2k Construction	3.5	8.9	11.1	3.2	3.6	4.2	4.7	5.4	6.6	4.8	6.0
1a2l Textile and Leather	23.4	13.5	12.2	15.8	21.8	19.3	17.8	23.5	13.4	12.2	14.1
1A2m Energy industry	17.8	12.4	14.1	33.0	34.1	32.4	31.1	28.0	32.2	40.3	41.4

AD on total fuel consumption (for RBDR and LBDR) within the 1A2 'Manufacturing Industries and Construction' category are presented in Table 3-103.

Table 3-103: Total fuel consumption with energy purposes within the category 1A2 'Manufacturing Industries and Construction' within 1990-2016 periods, TJ

	1990	1991	1992	1993	1994	1995	1996	1997	1998
Engine fuel	NO	NO	NO	NO	NO	NO	NO	NO	264
Other types of fuel	NO	NO	NO	NO	NO	NO	NO	117	59
Wood Waste	176	120	94	67	29	NO	NO	NO	NO
Fuel Wood	202	45	22	62	29	58	58	58	53.64
LPG	92	NO	NO	9	NO	NO	NO	NO	NO
Natural Gas	9034	5373	4216	3168	2288	3080	2347	3286	3198
Kerosene	647	NO	NO	191	29	NO	NO	NO	29
Gasoline	299	120	116	124	59	59	88	88	59
Other Petroleum Products	NO	NO	NO	3	NO	NO	NO	NO	NO
Fuel for Jet Engines	299	29	16	36	NO	NO	NO	NO	NO
Residual Fuel Oil	16159	11707	7900	4854	763	558	528	411	411
Coking Coal	468	NO	NO	53	59	29	88	117	59
Diesel Oil	1279	505	371	630	498	527	410	352	206
Coke	1029	124	90	443	323	381	410	352	264
Bituminous Coal	NO	NO	NO	NO	NO	NO	59	30	NO
Lignite	12	16	20	28	29	NO	NO	NO	NO
Anthracite	1122	NO	NO	15	NO	NO	29	29	58
Aviation Gasoline	NO	NO	NO	12	NO	NO	NO	NO	NO
Other types of fuel	NO	NO	NO	NO	NO	NO	NO	117	59
Pellets and Briquettes and other waste	NO	NO	NO	NO	NO	NO	NO	NO	88
Biogas	NO	NO	NO	NO	NO	NO	NO	NO	58
	1999	2000	2001	2002	2003	2004	2005	2006	2007
Other types of fuel	59	NO	NO	NO	NO	NO	NO	NO	NO
Wood Waste	NO	NO	NO	NO	NO	39	26	1	5
Fuel Wood	41.32	41.32	41.32	46.32	29	44	53	70	51
LPG	NO	NO	557	NO	29	12	15	24	16
Natural Gas	3051	3609	3286	4232.5	4514	4719	6082	6097	5981
Kerosene	NO	NO	NO	NO	NO	5	10	NO	NO
Gasoline	29	29	29	40.2	NO	48	30	54	60
Other Petroleum Products	NO	NO	NO	NO	NO	4	8	12	NO
Fuel for Jet Engines	NO	NO	NO	NO	NO	NO	NO	2	NO
Residual Fuel Oil	176	176	205	85	235	243	274	294	262
Coking Coal	117	117	117	86	29	28	23	15	11
Diesel Oil	117	117	117	127.54	117	200	192	227	155
Coke	205	176	235	184.87	147	58	8	11	11
Bituminous Coal	NO	29	NO	NO	NO	14	15	NO	NO
Anthracite	29	29	29	28	29	134	168	156	78
Other types of fuel	59	NO	NO	NO	NO	NO	NO	NO	NO

	2008	2009	2010	2011	2012	2013	2014	2015	2016
Wood Waste	14	NO	16	25	36	5	16	8	NO
Fuel Wood	35	NO	57	32	46	67	91	62	34
LPG	22	NO	66	9	15	5	71	8	18
Natural Gas	3522	1969.9	2637	2805	2670	2421	2190	2461	2493
Kerosene	NO	NO	1	NO	NO	NO	NO	NO	NO
Gasoline	39	NO	27	29	34	2	35	22	23
Other Petroleum Products	NO	NO	NO	NO	NO	NO	NO	6	1
Fuel for Jet Engines	NO	NO	17	NO	NO	NO	NO	NO	NO
Residual Fuel Oil	284	168	156	172	163	161	152	144	191
Coking Coal	18	NO	9	4	2	NO	NO	NO	NO
Diesel Oil	155	90.54	158	148	143	175	150	91	94
Coke	9	53	126	7	30	4	52	1	143
Bituminous Coal	1795	1374	NO	NO	NO	NO	NO	1646	915
Anthracite	226	82.4	269	1733	154	2244	534	58	65
Agricultural Fuel Residues	NO	NO	NO	5	1	10	1	NO	NO
Pellets and Briquettes and other waste	NO	NO	NO	NO	NO	NO	NO	28	19

3.3.3. Uncertainties Assessment and Time-Series Consistency

The primary uncertainties related factors pertain to methodology, emission factors used to estimate GHG emissions covered by the category 1A2 'Manufacturing Industries and Construction', and quality of available activity data. Uncertainties associated with EFs used to estimate CO_2 emissions from the 1A2 'Manufacturing Industries and Construction' category, were estimated at circa 5 per cent, while those pertaining to EFs used to estimate CH_4 and N_2O emissions reach up to ±50 per cent. Uncertainties associated with statistical data regarding fuel consumption within the 'Manufacturing Industries and Construction Sector' in the RM represent circa ±5 per cent for CO_2 and CH_4 emissions, and circa ±3 per cent for N_2O emissions. Thus, combined uncertainties account for circa ±7.1 per cent for CO_2 emissions, respectively circa ±50.2 per cent and ±50.1 per cent for CH_4 and N_2O emissions (Annex 5-3.1).

In view of ensuring time-series consistency of the obtained results, the same methodology 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 for estimating GHG emissions under the category 1A2 'Manufacturing Industries and Construction' were documented and archived both in hard copies and electronically. For identifying the data entry and emission estimation process related errors there were applied verifications and quality control procedures, including:

- Verification of AD collecting and manipulation procedures, including: verifying if disaggregation of AD collected for each source included in 1A2 'Manufacturing Industries and Construction' category complies with the requirements set out in the description of each source in the 2006 IPCC Guidelines (in the current inventory cycle, GHG emissions were calculated separately for 12 industrial branches);
- For each source, the AD are available in separate files in energy units; GHG emissions were calculated for each source even if the statistical evidence of fuel consumption within each source revealed uneven and fragmented trends associated with the consumption of certain limited types of fuels during the period under review;
- Verifying the correctness of EFs use for each source;
- Verifying if the primary reference sources are correctly indicated;
- The accuracy of calculations for sources included in 1A2 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 the 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;
- 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 emissions archive.

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

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 to recalculate GHG emissions from 1A2 'Manufacturing Industries and Construction' category. The main causes of these recalculations are, as follows:

- GHG emissions from this category were estimated separately for the RBDR and LBDR, respectively for each industrial branch;
- For a series of industrial branches, the missing values have been restored using the interpolation method for 1991-1992 (during these years, the EBs were not published);
- The recalculations for 2010-2015 time series were made taking into account the new structure of the EBs of the RM and the reallocations made between categories 1A2 and 1A1;
- Also, the transition from an average NCV for a longer period of time (1990-2015) to an annual average NCV for natural gases (Table 3-23), based on the information provided by 'Moldovagaz' for 1997-2016 time series (for 1990-1996 periods, were used annual average values characteristic to 1997).

In comparison with the results included into the NC4 of the RM under the UNFCCC (2018), the performed recalculations resulted in a decrease of direct GHG emissions in 1990-1991, 1994-1997, 1999-2008 and 2010-2015, with a variation from a minimum decrease by 0.1 per cent in 1990, to a maximum decrease by circa 20.2 per cent in 2014, respectively an increase in 1992-1993, 1998 and 2009, with a variation from a minimum increase by 1.4 per cent in 1998 and 2009 to a maximum increase by circa 21.2 per cent in 1993 (Table 3-104). For 2016, direct GHG emissions from this category were estimated for the first time. The results allow assert that between 1990 and 2016, the respective emissions decreased in the RM by circa 77.3 per cent.

Table 3-104: Recalculation results of GHG emissions from 1A2 'Manufacturing Industries and Construction' category included into the NC4 of the RM under the UNFCCC (2018), kt CO_2 eq.

	1990	1991	1992	1993	1994	1995	1996	1997	1998
NC4	2 213.8153	1 757.4603	1 016.9115	565.0857	830.3854	465.0111	378.5707	599.1025	560.0565
BUR2	2 212.4085	1 490.7200	1 068.3480	684.9689	792.0811	440.6772	370.3100	589.6544	568.0101
Difference, %	-0.1	-15.2	5.1	21.2	-4.6	-5.2	-2.2	-1.6	1.4
	1999	2000	2001	2002	2003	2004	2005	2006	2007
NC4	492.3400	537.9965	619.7443	432.4170	457.2714	471.8730	604.8584	669.4305	832.1733
BUR2	489.1123	531.7932	612.5378	425.1190	453.2059	465.8858	599.2226	662.2557	824.7942
Difference, %	-0.7	-1.2	-1.2	-1.7	-0.9	-1.3	-0.9	-1.1	-0.9

	2008	2009	2010	2011	2012	2013	2014	2015	2016
NC4	916.7788	509.1528	541.0995	601.4892	565.1582	601.6466	587.5527	668.2922	
BUR2	909.8553	516.3518	443.8184	598.2152	457.4388	599.3992	468.8030	534.6373	501.9962
Difference, %	-0.8	1.4	-18.0	-0.5	-19.1	-0.4	-20.2	-20.0	

Abbreviations: NC4 – Fourth National Communication of the RM under the UNFCCC (2018); BUR2 – Second Biennial Update Report of the RM under the UNFCCC (2019).

3.3.6. Planned Improvements

Potential improvements within the 1A2 'Manufacturing Industries and Construction' category could be possible once the updated AD regarding the fuel consumption with energy purposes for the territory on the LBDR are available, thus filling the gaps for certain years.

3.4. Transport (Category 1A3)

3.4.1. Source Category Description

The 1A3 'Transport' category 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 category 1A3 'Transport'

Total GHG emissions from category 1A3 'Transport' recorded a decreasing trend between 1990 and 2016, from 4,479.45 kt CO_2 equivalent in 1990 to 2,382.93 kt CO_2 equivalent in 2016, or by 46.8 per cent (Table 3-105).

Table 3-107: GHG emissions from 1A3 'Transport' category within 1990-2016 periods

	1990	1991	1992	1993	1994	1995	1996	1997	1998
1A3, kt CO_2 equivalent	4 479.4542	3 405.6396	2 399.6485	1 762.9007	1 527.4063	1 539.2813	1 490.6804	1 509.7178	1 307.0517
%, as compared to 1990	100.0	76.0	53.6	39.4	34.1	34.4	33.3	33.7	29.2
	1999	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**
1A3, kt CO_2 equivalent	876.1417	942.9727	1 019.9028	1 295.6232	1 512.4719	1 708.8588	1 767.1186	1 695.7978	1 803.7175
%, as compared to 1990	19.6	21.1	22.8	28.9	33.8	38.1	39.4	37.9	40.3
	2008	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**
1A3, kt CO_2 equivalent	1 895.5003	1 813.6345	2 054.1180	2 164.9327	1 901.8722	2 021.7651	2 090.0531	2 203.3296	2 382.9261
%, as compared to 1990	42.3	40.5	45.9	48.3	42.5	45.1	46.7	49.2	53.2

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

The table below shows the evolution of direct and indirect GHG emissions under the 1A3 'Transport' category, separately for the RBDR and LBDR (Table 3-106).

Table 3-106: Direct and indirect GHG emissions from 1A3 'Transport' category on the RBDR and the LBDR, within 1990-2016 periods, kt

	RBDR							LBDR						
	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	4 344.7615	1.3226	0.3410	18.3508	71.4239	8.8402	5.1891	IE	IE	IE	IE	IE	IE	IE
1991	3 299.6478	0.9966	0.2721	15.9307	64.7274	8.0260	3.8891	IE	IE	IE	IE	IE	IE	IE
1992	2 320.9288	0.6971	0.2057	10.5582	31.7322	4.0838	2.7653	IE	IE	IE	IE	IE	IE	IE
1993	1 469.8050	0.4063	0.1470	8.2465	20.7939	2.7717	1.9169	229.7624	0.0658	0.0259	2.5743	4.0479	0.5749	0.2801
1994	1 278.3714	0.3627	0.0884	4.9758	18.7013	2.3978	1.4738	207.3072	0.0618	0.0160	1.7328	3.6885	0.4873	0.2454
1995	1 290.3521	0.3694	0.0856	5.1264	19.5744	2.4889	1.4602	208.0355	0.0641	0.0152	1.6562	3.8182	0.4985	0.2401
1996	1 262.2268	0.3590	0.0818	4.9553	18.7209	2.3926	1.3784	189.4256	0.0595	0.0141	1.4699	3.5356	0.4608	0.2154
1997	1 273.5700	0.3963	0.0816	4.9370	21.1637	2.6399	1.4216	196.2044	0.0667	0.0136	1.4172	3.9691	0.5079	0.2080
1998	1 108.3894	0.3394	0.0680	4.1670	18.0137	2.2440	1.2461	165.2278	0.0563	0.0110	1.1328	3.3362	0.4243	0.1748
1999	753.2375	0.2085	0.0427	2.7986	10.6532	1.3394	0.8908	102.2165	0.0325	0.0065	0.7207	1.9181	0.2451	0.1151
2000	816.8939	0.2126	0.0478	3.1302	10.4956	1.3197	1.0605	103.7012	0.0319	0.0067	0.7537	1.8840	0.2423	0.1199
2001	885.2583	0.2254	0.0530	3.3764	11.2838	1.4083	1.1773	110.2352	0.0343	0.0072	0.8138	2.0309	0.2613	0.1263
2002	1 112.0001	0.2871	0.0761	4.7227	14.6845	1.8684	1.4421	149.2777	0.0438	0.0113	1.1396	2.5858	0.3409	0.1786
2003	1 299.8051	0.3379	0.0749	5.2118	17.8305	2.2156	1.7051	177.3944	0.0516	0.0108	1.1096	2.9922	0.3813	0.2136

	RBDR							LBDR						
	CO_2	CH_4	N_2O	NO_x	CO	NMVOC	SO_2	CO_2	CH_4	N_2O	NO_x	CO	NMVOC	SO_2
2004	1 501.5425	0.3664	0.0894	6.0813	19.2688	2.4236	1.9987	167.0679	0.0498	0.0108	1.1720	2.9235	0.3775	0.1976
2005	1 549.4161	0.3785	0.0981	6.4934	19.8173	2.5214	2.0712	174.1274	0.0509	0.0121	1.3075	2.9988	0.3932	0.2090
2006	1 476.0868	0.3490	0.1019	6.4589	18.2298	2.3437	2.0548	175.5386	0.0472	0.0131	1.3575	2.7615	0.3701	0.2229
2007	1 567.0889	0.3667	0.1068	6.8404	18.7944	2.4229	2.2153	190.3219	0.0484	0.0138	1.3797	2.7943	0.3746	0.2498
2008	1 654.1698	0.3867	0.1082	7.1646	19.6386	2.5346	2.3642	194.1256	0.0492	0.0136	1.3785	2.8336	0.3778	0.2553
2009	1 586.2179	0.3808	0.0922	6.4057	19.4528	2.4726	2.2227	185.5218	0.0607	0.0113	1.1939	2.7853	0.3579	0.2250
2010	1 792.5189	0.3843	0.1035	7.4363	19.1339	2.4716	2.6746	215.5747	0.0684	0.0130	1.3781	2.6931	0.3497	0.2788
2011	1 902.4491	0.3974	0.1084	7.7871	19.7276	2.5358	2.8449	215.0697	0.0548	0.0127	1.3523	2.7832	0.3626	0.2913
2012	1 661.2261	0.3429	0.0971	7.0204	16.6704	2.1712	2.5340	198.3387	0.0477	0.0121	1.2348	2.2747	0.3010	0.2799
2013	1 763.9646	0.3378	0.0967	7.1829	16.2296	2.1176	2.7321	215.4867	0.0562	0.0122	1.2606	2.1980	0.2875	0.3059
2014	1 795.0545	0.3355	0.0895	6.7879	15.9553	2.0633	2.7940	254.6249	0.0564	0.0131	1.1636	2.1354	0.2732	0.3837
2015	1 902.7295	0.3559	0.1005	7.4915	16.5498	2.1489	2.9724	256.1811	0.0567	0.0139	1.2627	2.1205	0.2769	0.3875
2016	2 062.6077	0.4243	0.1163	8.4190	17.0140	2.2306	3.1961	268.9892	0.0576	0.0155	1.3472	2.1521	0.2866	0.4112

By 2016, the direct and indirect GHG emissions within the category 1A3 ‘Transport’ in the RM accounted: for CO_2 – circa 53.7 per cent of emissions registered during the reference year, for CH_4 – 36.4 per cent, N_2O – 38.7 per cent, NO_x – 53.2 per cent, CO – 26.8 per cent, NMVOC – 28.5 per cent and SO_2 – 69.5 per cent (Table 3-107), with the largest share in the structure of total direct GHG emissions at category level represented by CO_2, followed by N_2O and CH_4 (Table 3-108).

Table 3-107: Direct and indirect GHG emissions from 1A3 ‘Transport’ category in the Republic of Moldova within 1990-2016 periods

	1A3, kt							in %, as compared to 1990						
	CO_2	CH4	N_2O	NO_x	CO	NMVOC	SO_2	CO_2	CH4	N_2O	NO_x	CO	NMVOC	SO_2
1990	4 344.7615	1.3226	0.3410	18.3508	71.4239	8.8402	5.1891	100.0	100.0	100.0	100.0	100.0	100.0	100.0
1991	3 299.6478	0.9966	0.2721	15.9307	64.7274	8.0260	3.8891	75.9	75.3	79.8	86.8	90.6	90.8	74.9
1992	2 320.9288	0.6971	0.2057	10.5582	31.7322	4.0838	2.7653	53.4	52.7	60.3	57.5	44.4	46.2	53.3
1993	1 699.5673	0.4721	0.1729	10.8208	24.8418	3.3466	2.1971	39.1	35.7	50.7	59.0	34.8	37.9	42.3
1994	1 485.6786	0.4245	0.1044	6.7086	22.3898	2.8852	1.7192	34.2	32.1	30.6	36.6	31.3	32.6	33.1
1995	1 498.3876	0.4335	0.1009	6.7826	23.3926	2.9874	1.7003	34.5	32.8	29.6	37.0	32.8	33.8	32.8
1996	1 451.6525	0.4184	0.0959	6.4252	22.2564	2.8534	1.5938	33.4	31.6	28.1	35.0	31.2	32.3	30.7
1997	1 469.7744	0.4631	0.0952	6.3542	25.1328	3.1478	1.6297	33.8	35.0	27.9	34.6	35.2	35.6	31.4
1998	1 273.6172	0.3957	0.0790	5.2998	21.3500	2.6683	1.4210	29.3	29.9	23.2	28.9	29.9	30.2	27.4
1999	855.4540	0.2410	0.0492	3.5193	12.5713	1.5845	1.0059	19.7	18.2	14.4	19.2	17.6	17.9	19.4
2000	920.5951	0.2445	0.0546	3.8839	12.3795	1.5620	1.1803	21.2	18.5	16.0	21.2	17.3	17.7	22.7
2001	995.4935	0.2597	0.0601	4.1902	13.3146	1.6695	1.3035	22.9	19.6	17.6	22.8	18.6	18.9	25.1
2002	1 261.2777	0.3310	0.0875	5.8622	17.2703	2.2093	1.6207	29.0	25.0	25.7	31.9	24.2	25.0	31.2
2003	1 477.1995	0.3896	0.0857	6.3214	20.8227	2.5969	1.9187	34.0	29.5	25.1	34.4	29.2	29.4	37.0
2004	1 668.6104	0.4162	0.1001	7.2533	22.1923	2.8012	2.1963	38.4	31.5	29.4	39.5	31.1	31.7	42.3
2005	1 723.5435	0.4294	0.1102	7.8009	22.8161	2.9145	2.2802	39.7	32.5	32.3	42.5	31.9	33.0	43.9
2006	1 651.6254	0.3962	0.1150	7.8164	20.9913	2.7138	2.2777	38.0	30.0	33.7	42.6	29.4	30.7	43.9
2007	1 757.4108	0.4151	0.1206	8.2201	21.5888	2.7975	2.4651	40.4	31.4	35.4	44.8	30.2	31.6	47.5
2008	1 848.2954	0.4358	0.1218	8.5432	22.4722	2.9125	2.6195	42.5	33.0	35.7	46.6	31.5	32.9	50.5
2009	1 771.7398	0.4415	0.1035	7.5996	22.2381	2.8305	2.4477	40.8	33.4	30.4	41.4	31.1	32.0	47.2
2010	2 008.0937	0.4528	0.1165	8.8144	21.8270	2.8213	2.9534	46.2	34.2	34.1	48.0	30.6	31.9	56.9
2011	2 117.5188	0.4522	0.1212	9.1394	22.5108	2.8983	3.1362	48.7	34.2	35.5	49.8	31.5	32.8	60.4
2012	1 859.5648	0.3906	0.1092	8.2552	18.9451	2.4721	2.8138	42.8	29.5	32.0	45.0	26.5	28.0	54.2
2013	1 979.4512	0.3941	0.1089	8.4436	18.4275	2.4051	3.0379	45.6	29.8	31.9	46.0	25.8	27.2	58.5
2014	2 049.6794	0.3919	0.1026	7.9515	18.0907	2.3365	3.1778	47.2	29.6	30.1	43.3	25.3	26.4	61.2
2015	2 158.9106	0.4126	0.1144	8.7542	18.6703	2.4258	3.3598	49.7	31.2	33.6	47.7	26.1	27.4	64.7
2016	2 331.5969	0.4819	0.1318	9.7662	19.1661	2.5173	3.6073	53.7	36.4	38.7	53.2	26.8	28.5	69.5

Table 3-108: Direct GHG emissions from 1A3 ‘Transport’ category in the Republic of Moldova within 1990-2016 periods

	Direct GHG emissions, kt CO_2 equivalent				the share from the total, %		
	CO_2	CH_4	N_2O	Total	CO_2	CH_4	N_2O
1990	4 344.7615	33.0652	101.6275	4 479.4542	97.0	0.7	2.3
1991	3 299.6478	24.9141	81.0777	3 405.6396	96.9	0.7	2.4
1992	2 320.9288	17.4287	61.2910	2 399.6485	96.7	0.7	2.6
1993	1 699.5673	11.8028	51.5306	1 762.9007	96.4	0.7	2.9
1994	1 485.6786	10.6126	31.1152	1 527.4063	97.3	0.7	2.0
1995	1 498.3876	10.8380	30.0557	1 539.2813	97.3	0.7	2.0
1996	1 451.6525	10.4609	28.5671	1 490.6804	97.4	0.7	1.9
1997	1 469.7744	11.5768	28.3666	1 509.7178	97.4	0.8	1.9
1998	1 273.6172	9.8924	23.5421	1 307.0517	97.4	0.8	1.8
1999	855.4540	6.0249	14.6629	876.1417	97.6	0.7	1.7
2000	920.5951	6.1129	16.2647	942.9727	97.6	0.6	1.7

	Direct GHG emissions, kt CO_2 equivalent				the share from the total, %		
	CO_2	CH_4	N_2O	Total	CO_2	CH_4	N_2O
2001	995.4935	6.4923	17.9170	1 019.9028	97.6	0.6	1.8
2002	1 261.2777	8.2741	26.0713	1 295.6232	97.3	0.6	2.0
2003	1 477.1995	9.7390	25.5334	1 512.4719	97.7	0.6	1.7
2004	1 668.6104	10.4049	29.8435	1 708.8588	97.6	0.6	1.7
2005	1 723.5435	10.7353	32.8398	1 767.1186	97.5	0.6	1.9
2006	1 651.6254	9.9044	34.2680	1 695.7978	97.4	0.6	2.0
2007	1 757.4108	10.3768	35.9299	1 803.7175	97.4	0.6	2.0
2008	1 848.2954	10.8957	36.3092	1 895.5003	97.5	0.6	1.9
2009	1 771.7398	11.0374	30.8574	1 813.6345	97.7	0.6	1.7
2010	2 008.0937	11.3198	34.7045	2 054.1180	97.8	0.6	1.7
2011	2 117.5188	11.3044	36.1094	2 164.9327	97.8	0.5	1.7
2012	1 859.5648	9.7647	32.5427	1 901.8722	97.8	0.5	1.7
2013	1 979.4512	9.8515	32.4624	2 021.7651	97.9	0.5	1.6
2014	2 049.6794	9.7987	30.5750	2 090.0531	98.1	0.5	1.5
2015	2 158.9106	10.3156	34.1035	2 203.3296	98.0	0.5	1.5
2016	2 331.5969	12.0472	39.2820	2 382.9261	97.8	0.5	1.6

Further are presented GHG emissions from this category within 1990-2016 time series by sources. The largest share in the structure of total direct GHG emissions within this category between 1990 and 2016 is represented by 1A3b ‘Road Transportation’, followed by 1A3c ‘Railways’ and 1A3e ‘Other Transportation’ (pipeline transport), while the share of sources like 1A3a ‘Civil Aviation’ and 1A3d ‘Water-borne Navigation’ being insignificant (Table 3-109, Figure 3-18).

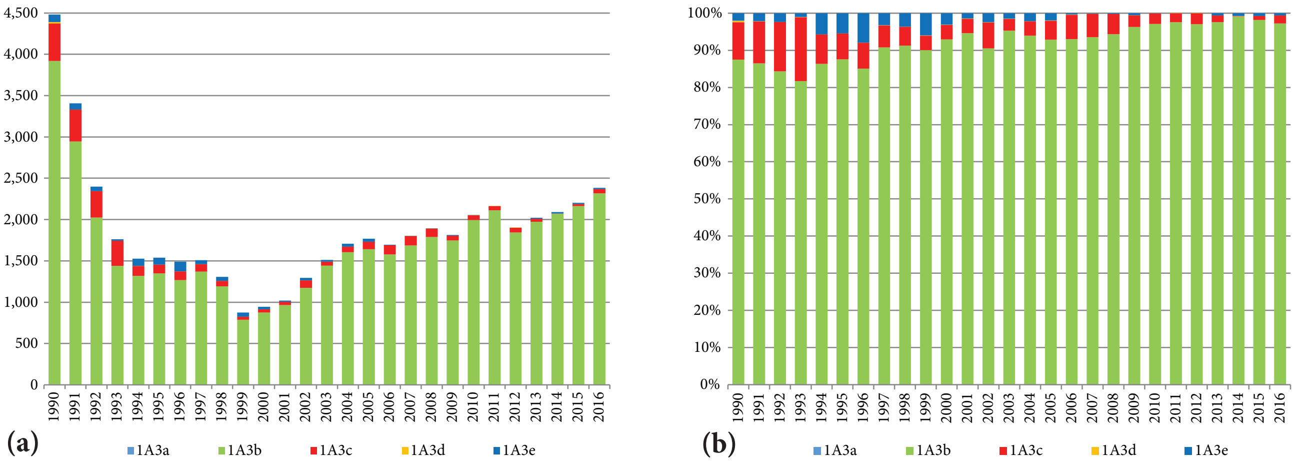


Figure 3-18: Breakdown of direct GHG emissions from category 1A3 ‘Transport’, by sources, within 1990-2016 periods, in kt CO_2 equivalent (a); and their share in the structure of total direct GHG emissions within the respective category, in % from the total (b).

As compared to the reference year (1990), by 2016, the GHG emissions from 1A3a ‘Civil Aviation’ decreased by circa 96.2 per cent, from 1A3b ‘Road Transportation’ – by 40.8 per cent, 1A3c ‘Railways’ – by 88.7 per cent, 1A3d ‘Water-borne Navigation’ – by 98.9 per cent, while from 1A3e ‘Other Transportation’ (pipeline transport) – by 84.0 per cent.

Table 3-109: Breakdown of direct GHG emissions from 1A3 ‘Transport’ category, by sources, within 1990-2016 periods

	1A3, kt CO_2 equivalent						in % from the total				
	1A3a	1A3b	1A3c	1A3d	1A3e	1A3	1A3a	1A3b	1A3c	1A3d	1A3e
1990	6.1044	3 913.7449	450.4560	19.1101	90.0389	4 479.4542	0.14	87.37	10.06	0.43	2.01
1991	4.2730	2 940.9757	385.1164	0.2421	75.0324	3 405.6396	0.13	86.36	11.31	0.01	2.20
1992	2.4417	2 020.9486	319.7768	0.2070	56.2743	2 399.6485	0.10	84.22	13.33	0.01	2.35
1993	0.6103	1 439.7046	303.7035	0.2389	18.6434	1 762.9007	0.03	81.67	17.23	0.01	1.06
1994	NA	1 318.3903	121.5073	0.1879	87.3207	1 527.4063	NA	86.32	7.96	0.01	5.72
1995	NA	1 348.2574	106.8347	0.1815	84.0076	1 539.2813	NA	87.59	6.94	0.01	5.46
1996	NA	1 268.2947	103.5893	0.1975	118.5989	1 490.6804	NA	85.08	6.95	0.01	7.96
1997	NA	1 370.9687	89.1194	0.2134	49.4162	1 509.7178	NA	90.81	5.90	0.01	3.27
1998	NA	1 193.0746	66.0556	0.1338	47.7877	1 307.0517	NA	91.28	5.05	0.01	3.66
1999	NA	788.7795	34.4099	0.2230	52.7294	876.1417	NA	90.03	3.93	0.03	6.02
2000	NA	876.0511	37.1731	0.0987	29.6497	942.9727	NA	92.90	3.94	0.01	3.14
2001	0.0980	964.8860	39.9323	0.1784	14.8080	1 019.9028	0.01	94.61	3.92	0.02	1.45

	1A3, kt CO_2 equivalent						in % from the total				
	1A3a	1A3b	1A3c	1A3d	1A3e	1A3	1A3a	1A3b	1A3c	1A3d	1A3e
2002	0.0848	1 172.2436	90.9440	0.4141	31.9367	1 295.6232	0.01	90.48	7.02	0.03	2.46
2003	0.6549	1 440.1173	48.3004	0.3758	23.0235	1 512.4719	0.04	95.22	3.19	0.02	1.52
2004	0.4127	1 604.9795	65.8538	0.3822	37.2306	1 708.8588	0.02	93.92	3.85	0.02	2.18
2005	0.1126	1 641.4074	90.0646	0.3249	35.2091	1 767.1186	0.01	92.89	5.10	0.02	1.99
2006	0.1970	1 576.4394	112.3174	0.2739	6.5701	1 695.7978	0.01	92.96	6.62	0.02	0.39
2007	0.1255	1 687.5140	112.7303	0.3153	3.0324	1 803.7175	0.01	93.56	6.25	0.02	0.17
2008	0.1513	1 787.5681	103.3907	0.3472	4.0431	1 895.5003	0.01	94.31	5.45	0.02	0.21
2009	0.0759	1 746.7485	56.4846	0.2739	10.0517	1 813.6345	0.00	96.31	3.11	0.02	0.55
2010	0.1168	1 994.3103	57.3245	0.2325	2.1339	2 054.1180	0.01	97.09	2.79	0.01	0.10
2011	0.1206	2 111.8501	52.7231	0.2389	NO	2 164.9327	0.01	97.55	2.44	0.01	NO
2012	0.2063	1 844.7477	56.6452	0.2729	NO	1 901.8722	0.01	97.00	2.98	0.01	NO
2013	0.1963	1 972.4785	36.1808	0.2747	12.6348	2 021.7651	0.01	97.56	1.79	0.01	0.62
2014	0.1190	2 070.1128	3.0198	0.3480	16.4534	2 090.0531	0.01	99.05	0.14	0.02	0.79
2015	0.3109	2 161.8956	24.1957	0.2495	16.6780	2 203.3296	0.01	98.12	1.10	0.01	0.76
2016	0.2298	2 317.2707	50.7765	0.2174	14.4318	2 382.9261	0.01	97.24	2.13	0.01	0.61

3.4.2. Methodological Issues, Emission Factors and Activity Data

GHG emissions from 1A3 'Transport' category were estimated following a Tier 1 methodological approach available in the 2006 IPCC Guidelines, based on activity data on fuel consumption and default values of emission factors. In order to estimate non-CO_2 emissions, there were used default EFs available in the EMEP/EEA Guidebook (2016, 2017) (Table 3-110).

Table 3-110: Emission factors used for estimating GHG emissions from 1A3 'Transport', kg/TJ

Category	Fuel Type	CO_2	CH_4	N_2O	NO_x	CO	NMVOC	SO_2	Sources of reference for: CO_2, CH_4, N_2O	Sources of reference for: NOx, CO and NMVOC
1A3a	Aviation Gasoline	69300	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, May 2017, Categories 1.A.3.a, 1.A.5.b, Table 3-3
1A3b	Gasoline	69300	33.0	3.2	8.7	84.7	10.1	45.7	2006 IPCC Guidelines, Volume 2, Chapter 3, Tables 3.2.1 and 3.2.2	EMEP/EEA Guidebook, June 2017, Categories 1A3.bi, 1A3b.ii, 1.A.3.b.iii, 1.A.3.b.iv, Tables 3-5 and 3-6
	Diesel Oil	74100	3.9	3.9	13.0	3.3	0.7	141.0		
	Natural Gas	56100	92.0	3.0	13.0	5.7	0.3	0.0		
	LPG	63100	62.0	0.2	15.2	84.7	13.6	130.3		
1A3c	Diesel Oil	74100	4.15	28.6	52.4	10.7	4.65	141.0	2006 IPCC Guidelines, Volume 2, Chapter 3, Table 3.4.1	EMEP/EEA Guidebook, June 2017, Category 1.A.3.c, Table 3-1
1A3d	Diesel Oil	74100	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, November 2016, Category 1A3d.i, 1.A.3.d.ii, 1.A.4.c.iii, Table 3-1
1A3e	Natural Gas	56100	1	0.1	74	29	23	0.67	2006 IPCC Guidelines, Volume 2, Chapter 3, Tables 2.2	EMEP/EEA Guidebook, November 2016, Categories 1.A.4.a.i, 1.A.4.b.i, 1.A.4.c.i, 1.A.5.a, Table 3-8

For 2014-2016 time series, an assessment method for estimating GHG emissions for the respective category was applied by using the COPERT model, ver. 4.9, the equivalent of a Tier 3 methodological approach. But while lacking AD, this method was not yet possible for the previous period, 1990-2013.

For the LBDR there are available only partial AD on diesel oil and gasoline consumption by the transport units in the agriculture sector, respectively partial information on natural gas consumption by the transport units in the region (Table 3-111).

Table 3-111: Fuel Consumption on the LBDR for 1A3b 'Road Transportation', TJ

	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
Gasoline	1825	1731	1809	1684	1920	1621	922	900	970	1225	1440	1397
Diesel Oil	801	942	910	785	685	590	453	490	508	706	961	842
	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Gasoline	1421	1291	1305	1325	1315	1237	1295	1041	991	968	949	957
Diesel Oil	877	984	1171	1220	1082	1488	1565	1561	1793	2402	2405	2533
Natural Gas	NA	NA	NA	NA	139	233	61	75	177	164	173	172

Note: it was accepted that 10 per cent of diesel oil consumed in agriculture is used on roads of national importance (Category 1A3), while the rest of 90 per cent off-roads or on agricultural fields (category 1A4c).

The main reference sources are data provided "The State of Housing and Communal Services of the ATULBD" (which were generated and published for 2011-2016 time series).

For the RBDR, the main reference sources regarding fuel consumption for the transport sector between 1993 and 2016 are the information provided by the Energy Balances of the Republic of Moldova, both in natural units (kt and million m^3), as well as in energy units (TJ). For 1990-1992, available data in natural units was converted to energy units (TJ) by using country specific NCVs (in the Energy Balances for 1990, AD are available in natural units, as well as in kt of conventional fuel; while for 1991 and 1992, the Energy Balances have not been published).

As for water-borne navigation and civil aviation, additionally are used AD provided through official letters by the Ministry of Transport and Roads Infrastructure, the S.O.E. 'Moldavian Railways', respectively by the Civil Aeronautical Authority of the Republic of Moldova.

The main types of fuel consumed in 1A3 category were represented by aviation gasoline, gasoline, natural gas, LPG, kerosene and other petroleum products.

It is accepted that part of the diesel oil consumption in the agriculture sector is used on roads of national importance, while the largest share on agricultural fields (in 1990 the report was 30 to 70 per cent; in 1991 – 20 to 80 per cent, in 1992 – 15 to 85 per cent, while within 1993-2016 time series – 10 to 90 per cent). Fuel consumed on roads of national importance was considered in the assessment of GHG emissions from 1A3 category, while fuel consumed by transport units on agricultural fields was considered in the assessment of GHG emissions from 1A4c source category.

To be noted that the consumption of lubricants in accordance with the assessment methods available in the 2006 IPCC Guidelines is considered in the Sector 2 'IPPU'.

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

Domestic aviation in the Republic of Moldova performs annually a small number of flights, with an increasing trend in activity between 2011 to 2014 (from 8 flights in 2001 to 3,609 in 2014), but with a significant decrease in the last two years of the current inventory cycle (1,543 in 2015 and 809 in 2016). Fuel consumption in domestic aviation is rather insignificant. Primary data on the use of fuel in domestic aviation were provided by the Civil Aviation Administration of the RM (subsequently renamed the Civil Aeronautical Authority of the RM).

AD on aviation gasoline consumption (Table 3-112) were recalculated from natural units (kt) to energy units (TJ) by using a country specific conversion factor (43.66 TJ/kt).

Table 3-112: AD on fuel consumption for 1A3a 'Civil Aviation' (1A3aii 'Domestic Aviation') in the RM within 2001-2016 periods

	2001	2002	2003	2004	2005	2006	2007	2008
Aviation Gasoline, kt	0.0321	0.0278	0.2146	0.135	0.037	0.065	0.041	0.049
Gasoline, TJ	1.4022	1.2133	9.3684	5.9030	1.6105	2.8173	1.7957	2.1643
	2009	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**
Aviation Gasoline, kt	0.0249	0.0383	0.0395	0.0676	0.0643	0.0390	0.1019	0.0753
Gasoline, TJ	1.0854	1.6704	1.7246	2.9514	2.8073	1.7027	4.4468	3.2876

Source: State Administration of Civil Aviation, through Letter No. 1328 dated 13.09.2011, answer to Letter No. 03-07/175 dated 02.02.2011; Civil Aeronautical Authority of the RM through Letter No. 474 dated 13.03.2014, answer to Letter No. 320/2014-01-01 dated 03.01.2014 from the Climate Change Office of the MoEN; Letter No. 366 dated 02.03.2015, answer to Letter No. 407/2015-01-09 dated 29.01.2015 from the Climate Change Office of the MoEN; Letter No. 1156 dated 27.05.2016, answer to Letter No. 512/2016-05-01 dated 10.05.2016 from the Climate Change Office of the MoEN; Letter No. 4040 dated 28.12.2017 answer to Letter No. 601/2017-12-03 dated 14.12.2017 from the Climate Change Office of the MoEN.

1A3b 'Road Transportation'

The park of road transport units in the RM is growing. The largest share in the total structure is represented by cars (Table 3-113).

Table 3-113: The structure of vehicle fleet in the RM, as of 01.01.2017, units

Cars	Trucks	Trailers	Tractors	Motorcycles	Buses	Semitrailers	Other	Total
546 794	177 575	50 665	39 518	37 906	20 968	16 173	3 143	892 742

Source: State Register of Transport (<http://www.registru.md/ro/registru-rst>).

For the RBDR, the AD associated with diesel oil (Table 3-114) and gasoline (Table 3-115) consumption within 1A3b 'Road Transportation' were collected from the Energy Balances of the RM (see Chapter S.2.1. 'Consumed directly as fuel or energy', in columns: 'for transport operation', 'for agriculture' and 'sold to the population') (for 1990, this information is available in natural units – kt and million m^3, respectively in energy units – thousand t.c.e., in 1991 and 1992, the Energy Balances have not been published; while for 1993-2016 time series, information is available in natural units – kt and million m^3, respectively in energy units– TJ).

Table 3-114: Diesel oil consumption within the 1A3b 'Road Transportation' in the Republic of Moldova within 1990-2016 periods

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
1A3b, TJ	18 845	14 275	9 706	5 937	6 977	6 868	6 324	6 207	5 648	4 481	5 692	6 464	7 432	9 523
	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	%
1A3b, TJ	11 100	11 273	11 325	12 546	13 525	12 842	16 491	17 822	15 966	17 915	19 361	20 277	21 761	15.5

Source: EBs of the RM for 1990, 1993-2016; SY of the ATULBD 2000 (page 106), 2006 (page 107), 2009 (page 106), 2010 (page 108), 2011 (page 109), 2012-2015 (page 113).

As the AD are incomplete, in order to fill the existing gaps associated with fuel consumption on the LBDR, information regarding diesel oil consumption were generated indirectly by considering the specific consumption per capita (it was determined fuel consumption per capita for the population on the RBDR between 1993 and 2016 and further this was extended to the population on the LBDR).

In order to estimate the total amount of diesel oil consumed by road transportation means in the country between 1993-2016, the amount of diesel oil from the Energy Balances was considered to be the sum of consumed diesel for transport operation, the ones sold to the population and 10 per cent of the amount consumed in the agriculture sector (90 per cent of the amount consumed in the agriculture sector was redistributed to 1A4c 'Agriculture / Forestry / Fishing'); to be noted that for 1990, the respective ratio was: 30 per cent of the diesel oil consumption was produced on roads of national importance, respectively 70 per cent on agricultural fields, in 1991 the ratio is: 20 and 80 per cent, while in 1992: 15 and 85 per cent, respectively.

A similar approach was used to deduce AD pertaining to the gasoline consumption between 1990 and 2016 within 1A3b 'Road Transportation', for which there were summed up the total amount of gasoline used for 'transport operation' and 'sold to population'.

Table 3-115: Gasoline consumption within the 1A3b 'Road Transportation' in the Republic of Moldova within 1990-2016 periods

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
1A3b, TJ	33 752	25 323	17 375	11 293	10 739	11 373	10 750	12 365	10 482	5 998	5 916	6 457	8 273	9 793
	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	%
1A3b, TJ	10 487	10 761	9 857	10 062	10 297	10 322	9 769	10 272	8 314	7 973	7 846	8 047	8 179	-75.8

Source: EBs of the RM for 1990, 1993-2016; SY of the ATULBD 2000 (page 106), 2006 (page 107), 2009 (page 106), 2010 (page 108), 2011 (page 109), 2012-2015 (page 113).

AD pertaining to consumption of LPG and compressed natural gas under the 1A3b 'Road Transportation' are provided by 'Moldovagaz' J.S.C. (Table 3-116).

Table 3-116: Liquefied Petroleum Gases and Compressed Natural Gases consumption within the 1A3b 'Road Transportation' in the Republic of Moldova within 1990-2016 periods

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
Liquefied Petroleum Gases, kt	13.0	11.5	9.9	8.4	6.0	4.0	4.0	2.6	2.7	2.4	1.5	0.8	1.3	6.0
Liquefied Petroleum Gases, TJ	599	436	412	387	264	176	205	235	205	235	264	176	230	293
Compressed Natural Gas, million m^3	8.2	9.4	10.6	11.8	7.3	6.8	9.4	10.5	10.9	10.8	12.3	12.7	13.7	13.0
Compressed Natural Gas, TJ	779	625	471	317	205	147	205	117	117	88	88	88	102	88
	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	%
Liquefied Petroleum Gases, kt	5.0	5.0	5.0	6.0	10.0	10.0	13.0	10.0	13.0	13.0	13.0	14.0	13.0	0.0
Liquefied Petroleum Gases, TJ	237	255	230	296	476	461	600	455	595	590	587	629	545	-9.0
Compressed Natural Gas, million m^3	12.0	12.0	2.0	3.0	7.1	13.0	8.9	3.8	4.2	7.2	6.8	17.0	29.0	253.7
Compressed Natural Gas, TJ	87	99	71	108	92	207	281	139	153	242	223	297	982	26.1

Source: Energy Balances of the RM for 1990, 1993-2016; "Moldovagaz" J.S.C. through Letter No. 604 dated 01.04.1999 (for 1990-1998), No. 02-541 dated 28.05.2001 (for 1999-2000), No. 02-156 dated 06.02.2004 (for 2001-2002), No. 06-1253 dated 27.09.2006 (for 2003-2005) and No. 02/1-476 dated 23.02.2011 (for 2006-2010).

1A3c 'Railways'

The railway transport in the RM includes railways, locomotives, passenger and cargo trains, buildings and edifices. At the end of 2016 operated: diesel locomotives – 138, maneuvering locomotives – 67, diesel trains (sections) – 21, cargo wagons – 6741, passenger coaches – 346. Fuel consumption within railways transport decreases by every year due to reduced cargo and passenger transport activity, poor rail and main rolling stock conditions.

The main sources of AD are the Energy Balances of the Republic of Moldova, where the information on diesel oil consumption is available in natural units (kt) and energy units (TJ) (Table 3-117). For the 1990-1992 period, AD associated with diesel oil consumption for railway transport is available only in natural units (for 1990, also in kt of coal equivalent), and in order to convert them to energy units (TJ) country specific NCVs were used.

Table 3-117: Diesel oil consumption for 1A3c 'Railways' on the RBDR within 1990-2016 periods according to data available in the Energy Balances of the RM

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
Diesel Oil, kt	128	109	91	72	29	26	25	21	16	8	9	10	22	12
Diesel Oil, TJ	5 445	4 655	3 865	3 078	1 232	1 086	1 056	910	675	352	381	410	936	498
	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	%
Diesel Oil, kt	16	22	28	28	26	14	14	13	14	9	1	6	13	-89.8
Diesel Oil, TJ	690	945	1 180	1 186	1 089	596	605	557	599	383	32	258	542	-90.0

Sources: Energy Balances of the RM for 1990 and 1993-2016.

For comparison, the table below presents AD associated with total diesel oil consumption for railways by S.O.E. "Moldavian Railways" (Table 3-118).

Table 3-118: Diesel oil consumption by S.O.E. "Moldavian Railways" within 1990-2016 periods

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
Diesel Oil, kt	143.550	122.530	85.270	64.080	65.830	45.770	42.410	39.740	37.190	21.590	26.360	29.566	36.687	42.300
	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	%
Diesel Oil, kt	35.700	36.536	47.149	39.575	36.505	21.495	20.187	21.767	17.990	19.153	18.465	14.628	12.642	-91.2

Sources: "Moldavian Railways" SOE through Letter dated 26 March 1999, No. 94/T; Letter dated 17 December 2003 No. H-4/993; Letter dated 19.09.2006 No. Nteh/338; Letter dated 28 February 2011 No. 54/Nteh; Letter dated 17.01.2014 No. H-4/147; Letter dated 02.03.2015 No.H-4/458; Letter dated 02.06.2016 No. H-4/1186 and Letter dated 02.01.2018 No. H-4/02

For the LBDR, the AD associated with diesel oil consumption between 1993 and 2016 were calculated indirectly (Table 3-119), based on specific consumption per capita (it was determined the diesel oil consumption average per capita for the population on the RBDR, and this was extended to the population on the LBDR).

Table 3-119: Diesel oil consumption for 1A3c 'Railways' on the LBDR within 1993-2016 periods

	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
Diesel Oil, kt	20	8	7	7	6	4	2	2	3	6	3	4
Diesel Oil, TJ	593	237	205	196	167	123	64	68	73	163	86	106
	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Diesel Oil, kt	6	8	8	7	4	4	4	4	3	0	2	4
Diesel Oil, TJ	144	178	177	161	87	88	80	86	54	5	34	72

The total diesel oil consumption for railways operation in the Republic of Moldova within 1990-2016 periods is presented below in Table 3-120.

Table 3-120: Total diesel oil consumption for 1A3c 'Railways' in the RM within 1990-2016 periods

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
1A3c, kt	128	109	91	92	37	33	32	27	20	10	11	13	28	15
1A3c, TJ	5 445	4 655	3 865	3 671	1 469	1 291	1 252	1 077	798	416	449	483	1 099	584
	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	%
1A3c, kt	20	28	36	36	33	18	18	17	18	12	1	8	17	-86.7
1A3c, TJ	796	1 089	1 358	1 363	1 250	683	693	637	685	437	37	292	614	-88.7

1A3d 'Water-borne Navigation'

Water-borne navigation in the RM includes a small number of ships, the fuel consumption being equally insignificant (for a great number of years, for example for: 1993-2003, 2005 and 2009, in the EBs of the RM, fuel consumption for water-borne navigation was indicated as zero). Under these circumstances, the main source of information on diesel oil consumption for water-borne navigation was the Ministry of Transport and Road Infrastructure (Table 3-121).

AD on diesel oil consumption for water-borne navigation were recalculated from natural units (t) to energy units (TJ) by using a country specific conversion factor (42.50 TJ/kt).

Table 3-121: Diesel oil consumption for 1A3d 'Water-borne Navigation' in the Republic of Moldova within 1990-2016 periods

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
Diesel Oil, t	6 000	76	65	75	59	57	62	67	42	70	31	56	130	118
Diesel Oil, TJ	255.2	3.2	2.8	3.2	2.5	2.4	2.6	2.9	1.8	3.0	1.3	2.4	5.5	5.0
	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	%
Diesel Oil t	120	102	86	99	109	86	73	75	86	86	109	78	68	-98.9
Diesel Oil, TJ	5.1	4.3	3.7	4.2	4.6	3.7	3.1	3.2	3.6	3.7	4.6	3.3	2.9	-98.9

Source: Official Letters from the Ministry of Transport and Communications dated 31.03.1999 No. 03-5-2/2-32; Ministry of Transport and Road Infrastructure dated 02.10.2006 No. 04-01-3/754; Ministry of Transport and Road Infrastructure dated 12.03.2011 No. 04/2-2-05; dated 21.01.2014 No. 03-02-5/52; dated 20.02.2015 No. 03-02-5/102; and dated 07.06.2016, No. 03-02-5/424; Energy Balances of the RM for 1990 and 1993-2016.

1A3e 'Other Transportation' (Pipeline Transport)

The RM has a developed natural gas transportation and distribution network (Table 3-122).

Table 3-122: Natural Gas Transportation and Distribution Networks in the Republic of Moldova (situation as of 01.01.2017)

No.	Main Gas Pipelines Branches	Pipelines diameter, mm	Pipelines length, km	Pressure, kgf/cm²
I.	**Main Gas Pipelines**			
1.	Ananiev-Tiraspol-Ismail	1220	62.9	75
2.	Sebelinka-Dnepropetrovsk-Krivoi Rog-Ismail	820	91.8	55
3.	Razdelinaia-Ismail	820	92.2	55
4.	Ananiev-Cernauti-Bogorodceni	1020	184.8	55
5.	Odessa-Chisinau	530	44	55
6.	Rabnița-Chisinau	530	91.1	55
7.	Oliscani-Saharna	530	26.7	55
8.	Tocuz-Cainari-Mereni	530	62.74	55
II.	**Connected Gas Pipelines**			
1.		Up to 200	364.718	55
2.		Up to 300	370.902	55
3.		Up to 400	161.008	55
4.		Up to 500	6.795	55
III.	**Natural Gas Distribution Networks**			
1.		Up to 50	1267.612	0.05-3 (average)
2.			641.045	Up to 0.05 (low)
3.		Up to 100	812.988	3-12 (high)
4.			2895.045	0.05-3 (average)
5.			5187.123	Up to 0.05 (low)
6.		Up to 200	2398.137	3-12 (high)
7.			1173.01	0.05-3 (average)
8.			778.321	Up to 0.05 (low)
9.		Up to 400	452.452	3-12 (high)
10.			253.264	0.05-3 (average)
11.			89.183	Up to 0.05 (low)
12.		Up to 700	49.491	3-12 (high)
13.			103.516	0.05-3 (average)
14.			0.946	Up to 0.05 (low)

Source: "Moldovagaz" J.S.C. through Letter No. 03/2-74 dated 12.01.2018.

AD associated with fuel consumption for pipeline transport (Table 3-123) are available in the Energy Balances of the RM (Chapter S.2.3. "Consumed directly as fuel or energy for transportation", column "Pipeline Transportation").

Table 3-123: Natural gas consumption for 1A3e 'Other Transportation' (Pipeline Transport) in the Republic of Moldova within 1990-2016 periods

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
1A3e, mill. m³	48	40	30	10	46	44	62	26	25	28	16	8	17	12
1A3e, TJ	1 603	1 336	1 002	332	1 555	1 496	2 112	880	851	939	528	264	569	410
	2004	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**%**
1A3e, mill. m³	20	19	3	2	2	5	1	NO	NO	7	8	8	8	-83.3
1A3e, TJ	663	627	117	54	72	179	38	NO	NO	225	293	297	257	-84.0

Source: Energy Balances of the RM for 1990 and 1993-2016; activity data for the 1991-1992 period were interpolated, as in these years the Energy Balances were not generated.

AD on natural gas consumption for pipeline transport were recalculated from natural units (million m³) to energy units (TJ) by using country specific conversion factors (Table 3-124).

Table 3-124: NCVs for imported and consumed natural gases in the RM within 1990-2016 periods, according to data provided by the J.S.C. „Moldovagaz"

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
NCV, TJ/mill. m³	33.404	33.404	33.404	33.404	33.404	33.404	33.404	33.404	33.362	33.388	33.396	33.371	33.455	33.517
	2004	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**%**
NCV, TJ/mill. m³	33.568	33.597	33.635	33.647	33.660	33.798	33.785	33.827	33.936	34.061	34.221	34.518	34.480	3.2

3.4.3. Uncertainties Assessment and Time-Series Consistency

The primary uncertainties related factors pertain to assessment methodology, emission factors used to estimate GHG emissions covered by the 1A3 'Transport' category, and the quality of activity data available. Uncertainties associated with EFs used to estimate CO_2 emissions from the 1A3 'Transport' category, were estimated at about 5 per cent, for CH_4 emissions at about ±40 per cent, while those pertaining to EFs used to estimate N_2O emissions reach up to ±50 per cent. Uncertainties associated with statistical data regarding fuel consumption within the Transport Sector in the Republic of Moldova can be considered relatively low (±5 per cent). Thus, combined uncertainties were estimated for CO_2 emissions at circa ±7.1 per cent, for CH_4 and N_2O emissions, respectively at circa ±40.3 per cent and ±50.2 per cent (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.

3.4.4. Quality Assurance and Quality Control

Standard verification and quality control forms and check-lists were filled in for the 1A3 'Transport' category, following the Tier 1 approach. To be noted, that the AD and methods used for estimating GHG emissions under the 1A3 'Transport' 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, including:

- Verification of AD collecting and manipulation procedures, including: verifying if disaggregation of AD collected for each source category included in 1A3 'Transport' category complies with the requirements set out in the description of each source category in the 2006 IPCC Guidelines (in the current inventory cycle, separate GHG emissions were calculated for 6 transport sources (civil aviation, road transportation, railways, water-borne navigation, pipeline transportation and other types of transportation, including off-road); for each source, the AD is available in separate files in natural and energy units; verifying the correctness of EFs use 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 the 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;
- 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 emissions archive.

Following the good practice recommendations, GHG emissions were estimated using AD and CS EFs from official sources of information.

3.4.5. 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 to recalculate GHG emissions from 1A3 'Transport' category.

The main causes of these recalculations are, as follows:

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

- In order to convert fuel consumption from natural units to energy units a NCV of 43.66 TJ/kt (specific to aviation gasoline) was used to the detriment of the NCV of 43.13 TJ/kt (specific to aviation kerosene), thus resulting an increase of GHG emissions by circa 1.23 per cent within 2001-2015 time period;
- AD expressed in energy units for 1990 and 1993 were updated based on the information available in the Energy Balances of the RM for the respective years;
- The missing AD for 1991 and 1992 were restored by extrapolation based on the information available for 1990 and 1993.

In comparison with the results included into the NC4 of the RM under the UNFCCC (2018), the performed recalculations resulted in an increase by circa 1.2 percent of direct GHG emissions in 2001-2015, respectively a decrease in 1990 and 1993, with a variation from a minimum decrease by 0.7 per cent in 1990, to a maximum decrease by circa 27.3 per cent in 1993 (Table 3-125). For 2016, direct GHG emissions were estimated for the first time. Between 1990 and 2016, the respective emissions from 1A3aii 'Domestic Aviation' decreased by circa 96.2 per cent.

Table 3-125: Recalculation results of GHG emissions from 1A3a 'Civil Aviation' (1A3aii 'Domestic Aviation') included into the NC4 of the RM under the UNFCCC (2018), kt CO_2 eq.

	1990	1991	1992	1993	2001	2002	2003	2004	2005	2006
NC4	6.1450	NA	NA	0.8389	0.0968	0.0838	0.6470	0.4077	0.1112	0.1946
BUR2	6.1044	4.2730	2.4417	0.6103	0.0980	0.0848	0.6549	0.4127	0.1126	0.1970
Difference, %	-0.7	NA	NA	-27.3	1.2	1.2	1.2	1.2	1.2	1.2
	2007	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**
NC4	0.1240	0.1495	0.0750	0.1154	0.1191	0.2038	0.1939	0.1176	0.3071	
BUR2	0.1255	0.1513	0.0759	0.1168	0.1206	0.2063	0.1963	0.1190	0.3109	0.2298
Difference, %	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	

Abbreviations: NC4 – Fourth National Communication of the RM under the UNFCCC (2018); BUR2 – Second Biennial Update Report of the RM under the UNFCCC (2019).

1A3b 'Road Transportation'

- AD expressed in energy units (TJ) were updated based on the information available in the Energy Balances of the RM; unlike the previous inventory cycle when activity data used were considered in natural units (kt or million m^3);
- AD for 1991 and 1992 were updated (during the respective years, the Energy Balances have not been published);
- For those years when AD are not available in energy units (TJ), but only in natural units, the conversion was possible by using country specific NCVs;
- AD on fuel consumption for transport on the LBDR were updated, based on the specific fuel consumption per capita for the population on the RBDR.

In comparison with the results included into the NC4 of the RM under the UNFCCC (2018), the performed recalculations resulted in a decrease of direct GHG emissions in 1990-1991, 1993-1994, 1996-1998, 2000, 2002-2009, 2012 and 2014, respectively a relatively insignificant increase in 1992, 1995, 1999, 2001, 2010-2011, 2013 and 2015 (Table 3-126). For 2016, direct GHG emissions were estimated for the first time. Between 1990 and 2016, the respective emissions from 1A3b 'Road Transportation' decreased in the RM by circa 40.8 per cent.

Table 3-126: Recalculation results of GHG emissions from 1A3b 'Road Transportation' included into the NC4 of the RM under the UNFCCC (2018), kt CO_2 equivalent

	1990	1991	1992	1993	1994	1995	1996	1997	1998
NC4	3 914.7862	4 060.0997	1 856.7585	1 453.7302	1 318.4350	1 331.9217	1 268.5430	1 371.2221	1 193.3229
BUR2	3 913.7449	2 940.9757	2 020.9486	1 439.7046	1 318.3903	1 348.2574	1 268.2947	1 370.9687	1 193.0746
Difference, %	-0.03	-27.56	8.84	-0.96	0.00	1.23	-0.02	-0.02	-0.02
	1999	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**
NC4	787.9251	876.3093	958.8336	1 172.5992	1 440.3805	1 605.4001	1 642.2631	1 577.0875	1 687.9880
BUR2	788.7795	876.0511	964.8860	1 172.2436	1 440.1173	1 604.9795	1 641.4074	1 576.4394	1 687.5140
Difference, %	0.11	-0.03	0.63	-0.03	-0.02	-0.03	-0.05	-0.04	-0.03

	2008	2009	2010	2011	2012	2013	2014	2015	2016
NC4	1 788.1359	1 747.1567	1 993.8803	2 111.1788	1 845.1261	1 965.7193	2 070.3511	2 161.6771	
BUR2	1 787.5681	1 746.7485	1 994.3103	2 111.8501	1 844.7477	1 972.4785	2 070.1128	2 161.8956	2 317.2707
Difference, %	-0.03	-0.02	0.02	0.03	-0.02	0.34	-0.01	0.01	

Abbreviations: NC4 – Fourth National Communication of the RM under the UNFCCC (2018); BUR2 – Second Biennial Update Report of the RM under the UNFCCC (2019).

1A3c Railways

- AD for 1991 and 1992 were also updated (during the respective years, the Energy Balances have not been published);
- An error regarding the introduction of activity data on diesel oil consumption for the railways sector in 2009 was corrected.

In comparison with the results included into the NC4 of the RM under the UNFCCC (2018), the performed recalculations resulted in a decrease of direct GHG emissions in 1991 and 2009, respectively in an increase in 1992 (Table 3-127). For 2016, direct GHG emissions were estimated for the first time. Between 1990 and 2016, the respective emissions from 1A3c 'Railways' decreased in the RM by circa 87.8 per cent.

Table 3-127: Recalculation results of GHG emissions from 1A3c 'Railways' included into the NC4 of the RM under the UNFCCC (2018), kt CO_2 equivalent

	1990	1991	1992	1993	1994	1995	1996	1997	1998
NC4	450.4560	431.2096	300.0811	303.7035	121.5073	106.8347	103.5893	89.1194	66.0556
BUR2	450.4560	385.1164	319.7768	303.7035	121.5073	106.8347	103.5893	89.1194	66.0556
Difference, %	0.00	-10.69	6.56	0.00	0.00	0.00	0.00	0.00	0.00
	1999	2000	2001	2002	2003	2004	2005	2006	2007
NC4	34.4099	37.1731	39.9323	90.9557	48.3004	65.8538	90.0646	112.3174	112.7303
BUR2	34.4099	37.1731	39.9323	90.9440	48.3004	65.8538	90.0646	112.3174	112.7303
Difference, %	0.00	0.00	0.00	-0.01	0.00	0.00	0.00	0.00	0.00
	2008	2009	2010	2011	2012	2013	2014	2015	2016
NC4	103.3907	96.8345	57.3245	52.7231	56.6452	36.1808	3.0198	24.1957	
BUR2	103.3907	56.4846	57.3245	52.7231	56.6452	36.1808	3.0198	24.1957	50.7765
Difference, %	0.00	-41.67	0.00	0.00	0.00	0.00	0.00	0.00	

Abbreviations: NC4 – Fourth National Communication of the RM under the UNFCCC (2018); BUR2 – Second Biennial Update Report of the RM under the UNFCCC (2019).

1A3d Water-borne Navigation

GHG emissions from this source category were recalculated only for 2015, due to updating activity data for the respective year. For 2016, direct GHG emissions were estimated for the first time. Between 1990 and 2016, the respective emissions from 1A3d 'Water-borne Navigation' decreased in the RM by circa 98.9 per cent (Table 3-128).

Table 3-128: Recalculation results of GHG emissions from 1A3d 'Water-borne Navigation' included into the NC4 of the RM under the UNFCCC (2018), kt CO_2 equivalent

	1990	1991	1992	1993	1994	1995	1996	1997	1998
NC4	19.1101	0.2421	0.2070	0.2389	0.1879	0.1815	0.1975	0.2134	0.1338
BUR2	19.1101	0.2421	0.2070	0.2389	0.1879	0.1815	0.1975	0.2134	0.1338
Difference, %	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	1999	2000	2001	2002	2003	2004	2005	2006	2007
NC4	0.2230	0.0987	0.1784	0.4141	0.3758	0.3822	0.3249	0.2739	0.3153
BUR2	0.2230	0.0987	0.1784	0.4141	0.3758	0.3822	0.3249	0.2739	0.3153
Difference, %	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
NC4	0.3472	0.2739	0.2325	0.2389	0.2729	0.2747	0.3480	0.1176	
BUR2	0.3472	0.2739	0.2325	0.2389	0.2729	0.2747	0.3480	0.2495	0.2174
Difference, %	0.00	0.00	0.00	0.00	0.00	0.00	0.00	112.1	

Abbreviations: NC4 – Fourth National Communication of the RM under the UNFCCC (2018); BUR2 – Second Biennial Update Report of the RM under the UNFCCC (2019).

1A3e Other Transportation (Pipeline Transport)

- For certain years – 1990-1992, 2002 and 2009, when AD are not available in energy units (TJ), but only in natural units, the conversion was possible by using country specific NCVs;
- An error regarding the introduction of activity data on natural gas consumption for the pipeline transport sector in 2000 was corrected.

In comparison with the results included into the NC4 of the RM under the UNFCCC (2018), the performed recalculations resulted in a decrease of direct GHG emissions in 1990-1992, 2000 and 2002, respectively in an increase in 2009 (Table 3-129). For 2016, direct GHG emissions were estimated for the first time. Between 1990 and 2016, the respective emissions from 1A3d 'Other Transportation' (Pipeline Transport) decreased in the RM by circa 84.0 per cent.

Table 3-129: Recalculation results of GHG emissions from 1A3e 'Other Transportation' (Pipeline Transport) included into the NC4 of the RM under the UNFCCC (2018), kt CO_2 equivalent

	1990	1991	1992	1993	1994	1995	1996	1997	1998
NC4	91.2673	76.0561	57.0420	18.6434	87.3207	84.0076	118.5989	49.4162	47.7877
BUR2	90.0389	75.0324	56.2743	18.6434	87.3207	84.0076	118.5989	49.4162	47.7877
Difference, %	-1.4	-1.4	-1.4	0.0	0.0	0.0	0.0	0.0	0.0
	1999	2000	2001	2002	2003	2004	2005	2006	2007
NC4	52.7294	35.2652	14.8080	32.3452	23.0235	37.2306	35.2091	6.5701	3.0324
BUR2	52.7294	29.6497	14.8080	31.9367	23.0235	37.2306	35.2091	6.5701	3.0324
Difference, %	0.0	-15.9	0.0	-1.3	0.0	0.0	0.0	0.0	0.0
	2008	2009	2010	2011	2012	2013	2014	2015	2016
NC4	4.0431	9.4902	2.1339	NO	NO	12.6348	16.4534	16.6780	
BUR2	4.0431	10.0517	2.1339	NO	NO	12.6348	16.4534	16.6780	14.4318
Difference, %	0.0	5.9	0.0	NO	NO	0.0	0.0	0.0	

Abbreviations: NC4 – Fourth National Communication of the RM under the UNFCCC (2018); BUR2 – Second Biennial Update Report of the RM under the UNFCCC (2019).

1A3 Transport

In comparison with the results included into the NC4 of the RM under the UNFCCC (2018), the performed recalculations within the current inventory cycle revealed, as presented above, a decreasing trend of direct GHG emissions from category 1A3 'Transport' in 1990-1991, 1993-1994, 1996-1998, 2000, 2002-2009, 2012 and 2014, respectively a relatively insignificant increase in 1992, 1995, 1999, 2001, 2010-2011, 2013 and 2015. For 2016, direct GHG emissions were estimated for the first time. Between 1990 and 2016, the respective emissions from category 1A3 'Transport' decreased in the RM by circa 46.8 per cent (Table 3-130).

Table 3-130: Recalculation results of GHG emissions from 1A3 'Transport' category included into the NC4 of the RM under the UNFCCC (2018), kt CO_2 equivalent

	1990	1991	1992	1993	1994	1995	1996	1997	1998
NC4	4 481.7645	4 567.6074	2 214.0887	1 777.1549	1 527.4509	1 522.9456	1 490.9287	1 509.9711	1 307.3000
BUR2	4 479.4542	3 405.6396	2 399.6485	1 762.9007	1 527.4063	1 539.2813	1 490.6804	1 509.7178	1 307.0517
Difference, %	-0.05	-25.44	8.38	-0.80	0.00	1.07	-0.02	-0.02	-0.02
	1999	2000	2001	2002	2003	2004	2005	2006	2007
NC4	875.2873	948.8464	1 013.8491	1 296.3979	1 512.7271	1 709.2744	1 767.9729	1 696.4435	1 804.1901
BUR2	876.1417	942.9727	1 019.9028	1 295.6232	1 512.4719	1 708.8588	1 767.1186	1 695.7978	1 803.7175
Difference, %	0.10	-0.62	0.60	-0.06	-0.02	-0.02	-0.05	-0.04	-0.03
	2008	2009	2010	2011	2012	2013	2014	2015	2016
NC4	1 896.0664	1 853.8302	2 053.6866	2 164.2599	1 905.5612	2 015.0035	2 090.2898	2 202.9754	
BUR2	1 895.5003	1 813.6345	2 054.1180	2 164.9327	1 901.8722	2 021.7651	2 090.0531	2 203.3296	2 382.9261
Difference, %	-0.03	-2.17	0.02	0.03	-0.19	0.34	-0.01	0.02	

Abbreviations: NC4 – Fourth National Communication of the RM under the UNFCCC (2018); BUR2 – Second Biennial Update Report of the RM under the UNFCCC (2019).

3.4.6. Planned Improvements

Potential improvements within the 1A3 'Transport' category could be possible once updating the available AD on real fuel consumption in the ATULBD for each source of emissions.

Regarding the 1A3a 'Civil Aviation' (1A3ii 'Domestic Aviation'), the opportunity to collect missing AD for 1994-2000 time series will be considered, and alternatively, if this is not possible, the gaps will be filled according to the methodologies available in the 2006 IPCC Guidelines.

Also, for 1A3a 'Civil Aviation' and 1A3c 'Railways', it would be possible to use higher-tier methods (Tier 2b, respectively Tier 2), but since these sources are not key categories, this activity is not cost-efficient and cost-effective for the national inventory team.

For 1A3b ‘Road Transportation’, potential improvements could be the result of collecting additional AD for 1990-2013 time series, required to use the COPERT 4.9 model. Due to their absence, for now it was possible to run the program only for 2014-2016 years.

3.5. Other Sectors (Category 1A4)

3.5.1. Source Category Description

The 1A4 ‘Other Sectors’ category includes the following sources: 1A4a ‘Commercial / Institutional’; 1A4b ‘Residential’; 1A4c ‘Agriculture/Forestry/Fishing’ (1A4ci ‘Stationary’ and 1A4cii ‘Mobile’ (off-road vehicles and other machinery)).

Between 1990 and 2016, GHG emissions from category 1A4 ‘Other Sectors’ tended to decrease by circa 76.4 per cent: from 7,689.71 kt CO_2 equivalent recorded in 1990, to circa 1,812.79 kt CO_2 equivalent in 2016 (Table 3-131).

Table 3-131: GHG emissions from 1A4 ‘Other Sectors’ category within 1990-2016 periods

	1990	1991	1992	1993	1994	1995	1996	1997	1998
1A4, kt CO_2 equivalent	7 689.7135	8 128.9575	6 164.6672	2 325.4332	2 160.4012	2 207.2356	2 349.6445	2 545.5057	2 105.6673
%, as compared to 1990	100.0	105.7	80.2	30.2	28.1	28.7	30.6	33.1	27.4
	1999	2000	2001	2002	2003	2004	2005	2006	2007
1A4, kt CO_2 equivalent	1 837.5824	1 523.7452	1 459.8599	1 781.9747	2 132.0162	2 296.9025	2 259.2406	2 251.7988	1 702.8467
%, as compared to 1990	23.9	19.8	19.0	23.2	27.7	29.9	29.4	29.3	22.1
	2008	2009	2010	2011	2012	2013	2014	2015	2016
1A4, kt CO_2 equivalent	1 714.4226	1 866.2043	2 030.0705	2 358.9684	2 328.2713	2 007.9234	2 051.8469	1 923.5784	1 812.7922
%, as compared to 1990	22.3	24.3	26.4	30.7	30.3	26.1	26.7	25.0	23.6

Compared to 1990, the level of GHG emissions from 1A4 ‘Other Sectors’ category represented by 2016, for CO_2 – 22.8 per cent of the base year level, CH_4 – 40.3 per cent, N_2O – 66.4 per cent, NO_x – 20.7 per cent, CO – 32.8 per cent, NMVOC – 44.9 per cent and SO_2 – 5.3 per cent (Table 3-132).

Table 3-132: Direct and indirect GHG emissions from 1A4 ‘Other Sectors’ category within 1990-2016 periods

	1A4, kt							in %, as 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	7 372.2624	11.5841	0.0935	21.4533	188.2435	20.5339	44.9266	100.0	100.0	100.0	100.0	100.0	100.0	100.0
1991	7 794.6662	12.2320	0.0956	20.5753	181.4709	19.5923	44.9417	105.7	105.6	102.3	95.9	96.4	95.4	100.0
1992	5 967.8768	7.1372	0.0616	14.3609	99.2287	10.8213	26.3830	81.0	61.6	65.9	66.9	52.7	52.7	58.7
1993	2 271.9102	1.8431	0.0250	9.2951	31.0782	3.8422	9.1547	30.8	15.9	26.7	43.3	16.5	18.7	20.4
1994	2 090.7472	2.4795	0.0257	8.5983	40.7319	4.8148	9.8738	28.4	21.4	27.5	40.1	21.6	23.4	22.0
1995	2 166.6313	1.3497	0.0230	9.1404	30.5063	3.2880	5.9766	29.4	11.7	24.6	42.6	16.2	16.0	13.3
1996	2 281.5067	2.3921	0.0280	7.8935	44.9136	4.8417	8.1114	30.9	20.7	29.9	36.8	23.9	23.6	18.1
1997	2 493.4333	1.7851	0.0250	7.8746	35.5006	3.8095	5.7662	33.8	15.4	26.7	36.7	18.9	18.6	12.8
1998	2 069.7199	1.1935	0.0205	6.1550	23.7795	2.6921	4.0184	28.1	10.3	21.9	28.7	12.6	13.1	8.9
1999	1 801.5918	1.2218	0.0183	4.6961	20.9461	2.5442	3.2790	24.4	10.5	19.6	21.9	11.1	12.4	7.3
2000	1 488.2025	1.2169	0.0172	3.8215	19.5985	2.4681	2.8261	20.2	10.5	18.4	17.8	10.4	12.0	6.3
2001	1 428.3712	1.0636	0.0164	3.7395	16.9934	2.2000	2.4655	19.4	9.2	17.6	17.4	9.0	10.7	5.5
2002	1 741.9621	1.3702	0.0193	4.4721	20.7406	2.8043	3.4683	23.6	11.8	20.7	20.8	11.0	13.7	7.7
2003	2 079.5633	1.8052	0.0246	4.7268	26.3790	3.5070	5.1110	28.2	15.6	26.3	22.0	14.0	17.1	11.4
2004	2 253.6075	1.4817	0.0210	4.6918	21.4752	2.9879	4.2007	30.6	12.8	22.4	21.9	11.4	14.6	9.4
2005	2 213.9626	1.5658	0.0206	4.3277	22.5157	3.0624	4.0412	30.0	13.5	22.0	20.2	12.0	14.9	9.0
2006	2 199.7343	1.8093	0.0229	4.2889	25.6932	3.4799	4.2136	29.8	15.6	24.5	20.0	13.6	16.9	9.4
2007	1 664.7540	1.3111	0.0178	3.3914	18.2795	2.5144	2.9324	22.6	11.3	19.1	15.8	9.7	12.2	6.5
2008	1 675.4850	1.3355	0.0186	3.3674	18.1831	2.5680	2.6248	22.7	11.5	19.9	15.7	9.7	12.5	5.8
2009	1 824.3586	1.4415	0.0195	3.4941	18.8063	2.6817	2.8745	24.7	12.4	20.9	16.3	10.0	13.1	6.4
2010	1 985.0640	1.5742	0.0190	3.7572	21.7528	2.9332	3.2007	26.9	13.6	20.3	17.5	11.6	14.3	7.1
2011	2 310.0323	1.7027	0.0214	4.1347	23.1600	3.2929	3.0189	31.3	14.7	22.9	19.3	12.3	16.0	6.7
2012	2 273.0863	1.9343	0.0229	4.0301	26.2302	3.6664	3.3897	30.8	16.7	24.5	18.8	13.9	17.9	7.5
2013	1 951.0935	1.9936	0.0235	3.7779	27.7566	3.7430	3.5798	26.5	17.2	25.1	17.6	14.7	18.2	8.0
2014	1 933.4972	4.0986	0.0533	4.4914	54.3206	7.9960	2.7674	26.2	35.4	57.0	20.9	28.9	38.9	6.2
2015	1 797.6960	4.3577	0.0568	4.5637	58.1907	8.5260	2.7814	24.4	37.6	60.8	21.3	30.9	41.5	6.2
2016	1 677.5744	4.6692	0.0620	4.4456	61.7768	9.2109	2.3703	22.8	40.3	66.4	20.7	32.8	44.9	5.3

Direct and indirect GHG emissions from 1A4 ‘Other Sectors’ category, separately for the RBDR and LBDR are presented below (Table 3-133).

Table 3-133: Direct and indirect GHG emissions from 1A4 'Other Sectors' category on the RBDR and the LBDR within 1990-2016 periods, kt

	RBDR, kt							LBDR, kt						
	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	7 372.2624	11.5841	0.0935	21.4533	188.2435	20.5339	44.9266	IE	IE	IE	IE	IE	IE	IE
1991	7 794.6662	12.2320	0.0956	20.5753	181.4709	19.5923	44.9417	IE	IE	IE	IE	IE	IE	IE
1992	5 967.8768	7.1372	0.0616	14.3609	99.2287	10.8213	26.3830	IE	IE	IE	IE	IE	IE	IE
1993	2 271.9102	1.8431	0.0250	9.2951	31.0782	3.8422	9.1547	NA	NA	NA	NA	NA	NA	NA
1994	2 090.7472	2.4795	0.0257	8.5983	40.7319	4.8148	9.8738	NA	NA	NA	NA	NA	NA	NA
1995	1 639.7398	1.2973	0.0214	7.7741	22.5486	2.9962	5.7557	526.8915	0.0524	0.0017	1.3663	7.9576	0.2917	0.2209
1996	1 882.5020	2.3525	0.0267	6.8275	39.8115	4.6396	7.9444	399.0047	0.0396	0.0013	1.0660	5.1021	0.2021	0.1670
1997	1 707.5287	1.7095	0.0228	6.2186	28.0389	3.5182	5.5379	785.9046	0.0756	0.0022	1.6561	7.4617	0.2913	0.2283
1998	1 376.8193	1.1276	0.0187	4.8021	18.7835	2.4839	3.8478	692.9006	0.0659	0.0018	1.3529	4.9959	0.2082	0.1706
1999	1 163.5742	1.1615	0.0167	3.4531	18.0826	2.3900	3.1350	638.0176	0.0603	0.0016	1.2430	2.8635	0.1542	0.1440
2000	1 010.2005	1.1720	0.0160	2.9123	17.8809	2.3624	2.7258	478.0021	0.0450	0.0012	0.9092	1.7176	0.1057	0.1003
2001	983.9677	1.0217	0.0153	2.8643	15.3406	2.0942	2.3670	444.4035	0.0420	0.0011	0.8752	1.6528	0.1057	0.0986
2002	1 219.2188	1.3218	0.0181	3.5761	19.4388	2.6675	3.3904	522.7433	0.0484	0.0012	0.8960	1.3018	0.1368	0.0779
2003	1 551.8024	1.7568	0.0235	3.9290	25.0808	3.3765	5.0533	527.7609	0.0484	0.0011	0.7977	1.2982	0.1305	0.0578
2004	1 488.7901	1.4124	0.0195	3.5968	20.4277	2.7608	4.1476	764.8175	0.0693	0.0015	1.0950	1.0475	0.2271	0.0531
2005	1 541.7115	1.5051	0.0193	3.4201	21.6667	2.8825	4.0026	672.2510	0.0607	0.0013	0.9077	0.8490	0.1800	0.0386
2006	1 592.8833	1.7545	0.0218	3.4901	24.9150	3.3269	4.1809	606.8510	0.0547	0.0012	0.7987	0.7782	0.1530	0.0326
2007	1 341.1456	1.2818	0.0172	2.9918	17.7927	2.4757	2.9105	323.6084	0.0293	0.0006	0.3996	0.4868	0.0387	0.0218
2008	1 343.3749	1.3053	0.0180	2.9640	17.7419	2.5271	2.6029	332.1102	0.0302	0.0007	0.4034	0.4412	0.0410	0.0219
2009	1 483.9715	1.3828	0.0184	3.0537	17.9166	2.5833	2.8458	340.3872	0.0586	0.0011	0.4405	0.8897	0.0984	0.0286
2010	1 555.6437	1.5056	0.0176	3.0947	20.5904	2.7958	3.1478	429.4203	0.0686	0.0013	0.6625	1.1624	0.1374	0.0529
2011	1 532.4102	1.6048	0.0194	2.9923	21.8852	3.0232	2.9557	777.6221	0.0978	0.0019	1.1424	1.2749	0.2697	0.0632
2012	1 504.4724	1.8498	0.0212	2.8759	25.0967	3.4232	3.3227	768.6139	0.0845	0.0018	1.1543	1.1335	0.2432	0.0670
2013	1 378.0156	1.9280	0.0220	2.8407	26.5539	3.5744	3.5057	573.0779	0.0655	0.0014	0.9371	1.2027	0.1686	0.0741
2014	1 350.1424	4.0241	0.0518	3.5473	53.1055	7.8101	2.6955	583.3548	0.0745	0.0015	0.9441	1.2151	0.1859	0.0719
2015	1 372.2190	4.2887	0.0555	3.8405	57.0063	8.3876	2.7150	425.4770	0.0690	0.0014	0.7232	1.1844	0.1384	0.0664
2016	1 380.1246	4.6239	0.0613	4.1574	61.3892	9.1508	2.3667	297.4499	0.0453	0.0008	0.2883	0.3876	0.0601	0.0037

Between 1990 and 2016, CO_2 emissions had the biggest share in the structure of total direct GHG emissions from 1A4 'Other Sectors' category, varying from 92.5 per cent to 98.3 per cent, followed by CH_4 emissions, with a share varying from 1.4 per cent to 6.4 per cent, respectively by N_2O emissions, with a share varying from 0.3 per cent to 1.0 per cent of the total (Table 3-134).

Table 3-134: Direct GHG emissions from 1A4 'Other Sectors' category in the RM within 1990-2016 periods

	1A4, kt CO_2 equivalent				the share, in % from the total		
	CO_2	CH_4	N_2O	Total	CO_2	CH_4	N_2O
1990	7 372.2624	289.6015	27.8496	7 689.7135	95.9	3.8	0.4
1991	7 794.6662	305.7997	28.4916	8 128.9575	95.9	3.8	0.4
1992	5 967.8768	178.4291	18.3613	6 164.6672	96.8	2.9	0.3
1993	2 271.9102	46.0765	7.4465	2 325.4332	97.7	2.0	0.3
1994	2 090.7472	61.9867	7.6673	2 160.4012	96.8	2.9	0.4
1995	2 166.6313	33.7413	6.8630	2 207.2356	98.2	1.5	0.3
1996	2 281.5067	59.8034	8.3344	2 349.6445	97.1	2.5	0.4
1997	2 493.4333	44.6285	7.4438	2 545.5057	98.0	1.8	0.3
1998	2 069.7199	29.8364	6.1110	2 105.6673	98.3	1.4	0.3
1999	1 801.5918	30.5458	5.4448	1 837.5824	98.0	1.7	0.3
2000	1 488.2025	30.4236	5.1191	1 523.7452	97.7	2.0	0.3
2001	1 428.3712	26.5909	4.8978	1 459.8599	97.8	1.8	0.3
2002	1 741.9621	34.2549	5.7577	1 781.9747	97.8	1.9	0.3
2003	2 079.5633	45.1299	7.3230	2 132.0162	97.5	2.1	0.3
2004	2 253.6075	37.0431	6.2518	2 296.9025	98.1	1.6	0.3
2005	2 213.9626	39.1457	6.1323	2 259.2406	98.0	1.7	0.3
2006	2 199.7343	45.2321	6.8324	2 251.7988	97.7	2.0	0.3
2007	1 664.7540	32.7780	5.3147	1 702.8467	97.8	1.9	0.3
2008	1 675.4850	33.3867	5.5509	1 714.4226	97.7	1.9	0.3
2009	1 824.3586	36.0363	5.8093	1 866.2043	97.8	1.9	0.3
2010	1 985.0640	39.3549	5.6517	2 030.0705	97.8	1.9	0.3
2011	2 310.0323	42.5665	6.3696	2 358.9684	97.9	1.8	0.3
2012	2 273.0863	48.3566	6.8284	2 328.2713	97.6	2.1	0.3
2013	1 951.0935	49.8388	6.9912	2 007.9234	97.2	2.5	0.3
2014	1 933.4972	102.4640	15.8856	2 051.8469	94.2	5.0	0.8
2015	1 797.6960	108.9414	16.9411	1 923.5784	93.5	5.7	0.9
2016	1 677.5744	116.7297	18.4881	1 812.7922	92.5	6.4	1.0

The breakdown of GHG emissions by sources within 1A4 'Other Sectors' category are presented below (Table 3-135, Figure 3-19a).

Table 3-135: Breakdown of direct GHG emissions by sources within 1A4 'Other Sectors' category within 1990-2016 periods, kt CO_2 equivalent

	1990	1991	1992	1993	1994	1995	1996	1997	1998
1A4a Commercial/Institutional	1 426.1119	1 106.7712	807.2314	594.6681	390.5659	399.0975	366.3592	310.2782	308.6055
1A4b Residential	4 701.8620	5 134.1590	3 984.8940	1 021.9061	1 123.4333	1 095.1565	1 405.3833	1 657.1319	1 360.7831
1A4 ci Agriculture/Forestry/Fishing	1 561.7397	1 888.0273	1 372.5418	708.8590	646.4020	712.9816	577.9021	578.0956	436.2788
1A4ci Stationary	165.9475	864.1164	706.0998	79.2523	34.0909	19.7505	28.2563	32.9675	39.3842
1A4cii Mobile (off-road vehicles)	1 395.7922	1 023.9109	666.4420	629.6067	612.3111	693.2311	549.6458	545.1281	396.8946
1A4 Other Sectors	7 689.7135	8 128.9575	6 164.6672	2 325.4332	2 160.4012	2 207.2356	2 349.6445	2 545.5057	2 105.6673
	1999	2000	2001	2002	2003	2004	2005	2006	2007
1A4a Commercial/Institutional	230.4551	206.9817	238.7345	428.2190	586.3508	825.3132	704.6918	647.6968	365.8772
1A4b Residential	1 307.6295	1 079.0518	988.8914	1 096.9942	1 306.3634	1 253.2412	1 368.2104	1 423.7780	1 183.5513
1A4 ci Agriculture/Forestry/Fishing	299.4977	237.7117	232.2339	256.7615	239.3020	218.3480	186.3383	180.3240	153.4182
1A4ci Stationary	18.6207	20.8566	22.1123	10.9790	12.3798	17.2352	8.0747	4.7663	1.9669
1A4cii Mobile (off-road vehicles)	280.8770	216.8551	210.1217	245.7825	226.9222	201.1128	178.2636	175.5576	151.4513
1A4 Other Sectors	1 837.5824	1 523.7452	1 459.8599	1 781.9747	2 132.0162	2 296.9025	2 259.2406	2 251.7988	1 702.8467
	2008	2009	2010	2011	2012	2013	2014	2015	2016
1A4a Commercial/Institutional	374.9380	483.5346	481.3254	810.6321	783.4868	476.4114	490.9551	345.6078	342.9948
1A4b Residential	1 188.7127	1 242.5050	1 391.8307	1 395.0859	1 394.7470	1 364.7336	1 361.0211	1 357.4512	1 257.3254
1A4 ci Agriculture/Forestry/Fishing	150.7719	140.1646	156.9144	153.2504	150.0375	166.7785	199.8706	220.5194	212.4720
1A4ci Stationary	6.3249	4.8237	6.1061	6.0077	8.7823	11.0017	6.2721	8.4752	8.4749
1A4cii Mobile (off-road vehicles)	144.4469	135.3409	150.8083	147.2428	141.2553	155.7768	193.5986	212.0442	203.9971
1A4 Other Sectors	1 714.4226	1 866.2043	2 030.0705	2 358.9684	2 328.2713	2 007.9234	2 051.8469	1 923.5784	1 812.7922

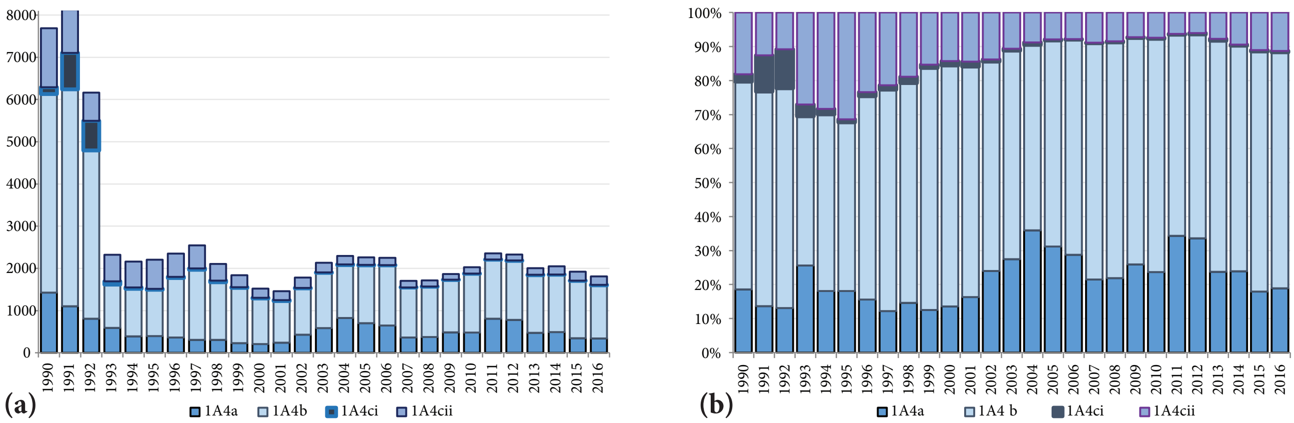


Figure 3-19: Breakdown of direct GHG emissions by sources within 1A4 'Other Sectors' category within 1990-2016 periods, in kt CO_2 equivalent (a); and their share in the structure of total direct GHG emissions within the respective category, in % from the total (b).

The emission source with the largest share in the structure of total direct GHG emissions from 1A4 'Other Sectors' category is represented by 1A4b 'Residential', with a share varying during the reference period between 43.9 per cent (1993) and 71.2 per cent (1999), followed by 1A4a 'Commercial/Institutional', with a share varying from 12.2 per cent (1997) and 35.9 per cent (2004), respectively by 1A4c 'Agriculture/Forestry/Fishing', with a share varying from 6.4 per cent (2012) and 32.3 per cent (1995) (Table 3-136, Figure 3-19b).

Table 3-136: The share of different sources in the structure of total direct GHG emissions from 1A4 'Other Sectors' category, % from the total

	1990	1991	1992	1993	1994	1995	1996	1997	1998
1A4a Commercial/Institutional	18.5	13.6	13.1	25.6	18.1	18.1	15.6	12.2	14.7
1A4b Residential	61.1	63.2	64.6	43.9	52.0	49.6	59.8	65.1	64.6
1A4 ci Agriculture/Forestry/Fishing	20.3	23.2	22.3	30.5	29.9	32.3	24.6	22.7	20.7
1A4ci Stationary	2.2	10.6	11.5	3.4	1.6	0.9	1.2	1.3	1.9
1A4cii Mobile (off-road vehicles)	18.2	12.6	10.8	27.1	28.3	31.4	23.4	21.4	18.8
	1999	2000	2001	2002	2003	2004	2005	2006	2007
1A4a Commercial/Institutional	12.5	13.6	16.4	24.0	27.5	35.9	31.2	28.8	21.5
1A4b Residential	71.2	70.8	67.7	61.6	61.3	54.6	60.6	63.2	69.5
1A4 ci Agriculture/Forestry/Fishing	16.3	15.6	15.9	14.4	11.2	9.5	8.2	8.0	9.0
1A4ci Stationary	1.0	1.4	1.5	0.6	0.6	0.8	0.4	0.2	0.1
1A4cii Mobile (off-road vehicles)	15.3	14.2	14.4	13.8	10.6	8.8	7.9	7.8	8.9
	2008	2009	2010	2011	2012	2013	2014	2015	2016
1A4a Commercial/Institutional	21.9	25.9	23.7	34.4	33.7	23.7	23.9	18.0	18.9
1A4b Residential	69.3	66.6	68.6	59.1	59.9	68.0	66.3	70.6	69.4
1A4 ci Agriculture/Forestry/Fishing	8.8	7.5	7.7	6.5	6.4	8.3	9.7	11.5	11.7
1A4ci Stationary	0.4	0.3	0.3	0.3	0.4	0.5	0.3	0.4	0.5
1A4cii Mobile (off-road vehicles)	8.4	7.3	7.4	6.2	6.1	7.8	9.4	11.0	11.3

3.5.2. Methodological Issues, Emission Factors and Activity Data

Direct GHG emissions originated from the 1A4 category 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 (2016, 2017) (Tables 3-137, 3-138, 3-139 and 3-140).

Table 3-137: Emission factors used to estimate GHG emissions from 1A4a 'Commercial / Institutional', kg/TJ

Fuel Type	CO_2	CH_4	N_2O	NO_x	CO	NMVOC
Gasoline	69300	10	0.6	306	93	20
Diesel Oil	74100	10	0.6	306	93	20
Residual Fuel Oil	77400	10	0.6	306	93	20
Kerosene	71900	10	0.6	306	93	20
LPG	63100	5	0.1	74	29	23
Other Petroleum Products	73300	10	0.6	306	93	20
Anthracite	98300	10	1.5	173	931	88.8
Bituminous Coal	94600	10	1.5	173	931	88.8
Lignite	101000	10	1.5	173	931	88.8
Brown coal - briquettes	97500	10	1.5	173	931	88.8
Coke	107000	10	1.5	173	931	88.8
Natural Gas	56100	5	0.1	74	29	23
Fuel Wood and Wood Waste	112000	300	4	91	570	300
Other Solid Biomass	100000	300	4	91	570	300
Charcoal	112000	200	1	91	570	300

Source: for CO_2, CH_4, N_2O – 2006 IPCC Guidelines, Volume 2, Chapter 2, Tables 2.4, 2.20-2.21, for NO_x, CO and NMVOC – EMEP/EEA Guidebook (July 2017), Tables 3.7-3.10, pages 40-43.

Table 3-138: Emission factors used to estimate GHG emissions from 1A4b 'Residential', kg/TJ

Fuel Type	CO_2	CH_4	N_2O	NO_x	CO	NMVOC
Residual Fuel Oil	77400	10	0.6	51	57	0.69
Kerosene	71900	10	0.6	51	57	0.69
LPG	63100	5	0.1	51	26	1.9
Other Petroleum Products	73300	10	0.6	51	57	0.69
Anthracite	98300	300	1.5	110	4600	484
Bituminous coal	94600	300	1.5	110	4600	484
Lignite	101000	300	1.5	110	4600	484
Coke	107000	300	1.5	110	4600	484
Peat	106000	300	1.4	110	4600	484
Natural Gas	56100	5	0.1	51	26	1.9
Fuel Wood and Wood Waste	112000	300	4	50	4000	600
Other Solid Biomass	100000	300	4	50	4000	600
Charcoal	112000	200	1	50	4000	600

Source: for CO_2, CH_4, N_2O – 2006 IPCC Guidelines, Volume 2, Chapter 2, Tables 2.5, .22-2.23; for NO_x, CO and NMVOC – EMEP/EEA Guidebook (July 2017), Tables 3.7-3.10, pages 40-43.

Table 3-139: Emission factors used to estimate GHG emissions from 1A4ci 'Agriculture / Forestry / Fishing' (Stationary), kg/TJ

Fuel Type	CO_2	CH_4	N_2O	NO_x	CO	NMVOC
Diesel oil	74100	10	0.6	306	93	20
Residual Fuel Oil	77400	10	0.6	306	93	20
Kerosene	71900	10	0.6	306	93	20
Other Petroleum Products	73300	10	0.6	306	93	20
Anthracite	98300	300	1.5	173	931	88.8
Bituminous coal	94600	300	1.5	173	931	88.8
Lignite	101000	300	1.5	173	931	88.8
Natural Gas	56100	5	0.1	74	29	23
Fuel Wood and Wood Waste	112000	300	4	91	570	300
Other Solid Biomass	100000	300	4	91	570	300

Source: for CO_2, CH_4, N_2O – 2006 IPCC Guidelines, Volume 2, Chapter 2, Tables 2.5, 2.22-2.23; for NO_x, CO and NMVOC – EMEP/EEA Guidebook (July 2017), Tables 3.3-3.6, pages 36-39.

Table 3-140: Emission factors used to estimate GHG emissions from 1A4cii 'Agriculture / Forestry / Fishing" (Mobile – Off-road Vehicles and Other Machinery)

Fuel Type	CO_2, kg/TJ	CH_4, kg/TJ	N_2O, kg/TJ	NO_x, kg/kt	CO, kg/kt	NMVOC, kg/kt
Gasoline	69300	10	0.6	7117	770368	18893
Diesel Oil	74100	10	0.6	34457	11469	3542
LPG	63100	5	0.1	28571	4823	6720

Source: for CO_2 – 2006 IPCC Guidelines, Volume 2, Chapter 3, Table 3.3.1; for CH_4, N_2O – 2006 IPCC Guidelines, Volume 2, Chapter 2, Tables 2.5, 2.22-2.23; NO_x, CO and NMVOC – EMEP/EEA Guidebook (November 2016, July 2017), Table 3-1, page 23.

AD on fuel consumption are available in the EB of the RM and the statistical publications "Socio-economic development of the ATULBD". A part of the information used was provided by the J.S.C. "Moldovagaz". To be noted that contrary to the previous inventories, when AD collected from the Energy

Balances were expressed in natural units (kt or million m^3), in the current inventory cycle these data were taken directly in energy units (TJ). In the Energy Balances of the RM, the AD on fuel consumption from 1A4a 'Commercial/Institutional' are available in categories: „For commerce" and „For communal services"; from 1A4b 'Residential' – in the category „Sold to population", respectively from 1A4c 'Agriculture/Forestry/Fishing' – in the category „For agriculture". The AD associated with fuel consumption from the '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 partially available only in natural units (kt or million m^3), being recalculated in energy units (TJ) by using country specific caloric factors. The AD available for each source category considered under 1A4 'Other Sectors' are examined below.

1A4a 'Commercial/Institutional'

The activity data for commercial and institutional sectors on the LBDR are available regarding natural gas consumption between 1999 and 2016, respectively for LPG consumption between 2011 and 2016 (Table 3-141).

Table 3-141: Fuel consumption under the 1A4a 'Commercial/Institutional' on the LBDR within 1999-2016 periods, TJ

	1999	2000	2001	2002	2003	2004
Natural Gas	227	311	454	2737	2929	7687
	2005	2006	2007	2008	2009	2010
Natural Gas	6101	5109	485	666	544	1274
	2011	2012	2013	2014	2015	2016
LPG	0.12	0.09	0.06	0.05	0.06	0.2
Natural Gas	7077	6865	3403	3597	932	610

As for the RBDR, the AD pertaining to fuel consumption within 1A4a 'Commercial/Institutional' (Table 3-142) are available in the Energy Balances of the RM.

Table 3-142: Fuel consumption under the 1A4a 'Commercial/Institutional' on the RBDR within 1990-2016 periods, TJ

	1990	1991	1992	1993	1994	1995	1996	1997	1998
Gasoline	NO	NO	NO	3	NO	NO	NO	NO	NO
Diesel Oil	468	360	252	144	88	117	88	59	59
Kerosene	NO	203	457	47	NO	NO	NO	NO	NO
Residual Fuel Oil	844	732	620	508	235	235	205	59	29
Fuel for Oven	733	NO	NO	50	29	NO	NO	NO	29
Fuel for Engines	43	NO	NO	12	NO	NO	NO	NO	NO
LPG	276	199	121	44	NO	59	59	29	NO
Anthracite	11616	8260	4903	1546	675	440	440	352	323
Bituminous Coal	NO	799	804	2363	2200	2553	2171	1966	2200
Lignite	12	193	375	557	411	352	352	205	176
Coal-briquettes	36	NO	NO	NO	NO	NO	NO	NO	NO
Coke	NO	NO	NO	3	NO	NO	NO	NO	NO
Natural Gas	1422	1422	1737	1138	616	557	734	734	616
Fuel Wood	333	258	184	109	117	117	147	117	117
Wood Waste	NO	NO	NO	6	NO	NO	29	NO	NO
	1999	2000	2001	2002	2003	2004	2005	2006	2007
Gasoline	NO	NO	NO	NO	NO	2	1	3	36
Diesel Oil	88	59	29	29	59	50	46	29	29
Kerosene	NO	NO	NO	NO	NO	2	NO	NO	NO
Residual Fuel Oil	29	29	59	30	58	47	19	7	6
Fuel for Oven	29	147	205	58	29	70	11	15	19
LPG	NO	NO	29	NO	29	32	72	32	41
Anthracite	323	645	264	675	1846	1788	1358	1136	1016
Bituminous Coal	1437	734	1203	1174	1115	745	732	859	570
Lignite	88	59	59	29	29	1	NO	NO	NO
Coke	NO	NO	NO	NO	NO	NO	NO	NO	1
Natural Gas	499	557	734	1467	1993	2257	2572	2799	3056
Fuel Wood	88	88	117	147	381	242	210	254	247
Wood Waste	NO	NO	NO	NO	146	78	31	26	18
Agriculture Residues	NO	NO	NO	NO	NO	14	5	2	14
Other types of fuel	NO	NO	29	NO	NO	NO	NO	NO	3

	2008	2009	2010	2011	2012	2013	2014	2015	2016
Gasoline	34	6	3	6	NO	NO	NO	NO	5
Diesel Oil	26	35	130	121	15	NO	NO	153	59
Residual Fuel Oil	96	177	30	10	1	6	NO	5	1
Fuel for Oven	19	17	59	15	5	1	4	1	NO
LPG	42	382	291	82	125	135	193	70	56
Other Petroleum Products	2	28	7	NO	NO	1	NO	3	3
Anthracite	801	1191	828	867	898	1032	587	672	655
Bituminous Coal	673	315	243	217	100	67	197	77	106
Coal-briquettes	NO	NO	NO	NO	1	NO	NO	NO	NO
Natural Gas	3105	4535	4722	5094	5061	2925	3462	3545	3949
Fuel Wood	268	240	209	219	244	185	232	220	237
Wood Waste	15	36	36	17	18	35	26	14	13
Agriculture Residues	28	NO	41	31	88	68	118	50	58
Other types of fuel	2	NO	NO	NO	NO	NO	NO	NO	NO
Charcoal	NO	NO	NO	NO	NO	3	21	16	13
Briquettes and Wood Pellets	NO	NO	NO	NO	NO	NO	94	83	NO

Below is presented the fuel consumption by type under the 1A4a 'Commercial/Institutional' between 1990 and 2016. As one can note from Table 3-143 and Figure 3-20, during this period, the fuel consumption decreased significantly for liquid fuels (by 94.6 per cent) as well as for solid fuels (by 93.5 per cent), respectively increased significantly for gaseous fuels (by 220.6 per cent).

Table 3-143: Fuel consumption by type under the 1A4a 'Commercial/Institutional' in the Republic of Moldova within 1990-2016 periods, TJ

	1990	1991	1992	1993	1994	1995	1996	1997	1998
Liquid fuels	2364	1494	1451	1108	440	470	381	176	176
Solid fuels	11790	9252	6082	4572	3315	3433	3051	2641	2699
Gaseous fuels	1422	1422	1737	1138	616	557	734	734	616
Biofuels	333	258	184	115	117	117	176	117	117
	1999	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**
Liquid fuels	146	235	322	117	175	203	149	86	131
Solid fuels	1848	1438	1526	1878	2990	2534	2091	1995	1588
Gaseous fuels	726	868	1188	4204	4922	9944	8673	7908	3541
Biofuels	88	88	146	147	527	334	246	282	282
	2008	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**
Liquid fuels	223	651	528	241	156	145	200	233	127
Solid fuels	1478	1508	1073	1085	1007	1100	784	749	761
Gaseous fuels	3771	5079	5996	12171	11926	6328	7059	4477	4559
Biofuels	313	576	286	267	350	291	491	383	321

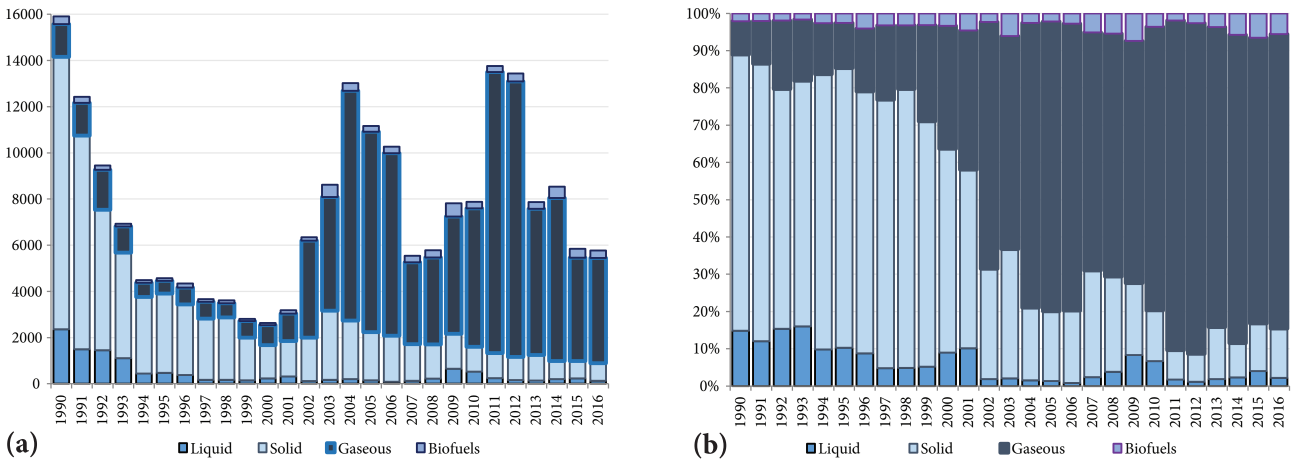


Figure 3-20: Fuel consumption under 1A4a 'Commercial/Institutional' in the Republic of Moldova within 1990-2016 periods, where: (a) Fuel consumption by type of fuel, TJ; and (b) Fuel consumption by type of fuel, in % of the total.

1A4b 'Residential'

The activity data for the 1A4b 'Residential' on the LBDR are available regarding natural gas and LPG consumption between 1995 and 2016, respectively for fuel wood consumption between 2009 and 2016 (Table 3-144).

Table 3-144: Fuel consumption under the 1A4b 'Residential' on the LBDR within 1995-2016 periods, TJ

	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
LPG	115	106	64	60	37	18	14	18	23	23	23
Natural Gas	7235	5458	11852	10729	9792	7277	6554	5868	5919	5465	5537
	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
LPG	23	21	23	18	27	28	22	18	16	13	11
Natural Gas	5422	5074	5049	5272	5889	6241	6248	6152	6163	6054	4674
Fuel Wood	NA	NA	NA	NA	NA	90	48	42	69	98	62

Sources: for fire wood – «Socio-economic development of the TMR», Chapter «Material and energy resources»; for LPG – Statistical Yearbooks of the ATULBD; for natural gas – J.S.C. "Moldovagaz" through Official Letters No. 07-730 dated 06.06.2007; No. 02/1-476 dated 23.02.2011; No. 02/1-288 dated 22.01.2014; No. 02/1-507 dated 10.02.2015; No. 02/1-2183 dated 03.06.2016, and No. 03/2-74 dated 12.01.2018. Note: AD were converted from natural units to energy units by using country specific NCVs.

For the RBDR, the AD on fuel consumption under the 1A4b 'Residential' (Table 3-145) for the period under review are available in the Energy Balances of the RM. Due to the lack of information regarding 1991 and 1992, the AD on the consumption of LPG, anthracite, lignite and fuel wood were estimated indirectly based on the trends recorded within 1990-1993 period.

Table 3-145: Fuel consumption under the 1A4b 'Residential' on the RBDR within 1990-2016 periods, TJ

	1990	1991	1992	1993	1994	1995	1996	1997	1998
Residual Fuel Oil	NO	1065	7714	NO	29	NO	NO	NO	NO
Kerosene	431	NO	NO	26	NO	NO	NO	NO	NO
Diesel Oil	1191	8593	553	15	NO	NO	29	NO	29
LPG	5758	4277	2797	1317	557	528	704	910	910
Anthracite	32485	22481	12477	2473	3491	1350	1584	1936	440
Bituminous Coal	25	9792	3961	1468	2847	440	3199	734	558
Lignite	1916	1348	781	214	29	29	29	29	NO
Coke	NO	NO	NO	6	NO	NO	29	NO	NO
Natural Gas	8702	10530	23854	8717	7306	7834	9301	11120	10152
Fuel Wood	1052	957	861	766	822	1526	1848	1907	1966
Other Solid Biomass	234	NO	NO	NO	NO	NO	NO	NO	NO
	1999	2000	2001	2002	2003	2004	2005	2006	2007
Residual Fuel Oil	NO	NO	NO	NO	NO	NO	2	NO	NO
Kerosene	NO	NO	NO	NO	NO	NO	1	NO	NO
Diesel Oil	29	59	29	NO	NO	NO	NO	NO	NO
LPG	1144	1320	1232	1936	1934	2098	2079	1977	2070
Other Petroleum Products	NO	NO	NO	NO	NO	NO	9	1	3
Anthracite	939	1115	763	1526	2286	1749	2012	2345	1334
Bituminous Coal	323	147	21	NO	59	57	92	45	73
Natural Gas	9389	7599	7775	8186	10288	10693	12096	12708	10620
Fuel Wood	1848	1731	1555	1878	1964	1673	1704	2123	1716
Other Solid Biomass	NO	29	NO	NO	117	130	214	245	197
	2008	2009	2010	2011	2012	2013	2014	2015	2016
Diesel Oil	NO	2	NO	11	NO	NO	NO	NO	NO
LPG	1982	1913	1849	2486	2591	2659	2664	2722	2912
Other Petroleum Products	1	1	NO	2	NO	NO	NO	NO	NO
Anthracite	1127	1409	2161	1885	2446	2538	1758	1584	1273
Bituminous Coal	42	17	7	70	17	10	9	149	8
Peat	NO	NO	NO	NO	NO	NO	NO	8	NO
Natural Gas	11240	11599	12308	11597	10498	9788	10012	9893	9899
Fuel Wood	1942	1767	1808	2134	2543	2880	10425	11439	13131
Other Solid Biomass	212	NO	66	419	96	134	181	244	115
Charcoal	NO	NO	NO	NO	17	11	NO	2	4

Source: Energy Balances of the RM for 1990 and 1993-2016.

Below is presented the fuel consumption by type under the 1A4b 'Residential' between 1990 and 2016. As one can note from Table 3-146 and Figure 3-21, during the period under review, the fuel consumption decreased significantly for solid fuels (by 96.3 per cent), as well as for liquid fuels (by 60.4 per cent), respectively increased significantly for gaseous fuels (by 67.5 per cent) and biofuels (by 941.5 per cent).

Table 3-146: Fuel consumption by type under the 1A4b 'Residential' in the Republic of Moldova within 1990-2016 periods, TJ

	1990	1991	1992	1993	1994	1995	1996	1997	1998
Liquid fuels	7380	13936	11065	1358	586	643	839	974	999
Solid fuels	34941	33621	17219	4161	6367	1819	4841	2699	998
Gaseous fuels	8702	10530	23854	8717	7306	15069	14759	22972	20881
Biofuels	1287	957	861	913	1027	1731	2171	2200	2142

	1999	2000	2001	2002	2003	2004	2005	2006	2007
Liquid fuels	1210	1397	1275	1954	1957	2121	2114	2001	2094
Solid fuels	1262	1262	784	1526	2345	1806	2104	2390	1407
Gaseous fuels	19181	14876	14329	14054	16207	16158	17633	18130	15694
Biofuels	2171	2259	2142	2377	2521	2123	2212	2708	2184
	2008	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**
Liquid fuels	2006	1934	1876	2527	2613	2677	2680	2735	2923
Solid fuels	1169	1426	2168	1955	2463	2548	1767	1741	1282
Gaseous fuels	16289	16871	18197	17838	16746	15940	16175	15947	14573
Biofuels	2466	2254	2208	2780	2977	3231	10799	11835	13401

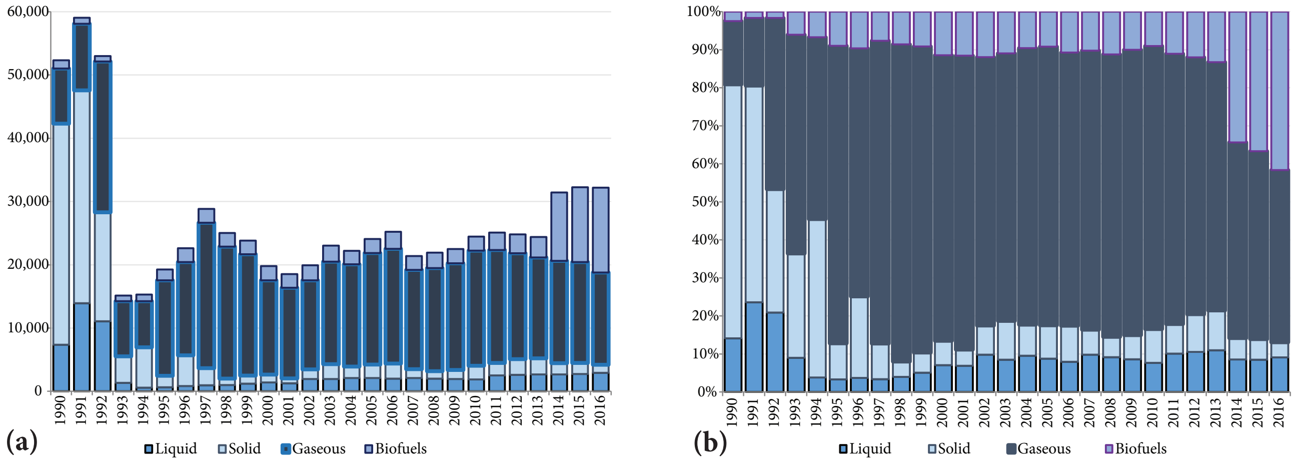


Figure 3-21: Fuel Consumption under the 1A4b 'Residential' in the Republic of Moldova within 1990-2016 periods, where: (a) Fuel consumption by type of fuel, TJ; and (b) Fuel consumption by type of fuel, in % of the total.

1A4c 'Agriculture/Forestry/Fishing'

Fuel consumption from 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 related to fuel consumption in agriculture, forestry and fishing sectors on the LBDR are available partially, only for residual fuel oil, natural gas and bituminous coal consumption within 2003-2016 period (Table 3-147).

Table 3-147: Fuel consumption under the 1A4c 'Agriculture/Forestry/Fishing' ('Stationary') on the LBDR within 2003-2016 periods, TJ

	2003	2004	2005	2006	2008	2009	2010	2011	2012	2013	2014	2015	2016
Residual Fuel Oil	NA	NA	NA	NA	0.1	0.1	0.1	0.1	0.1	0.1	NA	NA	NA
Natural Gas	30.5	23.7	13.5	3.4	3.4	NA	3.4	3.4	6.8	NA	NA	NA	NA
Bituminous Coal	NA	NA	NA	NA	0.4	0.3	0.2	0.8	0.6	0.6	0.6	0.6	0.95

Sources: for residual fuel oil and bituminous coal - «Socio-economic development of the TMR», Chapter «Material and energy resources»; for natural gas – J.S.C. „Moldovagaz" through Official Letters No. 07-730 dated 06.06.2007; No. 02/1-476 dated 23.02.2011; No. 02/1-288 dated 22.01.2014; No. 02/1-507 dated 10.02.2015; and No. 02/1-2183 dated 03.06.2016, No. 03/2-74 dated 12.01.2018, answer to Letter No. 601/2017-12-03 dated 14.12.2017.

For the RBDR, the AD on fuel consumption under the 1A4ci 'Agriculture/Forestry/Fishing' ('Stationary') (Table 3-148) for the period under review are available in the EBs of the RM.

Table 3-148: Fuel consumption under the 1A4c 'Agriculture/Forestry/Fishing' ('Stationary') on the RBDR within 1990-2016 periods, TJ

	1990	1991	1992	1993	1994	1995	1996	1997	1998
Diesel Oil	1078	1206	720	235	59	NO	117	88	264
Residual Fuel Oil	241	1005	683	200	88	NO	NO	29	NO
Kerosene	43	3429	2428	246	29	29	NO	NO	NO
Other Petroleum Products	NO	NO	NO	NO	NO	NO	NO	NO	NO
Anthracite	561	405	250	94	59	29	29	29	NO
Bituminous Coal	NO	3910	3834	120	88	59	59	NO	29
Lignite	NO	NO	NO	18	NO	NO	NO	NO	NO
Natural Gas	68	67	67	67	88	147	176	352	293
Fuel Wood and Wood Waste	36	27	18	12	29	29	29	29	NO
Other Solid Biomass	NO	NO	NO	29	29	NO	29	117	29

	1999	2000	2001	2002	2003	2004	2005	2006	2007
Diesel Oil	117	NO	NO	NO	NO	NO	NO	NO	NO
Residual Fuel Oil	NO	NO	NO	NO	NO	1	3	2	NO
Kerosene	NO	147	205	59	29	20	9	2	NO
Other Petroleum Products	NO	NO	NO	NO	NO	NO	2	NO	NO
Anthracite	NO	NO	NO	NO	NO	7	4	3	NO
Bituminous Coal	NO	NO	NO	NO	NO	3	2	2	2
Lignite	NO	NO	NO	NO	NO	NO	NO	NO	NO
Natural Gas	176	176	117	117	177	259	111	65	29
Fuel Wood and Wood Waste	NO	NO	29	NO	29	8	15	18	13
Other Solid Biomass	NO	NO	NO	NO	NO	2	7	12	2
	2008	2009	2010	2011	2012	2013	2014	2015	2016
Diesel Oil	NO	1	NO	2	NO	NO	NO	NO	NO
Residual Fuel Oil	2	1	NO	1	NO	3	NO	NO	NO
Kerosene	NO	NO	NO	NO	NO	NO	NO	NO	NO
Other Petroleum Products	NO	1	NO	NO	NO	NO	NO	1	2
Anthracite	1	2	2	5	NO	11	12	29	28
Bituminous Coal	1	NO	NO	NO	6	9	6	NO	NO
Lignite	NO	NO	NO	NO	NO	NO	NO	NO	NO
Natural Gas	100	74	96	86	132	148	70	89	86
Fuel Wood and Wood Waste	10	19	25	15	31	29	39	27	42

Sources: Energy Balances of the RM for 1990 and 1993-2016.

Below is presented the fuel consumption by type from 1A4ci 'Agriculture/Forestry/Fishing' ('Stationary') between 1990 and 2016. As one can note from Table 3-149 and Figure 3-22, during the period under review, fuel consumption decreased significantly for liquid fuels (by 99.9 per cent) as well as for solid fuels (by 94.8 per cent), respectively increased significantly for gaseous fuels (by 27.0 per cent) and biofuels (by 33.4 per cent).

Table 3-149: Fuel consumption by type under the 1A4ci 'Agriculture/Forestry/Fishing' ('Stationary') in the Republic of Moldova within 1990-2016 periods, TJ

	1990	1991	1992	1993	1994	1995	1996	1997	1998
Liquid fuels	1363	5639	3832	681	176	29	117	117	264
Solid fuels	561	4315	4083	232	147	88	88	29	29
Gaseous fuels	68	67	67	67	88	147	176	352	293
Biofuels	36	27	18	41	58	29	58	146	29
	1999	2000	2001	2002	2003	2004	2005	2006	2007
Liquid fuels	117	147	205	59	29	21	14	4	NO
Solid fuels	NO	NO	NO	NO	NO	10	6	5	2
Gaseous fuels	176	176	117	117	177	258	110	65	29
Biofuels	NO	NO	29	NO	29	10	22	30	15
	2008	2009	2010	2011	2012	2013	2014	2015	2016
Liquid fuels	2	3	NO	3	NO	3	NO	1	2
Solid fuels	2	2	2	6	7	21	19	30	29
Gaseous fuels	103	74	99	89	139	148	70	89	86
Biofuels	11	21	31	15	33	32	44	29	48

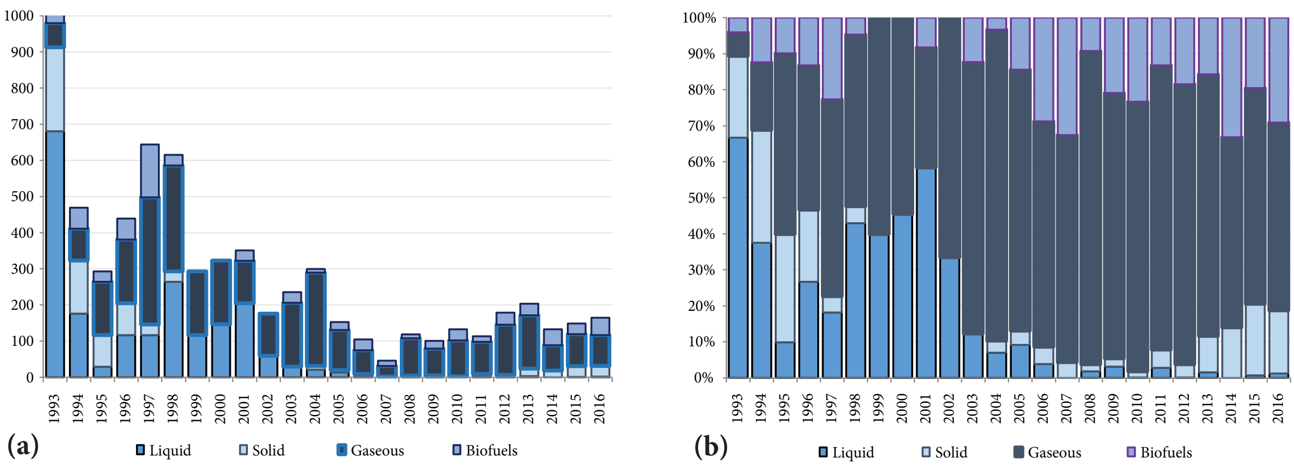


Figure 3-22: Fuel consumption under the 1A4ci 'Agriculture/Forestry/Fishing' ('Stationary') in the Republic of Moldova within 1990-2016 periods, where: (a) Fuel consumption by type of fuel, TJ; and (b) Fuel consumption by type of fuel, in % of the total.

1A4cii 'Mobile' ('Off-Road Vehicles and Other Machinery')

The activity data related to fuel consumption in 1A4ci 'Agriculture/Forestry/Fishing' ('Mobile' – 'Off-road Vehicles and Other Machinery') on the LBDR are available for diesel oil and gasoline consumption within 1995-2016 period (Table 3-150).

Table 3-150: Fuel consumption under the 1A4cii 'Agriculture/Forestry/Fishing' ('Mobile' – 'Off-road Vehicles and Other Machinery') on the LBDR within 1995-2016 periods, 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
Diesel Oil	4.0	2.9	2.7	3.5	7.4	8.4	9.2	10.5	10.2	9.7	2.7
Gasoline	0.6	0.4	0.3	0.4	0.6	0.6	0.6	0.8	0.7	0.6	0.3

Sources: Press Release "The State of Housing and Communal Services of the Republic for 2011-2016".

For the RBDR, the AD on fuel consumption under the 1A4cii 'Agriculture/Forestry/Fishing' ('Mobile' – 'Off-road Vehicles and Other Machinery') (Table 3-151) for the period under review are available in the Energy Balances of the RM.

Table 3-151: Fuel consumption under the 1A4cii 'Agriculture/Forestry/Fishing' ('Mobile' – 'Off-road Vehicles and Other Machinery') on the RBDR within 1990-2016 periods, kt

	1990	1991	1992	1993	1994	1995	1996	1997	1998
Diesel Oil	385.7	316.8	206.6	197.0	190.8	180.9	141.3	131.4	96.3
Gasoline	7.0	6.4	3.8	1.3	2.0	2.0	5.0	3.0	2.0
LPG	1.0	NO	NO	0.3	NO	NO	NO	NO	NO
	1999	2000	2001	2002	2003	2004	2005	2006	2007
Diesel Oil	63.9	51.3	49.5	65.7	62.1	55.8	50.4	50.4	44.1
Gasoline	1.0	1.0	1.0	NO	NO	NO	NO	NO	NO
	2008	2009	2010	2011	2012	2013	2014	2015	2016
Diesel Oil	42.3	38.7	39.6	36.9	34.2	37.8	49.5	55.8	63.9

Sources: Energy Balances of the RM for 1990 and 1993-2016.

Below is presented the total fuel consumption from 1A4ci 'Agriculture / Forestry / Fishing' ('Mobile' – 'Off-road Vehicles and Other Machinery') between 1990 and 2016. As can be seen, during the period under review, fuel consumption decreased significantly for gasoline (by 95.8 per cent), LPG (by 91.3 per cent) and diesel oil (by 85.2 per cent), thus, the total fuel consumption from the respective category decreasing by 85.4 per cent (Table 3-152).

Table 3-152: Total fuel consumption under the 1A4cii 'Agriculture/Forestry/Fishing' ('Mobile' – 'Off-road Vehicles and Other Machinery') in the RM within 1990-2016 periods, TJ

	1990	1991	1992	1993	1994	1995	1996	1997	1998
Diesel Oil	18 403	13 477	8 787	8 380	8 106	8 823	6 933	6 814	5 006
Gasoline	306	280	166	59	117	511	472	534	341
LPG	46	NO	NO	15	NO	NO	NO	NO	NO
Total	18 755	13 756	8 953	8 454	8 223	9 334	7 405	7 349	5 347
	1999	2000	2001	2002	2003	2004	2005	2006	2007
Diesel Oil	3 588	2 811	2 723	3 248	2 993	2 665	2 354	2 328	2 009
Gasoline	193	106	103	53	55	34	39	28	23
LPG	NO	NO	NO	NO	NO	2	2	2	1
Total	3 781	2 916	2 826	3 301	3 048	2 701	2 395	2 358	2 034
	2008	2009	2010	2011	2012	2013	2014	2015	2016
Diesel Oil	1 917	1 788	1 986	1 935	1 858	2 050	2 548	2 815	2 722
Gasoline	20	24	32	36	36	37	47	28	13
LPG	3	6	9	8	5	6	7	5	4
Total	1 940	1 818	2 027	1 979	1 898	2 093	2 602	2 848	2 739

3.5.3. Uncertainties Assessment and Time-Series Consistency

The primary uncertainties related factors pertain to methodology, emission factors used to estimate GHG emissions covered by the 1A4 'Other Sectors' category, and the quality of activity data available. Uncertainties associated with EFs used to estimate CO_2 emissions from the 1A4 'Other Sectors' category, were estimated at circa 5 per cent, while those related to EFs used to estimate CH_4 and N_2O emissions reach up to ±50 per cent. Uncertainties associated with activity data regarding fuel consumption within the 1A4 'Other Sectors' category in the RM represent circa ±5 per cent for CO_2 and CH_4, respectively circa ±3 per cent for N_2O emissions. Thus, combined uncertainties were estimated at circa ±7.1 per cent for CO_2 emissions, while for CH_4 and N_2O emissions, respectively at circa ±50.2 per cent and ±50.1 per cent (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.

3.5.4. Quality Assurance and Quality Control

Standard verification and quality control forms and checklists were filled in for the respective category under the Sector 1 'Energy', following the Tier 1 approach. The AD and methods used to estimate GHG emissions under the 1A4 'Other Sectors' 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 into the 2006 IPCC Guidelines, GHG emissions originated from the 1A4 'Other Sectors' category 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 1A4 'Other Sectors' category complies with the requirements set out in the description of each subcategory in the 2006 IPCC Guidelines (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;
- 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 emissions archive.

3.5.5. 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 to recalculate GHG emissions from 1A4 'Other Sectors' category. The main causes of these recalculations are, as follows:

- The GHG emissions from this category were estimated separately for the RBDR and LBDR, respectively for each source;
- For a series of sources, the missing values for certain types of fuel consumption have been restored using the interpolation method for 1991-1992 (during these years, the Energy Balances have not been published);
- Also, the transition from an average NCV for a longer period of time (1990-2015) to an annual average NCV for natural gases (Table 3-23), based on the information provided by 'Moldovagaz' for 1997-2016 time series (for 1990-1996 periods, were used annual average values characteristic to 1997).

In comparison with the results included into the NC4 of the Republic of Moldova under the UNFCCC (2018), the performed recalculations in the current inventory cycle resulted in an increasing trend of direct GHG emissions within 1990-1994, 1996, 1998-2001 and 2011-2015, respectively, in a decreasing trend within 1995, 1997 and 2002-2010 (Table 3-153). For 2016, direct GHG emissions were estimated for the first time. Between 1990 and 2016, the respective emissions from 1A4 'Other Sectors' category decreased in the RM by circa 76.4 per cent.

Table 3-153: Recalculation results of GHG emissions from 1A4 'Other Sectors' category included into the NC4 of the RM under the UNFCCC (2018), within 1990-2015 periods, kt CO_2 equivalent

	1990	1991	1992	1993	1994	1995	1996	1997	1998
NC4	7 608.4017	6 194.2317	4 334.5137	2 306.8036	2 156.0040	2 212.7842	2 342.9730	2 548.0695	2 092.8164
BUR2	7 689.7135	8 128.9575	6 164.6672	2 325.4332	2 160.4012	2 207.2356	2 349.6445	2 545.5057	2 105.6673
Difference, %	1.07	31.23	42.22	0.81	0.20	-0.25	0.28	-0.10	0.61
	1999	2000	2001	2002	2003	2004	2005	2006	2007
NC4	1 834.5386	1 514.3349	1 448.1708	1 783.4561	2 134.9593	2 302.2970	2 264.0705	2 255.5911	1 704.8440
BUR2	1 837.5824	1 523.7452	1 459.8599	1 781.9747	2 132.0162	2 296.9025	2 259.2406	2 251.7988	1 702.8467
Difference, %	0.17	0.62	0.81	-0.08	-0.14	-0.23	-0.21	-0.17	-0.12
	2008	2009	2010	2011	2012	2013	2014	2015	2016
NC4	1 716.3136	1 866.5664	2 031.0012	2 358.7490	2 326.6485	2 004.7593	2 046.0694	1 916.0651	
BUR2	1 714.4226	1 866.2043	2 030.0705	2 358.9684	2 328.2713	2 007.9234	2 051.8469	1 923.5784	1 812.7922
Difference, %	-0.11	-0.02	-0.05	0.01	0.07	0.16	0.28	0.39	

Abbreviations: NC4 – Fourth National Communication of the RM under the UNFCCC (2018); BUR2 – Second Biennial Update Report of the RM under the UNFCCC (2019)

The tables below present the performed recalculations for the most important emission sources within 1A4 'Other Sectors' category (Tables 3-154, 3-155 and 3-156).

Table 3-154: Recalculation results of GHG emissions from 1A4a 'Commercial/Institutional' included into the NC4 of the RM under the UNFCCC (2018), kt CO_2 equivalent

	1990	1991	1992	1993	1994	1995	1996	1997	1998
NC4	1 427.3919	824.9777	380.0979	594.6681	390.5659	399.0975	366.3592	310.2782	308.6055
BUR2	1 426.1119	1 106.7712	807.2314	594.6681	390.5659	399.0975	366.3592	310.2782	308.6055
Difference, %	-0.09	34.16	112.37	0.00	0.00	0.00	0.00	0.00	0.00
	1999	2000	2001	2002	2003	2004	2005	2006	2007
NC4	230.6187	207.2302	239.0809	430.0990	588.0153	829.0842	707.3816	649.6049	366.0731
BUR2	230.4551	206.9817	238.7345	428.2190	586.3508	825.3132	704.6918	647.6968	365.8772
Difference, %	-0.07	-0.12	-0.14	-0.44	-0.28	-0.45	-0.38	-0.29	-0.05
	2008	2009	2010	2011	2012	2013	2014	2015	2016
NC4	375.1371	483.5828	481.5109	811.0471	782.6299	475.3008	488.8411	344.5964	
BUR2	374.9380	483.5346	481.3254	810.6321	783.4868	476.4114	490.9551	345.6078	342.9948
Difference, %	-0.05	-0.01	-0.04	-0.05	0.11	0.23	0.43	0.29	

Abbreviations: NC4 – Fourth National Communication of the RM under the UNFCCC (2018); BUR2 – Second Biennial Update Report of the RM under the UNFCCC (2019).

Table 3-155: Recalculation results of GHG emissions from 1A4b 'Residential' included into the NC4 of the RM under the UNFCCC (2018), kt CO_2 equivalent

	1990	1991	1992	1993	1994	1995	1996	1997	1998
NC4	4 701.8620	3 427.1398	2 444.5033	1 020.7909	1 123.4333	1 100.7051	1 407.4316	1 666.2543	1 367.6078
BUR2	4 701.8620	5 134.1590	3 984.8940	1 021.9061	1 123.4333	1 095.1565	1 405.3833	1 657.1319	1 360.7831
Difference, %	0.00	49.81	63.01	0.11	0.00	-0.50	-0.15	-0.55	-0.50
	1999	2000	2001	2002	2003	2004	2005	2006	2007
NC4	1 313.1420	1 080.3487	992.1344	1 100.9927	1 309.7862	1 255.8968	1 370.6430	1 425.8098	1 185.3527
BUR2	1 307.6295	1 079.0518	988.8914	1 096.9942	1 306.3634	1 253.2412	1 368.2104	1 423.7780	1 183.5513
Difference, %	-0.42	-0.12	-0.33	-0.36	-0.26	-0.21	-0.18	-0.14	-0.15
	2008	2009	2010	2011	2012	2013	2014	2015	2016
NC4	1 190.4035	1 242.8935	1 392.5754	1 394.6003	1 393.9820	1 362.6801	1 357.3577	1 350.9580	
BUR2	1 188.7127	1 242.5050	1 391.8307	1 395.0859	1 394.7470	1 364.7336	1 361.0211	1 357.4512	1 257.3254
Difference, %	-0.14	-0.03	-0.05	0.03	0.05	0.15	0.27	0.48	

Abbreviations: NC4 – Fourth National Communication of the RM under the UNFCCC (2018); BUR2 – Second Biennial Update Report of the RM under the UNFCCC (2019).

Table 3-156: Recalculation results of GHG emissions from 1A4c 'Agriculture/Forestry/Fishing' included into the NC4 of the RM under the UNFCCC (2018), kt CO_2 equivalent

	1990	1991	1992	1993	1994	1995	1996	1997	1998
NC4	1 479.1478	1 942.1142	1 509.9125	691.3447	642.0048	712.9816	569.1822	571.5371	416.6032
BUR2	1 561.7397	1 888.0273	1 372.5418	708.8590	646.4020	712.9816	577.9021	578.0956	436.2788
Difference, %	5.58	-2.78	-9.10	2.53	0.68	0.00	1.53	1.15	4.72
	1999	2000	2001	2002	2003	2004	2005	2006	2007
NC4	290.7778	226.7560	216.9555	252.3643	237.1578	217.3160	186.0459	180.1764	153.4182
BUR2	299.4977	237.7117	232.2339	256.7615	239.3020	218.3480	186.3383	180.3240	153.4182
Difference, %	3.00	4.83	7.04	1.74	0.90	0.47	0.16	0.08	0.00

	2008	2009	2010	2011	2012	2013	2014	2015	2016
NC4	150.7730	140.0901	156.9148	153.1016	150.0367	166.7785	199.8706	220.5107	
BUR2	150.7719	140.1646	156.9144	153.2504	150.0375	166.7785	199.8706	220.5194	212.4720
Difference, %	0.00	0.05	0.00	0.10	0.00	0.00	0.00	0.00	

Abbreviations: NC4 – Fourth National Communication of the RM under the UNFCCC (2018); BUR2 – Second Biennial Update Report of the RM under the UNFCCC (2019).

3.5.6. Planned Improvements

Potential improvements within the 1A4 'Other Sectors' category could be possible by updating the available AD on fuel consumption on the territory of the LBDR and filling the existing gaps for certain years.

3.6. Other (Category 1A5)

3.6.1. Source Category Description

The 1A5 'Other' ('Non-Specified') category includes GHG emissions from fuels combustion for other works and needs within the Sector 1 'Energy', including military transport. The respective category includes two sources: 1A5a 'Stationary' (all types of fuels, with the exception of diesel oil, gasoline, aviation gasoline and kerosene) and 1A5b 'Mobile', including, 1A5bi 'Mobile' ('Aviation component') (aviation gasoline and kerosene), 1A5bii 'Mobile' ('Water-borne component') (diesel oil) and 1A5biii 'Mobile' ('Other') (diesel oil and gasoline consumption under other mobile sources, not included elsewhere).

Between 1990 and 2016, GHG emissions from 1A5 'Other' category registered a decreasing trend by 98.2 per cent: from 115.57 kt CO_2 eq. in 1990 to 2.13 kt CO_2 eq. in 2016 (Table 3-157).

Table 3-157: Total direct GHG emissions from 1A5 'Other' category within 1990-2016 periods

	1990	1991	1992	1993	1994	1995	1996	1997	1998
1A5, kt CO_2 equivalent	115.5701	107.5724	78.5337	94.3265	89.0194	126.5495	82.8034	77.4557	73.6783
in %, as compared with 1990 year	100.0	93.1	68.0	81.6	77.0	109.5	71.6	67.0	63.8
	1999	2000	2001	2002	2003	2004	2005	2006	2007
1A5, kt CO_2 equivalent	49.8010	36.8044	43.8813	40.1303	28.8076	28.0207	26.2833	39.4920	45.1203
in %, as compared with 1990 year	43.1	31.8	38.0	34.7	24.9	24.2	22.7	34.2	39.0
	2008	2009	2010	2011	2012	2013	2014	2015	2016
1A5, kt CO_2 equivalent	49.2337	13.4527	30.2051	21.5974	8.5786	3.9478	3.3383	2.9147	2.1288
in %, as compared with 1990 year	42.6	11.6	26.1	18.7	7.4	3.4	2.9	2.5	1.8

The table below presents direct and indirect GHG emissions from 1A5 'Other' category, separately for the territory on the RBDR and LBDR (Table 3-158).

Table 3-158: Direct and indirect GHG emissions from 1A5 'Other' category on the RBDR and the LBDR within 1990-2016 periods, kt

	RBDR							LBDR						
	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	0.00198	0.00074	0.0908	0.3458	0.0459	0.2890	NA	NA	NA	NA	NA	NA	NA
1991	51.5108	0.00114	0.00059	0.1355	0.2916	0.0316	0.2649	NA	NA	NA	NA	NA	NA	NA
1992	42.5895	0.00122	0.00043	0.1334	0.1655	0.0202	0.1522	NA	NA	NA	NA	NA	NA	NA
1993	62.1343	0.00206	0.00083	0.1586	0.3875	0.0485	0.3369	NA	NA	NA	NA	NA	NA	NA
1994	71.3256	0.00263	0.00077	0.1867	0.3052	0.0469	0.2561	NA	NA	NA	NA	NA	NA	NA
1995	104.4054	0.00497	0.00112	0.3366	0.3173	0.0599	0.2593	NA	NA	NA	NA	NA	NA	NA
1996	58.7906	0.00620	0.00117	0.2011	0.2969	0.0717	0.1964	NA	NA	NA	NA	NA	NA	NA
1997	51.7920	0.00308	0.00074	0.1428	0.2585	0.0462	0.2014	NA	NA	NA	NA	NA	NA	NA
1998	50.4380	0.00477	0.00098	0.1495	0.2909	0.0624	0.2034	NA	NA	NA	NA	NA	NA	NA
1999	30.9893	0.00326	0.00070	0.0812	0.2285	0.0465	0.1608	NA	NA	NA	NA	NA	NA	NA
2000	26.5856	0.00213	0.00053	0.0540	0.2033	0.0364	0.1515	NA	NA	NA	NA	NA	NA	NA
2001	28.7767	0.00227	0.00047	0.0593	0.1541	0.0341	0.1047	NA	NA	NA	NA	NA	NA	NA
2002	25.3685	0.00474	0.00088	0.0632	0.2530	0.0620	0.1534	NA	NA	NA	NA	NA	NA	NA
2003	20.4111	0.00267	0.00053	0.0565	0.1610	0.0359	0.1069	NA	NA	NA	NA	NA	NA	NA
2004	11.3982	0.00099	0.00019	0.0210	0.0596	0.0148	0.0372	NA	NA	NA	NA	NA	NA	NA
2005	11.6992	0.00111	0.00021	0.0215	0.0654	0.0163	0.0405	NA	NA	NA	NA	NA	NA	NA
2006	21.4826	0.00129	0.00036	0.0397	0.1547	0.0256	0.1197	NA	NA	NA	NA	NA	NA	NA
2007	17.7980	0.00136	0.00033	0.0335	0.1302	0.0238	0.0962	NA	NA	NA	NA	NA	NA	NA
2008	20.3604	0.00111	0.00033	0.0393	0.1450	0.0228	0.1147	5.0346	0.00006	0.00008	0.0095	0.0483	0.0046	0.0436
2009	7.4748	0.00059	0.00011	0.0162	0.0299	0.0081	0.0181	2.8421	0.00003	0.00004	0.0054	0.0271	0.0026	0.0245
2010	23.7958	0.00165	0.00038	0.0438	0.1389	0.0278	0.0991	2.6716	0.00003	0.00004	0.0049	0.0263	0.0025	0.0237
2011	15.9259	0.00069	0.00023	0.0276	0.1091	0.0164	0.0878	1.6420	0.00002	0.00003	0.0030	0.0162	0.0015	0.0146
2012	3.5864	0.00010	0.00002	0.0057	0.0070	0.0019	0.0046	1.5648	0.00002	0.00002	0.0029	0.0154	0.0015	0.0139

	RBDR							LBDR						
	CO_2	CH_4	N_2O	NO_x	CO	NMVOC	SO_2	CO_2	CH_4	N_2O	NO_x	CO	NMVOC	SO_2
2013	0.2064	0.00001	0.00000	0.0008	0.0002	0.0001	0.0003	1.5501	0.00002	0.00002	0.0028	0.0153	0.0015	0.0138
2014	0.1806	0.00001	0.00000	0.0007	0.0002	0.0000	0.0002	0.9071	0.00001	0.00001	0.0017	0.0089	0.0009	0.0081
2015	0.1548	0.00001	0.00000	0.0006	0.0002	0.0000	0.0002	1.0794	0.00001	0.00002	0.0020	0.0106	0.0010	0.0096
2016	NO	NO	NO	NO	NO	NO	NO	0.9015	0.00001	0.00001	0.0016	0.0089	0.0008	0.0080

Compared to 1990, in 2016 the level of GHG emissions from 1A5 'Other' category accounted: for CO_2 circa 1.8 per cent, for CH_4 – 2.2 per cent, N_2O – 1.7 per cent, NO_x – 1.3 per cent, CO – 2.6 per cent, NMVOC – 2.1 per cent and SO_2 – 2.4 per cent (Table 3-159), with the largest share in the structure of total direct GHG emissions at category level represented by CO_2, followed by N_2O and CH_4 (Table 3-1620).

Table 3-159: Direct and indirect GHG emissions from 1A5 'Other' category in the Republic of Moldova within 1990-2016 periods

	1A5, kt							in %, as compared with the reference year 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	0.4110	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	0.3599	93.3	66.4	77.2	86.6	74.5	69.8	87.6
1992	77.7474	0.0046	0.0023	0.4776	0.3429	0.0514	0.2146	68.2	42.3	50.6	62.9	41.4	42.0	52.2
1993	93.4518	0.0058	0.0024	0.4591	0.6253	0.0853	0.3903	82.0	53.4	55.0	60.4	75.5	69.6	95.0
1994	88.3648	0.0069	0.0016	0.3325	0.6071	0.0863	0.2787	77.5	63.0	36.4	43.8	73.3	70.4	67.8
1995	125.6438	0.0104	0.0022	0.5138	0.6299	0.1015	0.2872	110.2	95.0	48.8	67.6	76.0	82.8	69.9
1996	81.8376	0.0109	0.0023	0.4423	0.4659	0.0987	0.2300	71.8	100.1	52.3	58.2	56.2	80.6	56.0
1997	76.6587	0.0081	0.0020	0.2875	0.4997	0.0785	0.2379	67.3	74.0	44.9	37.8	60.3	64.1	57.9
1998	72.8283	0.0088	0.0021	0.3919	0.5862	0.1041	0.2375	63.9	81.1	47.4	51.6	70.7	84.9	57.8
1999	49.1563	0.0065	0.0016	0.1458	0.3630	0.0640	0.1887	43.1	59.6	36.4	19.2	43.8	52.3	45.9
2000	36.3881	0.0046	0.0010	0.1311	0.2320	0.0421	0.1644	31.9	42.0	22.8	17.2	28.0	34.4	40.0
2001	43.3961	0.0050	0.0012	0.1565	0.3569	0.0605	0.1268	38.1	46.0	27.2	20.6	43.1	49.4	30.8
2002	39.4529	0.0083	0.0016	0.1411	0.2860	0.0683	0.1720	34.6	76.2	35.4	18.6	34.5	55.7	41.8
2003	28.4228	0.0043	0.0009	0.1427	0.2811	0.0524	0.1187	24.9	39.0	21.0	18.8	33.9	42.8	28.9
2004	27.6373	0.0031	0.0010	0.2161	0.2875	0.0472	0.0644	24.2	28.7	23.0	28.4	34.7	38.5	15.7
2005	25.9403	0.0024	0.0010	0.2301	0.1272	0.0300	0.0661	22.8	21.8	21.4	30.3	15.3	24.5	16.1
2006	39.0397	0.0029	0.0013	0.3325	0.4037	0.0635	0.1512	34.3	26.5	28.7	43.8	48.7	51.8	36.8
2007	44.5097	0.0039	0.0017	0.3855	0.3075	0.0552	0.1437	39.1	35.8	38.7	50.7	37.1	45.1	35.0
2008	48.6609	0.0037	0.0016	0.3318	0.3542	0.0549	0.1988	42.7	33.6	36.3	43.7	42.7	44.8	48.4
2009	13.3329	0.0012	0.0003	0.1073	0.1811	0.0277	0.0472	11.7	10.8	6.8	14.1	21.9	22.6	11.5
2010	29.9692	0.0023	0.0006	0.1294	0.2782	0.0459	0.1281	26.3	21.5	13.4	17.0	33.6	37.5	31.2
2011	21.4301	0.0013	0.0005	0.1561	0.3630	0.0465	0.1085	18.8	11.8	10.2	20.6	43.8	37.9	26.4
2012	8.4998	0.0006	0.0002	0.0565	0.1496	0.0172	0.0238	7.5	5.6	4.8	7.4	18.1	14.0	5.8
2013	3.8998	0.0003	0.0001	0.0432	0.0450	0.0052	0.0176	3.4	2.7	3.1	5.7	5.4	4.2	4.3
2014	3.2915	0.0004	0.0001	0.0119	0.0423	0.0033	0.0118	2.9	3.2	2.9	1.6	5.1	2.7	2.9
2015	2.8778	0.0003	0.0001	0.0112	0.0355	0.0030	0.0124	2.5	2.5	2.3	1.5	4.3	2.4	3.0
2016	2.1005	0.0002	0.0001	0.0097	0.0217	0.0026	0.0098	1.8	2.2	1.7	1.3	2.6	2.1	2.4

Table 3-160: Direct GHG emissions from 1A5 'Other' category in the Republic of Moldova within 1990-2016 periods

	Direct GHG emissions, kt CO_2 equivalent				the share, in % from the 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	48.6609	0.0916	0.4812	49.2337	98.8	0.2	1.0
2009	13.3329	0.0294	0.0903	13.4527	99.1	0.2	0.7
2010	29.9692	0.0586	0.1772	30.2051	99.2	0.2	0.6
2011	21.4301	0.0322	0.1350	21.5974	99.2	0.1	0.6

	Direct GHG emissions, kt CO_2 equivalent				the share, in % from the total		
	CO_2	CH_4	N_2O	Total	CO_2	CH_4	N_2O
2012	8.4998	0.0153	0.0635	8.5786	99.1	0.2	0.7
2013	3.8998	0.0075	0.0405	3.9478	98.8	0.2	1.0
2014	3.2915	0.0088	0.0379	3.3383	98.6	0.3	1.1
2015	2.8778	0.0067	0.0302	2.9147	98.7	0.2	1.0
2016	2.1005	0.0061	0.0223	2.1288	98.7	0.3	1.0

Below is presented the evolution of GHG emissions from 1A5 'Other' category by sources between 1990 and 2016. If in the reference year, circa 36.5 per cent of the total emissions originated from the stationary combustion of fuels and other circa 63.5 per cent from the mobile combustion of fuels, by 2016 the share of emissions from stationary combustion increased up to circa 42.6 per cent, while the share of emissions from mobile combustion decreased to circa 57.4 per cent (Table 3-163, Figure 3-23).

Table 3-161: Direct GHG emissions from 1A5 'Other' category in the Republic of Moldova, by source categories, within 1990-2016 periods

	1A5a 'Stationary', kt				1A5b 'Mobile', kt				1A5 'Other', kt	the share, in % from the 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	25.3950	0.0291	0.1221	25.5462	23.2659	0.0625	0.3591	23.6875	49.2337	51.9	48.1	100.0
2009	10.3169	0.0155	0.0448	10.3772	3.0161	0.0139	0.0455	3.0755	13.4527	77.1	22.9	100.0
2010	26.4674	0.0420	0.1245	26.6339	3.5018	0.0166	0.0527	3.5712	30.2051	88.2	11.8	100.0
2011	17.5679	0.0177	0.0767	17.6624	3.8622	0.0145	0.0583	3.9350	21.5974	81.8	18.2	100.0
2012	5.1512	0.0028	0.0130	5.1669	3.3486	0.0125	0.0506	3.4116	8.5786	60.2	39.8	100.0
2013	1.7565	0.0006	0.0078	1.7649	2.1433	0.0069	0.0327	2.1828	3.9478	44.7	55.3	100.0
2014	1.0877	0.0004	0.0047	1.0928	2.2039	0.0084	0.0332	2.2455	3.3383	32.7	67.3	100.0
2015	1.2342	0.0004	0.0055	1.2401	1.6436	0.0063	0.0248	1.6747	2.9147	42.5	57.5	100.0
2016	0.9015	0.0002	0.0043	0.9060	1.1989	0.0058	0.0180	1.2228	2.1288	42.6	57.4	100.0

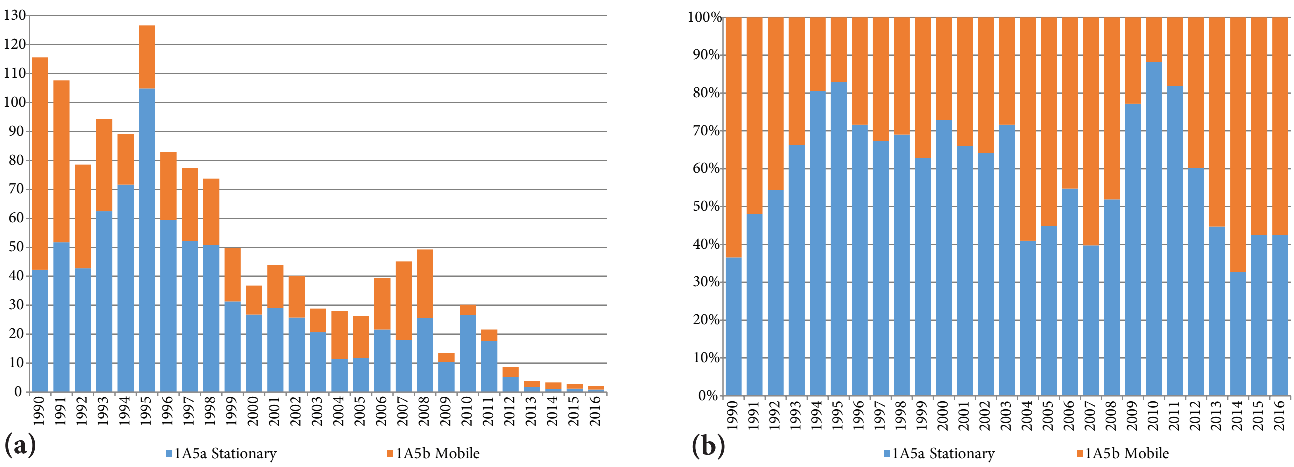


Figure 3-23: Direct GHG emissions from 1A5 'Other' category in the RM within 1990-2016 periods, when: (a) direct GHG emissions by sources, kt CO_2 equivalent; (b) direct GHG emissions by sources, in % of the total.

The table below presents direct and indirect GHG emissions from 1A5 'Other' category, by sources of emissions (Table 3-162).

Table 3-162: Direct and indirect GHG emissions from 1A5 'Other' category in the Republic of Moldova, by subcategories, within1990-2016 periods

	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	0.1220
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	0.0950
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	0.0624
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	0.0534
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	0.0226
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	0.0279
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	0.0336
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	0.0365
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	0.0341
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	0.0279
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	0.0130
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	0.0221
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	0.0185
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	0.0119
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	0.0272
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	0.0256
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	0.0314
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	0.0475
2008	25.3950	0.0012	0.0004	0.0488	0.1932	0.0274	0.1583	23.2659	0.0025	0.0012	0.2830	0.1610	0.0274	0.0405
2009	10.3169	0.0006	0.0002	0.0216	0.0570	0.0107	0.0426	3.0161	0.0006	0.0002	0.0856	0.1241	0.0170	0.0046
2010	26.4674	0.0017	0.0004	0.0487	0.1652	0.0303	0.1228	3.5018	0.0007	0.0002	0.0806	0.1130	0.0156	0.0053
2011	17.5679	0.0007	0.0003	0.0306	0.1252	0.0180	0.1024	3.8622	0.0006	0.0002	0.1255	0.2378	0.0285	0.0061
2012	5.1512	0.0001	0.0000	0.0086	0.0224	0.0034	0.0185	3.3486	0.0005	0.0002	0.0479	0.1273	0.0138	0.0053
2013	1.7565	0.0000	0.0000	0.0037	0.0155	0.0015	0.0140	2.1433	0.0003	0.0001	0.0395	0.0295	0.0036	0.0036
2014	1.0877	0.0000	0.0000	0.0024	0.0091	0.0009	0.0083	2.2039	0.0003	0.0001	0.0095	0.0331	0.0025	0.0035
2015	1.2342	0.0000	0.0000	0.0026	0.0108	0.0011	0.0098	1.6436	0.0003	0.0001	0.0086	0.0247	0.0019	0.0026
2016	0.9015	0.0000	0.0000	0.0016	0.0089	0.0008	0.0080	1.1989	0.0002	0.0001	0.0080	0.0128	0.0017	0.0018

3.6.2. Methodological Issues, Emission Factors and Activity Data

Direct GHG emissions originated from the 1A5 'Other' category 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 (2017) (Table 3-163).

Table 3-163: Emission factors used to estimate GHG emissions from 1A5 'Other' category, kg/TJ for direct GHGs and kg/t of 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	98300	1	1.5	173	931	88.8	840	2006 IPCC Guidelines, Volume 2, Table 2.2	EMEP/EEA Guidebook (July 2017), Categories 1.A.4.a/c, 1.A.5.a, Table 3.7
Brown Coal, Lignite	101000	1	1.5	173	931	88.8	840		
Other Bituminous Coal	94600	1	1.5	173	931	88.8	840		
Coke	107 000	1	1.5	173	931	88.8	840		
Fuel for Oven	71900	3	0.6	306	93	20	94		EMEP/EEA Guidebook (July 2017), Categories 1.A.4.a/c, 1.A.5.a, Table 3.9
Residual Fuel Oil	77400	3	0.6	306	93	20	94		
Kerosene	71900	3	0.6	306	93	20	94		
Other Petroleum Products	73300	3	0.6	306	93	20	94		
Natural Gas	56100	1	0.1	74	29	23	0.67		EMEP/EEA Guidebook (July 2017), Categories 1.A.4.a/c, 1.A.5.a, Table 3.8
LPG	63100	1	0.1	74	29	23	0.67		
Fuel Woods	112000	30	4	91	570	300	11		EMEP/EEA Guidebook (July 2017), Categories 1.A.4.a/c, 1.A.5.a, Table 3.10
Other types of fuel	112000	30	4	91	570	300	11		
Wood Waste	100000	30	4	91	570	300	11		
Agriculture Residues	100000	30	4	91	570	300	11		
Charcoal	112000	30	4	91	570	300	11		
Pellets and Briquettes	100000	30	4	91	570	300	11		
Biogas	54600	1	0.1	74	29	23	0.67		EMEP/EEA Guidebook (July 2017), Categories 1.A.4.a/c, 1.A.5.a, Table 3.8
1A5bi 'Mobile' ('Aviation component')									
Aviation Gasoline	71500	0.5	2	4	1200	19	1	2006 IPCC Guidelines, Volume 2, Tables 3.6.4 - 3.6.5	EMEP/EEA Guidebook (May 2017), Categories 1A3a, 1A5b, 1A3aii.(i), Table 3.3
Kerosene	69300	0.5	2	4	1200	19	1		

	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
1A5biii 'Mobile' ('Other')									
Gasoline	69300	33	3.2	8.73	84.7	10.05	45.75	2006 IPCC Guidelines, Volume 2, Tables 3.2.1 - 3.2.2	EMEP/EEA Guidebook (June 2017), Categories 1A3b.i, 1A3.bii, 1A3b.iii, 1.A.3.b.iv Tables 3.5 and 3.6
Diesel Oil	74100	3.9	3.9	33.37	7.58	1.92	141.04		

The Energy Balances of the RM (Chapter S.2.1 „Consumed as Fuel or Energy" and columns: "For Other Works and Needs" and „Used for other purposes") represented the main source of reference for AD associated to fuel consumption on the territory of the RBDR. Another relevant source of reference was the Ministry of Defense of the RM, which provides information on fuel combustion for military transport. The activity data pertaining to the fuel consumption on the territory of the LBDR were collected from the Statistical Yearbooks of the ATULBD (these are available for certain types of fuels (residual fuel oil and coal) only for 2008-2016 time series) (Table 3-164).

Table 3-164: Fuel consumption under the 1A5 'Other' category for the LBDR within 2008-2016 periods

	2008	2009	2010	2011	2012	2013	2014	2015	2016
Other bituminous coal, TJ	51.6418	28.9711	28.2409	17.3577	16.5411	16.3859	9.58834	11.4098	9.52982
Other bituminous coal, kt	2.030	1.139	1.110	0.682	0.650	0.644	0.377	0.449	0.375
Residual Fuel Oil, TJ	1.929	1.31	NA	NA	NA	NA	NA	NA	NA
Residual Fuel Oil, kt	0.048	0.033	NA	NA	NA	NA	NA	NA	NA

AD used to estimate GHG emissions from category 1A5 'Other', by sources, are presented below in Tables 3-165, 3-166, 3-167 and Figure 3-24.

Table 3-165: Fuel consumption under the 1A5a 'Stationary' within 1990-2016 periods, TJ

	1990	1991	1992	1993	1994	1995	1996	1997	1998
Anthracite	334.1	238.1	142	46	59	88	60	60	30
Brown coal	NO	46.7	NO	91	29	29	30	30	59
Other bituminous coal	NO	NO	NO	230	144.5	59	85	116	88
Coke	NO	NO	NO	3	29	30	1	NO	29
Kerosene for oven	43.1	NO	NO	NO	NO	NO	NO	NO	NO
Residual Fuel Oil	40.2	273.4	349.7	27	264	850	411	264	161.5
Kerosene	NO	NO	NO	247	118	59	88	29	147
Natural Gas	NO	NO	NO	100	235	118	30	117	59
LPG	46.1	35.4	24.7	14	59	117	30	44.5	59
Fuel Wood	45	NO	NO	13	30	30	89	30	88
Other types of fuel	NO	NO	NO	NO	NO	NO	30	1	NO
Wood Waste	NO	NO	NO	12	1	30	30	30	29.5
Total	**508.5**	**593.5**	**516.5**	**783**	**968.5**	**1410**	**884**	**721.5**	**750**
	1999	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**
Anthracite	30	30	59	58	1	16	27	33	98
Brown coal	29	29	NO	NO	NO	NO	NO	NO	NO
Other bituminous coal	118	88	58	118	116	26	20	108	15
Coke	NO	29	NO	NO	NO	1	NO	NO	NO
Residual Fuel Oil	59	30	59	41	23	5	3	7	7
Kerosene	59	1	1	1	59	2	2	1	1
Other Petroleum Products	NO	NO	NO	NO	NO	1	1	1	1
Natural Gas	59	89	30	60	58	104	106	115	90
LPG	29	30	177	30	1	13	12	14	16
Fuel Wood	59	29	30	87	59	24	24	27	26
Other types of fuel	NO	NO	NO	29	NO	NO	NO	NO	NO
Wood Waste	29	29	29	29	16	3	7	4	10
Agriculture Residues	NO	NO	NO	NO	NO	NO	NO	2	1
Total	**471**	**384**	**443**	**453**	**333**	**195**	**202**	**312**	**265**
	2008	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**
Anthracite	49	13	25	30	5	NO	NO	NO	NO
Other bituminous coal	136.6	34	118.2	91.4	16.5	16.4	9.6	11.4	9.5
Coke	NO	1	NO	NO	NO	NO	NO	NO	NO
Residual Fuel Oil	19.9	21.3	19	1	3	2.7	2.3	2	
Kerosene	1	1	1	1	1	NO	NO	NO	NO
Natural Gas	93	60	83	87	34	NO	NO	NO	NO
LPG	13	10	105	15	14	NO	NO	NO	NO
Fuel Wood	23	9	28	12	NO	NO	NO	NO	NO
Wood Waste	3	5.5	8	2	1	NO	NO	NO	NO
Agriculture Residues	1	NO	7	2	NO	NO	NO	NO	NO
Total	**339.6**	**154.8**	**394.2**	**241.4**	**74.5**	**19.1**	**11.9**	**13.4**	**9.5**

Table 3-166: Fuel consumption under the 1A5bi 'Mobile' ('Aviation component') within 2011-2015 periods

	2011	2012	2013	2014	2015
Aviation Gasoline, TJ	0.9169	0.7859	0.3297	0.5175	0.4366
Aviation Gasoline, kt	0.0210	0.0180	0.0080	0.0120	0.0100
Kerosene, TJ	0.1294	0.0863	0.0346	0.0910	NO
Kerosene, kt	0.0030	0.0020	0.0010	0.0020	NO

Table 3-167: Fuel consumption under the 1A5biii 'Mobile' ('Other'), within 1990-2016 periods

	1990	1991	1992	1993	1994	1995	1996	1997	1998
Gasoline, TJ	174.88	109.30	52.46	72.28	113.65	145.49	119.33	125.41	98.52
Gasoline, kt	4.00	2.50	1.20	2.05	3.25	3.29	1.38	2.52	2.90
Diesel Oil, TJ	808.26	638.10	425.40	355.04	123.66	150.56	199.42	218.30	210.02
Diesel Oil, kt	19.00	15.00	10.00	8.47	3.52	4.45	6.87	3.68	6.51
	1999	2000	2001	2002	2003	2004	2005	2006	2007
Gasoline, TJ	77.63	65.95	67.04	96.09	39.40	43.62	17.61	23.05	38.74
Gasoline, kt	1.45	0.14	2.18	0.19	1.22	2.22	0.17	2.21	1.18
Diesel Oil, TJ	172.57	70.61	134.59	100.21	71.27	178.36	175.72	215.38	324.25
Diesel Oil, kt	1.55	2.27	2.34	2.29	2.27	5.27	6.21	8.20	10.24
	2008	2009	2010	2011	2012	2013	2014	2015	2016
Gasoline, TJ	43.39	13.59	16.34	12.96	11.12	5.55	7.52	5.68	5.81
Gasoline, kt	1.17	1.27	1.15	2.18	1.12	0.13	0.17	0.13	0.13
Diesel Oil, TJ	273.40	28.00	31.98	39.00	33.96	23.38	22.12	16.44	10.74
Diesel Oil, kt	8.17	2.24	2.12	3.19	1.14	1.15	0.24	0.22	0.21

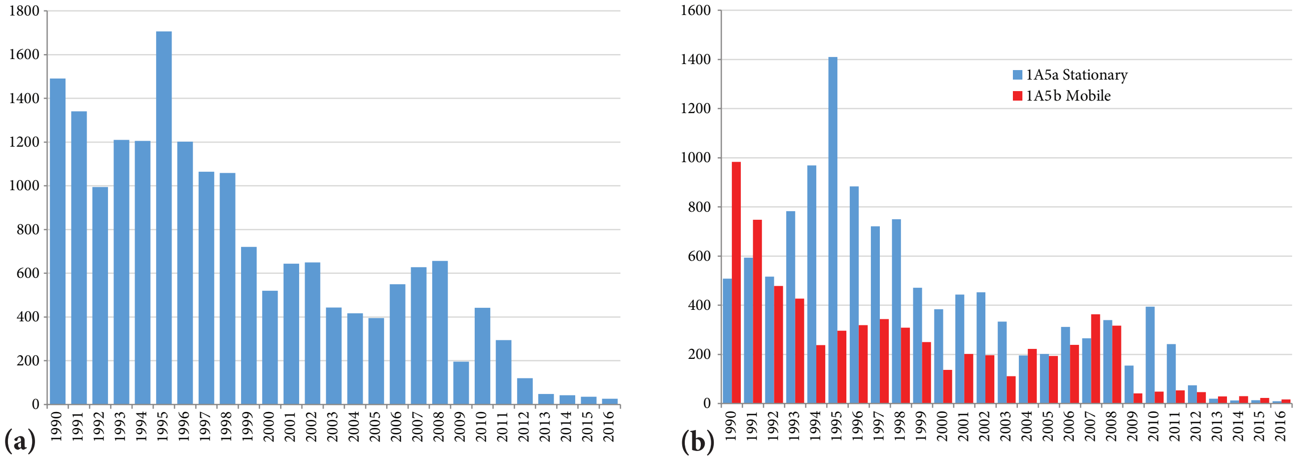


Figure 3-24: Fuel consumption under 1A5 'Other' category in the RM within 1990-2016 periods, where: (a) Total fuel consumption, TJ; and (b) Fuel consumption by sources, TJ.

Below are presented the AD pertaining to the fuel consumption by fuel type from 1A5 'Other' category. As compared to the reference year, by 2016 the share of liquid fuels in the total structure of fuel consumption within this category decreased, while the share of solid fuels increased (Table 3-168 and Figure 3-25).

Table 3-168: Total fuel consumption under the 1A5 'Other' category by fuel types in the Republic of Moldova within 1990-2016

	Fuel consumption by types, TJ					the share from the total, %			
	Solid	Liquid	Gaseous	Biofuels	Total	Solid	Liquid	Gaseous	Biofuels
1990	334.10	1112.53	NO	44.97	1491.60	22.4	74.6	*NO*	3.0
1991	284.79	1056.13	NO	NA	1340.92	21.2	78.8	*NO*	NA
1992	142.03	852.29	NO	NA	994.32	14.3	85.7	*NO*	NA
1993	370.00	715.32	100.00	25.00	1210.32	30.6	59.1	8.3	2.1
1994	261.50	678.31	235.00	31.00	1205.81	21.7	56.3	19.5	2.6
1995	206.00	1322.04	118.00	60.00	1706.04	12.1	77.5	6.9	3.5
1996	176.00	847.76	30.00	149.00	1202.76	14.6	70.5	2.5	12.4
1997	206.00	681.21	117.00	61.00	1065.21	19.3	64.0	11.0	5.7
1998	206.00	676.05	59.00	117.50	1058.55	19.5	63.9	5.6	11.1
1999	177.00	397.20	59.00	88.00	721.20	24.5	55.1	8.2	12.2
2000	176.00	197.56	89.00	58.00	520.56	33.8	38.0	17.1	11.1
2001	117.00	438.64	30.00	59.00	644.64	18.1	68.0	4.7	9.2
2002	176.00	268.30	60.00	145.00	649.30	27.1	41.3	9.2	22.3
2003	117.00	193.67	58.00	75.00	443.67	26.4	43.7	13.1	16.9
2004	43.00	242.98	104.00	27.00	416.98	10.3	58.3	24.9	6.5
2005	47.00	211.33	106.00	31.00	395.33	11.9	53.5	26.8	7.8
2006	141.00	261.43	115.00	33.00	550.43	25.6	47.5	20.9	6.0

	Fuel consumption by types, TJ					the share from the total, %			
	Solid	Liquid	Gaseous	Biofuels	Total	Solid	Liquid	Gaseous	Biofuels
2007	113.00	387.99	90.00	37.00	627.99	18.0	61.8	14.3	5.9
2008	185.64	350.72	93.00	27.00	656.36	28.3	53.4	14.2	4.1
2009	47.97	73.89	60.00	14.50	196.36	24.4	37.6	30.6	7.4
2010	143.24	173.32	83.00	43.00	442.56	32.4	39.2	18.8	9.7
2011	121.36	70.00	87.00	16.00	294.36	41.2	23.8	29.6	5.4
2012	21.54	63.94	34.00	1.00	120.48	17.9	53.1	28.2	0.8
2013	16.39	31.96	NO	NO	48.35	33.9	66.1	NO	NO
2014	9.59	32.59	NO	NO	42.17	22.7	77.3	NO	NO
2015	11.41	24.56	NO	NO	35.97	31.7	68.3	NO	NO
2016	9.53	16.56	NO	NO	26.09	36.5	63.5	NO	NO

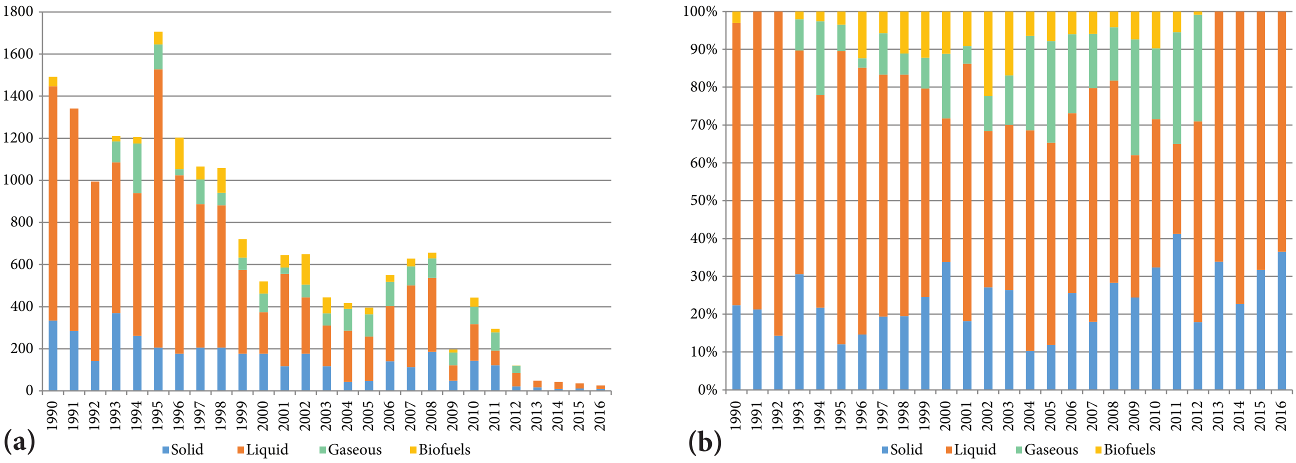


Figure 3-25: Total fuel consumption under 1A5 'Other' category in the Republic of Moldova within 1990-2016 periods, where: (a) fuel consumption by type of fuel, TJ; and (b) fuel consumption by type of fuel, in % of the total.

3.6.3. Uncertainties Assessment and Time-Series Consistency

The primary uncertainties related factors pertain to methodology, emission factors used to estimate GHG emissions covered by the 1A5 'Other' category, and quality of available activity data.

Uncertainties associated with EFs used to estimate CO_2 emissions from the 1A5 'Other' category are around ±5 per cent, while those pertaining to EFs used to estimate CH_4 and N_2O emissions reach up to ±50 per cent. Uncertainties associated with activity data regarding fuel consumption under this category represent circa ±5 per cent for CO_2 and CH_4 emissions, respectively circa ±3 per cent for N_2O emissions. Combined uncertainties, were estimated at circa ±7.1 per cent for CO_2 emissions, while for CH_4 and N_2O, respectively circa ±50.2 per cent and ±50.1 per cent (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.

3.6.4. Quality Assurance and Quality Control

Standard verification and quality control forms and checklists were filled in for 1A5 'Other' category, following the Tier 1 approach. The AD and methods used for estimating GHG emissions under 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 recommendations included into the 2006 IPCC Guidelines, GHG emissions originated from the 1A5 'Other' category were estimated based on AD and EFs from official sources of reference.

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 1A5 'Other' category complies with the requirements set out in the description of each source in the 2006 IPCC Guidelines – in the current inventory cycle, separate GHG emissions were calculated for 2 sources (1A5a 'Stationary', 1A5b 'Mobile' (including 'aviation component' and 'all other mobile sources not included elsewhere'); for each source, the AD is available in separate files in natural units and in energy units; verifying the correctness of EFs use for each source; verifying if the primary reference sources are correctly indicated; the accuracy of calculations for sources included in 1A5 'Other' 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;
- The consumption of lubricants was reallocated to source category 2D1 from Sector 2 'IPPU';
- Verifying to what extent the full geographical coverage of the national GHG inventory of the RM is ensured (for 2008-2016 time series GHG emissions were estimated for the entire country, while for 1990-2007 time series – only for 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, a number of measures have been taken to improve the quality of the national GHG inventory and this implied to recalculate GHG emissions from 1A5 'Other' category. The main causes of these recalculations are, as follows:

- GHG emissions from this category were estimated separately for the RBDR and LBDR, respectively for each source category;
- For a series of sources, the missing values for certain types of fuel consumption have been restored using the interpolation method for 1991-1992 (during these years, the Energy Balances have not been published);
- AD pertaining to the LPG consumption were updated for 1993-2015 time series;
- Also, the transition from an average NCV for a longer period of time to an annual average NCV for natural gases (Table 3-23), based on the information provided by 'Moldovagaz'.

In comparison with the results included into the NC4 of the Republic of Moldova under the UNFCCC (2018), the performed recalculations in the current inventory cycle resulted in an increasing trend of direct GHG emissions within 1991-1995, 1997-2003, 2009-2010 and 2012-2015, respectively, in a decreasing trend within 1996, 2004-2008 and 2011 (Table 3-169). For 2016, direct GHG emissions were estimated for the first time. Between 1990 and 2016, the respective emissions from 1A5 'Other' category decreased in the RM by circa 98.2 per cent.

Table 3-169: Recalculation results of GHG emissions from 1A5 'Other' category included into the NC4 of the RM under the UNFCCC (2018), within 1990-2015 periods, kt CO_2 equivalent

	1990	1991	1992	1993	1994	1995	1996	1997	1998
NC4	115.5701	81.5251	62.9457	92.6604	74.0749	118.5579	83.9263	73.4112	56.4845
BUR2	115.5701	107.5724	78.5337	94.3265	89.0194	126.5495	82.8034	77.4557	73.6783
Difference, %	0.0	24.2	19.8	1.8	16.8	6.3	-1.4	5.2	23.3
	1999	2000	2001	2002	2003	2004	2005	2006	2007
NC4	44.9606	26.2941	28.4247	35.7997	27.1388	34.1306	35.0177	51.4118	61.8745
BUR2	49.8010	36.8044	43.8813	40.1303	28.8076	28.0207	26.2833	39.4920	45.1203
Difference, %	9.7	28.6	35.2	10.8	5.8	-21.8	-33.2	-30.2	-37.1
	2008	2009	2010	2011	2012	2013	2014	2015	2016
NC4	63.4923	13.0278	24.2583	21.9369	7.7913	3.8456	2.3060	2.2742	
BUR2	49.2337	13.4527	30.2051	21.5974	8.5786	3.9478	3.3383	2.9147	2.1288
Difference, %	-29.0	3.2	19.7	-1.6	9.2	2.6	30.9	22.0	

Abbreviations: NC4 – Fourth National Communication of the RM under the UNFCCC (2018); BUR2 – Second Biennial Update Report of the RM under the UNFCCC (2019).

3.6.6. Planned Improvements

For the next inventory cycle, potential improvements in 1A5 'Other' category could be performed if new AD on fuel consumption would be available for the territory on the LBDR and filling the existing gaps for certain years.

3.7. Fugitive Emissions from Oil and Natural Gas (Category 1B2)

3.7.1. Source Category Description

The 1B2 'Fugitive Emissions from Oil and Natural Gas' source category includes the GHG emissions originated 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 sales point 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 oil fields of Valeni is circa 2-3 million tons, of which about 0.5-1.0 million tons are available reserves. After removing the water, oil is pumped through pipelines into storage tanks, from where it is transported in tanks to the refinery owned by Arnaut Petrol J.S.C. (Comrat, ATU Gagauzia), with a processing capacity of about 35 kt annually. 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. In 2006-2012 time series, 10 wells were servicing, while starting with 2013 – circa 15 wells. During the period under review, the amount of extracted oil varied between 1 and 17 kt annually or between 1 and 18 thousand m^3 annually (Table 3-170 and Figure 3-26a).

Table 3-170: Oil extraction in the Republic of Moldova within 2003-2016 periods

	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Oil, kt	1	8	5	4	8	15	17	11	13	11	10	8	7	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

Source: Energy Balances of the RM for 2003-2016.

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). Natural gas and oil resources were initially extracted (between 1995 and 2007) by an American company Redeco LTD, and starting with 2007, by Valiexchimp LTD Company. In 2016, the right to extract the resources in Valeni was granted to the American company "Fontera Resources Corporation".

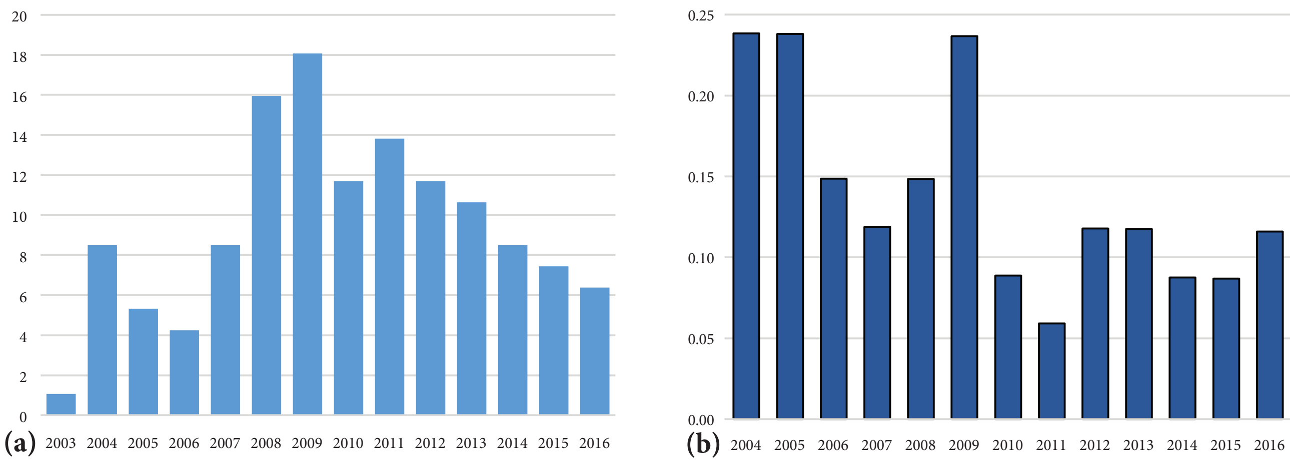


Figure 3-26: Oil and natural gas extracted in the Republic of Moldova within 2003-2016 periods, when: (a) Oil extraction, thousand m^3; (b) Natural gas extraction, million m^3.

Natural gas extraction is currently performed at 6 wells nearby Victorovca village, Cantemir district (Table 3-171, Figure 3-26b).

Table 3-171: Natural Gas Extraction in the Republic of Moldova within 2004-2016 periods

	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Natural Gas, TJ	8	8	5	4	5	8	3	2	4	4	3	3	4
Natural Gas, mill. m³	0.2383	0.2381	0.1487	0.1189	0.1485	0.2367	0.0888	0.0591	0.1179	0.1174	0.0877	0.0869	0.1160

Source: Energy Balances of the RM for 2004-2016.

The methane content reaches circa 86-92 per cent. 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 the J.S.C. "Moldovagaz", which distributes natural gas to consumers in the country and performs the transit of Russian natural gas to South-Eastern European countries. Information on natural gas consumption is available separately for RBDR and LBDR. The total natural gas consumption is presented in Table 3-172, Figure 3-27 (b).

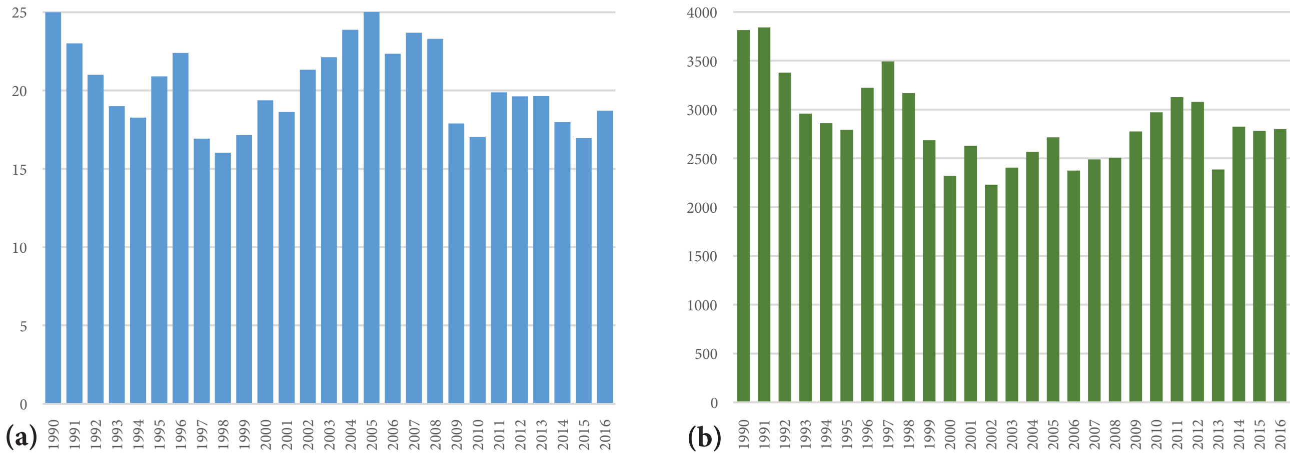


Figure 3-27: Natural gas transiting the RM (billion m³) (a); and natural gas consumption in the RM (million m³) (b) within the 1990-2016 periods.

Table 3-172: Natural gas consumption in the RM and natural gas transiting the territory of the RM within 1990-2016 periods

	1990	1991	1992	1993	1994	1995	1996	1997	1998
Natural gas transiting the RM, billion m³	25.0	23.0	21.0	19.0	18.2650	20.9090	22.3960	16.9340	16.0210
Natural gas consumption in the RM, million m³	3813.7	3843.1	3377.38	2959.8	2861.0	2791.0	3222.0	3491.9	3168.58
	1999	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**
Natural gas transiting the RM, billion m³	17.1424	19.3649	18.6248	21.3323	22.1319	23.8727	25.3129	22.3388	23.6928
Natural gas consumption in the RM, million m³	2685.3	2320.2	2628.0	2231.6	2405.4	2565.7	2715.6	2376.2	2489.9
	2008	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**
Natural gas transiting the RM, billion m³	23.2902	17.8911	17.0343	19.8895	19.6200	19.6511	17.9859	16.9700	18.7060
Natural gas consumption in the RM, million m³	2505.0	2775.0	2970.9	3099.5	3078.1	2386.0	2823.5	2782.0	2799.0

Source: "Moldovagaz" J.S.C. through Official Letters No. 604 dated 01.04.1999, answer to Letter No. 02-541 dated 28.05.2001; No. 02-156 dated 06.02.2004, answer to Letter No. 257-01-07 dated 26.01.2004; No. 06-1253 dated 27.09.2006, answer to Letter No.01-07/1400 dated 25.08.2006; No. 07-730 dated 6.6.2007, answer to Letter No. 47/21-103 dated 31.05.2007; No. 02/1-476 dated 23.02.2011, answer to Letter No. 03-07/175 dated 02.02.2011; No. 02/1-288 dated 22.01.2014, answer to Letter No. 320/2014-01-01 dated 03.01.2014; No. 02/1-507 dated 10.02.2015, answer to Letter No. 407/2015-01-09 dated 29.01.2015; No. 02/1-2183 dated 03.06.2016, answer to Letter No. 512/2016-05-01 dated 10.05.2016; No. 03/2-74 dated 12.01.2018, answer to Letter No. 601/2017-12-03 dated 14.12.2017.

Information on Liquefied Petroleum Gas (LPG) amounts are available for the territory on the RBDR for the entire period under review, while for the LBDR, only for 2011-2016 time series (Table 3-173, Figure 3-28).

Table 3-173: Liquefied Petroleum Gas consumption in the RM within 1990-2016 periods

		1990	1991	1992	1993	1994	1995	1996	1997	1998
RBDR	kt	146	128	75.4	39.9	19	19	22	26	25
	thousand m^3	250.00	219.18	129.11	68.32	32.53	32.53	37.67	44.52	42.81
		1999	2000	2001	2002	2003	2004	2005	2006	2007
RBDR	kt	31	35	47	48	50	52	53	50	53
	thousand m^3	53.08	59.93	80.48	82.19	85.62	89.04	90.75	85.62	90.75
		2008	2009	2010	2011	2012	2013	2014	2015	2016
RBDR	kt	55	60	64	67	74	74	77	76	78
	thousand m^3	94.18	102.74	109.59	114.73	126.71	126.71	131.85	130.14	133.56
LBDR	thousand m^3	NA	NA	NA	2.68	2.18	1.87	1.56	1.41	1.52
Republic of Moldova	thousand m^3	94.18	102.74	109.59	117.41	128.89	128.59	133.41	131.54	135.08

Sources: Energy Balances of the RM for 1990, 1993-2016 for the RBDR; Press Release "The State of Housing and Communal Services of the Republic for 2011-2016", for the LBDR.

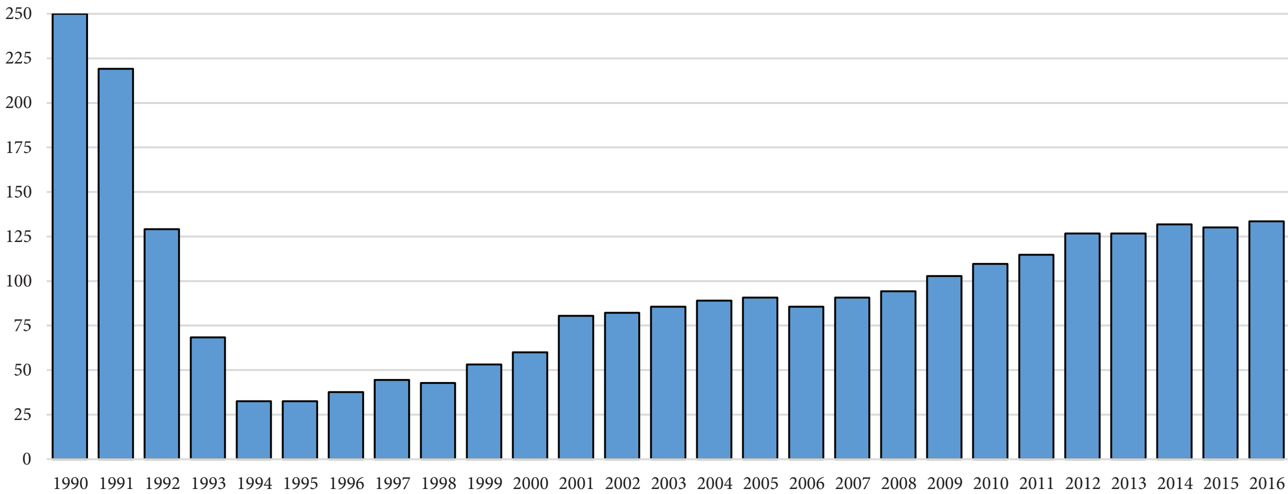


Figure 3-28: LPG consumption in the RM within 1990-2016 periods, thousand m^3.

Trends in GHG emissions

Between 1990 and 2016, GHG emissions from 1B2 'Fugitive Emissions from Oil and Natural Gas' source category tended to decrease on the territory of the RBDR by circa 23.2 per cent: from 805.17 kt CO_2 equivalent recorded in 1990 to 618.62 kt CO_2 equivalent in 2016 (Table 3-174).

Table 3-174: GHG emissions from 1B2 'Fugitive Emissions from Oil and Natural Gas' source category for the RBDR, within 1990-2016 periods

	1990	1991	1992	1993	1994	1995	1996	1997	1998
CO_2, kt	0.6377	0.6140	0.5175	0.4382	0.2451	0.3016	0.3339	0.3114	0.2871
CH_4, kt	25.6250	30.4926	27.6043	24.8026	20.7915	24.2359	26.1412	20.7466	19.4808
N_2O, kt	0.5500	0.4822	0.2840	0.1503	0.0716	0.0716	0.0829	0.0979	0.0942
Total, kt CO_2 eq.	**805.1627**	**906.6216**	**775.2688**	**665.2960**	**541.3629**	**627.5288**	**678.5611**	**548.1633**	**515.3714**
NMVOC	0.5817	0.5438	0.4931	0.4437	0.3824	0.4440	0.4783	0.3758	0.3534
	1999	2000	2001	2002	2003	2004	2005	2006	2007
CO_2, kt	0.2531	0.2421	0.2591	0.2773	0.9374	0.9685	0.9881	1.1253	1.1352
CH_4, kt	19.7666	21.5020	20.9907	23.7567	24.7626	26.8063	28.4961	25.4328	26.7464
N_2O, kt	0.1168	0.1318	0.1771	0.1808	0.1884	0.1959	0.1997	0.1884	0.1997
Total, kt CO_2 eq.	**529.2188**	**577.0822**	**577.7884**	**648.0794**	**676.1341**	**729.5032**	**772.8905**	**693.0769**	**729.2958**
NMVOC	0.3626	0.3976	0.3869	0.4390	0.5051	0.8323	0.7426	0.6519	0.8377
	2008	2009	2010	2011	2012	2013	2014	2015	2016
CO_2, kt	1.1435	1.1065	1.0951	1.1270	1.1201	1.5139	1.5023	1.4805	1.4946
CH_4, kt	26.4250	20.7761	19.8069	22.9109	22.4678	22.3596	20.6262	19.3268	21.1424
N_2O, kt	0.2072	0.2260	0.2411	0.2583	0.2836	0.2829	0.2935	0.2894	0.2972
Total, kt CO_2 eq.	**723.5146**	**587.8670**	**568.1149**	**650.8734**	**647.3175**	**644.8078**	**604.6224**	**570.8936**	**618.6186**
NMVOC	1.1126	1.0871	0.8281	0.9661	0.8782	0.8440	0.7311	0.6676	0.6615

Total GHG emissions from this source category (aggregated for the RBDR and LBDR) decreased between 1990 and 2016 by circa 12.9 per cent: from 805.17 kt CO_2 equivalent in 1990 to 701.32 kt CO_2 equivalent in 2016 (Table 3-175, Figure 3-29).

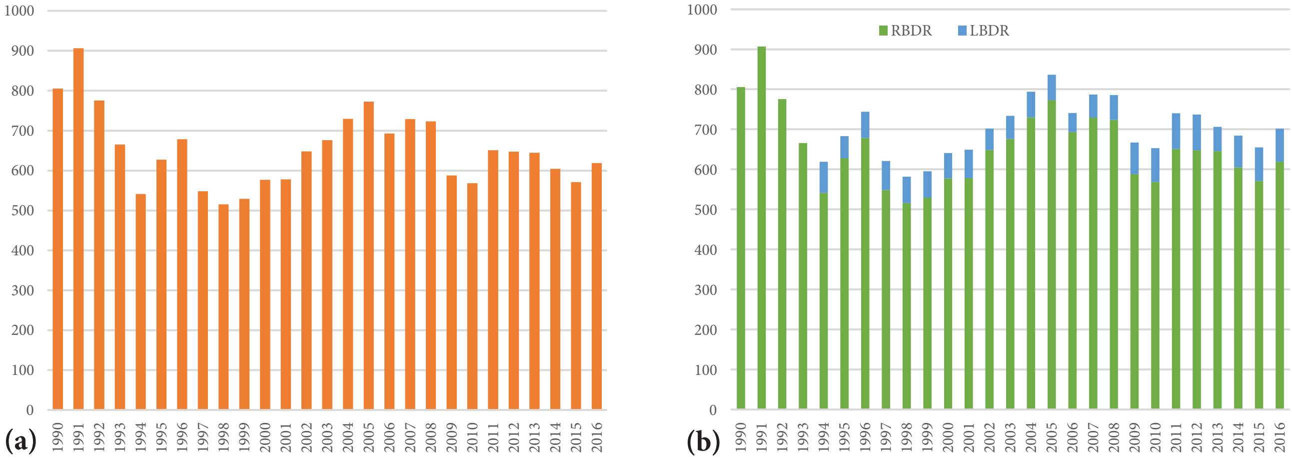


Figure 3-29: Total direct GHG emissions from 1B2 'Fugitive Emissions from Oil and Natural Gas' source category within 1990-2016 periods in the Republic of Moldova (a) and by regions (b).

Table 3-175: GHG emissions from 1B2 'Fugitive Emissions from Oil and Natural Gas' source category, separately for the RBDR and the LBDR, within 1990-2016 periods

	1990	1991	1992	1993	1994	1995	1996	1997	1998
RBDR	805.1627	906.6216	775.2688	665.2960	541.3629	627.5288	678.5611	548.1633	515.3714
LBDR	IE	IE	IE	IE	77.1607	55.6082	65.4963	72.5587	66.2453
Total - RM	**805.1627**	**906.6216**	**775.2688**	**665.2960**	**618.5236**	**683.1370**	**744.0574**	**620.7220**	**581.6167**
RBDR, %	100.0	100.0	100.0	100.0	87.5	91.9	91.2	88.3	88.6
LBDR, %	IE	IE	IE	IE	12.5	8.1	8.8	11.7	11.4
	1999	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**
RBDR	529.2188	577.0822	577.7884	648.0794	676.1341	729.5032	772.8905	693.0769	729.2958
LBDR	66.0875	63.2194	70.9037	53.2578	57.5193	64.2250	63.1653	47.5397	57.8079
Total - RM	**595.3063**	**640.3016**	**648.6921**	**701.3372**	**733.6534**	**793.7282**	**836.0558**	**740.6166**	**787.1037**
RBDR, %	88.9	90.1	89.1	92.4	92.2	91.9	92.4	93.6	92.7
LBDR, %	11.1	9.9	10.9	7.6	7.8	8.1	7.6	6.4	7.3
	2008	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**
RBDR	723.5146	587.8670	568.1149	650.8734	647.3175	644.8078	604.6224	570.8936	618.6186
LBDR	61.9702	78.6962	84.8291	89.0377	89.4073	61.0962	79.8377	83.6077	82.7058
Total - RM	**785.4848**	**666.5632**	**652.9440**	**739.9111**	**736.7248**	**705.9040**	**684.4601**	**654.5013**	**701.3244**
RBDR, %	92.1	88.2	87.0	88.0	87.9	91.3	88.3	87.2	88.2
LBDR, %	7.9	11.8	13.0	12.0	12.1	8.7	11.7	12.8	11.8

3.7.2. Methodological Issues, Emission Factors and Data Sources

GHG emissions originated from the 1B2 'Fugitive Emissions from Oil and Natural Gas' source category were estimated following a Tier 1 methodology (2006 IPCC Guidelines). Fugitive emissions of CO_2, CH_4, N_2O and NMVOC were monitored.

The basic equations used to estimate GHG emissions under this source category are:

$$E_{\text{gas, industry segment}} = A_{\text{industry segment}} \bullet EF_{\text{gas, industry segment}}$$

$$E_{\text{gas}} = \Sigma\, E_{\text{gas, industry segment}}$$

Where:

$E_{\text{gas, industry segment}}$ – annual emissions (kt);

$A_{\text{industry segment}}$ – activity data for the respective industry segment;

$EF_{\text{gas, industry segment}}$ – emission factor (kt/activity unit).

Average default EF values were used to estimate GHG emission according to 2006 IPCC Guidelines (Tables 3-176, 3-177, 3-178 and 3-179).

Table 3-176: Default EF values from 'Well Drilling, Testing and Servicing'

Category	IPCC Code	CO_2	CH_4	N_2O	NMVOC
		Ranges and Average for EFs Values Used			
Oil and Natural Gas well drilling, kg/well/yr	1B2aiii 1	100-1700	33-560	-	0.87-15.0
		900	**296.5**		**7.935**
Oil and Natural Gas well testing, kg/well/yr		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	1B2aiii 2	1.9-32.0	110-1800	-	17-2800
		17	**955**		**1408.5**

Table 3-177: Default EF values from 'Oil Extraction, Transportation and Storage in Tanks'

Category	IPCC Code	CO_2	CH_4	N_2O	NMVOC
		Ranges and Average for EFs Values Used			
Fugitives from oil production, kg/1000 m³/yr	1B2aiii 2	0.1-4300	2-60000	-	1.8-75000
		2150	**30000**		**37500.9**
Ventilation at oil extraction, kg/1000 m³/yr	1B2ai	95-130	720-990	-	430-590
		112.5	**855**		**510**
Flaring at oil production, kg/1000 m³/yr	1B2ai	41000-56000	25-34	0.64-0.88	21-29
		48500	**30**	**0.76**	**25**
Oil transportation in tanks, kg/1000 m³/yr	1B2aiii 3	**2.30**	**25**	-	**250**
Oil refining, kg/1000 m³/yr	1B2aiii 4	-	**21.8**	-	-

Table 3-178: Default EF values from 'Natural Gas Extraction, Transportation and Distribution'

Category	IPCC Code	CO_2	CH_4	N_2O	NMVOC
		Ranges and Average for EFs Values Used			
Fugitives from natural gas production, kg/mill. m³/yr	1B2bii 2	14-180	380-24000	-	91-1200
		97	**12190**		**645.5**
Fugitives from natural gas transportation, kg/mill. m³/yr	1B2bii 4	0.88-2.00	166-1100	-	7.0-16.0
		1.44	**633**		**11.50**
Fugitives from natural gas distribution, kg/mill. m³/yr	1B2bii 5	51-140	1100-2500	-	16-36
		95.5	**1800**		**26**
Flaring at natural gas production, kg/mill. m³/yr	1B2bii	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/mill. m³/yr	1B2bi	3.1-7.3	44-740	-	4.6-11.0
		5.20	**392**		**7.80**

Table 3-179: Default EF values from 'LPG Transportation'

Category	IPCC Code	CO_2	CH_4	N_2O	NMVOC
Fugitives from liquefied petroleum gas transportation, kg/1000 m³/yr	1B2aiii 3	430	-	0.0022	-

The activity data related to amounts of natural gas transited across the Republic of Moldova, as well as data about amounts of natural gas sold in the Republic of Moldova were provided by the "Moldovagaz" J.S.C. (Table 3-180).

Table 3-180: Natural Gas transited, imported and consumed in the RM within 1990-2016 periods

	1990	1991	1992	1993	1994	1995	1996	1997	1998
Natural gas imported, million m³	**3844**	**3873**	**3435**	**3093**	**3012**	**3005**	**3489**	**3676**	**3333**
Net caloric values for natural gas, kcal/m³	NA	NA	NA	NA	NA	NA	NA	7980	7970
Net caloric values for natural gas, TJ/million m³	NA	NA	NA	NA	NA	NA	NA	33.404	33.362
Methane density, kg/m³	NA	NA	NA	NA	NA	NA	NA	0.683	0.683
Share of methane in natural gas imported, %	NA	NA	NA	NA	NA	NA	NA	97.9	97.9
Technological losses, including:	30	30	58	133	151	214	267	184	164
in distribution networks	30	30	58	133	52	71	112	68	107
in main networks	0	0	0	0	98	143	155	116	58
Natural gas transited, billion. m³	**25.000**	**23.000**	**21.000**	**19.000**	**18.265**	**20.909**	**22.396**	**16.934**	**16.021**
Natural gas sold in the RM:	**3813.7**	**3843.1**	**3377.4**	**2959.8**	**2861.0**	**2791.0**	**3222.0**	**3491.9**	**3168.6**
On the Right Bank of the Dniester River	NA	NA	NA	NA	1149.95	1557.88	1769.61	1882.9	1699.58
On the Left Bank of Dniester River	NA	NA	NA	NA	1711.05	1233.12	1452.39	1609.00	1469.00
Technological losses, % of the total	0.78	0.77	1.69	4.30	5.01	7.12	7.65	5.01	4.92
	1999	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**
Natural gas imported, million m³	**2856.8**	**2477.5**	**2732.1**	**2419.8**	**2614.6**	**2687.2**	**2819.2**	**2472.3**	**2714.7**
Net caloric values for natural gas, kcal/m³	7976	7978	7972	7992	8007	8019	8026	8035	8038
Net caloric values for natural gas, TJ/million m³	33.388	33.396	33.371	33.455	33.517	33.568	33.597	33.635	33.647
Methane density, kg/m³	0.683	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	97.9
Technological losses, including:	154.7	116.9	90.1	92.6	103.3	73.3	102.8	94	96.2
in distribution networks	102.5	79.4	72.8	65.5	66.1	52.9	54.2	55.6	54.5
in main networks	52.2	37.5	17.3	27.0	37.2	20.4	48.6	38.4	41.7
Natural gas transited, billion. m³	**17.1424**	**19.3649**	**18.6248**	**21.3323**	**22.1319**	**23.8727**	**25.3129**	**22.3388**	**23.6928**
Natural gas sold in the RM:	**2685.3**	**2320.2**	**2628.0**	**2231.6**	**2405.4**	**2565.7**	**2715.6**	**2376.2**	**2489.9**
On the Right Bank of the Dniester River	1219.8	918.3	1055.7	1050.6	1129.9	1141.5	1314.9	1322.0	1208.0
On the Left Bank of Dniester River	1465.5	1401.9	1572.3	1181	1275.5	1424.2	1400.7	1054.2	1281.9
Technological losses, % of the total	5.42	4.72	3.30	3.83	3.95	2.73	3.65	3.80	3.54

	2008	2009	2010	2011	2012	2013	2014	2015	2016
Natural gas imported, million m³	**2725.5**	**2979.4**	**3176.2**	**3213.1**	**3182.5**	**2472.5**	**2915.6**	**2926**	**2956**
Net caloric values for natural gas, kcal/m³	8041	8074	8071	8081	8107	8137	8175	8246	8237
Net caloric values for natural gas, TJ/million m³	33.660	33.798	33.785	33.827	33.936	34.061	34.221	34.518	34.480
Methane density, kg/m³	0.683	0.683	0.683	0.6914	0.6906	0.6946	0.6992	0.705	0.706
Share of methane in natural gas imported, %	97.9	97.9	97.9	96.9	97.0	96.5	96.1	95.5	95.34
Technological losses, including:	94.7	93.9	98.6	113.6	104.4	86.5	92.1	144.0	155.0
in distribution networks	55.5	55.7	57.9	54.4	52.1	49.8	48.3	43.0	49.0
in main networks	39.2	38.2	40.7	59.2	52.3	36.7	43.8	101.0	106.0
Natural gas transited, billion. m³	**23.2902**	**17.8911**	**17.0343**	**19.8895**	**19.6200**	**19.6511**	**17.9859**	**16.9700**	**18.7080**
Natural gas sold in the RM:	**2505.0**	**2775.0**	**2970.9**	**3099.5**	**3078.1**	**2386.0**	**2823.5**	**2782.0**	**2799.0**
On the Right Bank of the Dniester River	1130.8	1029.9	1089.8	1152.1	1095.5	1031.2	1053.1	928.0	965.0
On the Left Bank of Dniester River	1374.2	1745.1	1881.1	1974.4	1982.6	1354.8	1770.4	1854.0	1834.0
Technological losses, % of the total	3.47	3.15	3.10	3.54	3.28	3.50	3.16	4.92	5.20

Source: "Moldovagaz" through Official Letter No. 604 dated 01.04.1999, answer to Letter No. 02-541 dated 28.05.2001; No. 02-156 dated 06.02.2004, answer to Letter No. 257-01-07 dated 26.01.2004; No.06-1253 dated 27.09.2006, answer to Letter No. 01-07/1400 dated 25.08.2006; No. 07-730 dated 6.6.2007, answer to Letter No. 47/21-103 dated 31.05.2007; No. 02/1-476 dated 23.02.2011, answer to Letter No. 03-07/175 dated 02.02.2011; No. 02/1-288 dated 22.01.2014, answer to Letter No. 320/2014-01-01 dated 03.01.2014; No. 02/1-507 dated 10.02.2015, answer to Letter No. 407/2015-01-09 dated 29.01.2015; No. 02/1-2183 dated 03.06.2016, answer to Letter No. 512/2016-05-01 dated 10.05.2016; No. 03/2-74 dated 12.01.2018, answer to Letter No. 601/2017-12-03 din 14.12.2017.

The activity data related to the exploration of oil and natural gas, respectively on LPG consumption 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 Energy Regulatory Agency (2009-2016)[32].

3.7.3. Uncertainties assessment and Time-Series Consistency

The primary uncertainties related factors pertain to methodology, emission factors used to estimate GHG emissions covered by the 1B2 'Fugitive Emissions from Oil and Natural Gas' source category, and quality of available activity data. Thus, uncertainties associated with emission factors used to estimate direct GHG emissions were estimated at circa ±25 per cent. Uncertainties related to activity data pertaining to fuel consumption in industrial sector is considered quite significant, up to ±25 per cent. The combined uncertainties represent circa 35.4 per cent (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.

3.7.4. 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 the Tier 1 approach. The AD and methods used for estimating GHG emissions under 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 recommendations included into the 2006 IPCC Guidelines, GHG emissions originated from the 1B2 'Fugitive Emissions from Oil and Natural Gas' source category 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 1B2 'Fugitive Emissions from Oil and Natural Gas' source category 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 use for each source; verifying if the primary reference sources are correctly indicated; the accuracy of calculations for sources included in 1B2 source 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;

[32] <http://anre.md/ro/reports/8>.

- 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 emissions archive.

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 to recalculate emissions from 1B2 'Fugitive Emissions from Oil and Natural Gas' source category. The main causes of these recalculations are, as follows:

- GHG emissions from this source category were estimated separately for the RBDR and LBDR;
- For a series of sources, the missing values for certain types of fuel consumption have been restored using the interpolation method for 1991-1992 (during these years, the Energy Balances have not been published);
- AD pertaining to the LPG consumption were updated for 1993-2015 time series;
- Also, the transition from an average NCV for a longer period of time to an annual average NCV for natural gases (Table 3-23), based on the information provided by "Moldovagaz".

In comparison with the results included into the NC4 of the Republic of Moldova under the UNFCCC (2018), the performed recalculations in the current inventory cycle resulted in an increasing trend of direct GHG emissions within 1991-2015, respectively, in an insignificant decrease in 1990 (Table 3-181). For 2016, direct GHG emissions were estimated for the first time. Between 1990 and 2016, the respective emissions from 1B2 'Fugitive Emissions from Oil and Natural Gas' source category decreased in the RM by circa 12.9 per cent.

Table 3-181: Recalculation results of GHG emissions from 1B2 'Fugitive Emissions from Oil and Natural Gas' source category included into the NC4 of the RM under the UNFCCC (2018), within 1990-2015 periods, kt CO_2 equivalent

	1990	1991	1992	1993	1994	1995	1996	1997	1998
NC4	812.8794	762.9286	690.6247	620.5042	597.1941	661.8075	719.3601	591.5343	553.5516
BUR2	805.1627	906.6216	775.2688	665.2960	618.5236	683.1370	744.0574	620.7220	581.6167
Difference, %	-0.9	18.8	12.3	7.2	3.6	3.2	3.4	4.9	5.1
	1999	2000	2001	2002	2003	2004	2005	2006	2007
NC4	560.5056	601.0105	595.9298	647.4523	677.5233	735.3523	776.5573	684.4862	727.6056
BUR2	595.3063	640.3016	648.6921	701.3372	733.6534	793.7282	836.0558	740.6166	787.1037
Difference, %	6.2	6.5	8.9	8.3	8.3	7.9	7.7	8.2	8.2
	2008	2009	2010	2011	2012	2013	2014	2015	2016
NC4	723.7414	599.2069	581.0975	661.7214	652.2248	621.6035	596.9973	568.2625	
BUR2	785.4848	666.5632	652.9440	739.9111	736.7248	705.9040	684.4601	654.5013	701.3244
Difference, %	8.5	11.2	12.4	11.8	13.0	13.6	14.7	15.2	

Abbreviations: NC4 – Fourth National Communication of the RM under the UNFCCC (2018); BUR2 – Second Biennial Update Report of the RM under the UNFCCC (2019).

3.7.6. Planned Improvements

Potential improvements within the 1B2 'Fugitive Emissions from Oil and Natural Gas' source category could be possible regarding the availability of new data related to 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 for the 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-ranking assessment methodology. It will also be estimated the possibility to obtain AD associated to LPG consumption on the territory of the LBDR for the entire period under review.

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 aircrafts which operate international flights, emissions are allocated to the country in which the aircraft was fueled). In the Republic of Moldova, international aviation includes jet propelled aircrafts using jet kerosene. The aviation fleet in the RM includes different types of aircrafts produced in foreign countries and CIS countries: large commercial jet aircrafts: A-319, 320, 321, 300-600; Boeing-707, 737, 739, 747, 757; EMB-120, 135, 145, 170, 190; Fokker 70, 100; MD-81, 82, 83; RJ-85, 100; CRJ, Rombac-561 Rc; turbo-propelled aircrafts for short and medium distances: Saab-340, 2000; L410, DHC8, ATR-42; light turbo-propelled aircrafts: X-32 Becas; small jet aircrafts: Falcon-2000EX, Learjet-35. The aircrafts produced in the CIS countries include: TU-134, 154; AN-2, 12, 24, 26, 28, 32, 72, 74; IL-18, 76; YAK-18, 40, 42; and helicopters Mi-8, 17, 26; Ka-26, 32.

Operation of aircrafts is divided into two phases: (i) Landing/Take-Off (LTO) occurring at altitudes lower than 914 meters and (ii) Cruise (C), occurring at altitudes higher than 914 meters.

Generally, about 10 per cent of all type aircraft emissions are produced during airport ground level operations and during the LTO (landing/take-off) phase of the flight, while the bulk of aircraft emissions (90 per cent) occur at higher altitudes. For NMVOC and CO, the split is closer to 30 per cent for LTO phase of the flight and 70 per cent for cruise phase of the flight.

The total number of flights in 1995-2005, respectively 2013-2016 time series, tended to increase continuously (Figure 3-30).

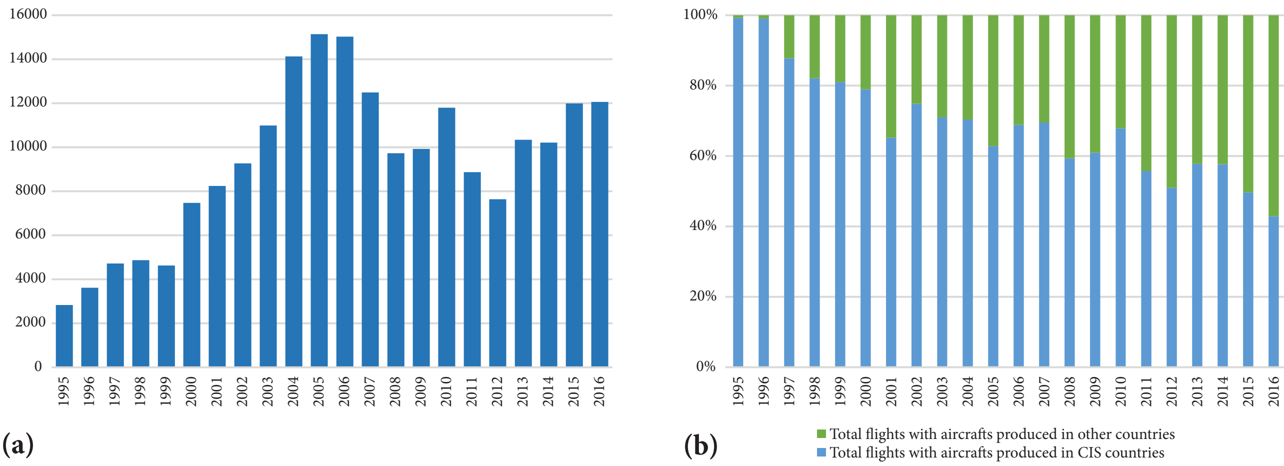


Figure 3-30: Total number of flights operated under the 'International Aviation' (Memo Items) source category in the RM within 1995-2016 periods (a); and the ratio of flights with aircrafts produced in CIS countries and other countries, in % from the total number of flights operated (b).

The largest share in the total GHG emissions from international aviation is covered by CO_2 (circa 70 per cent), less than 30 per cent of the total emissions are covered by water vapors and as little as circa 1 per cent by other gases (NO_x, CO, SO_2, NMVOC). The share of methane and nitrous oxide emissions is insignificant (it is considered that modern engines emit little or no CH_4, in particular, during the cruise cycle).

GHG emissions from source category 'International Aviation' (Memo Items) is presented below in Table 3-182. By 2015, CO_2 emissions reached the level of the reference year. For 1990-1994 time series, the results were restored using the partial overlapping method, while for 1995-2016 – by using a Tier 2b approach available in the 2006 IPCC Guidelines.

Table 3-182: GHG emissions from 'International Aviation' (Memo Items) in the Republic of Moldova within 1990-2016 periods, kt

	1990	1991	1992	1993	1994	1995	1996	1997	1998
CO_2	216.5837	232.8535	96.2944	62.1153	37.8367	41.9184	65.8650	75.6418	72.4923
CH_4	0.0105	0.0113	0.0047	0.0030	0.0018	0.0059	0.0048	0.0054	0.0041
N_2O	0.0070	0.0075	0.0031	0.0020	0.0012	0.0013	0.0021	0.0024	0.0023
NO_x	0.8905	0.9574	0.3959	0.2554	0.1556	0.1572	0.2563	0.3033	0.2935
CO	0.5270	0.5666	0.2343	0.1512	0.0921	0.1403	0.1684	0.1927	0.1739
NMVOC	0.2334	0.2510	0.1038	0.0669	0.0408	0.0813	0.0900	0.1018	0.0883
SO_2	0.0687	0.0738	0.0305	0.0197	0.0120	0.0133	0.0209	0.0240	0.0230
	1999	2000	2001	2002	2003	2004	2005	2006	2007
CO_2	72.4890	66.2279	61.8894	62.0647	70.1110	67.3304	67.6488	75.9610	79.8999
CH_4	0.0040	0.0043	0.0039	0.0036	0.0035	0.0035	0.0035	0.0040	0.0028
N_2O	0.0023	0.0021	0.0020	0.0020	0.0023	0.0022	0.0022	0.0025	0.0026
NO_x	0.2907	0.2728	0.2403	0.2505	0.2887	0.2767	0.2800	0.3208	0.3447
CO	0.1724	0.1738	0.1649	0.1652	0.1786	0.1815	0.1836	0.2037	0.1871
NMVOC	0.0877	0.0800	0.0728	0.0671	0.0705	0.0622	0.0628	0.0722	0.0698
SO_2	0.0230	0.0210	0.0196	0.0197	0.0222	0.0213	0.0214	0.0241	0.0253
	2008	2009	2010	2011	2012	2013	2014	2015	2016
CO_2	89.2738	82.6571	82.6894	95.4144	107.6790	130.4626	154.5245	218.4141	313.0386
CH_4	0.0017	0.0018	0.0027	0.0032	0.0031	0.0046	0.0034	0.0058	0.0063
N_2O	0.0029	0.0027	0.0027	0.0031	0.0034	0.0042	0.0050	0.0070	0.0100
NO_x	0.3939	0.3672	0.3600	0.3984	0.4332	0.5235	0.6239	0.9076	1.3124
CO	0.1807	0.1729	0.1894	0.2213	0.2338	0.3098	0.3279	0.4463	0.6066
NMVOC	0.0752	0.0709	0.0734	0.0959	0.1073	0.1345	0.1425	0.2200	0.2929
SO_2	0.0283	0.0262	0.0262	0.0303	0.0342	0.0414	0.0490	0.0693	0.0993

In comparison with the reference (1990) year level, by 2016, the GHG emissions from 'International Aviation' (Memo Items) source category represented: for CO_2 – circa 144.5 per cent, CH_4 – 60.0 per cent, N_2O – 142.9 per cent, NO_x – 147.4 per cent, CO – 115.1 per cent, NMVOC – 125.5 per cent and for SO_2 – 144.5 per cent (Table 3-183).

Table 3-183: GHG emissions from 'International Aviation' (Memo Items) in the Republic of Moldova within 1990-2016 periods, where 1990 represents 100 per cent

	1990	1991	1992	1993	1994	1995	1996	1997	1998
CO_2	100.0	107.5	44.5	28.7	17.5	19.4	30.4	34.9	33.5
CH_4	100.0	107.6	44.8	28.6	17.1	56.2	45.7	51.4	39.0
N_2O	100.0	107.1	44.3	28.6	17.1	18.6	30.0	34.3	32.9
NO_x	100.0	107.5	44.5	28.7	17.5	17.7	28.8	34.1	33.0
CO	100.0	107.5	44.5	28.7	17.5	26.6	32.0	36.6	33.0
NMVOC	100.0	107.5	44.5	28.7	17.5	34.8	38.6	43.6	37.8
SO_2	100.0	107.4	44.4	28.7	17.5	19.4	30.4	34.9	33.5
	1999	2000	2001	2002	2003	2004	2005	2006	2007
CO_2	33.5	30.6	28.6	28.7	32.4	31.1	31.2	35.1	36.9
CH_4	38.1	41.0	37.1	34.3	33.3	33.3	33.3	38.1	26.7
N_2O	32.9	30.0	28.6	28.6	32.9	31.4	31.4	35.7	37.1
NO_x	32.6	30.6	27.0	28.1	32.4	31.1	31.4	36.0	38.7
CO	32.7	33.0	31.3	31.3	33.9	34.4	34.8	38.7	35.5
NMVOC	37.6	34.3	31.2	28.7	30.2	26.6	26.9	30.9	29.9
SO_2	33.5	30.6	28.5	28.7	32.3	31.0	31.1	35.1	36.8
	2008	2009	2010	2011	2012	2013	2014	2015	2016
CO_2	41.2	38.2	38.2	44.1	49.7	60.2	71.3	100.8	144.5
CH_4	16.2	17.1	25.7	30.5	29.5	43.8	32.4	55.2	60.0
N_2O	41.4	38.6	38.6	44.3	48.6	60.0	71.4	100.0	142.9
NO_x	44.2	41.2	40.4	44.7	48.6	58.8	70.1	101.9	147.4
CO	34.3	32.8	35.9	42.0	44.4	58.8	62.2	84.7	115.1
NMVOC	32.2	30.4	31.4	41.1	46.0	57.6	61.1	94.3	125.5
SO_2	41.2	38.1	38.1	44.1	49.8	60.3	71.3	100.9	144.5

Between 1990 and 2001, direct GHG emissions originated from the 'International Aviation' (Memo Items) tended to decrease, from circa 218.93 kt CO_2 equivalent in 1990 to circa 62.59 kt CO_2 equivalent in 2001, while later, from 2002 to 2016 it slightly increased from circa 62.76 kt CO_2 equivalent in 2002 to circa 316.19 kt CO_2 equivalent in 2016 (Table 3-184, Figure 3-31).

Table 3-184: Direct GHG emissions from 'International Aviation' (Memo Items) in the Republic of Moldova within 1990-2016 periods

	Direct GHG emissions, kt CO_2 equivalent				in %, as compared to 1990				the share, in % of the total		
	CO_2	CH_4	N_2O	Total	CO_2	CH_4	N_2O	Total	CO_2	CH_4	N_2O
1990	216.5837	0.2618	2.0881	218.9336	100.0	100.0	100.0	100.0	98.9	0.1	1.0
1991	232.8535	0.2815	2.2450	235.3800	107.5	107.5	107.5	107.5	98.9	0.1	1.0
1992	96.2944	0.1164	0.9284	97.3393	44.5	44.5	44.5	44.5	98.9	0.1	1.0
1993	62.1153	0.0751	0.5989	62.7892	28.7	28.7	28.7	28.7	98.9	0.1	1.0
1994	37.8367	0.0457	0.3648	38.2473	17.5	17.5	17.5	17.5	98.9	0.1	1.0
1995	41.9184	0.1487	0.4001	42.4672	19.4	56.8	19.2	19.4	98.7	0.4	0.9
1996	65.8650	0.1196	0.6300	66.6146	30.4	45.7	30.2	30.4	98.9	0.2	0.9
1997	75.6418	0.1341	0.7235	76.4994	34.9	51.2	34.6	34.9	98.9	0.2	0.9
1998	72.4923	0.1025	0.6940	73.2888	33.5	39.1	33.2	33.5	98.9	0.1	0.9
1999	72.4890	0.0994	0.6934	73.2819	33.5	38.0	33.2	33.5	98.9	0.1	0.9
2000	66.2279	0.1086	0.6399	66.9765	30.6	41.5	30.6	30.6	98.9	0.2	1.0
2001	61.8894	0.0978	0.5990	62.5861	28.6	37.3	28.7	28.6	98.9	0.2	1.0
2002	62.0647	0.0909	0.6047	62.7602	28.7	34.7	29.0	28.7	98.9	0.1	1.0
2003	70.1110	0.0875	0.6823	70.8808	32.4	33.4	32.7	32.4	98.9	0.1	1.0
2004	67.3304	0.0866	0.6628	68.0797	31.1	33.1	31.7	31.1	98.9	0.1	1.0
2005	67.6488	0.0874	0.6661	68.4023	31.2	33.4	31.9	31.2	98.9	0.1	1.0
2006	75.9610	0.0989	0.7468	76.8068	35.1	37.8	35.8	35.1	98.9	0.1	1.0
2007	79.8999	0.0690	0.7782	80.7471	36.9	26.4	37.3	36.9	99.0	0.1	1.0
2008	89.2738	0.0421	0.8591	90.1750	41.2	16.1	41.1	41.2	99.0	0.0	1.0
2009	82.6571	0.0455	0.7970	83.4996	38.2	17.4	38.2	38.1	99.0	0.1	1.0
2010	82.6894	0.0663	0.8016	83.5573	38.2	25.3	38.4	38.2	99.0	0.1	1.0
2011	95.4144	0.0810	0.9115	96.4069	44.1	30.9	43.7	44.0	99.0	0.1	0.9
2012	107.6790	0.0765	1.0257	108.7812	49.7	29.2	49.1	49.7	99.0	0.1	0.9
2013	130.4626	0.1157	1.2430	131.8213	60.2	44.2	59.5	60.2	99.0	0.1	0.9
2014	154.5245	0.0859	1.4810	156.0913	71.3	32.8	70.9	71.3	99.0	0.1	0.9
2015	218.4141	0.1458	2.0772	220.6372	100.8	55.7	99.5	100.8	99.0	0.1	0.9
2016	313.0386	0.1576	2.9904	316.1867	144.5	60.2	143.2	144.4	99.0	0.0	0.9

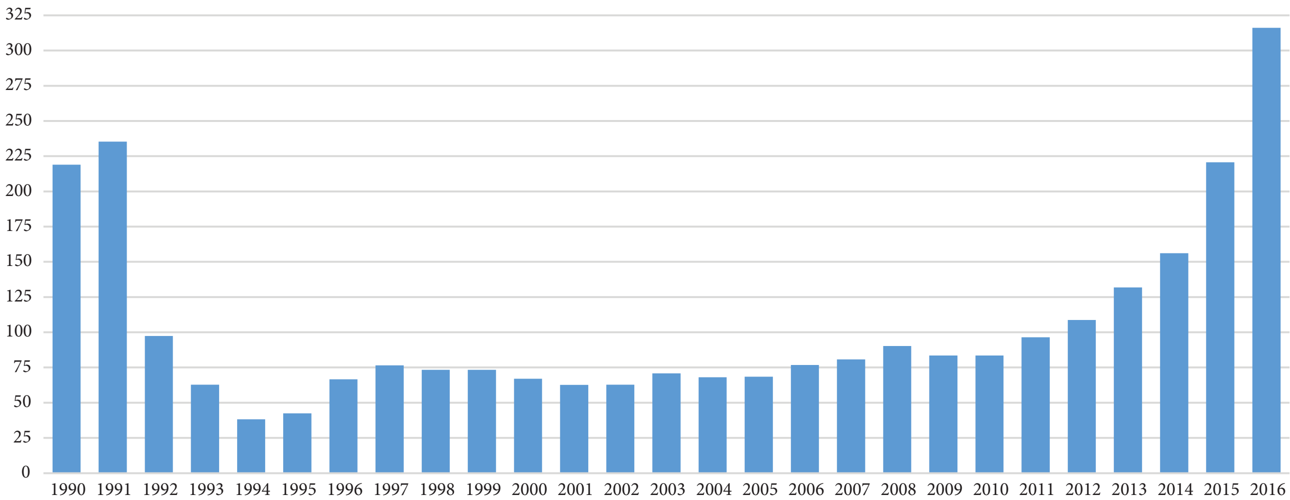


Figure 3-31: Direct GHG emissions from 'International Aviation' (Memo Items) in the Republic of Moldova within 1990-2016 periods, kt CO_2 equivalent.

3.8.2. Methodological Issues, Emission Factors and Data Sources

GHG emissions from the 'International Aviation' (Memo Items) were estimated using a Tier 2 methodological approach. Unlike Tier 1 methodology requiring only activity data on fuel consumption and default EFs values, 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' phases 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 (Table 3-185), as well as in 2006 IPCC Guidelines were used to estimate GHG emissions originated from this category (Tables 3-186, 3-187, 3-188).

Table 3-185: Default EFs used to estimate GHG emissions from 'International Aviation' (Memo Items) source category

	CO_2	CH_4	N_2O	NO_x	CO	NMVOC	SO_2
New Aircraft Types: LTO, kg/LTO	7900	1.5	0.2	41	50	15	2.5
Old aircraft types: LTO (kg/LTO)	7560	7	0.2	23.6	101	66	2.4
All aircraft types: cruise phase of flight (kg/t)	3150	0	0.1	17	5	2.7	1.0

ource: Revised 1996 IPCC Guidelines, Vol. 3, Table 1-52, Page 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, while for NO_x and for the LTO phase of the flight, there were used EFs available in the 2006 IPCC Guidelines.

For a number of aircrafts, EFs are available in the 2006 IPCC Guidelines (Volume 2, Chapter 3, Tables 3.6.9-3.6.10). In the process of selecting emission factors, information on the suitability of different types of aircrafts to representative classes can be useful (2006 IPCC Guidelines, Volume 2, Chapter 3, Table 3.6.3). Where EFs for a given type of aircraft are missing, the emission factors characteristic of the representative classes are used. For the types of aircrafts operating international flights in the RM, a table of their correspondence to the representative classes was completed, with a short description of their technical characteristics (Table 3-186).

Table 3-186: The correspondence between the most representative aircrafts and the aircrafts operating international flights in the Republic of Moldova

The generic name of the aircraft	Aircraft Class	Aircrafts operating international flights in the RM	Short technical description of aircraft
Large commercial jet aircrafts			
Airbus A319 Airbus A320 Airbus A321	Large commercial jet aircrafts	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 aircrafts	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 aircrafts	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 aircrafts	B747 (EFs similar for B-747/400 and 281F)	
Boeing 757	Large commercial jet aircrafts	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	Aircrafts 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 aircrafts 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 aircrafts, 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 aircrafts 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.
Bombardier CRJ-100/200	Jet aircrafts 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 aircrafts 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 aircrafts 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 aircrafts 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 c.p.
Saab-2000	Turbo-propelled aircrafts 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 c.p.

The generic name of the aircraft	Aircraft Class	Aircrafts operating international flights in the RM	Short technical description of aircraft
ATR-42 (ATR-42-320, ATR-42-500)	Turbo-propelled aircrafts 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 c.p.
DHC8-100	Turbo-propelled aircrafts 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 c.p.
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 c.p. 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 c.p.
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 c.p.; 1 c.p.= 735 W (c.p. meric); 1 kgc = 0.0098 кН; 1 horsepower = 75 kgc (www.covert-me.com). Since light and medium aircrafts have very different characteristics, for these the 2006 IPCC Guidelines does not provide specific EFs, in that case, for these aircrafts it will be selected the representative EFs (ATR-42; DHC8-100; Beech Kipr Air). For the light turbo-propelled aircrafts, in case of missing EFs, it will be applied emission factors characteristic for aircraft model Cesna 525/560.

Table 3-187: Default EFs for CO_2, CH_4, N_2O and NO_x available in the 2006 IPCC Guidelines, used to estimate GHG emissions from 'International Aviation' (Memo Items)

The generic name of the aircraft	Representative aircrafts (according to the 2006 IPCC Guidelines, V.2, Ch. 3, Tab. 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	7030	3150	11.9	0	0.2	0.1	14.33	9.1
TU-134	TU-134	0.93	2930	3150	1.8	0	0.1	0.1	8.68	8.5
YAK-40	YAK-42M	0.91	2880	3150	0.25	0	0.1	0.1	10.66	15.6
YAK-42	YAK-42M	0.91	2880	3150	0.25	0	0.1	0.1	10.66	15.6
IL-18		2.31	7300	3150	7.4	0	0.2	0.1	31.64	15.7
IL-76		2.31	7300	3150	7.4	0	0.2	0.1	31.64	15.7
AN-12 - AN-74	YAK-42M	0.91	2880	3150	0.25	0	0.1	0.1	10.66	15.6
A319	A319	0.73	2310	3150	0.06	0	0.1	0.1	8.73	11.6
A320	A320	0.77	2440	3150	0.06	0	0.1	0.1	9.01	12.9
A321	A321	0.96	3020	3150	0.14	0	0.1	0.1	16.72	16.1
B707	B707	1.86	5890	3150	9.75	0	0.2	0.1	10.96	5.9
B737	B737/300/400/500	0.78	2480	3150	0.08	0	0.1	0.1	7.19	11
B739	B737/900	0.8	2780	3150	0.07	0	0.1	0.1	12.3	14
B747	B747/400 and 281F	3.24	10240	3150	0.22	0	0.3	0.1	42.88	12.4
B757	B-757/300	1.46	4630	3150	0.01	0	0.1	0.1	17.85	9.8
L-410	DHC-8-400	0.2	640	3150	0	0	0.02	0.1	1.51	12.8
MD-83, MD-81, MD-82	MD-80	1.01	3180	3150	0.19	0	0.1	0.1	11.97	12.4
RJ-85, RJ-70, RJ-100	RJ-RJ85	0.6	1910	3150	0.13	0	0.1	0.1	4.34	15.6
BAE-146	BAE-146	0.57	1800	3150	0.14	0	0.1	0.1	4.07	8.4
E-120ER	ERJ-145	0.31	990	3150	0.06	0	0.03	0.1	2.69	7.9
E145, E135	E145	0.31	990	3150	0.06	0	0.03	0.1	2.69	7.9
Fokker-70	Fokker 100/70/28	0.76	2390	3150	0.14	0	0.1	0.1	5.75	8.4
Fokker-100	Fokker 100/70/28	0.76	2390	3150	0.14	0	0.1	0.1	5.75	8.4
CRJ-2	CRJ-100ER	0.33	1060	3150	0.06	0	0.03	0.1	2.27	8
ATR-42	ATR-42	0.2	620	3150	0.03	0	0.02	0.1	1.82	14.2
SF-340B	DHC8-100	0.2	640	3150	0	0	0.02	0.1	1.51	12.8
SF-2000	ATR-42	0.2	620	3150	0.03	0	0.02	0.1	1.82	14.2
DHC-8	DHC-8-400	0.2	640	3150	0	0	0.02	0.1	1.51	12.8
E190	E145	0.31	990	3150	0.06	0	0.03	0.1	2.69	7.9
HS-25	Cessna-525/500	0.34	1070	3150	0.33	0	0.03	0.1	0.74	7.2
Learjet-35	Cessna 525/500	0.34	1070	3150	0.33	0	0.03	0.1	0.74	7.2
Rom Bac 561R	BAC111	0.8	2520	3150	0.15	0	0.10	0.1	7.40	12
SA-227	DHC-8-400	0.2	640	3150	0.00	0	0.02	0.1	1.51	12.8
Falcon 2000EX	Cessna 525/500	0.34	1070	3150	0.33	0	0.03	0.1	0.74	7.2
X32-912 Becas	Beech King Air	0.07	230	3150	0.06	0	0.01	0.1	0.3	8.5
CRJ	CRJ-100ER	0.33	1060	3150	0.06	0	0.03	0.1	2.27	8
A-300-600	A-300	1.72	5450	3150	0.12	0	0.2	0.1	25.86	14.8

Table 3-188: Default EFs for CO, NMVOC and SO_2 available in the 2006 IPCC Guidelines, used to estimate GHG emissions from 'International Aviation' (Memo Items)

The generic name of the aircraft	Representative aircrafts (according to the 2006 IPCC Guidelines, Vol. 2, Ch. 3, Tab. 3.6.3, 3.6.9)	Consumption, t per LTO	Emission Factors					
			CO		NMVOC		SO_2	
			kg / LTO	kg / C	kg / LTO	kg / C	kg / LTO	kg / C
TU-154	ТУ-154В	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	B737/900	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
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 Republic of Moldova, large commercial jet aircrafts produced in the CIS countries were less exploited during the 2005-2016 time series, compared to 1995-2005. Of the contrary, the foreign produced aircrafts were much more intensely used for operating international flights between 2005 and 2016 (Table 3-189, Tab. 3-190).

Table 3-189: Number of international flights operated by aircrafts from the Republic of Moldova within 1995-2005 periods

	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	1037	755	976	749	562	124	3241	2811
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	1131	1038
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	1300	3294	5375	3906	3375
Mi-26											4
TU134	1001	1395	1261	1299	1325	1268	1329	1024	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
Other	158	176	366	137	104	102	91	178	142	255	475
Total flights with aircrafts of CIS production	**2809**	**3585**	**4142**	**3999**	**3751**	**5904**	**5379**	**6940**	**7798**	**9944**	**9511**

	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
A320					15				142	924	1256
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	1259	1467	1024	1671	369	132
SAAB-2000									269	970	2238
Total flights with other aircrafts	**20**	**34**	**576**	**872**	**877**	**1567**	**2867**	**2332**	**3189**	**4181**	**5626**
Total flights performed	**2829**	**3619**	**4718**	**4871**	**4628**	**7471**	**8246**	**9272**	**10987**	**14125**	**15137**

Table 3-190: Number of international flights operated by aircrafts from the Republic of Moldova within 2006-2016 periods

	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
AN-2	144	126	145	227	202						
AN-12	194	149	1								
AN-24	2782	1573	5								
AN-26	3085	1690	264	1175	863	463	652	689	302	765	383
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
Ka-32	42	283	126	126	139	300	284	309	268	171	193
Mi-2						1297	1022			1249	796
Mi-8	3088	3974	5032	4321	6720	2315	1264	3462	4133	2661	3021
Mi-17						320	493	1129	969	376	153
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	
Total flights with aircrafts of CIS production	**10350**	**8689**	**5774**	**6053**	**8007**	**4942**	**3895**	**5975**	**5891**	**5960**	**5168**
A319										445	965,5
A320	1679	1340	1517	1935	1779	1524	1399	1041.5	1239	1955	2701
A321	2									640	473
B-MD-81		9	134								
B-MD-82		196	182		11	20	35	3,50	157,5		
B-MD-83		28	54	31		6					
B707							58				
B737		61	1				6	22	6	104	40
B739									1		
B747										361	614
DHC-8		11									
E120	525	600	614	622	555	604	767	779	828	131	
E135								0	16	306	
E190					458	711	744	1500.5	1559	1654	1839,5
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	1934	1469	1442	1269	969	486	48				

	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
SA-227								95			
Falcon 2000EX								350	298		
X32-912 BECAS										228	
F28F Enstrom										21	
A-300-600											251
Total flights with other aircrafts	**4675**	**3803**	**3954**	**3874**	**3789**	**3924.5**	**3742**	**4369**	**4321**	**5933**	**6890**
Total flights performed	**15025**	**12492**	**9728**	**9927**	**11796**	**8866.5**	**7637**	**10344**	**10212**	**11933**	**12058**

Source: Civil Aviation State Administration of the RM through Official Letters No. 3978 dated 02.10.2006 and No. 1328 dated 13.09.2011; Civil Aviation Authority of the Republic of Moldova through Letters No. 474 dated 13.02.2014 and No. 366 dated 02.03.2015 and No. 1156 dated 27.05.2016 and No. 4040 dated 28.12.2017.

Table 3-191: Share of international flights operated in the RM within 1995-2016 periods with aircrafts from CIS and with other aircrafts, in % from the total number of flights operated

	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
Flights with aircrafts from CIS, %	99.3	99.1	87.8	82.1	81.1	79.0	65.2	74.8	71.0	70.4	62.8
Flights with other aircrafts, %	0.7	0.9	12.2	17.9	18.9	21.0	34.8	25.2	29.0	29.6	37.2
	2006	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**
Flights with aircrafts from CIS, %	68.9	69.6	59.4	61.0	67.9	55.7	51.0	57.8	57.7	49.7	42.9
Flights with other aircrafts, %	31.1	30.4	40.6	39.0	32.1	44.3	49.0	42.2	42.3	50.3	57.1

Source: Civil Aviation State Administration of the RM through Official Letters No. 3978 dated 02.10.2006 and No. 1328 dated 13.09.2011; Civil Aviation Authority of the Republic of Moldova through Letters No. 474 dated 13.02.2014 and No. 366 dated 02.03.2015 and No. 1156 dated 27.05.2016 and No. 4040 dated 28.12.2017.

The 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 there were revealed certain discrepancies between data on jet kerosene consumption for international aviation included in the Energy Balances of the Republic of Moldova for 1990 and 1993-2016 years and data provided by CAA (for 2003-2016 the difference being quite significant) (Table 3-192). Under such circumstances, in order to estimate GHG emissions from 'International Aviation', it was decided to use data provided by CAA, as deemed to be more accurate, since it was collected through direct questionnaires to the economic agents operating international flights in the RM.

Table 3-192: Jet kerosene consumption for international aviation in the Republic of Moldova within 1990-2016 periods, kt

	1990	1991	1992	1993	1994	1995	1996	1997	1998
Data available in the EBs	69.00	NA	NA	19.70	11.00	11.00	18.00	21.00	17.00
Data provided by CAA	68.69	73.85	30.54	19.70	12.00	13.30	20.90	24.00	23.00
Difference, %	-0.4	NA	NA	0.0	9.1	20.9	16.1	14.3	35.3
	1999	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**
Data available in the EBs	20.00	20.00	16.00	19.00	11.00	11.00	12.00	12.00	14.00
Data provided by CAA	23.00	21.00	19.62	19.67	22.22	21.33	21.44	24.07	25.33
Difference, %	15.0	5.0	22.6	3.5	102.0	93.9	78.6	100.6	80.9
	2008	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**
Data available in the EBs	14.00	14.00	13.00	13.00	15.00	13.00	17.00	18.00	32.00
Data provided by CAA	28.32	26.22	26.21	30.26	34.16	41.38	49.01	69.30	99.50
Difference, %	102.3	87.3	101.7	132.8	127.7	218.3	188.3	285.0	210.9

Source: EBs of the RM for 1990, 1993-2013; Civil Aviation State Administration of the RM through Official Letters Nr. 3978 dated 02.10.2006 and No. 1328 dated 13.09.2011; Civil Aviation Authority of the Republic of Moldova through Letters No. 474 dated 13.02.2014 and No. 366 dated 02.03.2015 and No. 1156 dated 27.05.2016 and No. 4040 dated 28.12.2017.

3.8.3. Uncertainties Assessment and Time-Series Consistency

The primary uncertainties related factors pertain to methodology, emission factors used to estimate GHG emissions covered by the 'International Aviation' (Memo Items) source category and quality of AD available.

Uncertainties associated with the EFs used to estimate CO_2 emissions are around ±5 per cent, those pertaining to EFs used to estimate CH_4 emissions reach up to ±10 per cent, while those related to EFs used to estimate N_2O emissions reach up to ±100 per cent. Uncertainties associated with the activity data regarding fuel consumption for international air transport represent ±5 per cent. Combined uncertainties for CO_2 emissions reach to circa ±7.1 per cent, while for CH_4 and N_2O, respectively at circa ±11.2% per cent and ±100.1 per cent (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.

3.8.4. 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.

For identifying the data entry and emission estimation process related errors there were applied verifications and quality control procedures.

Following the recommendations included into the 2006 IPCC Guidelines, the GHG emissions originated 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, a number of measures have been taken to improve the quality of the national GHG inventory and this implied to recalculate GHG emissions from 'International Aviation' source category. The main causes of these recalculations are, as follows:

- The missing values for AD regarding 1991-1992 were restored using the interpolation method (during the respective years, the Energy Balances have not been generated), GHG emissions were estimated using a Tier 1 approach;
- for 1995-2016 periods, GHG emissions from 'International Aviation' source category were estimated using two alternative approaches: Tier 1 and Tier 2b; after that, through the overlapping method, GHG emissions from 1990 to 1994 estimated by using the Tier 2b approach were restored (there are no AD on the number of operated flights for these years);
- Also, AD on the number of flights operated in 2014 and 2015 were updated.

In comparison with the results included into the NC4 of the Republic of Moldova under the UNFCCC (2018), the performed recalculations in the current inventory cycle resulted in an insignificant decrease of direct GHG emissions within 1990-1994, respectively, in an insignificant increase in 2014 and 2015 (Table 3-193). For 2016, the direct GHG emissions were estimated for the first time. Between 1990 and 2016, the respective emissions from 'International Aviation' (Memo Items) source category increased in the RM by circa 44.4 per cent.

Table 3-193: Recalculation results of GHG emissions from 'International Aviation' (Memo Items) included into the NC4 of the RM under the UNFCCC (2018), within 1990-2015 periods, kt CO_2 eq.

	1990	1991	1992	1993	1994	1995	1996	1997	1998
NC4	220.5278	236.2342	97.6598	62.9362	38.3261	42.4672	66.6146	76.4994	73.2888
BUR2	218.9336	235.3800	97.3393	62.7892	38.2473	42.4672	66.6146	76.4994	73.2888
Difference, %	-0.7	-0.4	-0.3	-0.2	-0.2	0.0	0.0	0.0	0.0
	1999	2000	2001	2002	2003	2004	2005	2006	2007
NC4	73.2819	66.9765	62.5861	62.7602	70.8808	68.0797	68.4023	76.8068	80.7471
BUR2	73.2819	66.9765	62.5861	62.7602	70.8808	68.0797	68.4023	76.8068	80.7471
Difference, %	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
NC4	90.1750	83.4996	83.5573	96.4069	108.7812	131.8213	156.0630	220.6280	
BUR2	90.1750	83.4996	83.5573	96.4069	108.7812	131.8213	156.0913	220.6372	316.1867
Difference, %	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	

Abbreviations: NC4 – Fourth National Communication of the RM under the UNFCCC (2018); BUR2 – Second Biennial Update Report of the RM under the UNFCCC (2019).

3.8.6. Planned Improvements

Within the 'International Aviation' (Memo Items) source category, 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 (2016), which considers the real values of emissions for each type of aircraft depending on the flight distance. Also, it could be used the emission calculator available in the updated version of the EMEP/EEA Air Pollutant Emission Inventory Guidebook (July 2017).

3.9. CO_2 Emissions from Biomass (Memo Items)

3.9.1. Source Category Description

Under the 'Memo Items' there are also monitored the 'CO_2 emissions from biomass'. In conformity with recommendations provided in the 2006 IPCC Guidelines, GHG emissions from biomass shall be estimated under each individual source category of the Sector 1 'Energy': non-CO_2 emissions shall be reported under the respective source category, while CO_2 emissions shall be reported separately, under the 'Memo Items', not being included into the national totals.

In comparison with the reference year level, by 2016 the CO_2 emissions from biomass increased by circa 570.9 per cent (Table 3-194, Figure 3-32).

Table 3-194: CO_2 emissions from biomass in the RM within 1990-2016 periods, kt

	1990	1991	1992	1993	1994	1995	1996	1997	1998
CO_2 emissions from biomass	232.8093	201.2009	169.5924	143.2360	157.4600	230.0480	294.0280	291.1280	269.0120
	1999	2000	2001	2002	2003	2004	2005	2006	2007
CO_2 emissions from biomass	266.1120	272.3720	282.2280	322.0800	373.5760	307.6800	307.3920	361.4360	304.6560
	2008	2009	2010	2011	2012	2013	2014	2015	2016
CO_2 emissions from biomass	352.4520	362.1000	341.0480	384.6400	403.3840	429.2796	1314.4896	1439.5226	1561.9690

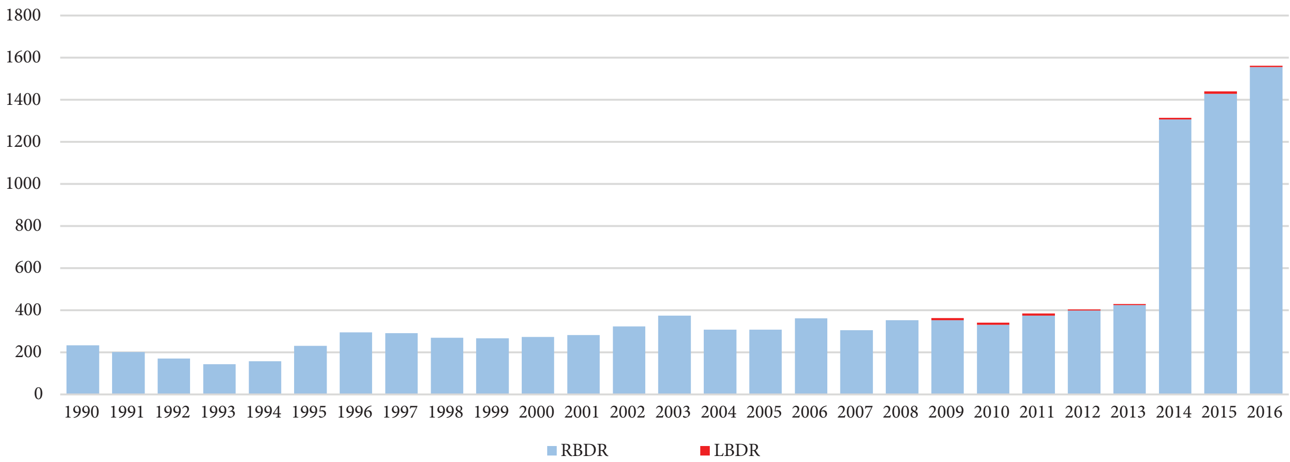


Figure 3-32: CO_2 Emissions from Biomass in the RM within 1990-2016 periods, kt.

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 emissions (fuel wood) = fuel consumption (thousand m³) • conversion factor in natural units (t/m³) • conversion factor in energy units (TJ/kt) • carbon emission factor (tC/TJ) – carbon stored • fraction oxidized • 44/12

CO_2 emissions (agricultural waste) = fuel consumption (thousand t.c.e.) • conversion factor in natural units (t/t.c.e.) • conversion factor in energy units (TJ/kt) • carbon emission factor (t C/TJ) –carbon stored • fraction oxidized • 44/12.

In the assessment process, a number of country specific factors were used, such as: 1 m^3 fuel wood – 0.73 t; 1 ton of bark – 0.42 t.c.e.; 1 ton of shavings – 0.05 t.c.e.; 1 ton of saw dust – 0.36 t.c.e.; 1 ton of wood processing waste – 0.12 t.c.e.; 1 ton of agricultural residues (straw, seed shells) – 0.50 t.c.e.; 1 ton of agricultural residues (maize cobs) – 0.33 t.c.e.; 1 t.c.e. – 2.00 t of agricultural residues; 1 kt of fuel wood – 12.32 TJ; 1000 m^3 fuel wood = 8.99 TJ; 1 TJ = 111.2 m^3 fuel wood; 1 kt of agricultural residues and wood waste = 14.67 TJ; 1000 t.e.c. of agricultural residues and wood waste = 29.34 TJ. The Fuel Wood Carbon Emission Factor is 30.50 t C/TJ, while the Agricultural Residues Carbon Emission Factor = 27.30 t C/TJ.

In order to estimate direct GHG emissions, default EFs available in the 2006 IPCC Guidelines were used, while for non-CO_2 emissions – the default EFs available in the EMEP/EEA Air Pollutant Emission Inventory Guidebook (2016, 2017) (Table 3-195).

Table 3-195: EFs used to estimate direct and indirect GHG emissions from biomass within the Sector 1 'Energy', kg/TJ

kg/TJ		CO_2	CH_4	N_2O	NO_x	CO	NMVOC	SO_2
1A1	Fuel Wood	112000	30	4	81	90	7.31	10.8
	Wood Waste and Agricultural Residues	112000	30	4	81	90	7.31	10.8
	Agricultural Residues	100000	30	4	81	90	7.31	10.8
	Charcoal	112000	200	4	81	90	7.31	10.8
	Pellets and Briquettes	100000	30	4	81	90	7.31	10.8
	Biogas	54600	1	0.1	89	39	2.6	0.281
	Other types of solid biomass	100000	30	4	81	90	7.31	10.8
1A2	Fuel Wood	112000	30	4	91	570	300	11
	Wood Waste and Agricultural Residues	112000	30	4	91	570	300	11
	Agricultural Residues	100000	30	4	91	570	300	11
	Charcoal	112000	200	4	91	570	300	11
	Pellets and Briquettes	100000	30	4	91	570	300	11
	Biogas	54600	1	0.1	74	29	23	0.67
	Other types of solid biomass	100000	30	4	91	570	300	11
1A4a	Fuel Wood	112000	300	4	91	570	300	11
	Wood Waste and Agricultural Residues	112000	300	4	91	570	300	11
	Agricultural Residues	100000	300	4	91	570	300	11
	Charcoal	112000	200	1	91	570	300	11
	Pellets and Briquettes	100000	300	4	91	570	300	11
	Biogas	54600	5	0.1	74	29	23	0.69
	Other types of solid biomass	100000	300	4	91	570	300	11
1A4b	Fuel Wood	112000	300	4	50	4000	600	11
	Wood Waste and Agricultural Residues	112000	300	4	50	4000	600	11
	Agricultural Residues	100000	300	4	50	4000	600	11
	Charcoal	112000	200	1	50	4000	600	11
	Pellets and Briquettes	100000	300	4	50	4000	600	11
	Biogas	54600	5	0.1	51	26	1.9	0.3
	Other types of solid biomass	100000	300	4	50	4000	600	11
1A4c	Fuel Wood	112000	300	4	91	570	300	11
	Wood Waste and Agricultural Residues	112000	300	4	91	570	300	11
	Agricultural Residues	100000	300	4	91	570	300	11
	Charcoal	112000	200	1	91	570	300	11
	Pellets and Briquettes	100000	300	4	74	29	23	0.69
	Biogas	54600	5	0.1	91	570	300	11
	Other types of solid biomass	100000	300	4	91	570	300	11
1A5	Fuel Wood	112000	30	4	91	570	300	11
	Wood Waste and Agricultural Residues	112000	30	4	91	570	300	11
	Agricultural Residues	100000	30	4	91	570	300	11
	Charcoal	112000	200	4	91	570	300	11
	Pellets and Briquettes	100000	30	4	74	29	23	11
	Biogas	54600	1	0.1	91	570	300	11
	Other types of solid biomass	100000	30	4	91	570	300	11

Sources: for CO_2, CH_4 and N_2O – 2006 IPCC Guidelines, Volume 2, Chapter 2, Tables 2.2-2.5, p. 17, 19, 21, 23; for NO_x, CO, NMVOC, SO_2 – EMEP/EEA Guidebook, November 2016, July 2017, Category 1A1, Tables 3-4 and 3-7; Category 1.A.2, Tables 3-1, 3-3 and 3-5; Category 1.A.4.a.i, Table 3-8 and 3-10; Category 1.A.4.b.i, Tables 3-4 and 3-6; Categories 1.A.4.c.i and 1.A.5.a, Table 3-8 and 3-10.

Activity data pertaining to biomass consumption (fuel wood, wood residues: barks, shavings, saw dust, wood processing waste; and agricultural crop residues: straw, seed shells, maize cobs; charcoal, briquettes and wood pellets and vegetal waste; biogas) in such categories as Energy Industries (1A1), Manufacturing Industry and Construction (1A2), Commercial/Institutional (1A4a), Residential (1A4b), Agriculture/Forestry/Fishing (1A4c), and Other (1A5), have been collected from the Energy Balances of the Republic of Moldova for 1990 and 1993-2016, respectively from the sectoral statistical publications of the ATULBD.

In the EBs of the RM the AD are available both in natural units (kt, thousand m^3), as well as in energy units (thousand t.c.e. and TJ) (with the exception of the EB for 1990, in which the information is available only in natural units and in tons of coal equivalent).

Regarding the types of biomass included in the inventory, the Energy Balances for 1990 and 1993-2002, present information on fuel wood and wood waste consumption; while the Energy Balances for 2003-2012 present information on fuel wood, wood waste and agricultural residues, in the Energy Balances for 2003-2016, there are also available data on biogas, pellets and briquettes consumption. For certain years, there are data also for 'Other Types of Fuel' (Table 3-196).

Table 3-196: Biomass consumption in the Republic of Moldova within 1990-2002 periods, TJ

IPCC Category	Fuel Type	1990	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
1A1	Fuel Wood /Wood Waste	9	6		9							
	Other types of solid biomass	59	50	147	88	88	59	29	29	59	147	235
1A2	Fuel Wood /Wood Waste	135	1027		29	29	29					
	Other types of solid biomass	176	302	29								
1A4a	Fuel Wood /Wood Waste	333	109	117	107	147	117	117	88	88	117	147
	Other types of solid biomass		6			29						
1A4b	Fuel Wood /Wood Waste	1052	766	822	1526	1048	1907	1966	1848	1731	1555	1878
	Other types of solid biomass	234	147	205	205	323	293	176	323	499	587	499
1A4c	Fuel Wood /Wood Waste	36	9	29	29	29	29				29	
	Other types of solid biomass		3									
1A5	Fuel Wood /Wood Waste	45	13	30	30	88	30	88	59	29	30	87
	Other types of solid biomass		12	1	30		30		29		29	29
1A	**Total biomass consumption**	**2079**	**2450**	**1380**	**2053**	**1781**	**2494**	**2376**	**2376**	**2406**	**2494**	**2875**

In the current inventory cycle, CO_2 emissions from the following types of biofuels were estimated: fuel wood, wood waste, agricultural residues, biogas, briquettes and wood pellets, charcoal and other types of solid biomass (Tables 3-197 and 3-198, Figure 3-33). For 1991-1992 time series, AD were restored using the interpolation method (AD used in previous inventory cycles have been replaced with new restored data).

Table 3-197: Biomass consumption in the Republic of Moldova within 1990-2003 periods, TJ

		1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
1A1a iii	Fuel Wood	9	8	7	6										
	Wood Waste and Agricultural Residues	59	56	53	50	147	88		59	29	29	59	147		29
	Agricultural Residues							88						235	205
1A2	Fuel Wood	134.9	112	88	65		29	29	29						
	Wood Waste and Agricultural Residues	175.8	140	103	67	29									
1A4a	Fuel Wood	332.76	258	184	109	117	117	147	117	117	88	88	117	147	381
	Wood Waste and Agricultural Residues				6			29							146
	Other types of solid biomass												29		
1A4b	Fuel Wood	1052.3	957	861	766	822	1526	1848	1907	1966	1848	1731	1555	1878	1964
RBDR	Wood Waste and Agricultural Residues	234.4	205	176	147	205	205	323	293	176	323	499	587	499	440
	Agricultural Residues											29			117
	Other types of solid biomass				29	29		29	117	29					
LBDR	Fuel Wood														
1A4c	Fuel Wood	35.974	27	18	9	29	29	29	29				29		29
	Wood Waste and Agricultural Residues				3										
	Other types of solid biomass				29	29		29	117	29					
1A5	Fuel Wood	44.968	34	24	13	30	30	89	30	88	59	29	30	87	59
	Wood Waste and Agricultural Residues				12	1	30		30		29		29	29	
	Other types of solid biomass							30	1					29	
1A	**Total, TJ**	**2079**	**1823**	**1567**	**1311**	**1438**	**2054**	**2670**	**2729**	**2434**	**2376**	**2435**	**2523**	**2904**	**3370**

Table 3-198: Biomass consumption in the Republic of Moldova within 2004-2016 periods, TJ

		2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
1A1a i	Biogas										10	18	14	2
1A1a ii	Biogas										29	79		
1A1a iii	Fuel Wood	3	3	2		1	1	2	1	1	37	29		
	Wood Waste and Agricultural Residues	16	16	1	1	1	2	2	1	3	3	5		
	Agricultural Residues	226	226	214	239	373	435	514	399	226	229	321		
	Pellets and Briquettes													22
	Biogas										7	99	387	359
1A2	Fuel Wood	9	11	7	6	7	4	11	17	17	20	13	44	
	Wood Waste and Agricultural Residues	39	26	1	5	14	10	16	25	36	5	16	407	
	Agricultural Residues								5	2	10			
1A4a	Fuel Wood	242	210	254	247	268	240	209	219	244	185	232	220	237
	Wood Waste and Agricultural Residues	78	31	26	18	15	36	36	17	18	35	26	14	13

		2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
	Agricultural Residues	14	5	2	14	28	300	41	31	88	68	118	50	58
	Coal and charcoal										3	21	16	13
	Pellets and Briquettes											94	83	
1A4b	Fuel Wood	1673	1704	2123	1716	1942	1767	1808	2134	2543	2880	10425	11439	13131
RBDR	Wood Waste and Agricultural Residues	320	294	340	271	312	395	237	137	273	164	124	52	89
	Agricultural Residues	130	214	245	197	212		66	419	96	134	105	135	53
	Charcoal									17	11		2	4
	Pellets and Briquettes											76	109	62
LBDR	Fuel Wood, TJ						92	97	90	48	42	69	98	62
1A4c	Fuel Wood	8	12	18	12	10	17	25	15	31	28	37	27	42
	Wood Waste and Agricultural Residues		3		1		2				1	2		
	Agricultural Residues	2	7	12	2	1	2	6		2	3	5	1	2
	Pellets and Briquettes												1	4
1A5	Fuel Wood	24	24	27	26	23	9	28	12					
	Wood Waste and Agricultural Residues	3	7	4	10	3		8	2	1				
	Agricultural Residues			2	1	1		7	2					
1A	**Total, TJ**	**2787**	**2793**	**3278**	**2769**	**3213**	**3312**	**3113**	**3526**	**3646**	**3904**	**11914**	**13099**	**14153**

In the sectoral statistical publications of the ATULBD, information associated with biomass consumption – fuel wood in the residential sector, is available in natural units (thousand m^3 comp.), but only for 2009-2016 time series (Table 3-199).

Table 3-199: Fuel wood consumption on the territory of LBDR under the 1A4b 'Residential' category, within 2009-2016 periods

	2009	2010	2011	2012	2013	2014	2015	2016
Fuel wood, thousand m^3 comp.	10.1793	10.8175	9.2527	5.5379	4.8690	7.6844	10.9011	6.8596
Fuel wood, TJ	91.55	91.57	89.51	48.37	42.17	69.11	98.00	62.00

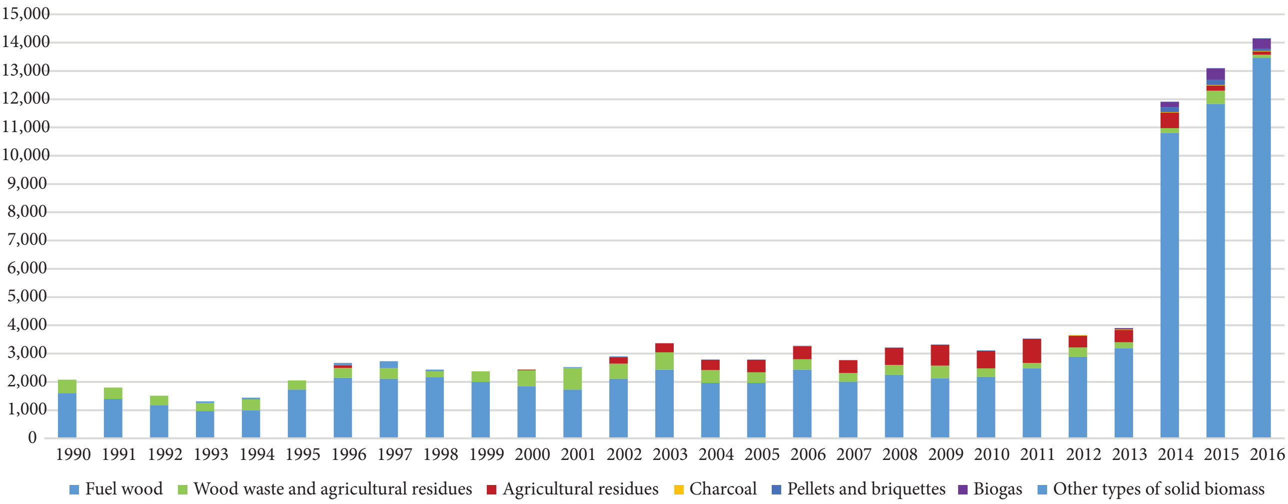


Figure 3-33: Biomass consumption in the RM, by types of fuels, within 1990-2016 periods, TJ.

3.9.3. Uncertainties Assessment and Time-Series Consistency

The primary uncertainties 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 represented circa 80 per cent while those related to AD – 20 per cent. Combined uncertainties were estimated at circa 82.5 per cent (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.

3.9.4. 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 AD and methods used for estimating GHG emissions under 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.

The specific verifications and quality control procedures applied for this source category included:

- Verification of AD collecting and manipulation procedures, including: verifying if disaggregation of AD collected for each category included in 1A 'Fuel Combustion Activities' subsector complies with the requirements set out in the description of each category in the 2006 IPCC Guidelines (1A1, 1A2, 1A3, 1A4 and 1A5); for each category, AD on biomass consumption are available in separate files in natural and energy units; verifying the correctness of EFs use for each category according to the 2006 IPCC Guidelines for direct GHG emissions, respectively according to the EMEP/EEA Guidebook 2016, 2017, for indirect GHG emissions; verifying if the primary reference sources are correctly indicated; the accuracy of calculations for categories included in 1A 'Fuel Combustion Activities' subsector 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 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;
- Verifying the inter-annual evolution trends of emissions by creating representative charts, while unusual fluctuations are explained;
- Verifying to what extent the full geographical coverage of the inventory is ensured;
- 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 into 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, a number of measures have been taken to improve the quality of the national GHG inventory and this implied to recalculate GHG emissions from 'CO_2 emissions from biomass' (Memo Items). The main causes of these recalculations are, as follows:

- The missing values for AD regarding 1991-1992 were restored using the interpolation method (during the respective years, the Energy Balances have not been generated);
- The errors related with correct insertion of AD into the spreadsheet were reviewed and corrected (for example, for 1996, it was mistakenly inserted a value associated with fuel consumption under the 1A5 category, while in 2002 – under 1A4a);
- The errors associated with the use of EFs related to wood waste consumption in 1990 under the 1A2 and 1A4b categories were corrected;
- Errors were corrected in the estimation equations used to assess indirect GHG emissions (CH_4, N_2O, NO_x, CO and NMVOC) from biofuels combustion;
- AD on biofuels consumption from 1A1 were updated for 2010-2015 time series.

In comparison with the results included into the NC4 of the Republic of Moldova under the UNFCCC (2018), the performed recalculations in the current inventory cycle resulted in a decrease of CO_2 emissions from biomass within 1991-1992, 1996, 2002, 2010-2015, respectively, in an insignificant increase in 1990 (Table 3-200). For 2016, CO_2 emissions from biomass were estimated for the first time. Between 1990 and 2016, the respective emissions increased by 570.9 per cent.

Table 3-200: Recalculation results of 'CO_2 emissions from biomass' (Memo Items) included into the NC4 of the RM under the UNFCCC (2018), within 1990-2015 periods, kt

	1990	1991	1992	1993	1994	1995	1996	1997	1998
NC4	229.3072	427.7268	531.1505	143.2360	157.4600	230.0502	295.4440	291.0280	269.0120
BUR2	232.8093	201.2009	169.5924	143.2360	157.4600	230.0480	294.0280	291.1280	269.0120
Difference, %	1.5	-53.0	-68.1	0.0	0.0	0.0	-0.5	0.0	0.0
	1999	2000	2001	2002	2003	2004	2005	2006	2007
NC4	266.1120	272.3720	282.2280	324.9000	373.5760	307.6800	307.3920	361.4360	304.6560
BUR2	266.1120	272.3720	282.2280	322.0800	373.5760	307.6800	307.3920	361.4360	304.6560
Difference, %	0.0	0.0	0.0	-0.9	0.0	0.0	0.0	0.0	0.0
	2008	2009	2010	2011	2012	2013	2014	2015	2016
NC4	352.4520	362.1000	343.3412	386.2234	404.3122	431.4636	1 317.1650	1 439.8048	
BUR2	352.4520	362.1000	341.0480	384.6400	403.3840	429.2796	1 314.4896	1 439.5226	1 561.9690
Difference, %	0.0	0.0	-0.7	-0.4	-0.2	-0.5	-0.2	0.0	

Abbreviations: NC4 – Fourth National Communication of the RM under the UNFCCC (2018); BUR2 – Second Biennial Update Report of the RM under the UNFCCC (2019).

3.9.6. Planned Improvements

Potential improvements within the 'CO_2 emissions from biomass' (Memo Items) could be achieved by collecting new available AD on fuel consumption on the territory of the LBDR and filling the existing gaps for certain years. To be noted that beginning with 2015, the Energy Balances of the Republic of Moldova are published in a new format – according to the common framework for the production, transmission, assessment and dissemination of comparable statistics in the energy sector within the Energy Community, as established at the international level by (EC) Regulation No.1099/2008 of the European Parliament and the Council from October, 22, 2008 on energy statistics, with further amendments, while at the national level, by the Decision of the National Bureau of Statistics College No. 6/3 from December, 23 2014.

In the Energy Balances for 2015/2016, the AD on biofuels consumption and waste in the residential sector (by population) were revised. The recalculation was carried out with the support of the Energy Community experts and the results were obtained within the 'Research on household energy consumption' developed by the NBS of the Republic of Moldova in 2015.

The significant increase of CO_2 emissions from biomass in recent years is due, on one hand, to a more strict evidence of biomass consumption, while on the other hand, to the use of a different method of recording the energy consumption in households, but only for 2010-2015/2016 time series. Expanding this method for the remaining years (1990-2009) covered by the national inventory would allow for more substantial improvements within the category 'CO_2 emissions from biomass' (Memo Items).

3.10. Comparison of CO_2 Emissions Estimated by using Reference and Sectoral Approaches

In conformity with the recommendations provided in the 2006 IPCC Guidelines, CO_2 emissions calculated by using two distinct approaches: the reference approach (top-down) and the sectoral approach (bottom-up) were compared (Table 3-201).

Table 3-201: Comparison of CO2 emissions estimated by using reference and sectoral approaches in the Republic of Moldova for 1990-2016 periods, kt

	1990	1991	1992	1993	1994	1995	1996	1997	1998
Reference Approach	35 068.3279	31 331.7444	24 946.0303	17 288.4173	14 347.7336	11 331.5265	11 194.2167	10 137.5783	8 718.4021
Sectoral Approach	35 280.1538	31 559.4826	25 040.2094	17 349.1681	14 384.7392	11 372.5410	11 258.6680	10 211.5893	8 789.3294
Difference, %	0.6	0.7	0.4	0.4	0.3	0.4	0.6	0.7	0.8
	1999	2000	2001	2002	2003	2004	2005	2006	2007
Reference Approach	7 257.1721	6 518.8855	7 119.8320	6 754.3765	7 400.2744	8 074.9948	8 250.9171	7 441.4607	7 696.0567
Sectoral Approach	7 328.0994	6 583.6452	7 180.3360	6 815.0348	7 468.7964	8 140.7721	8 317.0204	7 515.7016	7 774.1723
Difference, %	1.0	1.0	0.8	0.9	0.9	0.8	0.8	1.0	1.0
	2008	2009	2010	2011	2012	2013	2014	2015	2016
Reference Approach	8 164.8770	9 070.7585	9 361.0696	9 560.0251	9 089.1596	8 084.7552	8 654.6544	9 016.2301	8 724.6578
Sectoral Approach	8 252.2054	9 151.6023	9 441.9107	9 653.3531	9 194.4989	8 212.3614	8 805.8026	9 229.9350	9 030.9428
Difference, %	1.1	0.9	0.9	1.0	1.2	1.6	1.7	2.4	3.5

As the table reveals, with the exception of the last two years of the reference period, the differences do not reach the critical level of 2.0 per cent.

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, methodological guidance used, including the 2006 IPCC Guidelines for National Greenhouse Gas Inventories (IPCC, 2006) and EMEP/EEA Air Pollutant Emission Inventory Guidebook (2016).

In the Republic of Moldova, the source categories covered by this sector are: 2A 'Mineral Products' (*2A1 'Cement Production', 2A2 'Lime Production', 2A3 'Glass Production', 2A4 'Other Process Uses of Carbonates'[2A4a 'Ceramics', 2A4b 'Other Uses of Soda Ashes']*), 2B 'Chemical Industry' (*2B10 'Others' [Polyethylene, Acrylonitrile Butadiene Styrene Resins and Polystyrene Production]*), 2C 'Metal Production' (*2C1 'Iron and Steel Production'*), 2D 'Non-energy Products from Fuels and Solvent Use' (*2D1 'Lubricants Use', 2D2 'Paraffin Wax Use', 2D3 'Solvents Use' [domestic solvent use, road paving with asphalt, asphalt roofing, paint applications, degreasing, dry cleaning, chemical products, printing, other solvent and product use (seed oil extraction, uses of glues and adhesives, wood preservation, vehicle underseal treatment and vehicle dewaxing)], 2D4* 'Others' *(urea-based catalysts)*), 2F 'Product uses as substitutes for ODS' (*2F1 'Refrigeration and Air Conditioning', 2F2 'Foam Blowing Agents', 2F4 'Aerosols'*), 2G 'Other Products Manufacture and Use'(*2G1'Electric Equipment', 2G3 'N_2O from product uses' (medical application), 2G4 'Other' (Tobacco Combustion, Use of Shoes)* and 2H 'Other' (*2H2 'Food and Beverages Industry'*).

A brief overview, methodological issues and data sources, key categories, uncertainties 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 2016, Sector 2 'IPPU' accounted for circa 5.2 per cent of total national GHG direct emissions (without LULUCF), being a relevant source of GHG emissions in the country. This sector represented an important source of CO_2 national emissions (6.1 per cent of national total) and F-gas emissions (HFC, PFC and SF_6).

Table 4-1: Direct GHG Emissions from Sector 2 'IPPU' within 1990-2016, kt CO_2 equivalent

	1990	1991	1992	1993	1994	1995	1996	1997	1998
CO_2	1572.2808	1394.6352	808.8996	724.8725	548.7445	446.5790	405.4054	446.3084	371.0737
N_2O	0.0197	0.0164	0.0149	0.0179	0.0149	0.0003	0.0006	0.0009	0.0015
HFC	NO	NO	NO	NO	NO	3.9514	4.2815	5.1070	6.0624
PFC	NO	NO	NO	NO	NO	NO	NO	NO	NO
SF_6	NO	NO	NO	NO	NO	NO	NO	NO	NO
Total	**1572.3005**	**1394.6516**	**808.9145**	**724.8904**	**548.7594**	**450.5308**	**409.6875**	**451.4163**	**377.1376**
	1999	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**
CO_2	334.1373	305.7865	308.5598	357.7976	385.6075	456.2031	551.0519	648.0792	893.3513
N_2O	0.0128	0.0131	0.0131	0.0131	0.0131	0.0149	0.0182	0.0176	NO
HFC	6.8017	8.3038	10.4771	14.5015	20.8415	29.1966	40.7988	53.5982	67.7992
PFC	NO	NO	NO	NO	NO	NO	NO	0.0231	0.0231
SF_6	NO	NO	NO	NO	0.0071	0.0071	0.0572	0.3307	0.4306
Total	**340.9518**	**314.1033**	**319.0500**	**372.3123**	**406.4693**	**485.4217**	**591.9260**	**702.0487**	**961.6041**
	2008	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**
CO_2	972.6989	463.8910	488.7178	578.6725	588.1935	631.0394	651.6580	615.2290	585.1146
N_2O	NO	NO	NO	NO	NO	NO	NO	NO	NO
HFC	82.0655	91.3620	102.8657	116.5249	124.2123	130.5506	142.0853	167.8122	175.5848
PFC	0.0288	0.0288	0.0403	0.0403	0.0403	0.0403	0.0403	0.0403	0.0403
SF_6	0.5186	0.5615	0.6819	0.7174	0.7757	0.9770	1.0667	1.1195	1.1252
Total	**1055.3117**	**555.8433**	**592.3056**	**695.9553**	**713.2218**	**762.6073**	**794.8503**	**784.2010**	**761.8649**

Abbreviations: NO – 'Not Occurring'.

Between 1990 and 2016, the total GHG emissions originated from the Sector 2 'IPPU' tended to lower values, decreasing by circa 51.5 per cent, from 1.57 Mt CO_2 equivalent in 1990 to 0.76 Mt CO_2 equivalent in 2016 (Table 4-1, Figure 4-1), in particular due to reduced industrial output, such as mineral products (for example, cement production decreased by 60.7 per cent; clinker production – by 55.1 per cent; lime production – by 90.7 per cent; glass production – by 25.2 per cent; bricks production – by 81.4 per cent; soda ash use – by 55.1 per cent), steel production – by 81.8 per cent, rolling mills production – by 63.8 per cent and non-energy products from fuels and solvent use (lubricants use decreased by 80.2 per cent, while paraffin wax use – by 60.5 per cent, etc.

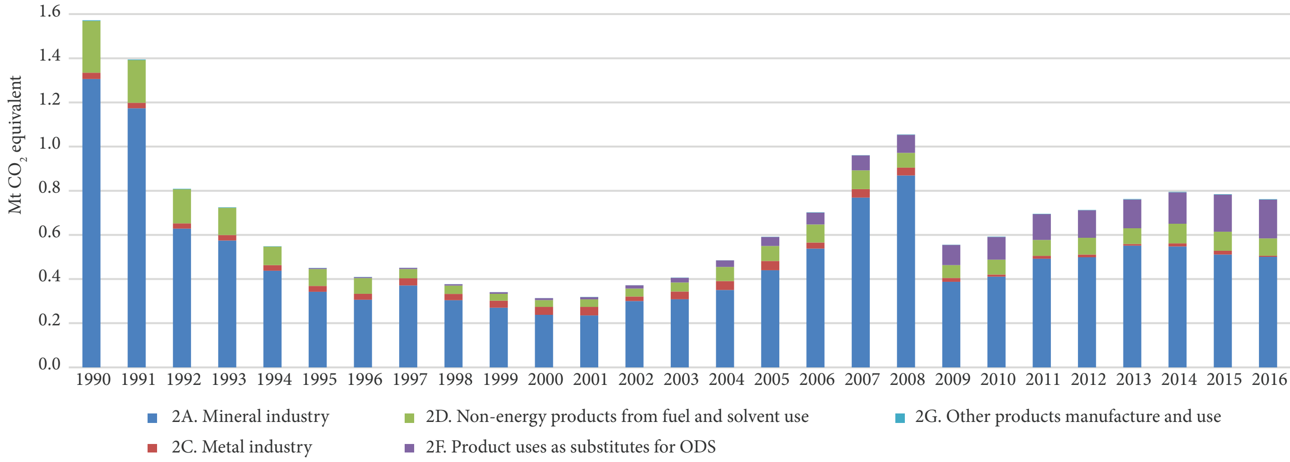


Figure 4-1: Total Direct GHG Emissions from Sector 2 'IPPU' in the RM within 1990-2016

In 1990, there were registered only CO_2 and N_2O emissions within this sector, while in 2016, the share in the total GHG emissions covered by Sector 2 'IPPU' represented: CO_2 – 76.8 per cent, HFC – 23.0 per cent, PFC – 0.005 per cent and SF_6 – 0.148 per cent.

It can be noted that 2A 'Mineral industry', 2D 'Non-energy products from fuel and solvent use' and 2F 'Product uses as substitutes for ODS' categories represent the major sources of direct GHG emissions under Sector 2 'IPPU' (Tables 4-2 and 4-3) with a share varying from a minimum of 65.1 per cent (2015) to a maximum of 84.2 per cent (1991), from a minimum of 6.4 per cent (2008) to a maximum of 19.1 per cent (1992), respectively from a minimum of 0.9 per cent (1995) to a maximum of 23.0 per cent (2016) of the total.

Table 4-2: Total Direct GHG Emissions from the Sector 2 'IPPU' by Category in the RM within 1990-2016, kt CO_2 equivalent

	1990	1991	1992	1993	1994	1995	1996	1997	1998
2A. Mineral industry	1306.2407	1173.7238	628.3873	574.7172	437.5899	342.6866	306.5696	370.9362	304.0902
2C. Metal industry	28.5023	24.7297	23.9922	24.4250	25.3289	26.2369	26.7261	32.3806	28.6822
2D. Non-energy products from fuel and solvent use	234.3591	193.3185	154.2628	123.8759	84.4738	76.5608	71.0711	42.0527	37.5993
2F. Product uses as substitutes for ODS	NO	NO	NO	NO	NO	3.9514	4.2815	5.1070	6.0624
2G. Other products manufacture and use	3.1983	2.8795	2.2722	1.8723	1.3668	1.0950	1.0392	0.9398	0.7035
2. IPPU	**1572.3005**	**1394.6516**	**808.9145**	**724.8904**	**548.7594**	**450.5308**	**409.6875**	**451.4163**	**377.1376**
	1999	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**
2A. Mineral industry	270.1228	237.9796	235.2359	300.3739	308.3700	350.6290	440.2134	538.2308	768.8438
2C. Metal industry	31.7942	36.2689	38.6274	20.5030	35.4283	40.5084	41.9358	27.0182	38.6127
2D. Non-energy products from fuel and solvent use	31.6142	30.6392	33.9235	36.1900	40.9211	64.1000	67.8400	81.8718	84.9474
2F. Product uses as substitutes for ODS	6.8017	8.3038	10.4771	14.5015	20.8415	29.1966	40.7988	53.5982	67.7992
2G. Other products manufacture and use	0.6190	0.9118	0.7861	0.7438	0.9083	0.9876	1.1379	1.3298	1.4010
2. IPPU	**340.9518**	**314.1033**	**319.0500**	**372.3123**	**406.4693**	**485.4217**	**591.9260**	**702.0487**	**961.6041**
	2008	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**
2A. Mineral industry	869.1962	387.9410	411.0616	492.3783	498.5638	551.2987	547.8150	510.8250	500.5774
2C. Metal industry	35.4118	17.0619	9.6985	12.8556	12.6973	7.6569	13.8464	17.2792	5.2203
2D. Non-energy products from fuel and solvent use	67.1050	58.1883	67.0530	72.3407	75.8897	70.9399	88.9627	86.3698	78.6128
2F. Product uses as substitutes for ODS	82.0655	91.3620	102.8657	116.5249	124.2123	130.5506	142.0853	167.8122	175.5848
2G. Other products manufacture and use	1.5333	1.2901	1.6268	1.8557	1.8588	2.1611	2.1409	1.9148	1.8696
2. IPPU	**1055.3117**	**555.8433**	**592.3056**	**695.9553**	**713.2218**	**762.6073**	**794.8503**	**784.2010**	**761.8649**

Abbreviations: NO – 'Not Occurring'.

To be noted that the specific weight of the source category 2F 'Product uses of substitutes of ODS' in the total direct GHG emissions covered by Sector 2 'IPPU', tends to increase significantly lately (Table 4-3).

Table 4-3: Breakdown of the Sector 2 'IPPU' GHG Emissions by Category within 1990-2016

	1990	1991	1992	1993	1994	1995	1996	1997	1998
2A. Mineral industry	83.1	84.2	77.7	79.3	79.7	76.1	74.8	82.2	80.6
2C. Metal industry	1.8	1.8	3.0	3.4	4.6	5.8	6.5	7.2	7.6
2D. Non-energy products from fuel and solvent use	14.9	13.9	19.1	17.1	15.4	17.0	17.3	9.3	10.0
2F. Product uses as substitutes for ODS	NO	NO	NO	NO	NO	0.9	1.0	1.1	1.6
2G. Other products manufacture and use	0.20	0.21	0.28	0.26	0.25	0.24	0.25	0.21	0.19
	1999	2000	2001	2002	2003	2004	2005	2006	2007
2A. Mineral industry	79.2	75.8	73.7	80.7	75.9	72.2	74.4	76.7	80.0
2C. Metal industry	9.3	11.5	12.1	5.5	8.7	8.3	7.1	3.8	4.0
2D. Non-energy products from fuel and solvent use	9.3	9.8	10.6	9.7	10.1	13.2	11.5	11.7	8.8
2F. Product uses as substitutes for ODS	2.0	2.6	3.3	3.9	5.1	6.0	6.9	7.6	7.1
2G. Other products manufacture and use	0.18	0.29	0.25	0.20	0.22	0.20	0.19	0.19	0.15
	2008	2009	2010	2011	2012	2013	2014	2015	2016
2A. Mineral industry	82.4	69.8	69.4	70.7	69.9	72.3	68.9	65.1	65.7
2C. Metal industry	3.4	3.1	1.6	1.8	1.8	1.0	1.7	2.2	0.7
2D. Non-energy products from fuel and solvent use	6.4	10.5	11.3	10.4	10.6	9.3	11.2	11.0	10.3
2F. Product uses as substitutes for ODS	7.8	16.4	17.4	16.7	17.4	17.1	17.9	21.4	23.0
2G. Other products manufacture and use	0.15	0.23	0.27	0.27	0.26	0.28	0.27	0.24	0.25

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, as well as in the Annex 1-2. Table 4-4 provides information on identified key categories by level and trend under the Sector 2 'IPPU'.

Table 4-4: Key Categories Identified under the Sector 2 'IPPU'

IPCC Codes	GHG	IPCC Categories	Key Categories
2A1.	CO_2	Cement Production	Yes (L, T)
2A2.	CO_2	Lime Production	Yes (T)
2A3.	CO_2	Glass Production	No
2A4.	CO_2	Other Process Uses of Carbonates	No
2C1.	CO_2	Iron and Steel Production	No
2D1.	CO_2	Lubricants Use	No
2D2.	CO_2	Paraffin Waxes Use	No
2D3.	CO_2	Solvents Use	No
2D4.	CO_2	Other (Urea-Based Catalysts)	No
2F1.	HFC	Refrigeration and Air Conditioning Equipment	Yes (T)
2F2.	HFC	Foam Blowing	Yes (L, T)
2F4.	HFC	Aerosols	No
2G1.	PFC	Electrical Equipment	No
2G1.	SF_6	Electrical Equipment	No
2G3.	N_2O	N_2O from Product Uses (Medical Applications)	No
2G4.	CO_2	Other (Tobacco Burning and Use of Shoes)	No

4.1.3. Methodological Issues

Emissions covered by categories 2A 'Mineral Industry', 2C 'Metal Industry', 2D 'Non-Energy Products from Fuels and Solvents 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 values, as well as the Tier 2 methodological approach and country specific emission factors. A summary description of methods used to estimate emissions by source categories is provided in Table 4-5, while a more detailed description is available in the respective sub-chapters of this report (4.2-4.8).

Table 4-5: Summary of Methods and Emission Factors Used to Estimate GHG Emissions from the Sector 2 'IPPU'

IPCC Codes	Category name	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 fuel and solvent use	T2, T1	D	NO	NO	NA	NA	NA	NA	NA	NA
2E.	Electronic 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 products 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 Assessment and Time-Series Consistency

The uncertainty analysis of the GHG emissions from the Sector 2 'IPPU' (by categories) is described in detail in sub-chapters (4.2-4.8) of the NIR, as well as in Annex 5-3.2. To be noted, that combined uncertainties as a percentage of total sectoral emissions were estimated at circa ±8.84 per cent. The uncertainties introduced in trend in sectoral emissions were estimated at ±4.66 per cent. 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 GPG.

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. To be noted that the AD and methods used for estimating GHG emissions originated 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 included into the 2006 IPCC Guidance, GHG emissions were estimated using AD and national coefficients and parameters from official sources of reference.

4.1.6. Recalculations

GHG emissions recalculation under the Sector 2 'IPPU' are due to: the use of 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 2005-2016', respectively due to use of updated EFs, coefficients and CS parameters.

In comparison with the results included into the NC4 of the RM under the UNFCCC (2018), the performed recalculation resulted in a decrease of direct GHG emissions between 1990 and 2015, varying from a minimum of 0.4 per cent in 2011-2012, up to a maximum of 2.1 per cent in 2010 (Table 4-6).

Table 4-6: Recalculated GHG Emissions under the Sector 2 'IPPU' for the 1990-2016, included in the NC4 of the Republic of Moldova under the UNFCCC, kt CO_2 equivalent

	1990	1991	1992	1993	1994	1995	1996	1997	1998
NC4	1581.0137	1402.6457	814.3716	733.1500	552.8991	453.5222	412.8731	455.0080	380.9260
BUR2	1572.3005	1394.6516	808.9145	724.8904	548.7594	450.5308	409.6875	451.4163	377.1376
Difference, %	-0.6	-0.6	-0.7	-1.1	-0.7	-0.7	-0.8	-0.8	-1.0
	1999	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**
NC4	345.2145	319.0457	324.2573	377.0015	411.9173	489.7155	598.5509	709.1884	971.2988
BUR2	340.9518	314.1033	319.0500	372.3123	406.4693	485.4217	591.9260	702.0487	961.6041
Difference, %	-1.2	-1.5	-1.6	-1.2	-1.3	-0.9	-1.1	-1.0	-1.0
	2008	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**
NC4	1063.8673	560.0802	604.9577	698.5117	716.3927	770.2877	804.9205	795.0511	
BUR2	1055.3117	555.8433	592.3056	695.9553	713.2218	762.6073	794.8503	784.2010	761.8649
Difference, %	-0.8	-0.8	-2.1	-0.4	-0.4	-1.0	-1.3	-1.4	

Abbreviations: NC4 – Fourth National Communication; BUR2 – Second Biennial Update Report.

4.1.7. Assessment of Completeness

The current inventory covers GHG emissions from 7 source categories of the 8 included in Sector 2 'IPPU' (Table 4-7).

Table 4-7: Assessment of Completeness under the Sector 2 'IPPU'

IPCC Codes	Category name	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 fuel and solvent use	X	NO	NA	NA	NA	NA
2E	Electronic industry	NA	NA	NA	NO	NO	NO
2F	Product uses as substitutes for ODS	NA	NA	X	NA	NA	NA
2G	Other products manufacture and use	X	X	NA	X	X	NA
2H	Other	NO	NO	NA	NA	NA	NA

Abbreviations: X – source categories included into inventory; NO – Not Occurring; NA – Not Applicable.

4.1.8. Planned Improvements

Planned improvements at the source categories level within the Sector 2 'IPPU' is described in more detail in the respective sub-chapters (4.2-4.8) of the NIR.

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' (bricks, expanded clay and ceramics production). Over the period under review, 1990-2016, the direct GHG emissions originated from the category 2A 'Mineral Industry' decreased by circa 61.7 per cent (Table 4-8).

Table 4-8: Total Direct GHG Emissions from the Category 2A 'Mineral Industry' by Source within 1990-2016, kt CO_2 equivalent

	1990	1991	1992	1993	1994	1995	1996	1997	1998
2A1. Cement Production	971.6967	900.7877	474.3138	405.7165	328.4361	248.5258	193.1220	270.1273	215.0572
2A2. Lime Production	232.4996	176.5179	103.7620	100.6076	76.1330	69.3788	89.0847	75.7247	64.8141
2A3. Glass Production	25.2212	25.0580	11.9560	10.8638	3.7901	4.7151	6.9080	4.6608	4.9882
2A4. Other Process Uses of Carbonates	76.8231	71.3602	38.3555	57.5293	29.2308	20.0670	17.4550	20.4234	19.2306
2A. Mineral Industry	**1306.2407**	**1173.7238**	**628.3873**	**574.7172**	**437.5899**	**342.6866**	**306.5696**	**370.9362**	**304.0902**
	1999	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**
2A1. Cement Production	210.8122	172.7600	173.8847	219.1917	245.6276	282.5765	365.0817	457.0753	702.6656
2A2. Lime Production	36.6099	30.7649	28.5383	39.4860	22.0253	22.8789	31.5025	35.1917	24.9579
2A3. Glass Production	3.4167	15.4704	14.0377	18.7603	17.2567	17.8332	20.5674	21.5950	18.7981
2A4. Other Process Uses of Carbonates	19.2840	18.9843	18.7753	22.9359	23.4604	27.3405	23.0617	24.3688	22.4222
2A. Mineral Industry	**270.1228**	**237.9796**	**235.2359**	**300.3739**	**308.3700**	**350.6290**	**440.2134**	**538.2308**	**768.8438**
	2008	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**
2A1. Cement Production	789.9160	340.5679	349.8333	427.2624	442.1615	476.9104	464.6082	443.2441	433.9022
2A2. Lime Production	35.5041	10.5446	21.6512	22.0613	20.6563	30.1662	39.1904	21.7547	21.5797
2A3. Glass Production	21.5408	16.3507	19.5231	25.0779	20.7542	26.9857	27.1317	30.3969	30.1307
2A4. Other Process Uses of Carbonates	22.2352	20.4778	20.0540	17.9768	14.9917	17.2364	16.8848	15.4294	14.9649
2A. Mineral Industry	**869.1962**	**387.9410**	**411.0616**	**492.3783**	**498.5638**	**551.2987**	**547.8150**	**510.8250**	**500.5774**

The significant decrease of emissions recorded in 2008 and 2009, can be explained by the effects of the global economic crises from 2009 that affected the national economy, including the industrial sector, in particular due to a sharp decrease of customer's purchasing power from the traditional markets. The subsequent economic recovery of the industrial sector during 2010-2013 had slow growth rates. Compared with 2013 level, the GHG emissions originated from this category decreased by circa 0.6 per cent in 2014, in 2015 they decreased by another 6.8 per cent compared with the previous year, while in 2016, GHG emissions continued to decrease with another 2.0 per cent in comparison with 2015 (Figure 4-2).

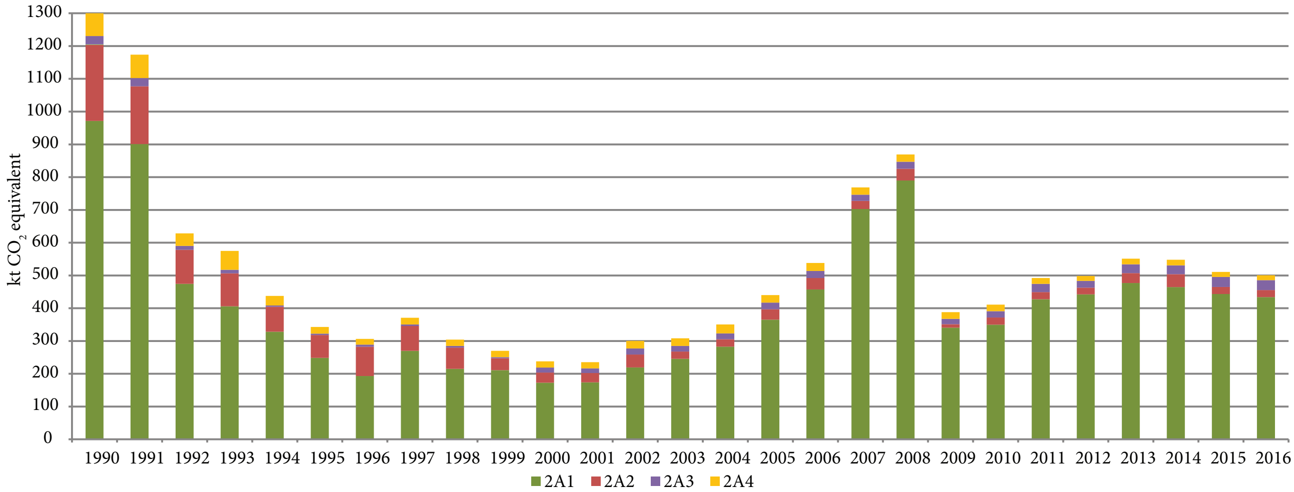


Figure 4-2: Direct GHG Emissions from the Category 2A 'Mineral Industry' by Source, 1990-2016

Similar trends were recorded for the indirect GHG emissions (NO_x, CO, NMVOC) and SO_2 originated from the source category 2A 'Mineral Industry' (Table 4-9).

Table 4-9: Indirect GHG Emissions and SO_2 from the Category 2A 'Mineral Industry' by Gas in the Republic of Moldova within 1990-2016, kt

	1990	1991	1992	1993	1994	1995	1996	1997	1998
NO_x	3.4824	3.2148	1.6607	1.5690	1.2218	1.0250	0.8724	1.0716	0.9420
CO	3.3540	3.0021	1.6135	1.4535	1.1320	0.8818	0.7810	0.9575	0.7779
NMVOC	0.0339	0.0315	0.0165	0.0143	0.0115	0.0089	0.0069	0.0096	0.0078
SO_2	1.2645	1.1965	0.5982	0.5827	0.4572	0.4060	0.3361	0.4134	0.3832
	1999	2000	2001	2002	2003	2004	2005	2006	2007
NO_x	0.8158	0.9242	0.8765	1.0852	1.0721	1.1984	1.4680	1.6619	2.1654
CO	0.6939	0.5746	0.5715	0.7298	0.7534	0.8689	1.1141	1.3730	2.0062
NMVOC	0.0075	0.0067	0.0066	0.0083	0.0091	0.0104	0.0133	0.0164	0.0244
SO_2	0.3247	0.4349	0.4038	0.4931	0.4765	0.5238	0.6274	0.6761	0.8139
	2008	2009	2010	2011	2012	2013	2014	2015	2016
NO_x	2.3845	1.1775	1.2832	1.5766	1.5049	1.6944	1.6724	1.6204	1.5895
CO	2.2999	0.9929	1.0406	1.2592	1.2916	1.4147	1.4004	1.2924	1.2591
NMVOC	0.0277	0.0122	0.0126	0.0155	0.0158	0.0172	0.0167	0.0160	0.0157
SO_2	0.8688	0.4724	0.5285	0.6562	0.5987	0.6865	0.6764	0.6756	0.6655

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, is heated at high temperatures in a kiln, to form the lime (CaO) and/or dolomite lime (CaO • MgO) and carbon dioxide (CO_2) in a process called "calcination".

$$CaCO_3 \text{ (limestone)} + heat \rightarrow CaO \text{ (lime)} + CO_2$$

$$CaMg(CO_3)_2 \text{ (dolomite)} + heat \rightarrow CaO \bullet MgO \text{ (dolomite lime)} + 2CO_2$$

Lime and/or dolomite lime is then combined with silicon containing materials (SiO_2), aluminum (Al_2O_3) and iron oxide (Fe_2O_3) to produce clinker (grayish-black pellets about the size of 12 mm-diameter marbles). The clinker is then removed from the kiln, chilled and pulverized, and added to gypsum to obtain 'Portland Cement'. Currently, all cement produced in the Republic of Moldova is of 'Portland' type, in which, according to ORTECH Corporation (1994), CaO content varies between 60-67 per cent, and MgO content is around 2 per cent.

To be noted, two cement producing plants are currently operating in the RM: Lafarge Cement (Moldova) J.S.C. in Rezina and Cement and Slate Combined Works in Ribnita (ATULBD). CO_2 emissions from cement production are directly proportionate to CaO fraction from the clinker used in its production. GHG emissions resulting from the combustion of fossil fuels used to produce heat which induces reaction in the oven, are covered by the Energy Sector and are not discussed in this chapter.

2A2. Lime Production

Lime (CaO) is formed by heating the 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 the quarry to produce caustic lime (quicklime) using the above-mentioned reaction (see '*Cement Production*' section). Dolomite limestone can also be heated at high temperatures to obtain dolomite lime, consequently, produce 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 (window) glass, containers, fiber glass 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 alkalis and alkaline earths, 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 per cent of the total raw material used). The process of glass melting for different types is similar. The process of glass production consists of the following steps: selection and preparation of raw material, melting, moulding, hardening, quenching and finishing. During this process, the main pollutants emitted are $CO_{2,}$ as well as NO_x, CO and SO_2. CO_2 emissions result from lime and other carbonates calcination at high temperature. The main mechanisms for NO_x emissions 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_2 emitted in the glass production process is determined in particular by the sulfur content of the molten dose and the sulfur absorption capacity, the excess air and the combustion temperature.

2A4. Other Process Uses of Carbonates

a. Ceramics

Ceramics production includes mining, processing and refining the raw materials (clays) using additives such as kaolin or limestone, forming, cutting, drying and firing in the kiln the final product. The main pollutants resulting from the calcination of carbonates at high temperatures in the process of ceramics production are CO_2 and SO_2.

b. Other Uses of Soda Ash

Other from the glass production, soda ash or sodium carbonate (Na_2CO_3) is used as raw material in a number of industries, such as: soap and detergents production, paper production, as well as in wastewater treatment. CO_2 emissions are produced by the use of sodium carbonate, as well as during the production process, depending on its type (to be noted that in the RM, no sodium carbonate is being produced).

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 Guidance), 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.

$$EF_{clinker} = Content\ CaO \bullet stoichiometric\ ratio\ CO_2/CaO + Content\ MgO \bullet stoichiometric\ ratio\ CO_2/MgO$$

$$CO_2\ emissions = EF_{clinker} \bullet Clinker\ Production \bullet CKD\ Correction\ Factor$$

This approach assumes that all the CaO and MgO from the clinker is 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 CKD correction factor was also considered. Cement Kiln Dust (CKD) represents a mix of completely calcinated and uncalcinated raw materials. Practically, all cement kilns produce CKD, its quantity depending of plant technologies. To be noted that cement kiln dust may be recovered via electrostatic precipitation or filtration from the exhaust stacks, the recovered CKD may be recycled to the kiln as a raw material. Any CKD not recycled to the kiln is lost to the cement system in terms of CO_2 emissions. To be noted that default CKD correction factor is 1.02, and in the Republic of Moldova its value varied during 1990-2016 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, stoichiometric ratio on CO_2/CaO and CO_2/MgO and CKD correction factor values (Table 4-10).

Table 4-10: Country Specific Emission Factors used to estimate CO_2 emissions from Clinker Production in the Republic of Moldova, 1990-2016

Coefficients	1990	1991	1992	1993	1994	1995	1996	1997	1998
CaO fraction	0.6576	0.6576	0.6576	0.6566	0.6566	0.6577	0.6577	0.6577	0.6577
CO_2/CaO stoichiometric ratio	0.7848	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	0.0160
CO_2/MgO stoichiometric ratio	1.0919	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	1.0130
$EF_{clinker}$	**0.5394**	**0.5405**	**0.5394**	**0.5392**	**0.5397**	**0.5406**	**0.5406**	**0.5400**	**0.5406**

Coefficients	1999	2000	2001	2002	2003	2004	2005	2006	2007
CaO fraction	0.6577	0.6569	0.6599	0.6602	0.6621	0.6586	0.6591	0.6605	0.6570
CO_2/CaO stoichiometric ratio	0.7848	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	0.0181	0.0160	0.0160	0.0140	0.0190
CO_2/MgO stoichiometric ratio	1.0919	1.0919	1.0919	1.0919	1.0919	1.0919	1.0919	1.0919	1.0919
CKD fraction	1.0120	1.0120	1.0090	1.0060	1.0060	1.0060	1.0060	1.0070	1.0060
$EF_{clinker}$	**0.5400**	**0.5394**	**0.5402**	**0.5388**	**0.5426**	**0.5376**	**0.5379**	**0.5374**	**0.5396**
Coefficients	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**
CaO fraction	0.6570	0.6510	0.6550	0.6529	0.6521	0.6551	0.6569	0.6565	0.6602
CO_2/CaO stoichiometric ratio	0.7848	0.7848	0.7848	0.7848	0.7848	0.7848	0.7848	0.7848	0.7848
MgO fraction	0.0120	0.0170	0.0160	0.0166	0.0168	0.0156	0.0158	0.0166	0.0166
CO_2/MgO stoichiometric ratio	1.0919	1.0919	1.0919	1.0919	1.0919	1.0919	1.0919	1.0919	1.0919
CKD fraction	1.0050	1.0030	1.0040	1.0008	1.0015	1.0003	1.0002	1.0002	1.0002
$EF_{clinker}$	**0.5314**	**0.5311**	**0.5336**	**0.5310**	**0.5309**	**0.5313**	**0.5329**	**0.5335**	**0.5363**

Below are presented the default EFs values used to estimate indirect GHG (NO_x, CO, NMVOC) and SO_2 emissions from cement production (Table 4-11).

Information on clinker production at the Lafarge Cement (Moldova) J.S.C. in Rezina was received directly from the producer.

Table 4-11: Default Emission Factors used to Estimate Indirect GHG and SO_2 Emissions from 2A1 'Cement Production' Source Category

Category	Process Description	NO_x	CO	NMVOC	SO_2
		g/t clinker			
Mineral Industry	Cement Production	1241	1455	18	374

Source: EMEP/EEA Atmospheric Emissions Inventory Guidebook, November 2016, Code SNAP 030311 Cement, Category 1.A.2.f.i, Table 3-24.

As for the Cement and Slate Combined Works in Ribnita, activity data on clinker production are available in the statistical publications of the ATULBD starting only with 2009[33] (for 2007-2016 time series). For other years (1990-2006), following the 2006 IPCC Guidance recommendations, 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:

$$\textit{Clinker Production} = \textit{Cement Production} \bullet \textit{Clinker Fraction in Cement}$$

In conformity with the technological documentation for Portland type cement production, in order to produce one tone of cement, cement plants in the Republic of Moldova use 786.9 kg of clinker (Annex 3-2). The information provided by Lafarge Cement (Moldova) J.S.C. in Rezina through the Official Letter No. 74 as of 02.03.2011 and No. 67 as of 06.02.2014 was qualified as '*trade secret with commercial value*', which is 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. In these circumstances, the activity data used to calculate GHG emissions from the source category 2A1 'Cement Production' is presented below only aggregated at the national level (Table 4-12).

Table 4-12: Activity Data on Cement and Clinker Production in the RM, 1990-2016, kt

	1990	1991	1992	1993	1994	1995	1996	1997	1998
Cement Production	2288.0	1800.0	1088.2	960.3	769.1	518.8	494.4	611.8	493.0
Clinker Production	1801.3	1666.6	879.3	752.5	608.6	459.7	357.3	500.2	397.8
	1999	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**
Cement Production	462.0	431.9	402.1	477.0	484.4	667.6	772.8	1051.1	1531.0
Clinker Production	390.4	320.3	321.9	406.8	452.7	525.7	678.7	850.6	1302.2
	2008	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**
Cement Production	1775.9	869.4	861.4	1018.0	1051.4	1095.3	1086.2	1122.8	900.2
Clinker Production	1486.6	641.3	655.6	804.7	832.8	897.6	871.9	830.9	809.0

Source: Lafarge Cement (Moldova) J.S.C. in Rezina, Official Letter No. 780 dated 22.12.2017, as a response to the request of the Climate Change Office, the Ministry of Agriculture, Regional Development and Environment No. 601/2017-12-03 dated 14.12.2017; Official Letter No. 395 dated 24.05.2016, as a response to the request of the Climate Change Office, the Ministry of Environment No. 512/2016-05-01 dated 10.05.2016; Official Letter No. 82 dated 18.02.2015, as a response to the request of the Climate Change Office, the Ministry of Environment No. 407/2015-01-09 dated 29.01.2015; Official Letter No. 67 dated 06.02.2014, as a response to the request of the Climate Change Office, the Ministry of Environment No. 320/2014-01-01 dated 03.01.2014; Official Letter No. 74 dated 02.03.2011, as a response to the request of the Ministry of Environment No. 03-07/175 dated 02.02.2011; as well as Official Letter No. 186 dated 18.04.2007, as a response to the request of 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).

[33] Express Information, Key Performance Indicators for the Industry Sector in the Republic for 2016 (other than the small industries). State Statistical Service of the Transnistrian Moldovan Republic - Tiraspol, 2017 – 13p.; Express Information, Key Performance Indicators for the Industry Sector in the Republic for 2015 (other than the small industries). State Statistical Service of the Transnistrian Moldovan Republic - Tiraspol, 2016 – 13p.; Express Information, Key Performance Indicators for the Industry Sector in the Republic for 2014 (other than the small industries). State Statistical Service of the Transnistrian Moldovan Republic - Tiraspol, 2015 – 14p.; Express Information, Key Performance Indicators for the Industry Sector in the Republic for 2013 (other than the small industries). State Statistical Service of the Ministry of Economy of the Transnistrian Moldovan Republic - Tiraspol, 2014 – 14p.; Express Information, Key Performance Indicators for the Industry Sector in the Republic for 2012. State Statistical Service of the Ministry of Economy of the Transnistrian Moldovan Republic - Tiraspol, 2013 – 13p.; Express Information, Key Performance Indicators for the Industry Sector in the Republic for 2011. State Statistical Service of the Ministry of Economy of the Transnistrian Moldovan Republic - Tiraspol, 2012 – 13p.; Express Information, Key Performance Indicators for the Industry Sector in the Republic for 2010. State Statistical Service of the Ministry of Economy of the Transnistrian Moldovan Republic - Tiraspol, 2011 – 13p.; Express Information, Key Performance Indicators for the Industry Sector in the Republic for January- December 2010 (Preliminary Data). State Statistical Service of the Ministry of Economy of the Transnistrian Moldovan Republic - Tiraspol, 2011 – 13p.; Express Information, Key Performance Indicators for the Industry, Road Transport, Trade and Paid Services Sectors for 2009. State Statistical Service of the Ministry of Economy of the Transnistrian Moldovan Republic - Tiraspol, 2009 – 15 p.

2A2. Lime Production

The mass of CO_2 produced per unit of lime manufactured was estimated from the molecular weights and the lime content of products (ORTECH, 1991). On the basis of 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 on the basis of equations below.

$$EF_{quicklime} = Stoichiometric\ Ratio\ (CO_2/CaO)\ (0.785) \bullet CaO\ Content$$

$$EF_{dolomitic\ quicklime} = Stoichiometric\ Ratio\ (CO_2/CaO{\bullet}MgO)\ (0.913) \bullet (CaO{\bullet}MgO)\ Content$$

To be noted that there are three types of lime: high-calcium lime (CaO + impurities); dolomitic lime (CaO•MgO + impurities); hydraulic lime (CaO + calcium silicates), that is a substance between lime and cement (the first two types have different stoichiometric ratios, and the third has a reduced content of CaO). Taking the types of lime into account allow improve emissions estimates.

As in the Republic of Moldova does not exist statistic information on lime production by type, following the good practice, the AD on lime production was disaggregated for the breakdown of lime types according the default values for high-calcium/dolomitic lime (85% high calcium lime and 15% dolomitic lime), the proportion of hydraulic lime being assumed as zero. The basic parameters used for estimating CO_2 emission from lime production are presented in Table 4-13.

Table 4-13: Basic Parameters for Estimating EFs from 2A2 'Lime Production'

Type of lime	Stoichiometric Ratio (1)	Range of CaO Content (%)	Range of MgO Content (%)	Default Values for CaO/CaO·MgO Content (2)	Default EF, 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 Guidance, Chapter 2.3 „Lime Production", Table 2.4, page 2.22.

The emission factors values for indirect GHG emissions and SO_2 originated from 2A2 'Lime Production' are available below in Table 4-14.

Table 4-14: Default Emission Factors used to Estimate Indirect GHG and SO_2 Emissions from 2A2 'Lime Production' Source Category

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, November 2016, Code SNAP 030312 Lime, Category 1.A.2.f.i, Table 3-23.

Statistical Yearbooks of the Republic of Moldova contain aggregated AD on lime production for the period until 1992. For the time series from 1993 through 2016, activity data on lime production are available separately for the right and left bank of Dniester, in the Statistical Yearbooks of the Republic of Moldova and ATULBD (Table 4-15).

Table 4-15: Activity Data on Lime Production in the Republic of Moldova within 1990-2016, kt

	1990	1991	1992	1993	1994	1995	1996	1997	1998
RM: left bank of Dniester River	90.00	78.60	55.00	48.00	45.00	28.00	34.00	39.00	26.00
RM: right bank of Dniester River	114.30	100.00	32.80	30.00	15.90	10.80	19.90	9.70	12.70
RM: total	**204.30**	**178.60**	**87.80**	**78.00**	**60.90**	**38.80**	**53.90**	**48.70**	**38.70**
	1999	2000	2001	2002	2003	2004	2005	2006	2007
RM: left bank of Dniester River	19.00	12.00	2.00	8.00	0.00	1.00	7.00	8.00	14.00
RM: right bank of Dniester River	5.20	3.10	3.30	3.30	2.90	2.10	2.08	2.15	1.14
RM: total	**24.20**	**15.10**	**5.30**	**11.30**	**2.90**	**3.10**	**9.08**	**10.15**	**15.14**
	2008	2009	2010	2011	2012	2013	2014	2015	2016
RM: left bank of Dniester River	14.00	4.28	3.18	7.44	6.84	5.49	8.33	8.01	4.02
RM: right bank of Dniester River	0.34	0.33	0.19	0.18	0.13	0.08	0.05	0.17	0.05
RM: total	**14.34**	**4.61**	**3.37**	**7.61**	**6.97**	**5.57**	**8.38**	**8.18**	**4.07**

Source: National Bureau of Statistics of the Republic of Moldova through the Statistical Yearbooks for 1994 (page 286), 1999 (page 302), 2003 (page 392), 2006 (page 312); Statistical Reports PROD-MOLD-A „Total production, as a natural expression, in the Republic, by product type for 2005-2016"; Statistical Yearbooks of the ATULBD for 1998 (page 176), 2000 (page 99), 2002 (page 103), 2005 (page94), 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).

As revealed in the table above, during the last years, in the RM (Right Bank of Dniester River), lime production decreased sharply. In this context, the amount of lime needed for domestic consumption is imported. Table 4-16 provides statistical data on lime imports during 1995-2016. According to these data, lime imports increased by circa 84 times within this time period.

Table 4-16: Lime Imports in the RM (Right Bank of Dniester River), 1995-2016, kt

	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
Lime imports, kt	0.063	0.234	0.336	0.515	0.405	0.603	1.783	2.109	3.243	3.662	3.953
	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Lime imports, kt	5.121	6.423	7.540	3.798	4.826	4.699	5.053	4.256	5.260	4.657	5.330

Source: Custom Service, Official Letter No. 28/07-1893 dated 23.02.2011, as a response to the request No. 03-07/175 din 02.02.2011, from the Ministry of the Environment; Official Letter No. 15-03-05 dated 24.01.2014, as a response to the request No. 320/2014-01-01 dated 03.01.2014, from the Climate Change Office of the Ministry of Environment; Official Letter No. 28/07-2231 dated 26.02.2015, as a response to the request No. 407/2015-01-09 dated 29.01.2015, from the Climate Change Office of the Ministry of Environment; Official Letter No. 28/07-8785 dated 26.05.2016, as a response to the request No. 512/2016-05-01 dated 10.05.2016, from the Climate Change Office of the Ministry of Environment; Official Letter No. 28/07-612 dated 12.01.2018, as a response to the request No. 601/2017-12-03 dated 14.12.2017, from the Climate Change Office of the Ministry of Agriculture, Regional Development and Environment.

According to the 2006 IPCC Guidelines (Volume 3, Chapter 2.5, Table 2-7), emissions from lime production at sugar mills should be reported under 2A2 'Lime production'. Since the amount of lime produced and used by the other producers is unknown, this value was inferred from AD on the amount used in the process of sugar production (250 kg CaO per ton of sugar), according to the relevant literature in the field[34].

Table 4-17: Activity Data on Lime Production at Sugar Mills in the RM, 1990-2016, kt

	1990	1991	1992	1993	1994	1995	1996	1997	1998
Granulated sugar from sugar beet, kt [1]	435.800	236.900	208.000	230.200	166.700	218.700	264.500	213.300	194.500
Lime used for sugar production, kt [2]	108.9500	59.2250	52.0000	57.5500	41.6750	54.6750	66.1250	53.3250	48.6250
	1999	2000	2001	2002	2003	2004	2005	2006	2007
Granulated sugar from sugar beet, kt [1]	100.500	105.400	132.600	167.600	107.100	110.900	133.472	149.046	73.964
Lime used for sugar production, kt [2]	25.1250	26.3500	33.1500	41.9000	26.7750	27.7250	33.3680	37.2615	18.4910
	2008	2009	2010	2011	2012	2013	2014	2015	2016
Granulated sugar from sugar beet, kt [1]	133.966	38.373	103.209	88.436	83.440	140.297	177.695	84.519	99.999
Lime used for sugar production, kt [2]	33.4915	9.5933	25.8023	22.1090	20.8599	35.0743	44.4237	21.1298	24.9998

Source: [1] Statistical Yearbooks of the Republic of Moldova for 1994 (page 289), 1999 (page 304), 2003 (page 393), 2006 (page 310), Statistical Reports PRODMOLD-A 'Total production, as a natural expression, in the Republic, by product type, for 2005-2016'; Statistical Yearbooks of the ATULBD for 1998 (page 177), 2000 (page 100), 2002 (page 104), 2005 (page 94);[2] Ukrainian Association for Lime Industry: <http://limeindustry.org/ru/analytics/show/10>.

The total amount of lime produced in the country between 1990 and 2016 (commercial lime and the lime produced by other producers in particular at sugar mills) is revealed below (Table 4-18).

Table 4-18: Activity Data on Lime Production in the Republic of Moldova,1990-2016, kt

	1990	1991	1992	1993	1994	1995	1996	1997	1998
Commercial lime, kt	204.300	178.600	87.800	78.000	60.900	38.800	53.900	48.700	38.700
Lime produced at sugar mills, kt	108.950	59.225	52.000	57.550	41.675	54.675	66.125	53.325	48.625
Total lime produced, kt	**313.250**	**237.825**	**139.800**	**135.550**	**102.575**	**93.475**	**120.025**	**102.025**	**87.325**
	1999	2000	2001	2002	2003	2004	2005	2006	2007
Commercial lime, kt	24.200	15.100	5.300	11.300	2.900	3.100	9.076	10.153	15.135
Lime produced at sugar mills, kt	25.125	26.350	33.150	41.900	26.775	27.725	33.368	37.262	18.491
Total lime produced, kt	**49.325**	**41.450**	**38.450**	**53.200**	**29.675**	**30.825**	**42.444**	**47.414**	**33.626**
	2008	2009	2010	2011	2012	2013	2014	2015	2016
Commercial lime, kt	14.344	4.614	3.369	7.615	6.971	5.569	8.378	8.181	4.075
Lime produced at sugar mills, kt	33.492	9.593	25.802	22.109	20.860	35.074	44.424	21.130	25.000
Total lime produced, kt	**47.835**	**14.207**	**29.171**	**29.723**	**27.831**	**40.643**	**52.802**	**29.310**	**29.075**

As the produced amount of hydrated lime (by means of slaking, lime is disaggregated into hydrated lime, that is $Ca(OH)_2$ 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 (Table 4-18), 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 slaking lime, by using the default value for high calcium/dolomitic lime 85/15 (Table 4-19).

Table 4-19: Activity Data on Hydrated Lime Production, 1990-2016, kt

	1990	1991	1992	1993	1994	1995	1996	1997	1998
High-calcium lime	266.2625	202.1513	118.8300	115.2175	87.1888	79.4538	102.0213	86.7213	74.2263
Dolomitic lime	46.9875	35.6738	20.9700	20.3325	15.3863	14.0213	18.0038	15.3038	13.0988
Total hydrated lime produced	**313.2500**	**237.8250**	**139.8000**	**135.5500**	**102.5750**	**93.4750**	**120.0250**	**102.0250**	**87.3250**
	1999	2000	2001	2002	2003	2004	2005	2006	2007
High-calcium lime	41.9263	35.2325	32.6825	45.2200	25.2238	26.2013	36.0772	40.3022	28.5822
Dolomitic lime	7.3988	6.2175	5.7675	7.9800	4.4513	4.6238	6.3666	7.1121	5.0439
Total hydrated lime produced	**49.3250**	**41.4500**	**38.4500**	**53.2000**	**29.6750**	**30.8250**	**42.4438**	**47.4143**	**33.6261**

[34] Ukrainian Association for Lime Industry: <http://limeindustry.org/ru/analytics/show/10>.

	2008	2009	2010	2011	2012	2013	2014	2015	2016
High-calcium lime	40.6599	12.0758	24.7953	25.2649	23.6560	34.5468	44.8815	24.9138	24.7134
Dolomitic lime	7.1753	2.1310	4.3756	4.4585	4.1746	6.0965	7.9203	4.3966	4.3612
Total hydrated lime produced	**47.8352**	**14.2069**	**29.1710**	**29.7235**	**27.8306**	**40.6433**	**52.8017**	**29.3104**	**29.0746**

CO_2 emissions were estimated following a Tier 2 methodological approach available in the 2006 IPCC Guidelines, by multiplying the emission factors mentioned above to 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 uncalcinated state to a completely calcinated state. Virtually all types of kilns used to produce lime generate such dust, but the amount depends on the technology applied within the respective plant. To 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. Relating to CO_2 emissions, any amount of dust that is not returned to the kiln is considered to be a system loss.

$$Total_{l} = P_i \bullet FE_{lime,\,i} \bullet correction\ factor\ (LKD)$$

Where:

- $Total_1$ – CO_2 emissions from type *i* lime production (kt/yr);
- P_i – production of lime of type *i* (kt/yr);
- $EF_{lime,\,i}$ – emission factor for lime of type *i* (0.7456 t CO_2/t high-calcium lime and 0.7763 t CO_2/t dolomitic lime);
- LKD – correction factor, the default value used is 1.02, the country specific value is unknown.

2A3. Glass Production

Under this source category are covered GHG emissions originated from the production of different types of glass (flat window glass, multi-layer insulating glass, glassware, glass for recipients (containers), glass for 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 aluminum (Al_2O_3) and alkaline substances, plus other minor ingredients. Glass production process allows for a small quantity of recycled glass (cullet) to be used (its share can vary between 10-80 per cent of the total raw material used). The melting process for glass of different types is similar. Glass production process implies the following phases: selection and preparation of the raw material; melting, moulding, hardening, quenching and finishing. Methodological issues regarding 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 (2016).

CO_2 emissions were estimated following a Tier 2 methodological approach available in the 2006 IPCC Guidelines.

$$Total\ CO_2 = \Sigma\ [M_{g,\,i} \bullet FE_{g,\,i} \bullet (1 - CR_i)]$$

Where:

- Total – CO_2 emissions from glass production (kt/yr);
- $M_{g,\,i}$ – mass of melted glass of type *i* (kt/yr);
- FE_i – emission factor for manufacturing of glass of type *i* (t CO_2/t glass melted);
- CR_i – cullet ratio for manufacturing of glass of type *i*, 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 EF 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%

Type of Glass	Default EF, t CO_2 / t glass	CR for manufacturing glass	Average CR value in glass production
Specialty glass (TV funnels)	0.13	20%-70%	45.0%
Glass for 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.

Four glass plants used to produce glass in the RM: the SOE "Chisinau Glass Factory No.1" and "Glass Container Company" (since 1997) in Chisinau, "Cristal-Flor" Glass Factory in Floresti and the Glass Factory in Tiraspol (ATULBD), but the last two plants ceased their activity.

Activity data on flat 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).

Table 4-21: Activity Data on Glass Production in the RM, 1990-2016

	1990	1991	1992	1993	1994	1995	1996	1997	1998
Flat glass for windows, thousand m^2	226.000	287.000	184.000	NO	NO	NO	NO	NO	NO
Glass jars, mill. conventional units	657.600	693.700	187.400	248.900	152.700	87.400	39.600	86.400	84.200
Glass containers and bottles, mill. units	165.500	153.000	138.800	138.200	133.400	184.000	165.200	172.200	189.100
	1999	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**
Multi-layer insulating glass, thousand m^2	NO	NO	NO	NO	NO	NO	31.397	85.233	79.742
Glassware, tones	NO	NO	NO	NO	93.396	95.283	92.023	101.361	113.297
Glass jars, mill. conventional units	104.600	156.200	148.800	137.400	107.400	98.900	103.100	121.300	98.700
Glass containers and bottles, mill. units	125.200	260.500	228.300	296.100	281.400	308.000	354.639	321.450	302.716
Products from fiberglass, tones	NO	NO	NO	NO	NO	NO	0.055	0.011	40.638
Other products not included elsewhere, tones	NO	NO	NO	NO	NO	NO	141.184	291.123	77.990
	2008	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**
Multi-layer insulating glass, thousand m^2	246.673	185.955	339.589	352.126	389.882	449.631	531.659	476.770	403.273
Glassware, tones	278.583	81.408	10.760	11.680	19.547	19.775	13.473	21.191	12.822
Glass jars, mill. conventional units	80.700	92.200	99.800	107.408	145.204	170.493	212.537	287.481	307.229
Glass containers and bottles, mill. units	284.707	201.299	246.213	326.270	223.109	272.534	243.722	228.942	218.546
Products from fiberglass, tones	32.612	14.785	18.148	26.365	392.821	1711.140	NA	NA	NA
Other products not included elsewhere, tones	87.905	61.682	35.988	51.108	63.127	89.829	147.435	182.205	150.750

Source: Statistical Yearbooks of the RM for 1988 (page 228), 1994 (page 287), 1999 (page 303), 2003 (page 393), 2004 (page 443), 2005 (pages 321-322), 2006 (page 312); Statistical Yearbooks of the ATULBD for 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 2005-2016".

Country specific values regarding the cullet ratio in the canning industry (the production of glass jars and containers), were provided through questionnaires by the SOE "Chisinau Glass Factory No.1" and "Glass Container Company" from Chisinau. The share of these enterprises in the total glass production at national level was considered, thus being determined the average value of the CR coefficient.

The default EF for glass used to produce jars, glass containers and bottles represents 210 kg CO_2 per ton of glass produced. Country specific (CS) emission factors (EF) were calculated considering the annual country specific CR values (Table 4-22).

Table 4-22: Country Specific Emission Factors Used to Estimate CO_2 Emissions from Glass Production (glass jars, glass containers and bottles) in the RM, 1990-2016

	1990	1991	1992	1993	1994	1995	1996	1997	1998
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	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	48.7
	1999	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**
Average value of CR in the production process of glass jars, glass containers and bottles %	79.7	51.2	50.6	44.7	44.5	46.0	45.4	39.8	43.0
CS EF, kg CO_2/t glass used for the production of glass jars, glass containers and bottles	42.7	102.4	103.7	116.0	116.6	113.4	114.7	126.4	119.7
	2008	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**
Average value of CR in the production process of glass jars, glass containers and bottles %	30.7	31.4	32.6	31.5	29.6	24.4	22.9	19.0	19.3
CS EF, kg CO_2/t glass used for the production of glass jars, glass containers and bottles	145.6	144.0	141.6	143.8	147.8	158.7	161.9	170.2	169.5

Source: SOE "Chisinau Glass Factory No. 1", Official Letter No. 31 dated 21.02.2011, as a response to the request No. 03-07/175 dated 02.02.2011; Official Letter No. 9/01-01 dated 16.01.2014, as a response to the request No. 320/2014-01-01 dated 03.01.2014; Official Letter No. 16 dated 12.02.2015, as a response to the request No. 407/2015-01-09 dated 29.01.2015; Official Letter No. 86 dated 19.05.2016, as a response to the request No. 512/2016-05-01 dated 10.05.2016; Glass Container Company Chisinau, Official Letter dated 28.02.2011, as a response to the request No. 03-07/175 dated 02.02.2011; Official Letter No. 01-1C-78 dated 19.02.2014, as a response to the request No. 320/2014-01-01 dated 03.01.2014; Official Letter No. 01-3C-63 dated 30.03.2015, as a response to the request No. 407/2015-01-09 dated 29.01.2015; Official Letter dated 23.05.2016, as a response to the request No. 512/2016-05-01 dated 10.05.2016; Official Letter No. 23.02.2018, as a response to the request No. 601/2017-12-03 dated 14.12.2017.

As for other types of glass produced in the Republic of Moldova, default EF values available in 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[35] – 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[36]; the average weight of a conventional glass container – 0.43 kg; the average weight of a glass jar – 0.25 kg[37].

To be noted that since 1993, flat glass for the construction sector is no longer produced in the Republic of Moldova, glass bottles for the wine industry are produced only on the right bank of the Dniester River while the production of glass jars for the canning industry on the left bank of Dniester River was stopped since 2009.

AD related to glass production in the Republic of Moldova, is available below (Table 4-23).

Table 4-23: AD on Glass Production in the Republic of Moldova within 1990-2016, kt

	1990	1991	1992	1993	1994	1995	1996	1997	1998
Flat glass for windows	1.978	2.511	1.610						
Glass jars	164.400	173.425	46.850	62.225	38.175	21.850	9.900	21.600	21.050
Glass containers and bottles	71.165	65.790	59.684	59.426	57.362	79.120	71.036	74.046	81.313
Total glass production in the RM	**237.543**	**241.726**	**108.144**	**121.651**	**95.537**	**100.970**	**80.936**	**95.646**	**102.363**
	1999	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**
Multi-layer insulating glass							0.530	1.438	1.346
Glassware					0.093	0.095	0.092	0.101	0.113
Glass jars	26.150	39.050	37.200	34.350	26.850	24.725	25.775	30.325	24.675
Glass containers and bottles	53.836	112.015	98.169	127.323	121.002	132.440	152.495	138.223	130.168
Products from fiberglass							0.00006	0.00001	0.041
Other products not included elsewhere							0.141	0.291	0.078
Total glass production in the RM	**79.986**	**151.065**	**135.369**	**161.673**	**147.945**	**157.260**	**179.033**	**170.379**	**156.420**
	2008	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**
Multi-layer insulating glass	4.163	3.138	5.731	5.942	6.579	7.588	8.972	8.045	6.805
Glassware	0.279	0.081	0.011	0.012	0.020	0.020	0.013	0.021	0.013
Glass jars	20.175	23.050	24.950	26.852	36.301	42.623	53.134	71.870	76.807
Glass containers and bottles	122.424	86.559	105.871	140.296	95.937	117.189	104.801	98.445	93.975
Products from fiberglass	0.033	0.015	0.018	0.026	0.393	1.711	0.000	0.000	0.000
Other products not included elsewhere	0.088	0.062	0.036	0.051	0.063	0.090	0.147	0.182	0.151
Total glass production in the RM	**147.161**	**112.904**	**136.617**	**173.179**	**139.293**	**169.221**	**167.067**	**178.564**	**177.751**

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 94 per cent of the total glass production in the country.

Table 4-24: AD on Glass Production at Two Glass Factories in Chisinau Municipality within 2002-2016, kt

	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Glass Factory No.1, Chisinau	84.7	81.8	88.1	80.6	70.0	60.2	48.0	47.3	47.1	34.9	47.0	61.6	59.8	57.4	35.7
"Glass Container", Chisinau	59.1	56.4	50.3	61.1	59.0	62.7	61.2	59.3	60.1	97.1	84.4	59.1	57.9	94.1	123.8
Total	**143.8**	**138.2**	**138.4**	**141.7**	**129.0**	**123.0**	**109.2**	**106.5**	**107.3**	**132.1**	**131.4**	**120.7**	**117.7**	**151.5**	**159.4**

Default EF values used for NO_x, NMVOC and SO_2 are available in Table 4-25.

Table 4-25: Default EF values used for Estimating 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 tableware, fiberglass etc.)	2930	6.13	1960

Source: EMEP/EEA Atmospheric Emissions Inventory Guidebook, November 2016, Code SNAP 030314-030317Glass, Category 1.A.2.f.i, Table 3-26.

2A4. Other Process Uses of Carbonates

2A4a. Ceramics

[35] 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.

[36] Airapetov G.A., Bezrodnii O.C., Jolobov A.L. (2005), Building materials: teaching handbook. – Rostov-on-Don, Pheonix, 2005.

[37] Methodological recommendations for the voluntary inventory of Greenhouse Gas Emissions in the constituent entities of the Russian Federation. Appendix 1. Reference guide for conducting voluntary inventory of GHG emissions in the constituent entities of the Russian Federation. Part III. Industrial Processes and Product Use. Ministry of Natural Recourses and Ecology of the Russian Federation. Moscow 2015. <http://www.mnr.gov.ru/regulatory/detail.php?ID=140995>.

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).

Within 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 with 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 (tons);

EF_c – emission factor for carbonates calcination (t CO_2 / t).

During the calcination of the carbonates in the clay, each mole of CaO and respectively, MgO forms one mole of CO_2. This principle was used for developing countries specific values of emission factors.

$$EF = Stoichiometric\ Ratio\ (CO_2/CaO) \bullet Content\ of\ CaO\ in\ Clay + Stoichiometric\ Ratio\ (CO_2/MgO) \bullet Content\ of\ MgO\ in\ Clay$$

In the RM the content of CaO in clay varies between 6-9 per cent, while the content of MgO, respectively between 2-4 per cent[38]. The data provided by the main national producer of bricks (the share of bricks production from „MACON" J.S.C. between 1998 and 2016 varied from a minimum of 46.2 per cent in 2004 to a maximum of 65.5 per cent in 2010 from the national total) were used to calculate the annual values of the country specific EF used to estimate CO_2 emissions from bricks and ceramics production in the RM (Annex 3-2) (Table 4-26).

Table 4-26: Country Specific Emission Factors Used to Estimate CO_2 Emissions from Bricks, Expanded Clay and Ceramics Production, 1990-2016

Indicators	1990	1991	1992	1993	1994	1995	1996	1997	1998
Content of CaO in clay used	0.0844	0.0844	0.0844	0.0844	0.0844	0.0844	0.0844	0.0822	0.0822
Stoichiometric Ratio CO_2/CaO	0.7848	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	0.0645
Content of MgO in clay used	0.0303	0.0303	0.0303	0.0303	0.0303	0.0303	0.0303	0.0357	0.0357
Stoichiometric Ratio CO_2/MgO	1.0919	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	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**	**0.1035**
Indicators	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**
Content of CaO in clay used	0.0822	0.0822	0.0800	0.0787	0.0753	0.0721	0.0535	0.0610	0.0509
Stoichiometric Ratio CO_2/CaO	0.7848	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	0.0628	0.0618	0.0591	0.0566	0.0420	0.0479	0.0399
Content of MgO in clay used	0.0357	0.0357	0.0355	0.0354	0.0351	0.0321	0.0302	0.0304	0.0302
Stoichiometric Ratio CO_2/MgO	1.0919	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	0.0388	0.0387	0.0383	0.0351	0.0330	0.0332	0.0330
EF, t CO_2/t clay used (total)	**0.1035**	**0.1035**	**0.1015**	**0.1005**	**0.0974**	**0.0916**	**0.0750**	**0.0811**	**0.0729**
Indicators	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**
Content of CaO in clay used	0.0530	0.0769	0.0787	0.0669	0.0667	0.0668	0.0668	0.0666	0.0667
Stoichiometric Ratio CO_2/CaO	0.7848	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)	0.0416	0.0604	0.0618	0.0525	0.0524	0.0524	0.0524	0.0523	0.0524
Content of MgO in clay used	0.0305	0.0319	0.0326	0.0288	0.0283	0.0285	0.0286	0.0288	0.0287
Stoichiometric Ratio CO_2/MgO	1.0919	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)	0.0334	0.0349	0.0356	0.0314	0.0310	0.0311	0.0312	0.0314	0.0313
EF, t CO_2/t clay used (total)	**0.0750**	**0.0952**	**0.0974**	**0.0839**	**0.0833**	**0.0835**	**0.0836**	**0.0837**	**0.0837**

As the table reveals, the annual values of the EF varied between 1990 and 2016 from a minimum of 72.9 kg CO_2 per ton of clay used (in 2007) and a maximum of 103.5 kg CO_2 per ton of clay used (between 1997-2000).

According to the 2006 IPCC Guidelines (Volume 3, Chapter 2.5, Page 2.34), the default EF represents 100 kg CO_2 per ton of clay used or 10 per cent of carbonate content used as raw material.

[38] In conformity with the information provided by 'MACON' J.S.C., the average content of CaO in clay extracted in Purcel quarry is circa 8.44 per cent, in Pruncul quarry – 8.22 per cent, in Micauti – 6.70 per cent, in Haruza Mica – 6.66 per cent; while the average content of MgO in clay extracted in Purcel quarry is 3.03 per cent, in Pruncul – 3.57 per cent, in Micautil – 2.93 per cent, and in Haruza Mica – 2.60 per cent.

Statistical Yearbooks of the Republic of Moldova and those of the ATULBD contain activity data regarding brick production (*expressed in million conventional unit)* (Table 4-27).

Table 4-27: AD on Brick Production within 1990-2016, million conventional units

	1990	1991	1992	1993	1994	1995	1996	1997	1998
RM: right bank of Dniester River	190.500	177.500	83.200	149.700	64.300	39.200	37.200	47.700	48.700
RM: left bank of Dniester River	45.000	40.000	35.000	30.000	25.000	20.000	16.000	12.000	7.000
RM: total	**235.500**	**217.500**	**118.200**	**179.700**	**89.300**	**59.200**	**53.200**	**59.700**	**55.700**
	1999	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**
RM: right bank of Dniester River	44.800	39.900	38.100	45.800	52.200	54.900	55.700	52.800	55.900
RM: left bank of Dniester River	12.000	13.000	15.000	17.000	16.000	21.000	18.000	18.000	19.000
RM: total	**56.800**	**52.900**	**53.100**	**62.800**	**68.200**	**75.900**	**73.700**	**70.800**	**74.900**
	2008	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**
RM: right bank of Dniester River	53.000	38.100	37.373	40.995	28.325	35.765	35.895	37.775	34.571
RM: left bank of Dniester River	20.697	13.523	11.582	13.010	14.657	14.618	14.669	9.063	9.305
RM: total	**73.697**	**51.623**	**48.955**	**54.005**	**42.982**	**50.383**	**50.564**	**46.838**	**43.876**

Source: Statistical Yearbooks for 1988 (page 228), 1994 (page 287), 1999 (page 303), 2005 (page 322), 2010 (page 305); Statistical Yearbooks of the ATULBD for 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); Statistical Reports PRODMOLD-A „Total production, as a natural expression, in the Republic, by product type, for 2005-2016".

To convert the AD in metric mass units (kilotons), conversion coefficients were used based on the data available on the web pages of national and foreign construction companies[39]. According to those, one conventional brick piece represents: 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 these 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 tons of the national bricks production.

At the same time, for estimating the mass of carbonates used for brick production, it was used the method recommended by the 2006 IPCC Guidelines; 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).

Table 4-28: Activity Data on the Amount of Clay Used in Brick Production in the Republic of Moldova within 1990-2016, kt

	1990	1991	1992	1993	1994	1995	1996	1997	1998
Total brick production	663.3505	612.6486	332.9428	506.1745	251.5380	166.7531	149.8524	168.1615	156.8944
Clay used in brick production	729.6856	673.9134	366.2371	556.7919	276.6918	183.4284	164.8377	184.9776	172.5838
	1999	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**
Total brick production	159.9928	149.0074	149.5708	176.8935	192.1041	213.7932	207.5963	199.4277	210.9764
Clay used in brick production	175.9921	163.9081	164.5278	194.5828	211.3145	235.1725	228.3559	219.3704	232.0741
	2008	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**
Total brick production	207.5879	145.4104	137.8941	152.1211	121.0700	141.9181	142.4287	131.9335	123.5886
Clay used in brick production	228.3467	159.9514	151.6835	167.3332	133.1770	156.1100	156.6715	145.1268	135.9475

AD regarding expanded clay production in the 2001-2016 periods (expressed in thousand m^3) were provided directly by MACON J.S.C., the only expanded clay producer in the RM (Table 4-29).

Table 4-29: Activity Data on the Amount of Clay Used in Expanded Clay Production in the Republic of Moldova, 2001-2016

	2001	2002	2003	2004	2005	2006	2007	2008
Expanded clay production, thousand m^3	3.5958	17.1730	12.7545	55.0500	63.4000	72.2000	80.5550	64.9630
Specific weight, kg/m^3	390.1	388.9	387.3	371.1	392.9	399.7	385.4	376.2
Expanded clay production, kt	1.4028	6.6791	4.9394	20.4307	24.9067	28.8591	31.0435	24.4384
Clay used, t/m^3 expanded clay	0.715	0.711	0.717	0.731	0.710	0.711	0.550	0.624
Clay used in expanded clay production, kt	**2.5710**	**12.2100**	**9.1450**	**40.2416**	**45.0140**	**51.3342**	**44.3053**	**40.5369**
	2009	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**
Expanded clay production, thousand m^3	61.1990	61.4200	30.3630	38.1500	42.0110	34.5680	22.9780	28.7730
Specific weight, kg/m^3	399.4	353.3	324.8	403.5	376.9	375.7	398.8	387.3
Expanded clay production, kt	24.4404	21.6991	9.8631	15.3939	15.8331	12.9875	9.1636	11.1425
Clay used, t/m^3 expanded clay	0.629	0.572	0.617	0.717	0.639	0.639	0.680	0.660
Clay used in expanded clay production, kt	**38.4942**	**35.1322**	**18.7340**	**27.3536**	**26.8450**	**22.0890**	**15.6250**	**18.9758**

[39] <http://aquagroup.ru/articles/ves-kirpicha.html>, <http://www.lucceram.ro/index.php/products>.

AD regarding the production of ceramics in the 2005-2016 periods were provided by the National Bureau of Statistics, the information is available in the Statistical Reports PRODMOLD-A "Total production, as a natural expression, in the Republic, by product type" (Table 4-30).

Table 4-30: AD on the Amount of Clay Used in Expanded Clay Production in the RM, 2005-2016

	2005	2006	2007	2008	2009	2010
Roof tiles, pieces	243.510	182.978	288.253	223.355	86.665	7.210
Non-refractory ceramics for construction, tones	303.800	260.800	201.300	150.500	138.800	68.900
Table and ornamental ware (household ceramics), tones	579.719	478.955	838.189	276.802	188.722	169.089
Wall and floor tiles, thousand m^2	625.200	734.000	1248.500	808.700	9.800	1.900
Total ceramics produced, kt	1.8906	1.5105	2.2586	1.3635	0.6747	0.2669
Total clay used to produce ceramics, kt	**2.0797**	**1.6616**	**2.4844**	**1.4999**	**0.7422**	**0.2936**
	2011	**2012**	**2013**	**2014**	**2015**	**2016**
Roof tiles, pieces	66.870	NA	1.890	NA	NA	NA
Non-refractory ceramics for construction, tones	55.400	12.700	24.400	NA	NA	NA
Table and ornamental ware (household ceramics), tones	136.854	118.369	89.630	105.969	89.866	521.112
Wall and floor tiles, thousand m^2	1.600	0.700	0.500	0.600	1.500	248.200
Total ceramics produced, kt	0.4598	0.1311	0.1216	0.1060	0.0899	0.5342
Total clay used to produce ceramics, kt	**0.5058**	**0.1442**	**0.1338**	**0.1166**	**0.0989**	**0.5877**

Source: Statistical Reports PRODMOLD-A „Total production, as a natural expression, in the Republic, by product type, for 2005-2016".

As one can see, AD regarding roof tiles production are available in pieces. In order to transform these data in tones, the following conversion factor was used: 1 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 Russian Federation GOST R 56688 - 201540. According to this, the mass of 1 m2 of roof tile varies between 54 and 74 kg, while 1 m2 of light roof tile contains circa 14.8-16.6 pieces with an average weight of circa 3.4 kg, and 1 m2 of heavy roof tile contains circa 15-17 pieces with an average weight of circa 4.6 kg. For comparing, web pages of companies importing roof tiles in the Republic of Moldova and Romania were consulted41, and similar values of the conversion factors were found.

AD regarding the production of wall and floor tiles are available in thousand m2. In order to transform these 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 products42. In comparison, the 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 tiles43. For estimating the mass of carbonates used for the production of ceramics, it was used the method recommended by the 2006 IPCC Guidelines; 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)

Table 4-31: Data used to determine the average value of the conversion factor used to transform AD from thousand m^2 to kilotons for wall and floor tiles

Size of a floor tile, cm	Weight, kg per 1 m^2	Size of a wall tile, cm	Weight, kg per 1 m^2
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**

The methodology for estimating indirect GHG emissions from brick and ceramics production is available in the EMEP/EEA Atmospheric Emissions Inventory Guidebook (November 2016) (Table 4-32).

Table 4-32: EF Used to Estimate Indirect GHG Emissions from Brick and Ceramics 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, November 2016, Code SNAP 030319 Brick and Ceramics, Category 1.A.2.f.i, Table 3-28.

[40] 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>.
[41] <http://www.acoperisuldetigla.ro/tigla-ceramica-tondach/>, <https://acoperisuldetigla.wordpress.com/tigla-ceramica-siceram/>.
[42] <http://www.cesarom.ro/calculator-placi-gresie-si-faianta>.
[43] 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.

2A4b. Other Uses of Soda Ash

Methodological issues regarding 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; respectively in Chapter 2.5, Pages 2.32-2.40).

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 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 other 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 the source category 2A4b 'Other Uses of Soda Ash'.

Data on soda ash imports for 1990-2016 are available in Table 4-33, and were provided by the Custom Service of the Republic of Moldova (no exports were recorded during the respective time periods). There is no information regarding 1990-1994 years and, in order to fill this gap, data were reconstructed based on the evolution of glass production during the respective period (in 1995, circa 87.5 per cent of soda ash imports were used in glass industry, and the same share was considered for 1990-1994), respectively based on the information regarding soda ash used to produce one tone of glass (250 kg of soda ash per ton of glass).

Table 4-33: AD on Soda Ash Imports in the Republic of Moldova within 1990-2016, kt

	1990	1991	1992	1993	1994	1995	1996	1997	1998
Soda ash consumption	67.8693	69.0646	30.8983	34.7574	27.2963	28.8486	19.6869	25.2708	20.2975
	1999	2000	2001	2002	2003	2004	2005	2006	2007
Soda ash consumption	16.1479	33.7542	34.6490	34.2346	30.4387	38.4227	43.7608	38.6980	34.1175
	2008	2009	2010	2011	2012	2013	2014	2015	2016
Soda ash consumption	33.7002	24.2468	29.0280	37.0516	22.5167	37.4016	33.8123	26.3379	25.7534

Source: Custom Service of the Republic of Moldova, Official Letter No. 28/07-612 dated 12.01.2018, as a response to the request of the Climate Change Office of the Ministry of Agriculture, Regional Development and Environment No. 601/2017-12-03 dated 14.12.2017; Official 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; Official 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; Official 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; Official 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 amount of imported soda ash is not fully used in the same year, some of it is kept for use in the coming years. Thus, the imported quantities do not correspond to the annual consumption of soda ash. From the discussions with the representatives of the glass production industry, it was revealed that between 1990 and 2016, about 85 per cent (average for 27 years) of the annual soda ash consumption was used in the glass industry (Table 4-34).

Table 4-34: AD on Soda Ash Consumption in the RM within 1990-2016, kt

	1990	1991	1992	1993	1994	1995	1996	1997	1998
Average annual consumption	69.8654	71.0960	31.8071	35.7797	28.0991	29.6971	17.3965	20.5583	22.0020
Soda ash used in the glass industry	59.3856	60.4316	27.0360	30.4128	23.8843	25.2425	14.7870	17.4745	18.7017
Soda ash used in other industries	**10.4798**	**10.6644**	**4.7711**	**5.3670**	**4.2149**	**4.4546**	**2.6095**	**3.0837**	**3.3003**
	1999	2000	2001	2002	2003	2004	2005	2006	2007
Average annual consumption	17.1923	32.4701	29.0964	34.7502	31.7996	33.8017	38.4815	36.6215	33.6212
Soda ash used in the glass industry	14.6134	27.5996	24.7319	29.5377	27.0296	28.7315	32.7093	31.1283	28.5780
Soda ash used in other industries	**2.5788**	**4.8705**	**4.3645**	**5.2125**	**4.7699**	**5.0703**	**5.7722**	**5.4932**	**5.0432**
	2008	2009	2010	2011	2012	2013	2014	2015	2016
Average annual consumption	31.6309	24.2678	29.3646	37.2233	25.8101	31.3556	30.9566	31.5114	31.3678
Soda ash used in the glass industry	26.8863	20.6276	24.9599	31.6398	21.9386	26.6523	26.3131	26.7847	26.6626
Soda ash used in other industries	**4.7446**	**3.6402**	**4.4047**	**5.5835**	**3.8715**	**4.7033**	**4.6435**	**4.7267**	**4.7052**

The amount of soda ash used in the glass industry was deducted from the specific consumption of soda ash per ton of glass produced. The average value of the specific consumption (187.2 kg of soda ash per ton of glass produced between 1996 and 2011, 175.5 kg of soda ash per ton of glass produced within 2012-2014 time series and circa 150.0 kg produced between 2015 and 2017) was estimated on the basis of the information provided by two glass factories in the RM (the SOE "Chisinau Glass Factory No.1" and "Glass Container Company" from Chisinau). These average values were used for estimating AD on the consumption of soda ash in the glass production industry for the period from 1996 to 2016. At the same time, for 1990 to 1995, AD on the consumption of soda ash in the glass production industry were reconstructed based on the world average specific value of soda ash consumption within the glass industry (250 kg of soda ash per ton of glass produced[44]), which was considered closer to the realities of glass production industry in the RM in the early years after independence.

The emission factor used to calculate CO_2 emissions from soda ash use will be estimated using the stoichiometry of the chemical processes and the following equation:

$$EF_{sa} = 44.0099\ g/mole\ CO_2 / 106.0685\ g/mole\ Na_2CO_3 = 0.41492\ t\ CO_2 / t\ Na_2CO_3$$

Total 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 EF for CO_2 emissions from soda ash use (0.41492 t CO_2/t of soda ash).

4.2.3. Uncertainties Assessment and Time-Series Consistency

2A1. Cement Production

The EF related uncertainties are considered to account for circa ±3 per cent. The activity data related uncertainties were also estimated as being low (±2 per cent), in the case of AD provided by the Lafarge Cement (Moldova) J.S.C. uncertainties account for circa ±1 per cent and are provided directly by the producer, while in the case of Cement and Slake Integrated Works in Ribnita, uncertainties reach up to (±3 per cent) and are collected from statistical publications. Thus, combined uncertainties related to GHG emissions from 2A1 'Cement Production' source category are considered to represent circa ±3.61 per cent (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

The EF related uncertainties are considered to account for circa ±2 per cent. The activity data related uncertainties were estimated at circa ±10 per cent, as a result of indirect generation of activity data on lime production directly by other producers (sugar mils) as well as due to the correction factor used for hydrated lime. Thus, combined uncertainties related to GHG emissions from 2A2 'Lime Production' source category account for circa ±10.20 per cent (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

The EF related uncertainties used within the Tier 2 method account for circa ±10 per cent (2006 IPCC Guidelines). The activity data related uncertainties were estimated at circa ±15 per cent, including due to the conversion in other units (from thousand m^2 and million conventional pieces to kilotons, respectively due to use of an average value for glass containers within the conversion process from a specific unit to another type. Thus, combined uncertainties related to GHG emissions from 2A3 'Glass Production' source category account for circa ±18.03 per cent (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

The EF related uncertainties used within the Tier 2 method account for circa ±5 per cent (2006 IPCC Guidelines). The activity data related uncertainties were estimated at circa ±*20 per cent*, including due to the conversion in 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

[44] 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>.

factors, 1.1 tons of clay to 1.0 ton of production). Thus, combined uncertainties related to GHG emissions from 2A4 'Other Process Uses of Carbonates' source category account for circa ±20.62 per cent (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 EF, 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 in case of converting AD into mass units compatible with GHG emissions estimation methods; comparing the results obtained by using different estimating methodologies and explaining the identified discrepancies, etc. AD and methods used for estimating GHG emissions under the category 2A 'Mineral Industry' were documented and archived both in hard copies and electronically.

4.2.5. Recalculations

2A1. Cement Production

In comparison with the results obtained in the NC4 of the RM under UNFCCC (2018), GHG emissions from the clinker production were not recalculated. For 2016, the respective emissions were estimated for the first time. Between 1990 and 2016 GHG emissions from cement production decreased by circa 55 per cent (Table 4-35).

Table 4-35: GHG Emissions from the 2A1 'Cement Production' in the RM, 1990-2016, kt

	1990	1991	1992	1993	1994	1995	1996	1997	1998
CO_2	971.6967	900.7877	474.3138	405.7165	328.4361	248.5258	193.1220	270.1273	215.0572
NO_x	2.2355	2.0682	1.0912	0.9338	0.7552	0.5705	0.4434	0.6207	0.4937
CO	2.6210	2.4249	1.2794	1.0949	0.8854	0.6689	0.5198	0.7278	0.5788
NMVOC	0.0324	0.0300	0.0158	0.0135	0.0110	0.0083	0.0064	0.0090	0.0072
SO_2	0.6737	0.6233	0.3289	0.2814	0.2276	0.1719	0.1336	0.1871	0.1488
	1999	2000	2001	2002	2003	2004	2005	2006	2007
CO_2	210.8122	172.7600	173.8847	219.1917	245.6276	282.5765	365.0817	457.0753	702.6656
NO_x	0.4844	0.3975	0.3995	0.5048	0.5618	0.6524	0.8422	1.0555	1.6161
CO	0.5680	0.4660	0.4684	0.5919	0.6586	0.7649	0.9874	1.2376	1.8948
NMVOC	0.0070	0.0058	0.0058	0.0073	0.0081	0.0095	0.0122	0.0153	0.0234
SO_2	0.1460	0.1198	0.1204	0.1521	0.1693	0.1966	0.2538	0.3181	0.4870
	2008	2009	2010	2011	2012	2013	2014	2015	2016
CO_2	789.9160	340.5679	349.8333	427.2624	442.1615	476.9104	464.6082	443.2441	433.9022
NO_x	1.8448	0.7959	0.8135	0.9986	1.0335	1.1139	1.0820	1.0311	1.0040
CO	2.1630	0.9331	0.9538	1.1709	1.2118	1.3060	1.2686	1.2089	1.1771
NMVOC	0.0268	0.0115	0.0118	0.0145	0.0150	0.0162	0.0157	0.0150	0.0146
SO_2	0.5560	0.2398	0.2452	0.3010	0.3115	0.3357	0.3261	0.3107	0.3026

2A2. Lime Production

In comparison with the results obtained in the NC4 of the RM under UNFCCC (2018), GHG emissions from the lime production were not recalculated. For 2016, the respective emissions were estimated for the first time. Between 1990 and 2016 GHG emissions from lime production decreased by circa 90.7 per cent (Table 4-36).

Table 4-36: GHG Emissions from the 2A2 'Lime Production' in the RM, 1990-2016, kt

	1990	1991	1992	1993	1994	1995	1996	1997	1998
CO_2	232.4996	176.5179	103.7620	100.6076	76.1330	69.3788	89.0847	75.7247	64.8141
NO_x	0.4288	0.3256	0.1914	0.1856	0.1404	0.1280	0.1643	0.1397	0.1195
CO	0.6077	0.4614	0.2712	0.2630	0.1990	0.1813	0.2328	0.1979	0.1694
SO_2	0.0990	0.0752	0.0442	0.0428	0.0324	0.0295	0.0379	0.0322	0.0276
	1999	2000	2001	2002	2003	2004	2005	2006	2007
CO_2	36.6099	30.7649	28.5383	39.4860	22.0253	22.8789	31.5025	35.1917	24.9579
NO_x	0.0675	0.0567	0.0526	0.0728	0.0406	0.0422	0.0581	0.0649	0.0460
CO	0.0957	0.0804	0.0746	0.1032	0.0576	0.0598	0.0823	0.0920	0.0652
SO_2	0.0156	0.0131	0.0122	0.0168	0.0094	0.0097	0.0134	0.0150	0.0106

	2008	2009	2010	2011	2012	2013	2014	2015	2016
CO_2	35.5041	10.5446	21.6512	22.0613	20.6563	30.1662	39.1904	21.7547	21.5797
NO_x	0.0655	0.0194	0.0399	0.0407	0.0381	0.0556	0.0723	0.0401	0.0398
CO	0.0928	0.0276	0.0566	0.0577	0.0540	0.0788	0.1024	0.0569	0.0564
SO_2	0.0151	0.0045	0.0092	0.0094	0.0088	0.0128	0.0167	0.0093	0.0092

2A3. Glass Production

CO_2 emissions from the glass production were calculated for 2011-2015 time series due to updated AD regarding the number of conventional glass jars for the canning industry equivalent 0.5 l of the total glass produced. Until 2010, this information is available in the Statistical Yearbooks of the Republic of Moldova, respectively in the Statistical Reports PRODMOLD-A "Total production, as a natural expression, in the Republic, by product type", while more recent information is not included in statistical publications due to confidentiality terms and, in these conditions, the respective AD activity data are collected directly from the glass factories.

In comparison with the results obtained in the NC4 of the RM under UNFCCC (2018), the recalculations resulted in an increase of CO_2 emissions, with a variation from a minimum increase of 4.1 per cent in 2014, up to a maximum of 16.4 per cent in 2012 (Table 4-37).

Table 4-37: Comparative Results of CO_2 Emissions from Glass Production included into the NC4 and the BUR2 of the RM under the UNFCCC, kt

	1990	1991	1992	1993	1994	1995	1996	1997	1998
NC4	25.2212	25.0580	11.9560	10.8638	3.7901	4.7151	6.9080	4.6608	4.9882
BUR2	25.2212	25.0580	11.9560	10.8638	3.7901	4.7151	6.9080	4.6608	4.9882
Difference, %	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	1999	2000	2001	2002	2003	2004	2005	2006	2007
NC4	3.4167	15.4704	14.0377	18.7603	17.2567	17.8332	20.5674	21.5950	18.7981
BUR2	3.4167	15.4704	14.0377	18.7603	17.2567	17.8332	20.5674	21.5950	18.7981
Difference, %	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
NC4	21.5408	16.3507	19.5231	22.9484	17.8264	25.7612	26.0660	27.9127	
BUR2	21.5408	16.3507	19.5231	25.0779	20.7542	26.9857	27.1317	30.3969	30.1307
Difference, %	0.0	0.0	0.0	9.3	16.4	4.8	4.1	8.9	

Abbreviations: NC4 – Fourth National Communication; BUR2 – Second Biennial Update Report.

CO_2 emissions from the glass production were calculated for 2016 for the first time. Between 1990 and 2016, CO_2 emissions from the glass production increased by circa 19.5 per cent, in particular due to the decreasing share of glass bits in batch, respectively the increase of country specific emission factor by circa 60.5 per cent, from 105.6 kg CO_2/t of glass in 1990, up to 169.5 kg CO_2/t in 2016.

Indirect GHG emissions from glass production for 1990-2016 time series are presented in Table 4-38. Between 1990 and 2016, the respective emissions decreased by circa 25.2 per cent due to the decrease of this production in the country.

Tale 4-38: Indirect GHG Emissions from the 2A3 'Glass Production' within 1990-2016, kt

	1990	1991	1992	1993	1994	1995	1996	1997	1998
NO_x	0.6960	0.7083	0.3169	0.3564	0.2799	0.2958	0.2371	0.2802	0.2999
NMVOC	0.0015	0.0015	0.0007	0.0007	0.0006	0.0006	0.0005	0.0006	0.0006
SO_2	0.4656	0.4738	0.2120	0.2384	0.1873	0.1979	0.1586	0.1875	0.2006
	1999	2000	2001	2002	2003	2004	2005	2006	2007
NO_x	0.2344	0.4426	0.3966	0.4737	0.4335	0.4608	0.5246	0.4992	0.4583
NMVOC	0.0005	0.0009	0.0008	0.0010	0.0009	0.0010	0.0011	0.0010	0.0010
SO_2	0.1568	0.2961	0.2653	0.3169	0.2900	0.3082	0.3509	0.3339	0.3066
	2008	2009	2010	2011	2012	2013	2014	2015	2016
NO_x	0.4312	0.3308	0.4003	0.5074	0.4081	0.4958	0.4895	0.5232	0.5208
NMVOC	0.0009	0.0007	0.0008	0.0011	0.0009	0.0010	0.0010	0.0011	0.0011
SO_2	0.2884	0.2213	0.2678	0.3394	0.2730	0.3317	0.3275	0.3500	0.3484

2A4. Other Process Uses of Carbonates

'Brick Production'

CO_2 emissions from the brick production were recalculated for the 1990-2015 periods due to use of an updated conversion factor for the weight of a conventional brick (in the current inventory cycle a value of 2.87 kg was used, while during the previous inventory cycle – a value of 3.27 kg).

In comparison with the results obtained in the NC4 of the RM under UNFCCC (2018), the recalculations performed resulted in a decrease of CO_2 emissions from brick production by circa 13.8 per cent (Table 4-38).

Table 4-38: Comparative Results of CO_2 Emissions from Brick Production included into the NC4 and the BUR2 of the RM under the UNFCCC, kt

	1990	1991	1992	1993	1994	1995	1996	1997	1998
NC4	84.0397	77.6163	42.1804	64.1271	31.8673	21.1259	18.9848	22.1988	20.7114
BUR2	72.4748	66.9354	36.3759	55.3025	27.4820	18.2187	16.3722	19.1439	17.8613
Difference, %	-13.8	-13.8	-13.8	-13.8	-13.8	-13.8	-13.8	-13.8	-13.8
	1999	2000	2001	2002	2003	2004	2005	2006	2007
NC4	21.1204	19.6702	19.3687	22.6656	23.8757	24.9880	19.8673	20.6304	19.6184
BUR2	18.2140	16.9634	16.7033	19.5466	20.5902	21.5493	17.1333	17.7914	16.9186
Difference, %	-13.8	-13.8	-13.8	-13.8	-13.8	-13.8	-13.8	-13.8	-13.8
	2008	2009	2010	2011	2012	2013	2014	2015	2016
NC4	19.8469	17.6617	17.1333	16.2864	12.8650	15.1122	15.1918	14.0906	
BUR2	17.1157	15.2312	14.7756	14.0452	11.0946	13.0326	13.1012	12.1516	11.3756
Difference, %	-13.8	-13.8	-13.8	-13.8	-13.8	-13.8	-13.8	-13.8	

Abbreviations: NC4 – Fourth National Communication; BUR2 – Second Biennial Update Report.

For 2016, the respective emissions were estimated for the first time. Between 1990 and 2016, CO_2 emissions from brick production decreased by circa 84.3 per cent due to the decrease of this production in the country.

Indirect GHG emissions from brick production were recalculated for the 1990-2015 periods due to use of a précised conversion factor for the weight of a conventional brick. In comparison with the results recorded in the NC4 of the RM under UNFCCC (2018), the recalculations performed resulted in a decrease by circa 13.8 per cent. For 2016, the respective emissions were estimated for the first time (Table 4-39). Between 1990 and 2016, indirect GHG emissions from brick production decreased by circa 81.4 per cent due to the decrease of this production in the country.

Table 4-39: Indirect GHG Emissions from Brick Production in the RM within 1990-2016, kt

	1990	1991	1992	1993	1994	1995	1996	1997	1998
NO_x	0.1221	0.1127	0.0613	0.0931	0.0463	0.0307	0.0276	0.0309	0.0289
CO	0.1254	0.1158	0.0629	0.0957	0.0475	0.0315	0.0283	0.0318	0.0297
SO_2	0.0263	0.0243	0.0132	0.0200	0.0100	0.0066	0.0059	0.0067	0.0062
	1999	2000	2001	2002	2003	2004	2005	2006	2007
NO_x	0.0294	0.0274	0.0275	0.0325	0.0353	0.0393	0.0382	0.0367	0.0388
CO	0.0302	0.0282	0.0283	0.0334	0.0363	0.0404	0.0392	0.0377	0.0399
SO_2	0.0063	0.0059	0.0059	0.0070	0.0076	0.0085	0.0082	0.0079	0.0084
	2008	2009	2010	2011	2012	2013	2014	2015	2016
NO_x	0.0382	0.0268	0.0254	0.0280	0.0223	0.0261	0.0262	0.0243	0.0227
CO	0.0392	0.0275	0.0261	0.0288	0.0229	0.0268	0.0269	0.0249	0.0234
SO_2	0.0082	0.0058	0.0055	0.0060	0.0048	0.0056	0.0056	0.0052	0.0049

'Expanded Clay Production'

GHG emissions from expanded clay production were not recalculated for 2001-2015 periods. For 2016, the respective emissions were estimated for the first time (Table 4-40). Between 2001 and 2016, CO_2 emissions from expanded clay production increased by circa 6 times, while indirect GHG emissions – by 8 times due to the increase of this production in the country.

Table 4-40: GHG Emissions from Expanded Clay Production in the RM within 2001-2016, kt

	2001	2002	2003	2004	2005	2006	2007	2008
CO_2	0.2610	1.2265	0.8911	3.6874	3.3774	4.1633	3.2299	3.0384
NO_x	0.0003	0.0012	0.0009	0.0038	0.0046	0.0053	0.0057	0.0045
CO	0.0003	0.0013	0.0009	0.0039	0.0047	0.0055	0.0059	0.0046
SO_2	0.0001	0.0003	0.0002	0.0008	0.0010	0.0011	0.0012	0.0010
	2009	2010	2011	2012	2013	2014	2015	2016
CO_2	3.6656	3.4223	1.5724	2.2787	2.2411	1.8471	1.3083	1.5878
NO_x	0.0045	0.0040	0.0018	0.0028	0.0029	0.0024	0.0017	0.0021
CO	0.0046	0.0041	0.0019	0.0029	0.0030	0.0025	0.0017	0.0021
SO_2	0.0010	0.0009	0.0004	0.0006	0.0006	0.0005	0.0004	0.0004

'Ceramics Production'

For 2005-2015, GHG emissions from the production of ceramics were not recalculated. For 2016, the respective emissions were estimated for the first time (Table 4-41). Between 2005 and 2016, CO_2 emissions from the production of ceramics decreased by circa 68.5 per cent, while indirect GHG emissions – by circa 71.7 per cent due to the decrease of this production in the country.

Table 4-41: GHG Emissions from the Production of Ceramics in the RM within 2005-2016, kt

	2005	2006	2007	2008	2009	2010
CO_2	0.15604	0.13476	0.18112	0.11242	0.07067	0.02860
NO_x	0.00035	0.00028	0.00042	0.00025	0.00012	0.00005
CO	0.00036	0.00029	0.00043	0.00026	0.00013	0.00005
SO_2	0.00007	0.00006	0.00009	0.00005	0.00003	0.00001
	2011	2012	2013	2014	2015	2016
CO_2	0.04245	0.01201	0.01117	0.00975	0.00828	0.04917
NO_x	0.00008	0.00002	0.00002	0.00002	0.00002	0.00010
CO	0.00009	0.00002	0.00002	0.00002	0.00002	0.00010
SO_2	0.00002	0.00001	0.00000	0.00000	0.00000	0.00002

'Other Uses of Soda Ash'

CO_2 emissions from the other uses of soda ash were recalculated for the 1990-2015 time series due to updating information on annual consumption of soda ash in glass industry (in the current inventory cycle it is considered that circa 85 per cent of the annual consumption of soda ash is recorded in glass production, while during the previous inventory cycle – 90 per cent, considering that between 1990 and 1995, soda ash use in glass production represented 250 kg of soda ash per ton of glass produced[45], within 1996-2011 time periods – it represented 187.2 kg, in 2012-2014 soda ash use in glass production represented 175.5 kg, while between 2015 and 2017 it reached to circa 150.0 kg), respectively due to updating information on glass production in the Republic of Moldova for 2011-2015 time series.

In comparison with the results obtained in the NC4 of the RM under UNFCCC (2018), the recalculations resulted in an increase of CO_2 emissions from other uses of soda ash, varying from a minimum increase by circa 3.7 per cent in 1993, up to a maximum increase by circa 75.3 per cent in 2011. For 2016, the respective emissions were estimated for the first time. Between 1990 and 2016, CO_2 emissions from other uses of soda ash decreased by circa 55.1 per cent due to the decreasing consumption of soda ash in the country (Table 4-42).

Table 4-42: Comparative Results of CO_2 Emissions from Other Uses of Soda Ash included into the NC4 and the BUR2 of the RM under the UNFCCC, kt

	1990	1991	1992	1993	1994	1995	1996	1997	1998
NC4	2.6469	2.6935	2.1243	2.1466	1.3737	1.3744	0.8253	0.9689	0.9625
BUR2	4.3483	4.4249	1.9796	2.2269	1.7488	1.8483	1.0827	1.2795	1.3694
Difference, %	64.3	64.3	-6.8	3.7	27.3	34.5	31.2	32.1	42.3
	1999	2000	2001	2002	2003	2004	2005	2006	2007
NC4	0.7070	1.3772	1.2734	1.5096	1.3783	1.4060	1.5626	1.4988	1.3885
BUR2	1.0700	2.0209	1.8109	2.1628	1.9791	2.1038	2.3950	2.2793	2.0925
Difference, %	51.3	46.7	42.2	43.3	43.6	49.6	53.3	52.1	50.7
	2008	2009	2010	2011	2012	2013	2014	2015	2016
NC4	1.2298	0.9420	1.1399	1.3214	0.9969	1.3475	1.3390	1.3681	
BUR2	1.9686	1.5104	1.8276	2.3167	1.6064	1.9515	1.9267	1.9612	1.9523
Difference, %	60.1	60.3	60.3	75.3	61.1	44.8	43.9	43.4	

Abbreviations: NC4 – Fourth National Communication; BUR2 – Second Biennial Update Report.

4.2.6. Planned Improvements

Possible improvements under the 2A 'Mineral Industry' category 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

[45] Russian Center for Foreign Trade. Conjuncture. Goods and Markets. Soda Ash on the World Market. http://www.rusimpex.ru/Content/Economics/Conjuncture/99_11002.htm>.

The 2B 'Chemical Industry' category 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 2016, no emissions were registered in the Republic of Moldova under the categories 2B1-2B9 (NO). Within the 2B10 'Other' in the RM were monitored the NMVOC emissions from the following sources: polyethylene production, acrylonitrile butadiene styrene (ABS) resins and polystyrene production. Between 1990 and 2016, the NMVOC emissions from 2B 'Chemical Industry' decreased by 79.8 per cent, from circa 0.0650 kt in 1990 to 0.0131 kt in 2016 (Table 4-43).

Table 4-43: NMVOC emissions from the 2B10 'Other' source category, by source, within 1990-2016, kt

	1990	1991	1992	1993	1994	1995	1996	1997	1998
Polyethylene Production	0.0125	0.0106	0.0063	0.0055	0.0028	0.0017	0.0044	0.0030	0.0030
ABS Resins Production	0.0525	0.0438	0.0175	0.0144	0.0045	0.0033	0.0001	0.0007	0.0012
2B10 „Other"	**0.0650**	**0.0544**	**0.0238**	**0.0199**	**0.0074**	**0.0051**	**0.0046**	**0.0037**	**0.0042**
	1999	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**
Polyethylene Production	0.0016	0.0041	0.0050	0.0080	0.0102	0.0091	0.0111	0.0094	0.0096
ABS Resins Production	0.0018	0.0024	0.0029	0.0023	0.0021	0.0027	0.0031	0.0025	0.0031
Polystyrene Production	NO	NO	NO	NO	NO	NO	0.0007	0.0012	0.0012
2B10 „Other"	**0.0035**	**0.0065**	**0.0080**	**0.0104**	**0.0123**	**0.0118**	**0.0149**	**0.0130**	**0.0139**
	2008	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**
Polyethylene Production	0.0088	0.0070	0.0092	0.0101	0.0090	0.0098	0.0109	0.0086	0.0085
ABS Resins Production	0.0029	0.0023	0.0045	0.0050	0.0053	0.0055	0.0052	0.0028	0.0044
Polystyrene Production	0.0006	0.0007	0.0005	0.0006	0.0007	0.0005	0.0005	0.0005	0.0003
2B10 „Other"	**0.0122**	**0.0100**	**0.0143**	**0.0157**	**0.0150**	**0.0159**	**0.0166**	**0.0118**	**0.0131**

2B10. 'Other'

a) Polyethylene Production

Three types of polyethylene are produced: 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 $(-CH_2CH_2-)n$. The manufacturing process used depends upon the type of polymer produced. LDPE is a tough waxy polymer, with approximately 2 per cent 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. NMVOCs are emitted primarily through leakages, and may be production time dependent rather than production dependent. Control techniques are primarily through 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 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 batch process; in the second step, which can be operated as batch and continuous, 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 destabilizing 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, being styrene and acrylonitrile; during the reaction the dissolved rubber is replaced by the Styrene Acrylonitrile Copolymer (SAN) and forms discrete rubber particles; part of the SAN is grafted on the rubber particles, while another part is occluded in the particles; the reaction mixture contains several additives, these are needed in the polymerization; the product is devolatilized to remove unreacted monomer, which are recycled to the reactor, and then pelletized; (3) mass suspension: this batch process starts with a mass polymerization which is stopped at a monomer conversion of 15-30 per cent; then 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 is continued; unreacted monomers are stripped, then the product is centrifuged and dried. NMVOC emissions of acrylonitrile butadiene styrene resins plants can be subdivided as follows: leakage losses from appendages, pumps, and other leakage. The losses due to leakage can be limited by use of certain types of seals and application of double seals near pumps.

c) Polystyrene Production

Polystyrene is made by polymerising styrene monomer and is rigid plastic material, transparent or opaque, having 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 the 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 block, 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 yellowing of the polymer. For this reason, on industrial scale it is applied thermal initiation, 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 cent per hour), and at the end (at conversions higher than 90 per cent) the polymerization rate drops greatly and only when temperature rises at 220-260°C it can lead to a polymer with a monomer content of less than 1 per cent. 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 the 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 an air or inert gas environment is transformed into a hard mass taking the shape of the glass form. The continuous mass polymerization allows the production of a polymer free of monomer traces, characterized 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

d) Polyethylene Production

Methodological issues for estimating the NMVOC emissions from polyethylene production are addressed in the EMEP/EEA Atmospheric Emissions Inventory Guidebook (2016). 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 Statistical Yearbooks of the Republic of Moldova and those of the ATULBD (Table 4-45).

Table 4-44: Default EF Used to Estimate NMVOC Emissions from Polyethylene Production

Source	SNAP	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, November 2016, Code SNAP 040506 LDPE Production, Category 2.B.5.a, Table 3.39.Code SNAP 040507 HDPE Production, Category 2.B.5.a, Table 3.40.

Table 4-45: Activity Data on Polyethylene Production in the RM within 1990-2016, kt

	1990	1991	1992	1993	1994	1995	1996	1997	1998
RM: right bank of Dniester River	3.519	3.100	1.715	1.601	0.878	0.717	1.552	1.168	1.170
RM: left bank of Dniester River	1.681	1.300	0.900	0.700	0.300	0.012	0.296	0.085	0.068
RM: total	**5.200**	**4.400**	**2.615**	**2.301**	**1.178**	**0.729**	**1.848**	**1.253**	**1.238**
	1999	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**
RM: right bank of Dniester River	0.683	1.689	2.050	3.324	4.225	3.595	4.254	3.514	3.637
RM: left bank of Dniester River	0.001	0.034	0.041	0.024	0.011	0.188	0.364	0.385	0.353
RM: total	**0.684**	**1.723**	**2.091**	**3.348**	**4.236**	**3.783**	**4.618**	**3.899**	**3.990**
	2008	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**
RM: right bank of Dniester River	3.417	2.795	3.626	4.105	3.635	3.987	4.196	3.290	3.242
RM: left bank of Dniester River	0.234	0.131	0.201	0.116	0.125	0.112	0.336	0.291	0.285
RM: total	**3.651**	**2.926**	**3.827**	**4.221**	**3.760**	**4.099**	**4.532**	**3.581**	**3.527**

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 2005-2016"; 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).

a) *Acrylonitrile Butadiene Styrene Resins (ABS) Production*

Methodological issues for estimating the NMVOC emissions from synthetic resins (Acrylonitrile Butadiene Styrene) production are addressed in the EMEP/EEA Atmospheric Emissions Inventory Guidebook (2016). The methodology used relied on the use of a default emission factor (Table 4-46), combined with activity data from the national statistics (Table 4-47).

Table 4-46: Default EF used to Estimate NMVOC Emissions from Acrylonitrile Butadiene Styrene Resins (ABS) Production

Source	SNAP	Description	NMVOC Emissions, kg / t
Other Chemical Products	040515	Production of ABS Resins	3.0

Source: EMEP/EEA Atmospheric Emissions Inventory Guidebook, November 2016, Code SNAP 040515 Production of ABS resins, Category 2.B.5.a, Table 3.51.

Table 4-47: Activity Data on Acrylonitrile Butadiene Styrene Resins (ABS) Production in the Republic of Moldova within 1990-2016, kt

	1990	1991	1992	1993	1994	1995	1996	1997	1998
Production of ABS Resins	17.500	14.600	5.839	4.792	1.510	1.104	0.040	0.228	0.416
	1999	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**
Production of ABS Resins	0.603	0.791	0.979	0.776	0.708	0.910	1.048	0.825	1.026
	2008	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**
Production of ABS Resins	0.961	0.777	1.516	1.657	1.774	1.842	1.739	0.929	1.453

Source: Statistical Yearbooks of the Republic of Moldova 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).

b) *Polystyrene Production*

Methodological issues for estimating the NMVOC emissions from polystyrene production are addressed in the EMEP/EEA Atmospheric Emissions Inventory Guidebook (2016). The methodology used relied on the use of a default emission factor (Table 4-48), combined with activity data from the national statistics (Table 4-49).

Table 4-48: Default EF used to Estimate NMVOC Emissions from Polystyrene Production

Source	SNAP	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 (2016), Code SNAP 040511 Polystyrene Production, Category 2.B.5.a, Tables 3.45-3.47, Page 42.

Table 4-49: Activity Data on Polystyrene Production within 2005-2016, kt

	2005	2006	2007	2008	2009	2010
Polystyrene plates, sheets and alveolar strips	0.249	0.706	0.804	0.559	1.582	1.876
Polystyrenes, copolymers and other styrene polymers in primary forms	0.210	0.425	0.437	0.235	0.255	0.099
Total polystyrene production	**0.459**	**1.131**	**1.242**	**0.794**	**1.837**	**1.975**
	2011	**2012**	**2013**	**2014**	**2015**	**2016**
Polystyrene plates, sheets and alveolar strips	2.169	2.013	2.119	2.471	2.806	2.474
Polystyrenes, copolymers and other styrene polymers in primary forms	0.093	0.143	0.075	0.060	0.038	NO
Total polystyrene production	**2.262**	**2.155**	**2.194**	**2.532**	**2.844**	**2.474**

Source: Statistical Reports PRODMOLD-A „Total production, as a natural expression, in the Republic of Moldova, by product type, for 2005-2016".

4.3.3. Uncertainty Assessment and Time-Series Consistency

The primary uncertainties related factors pertain to methodology, emission factors used to estimate NMVOC emissions covered by the category 2B 'Chemical Industry', as well as the quality of activity data available. Uncertainty of the default emission factors values were considered as being of ±100 per cent, while those of activity data respectively, of ±5 per cent. 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 EF, available in the EMEP/EEA Atmospheric Emissions Inventory Guidebook (2016); verification was also focused on correct use of AD obtained from different sources of reference, including official sources etc. AD and methods used for estimating GHG emissions under the category 2B 'Chemical Industry' were documented and archived both in hard copies and electronically.

4.3.5. Recalculations

NMVOC emissions from the 2B10 'Other' source category were recalculated for 2014-2015 due to updating the AD regarding polyethylene production on the left bank of Dniester River, available in the Statistical Yearbooks of the A TULBD.

In comparison with the results obtained in the NC4 of the RM under UNFCCC (2018), the recalculations resulted in a small increase of NMVOC emissions from this category (Table 4-50).

Table 4-50: Comparative Results of NMVOC Emissions from 2B10 'Other' source category included into the NC4 and the BUR2 of the Republic of Moldova under the UNFCCC, kt

	1990	1991	1992	1993	1994	1995	1996	1997	1998
NC4	0.0650	0.0544	0.0238	0.0199	0.0074	0.0051	0.0046	0.0037	0.0042
BUR2	0.0650	0.0544	0.0238	0.0199	0.0074	0.0051	0.0046	0.0037	0.0042
Difference, %	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	1999	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**
NC4	0.0035	0.0065	0.0080	0.0104	0.0123	0.0118	0.0149	0.0130	0.0139
BUR2	0.0035	0.0065	0.0080	0.0104	0.0123	0.0118	0.0149	0.0130	0.0139
Difference, %	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**
NC4	0.0122	0.0100	0.0143	0.0157	0.0150	0.0159	0.0161	0.0114	
BUR2	0.0122	0.0100	0.0143	0.0157	0.0150	0.0159	0.0166	0.0118	0.0131
Difference, %	0.0	0.0	0.0	0.0	0.0	0.0	3.0	4.1	

Abbreviations: NC4 – Fourth National Communication; BUR2 – Second Biennial Update Report.

For 2016, NMVOC emissions from the 2B10 'Other' source category was estimated for the first time. Between 1990 and 2016, NMVOC emissions from other uses of soda ash decreased by circa 79.8 per cent due to the decreasing production of polyethylene, synthetic resins ABS and polystyrene in the country.

4.3.6. Planned Improvements

Possible improvements under the 2B 'Chemical Industry' category aim at updating the 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

The 2C 'Metal Industry' category covers GHG emissions from the following emission sources: 2C1 'Iron and Steel Production', 2C2 'Ferroalloys Production', 2C3 'Aluminium Production', 2C4 'Magnesium Production', 2C5 'Lead Production', 2C6 'Zinc Production' and 2C7 'Other'. At the moment, the 2C1 'Iron and Steel Production' is the only source category relevant for the Republic of Moldova in terms of GHG emissions originated under the 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, in particular, 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 per cent of the world iron and steel production, and basic oxygen steelmaking furnaces (BOFs), accounting for circa 63 per cent 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 per cent of the world iron and steel production. Electric arc furnaces are equipped with carbon electrodes (usually made from graphite with a carbon content of circa 97 per cent[46]). Through carbon electrodes electricity is added to the scrap in the furnace, thus raising the temperature to 1700°C. Lime, anthracite and pig-iron are also added. Depending on the desired quality of the steel, chromium, magnesium, molybdenum or vanadium compounds can be added as well.

CO_2 emissions from steel production in electric arc furnaces are determined by carbon losses in electrodes, as well as from carbonates use. When electrodes are placed above the melted metal, the electric arc oxidizes the carbon to CO or CO_2. Sometimes, electrodes are immersed in the melted metal to increase carbon concentration in steel, thus contributing to additional CO_2 emissions. Between 1990 and 2016 years, CO_2 emissions from the category 2C 'Metal Industry' decreased in the Republic of Moldova by circa 81.7 per cent (Table 4-51).

To be noted that the economic crisis in 2009 has significantly affected the metal industry in the Republic of Moldova, with steel production declining between 2008 and 2009 by circa 52 per cent, and the same trend was observed in the following year: between 2009 and 2010 steel production decreased with another 43 per cent. In 2010-2015 years, there was a tendency to increase the metal production, for example, between 2013 and 2014, it increased by 80.2 per cent, while between 2014 and 2015, by another 24.8 per cent. Concomitantly, between 2015 and 2016, the CO_2 emissions from metal industry decreased by 70 per cent, this evolution being caused by the unfavorable situation on the traditional markets for Moldovan steel production.

Table 4-51: CO_2 Emissions from 2C 'Metal Industry' category within 1990-2016 period, kt

	1990	1991	1992	1993	1994	1995	1996	1997	1998
RM: Left Bank of Dniester River	28.2916	24.5575	23.8586	24.3298	25.2723	26.2189	26.7141	32.3652	28.6750
RM: Right Bank of Dniester River	0.2107	0.1722	0.1337	0.0951	0.0566	0.0180	0.0120	0.0154	0.0072
RM: Total	**28.5023**	**24.7297**	**23.9922**	**24.4250**	**25.3289**	**26.2369**	**26.7261**	**32.3806**	**28.6822**
	1999	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**
RM: Left Bank of Dniester River	31.7901	36.2631	38.6194	20.4879	35.3845	40.4565	41.8543	26.9577	38.5395
RM: Right Bank of Dniester River	0.0040	0.0058	0.0080	0.0152	0.0438	0.0519	0.0815	0.0605	0.0732
RM: Total	**31.7942**	**36.2689**	**38.6274**	**20.5030**	**35.4283**	**40.5084**	**41.9358**	**27.0182**	**38.6127**
	2008	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**
RM: Left Bank of Dniester River	35.3429	17.0110	9.6449	12.8029	12.6474	7.5915	13.7620	17.1721	5.0940
RM: Right Bank of Dniester River	0.0689	0.0509	0.0536	0.0527	0.0499	0.0654	0.0844	0.1071	0.1263
RM: Total	**35.4118**	**17.0619**	**9.6985**	**12.8556**	**12.6973**	**7.6569**	**13.8464**	**17.2792**	**5.2203**

4.4.2. Methodological Issues, Emission Factors and Data Sources

CO_2 emissions from 2C1 'Iron and Steel Production' source category were estimated using a Tier 2 methodology (2006 IPCC Guidelines), based on carbon track through the production process.

[46] <http://ukrgrafit.zp.ua/elektrody>, <http://tdvial.ru/ge.htm>, <http://www.ruscastings.ru/work/168/441/449/4785>

Total CO_2 emission from 2C1 'Iron and Steel Production' source category were estimated using equation 4.9 from the 2006 IPCC Guidelines (Volume 3, Chapter 4.2, page 4.22). Below is the simplified version of this equation, 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, tones;
- L – quantity of limestone consumed in steel production, tones;
- C_L – carbon content in limestone consumed in steel production, tC/t limestone;
- D – quantity of dolomite consumed in steel production, tones;
- C_D – carbon content in dolomite consumed in steel production, tC/t dolomite;
- CE – quantity of carbon electrodes consumed in EAFs, tones;
- C_{CE} – carbon content in electrodes consumed in EAFs, tC/t electrodes;
- S – quantity of steel produced, tones;
- C_S – carbon content in steel produced, tC/t steel;
- 44/12 – stoichiometric ratio CO_2/C.

In the Republic of Moldova, the content of carbon in crude steel represents circa 0.25 per cent (according to the information provided by producer, the content of carbon in crude steel varies between 0.17 and 0.33 per cent)[47].

According to the 2006 IPCC Guidelines, depending of steel type and quality, the content of carbon in crude steel varies between 0.5 and 2 per cent, the default value used is 1 per cent (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 the national level, t C / t
Limestone	0.12	Lime with high calcium content	0.2142
Dolomite	0.13	Dolomite 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 it was also considered the specific consumption of raw materials and graphite electrodes for producing 1 ton of steel, this information being identified in the literature in the field and on the web pages of the metallurgical companies. Thus, for example, the consumption of graphite electrodes in electric arc furnaces with a capacity of 30-50 tones, specific to enterprises on the right bank of Dniester River, was agreed to be 7 kg/t of steel produced[48]. 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 tons[49]) was agreed to be 1.3 kg/t of steel produced[50]. The specific consumption of lime with high calcium content and/or dolomite lime is considered to be 55 kg/ton of steel produced[51] (representing 45 kg of lime with high calcium content, respectively 10 kg of dolomite lime).

To be noted that Metal Integrated Works in Ribnita is one of the two mini-metallurgical works (the second is located in Jlobino, Belarus) bought by the USSR in the early 80's of the twentieth century on „dollar for oil" account. 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 year represented about 684 kt of steel and 500 kt of rolling mills. By 2004/2005, steel production

[47] Metal Integrated Works from Ribnita, <http://www.aommz.com/pls/webus/webus.main.show>.
[48] <http://metal-archive.ru/tyazhelye-metally/1468-vyplavka-stali-v-dugovyh-pechah.html>.
[49] <http://www.aommz.com/pls/web/web.main.show?main_id=10&m_id=11>.
[50] <http://elar.urfu.ru/bitstream/10995/40661/1/978-5-7996-1725-7_2016.pdf>.
[51] <https://rep.bntu.by/bitstream/handle/data/6984/%D0%A1.%20128-130.pdf?sequence=1>.

reached 1 million tons of steel and 800 thousand tons of rolling mills. The Metal Integrated Works in Ribnita uses scrap metal collected mainly in the Republic of Moldova, but also from the neighboring countries, especially from Ukraine. At the same time, there are a number of enterprises on the right bank of Dniester River (such as: "Incomaş" J.S.C., Plant "Fiting" J.S.C., Pipe Plant "Protos" J.S.C. owned by the company IM "Orvento Metall Trading Co" Ltd., etc.) that use low-capacity electric arc furnaces (less than 50 tones). The steel production of these enterprises is insignificant compared to that of the Metal Integrated Works in Ribnita.

AD related to steel (Table 4-53) and rolling mills production (Table 4-54) in the Republic of Moldova is available in the statistical publications of the Republic of Moldova and ATULBD.

Table 4-53: Activity Data on Steel Production in the RM within 1990-2016, kt

	1990	1991	1992	1993	1994	1995	1996	1997	1998
RM: Right Bank of Dniester River	3.500	2.860	2.220	1.580	0.940	0.299	0.199	0.255	0.120
RM: Left Bank of Dniester River	708.400	614.900	597.400	609.200	632.800	656.500	668.900	810.400	718.000
RM: Total	**711.900**	**617.760**	**599.620**	**610.780**	**633.740**	**656.799**	**669.099**	**810.655**	**718.120**
	1999	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**
RM: Right Bank of Dniester River	0.067	0.097	0.133	0.252	0.727	0.862	1.354	1.005	1.215
RM: Left Bank of Dniester River	796.000	908.000	967.000	513.000	886.000	1013.000	1048.000	675.000	965.000
RM: Total	**796.067**	**908.097**	**967.133**	**513.252**	**886.727**	**1013.862**	**1049.354**	**676.005**	**966.215**
	2008	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**
RM: Right Bank of Dniester River	1.145	0.845	0.890	0.876	0.828	1.087	1.401	1.778	2.098
RM: Left Bank of Dniester River	884.958	425.943	241.501	320.574	316.682	190.086	344.590	429.976	127.549
RM: Total	**886.103**	**426.788**	**242.391**	**321.450**	**317.510**	**191.173**	**345.991**	**431.754**	**129.647**

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 Republic of Moldova, by product type, for 2005-2016"; 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).

Table 4-54: Activity Data on Rolling Mills Production in the RM within 1990-2016, kt

	1990	1991	1992	1993	1994	1995	1996	1997	1998
Production of Rolling Mills	614.200	561.300	547.600	487.200	438.000	357.000	341.000	407.000	588.000
	1999	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**
Production of Rolling Mills	593.000	636.000	791.000	381.000	693.000	791.000	890.000	633.000	914.000
	2008	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**
Production of Rolling Mills	818.035	437.515	237.710	302.162	360.402	173.146	389.260	318.840	222.489

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), 2016 (page 99), 2017 (page 101).

Methodological issues related to estimating non-CO_2 emissions from steel production in electric arc furnaces are addressed in the EMEP/EEA Atmospheric Emissions Inventory Guidebook (2016). The assessment method used is based on default EF (Table 4-55), combined with activity data from the national statistics (Tables 4-53 and 4-54).

Table 4-55: Default EF Used to Estimate Non-CO_2 Emissions from Steel Production in EAF

Source	Description	NO_x	CO	NMVOC	SO_2
		g / t			
Steel Production in Electric Arc Furnaces (EAF)	Steel Production[1]	130	1700	46	60
	Production of Rolling Mills [2]			7	

Source: EMEP/EEA Atmospheric Emissions Inventory Guidebook, November 2016, [1] 2.C.1 Steel Production, 040207 – Steel Production in Electric Arc Furnaces, Table 3.19, page 43; [2] 2.C.1 Steel Production, 040208 – Production of Rolling Mills, Table 3.22, page 45.

4.4.3. Uncertainties Assessment 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 is considered to represent ±10 per cent (2006 IPCC Guidelines). Uncertainties associated with activity data on steel and rolling mills production in the Republic of Moldova can be considered low (±1-2 per cent), but considering that in the process of assessment there are also used AD regarding the consumption of electrodes, lime and dolomite, which are estimated according to the specific consumption per specific sector, total uncertainties associated with AD could increase to circa ± 5 per cent. Thus, combined uncertainties of total sectoral emissions represent circa ±11.18 per cent (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 EF, available in the EMEP/EEA Atmospheric Emissions Inventory Guidebook (2016); verification was also focused on correct use of AD obtained from different sources of reference, 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 Republic, by product type', Statistical Yearbooks of the ATULBD, Steel Statistical Yearbooks, published by the International Institute of Iron and Steel[52], as well as web pages of national and foreign enterprises in the field) etc. The AD and methods used for estimating GHG emissions under the 2C1 'Iron and Steel Production' source category were documented and archived both in hard copies and electronically.

4.4.5. Recalculations

CO_2 emissions from the 2C1 'Iron and Steel Production' source category were recalculated for 2014-2015, due to updating the AD on steel production on the Right Bank of Dniester River, available in the Statistical Reports PRODMOLD-A "Total production, as a natural expression, in the Republic, by product type".

In comparison with the results obtained in the NC4 of the RM under UNFCCC (2018), the recalculations resulted in an insignificant increase of CO_2 emissions from steel production (Table 4-56). For 2016, CO_2 emissions from the 2C1 'Iron and Steel Production' source category was estimated for the first time. Between 1990 and 2016, the respective emissions decreased by circa 81.7 per cent due to the decreasing production.

Table 4-56: Comparative Results of CO_2 Emissions from 2C1 'Iron and Steel Production' source category included into the NC4 and the BUR2 of the RM under the UNFCCC, kt

	1990	1991	1992	1993	1994	1995	1996	1997	1998
NC4	28.5023	24.7297	23.9922	24.4250	25.3289	26.2369	26.7261	32.3806	28.6822
BUR2	28.5023	24.7297	23.9922	24.4250	25.3289	26.2369	26.7261	32.3806	28.6822
Difference, %	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	1999	2000	2001	2002	2003	2004	2005	2006	2007
NC4	31.7942	36.2689	38.6274	20.5030	35.4283	40.5084	41.9358	27.0182	38.6127
BUR2	31.7942	36.2689	38.6274	20.5030	35.4283	40.5084	41.9358	27.0182	38.6127
Difference, %	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
NC4	35.4118	17.0619	9.6985	12.8556	12.6973	7.6569	13.7976	17.2258	
BUR2	35.4118	17.0619	9.6985	12.8556	12.6973	7.6569	13.8464	17.2792	5.2203
Difference, %	0.0	0.0	0.0	0.0	0.0	0.0	0.4	0.3	

Abbreviations: NC4 – Fourth National Communication; BUR2 – Second Biennial Update Report.

The table below presents the non-CO_2 emissions from the 2C1 'Iron and Steel Production' source category for 1990-2016 time series (Table 4-57). During the period under review, the respective emissions followed a similar trend as CO_2 emissions.

Table 4-57: Non-CO_2 Emissions from the 2C1 'Iron and Steel Production' source category in the Republic of Moldova within 1990-2016 periods, kt

	1990	1991	1992	1993	1994	1995	1996	1997	1998
NO_x	0.0925	0.0803	0.0780	0.0794	0.0824	0.0854	0.0870	0.1054	0.0934
CO	1.2102	1.0502	1.0194	1.0383	1.0774	1.1166	1.1375	1.3781	1.2208
NMVOC	0.0370	0.0323	0.0314	0.0315	0.0322	0.0327	0.0332	0.0401	0.0371
SO_2	0.0427	0.0371	0.0360	0.0366	0.0380	0.0394	0.0401	0.0486	0.0431
	1999	2000	2001	2002	2003	2004	2005	2006	2007
NO_x	0.1035	0.1181	0.1257	0.0667	0.1153	0.1318	0.1364	0.0879	0.1256
CO	1.3533	1.5438	1.6441	0.8725	1.5074	1.7236	1.7839	1.1492	1.6426
NMVOC	0.0408	0.0462	0.0500	0.0263	0.0456	0.0522	0.0545	0.0355	0.0508
SO_2	0.0478	0.0545	0.0580	0.0308	0.0532	0.0608	0.0630	0.0406	0.0580
	2008	2009	2010	2011	2012	2013	2014	2015	2016
NO_x	0.1152	0.0555	0.0315	0.0418	0.0413	0.0249	0.0450	0.0561	0.0169
CO	1.5064	0.7255	0.4121	0.5465	0.5398	0.3250	0.5882	0.7340	0.2204
NMVOC	0.0465	0.0227	0.0128	0.0169	0.0171	0.0100	0.0186	0.0221	0.0075
SO_2	0.0532	0.0256	0.0145	0.0193	0.0191	0.0115	0.0208	0.0259	0.0078

[52] <https://www.worldsteel.org/steel-by-topic/statistics/Steel-Statistical-Yearbook-.html>.

4.4.6. Planned Improvements

Possible improvements under the 2C 'Metal Industry' category aim at updating the activity data regarding the consumption of raw materials per ton of production, as well as the specific consumption of electrodes per ton of steel produced by the national enterprises. If new country specific data will be available, the uncertainties associated with GHG emissions from this source category could be decreased with the next 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 industrial and transportation applications. The use of lubricants in engines is primarily for their lubricating properties and associated emissions are therefore considered as non-combustion emissions to be reported in the Sector 2 'IPPU' and not in the Sector 1 'Energy'.

2D2. Paraffin Wax Use

Within this category, CO_2 emissions from the use of different products are monitored: petroleum jelly, 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, for paper coating, food production, wax polishes, surfactants (as used in 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, wood preservation, 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 2016, direct CO_2 emissions from 2D 'Non-energy Products from Fuels and Solvent Use' category decreased by circa 66.5 per cent (Table 4-58). In comparison with the 2014-year level, in 2015 GHG emissions decreased by circa 2.9 per cent, while in 2016, compared to the previous year level, a decrease by another 9.0 per cent was recorded.

Table 4-58: CO_2 Emissions from 2D 'Non-Energy Products from Fuels and Solvent Use' category, by Source, within 1990-2016 periods, kt

	1990	1991	1992	1993	1994	1995	1996	1997	1998
2D1. Lubricant Use	24.7987	20.7617	12.1110	10.9576	10.1022	10.1316	9.7676	9.2153	7.0105
2D2. Paraffin Wax Use	0.1138	0.0953	0.0556	0.0503	0.0464	0.0465	0.0448	0.0423	0.0322
2D3. Solvent Use	204.1460	167.7797	138.5232	110.2218	72.1539	64.2796	59.4607	31.0928	29.1801
2D4. Other	5.3005	4.6818	3.5730	2.6463	2.1713	2.1031	1.7979	1.7024	1.3765
2D. Non-Energy Products from Fuels and Solvent Use	234.3591	193.3185	154.2628	123.8759	84.4738	76.5608	71.0711	42.0527	37.5993
	1999	2000	2001	2002	2003	2004	2005	2006	2007
2D1. Lubricant Use	4.9998	3.9115	4.3872	4.3239	6.5825	6.5622	6.4692	6.9861	5.7679
2D2. Paraffin Wax Use	0.0230	0.0180	0.0201	0.0198	0.0302	0.0301	0.0149	0.0594	0.0595
2D3. Solvent Use	25.5994	25.6400	28.3468	30.4210	32.7176	55.7018	59.5365	72.9830	77.1889
2D4. Other	0.9920	1.0697	1.1693	1.4252	1.5908	1.8059	1.8195	1.8432	1.9311
2D. Non-Energy Products from Fuels and Solvent Use	31.6142	30.6392	33.9235	36.1900	40.9211	64.1000	67.8400	81.8718	84.9474
	2008	2009	2010	2011	2012	2013	2014	2015	2016
2D1. Lubricant Use	6.1481	5.0916	5.4648	5.7762	4.9418	4.8461	4.7832	4.8165	4.9177
2D2. Paraffin Wax Use	0.0295	0.0742	0.1795	0.0747	0.1351	0.0751	0.0301	0.0600	0.0449
2D3. Solvent Use	58.9055	51.1739	59.1169	64.0577	68.6412	63.6359	81.6487	78.8011	70.7300
2D4. Other	2.0219	1.8487	2.2918	2.4321	2.1716	2.3829	2.5008	2.6922	2.9202
2D. Non-Energy Products from Fuels and Solvent Use	67.1050	58.1883	67.0530	72.3407	75.8897	70.9399	88.9627	86.3698	78.6128

A similar trend was recorded for indirect GHG emissions (NO_x, CO, NMVOC) and SO_2 from this category (Table 4-59).

Table 4-59: Indirect GHG Emissions from 2D 'Non-energy Products from Fuels and Solvent Use' category, by Source, within 1990-2016 periods, kt

	1990	1991	1992	1993	1994	1995	1996	1997	1998
NO_x	0.0434	0.0361	0.0304	0.0241	0.0146	0.0132	0.0119	0.0040	0.0033
CO	0.2441	0.2030	0.1706	0.1356	0.0820	0.0740	0.0671	0.0227	0.0185
NMVOC	92.7937	76.2635	62.9651	50.1008	32.7972	29.2180	27.0276	14.1331	13.2679
SO_x	0.0216	0.0180	0.0151	0.0120	0.0073	0.0065	0.0059	0.0020	0.0016
	1999	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**
NO_x	0.0024	0.0019	0.0024	0.0021	0.0026	0.0082	0.0077	0.0124	0.0130
CO	0.0133	0.0108	0.0135	0.0118	0.0145	0.0459	0.0431	0.0697	0.0732
NMVOC	11.6405	11.6590	12.8867	13.8294	14.8735	25.3328	27.0205	33.1366	35.0576
SO_x	0.0012	0.0010	0.0012	0.0010	0.0013	0.0041	0.0038	0.0062	0.0065
	2008	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**
NO_x	0.0075	0.0056	0.0069	0.0078	0.0088	0.0088	0.0128	0.0089	0.0055
CO	0.0427	0.0316	0.0392	0.0443	0.0500	0.0501	0.0723	0.0503	0.0313
NMVOC	26.7467	23.2322	26.8426	29.0886	31.1720	28.8972	37.0850	35.8010	32.3532
SO_x	0.0037	0.0028	0.0034	0.0039	0.0044	0.0044	0.0064	0.0044	0.0028

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 the AD regarding lubricant consumption available in the Energy Balances of the Republic of Moldova and the statistical publication Social-Economical Development of the Transnistrian Moldovan Republic (ATULBD). CO_2 emissions 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 represents 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 represents 20 per cent for oil and 5 per cent for grease (2006 IPCC Guidelines, Vol. 3, Chapter 5.2, Tab.5.2, p. 5.9);

44/12 – mass ratio of CO_2/C.

In line with the recommendations in the 2006 IPCC Guidelines, where statistical data on lubricant consumption are aggregated without the possibility of delimiting oil and grease consumption, it is recommended to consider that 90 per cent of total lubricants are oils and 10 per cent – grease. AD used to estimate CO_2 emissions from this source are presented below (Table 4-60).

Table 4-60: AD on Lubricant Use within 1990-2016 periods, TJ

	1990	1991	1992	1993	1994	1995	1996	1997	1998
Total lubricant used, of which:	1827.9	1530.3	892.7	807.7	744.6	746.8	720.0	679.3	516.7
Oil	1645.1	1377.3	803.4	726.9	670.2	672.1	648.0	611.3	465.1
Grease	182.8	153.0	89.3	80.8	74.5	74.7	72.0	67.9	51.7
	1999	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**
Total lubricant used, of which:	368.5	288.3	323.4	318.7	485.2	483.7	476.8	514.9	425.1
Oil	331.7	259.5	291.0	286.8	436.7	435.3	429.2	463.5	382.6
Grease	36.9	28.8	32.3	31.9	48.5	48.4	47.7	51.5	42.5
	2008	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**
Total lubricant used, of which:	453.2	375.3	402.8	425.8	364.3	357.2	352.6	355.0	362.5
Oil	407.9	337.8	362.5	383.2	327.8	321.5	317.3	319.5	326.2
Grease	45.3	37.5	40.3	42.6	36.4	35.7	35.3	35.5	36.2

Source: Energy Balances of the Republic of Moldova for 1990, 1993-2016; Socio-economic Development of the TMR, 2016 (final data). / State Statistical Service of the TMR - Tiraspol, 2017 – 81p.; Socio-economic Development of the TMR, 2015 (final data). / State Statistical Service of the TMR - Tiraspol, 2016 – 81p.; Socio-economic Development of the TMR, 2014 (final data). / State Statistical Service of the TMR - Tiraspol, 2015 – 81p.; Socio-economic Development of the TMR, 2013 (final data). / State Statistical Service of the Ministry of Economic Development of the TMR - Tiraspol, 2014 – 88p.; Socio-economic Development of the TMR, 2012. / State Statistical Service of the Ministry of Economic Development of the TMR - Tiraspol, 2013 – 85p.; Socio-economic Development of the TMR, 2011. / State Statistical Service of the Ministry of Economic Development of the TMR - Tiraspol, 2012 – 85p.; Socio-economic Development of the TMR, 2010. / State Statistical Service of the Ministry of Economic Development of the TMR - Tiraspol, 2011 – 79p.; Socio-economic Development of the TMR, 2009. / State Statistical Service of the Ministry of Economic Development of the TMR - Tiraspol, 2010 – 75p.

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 the AD regarding paraffin wax consumption available in the Energy Balances of the Republic of Moldova (since 2004; for 1990-2003 time series paraffin wax consumption was estimated indirectly based on lubricants consumption). In contrast to the previous inventory cycle, in the current cycle paraffin wax use on the left bank of Dniester River (in the ATULBD) was also estimated indirectly: it was considered that the share of paraffin was consumption on the left bank of Dniester River from the total national consumption is similar to the share of lubricants consumption in the ATULBD from 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, t C/ TJ; the default value used represents 20 t C / TJ (2006 IPCC Guidelines, Volume 3, Chapter 5.3, page 5.12);

ODU_{Wax} – ODU factor (oxidized during use) for paraffin wax, fraction; the default value used represents 20 per cent (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 this source are presented below (Table 4-61).

Table 4-61: AD on Paraffin Wax Use in the Republic of Moldova, within 1990-2016 periods, TJ

	1990	1991	1992	1993	1994	1995	1996	1997	1998
Paraffin Wax Used	7.8	6.5	3.8	3.4	3.2	3.2	3.1	2.9	2.2
	1999	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**
Paraffin Wax Used	1.6	1.2	1.4	1.4	2.1	2.1	1.0	4.0	4.1
	2008	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**
Paraffin Wax Used	2.0	5.1	12.2	5.1	9.2	5.1	2.0	4.1	3.1

2D3. Solvent Use

Between 1990 and 2016, indirect CO_2 emissions from 2D3 'Solvent Use' source category decreased by circa 65.4 per cent (Table 4-62). Similar trends were recorded for indirect GHG emissions (NO_x, CO, NMVOC) and SO_2 from the respective category (Table 4-59).

Table 4-62: Indirect CO_2 Emissions from 2D3 'Solvent Use', by Source, 1990-2016 periods, kt

	1990	1991	1992	1993	1994	1995	1996	1997	1998
2D3a. Domestic Solvent Use	11.5146	11.5270	11.5080	11.4782	11.4911	11.4785	11.4428	11.4048	11.4201
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	6.0936
2D3c. Asphalt Roofing	NO	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	1.2211
2D3e. Degreasing	2.6034	1.4818	0.8383	0.5482	0.4094	0.4626	0.1545	0.2217	0.4572
2D3f. Dry Cleaning	1.4018	0.7979	0.4514	0.2952	0.2204	0.2491	0.0832	0.1194	0.2462
2D3g. Chemical Products Manufacturing and Processing	78.6836	65.5702	54.3484	42.8017	25.9697	23.3207	21.1118	7.7410	6.3694
2D3h. Printing	0.5406	0.3631	0.2489	0.1796	0.1349	0.0782	0.0961	0.0703	0.0872
2D3i. Other Solvent Use	6.7953	4.8695	3.4559	2.9881	2.8247	2.7315	2.4874	2.7821	3.2852
2D3. Solvent Use	**204.1460**	**167.7797**	**138.5232**	**110.2218**	**72.1539**	**64.2796**	**59.4607**	**31.0928**	**29.1801**
	1999	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**
2D3a. Domestic Solvent Use	11.3916	11.3612	11.3158	11.2720	11.2234	11.1688	10.4027	10.4098	10.4898
2D3b. Production and Use of Asphalt for Road Paving	4.3875	3.5502	4.4447	3.8891	4.7652	15.1338	14.1948	22.9614	24.1157
2D3c. Asphalt Roofing	NO	NO	NO	NO	0.0025	0.0019	0.0020	0.0030	0.0032
2D3d. Paint Application	1.2900	2.8430	3.6133	5.8351	6.1180	8.1444	13.5648	9.1459	11.3119
2D3e. Degreasing	0.3971	0.3982	0.4081	0.5864	0.3329	0.4382	0.4186	0.5858	0.5388
2D3f. Dry Cleaning	0.2138	0.2144	0.2198	0.3157	0.1793	0.2360	0.2254	0.3154	0.2901
2D3g. Chemical Products Manufacturing and Processing	4.9515	4.3259	5.1612	4.8628	5.7279	15.3565	15.0309	23.2269	24.8340
2D3h. Printing	0.0645	0.0776	0.1103	0.1412	0.1599	0.2088	0.2823	0.2160	0.2509
2D3i. Other Solvent Use	2.9034	2.8695	3.0737	3.5187	4.2084	5.0134	5.4149	6.1189	5.3546
2D3. Solvent Use	**25.5994**	**25.6400**	**28.3468**	**30.4210**	**32.7176**	**55.7018**	**59.5365**	**72.9830**	**77.1889**

	2008	2009	2010	2011	2012	2013	2014	2015	2016
2D3a. Domestic Solvent Use	10.4489	10.4198	10.3966	10.3778	10.3646	10.3587	10.3445	10.2558	10.1471
2D3b. Production and Use of Asphalt for Road Paving	13.8172	10.3574	12.8330	14.5076	16.3806	16.3904	23.7660	16.5279	10.2778
2D3c. Asphalt Roofing	0.0259	0.0050	0.0107	0.0098	0.0113	0.0117	0.0092	0.0067	0.0043
2D3d. Paint Application	11.1305	10.6405	11.6314	14.5764	14.0092	10.6746	13.8369	18.8792	22.4689
2D3e. Degreasing	0.5382	0.4990	0.6128	0.6838	1.9442	1.2663	1.1002	0.9206	0.7758
2D3f. Dry Cleaning	0.2898	0.2687	0.3300	0.3682	1.0469	0.6819	0.5924	0.4957	0.4177
2D3g. Chemical Products Manufacturing and Processing	17.2385	13.9175	17.2798	17.9677	19.7555	19.4641	26.7934	20.7252	14.7250
2D3h. Printing	0.2652	0.2378	0.2957	0.2786	0.2569	0.2894	0.3099	0.4044	0.3280
2D3i. Other Solvent Use	5.1514	4.8282	5.7271	5.2878	4.8721	4.4989	4.8962	10.5855	11.5855
2D3. Solvent Use	**58.9055**	**51.1739**	**59.1169**	**64.0577**	**68.6412**	**63.6359**	**81.6487**	**78.8011**	**70.7300**

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. To be noted that their production within the country is relatively low (Table 4-63).

Table 4-63: AD on the Production of Domestic Products in the RM within 2005-2016 periods

	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Preparations for perfuming and deodorizing rooms, tons					2.450	2.241	12.226	12.886	15.365			
Perfumery and cosmetics (exclusively perfume and eau de toilette), mil. pieces	2 234.6	1 731.2	2 043.6	1 379.6	1 145.3	1 557.3	1 315.4	2 723.3	4 145.9	3 733.0	3 455.0	3 925.7
Perfumes, thousand liters	0.679	0.126	0.312				0.025	3.019	2.835			
Eau de toilette, thousand liters	328.175	407.644	414.315	384.966	295.415	307.241	285.723	130.635	77.908		10.092	
Other beauty products, mil. pieces	982.8	653.6	832.8	628.9	395.4	623.7	523.2	751.9	1 271.3	1 349.6	854.2	1 420.9
Shampoo, mil. pieces	1 540.2	1 220.2	1 354.7	723.4	588.8	815.7	566.9	450.5	383.8	253.1	346.5	326.2
Other cosmetics and perfumery, mil. pieces	362.6	651.8	386.2	609.0	684.2	826.1	957.6	3 772.5	2 349.5	1 913.5	2 043.2	1 910.5

Source: NBS through Statistical Reports PRODMOLD-A „Total production, as a natural expression, in the Republic, by product type 2005-2016".

It should also be noted that the Statistical Reports PRODMOLD-A "Total production, as a natural expression, in the Republic, by product type" include relevant data only for 2005-2016 periods (Table 4-64) and thus cannot be considered complete for the entire period under review. Also, activity data are not always available in tons or liters thus requesting the use of conversion factors.

Table 4-64: Activity Data on Domestic Solvents Import in the RM within 1995-2016 periods, kt

	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
Perfumes and eau de toilette	0.0925	0.1429	0.1454	0.0068	0.0170	0.0991	0.1585	0.2607	0.2364	0.2087	0.2404
Beauty or make-up products and skin care, manicure or pedicure products	0.0667	0.0713	0.1068	0.0580	0.0532	0.0800	0.1974	0.3326	0.5557	0.5567	0.7338
Hair care products	0.2130	0.3283	0.3816	0.3358	0.5573	1.0675	1.2892	1.5030	1.8767	1.9802	2.3080
Pre-shave, shave or after-shave products, deodorants, bath products, depilatories, other perfumery or toiletries and other cosmetics, air freshener	0.0399	0.0397	0.0807	0.0687	0.0478	0.0864	0.1897	0.4108	0.6529	0.7696	1.2069
	2006	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**
Perfumes and eau de toilette	0.2858	0.4660	0.2012	0.1323	0.1114	0.0918	0.1441	0.1502	0.1122	0.1006	0.1103
Beauty or make-up products and skin care, manicure or pedicure products	0.8086	0.9913	1.0283	0.8313	0.8856	0.9429	0.9405	1.0121	1.0180	0.9784	0.1409
Hair care products	2.4143	2.8395	2.6788	2.6876	2.7463	2.8667	3.0558	2.9765	3.1153	1.1279	1.1515
Pre-shave, shave or after-shave products, deodorants, bath products, depilatories, other perfumery or toiletries and other cosmetics, air freshener	1.3931	1.6538	1.8950	1.5354	1.6036	1.8711	2.1028	2.2754	2.2930	1.3670	2.0612

Source: Customs Service of the RM, Official 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; Official 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; Official 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; Official 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; Official Letter No. 28/07-612 dated 12.01.2018, as a response to the request from the Climate Change Office of the Ministry of Agriculture, Regional Development and Environment No. 601/2017-12-03 dated 14.12.2017.

Customs Service of the Republic of Moldova is a primary source of information on national import operations. Though AD on the production and imports of certain household products are available, the solvents share in these products is unknown.

The methodology used to estimate NMVOC emissions from source category 2D3a 'Domestic Solvents Use' is the one available in the EMEP/EEA Air Pollutant Emission Inventory Guidebook (2016) and is represented by the following equation:

$$E_{pollutant} = (P \bullet EF_{pollutant}) / 10^3$$

Where:

$E_{pollutant}$ – Pollutant gas emissions from domestic solvents use, t/yr;

P – Population, thousand inhabitants/yr (Table 4-66);

$EF_{pollutant}$ – Emission Factor for this pollutant gas, kg/person/yr.

The EMEP/EEA Air Pollutant Emission Inventory Guidebook (2016) provides default EFs and a Tier 1 methodological approach (Table 4-65).

Table 4-65: Tier 1 Default EF used to Estimate NMVOC Emissions from 2D3a 'Domestic Solvents Use'

Source Category	NMVOC Emission Factor	Unit
Domestic Solvent Use	1.2	kg/person/yr

Source: EMEP/EEA Air Pollutant Emission Inventory Guidebook (November 2016 Edition), Category 2.D.3.a „Domestic Solvent Use" (including fungicides), Chapter 3.1, Table 3.1, page 8.

Table 4-66: Republic of Moldova's Population within 1990-2016 periods

	1990	1991	1992	1993	1994	1995	1996	1997	1998
Total population (including ATULBD), thousand inhabitants	4361.6	4366.3	4359.1	4347.8	4352.7	4347.9	4334.4	4320.0	4325.8
	1999	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**
Total population (including ATULBD), thousand inhabitants	4315.0	4303.5	4286.3	4269.7	4251.3	4230.6	3940.4	3943.1	3973.4
	2008	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**
Total population (including ATULBD), thousand inhabitants	3957.9	3946.9	3938.1	3931.0	3926.0	3923.7	3918.4	3884.8	3843.6

Source: Statistical Yearbooks of the RM for 1990-2017. Statistical Yearbooks of the ATULBD for 1998-2017.

Indirect CO_2 emissions were estimated based on the carbon content in NMVOC emissions. The default value used represents 60% per cent (2006 IPCC Guidelines, Volume 3, Chapter 5.5, page 5.17). By oxidizing, this carbon converts into CO_2 in atmosphere (it is assumed that all solvents from household waste products are of fossil origin).

CO_2 emissions from domestic solvents use were estimated using the following equation:

$$CO_2\ emissions = NMVOC \bullet CC \bullet 44/12$$

Where:

CO_2 emissions – carbon dioxide emissions from domestic solvents use, kt/yr;

NMVOC – total NMVOC emissions within the respective category, kt/yr;

CC – carbon content in NMVOC, fraction (the default value used represents 60 per cent, with a margin of 50-70 per cent; 2006 IPCC Guidelines, Volume 3, Chapter 5.5, page 5.17);

44/12 – stoichiometric ratio 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 (2016). Default EF's values are presented in Table 4-67, while the annual data related to asphalt production were provided by the Ministry of Transport and Roads Infrastructure for 1990-2002, periods, respectively by the National Bureau of Statistics for 2003-2016 periods (Table 4-68).

Table 4-67: Default EF used to estimate GHG Emissions from Asphalt Production and Use for Road Paving with Asphalt

Description	NO_x	CO	SO_2	NMVOC
	g / t			kg / t
Asphalt Plants[1]	35.6	200	17.7	
Asphalt Use for Road Paving[2]				30

Source: EMEP/EEA Atmospheric Emissions Inventory Guidebook, November 2016.[1]Code SNAP 030313Asphalt Plants, Category 1.A.2.f.i, Table 3-25.[2]Code SNAP 040611Road Paving with Asphalt, Category 2.D.3.b, Table 3.4.

Table 4-68: AD regarding Road Paving with Asphalt within 1990-2016 periods, kt

	1990	1991	1992	1993	1994	1995	1996	1997	1998
Road paving with asphalt	1220.305	1014.808	853.000	678.000	410.000	370.000	335.600	113.727	92.328
	1999	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**
Road paving with asphalt	66.477	53.791	67.343	58.925	72.200	229.300	215.073	347.899	365.390
	2008	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**
Road paving with asphalt	209.351	156.931	194.440	219.812	248.191	248.339	360.090	250.423	155.724

Source: Ministry of Transport and Roads Infrastructure, Official 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; Official 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; Official 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, Official Letter No. 06-39/08 dated 23.02.2011, as a response to the 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 2005-2016".

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/an;

$EF_{pollutant}$ – Default Emission Factor, g/t.

Indirect CO_2 emissions were estimated considering the carbon content in NMVOC emissions. The default value used represents 60 per cent (2006 IPCC Guidelines, Volume 3, Chapter 5.5, page 5.17). By oxidizing, this carbon is converted into CO_2 in atmosphere (it is assumed that all solvents from asphalt are of fossil origin).

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 – carbon dioxide emissions from road paving with asphalt, kt/yr;

NMVOC – total NMVOC emissions within the respective category, kt/an;

CC – carbon content in NMVOC, fraction (the default value used represents 60 per cent, with a margin of 50-70 per cent; IPCC 2006 Guidelines, Volume 3, Chapter 5.5, page 5.17);

44/12 – stoichiometric ratio 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 (2016). Default EF's value (for production technologies and typical or medium mitigation measures) are presented below (Table 4-69).

Table 4-69: Default EF used to estimate GHG Emissions from Asphalt Roofing

Source Category	CO	NMVOC
	g / t	
Asphalt Roofing	9.5	130

Source: EMEP/EEA Atmospheric Emissions Inventory Guidebook, November 2016, Code SNAP 040610 Asphalt Roofing, Category 2.D.3.c, Table 3.1.

AD regarding asphalt roofing production for 2003-2016 periods was provided by the NBS of the Republic of Moldova (Table 4-70). According to these data, until 2003, no domestic asphalt roofing production was recorded, the respective production being imported.

Table 4-70: AD on Asphalt Roofing in the Republic of Moldova within 2003-2016 periods, kt

	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
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	23.6	15.0

Source: National Bureau of Statistics, Official Letter No. 06-39/08 dated 23.02.2011, as a response to the request 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 2005-2016".

Total GHG emissions from asphalt roofing 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 represents 60 per cent (2006 IPCC Guidelines, Volume 3, Chapter 5.5, page 5.17). By oxidizing, this carbon is converted into CO_2 in atmosphere (it is assumed that all solvents from asphalt are of fossil origin).

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 – carbon dioxide emissions from asphalt roofing, kt/yr;

NMVOC – total NMVOC emissions within the respective category, kt/yr;

CC – carbon content in NMVOC, fraction (the default value used represents 60 per cent, with a margin of 50-70 per cent; 2006 IPCC Guidelines, Volume 3, Chapter 5.5, page 5.17);

44/12 – stoichiometric ratio CO_2/C.

2D3d. Paint Application

Under this category there are reported emissions from decorative coating application, in particular in construction (SNAP 060103) and domestic paint application (SNAP 060104); industrial coating application, in particular from manufacture of automobiles (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 aircrafts, carriages, steel bridges, military vehicles, engines, pumps, tanks, office equipment, plastic articles, toys etc.) (SNAP 060108); respectively, other non-industrial paint application' (paint or varnish application to protect large metal construction from corrosion, for road marking etc.) (SNAP 060109). Since the breakdown of AD on paint and varnish consumption in the RM by sectors 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 4-71).

Table 4-71: Carbon and Solvent Content in Different Types of Products

Products containing solvents	Carbon content, %[1]	Solvent Content, %[2]
Conventional solvent paints	60	40-70
Waterborne paints		<20

Source: [1] 2006 IPCC Guidelines, Volume 3, Chapter 5.4, page 5.17; [2] EMEP/EEA Atmospheric Emissions Inventory Guidebook, (2016), Category 2.D.3.d "Paint Application", 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 (2016) and uses the following equation:

$$E_{pollutant} = (AR_{product} \bullet EF_{pollutant}) / 10^3$$

Where:

$E_{pollutant}$ – the emission of the specified pollutant, t/yr;

$AR_{product}$ – the activity rate for the coating application (consumption of paint), t/yr;

$EF_{pollutant}$ – the emission factor for the pollutant, kg/t.

The EMEP/EEA Air Pollutant Emission Inventory Guidebook (2016) provides default EFs for Tier 1 approach (Table 4-72). In order to determine the EFs values there were taken into consideration also typical mitigation actions for NMVOC emission from paint producing plants.

Table 4-72: Default Tier 1 EFs for the 2D3d 'Paint Application'

Source	NMVOC EF	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, (2016), 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 internal production and statistical data on import and export of such substances in the RM. Statistical Yearbooks of the RM contain aggregated data on total production of varnishes and paints in the country (Table 4-73). The NBS also provides disaggregated activity data on production of different types of varnishes and paints.

Table 4-73: Activity Data on Production of Varnishes and Paints within 1990-2016 periods, kt

	1990	1991	1992	1993	1994	1995	1996	1997	1998
Production of conventional solvent paints	10.100	8.250	5.549	2.714	1.131	0.738	0.664	0.451	0.350
Production of waterborne paints	1.600	0.550	0.451	0.386	0.069	0.062	0.036	0.058	0.020
Total paints production	**11.700**	**8.800**	**6.000**	**3.100**	**1.200**	**0.800**	**0.700**	**0.509**	**0.370**
	1999	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**
Production of conventional solvent paints	0.674	2.025	2.701	3.379	2.417	3.872	5.085	6.693	8.793
Production of waterborne paints	0.000	0.029	0.169	0.716	1.026	1.264	1.184	1.626	2.252
Total paints production	**0.674**	**2.054**	**2.870**	**4.095**	**3.443**	**5.136**	**6.269**	**8.319**	**11.045**
	2008	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**
Production of conventional solvent paints	8.768	8.270	9.657	12.915	13.673	9.474	13.540	20.573	25.363
Production of waterborne paints	2.789	3.553	3.208	5.097	4.234	2.857	4.131	6.268	7.104
Total paints production	**11.557**	**11.822**	**12.864**	**18.011**	**17.907**	**12.345**	**17.685**	**26.858**	**32.746**

Source: National Bureau of Statistics, Official Letter No. 06-39/08 dated 23.02.2011, as a response to the request No. 03-07/175 dated 02.02.2011, from the Ministry of Environment; Official Letter No. 06-39/38 dated 22.09.2011, as a response to the request No. 101/2011-09-01 dated 02.09.2011, from the Climate Change Office of the Ministry of Environment; Official Letter No. 15-03/05 dated 24.01.2014, as a response to the request No. 320/2014-01-01 dated 03.01.2014, from the Climate Change Office, the Ministry of Environment; Official Letter No. 15-03-09 dated 13.02.2015, as a response to the request No. 407/2015-01-09 dated 29.01.2015, from the Climate Change Office of the Ministry of Environment; Statistical Reports PRODMOLD-A "Total production, as a natural expression, in the Republic of Moldova, by product type, for 2005-2016".

The Customs Service of the Republic of Moldova represents a primary source of information on varnishes and paints import-export operations (conventional solvent paints, code 3208; waterborne paints, code 3209; other paints and varnishes, prepared water pigments, like those used for leather coating, code 3210; prepared driers, code 3211; pigment dispersed in non-aqueous media as liquid or paste used in paint manufacture, code 3212) undertaken by economic agents (Table 4-74).

AD on national consumption of varnishes and paints (Table 4-75) was inferred from information on national production (Table 4-73) and import (Table 4-74) of these products in the Republic of Moldova (within the period of reference no exports of these products were registered).

Table 4-74: Activity data on import of varnishes and paints in the RM within 1990-2016, kt

	1990	1991	1992	1993	1994	1995	1996	1997	1998
Imports of conventional solvent paints	16.522	12.189	9.122	6.703	4.522	1.694	2.462	1.401	1.381
Imports of waterborne paints	11.112	7.875	5.153	3.000	1.486	0.250	0.288	0.313	0.426
Total paints import	**27.635**	**20.064**	**14.275**	**9.703**	**6.008**	**1.943**	**2.750**	**1.715**	**1.807**
	1999	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**
Imports of conventional solvent paints	1.063	1.853	1.678	3.718	4.688	7.131	15.642	5.582	6.264
Imports of waterborne paints	0.563	1.161	1.892	2.588	2.774	2.251	2.268	2.402	2.854
Total paints import	**1.625**	**3.014**	**3.571**	**6.306**	**7.463**	**9.382**	**17.911**	**7.984**	**9.118**
	2008	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**
Imports of conventional solvent paints	5.197	4.634	5.142	4.888	3.892	3.668	3.904	3.673	4.214
Imports of waterborne paints	3.087	2.511	2.726	3.084	3.172	3.028	3.090	3.138	3.371
Total paints import	**8.283**	**7.145**	**7.869**	**7.972**	**7.064**	**6.696**	**6.994**	**6.811**	**7.585**

Source: Custom Service, Official Letter No. 28/07-1893 dated 23.02. 2011, as a response to the request No. 03-07/175 dated 02.02.2011, from the Ministry of Environment; Official Letter No. 15-03-05 dated 24.01.2014, as a response to the request No. 320/2014-01-01 dated 03.01.2014, from the Climate Change Office of the Ministry of Environment; Official Letter No. 28/07-2231 dated 26.02.2015, as a response to the request No. 407/2015-01-09 dated 29.01.2015, from the Climate Change Office of the Ministry of Environment; Official Letter No. 28/07-8785 dated 26.05.2016, as a response to the request No. 512/2016-05-01 dated 10.05.2016, from the Climate Change Office of the Ministry of Environment; Official Letter No. 28/07-612 dated 12.01.2018, as a response to the request No. 601/2017-12-03 dated 14.12.2017, from the Climate Change Office of the Ministry of Agriculture, Regional Development and Environment.

Table 4-75: Activity data on consumption of varnishes and paints in the RM within 1990-2016, kt

	1990	1991	1992	1993	1994	1995	1996	1997	1998
Consumption of conventional solvent paints	26.622	20.439	14.671	9.417	5.653	2.432	3.126	1.852	1.731
Consumption of waterborne paints	12.712	8.425	5.604	3.386	1.555	0.312	0.324	0.371	0.446
Total paints consumption	**39.335**	**28.864**	**20.275**	**12.803**	**7.208**	**2.743**	**3.450**	**2.224**	**2.177**
	1999	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**
Consumption of conventional solvent paints	1.737	3.878	4.379	7.097	7.105	11.003	20.728	12.275	15.058
Consumption of waterborne paints	0.563	1.190	2.061	3.304	3.800	3.515	3.452	4.028	5.106
Total paints consumption	**2.299**	**5.068**	**6.441**	**10.401**	**10.906**	**14.518**	**24.180**	**16.303**	**20.164**
	2008	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**
Consumption of conventional solvent paints	13.964	12.904	14.799	17.802	17.565	13.142	17.444	24.246	29.577
Consumption of waterborne paints	5.876	6.063	5.934	8.181	7.406	5.886	7.221	9.407	10.475
Total paints consumption	**19.840**	**18.967**	**20.733**	**25.983**	**24.972**	**19.028**	**24.665**	**33.653**	**40.051**

For most activities involving paint application, no statistics is available for activity data. Under such circumstances, it was considered that the share of paints in decorative coating application represents 50 per cent of the total national consumption, the share of paints in industrial coating application – 40 per cent, while the share in other coating application – 10 per cent (Table 4-76).

Table 4-76: Activity data on consumption of varnishes and paints in various applications in the Republic of Moldova within 1990-2016 periods, kt

	1990	1991	1992	1993	1994	1995	1996	1997	1998
Decorative Coating Application	19.667	14.432	10.137	6.402	3.604	1.372	1.725	1.112	1.088
Industrial Coating Application	15.734	11.546	8.110	5.121	2.883	1.097	1.380	0.890	0.871
Other Coating Application	3.933	2.886	2.027	1.280	0.721	0.274	0.345	0.222	0.218
Total consumption	**39.335**	**28.864**	**20.275**	**12.803**	**7.208**	**2.743**	**3.450**	**2.224**	**2.177**
	1999	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**
Decorative Coating Application	1.150	2.534	3.220	5.201	5.453	7.259	12.090	8.151	10.082
Industrial Coating Application	0.920	2.027	2.576	4.160	4.362	5.807	9.672	6.521	8.065
Other Coating Application	0.230	0.507	0.644	1.040	1.091	1.452	2.418	1.630	2.016
Total consumption	**2.299**	**5.068**	**6.441**	**10.401**	**10.906**	**14.518**	**24.180**	**16.303**	**20.164**
	2008	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**
Decorative Coating Application	9.920	9.483	10.367	12.991	12.486	9.514	12.332	16.826	20.026
Industrial Coating Application	7.936	7.587	8.293	10.393	9.989	7.611	9.866	13.461	16.021
Other Coating Application	1.984	1.897	2.073	2.598	2.497	1.903	2.466	3.365	4.005
Total consumption	**19.840**	**18.967**	**20.733**	**25.983**	**24.972**	**19.028**	**24.665**	**33.653**	**40.051**

Indirect CO_2 emissions were estimated taking into consideration the content of carbon in NMVOC emissions. The default value used represents 60 per cent (2006 IPCC Guidelines, Volume 3, Chapter 5.5, page 5.17). By oxidizing, this carbon is converted into CO_2 in atmosphere (it is assumed that all solvents from paint application are of fossil origin).

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 – carbon dioxide 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 represents 60 per cent, with a margin of 50-70 per cent; 2006 IPCC Guidelines, Volume 3, Chapter 5.5, page 5.17);

44/12 – stoichiometric ratio CO_2/C.

2D3e. Degreasing

Within the 2D3e 'Degreasing' there are monitored the GHG emissions from solvent use in industry, especially for metal degreasing – SNAP 060201; electronic components manufacturing – SNAP 060203, as well as other industrial cleaning – SNAP 060204. Typically, the 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 articles, 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 (2016) and uses the following equation:

$$E_{pollutant} = (AR_{product} \bullet EF_{pollutant}) / 10^3$$

Where:

$E_{pollutant}$ – the emission of the specified pollutant, t/yr;

$AR_{product}$ – the activity rate for the use of solvents for degreasing, t/yr;

$EF_{pollutant}$ – the emission factor for this pollutant technology, kg/t.

The EMEP/EEA Air Pollutant Emission Inventory Guidebook (2016) provides default EFs for Tier 1 approach (Table 4-77).

Table 4-77: Tier 1 Default EFs for Estimating NMVOC Emissions from 2D3e „Degreasing"

Source Category	NMVOC Emission Factor	Unit
Degreasing	460	g/kg of degreased products

Source: EMEP/EEA Atmospheric Emissions Inventory Guidebook, (2016), Category 2.D.3.e "Degreasing", Table 3-1, page 8.

Since no AD breakdown on solvents consumption for degreasing within various industrial applications is available in the Republic of Moldova, it was used an alternative approach, represented by the following formula:

$$E_{pollutant} = AR_{product} \bullet EF_{pollutant}$$

Where:

$E_{pollutant}$ – pollutant gas emissions from the use of solvents for degreasing, t/yr;

$AR_{product}$ – activity rate for the use of solvents for degreasing (consumption), t/yr;

$EF_{pollutant}$ – the emission factor for this pollutant technology.

According to the available methodology, the content of organic solvents in substances used in degreasing and dry cleaning is considered to be 100 per cent (EMEP/EEA Air Pollutant Emission Inventory Guidebook (2016), Category 2D3e 'Degreasing', Table 3-5, page 12). It is considered that the total amount of solvents for degreasing evaporate into the atmosphere, NMVOC emissions being equal thus to the quantity of solvent used.

Total consumption of organic solvents for degreasing is estimated following the equation:

$$Total\ Consumption = Production + Import - Export$$

Table 4-78: Activity Data on Consumption of Solvents Used in Degreasing in the Republic of Moldova within 1990-2016 periods, kt

	1990	1991	1992	1993	1994	1995	1996	1997	1998
Cyclic and Acyclic Hydrocarbons	1.2254	0.7601	0.4932	0.3530	0.2559	0.2852	0.0586	0.1109	0.1241
Alcohols	0.5952	0.2761	0.0930	0.0304	0.0304	0.0383	0.0494	0.0441	0.1956
Total solvents	**1.8205**	**1.0363**	**0.5862**	**0.3834**	**0.2863**	**0.3235**	**0.1080**	**0.1550**	**0.3197**
	1999	2000	2001	2002	2003	2004	2005	2006	2007
Cyclic and Acyclic Hydrocarbons	0.0282	0.1537	0.0604	0.1700	0.1197	0.1907	0.1089	0.1259	0.1273
Alcohols	0.2495	0.1247	0.2251	0.2401	0.1131	0.1158	0.1838	0.2837	0.2495
Total solvents	**0.2777**	**0.2784**	**0.2854**	**0.4101**	**0.2328**	**0.3064**	**0.2927**	**0.4096**	**0.3768**
	2008	2009	2010	2011	2012	2013	2014	2015	2016
Cyclic and Acyclic Hydrocarbons	0.1115	0.1165	0.1752	0.2036	0.9318	0.3641	0.1567	0.1937	0.1173
Alcohols	0.2649	0.2325	0.2534	0.2746	0.4277	0.5214	0.6126	0.4500	0.4253
Total solvents	**0.3764**	**0.3489**	**0.4285**	**0.4782**	**1.3596**	**0.8855**	**0.7694**	**0.6438**	**0.5425**

Source: Custom Service, Official Letter No. 28/07-1893 dated 23.02.2011, as a response to the request No. 03-07/175 dated 02.02.2011, from the Ministry of Environment; Official Letter No. 15-03-05 dated 24.01.2014, as a response to the request No. 320/2014-01-01 dated 03.01.2014, from the Climate Change Office of the Ministry of Environment; Official Letter No. 28/07-2231 dated 26.02.2015, as a response to the request No. 407/2015-01-09 dated 29.01.2015, from the Climate Change Office of the Ministry of Environment; Official Letter No. 28/07-8785 dated 26.05.2016, as a response to the request No. 512/2016-05-01 dated 10.05.2016, from the Climate Change Office of the Ministry of Environment; Official Letter No. 28/07-612 dated 12.01.2018, as a response to the request No. 601/2017-12-03 dated 14.12.2017, from the Climate Change Office of the Ministry of Agriculture, Regional Development and Environment.

To be noted that for most activities involving use of organic solvents for degreasing in the RM there are no statistical data. Under such circumstances, the total consumption of solvents used for degreasing was estimated based on information on import of solvents (internal production of solvents is insignificant, also it was assumed that such substances are not re-exported). Customs Service is a primary source of information on solvents import-export operations in the country.

Since the same substances are widely used for both degreasing and dry cleaning, it was accepted that out of the total amount consumed, 65 per cent were used for degreasing, while 35 per cent – for dry cleaning.

Table 4-79: Activity Data on Consumption of Solvents Used in Degreasing in the Republic of Moldova within 1990-2016 periods, kt

	1990	1991	1992	1993	1994	1995	1996	1997	1998
Cyclic and Acyclic Hydrocarbons	0.7965	0.4941	0.3206	0.2294	0.1663	0.1854	0.0381	0.0721	0.0807
Alcohols	0.3869	0.1795	0.0604	0.0198	0.0198	0.0249	0.0321	0.0287	0.1272
Total solvents	**1.1834**	**0.6736**	**0.3811**	**0.2492**	**0.1861**	**0.2103**	**0.0702**	**0.1008**	**0.2078**
	1999	2000	2001	2002	2003	2004	2005	2006	2007
Cyclic and Acyclic Hydrocarbons	0.0183	0.0999	0.0392	0.1105	0.0778	0.1239	0.0708	0.0819	0.0827
Alcohols	0.1622	0.0811	0.1463	0.1561	0.0735	0.0753	0.1195	0.1844	0.1622
Total solvents	**0.1805**	**0.1810**	**0.1855**	**0.2665**	**0.1513**	**0.1992**	**0.1903**	**0.2663**	**0.2449**

	2008	2009	2010	2011	2012	2013	2014	2015	2016
Cyclic and Acyclic Hydrocarbons	0.0725	0.0757	0.1138	0.1323	0.6057	0.2367	0.1019	0.1259	0.0762
Alcohols	0.1722	0.1511	0.1647	0.1785	0.2780	0.3389	0.3982	0.2925	0.2764
Total solvents	**0.2446**	**0.2268**	**0.2785**	**0.3108**	**0.8837**	**0.5756**	**0.5001**	**0.4185**	**0.3526**

Indirect CO_2 emissions were estimated taking into consideration the content of carbon in NMVOC emissions. The default value used represents 60 per cent (2006 IPCC Guidelines, Volume 3, Chapter 5.5, page 5.17). By oxidizing, this carbon is converted into CO_2 in atmosphere (it is assumed that all solvents are of fossil origin).

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 – carbon dioxide emissions from degreasing, kt/yr;

NMVOC – total NMVOC emissions within the respective category, kt/yr;

CC – carbon content in NMVOC, fraction (the default value used represents 60 per cent, with a margin of 50-70 per cent; 2006 IPCC Guidelines, Volume 3, Chapter 5.5, page 5.17);

44/12 – stoichiometric ratio CO_2/C.

2D3f. Dry Cleaning

Within the 2D3f 'Dry Cleaning' there are monitored the GHG emissions from solvent use in dry cleaning of clothes and other textiles from animal grease, oils, wax, resin, 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 (2016) and uses the following equation:

$$E_{pollutant} = (AR_{product} \bullet EF_{pollutant}) / 10^3$$

Where:

$E_{pollutant}$ – the emission of the specified pollutant, kt/yr;

$AR_{product}$ – the activity rate for the use of solvents for dry cleaning, kt/yr;

$EF_{pollutant}$ – the emission factor for this pollutant technology, kg/t.

The EMEP/EEA Air Pollutant Emission Inventory Guidebook (2016) provides default EFs for Tier 1 approach (Table 4-80).

Table 4-80: Tier 1 Default EFs for Estimating NMVOC Emissions from 2D3f 'Dry Cleaning'

Source Category	NMVOC Emission Factor	Unit
Dry Cleaning	40	g/kg treated textiles

Source: EMEP/EEA Atmospheric Emissions Inventory Guidebook (2016), Category 2.D.3.f "Dry Cleaning", Table 3-1, page 7.

Since no AD breakdown on solvents consumption for dry cleaning it was used an alternative approach, represented by the following formula:

$$E_{pollutant} = AR_{product} \bullet EF_{pollutant}$$

Where:

$E_{pollutant}$ – pollutant gas 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;

$EF_{pollutant}$ – the emission factor for this pollutant technology.

According to the available methodology, the content of organic solvents in substances used in degreasing and dry cleaning is considered to be 100 per cent (EMEP/EEA Air Pollutant Emission Inventory Guidebook (2016), Source Category 2D3f 'Dry Cleaning', page 10).

It is considered that the total amount of solvents for degreasing evaporate into the atmosphere, NMVOC emissions being equal thus to the quantity of solvent 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 following the equation:

$$\textit{Total Consumption} = \textit{Production} + \textit{Import} - \textit{Export}$$

To be noted that for most activities involving use of organic solvents for dry cleaning in the RM there are no statistical data. Under such circumstances, the total consumption of solvents used for dry cleaning was estimated based on information on import of solvents in the RM (internal production of solvents is insignificant, also it was assumed that such substances are not re-exported). Since the same substances are widely used for both degreasing and dry cleaning, it was accepted that out of the total amount consumed (Table 4-78), 65 per cent were used for degreasing (Table 4-79), while 35 per cent – for dry cleaning (Table 4-81).

Table 4-81: Activity Data on Consumption of Solvents Used in Dry Cleaning of Textile in the Republic of Moldova within 1990-2016 periods, kt

	1990	1991	1992	1993	1994	1995	1996	1997	1998
Cyclic and Acyclic Hydrocarbons	0.4289	0.2660	0.1726	0.1235	0.0896	0.0998	0.0205	0.0388	0.0434
Alcohols	0.2083	0.0966	0.0325	0.0106	0.0106	0.0134	0.0173	0.0154	0.0685
Total solvents	**0.6372**	**0.3627**	**0.2052**	**0.1342**	**0.1002**	**0.1132**	**0.0378**	**0.0543**	**0.1119**
	1999	2000	2001	2002	2003	2004	2005	2006	2007
Cyclic and Acyclic Hydrocarbons	0.0099	0.0538	0.0211	0.0595	0.0419	0.0667	0.0381	0.0441	0.0445
Alcohols	0.0873	0.0436	0.0788	0.0840	0.0396	0.0405	0.0643	0.0993	0.0873
Total solvents	**0.0972**	**0.0975**	**0.0999**	**0.1435**	**0.0815**	**0.1073**	**0.1025**	**0.1434**	**0.1319**
	2008	2009	2010	2011	2012	2013	2014	2015	2016
Cyclic and Acyclic Hydrocarbons	0.0390	0.0408	0.0613	0.0712	0.3261	0.1274	0.0549	0.0678	0.0410
Alcohols	0.0927	0.0814	0.0887	0.0961	0.1497	0.1825	0.2144	0.1575	0.1488
Total solvents	**0.1317**	**0.1221**	**0.1500**	**0.1674**	**0.4758**	**0.3099**	**0.2693**	**0.2253**	**0.1899**

Indirect CO_2 emissions were estimated taking into consideration the content of carbon in NMVOC emissions. The default value used represents 60 per cent (2006 IPCC Guidelines, Volume 3, Chapter 5.5, page 5.17). By oxidizing, this carbon is converted into CO_2 in atmosphere (it is assumed that all solvents are of fossil origin).

In order to estimate indirect CO_2 emissions, the following equation was used:

$$CO_2\,\textit{Emissions} = \textit{NMVOC} \bullet \textit{CC} \bullet 44/12$$

Where:

CO_2 Emissions – carbon dioxide emissions from dry cleaning, kt/yr;

NMVOC – total NMVOC emissions within the respective category, kt/yr;

CC – carbon content in NMVOC, fraction (the default value used represents 60 per cent, with a margin of 50-70 per cent; 2006 IPCC Guidelines, Volume 3, Chapter 5.5, page 5.17);

44/12 – stoichiometric ratio CO_2/C.

2D3g. Chemical Products

Under the 2D3g 'Chemical Products' there are reported NMVOC emissions from polyester processing (SNAP 060301); polyurethane foam processing (SNAP 060303) and polystyrene foam processing (SNAP 060304); rubber processing (SNAP 060305); pharmaceutical products manufacturing (SNAP 060306); paints manufacturing (SNAP 060307); inks manufacturing (SNAP 060308); glues and adhesive products manufacturing (SNAP 060309); asphalt blowing (SNAP 060310); adhesive, magnetic tapes, films and photographs (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 (2016) and uses the following equation:

$$E_{pollutant} = (AR_{product} \bullet EF_{pollutant}) / 10^3$$

Where:

$E_{pollutant}$ – the emission of the specified pollutant, kt/yr;

$AR_{product}$ – the activity rate for the use of solvents for manufacture and processing of chemical products, kt/yr;

$EF_{pollutant}$ – the emission factor for this pollutant technology, kg/t.

The EMEP/EEA Air Pollutant Emission Inventory Guidebook (2016) provides default EFs for Tier 2 approach (Table 4-82).

Table 4-82: Tier 2 Default Emission Factors for 2D3g 'Chemical Products'

Source Category	EF_{NMVOC}	Unit
SNAP 060301, Polystyrene processing	50	g/kg monomer
SNAP 060303, Polyurethane 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
Shoes manufacture	0.045	kg/pair of shoes

Source: EMEP/EEA Atmospheric Emissions Inventory Guidebook (2016), Category 2.D.3.g "Chemical Products", Tables 3-2 – 3-13, pages 17-22.

Statistical publications of the RM provide activity data on manufacturing different industrial commodities, including: polyurethane and polystyrene products, refurbished tires and rubber soles, paints and varnishes, glues, inks, pharmaceutical products, shoes (Table 4-83).

Customs Service of the Republic of Moldova is a primary source of information on import-export operations regarding primary polyurethane products (code 3909 50); polyurethane products (code 3921 13); primary polystyrene products (code 3903 11), respectively styrene polymers products (code 3921 11). In order to convert AD in mass metric units (tones), the following conversion coefficients were used: a car tire weights about 7.1 kg; a minibus and small tonnage truck tire – about 11.1 kg; bus and heavy truck tire – 46.0 kg; a tractor tire – about 69.9 kg).

Table 4-83: Selective Activity Data on Manufacturing Industrial Commodities in the Republic of Moldova within 1990-2016 periods

	1990	1991	1992	1993	1994	1995	1996	1997	1998
Polyurethane Processing, kt	0.830	0.699	0.589	0.496	0.418	0.352	0.286	0.179	0.116
Polystyrene Processing, kt	5.917	3.707	2.323	1.455	0.912	0.571	0.231	0.206	0.216
Rubber Processing, kt	46.900	44.300	20.700	4.200	0.900	1.400	1.512	1.361	1.234
Pharmaceutical Products Manufacturing, kt	1.853	1.648	1.069	0.683	0.334	0.321	0.289	0.315	0.450
Paints Manufacturing, kt	11.700	8.800	6.000	3.100	1.200	0.800	0.700	0.509	0.370
Asphalt Production, kt	1220.305	1014.808	853.000	678.000	410.000	370.000	335.600	113.727	92.328
Refurbished Tires, thousand pieces	75.300	73.100	40.100	1.500	4.500	6.600	8.000	9.800	7.100
Refurbished Tires, kt	1.443	1.401	0.768	0.029	0.086	0.126	0.153	0.188	0.136
Shoes, mill. pairs	23.200	20.800	16.268	13.197	9.467	7.606	6.929	6.193	4.591
	1999	2000	2001	2002	2003	2004	2005	2006	2007
Polyurethane Processing, kt	0.154	0.187	0.225	0.438	0.596	0.755	1.536	1.691	2.215
Polystyrene Processing, kt	0.187	0.410	0.391	0.750	1.290	1.388	2.881	4.141	4.494
Rubber Processing, kt	0.853	1.598	1.801	3.071	2.425	2.259	0.061	0.296	0.511
Pharmaceutical Products Manufacturing, kt	0.760	0.512	0.646	0.726	0.522	0.628	0.701	0.760	1.261
Paints Manufacturing, kt	0.674	2.054	2.870	4.095	3.443	5.136	6.269	8.319	11.045
Glues Manufacturing, kt						0.361	0.655	0.853	1.465
Asphalt Production, kt	92.328	66.477	53.791	67.343	58.925	72.200	229.300	215.073	347.899
Refurbished Tires, thousand pieces	7.100	10.200	7.000	9.200	4.600	6.000	4.600	3.200	2.800
Refurbished Tires, kt	0.136	0.195	0.134	0.176	0.088	0.115	0.088	0.061	0.054
Shoes, mill. pairs	4.591	3.747	5.912	4.944	4.925	6.038	6.633	7.450	6.774

	2008	2009	2010	2011	2012	2013	2014	2015	2016
Polyurethane Processing, kt	2.551	2.134	2.376	2.220	1.583	1.593	1.510	2.557	1.576
Polystyrene Processing, kt	4.449	4.889	5.711	5.944	6.141	6.209	7.019	7.839	7.439
Rubber Processing, kt	0.189	0.036	0.058	0.063	0.070	0.072	0.066	0.049	0.048
Pharmaceutical Products Manufacturing, kt	3.713	3.832	4.994	3.347	3.745	3.347	4.101	4.063	3.814
Paints Manufacturing, kt	11.557	11.822	12.864	18.011	17.907	12.345	17.685	26.858	32.746
Inks Manufacturing, kt				0.010	0.016	0.027			
Glues Manufacturing, kt	0.580	0.921	1.373	1.323	1.077	0.953	1.118	5.997	7.607
Asphalt Production, kt	209.351	156.931	194.440	219.812	248.191	248.339	360.090	250.423	155.724
Refurbished Tires, thousand pieces	2.252	5.829	6.735	6.852	18.361	17.299	11.947	6.035	7.272
Refurbished Tires, kt	0.055	0.080	0.161	0.157	0.248	0.268	0.200	0.139	0.156
Shoes, mill. pairs	7.083	4.829	6.247	7.692	7.448	8.329	7.607	5.547	5.156

Source: NBS through the Statistical Yearbooks for 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 (page 302); Statistical Reports PRODMOLD-A „Total production, as a natural expression, in the Republic of Moldova, by product type, for 2005-2016"; Customs Service of the RM, Official Letter No. 28/07-1893 dated 23.02.2011, as a response to the request No. 03-07/175 dated 02.02.2011, from the Ministry of Environment; Official Letter No. 15-03-05 dated 24.01.2014, as a response to the request No. 320/2014-01-01 dated 03.01.2014, from the Climate Change Office of the Ministry of Environment; Official Letter No. 28/07-2231 dated 26.02.2015, as a response to the request No. 407/2015-01-09 dated 29.01.2015, from the Climate Change Office of the Ministry of Environment; Official Letter No. 28/07-8785 dated 26.05.2016, as a response to the request No. 512/2016-05-01 dated 10.05.2016, from the Climate Change Office of the Ministry of Environment; Official Letter No. 28/07-612 dated 12.01.2018, as a response to the request No. 601/2017-12-03 din 14.12.2017, from the Climate Change Office of the Ministry of Agriculture, Regional Development and Environment.

Indirect CO_2 emissions were estimated taking into consideration the content of carbon in NMVOC emissions. The default value used represents 60 per cent (2006 IPCC Guidelines, Volume 3, Chapter 5.5, page 5.17). By oxidizing, this carbon is converted into CO_2 in atmosphere (it is assumed that all solvents are of fossil origin).

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 – carbon dioxide 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 represents 60 per cent, with a margin of 50-70 per cent; 2006 IPCC Guidelines, Volume 3, Chapter 5.5, page 5.17);

44/12 – stoichiometric ratio 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 (November 2016 Edition) and uses the following equation:

$$E_{pollutant} = (AR_{product} \bullet EF) / 10^3$$

Where:

$E_{pollutant}$ – the emission of the specified pollutant from ink consumption for printing, kt/yr;

$AR_{product}$ – the activity rate for the use of inks for printing, kt/yr;

EF – the default emission factor, kg/t (Table 4-84).

Table 4-84: Tier 1 Default EFs for 2D3h 'Printing'

Source Category	EF_{NMVOC}	Unit
Printing	500	kg/t ink

Source: EMEP/EEA Atmospheric Emissions Inventory Guidebook (2016), 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. In such conditions, the total inks consumption was estimated considering statistical data on production (see Table 4-83), import and export (Table 4-85) (according to the Statistical Reports PRODMOLD-A "Total production, as a natural expression, by product type, for 2005-2016" inks were produced only during 2011-2013; there are no information on the export of inks during the period of reference).

Table 4-85: Activity Data on Inks Import in the Republic of Moldova within 1990-2016 periods, kt

	1990	1991	1992	1993	1994	1995	1996	1997	1998
Inks for printing, writing and drawing, as well as other inks	0.3557	0.2214	0.1427	0.1026	0.0788	0.0405	0.0577	0.0604	0.0596
Paints for artistic painting, for educational use, firms painting, amusement as well as similar paints	0.1358	0.1086	0.0836	0.0607	0.0438	0.0306	0.0297	0.0035	0.0197
Total inks	**0.4914**	**0.3301**	**0.2262**	**0.1633**	**0.1226**	**0.0711**	**0.0874**	**0.0639**	**0.0793**

	1999	2000	2001	2002	2003	2004	2005	2006	2007
Inks for printing, writing and drawing, as well as other inks	0.0444	0.0553	0.0838	0.1024	0.1175	0.1568	0.2260	0.1502	0.1925
Paints for artistic painting, for educational use, firms painting, amusement as well as similar paints	0.0142	0.0152	0.0164	0.0259	0.0278	0.0330	0.0306	0.0462	0.0356
Total inks	**0.0586**	**0.0706**	**0.1002**	**0.1284**	**0.1453**	**0.1898**	**0.2566**	**0.1964**	**0.2281**
	2008	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**
Inks for printing, writing and drawing, as well as other inks	0.1906	0.1721	0.2209	0.2108	0.1949	0.2273	0.2112	0.2979	0.2207
Paints for artistic painting, for educational use, firms painting, amusement as well as similar paints	0.0505	0.0441	0.0479	0.0524	0.0546	0.0623	0.0706	0.0698	0.0774
Total inks	**0.2411**	**0.2162**	**0.2688**	**0.2533**	**0.2335**	**0.2631**	**0.2818**	**0.3677**	**0.2981**

Source: Customs Service, Official Letter No. 28/07-1893 dated 23.02.2011, as a response to the request No. 03-07/175 dated 02.02.2011, from the Ministry of Environment; Official Letter No. 15-03-05 dated 24.01.2014, as a response to the request No. 320/2014-01-01 dated 03.01.2014, from the Climate Change Office of the Ministry of Environment; Official Letter No. 28/07-2231 dated 26.02.2015, as a response to the request No. 407/2015-01-09 dated 29.01.2015, from the Climate Change Office of the Ministry of Environment; Official Letter No. 28/07-8785 dated 26.05.2016, as a response to the request No. 512/2016-05-01 dated 10.05.2016, from the Climate Change Office of the Ministry of Environment; Official Letter No. 28/07-612 dated 12.01.2018, as a response to the request No. 601/2017-12-03 dated 14.12.2017, from the Climate Change Office of the Ministry of Agriculture, Regional Development and Environment.

Customs Service of the Republic of Moldova is the primary source of information on import-export operations (including for 'printing, writing or drawing', as well as 'other inks' – code 3215 10-90; paints for 'artistic painting, educational use, firms painting, amusement, as well as similar paints' – code 3213 10-90).

Indirect CO_2 emissions were estimated taking into consideration the content of carbon in NMVOC emissions. The default value used represents 60 per cent (2006 IPCC Guidelines, Volume 3, Chapter 5.5, page 5.17). By oxidizing, this carbon is converted into CO_2 in atmosphere (it is assumed that all solvents are of fossil origin).

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 – carbon dioxide 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 represents 60 per cent, with a margin of 50-70 per cent; IPCC 2006 Guidelines, Volume 3, Chapter 5.5, page 5.17);
- 44/12 – stoichiometric ratio CO_2/C.

2D3i. 'Other Solvent and Product Use'

'Seed Oil Extraction'

A certain amount of solvents, hexane in particular, is used in extracting oil from seeds (mechanical extraction does not require the use of solvents). The cleaned and prepared seeds are washed several times in warm hexane solvent until all the oil is extracted, while the remaining seeds 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 (it has 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 the enterprises in this branch. The 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 (2016), is represented by the following equation:

$$E_{pollutant} = (AR_{product} \bullet EF_{pollutant}) / 10^3$$

Where:

- $E_{pollutant}$ – the emission of the specified pollutant, kt/yr;
- $AR_{product}$ – the activity rate for the use of solvents in seed oil extraction, kt/yr;
- $EF_{pollutant}$ – the emission factor for this pollutant technology, kg/t.

The EMEP/EEA Air Pollutant Emission Inventory Guidebook (2016) provides default EFs for Tier 2 approach (Table 4-86).

Table 4-86: Tier 2 Default EFs for Estimating NMVOC Emissions from Seed Oil Extraction

Source Category	EF NMVOC	Unit
Seed Oil Extraction	1.57	g/kg seeds

Source: EMEP/EEA Atmospheric Emissions Inventory Guidebook (2016), Category 2.D.3.i 'Other Solvent and Product Use', SNAP 060404, Table 3-4, page 14.

In order to estimate NMVOC emissions, statistical data on the amount of oil extracted at the Moldovan enterprises are used. At the national level, there are over 100 enterprises specialized in oil production, the largest being 'Floarea-Soarelui' J.S.C. in Balti. Current technologies used in seed oil extraction by use of solvents allow obtain around 450 kg of oil per one tone of seeds. This particular conversion factor was used to estimate the quantity of seeds consumed for oil extraction (Table 4-87).

Table 4-87: Activity Data on Oil Production and Quantity of Seeds Used for Oil Extraction in the Republic of Moldova within 1990-2016 periods, kt

	1990	1991	1992	1993	1994	1995	1996	1997	1998
Total crude oil non-chemically modified	125.600	117.900	57.317	60.271	50.439	50.715	39.374	35.168	28.747
Total refined oil non-chemically modified	57.525	53.998	26.251	27.604	23.101	23.227	18.033	16.107	13.166
Seeds used for oil extraction	**127.833**	**119.996**	**58.336**	**61.342**	**51.336**	**51.617**	**40.074**	**35.793**	**29.258**
	1999	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**
Total crude oil non-chemically modified	125.600	117.900	57.317	60.271	50.439	50.715	39.374	35.168	28.747
Total refined oil non-chemically modified	57.525	53.998	26.251	27.604	23.101	23.227	18.033	16.107	13.166
Seeds used for oil extraction	**127.833**	**119.996**	**58.336**	**61.342**	**51.336**	**51.617**	**40.074**	**35.793**	**29.258**
	2008	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**
Total crude oil non-chemically modified	79.307	83.881	80.705	89.787	96.828	65.502	113.223	109.534	79.963
Total refined oil non-chemically modified	34.578	28.446	26.506	20.942	20.618	14.418	16.197	16.697	25.722
Seeds used for oil extraction	**76.840**	**63.213**	**58.901**	**46.539**	**45.817**	**32.039**	**35.992**	**37.105**	**57.161**

Source: NBS, Official Letter No. 06-39/08 dated 23.02.2011, as a response to the request No. 03-07/175 dated 02.02.2011 from the Ministry of Environment; Official Letter No. 06-39/38 dated 22.09.2011, as a response to the request No. 101/2011-09-01 dated 02.09.2011 from the Climate Change Office 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"; 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).

Indirect CO_2 emissions were estimated taking into consideration the content of carbon in NMVOC emissions. The default value used represents 60 per cent (2006 IPCC Guidelines, Volume 3, Chapter 5.5, page 5.17). By oxidizing, this carbon is converted into CO_2 in atmosphere (it is assumed that all solvents are of fossil origin). 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 – carbon dioxide 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 represents 60 per cent, with a margin of 50-70 per cent; 2006 IPCC Guidelines, Volume 3, Chapter 5.5, page 5.17);

44/12 – stoichiometric ratio 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 (2016), is represented by the following equation:

$$E_{pollutant} = (AR \bullet EF_{pollutant}) / 10^3$$

Where:

$E_{pollutant}$ – the emission of the specified pollutant from use of glues and other adhesives, t/yr;

AR – the activity rate for the use of glues and other adhesives, t/yr;

$EF_{pollutant}$ – the emission factor for this pollutant technology, kg/t (Table 4-88).

The EMEP/EEA Air Pollutant Emission Inventory Guidebook (2016) provides default EFs for Tier 2 approach.

Table 4-88: Tier 2 Default EFs for 2D3i 'Use of Glues and Other Adhesives'

Source Category	NMVOC Emission Factor	Unit
Use of Glues and Other Adhesives	522	g/kg glue

Source: EMEP/EEA Atmospheric Emissions Inventory Guidebook (2016), Category 2.D.3.i 'Other Solvent and Product Use', SNAP 060405, Table 3-11, page 18.

For most activities related to other solvent use in the Republic of Moldova, there are no reliable statistical sources of reference. Under such circumstances, the total consumption of glues and other adhesives was estimated based on information on production, import and export. To be noted that production of glues and other adhesives in the Republic of Moldova was insignificant and is recorded starting only with 2003, though it increased in the recent years (Table 4-89).

Table 4-89: AD on Glues and Other Adhesives Production, Import and Consumption in the Republic of Moldova within 1990-2016 periods, kt

	1990	1991	1992	1993	1994	1995	1996	1997	1998
Glues and Other Adhesives Production	NO	NO	NO	NO	NO	NO	NO	NO	NO
Glues and Other Adhesives Import	3.2508	1.7106	0.9162	0.6208	0.5598	0.4962	0.3323	0.6172	1.0852
Glues and Other Adhesives Consumption	**3.2508**	**1.7106**	**0.9162**	**0.6208**	**0.5598**	**0.4962**	**0.3323**	**0.6172**	**1.0852**
	1999	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**
Glues and Other Adhesives Production	NO	NO	NO	NO	0.3611	0.6552	0.8533	1.4646	0.7735
Glues and Other Adhesives Import	0.7549	0.7264	0.8643	1.2217	1.3874	1.7522	1.9457	1.9679	1.9609
Glues and Other Adhesives Consumption	**0.7549**	**0.7264**	**0.8643**	**1.2217**	**1.7485**	**2.4074**	**2.7990**	**3.4326**	**2.7344**
	2008	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**
Glues and Other Adhesives Production	0.5797	0.9211	1.3725	1.3234	1.0774	0.9527	1.1179	5.9971	7.6074
Glues and Other Adhesives Import	1.9713	1.4342	1.8004	1.5226	1.4106	1.2544	1.4043	1.4872	1.1646
Glues and Other Adhesives Consumption	**2.5509**	**2.3552**	**3.1729**	**2.8460**	**2.4880**	**2.2070**	**2.5222**	**7.4843**	**8.7719**

Source: Customs Service, Official Letter No. 28/07-1893 dated 23.02.2011, as a response to the request No. 03-07/175 dated 02.02.2011, from the Ministry of Environment; Official Letter No. 15-03-05 dated 24.01.2014, as a response to the request No. 320/2014-01-01 dated 03.01.2014, from the Climate Change Office of the Ministry of Environment; Official Letter No. 28/07-2231 dated 26.02.2015, as a response to the request No. 407/2015-01-09 dated 29.01.2015, from the Climate Change Office of the Ministry of Environment; Official Letter No.. 28/07-8785 dated 26.05.2016, as a response to the request No. 512/2016-05-01 dated 10.05.2016, from the Climate Change Office of the Ministry of Environment; Official Letter No. 28/07-612 dated 12.01.2018, as a response to the request No. 601/2017-12-03 dated 14.12.2017, from the Climate Change Office of the Ministry of Agriculture, Regional Development and Environment; Statistical Reports PRODMOLD-A „Total production, as a natural expression, in the Republic of Moldova, by product type, for 2005-2016".

Customs Service of the Republic of Moldova is the primary source of information on national import operations (no data on glue and other adhesives exports was recorded during the period under review).

Indirect CO_2 emissions were estimated taking into consideration the content of carbon in NMVOC emissions. The default value used represents 60 per cent (2006 IPCC Guidelines, Volume 3, Chapter 5.5, page 5.17). By oxidizing, this carbon is converted into CO_2 in atmosphere (it is assumed that all solvents are of fossil origin).

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 – carbon dioxide 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 represents 60 per cent, with a margin of 50-70 per cent; 2006 IPCC Guidelines, Volume 3, Chapter 5.5, page 5.17);

44/12 – stoichiometric ratio 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 (2016), is represented by the following equation:

$$E_{pollutant} = (AR_{product} \bullet EF_{pollutant}) / 10^3$$

Where:

$E_{pollutant}$ – the emission of the specified pollutant from solvent use in preservation of wood, t/yr;

$AR_{product}$ – the activity rate for preservation of wood, t/yr;

$EF_{pollutant}$ – the emission factor for this pollutant technology, kg/t.

The EMEP/EEA Air Pollutant Emission Inventory Guidebook (2016) provides default EFs for Tier 2 approach (Table 4-90).

Table 4-90: Tier 2 Default EFs for Estimating NMVOC Emissions from 'Preservation of Wood'

Source Category	NMVOC Emission Factors	Unit
'Preservation of Wood'	105	g/kg creosote
	945	g/kg preservative on base of organic solvents
	5	g/kg waterborne preservative

Source: EMEP/EEA Atmospheric Emissions Inventory Guidebook (2016), Category 2.D.3.i 'Other Solvent and Product Use', SNAP 060406, Tables 3-5 – 3-7, pages 15-16.

In order to estimate NMVOC emissions, statistical data on the total amount of timber produced at the Moldovan enterprises are used (Table 4-91).

Table 4-91: AD on Timber Production in the RM within 1990-2016 periods

	1990	1991	1992	1993	1994	1995	1996	1997	1998
Total timber production, thousand m^3	265.0	215.0	106.0	55.0	32.0	25.1	21.2	17.2	15.2
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	2.3
	1999	2000	2001	2002	2003	2004	2005	2006	2007
Total timber production, thousand m^3	21.2	14.9	16.2	17.1	17.2	24.1	23.1	27.0	31.8
Timber treated with creosote-based preservatives, thousand m^3	3.2	2.2	2.4	2.6	2.6	3.6	3.5	4.0	4.8
	2008	2009	2010	2011	2012	2013	2014	2015	2016
Total timber production, thousand m^3	46.5	34.0	25.6	18.5	19.4	16.7	15.8	16.5	14.3
Timber treated with creosote-based preservatives, thousand m^3	7.0	5.1	3.8	2.8	2.9	2.5	2.4	2.5	2.2

Source: Statistical Yearbooks of the Republic of Moldova 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 2005-2016"; 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).

The literature in the field reveals that about 50 per cent of the total timber is used in construction, 15 per cent in the furniture industry and other finished wood products, 15 per cent in the packaging industry and 20 per cent in other uses. Since the share of timber treated with preservatives is unknown (it is assumed that in the RM, the preservatives 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 per cent 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 meter of wood, while for the same volume of wood, 24 kg of organic solvents can be used (EMEP/EEA Air Pollutant Emission Inventory Guidebook (2016), source category 2.D.3.i 'Other Solvent and Product Use', SNAP 060406 'Preservation of Wood', page 14). The respective conversion factor was used to estimate the amount of creosote used in timber treatment at the Moldovan enterprises (Table 4-92).

Table 4-92: AD on Creosote Use in Preservation of Wood in the RM within 1990-2016 periods, kt

	1990	1991	1992	1993	1994	1995	1996	1997	1998
Creosote use in preservation of wood	2.9813	2.4188	1.1925	0.6188	0.3600	0.2824	0.2385	0.1935	0.1710
	1999	2000	2001	2002	2003	2004	2005	2006	2007
Creosote use in preservation of wood	0.2385	0.1676	0.1823	0.1924	0.1935	0.2711	0.2596	0.3032	0.3580
	2008	2009	2010	2011	2012	2013	2014	2015	2016
Creosote use in preservation of wood	0.5228	0.3822	0.2880	0.2081	0.2183	0.1884	0.1780	0.1856	0.1614

Indirect CO_2 emissions were estimated taking into consideration the content of carbon in NMVOC emissions. The default value used represents 60 per cent (2006 IPCC Guidelines, Volume 3, Chapter 5.5, page 5.17). By oxidizing, this carbon is converted into CO_2 in atmosphere (it is assumed that all solvents are of fossil origin).

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 – carbon dioxide 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 represents 60 per cent, with a margin of 50-70 per cent; 2006 IPCC Guidelines, Volume 3, Chapter 5.5, page 5.17);

44/12 – stoichiometric ratio 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 (2016), is represented by the following equation:

$$E_{pollutant} = (AR \bullet EF) / 10^3$$

Where:

$E_{pollutant}$ – the emission of the specified pollutant from 'Underseal Treatment and Conservation of Vehicles', t/yr;

AR – the activity rate, population;

EF – the emission factor, kg/person.

The EMEP/EEA Air Pollutant Emission Inventory Guidebook (2016) provides default EFs for Tier 2 approach (Table 4-93).

Table 4-93: Tier 2 Default EFs for Estimating NMVOC Emissions from 'Underseal Treatment and Conservation of Vehicles'

Source Category	EF_{NMVOC}	Unit
'Underseal Treatment and Conservation of Vehicles'	0.2	kg/person
	636	g/kg underseal agent
	950	g/kg solvent

Source: EMEP/EEA Atmospheric Emissions Inventory Guidebook (2016), Category 2.D.3.i 'Other Solvent and Product Use', SNAP 060407, Table 3-10, page 17.

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 were used (Table 4-66).

Indirect CO_2 emissions were estimated taking into consideration the content of carbon in NMVOC emissions. The default value used represents 60 per cent (2006 IPCC Guidelines, Volume 3, Chapter 5.5, page 5.17). By oxidizing, this carbon is converted into CO_2 in atmosphere (it is assumed that all solvents are of fossil origin).

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 – carbon dioxide emissions from solvent used for 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 represents 60 per cent, with a margin of 50-70 per cent; 2006 IPCC Guidelines, Volume 3, Chapter 5.5, page 5.17);

44/12 – stoichiometric ratio CO_2/C.

'Vehicles Dewaxing'

The methodology used to estimate NMVOC emissions from vehicles dewaxing after long storage and long-distance transport, available in the EMEP/EEA Air Pollutant Emission Inventory Guidebook (2016), 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 (2016) provides default EFs for Tier 2 approach (Table 4-94).

Table 4-94: Tier 2 Default Emission Factors for 2D3i 'Vehicles Dewaxing'

Source Category	EF_{NMVOC}	Unit
Vehicles Dewaxing	1.0	kg/vehicle

Source: EMEP/EEA Atmospheric Emissions Inventory Guidebook (2016), Category 2.D.3.i 'Other Solvent and Product Use', SNAP 060409, Table 3-9, page 17.

No vehicles are produced in the Republic of Moldova. Customs Service is a primary source of information on national import operations (Table 4-95).

Table 4-95: AD on New Cars Import in the Republic of Moldova within 1990-2016 periods

	1990	1991	1992	1993	1994	1995	1996	1997	1998
Imported vehicles – total, units	5 803	4 836	4 030	3 358	2 798	2 332	2 334	1 922	1 947
	1999	2000	2001	2002	2003	2004	2005	2006	2007
Imported vehicles – total, units	3 281	1 161	1 841	3 503	8 431	7 768	10 030	7 477	10 523
	2008	2009	2010	2011	2012	2013	2014	2015	2016
Imported vehicles – total, units	14 368	7 832	7 923	8 237	7 171	9 869	22 103	32 373	14 998

Source: Custom Service, Official Letter No 28/07-1893 dated 23.02.2011, as a response to the request No. 03-07/175 dated 02.02.2011, from the Ministry of Environment; Official Letter No. 15-03-05 dated 24.01.2014, as a response to the request No. 320/2014-01-01 dated 03.01.2014, from the Climate Change Office of the Ministry of Environment; Official Letter No. 28/07-2231 dated 26.02.2015, as a response to the request No. 407/2015-01-09 dated 29.01. 2015, from the Climate Change Office of the Ministry of Environment; Official Letter No 28/07-8785 dated 26.05.2016, as a response to the request No. 512/2016-05-01 dated 10.05.2016, from the Climate Change Office of the Ministry of Environment; Official Letter No. 28/07-612 dated 12.01.2018, as a response to the request No. 601/2017-12-03 dated 14.12.2017, from the Climate Change Office of the Ministry of Agriculture, Regional Development and Environment.

Indirect CO_2 emissions were estimated taking into consideration the content of carbon in NMVOC emissions. The default value used represents 60 per cent (2006 IPCC Guidelines, Volume 3, Chapter 5.5, page 5.17). By oxidizing, this carbon is converted into CO_2 in atmosphere (it is assumed that all solvents are of fossil origin).

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 – carbon dioxide emissions from solvent used for vehicles dewaxing, kt/yr;

NMVOC – total NMVOC emissions within the respective category, kt/yr;

CC – carbon content in NMVOC, fraction (the default value used represents 60 per cent, with a margin of 50-70 per cent; 2006 IPCC Guidelines, Volume 3, Chapter 5.5, page 5.17);

44/12 – stoichiometric ratio 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 – Stoichiometric ratio between carbon (C) and urea ($CO(NH_2)_2$);

Purity – Mass fraction of urea in the urea-based additive (the default value used represents 32.5 per cent);

44/12 – stoichiometric ratio between Carbon (C) and CO_2.

AD on the amount of urea-based additive used in catalytic converters are determined indirectly from national diesel oil consumption (on the average, the activity level is 1 to 3 per cent of diesel oil consumption by the vehicle). Activity data on diesel oil consumption are available in the EBs of the RM for 1990 and 1993-2015 periods (in 1991 and 1992 the EBs were not elaborated, 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, while for the rest of the period, it covers only the right bank of Dniester River. The table below shows data on the number of the population between 1990 and 2016, separately for the two banks of Dniester River (Table 4-96).

Table 4-96: Population of the Republic of Moldova within 1990-2016 periods, million persons

	1990	1991	1992	1993	1994	1995	1996	1997	1998
RM: Right Bank of Dniester River	3.6306	3.6356	3.6288	3.6182	3.6502	3.6462	3.6428	3.6409	3.6550
RM: Left Bank of Dniester River	0.7310	0.7307	0.7303	0.7296	0.7025	0.7017	0.6916	0.6791	0.6708
RM: Total	**4.3616**	**4.3663**	**4.3591**	**4.3478**	**4.3527**	**4.3479**	**4.3344**	**4.3200**	**4.3258**
	1999	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**
RM: Right Bank of Dniester River	3.6493	3.6435	3.6345	3.6272	3.6177	3.6068	3.3860	3.3956	3.4328
RM: Left Bank of Dniester River	0.6657	0.6600	0.6518	0.6425	0.6336	0.6238	0.5544	0.5475	0.5406
RM: Total	**4.3150**	**4.3035**	**4.2863**	**4.2697**	**4.2513**	**4.2306**	**3.9404**	**3.9431**	**3.9734**
	2008	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**
RM: Right Bank of Dniester River	3.4244	3.4194	3.4156	3.4130	3.4126	3.4143	3.4132	3.3841	3.3691
RM: Left Bank of Dniester River	0.5335	0.5275	0.5225	0.5180	0.5134	0.5094	0.5052	0.5007	0.4745
RM: Total	**3.9579**	**3.9469**	**3.9381**	**3.9310**	**3.9260**	**3.9237**	**3.9184**	**3.8848**	**3.8436**

Source: Statistical Yearbooks of the Republic of Moldova for 1990-2017. Statistical Yearbooks of the ATULBD for 1998-2017.

In order to generate data on diesel oil consumption on ATULBD, it was used information on specific consumption of diesel oil per capita for the territory to the right of Dniester, the number of the population in the ATULBD was multiplied by the specific consumption of diesel oil per capita (for 1990 and 1991 the information was representative for the entire country) (Table 4-97).

Table 4-97: Specific Consumption of Diesel Oil within 1990-2016 periods

	1990	1991	1992	1993	1994	1995	1996	1997	1998
Specific Consumption of Diesel Oil, kg/per capita/yr	255.0	225.0	172.0	127.7	104.7	101.5	87.0	82.7	66.8
	1999	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**
Specific Consumption of Diesel Oil, kg/per capita/yr	48.2	52.1	57.2	70.0	78.5	89.6	96.9	98.1	102.0
	2008	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**
Specific Consumption of Diesel Oil, kg/per capita/yr	107.2	98.3	122.1	129.8	116.0	127.4	133.9	145.4	159.4

Below is presented the information on total consumption of diesel oil in the RM between 1990 and 2016 (Table 4-98).

Table 4-98: Consumption of Diesel Oil in the RM within 1990-2016 periods, kt

	1990	1991	1992	1993	1994	1995	1996	1997	1998
RM: Right Bank of Dniester River	925.6	817.8	624.0	462.0	382.0	370.0	317.0	301.0	244.0
RM: Left Bank of Dniester River	186.4	164.4	125.6	93.2	73.5	71.2	60.2	56.1	44.8
RM: Total	**1 112.0**	**982.2**	**749.6**	**555.2**	**455.5**	**441.2**	**377.2**	**357.1**	**288.8**
	1999	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**
RM: Right Bank of Dniester River	176.0	190.0	208.0	254.0	284.0	323.0	328.0	333.0	350.0
RM: Left Bank of Dniester River	32.1	34.4	37.3	45.0	49.7	55.9	53.7	53.7	55.1
RM: Total	**208.1**	**224.4**	**245.3**	**299.0**	**333.7**	**378.9**	**381.7**	**386.7**	**405.1**
	2008	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**
RM: Right Bank of Dniester River	367.0	336.0	417.0	443.0	396.0	435.0	457.0	492.0	537.0
RM: Left Bank of Dniester River	57.2	51.8	63.8	67.2	59.6	64.9	67.6	72.8	75.6
RM: Total	**424.2**	**387.8**	**480.8**	**510.2**	**455.6**	**499.9**	**524.6**	**564.8**	**612.6**

Source: NBS through the Energy Balances of the RM for 1990, 1993-2016.

The amount of urea-based additive in catalytic converters was determined indirectly based on the total consumption of diesel oil, considering that additive consumption represents 2 per cent of the total amount of diesel oil consumed in the RM (Table 4-99).

Table 4-99: Urea-Based Catalyst Used in the Republic of Moldova, 1990-2016, kt

	1990	1991	1992	1993	1994	1995	1996	1997	1998
Urea-based additive use	22.2	19.6	15.0	11.1	9.1	8.8	7.5	7.1	5.8
	1999	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**
Urea-based additive use	4.2	4.5	4.9	6.0	6.7	7.6	7.6	7.7	8.1
	2008	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**
Urea-based additive use	8.5	7.8	9.6	10.2	9.1	10.0	10.5	11.3	12.3

4.5.3. Uncertainties Assessment and Time-Series Consistency

2D1. 'Lubricant Use'

Uncertainties related to emission factors used to calculate CO_2 emissions from source category 2D1 'Lubricant Use' following a Tier 1 approach reach to ±50 per cent (2006 IPCC Guidelines). Uncertainties related to activity data on lubricant use in the RM are low (±5 per cent). Thus, the combined uncertainties related to GHG emissions from 2D1 'Lubricant Use' represents circa ±50.25 per cent (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.

2D2. 'Paraffin Wax Use'

Uncertainties related to emission factors used to calculate CO_2 emissions from source category 2D2 'Paraffin Wax Use' following a Tier 1 approach reach to ±100 per cent (2006 IPCC Guidelines). Uncertainties related to activity data on paraffin wax use in the RM can be considered moderate (±20 per cent). Thus, the combined uncertainties related to GHG emissions from 2D2 'Paraffin Wax Use' represents circa ±101.98 per cent (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 related to emission factors used to calculate indirect CO_2 emissions from source category 2D3 'Solvent Use' were estimated at circa ±35 per cent (2006 IPCC Guidelines). Uncertainties related to activity data on solvent use in the RM can be considered moderate (±20 per cent). Thus, the combined uncertainties related to GHG emissions from 2D3 'Solvent Use' represents circa ±40.31 per cent (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 related to emission factors used to calculate CO_2 emissions from source category 2D4 'Other' (Urea-Based Catalysts) are low (±2 per cent). Uncertainties related to activity data on use of urea catalysts in the RM can be considered moderate (±20 per cent). Thus, the combined uncertainties related to GHG emissions from 2D4 'Other' (urea-based catalysts) represents circa ±20.10 per cent (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 sources of reference, including official sources, especially in case of converting AD into mass units compatible with GHG emissions estimation methods; comparing the results obtained by using different estimating methodologies and explaining the identified discrepancies. AD and methods used for estimating GHG emissions under the 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 lubricant use were recalculated for 1990-1994, 1997-2002, 2004-2015 time periods, due to updating AD on lubricants use on the RBDR, available in the EBs of the RM for 1990 and 1993-2015 time series, respectively due to considering for the first time lubricants use on the LBDR for 1990-1993 time series (determined indirectly based on lubricants use in 1994 (the reference point), respectively based on the decreasing trend regarding lubricant use on the RBDR between 1990 and 1993). In comparison with the results obtained in the NC4 of the RM under UNFCCC (2018), the recalculations resulted in an increase of CO_2 emissions between 1990-1994, 1998-1999, 2004 and 2015, respectively a decrease in 1994, 1997, 2000-2002 and 2005-2014 (Table 4-100).

Table 4-100: Comparative Results of CO_2 Emissions from 2D1 'Lubricant Use' Source Category included into the BUR2 and the NC4 of the RM under the UNFCCC, kt

	1990	1991	1992	1993	1994	1995	1996	1997	1998
NC4	23.4455	19.6288	11.4501	10.3596	10.1157	10.1316	9.7676	9.2158	7.0099
BUR2	24.7987	20.7617	12.1110	10.9576	10.1022	10.1316	9.7676	9.2153	7.0105
Difference, %	5.77	5.77	5.77	5.77	-0.13	0.00	0.00	-0.01	0.01
	1999	2000	2001	2002	2003	2004	2005	2006	2007
NC4	4.9993	4.7117	5.1876	4.3240	6.5825	6.5215	6.5370	7.0202	5.7882
BUR2	4.9998	3.9115	4.3872	4.3239	6.5825	6.5622	6.4692	6.9861	5.7679
Difference, %	0.01	-16.98	-15.43	0.00	0.00	0.62	-1.04	-0.49	-0.35
	2008	2009	2010	2011	2012	2013	2014	2015	2016
NC4	6.1680	5.1273	5.5099	5.8338	4.9558	4.8761	4.7900	4.8162	
BUR2	6.1481	5.0916	5.4648	5.7762	4.9418	4.8461	4.7832	4.8165	4.9177
Difference, %	-0.32	-0.70	-0.82	-0.99	-0.28	-0.62	-0.14	0.01	

Abbreviations: NC4 – Fourth National Communication; BUR2 – Second Biennial Update Report.

For 2016, CO_2 emissions from lubricants use were estimated for the first time. The results allow assert that over the periods 1990 through 2016, the respective emissions decreased in the RM by circa 80.2 per cent due to the decreasing consumption of lubricants.

2D2. 'Paraffin Wax Use'

CO_2 emissions from paraffin wax use were recalculated for 1990-2015 time series, due to updating AD on paraffin wax use on the RBDR, available in the EBs of the RM for 2004-2015 (in the Energy Balances of the RM for 1990 and 1993-2003 paraffin wax use was not included until 2004), respectively due to generating AD on paraffin wax use for 1990-2003 time periods, considering 2004 as the reference year, the evolution of lubricants use between 1990 and 2003 (this approach is more conservative than the one used in the previous inventory cycle, generating lower values for the activity data). Additionally, for the first time was included paraffin wax use on the LBDR for 1990-2015 time series (determined indirectly based on the share of lubricants use on the RBDR and LBDR from the total national consumption).

In comparison with the results obtained in the NC4 of the RM under UNFCCC (2018), the recalculations resulted in a decrease of CO_2 emissions from paraffin wax use in 1990-2002, 2004-2005 and 2007-2009, respectively an increase in 2003, 2006 and 2010-2015 (Table 4-101).

Table 4-101: Comparative Results of CO_2 Emissions from 2D2 'Paraffin Wax Use' Source Category included into the BUR2 and the NC4 of the RM under the UNFCCC, kt

	1990	1991	1992	1993	1994	1995	1996	1997	1998
NC4	0.2787	0.2347	0.1907	0.1467	0.1173	0.0880	0.0733	0.0587	0.0440
BUR2	0.1138	0.0953	0.0556	0.0503	0.0464	0.0465	0.0448	0.0423	0.0322
Difference, %	-59.1	-59.4	-70.8	-65.7	-60.5	-47.1	-38.9	-27.9	-26.9
	1999	2000	2001	2002	2003	2004	2005	2006	2007
NC4	0.0440	0.0293	0.0293	0.0293	0.0293	0.0440	0.0440	0.0587	0.0733
BUR2	0.0230	0.0180	0.0201	0.0198	0.0302	0.0301	0.0149	0.0594	0.0595
Difference, %	-47.8	-38.8	-31.3	-32.3	3.0	-31.5	-66.0	1.2	-18.8
	2008	2009	2010	2011	2012	2013	2014	2015	2016
NC4	0.0733	0.1027	0.1760	0.0733	0.0293	0.0733	0.0293	0.0587	
BUR2	0.0295	0.0742	0.1795	0.0747	0.1351	0.0751	0.0301	0.0600	0.0449
Difference, %	-59.7	-27.7	2.0	1.9	360.4	2.4	2.5	2.3	

Abbreviations: NC4 – Fourth National Communication; BUR2 – Second Biennial Update Report.

For 2016, CO_2 emissions from paraffin wax use were estimated for the first time. The results allow assert that over the periods 1990 through 2016, the respective emissions decreased in the RM by circa 60.5 per cent due to the decreasing consumption of paraffin wax.

2D3. 'Solvent Use'

GHG emissions from the 2D3 'Solvent Use' source category were recalculated for 1998-2015 time period due to use of an updated set of activity data available in the Statistical Yearbooks of the ATULBD and of the RM, as well as in the Statistical Reports PRODMOLD-A 'Total production, as a natural expression, in the Republic, by product type for 2005-2015", in particular were updated AD on asphalt production in 1999-2002, production of glues from 2003 to 2004, on the processing of polyurethane products in 2015, imports of vehicles in 2015 and the number of population for 1998-2015 time series (it was considered the number of stable population at the beginning of the year on RBDR and LBDR; it should also be noted that the NBS reconsidered in 2017 the data series regarding the number of population resulting from the 2004 and 2014 population censuses carried out in parallel on RBDR and LBDR).

In comparison with the results obtained in the NC4 of the RM under UNFCCC (2018), the recalculations resulted in an increase of CO_2 emissions from the 2D3 'Solvent Use' source category between 1998-2004, respectively a decrease from 2005 through 2015 (Table 4-102).

Table 4-102: Comparative Results of CO_2 Emissions from 2D3 'Solvent Use' Source Category included into BUR2 and the NC4 of the RM under the UNFCCC, kt

	1990	1991	1992	1993	1994	1995	1996	1997	1998
NC4	204.1460	167.7797	138.5232	110.2218	72.1539	64.2796	59.4607	31.0928	29.1244
BUR2	204.1460	167.7797	138.5232	110.2218	72.1539	64.2796	59.4607	31.0928	29.1801
Difference, %	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2
	1999	2000	2001	2002	2003	2004	2005	2006	2007
NC4	25.4949	25.5444	28.2768	30.3579	32.6846	55.5043	60.0843	73.4778	77.5617
BUR2	25.5994	25.6400	28.3468	30.4210	32.7176	55.7018	59.5365	72.9830	77.1889
Difference, %	0.4	0.4	0.2	0.2	0.1	0.4	-0.9	-0.7	-0.5
	2008	2009	2010	2011	2012	2013	2014	2015	2016
NC4	59.2811	51.5516	59.4960	64.4348	69.0187	64.0079	82.0236	79.2460	
BUR2	58.9055	51.1739	59.1169	64.0577	68.6412	63.6359	81.6487	78.8011	70.7300
Difference, %	-0.6	-0.7	-0.6	-0.6	-0.5	-0.6	-0.5	-0.6	

Abbreviations: NC4 – Fourth National Communication; BUR2 – Second Biennial Update Report.

For 2016, CO_2 emissions from solvent use were estimated for the first time. The results allow assert that over the periods 1990 through 2016, the respective emissions decreased in the RM by circa 65.4 per cent due to the decreasing consumption.

The same trends were recorded for the NMVOC emissions from solvent use (Table 4-103). For 2016, NMVOC emissions were estimated for the first time. The results allow assert that over the periods 1990 through 2016, the respective emissions decreased in the RM by circa 65.1 per cent.

Table 4-103: Comparative Results of NMVOC Emissions from 2D3 'Solvent Use' Source Category included into BUR2 and the NC4 of the RM under the UNFCCC, kt

	1990	1991	1992	1993	1994	1995	1996	1997	1998
NC4	92.7937	76.2635	62.9651	50.1008	32.7972	29.2180	27.0276	14.1331	13.2383
BUR2	92.7937	76.2635	62.9651	50.1008	32.7972	29.2180	27.0276	14.1331	13.2679
Difference, %	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2
	1999	2000	2001	2002	2003	2004	2005	2006	2007
NC4	11.5886	11.6111	12.8531	13.7991	14.8566	25.2292	27.3110	33.3990	35.2553
BUR2	11.6405	11.6590	12.8867	13.8294	14.8735	25.3328	27.0205	33.1366	35.0576
Difference, %	0.4	0.4	0.3	0.2	0.1	0.4	-1.1	-0.8	-0.6
	2008	2009	2010	2011	2012	2013	2014	2015	2016
NC4	26.9460	23.4326	27.0436	29.2885	31.3721	29.0945	37.2835	36.0209	
BUR2	26.7467	23.2322	26.8426	29.0886	31.1720	28.8972	37.0850	35.8010	32.3532
Difference, %	-0.7	-0.9	-0.7	-0.7	-0.6	-0.7	-0.5	-0.6	

Abbreviations: NC4 – Fourth National Communication; BUR2 – Second Biennial Update Report.

2D4. 'Other' (Urea-Based Catalysts)

CO_2 emissions from use of urea-based catalysts were recalculated for 1990-2015 time periods due to use of an updated set of activity data related to Diesel Oil consumption in the RM (in the current inventory cycle was considered total diesel oil consumption as energy and fuel, while in the previous inventory cycle it was considered total national diesel oil consumption, including for non-energy use).

In comparison with the results obtained in the NC4 of the Republic of Moldova under UNFCCC (2018), the recalculations resulted in a decrease of CO_2 emissions from 2D4 'Other' (use of urea-based catalysts) source category in 1990-1994, 1999-2000 and 2012-2014 time series, respectively an increase in 1995-1998, 2001-2011 and 2015 (Tab. 4-104).

Table 4-104: Comparative Results of CO_2 Emissions from 2D4 'Other' (Urea-Based Catalysts) Source Category included into BUR2 and the NC4 of the RM under the UNFCCC, kt

	1990	1991	1992	1993	1994	1995	1996	1997	1998
NC4	5.3387	4.7200	3.6067	2.6630	2.2163	1.9834	1.6968	1.6402	1.3442
BUR2	5.3005	4.6818	3.5730	2.6463	2.1713	2.1031	1.7979	1.7024	1.3765
Difference, %	-0.7	-0.8	-0.9	-0.6	-2.0	6.0	6.0	3.8	2.4
	1999	2000	2001	2002	2003	2004	2005	2006	2007
NC4	1.0256	1.0736	1.1350	1.3108	1.5601	1.7055	1.8177	1.8318	1.9224
BUR2	0.9920	1.0697	1.1693	1.4252	1.5908	1.8059	1.8195	1.8432	1.9311
Difference, %	-3.3	-0.4	3.0	8.7	2.0	5.9	0.1	0.6	0.5
	2008	2009	2010	2011	2012	2013	2014	2015	2016
NC4	2.0131	1.8416	2.2821	2.4216	2.1904	2.4059	2.5230	2.6910	
BUR2	2.0219	1.8487	2.2918	2.4321	2.1716	2.3829	2.5008	2.6922	2.9202
Difference, %	0.4	0.4	0.4	0.4	-0.9	-1.0	-0.9	0.0	

Abbreviations: NC4 – Fourth National Communication; BUR2 – Second Biennial Update Report.

For 2016, CO_2 emissions from use of urea-based catalysts were estimated for the first time. The results allow assert that over the periods 1990 through 2016, the respective emissions decreased in the RM by circa 44.9 per cent to the decrease of Diesel Oil consumption.

4.5.6. Planned Improvements

Possible improvements under the 2D 'Non-Energy Products from Fuels and Solvent Use' category aim at updating the activity data used to estimate GHG emissions within this category for the 1990-2015 periods.

4.6. Product Uses as Substitutes for ODS (Category 2F)

4.6.1. Source Category Description

A large number of hydrofluorocarbons are serving as alternatives to ozone depleting substances (ODS) (Table 4-105).

Table 4-105: Global Warming Potentials for 100 years and Atmospheric Lifetimes [53]

GHGs	Chemical formula	Atmospheric lifetime, according to AR5	SAR	TAR	AR4	AR5
HFC-23	CHF_3	222	11700	12000	14800	12140
HFC-32	CH_2F_2	5.2	650	550	675	677
HFC-125	C_2HF_5	28.2	2800	3400	3500	3170
HFC-134a	$C_2H_2F_4$ (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).

Globally, wide scale production of halocarbons started in 1991, as alternative substances to chlorofluorocarbons (CFC), ozone layer depleting substances (ODS). According the Montreal Protocol, the Parties to this treaty committed to phase out the import and consumption of chemical substances that deplete the ozone layer, with further complete elimination starting 2008 (because halocarbons do not contain atoms of chlorine, they do not have any impact on ozone layer).

The 2F 'Product Uses as Substitutes for ODS' category includes GHG emissions from the following emission sources: 2F1 'Refrigeration and Air Conditioning', 2F2 'Foam Blowing Agents', 2F3 'Fire Extinguishers', 2F4 'Aerosols', 2F5 'Solvents' and 2F6 'Other Applications'. Under the current inventory cycle the Republic of Moldova monitored emissions generated by the consumption of HFCs from source categories 2F1, 2F2 and 2F4. Emissions from source categories 2F5 and 2F6, were not estimated due to lack of activity data. No data are reported for source category 2F3, in particular due to the fact that the fire extinguishers used in the country do not contain HFCs.

To be noted that the process of collecting activity data on consumption of alternative substances to chlorofluorocarbons is extremely difficult in the Republic of Moldova. The primary difficulty is due to

[53] < http://www.epa.gov/climatechange/Downloads/ghgemissions/US-GHG-Inventory-2014-Annex-6-Additional-Information.pdf>.

the fact that import, export, re-export and circulation of these substances on the market is not regulated at the national level (like, for example, the ODS[54] starting with 01.01.2013). Import of substitutes for ODS in bulk, as well as products and equipment charged with halocarbons does not require a license and/or environmental authorization, being allowed to practically any legal entity or individual. Secondly, there are difficulties in monitoring the import of disaggregated HFCs by type of substance, as ODS and its alternatives are aggregated in the Nomenclature of Goods of the RM in several tariff positions (2903 79 110 – 2903 79 190; 3824 71 000; 3824 74 000 and 3824 78 000). 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 practically by any individual.

In these circumstances, HFCs emissions from the category 2F ‘Product Uses as Substitutes for ODS’ were estimated based on assessment methodologies available in 2006 IPCC Guidelines, considering data on import and consumption of halocarbons provided by the economic agents, including through the Annual Reports submitted by enterprises to the Ozone Office (to be noted that between 2003-2015, only a limited number of enterprises were licensed to import, export, re-export, transit and placing ODS and equipment containing ODS on the market: ‘Frigoinds’ Ltd., ‘Ecolux’ Ltd, ‘Frio-Dins’ Ltd, ‘York Regrigerent’ Ltd, ”Dina Cociug” Ltd.).

In addition, were also used the Generalized Reports 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 (from 2009 through 2016 the responsibility for collecting statistical information according to the Statistical Report No. 1-Ozone was kept by the Inspectorate for Environmental Protection, but due to lack of capacities, this information was not collected). It should be noted that the Republic of Moldova does not produce HFCs, and before 1995 these substances had a relatively narrow use, being imported in insignificant amounts.

2F1. ‘Refrigeration and Air Conditioning’

Refrigeration equipment (household/domestic refrigerators, freezers, AC window units, industrial refrigeration equipment) and air conditioning equipment (stationary and mobile air conditioners) are a primary source of HFCs emissions in the Republic of Moldova.

Since from 1995, in conformity with Montreal Protocol, the developed countries are not supposed to produce CFC and equipment using CFC, the RM uses R-22 and R-600a refrigerants as transit substances, and R-134a, R-404a, R-407a, R-407c, R-410a and R-507a, as alternative refrigerants to chlorofluorocarbons (Table 4-106).

Table 4-106: Composition of Refrigerants Preponderantly Used in the Republic of Moldova

Commercial Name	Sector of Use	Composition
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 refrigerant	HFC-32 (30%)/HFC-125 (40%)/HFC-134a (40%)
R-408a	Air Conditioning	HCFC-22 (47%)/HFC-143a (46%)/HFC-125 (7%)
R-410a	Transport, commercial, industrial refrigerant	HFC-32 (50%)/HFC-125 (50%)
R-422d	Commercial, industrial refrigerant	HFC-125 (65.1%)/HFC-134a (31.5%)/R-600a (3.4%)
R-507c	Transport, commercial, industrial refrigerant	HFC-125 (50%)/HFC-143a (50%)

In 2017, on the national market were introduced relatively large amounts (circa 1.7 tones) of R-407f as an alternative substance for the refrigerant agent R-404a, respectively (circa 4.8 tones) of R-422d as an alternative substance for the refrigerant agent R-22.

2F2. ‘Foam Blowing Agents’

Since 1995 hydrofluorocarbons have been also used to replace CFCs and HCFC used in foam blowing (closed and opened cell foams), used in insulation, cushioning and packaging. The basic components for 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 are

[54] <http://mediu.gov.md/index.php/activitate/autorizatii>.

produced since 2005. Foams produced as well as imported ones are mostly closed cell foams (the emissions from these last longer, for about 20 years).

2F3. 'Fire Extinguishers'

There are two types of fire extinguishers: fixed flooding fire extinguishing systems and portable streaming fire extinguishers. At the international level, halon-based extinguishers (halon-1211 or bromoclorodifluoromethane; halon-1301 or bromotrifluoromethane and halon-2402 or dibromotetrafluoroethane) tend to be replaced by HFCs based extinguishers (HFC-227ea and HFC-236fa and CO_2). According to the information received from the Civil Protection and Emergency Situations Service of the Ministry of Intern Affaire, only carbon dioxide is used in flooding fixed fire extinguishing systems as an extinguishing agent (halon and HFCs based stationary and portable extinguishing systems are not in use) (Table 4-107).

Table 4-107: Import of Carbon Dioxide Based Portable Fire Extinguishers in the Republic of Moldova, in tones for 1995-1999 time periods and in units for 2000-2016 time periods

	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
Total portable fire extinguishers	59.679	48.157	60.798	84.692	13.531	7 572	4 178	9 247	13 806	20 913	18 494
	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Total portable fire extinguishers	26 666	41 232	46 428	154 462	43 347	29 374	42 465	51 143	51 942	42 613	42 601

Source: Customs Service of the RM, Official 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; Official 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; Official 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; Official 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; Official Letter No. 28/07-612 dated 12.01.2018, as a response to the request from the Climate Change Office of the Ministry of Agriculture, Regional Development and Environment No. 601/2017-12-03 dated 14.12.2017.

2F4. 'Aerosols' (Metered Dose Aerosols)

In most aerosol products HFCs are used as propellants. Gases from aerosols are usually released shortly after production, on average 1-2 years after sale. During the use of aerosols, 100 per cent of the chemical is emitted. Most frequently, HFC-134a is used as 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 at commission and used by the Ministry of Intern Affaire or other organizations entitled to ensure public order, and used in cases stipulated by legislation).

HFCs emissions from 2F 'Product Uses as Substitutes for ODS' category increased in the RM between 1995 and 2016 by circa 44.5 times, from 3.95 kt CO_2 equivalent in 1995 to 175.58 kt CO_2 equivalent in 2016 (Table 4-108, Figure 4-3).

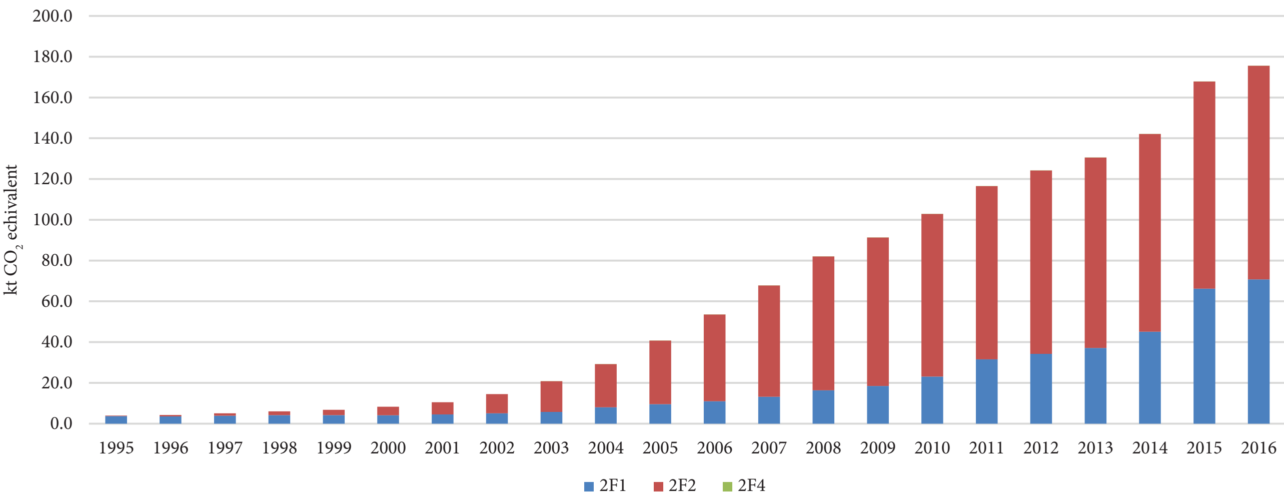


Figure 4-3: F-gases Emissions from 2F 'Product Uses as Substitutes for ODS' Category, by Source, within 1995-2016 periods.

Categories 2F1 ‘Refrigeration and Air Conditioning’ and 2F2 ‘Foam Blowing Agents’ had the largest share in the total HFCs emissions from 2F ‘Product Uses as Substitutes for ODS’ category.

Table 4-108: HFCs Emissions from 2F ‘Product Uses as Substitutes for ODS’ Category in the RM between 1995-2016, kt CO_2 equivalent

	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
HFCs emissions	3.9514	4.2815	5.1070	6.0624	6.8017	8.3038	10.4771	14.5015	20.8415	29.1966	40.7988
	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
HFCs emissions	53.5982	67.7992	82.0655	91.3620	102.8657	116.5249	124.2123	130.5506	142.0853	167.8122	175.5848

4.6.2. Methodological Issues, Emission Factors and Data Sources

2F1. ‘Refrigeration and Air Conditioning’

Refrigeration equipment (household/domestic refrigerators, freezers, AC window units, industrial refrigeration equipment) and air conditioning equipment (stationary and mobile air conditioners) are a primary source of HFCs emissions in the Republic of Moldova.

Greenhouse gas emissions generated from 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 refrigerant container management;

$E_{charge,\ t}$ – emissions related to the charging process of refrigerant: connecting and disconnecting the refrigerant container to and from the equipment when it is initially charged;

$E_{lifetime,\ t}$ – annual leakage from the refrigerant bank during lifetime (operation and servicing);

$E_{end\text{-}of\text{-}life,\ t}$ – emissions at end-of-life, at system disposal.

The assessment process involves several steps, using the following equations.

Step 1: Management of refrigerant containers

The emissions related to the refrigerant container management comprises all the emissions related to the refrigerant transfer from bulk containers (typically 40 tones) down to small capacities where the mass varies from 0.5 kg to 1 ton. The emissions are estimated using Equation 7.11 from the IPCC 2006 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 – EF of HFC container management of the current refrigerant market, % (varies between 2 and 10 per cent of the refrigerant market; on average, circa 6 per cent).

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 the new equipment in year t per sub-application (including those that are produced for export) kg; to be noted, 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), % (varies from 0.1 to 3 per cent).

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, %.

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 emitted at system disposal in year *t*, kg;

p – residual charge of HFC in equipment being disposed of expressed in percentage of full charge, %;

$\eta_{rec,d}$ – recovery efficiency at disposal, which is the ratio of recovered HFC referred to the HFC contained in the system, %.

During the assessment process were used default EF available in the IPCC 2006 Guidelines, as well as country specific EF provided by the members of the Republican Association of Refrigeration Technicians, respectively from the reports submitted by companies to the Ozone Office of the Ministry of Agriculture, Regional Development and Environment (Table 4-109).

Table 4-109: EFs and Parameters Used to Estimate HFC Emissions from Refrigeration and Air Conditioning Equipment Imported in the Republic of Moldova

Equipment Type (sub-application)	Charge, kg (marge and value used)	Lifetime, years (marge and value used)	EF, % 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	$0.05 \le M \le 0.5$ **0.10**	$12 \le d \le 20$ **16**	$0.2 \le k \le 1$ **0.6**	$0.1 \le x \le 0.5$ **0.5**	$0 < \eta_{rec,d} < 70$ **0**	$0 < p < 80$ **50**
Chest freezers	$0.05 \le M \le 0.5$ **0.20**	$12 \le d \le 20$ **16**	$0.2 \le k \le 1$ **0.6**	$0.1 \le x \le 0.5$ **0.5**	$0 < \eta_{rec,d} < 70$ **0**	$0 < p < 80$ **50**
Upright freezers	$0.05 \le M \le 0.5$ **0.18**	$12 \le d \le 20$ **16**	$0.2 \le k \le 1$ **0.6**	$0.1 \le x \le 0.5$ **0.5**	$0 < \eta_{rec,d} < 70$ **0**	$0 < p < 80$ **50**
Stand-alone commercial application	$0.2 \le M \le 6$ **0.4**	$10 \le d \le 15$ **12**	$0.5 \le k \le 3$ **1.5**	$1 \le x \le 15$ **16.8**	$0 < \eta_{rec,d} < 70$ **30**	$0 < p < 80$ **50**
Medium commercial refrigeration	$3 \le M \le 30$ **6**	$10 \le d \le 15$ **12**	$0.5 \le k \le 3$ **1.5**	$1 \le x \le 15$ **16.8**	$0 < \eta_{rec,d} < 70$ **30**	$0 < p < 80$ **50**
Large commercial refrigeration	$100 \le M \le 200$ **150**	$10 \le d \le 15$ **12**	$0.5 \le k \le 3$ **1.5**	$1 \le x \le 15$ **16.8**	$0 < \eta_{rec,d} < 70$ **50**	$0 < p < 80$ **50**
Industrial refrigeration	$10 \le M \le 10000$ **150**	$15 \le d \le 30$ **20**	$0.5 \le k \le 3$ **1.5**	$7 \le x \le 25$ **16**	$0 < \eta_{rec,d} < 90$ **50**	$50 < p < 100$ **75**
Residential and Commercial A/C, including Heat Pumps	$0.5 \le M \le 100$ **0.6**	$10 \le d \le 20$ **12**	$0.2 \le k \le 1$ **0.6**	$1 \le x \le 10$ **5**	$0 < \eta_{rec,d} < 80$ **0**	$0 < p < 80$ **50**
Mobile A/C – personal cars	$0.4 \le M \le 0.8$ **0.6**	$9 \le d \le 16$ **16**	$0.2 \le k \le 0.5$ **0.5**	$10 \le x \le 20$ **15**	$0 < \eta_{rec,d} < 50$ **0**	$0 < p < 50$ **50**
Mobile A/C – buses, trains, passenger wagons	$10 \le M \le 20$ **12**	$9 \le d \le 16$ **12**	$0.2 \le k \le 0.5$ **0.5**	$10 \le x \le 20$ **15**	$0 < \eta_{rec,d} < 50$ **30**	$0 < p < 50$ **50**
Mobile A/C – minibuses	$0.5 \le M \le 1.5$ **1.2**	$9 \le d \le 16$ **12**	$0.2 \le k \le 0.5$ **0.5**	$10 \le x \le 20$ **15**	$0 < \eta_{rec,d} < 50$ **30**	$0 < p < 50$ **50**
Mobile A/C – trucks	$0.5 \le M \le 1.5$ **1**	$9 \le d \le 16$ **12**	$0.2 \le k \le 0.5$ **0.5**	$10 \le x \le 20$ **15**	$0 < \eta_{rec,d} < 50$ **30**	$0 < p < 50$ **50**
Refrigeration vehicles	$3 \le M \le 8$ **7**	$6 \le d \le 9$ **9**	$0.2 \le k \le 1$ **0.6**	$15 \le x \le 50$ **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 Ozone Office of the Ministry of Environment.

I) Domestic Refrigeration

The refrigerators plant in Chisinau was founded in November 1964 and 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 has been exhibited at international fairs and exhibitions, enjoying popularity in the Republic of Moldova, other union republics of the former USSR as well as in the socialist countries. Once the transition to the market economy began, the production did not resist the competition with the imports and as a result, in 1997, the company went bankrupt. Since 1998, in the RM no domestic refrigerators and freezers are produced (Table 4-110). Refrigerant R-12 was used in the production process at the respective plant.

Table 4-110: AD on Refrigerators and Freezers Production within 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 2016, the import of domestic refrigerators increased by circa 2.7 times, while for domestic freezers – by circa 158 times (Table 4-111).

Table 4-111: Activity Data on Refrigeration Equipment Imported in the Republic of Moldova within 1995-2016, units

Equipment	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
Refrigerators	18 958	8 376	11 597	15 230	8 498	12 092	19 937	30 689	42 524	52 694	70 412
Chest freezers	36	243	100	148	96	242	428	97	442	457	1 265
Upright freezers	43	337	22	320	200	393	558	995	2 033	1 481	1 965
Equipment	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**
Refrigerators	87 034	112 982	78 880	65 306	72 824	66 900	63 433	55 638	60 963	55 713	51 245
Chest freezers	1 713	1 549	2 834	2 529	2 492	3 395	2 107	2 870	3 151	5 413	6 822
Upright freezers	5 180	9 574	3 169	4 323	8 825	9 239	7 994	6 164	8 242	7 482	5 660

Source: Custom Service, Official 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; Official 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; Official 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; Official 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; Official Letter No. 28/07-612 dated 12.01.2018, as a response to the request from the Climate Change Office of the Ministry of Agriculture, Regional Development and Environment No. 601/2017-12-03 dated 14.12.2017.

The share of refrigerants charged into the domestic refrigeration equipment varied from one year to another (Table 4-112).

Table 4-112: The Share of Refrigerants Charged into the Domestic Refrigeration Equipment in the Republic of Moldova within 1995-2016, %

Equipment	Refrigerants	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
Refrigerators	R-134a	0	0	3	5	10	15	20	25	30	45	50
	R-600a	0	0	0	0	0	0	0	0	0	0	5
	R-12	100	100	97	95	90	85	80	75	70	55	45
Freezers	R-134a	0	0	3	5	8	10	15	20	30	35	40
	R-404a	0	0	2	5	7	10	15	20	25	30	35
	R-507c	0	0	0	0	0	0	0	0	5	5	5
	R-12	100	100	95	90	85	80	70	60	40	30	20
Equipment	**Refrigerants**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**
Refrigerators	R-134a	65	75	75	75	75	70	70	65	65	60	60
	R-600a	10	10	15	25	25	30	30	45	45	40	40
	R-12	25	15	10	0	0	0	0	0	0	0	0
Freezers	R-134a	45	40	35	30	25	20	15	10	10	10	10
	R-404a	40	45	50	60	65	65	70	75	75	75	75
	R-507c	5	10	10	10	10	15	15	15	15	15	15
	R-12	10	5	5	0	0	0	0	0	0	0	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 in the country (Table 4-106), the share of refrigerants charged into the refrigeration equipment imported in the country over the period from 1995 through 2016 (Table 4-112), the average charge of equipment with refrigerant (Table 4-109) and statistical data on import of refrigeration equipment (Table 4-111), was used to estimate the total amount of freons imported in the country within the domestic refrigeration equipment (Table 4-113) and the cumulative amount of freons used in the domestic refrigeration equipment imported in the Republic of Moldova (Table 4-114).

Table 4-113: AD on Imported Freons Charged into Domestic Refrigeration Equipment in the RM within 1997-2016 periods, t/yr

	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
R-134a	0.0355	0.0805	0.0894	0.1933	0.4266	0.8069	1.4120	2.4965	3.7633	6.2310
R-404a	0.0005	0.0044	0.0039	0.0119	0.0279	0.0397	0.1136	0.1074	0.2123	0.5100
R-507c	NO	NO	NO	NO	NO	NO	0.0227	0.0179	0.0303	0.0638
	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
R-134a	9.2869	6.3140	5.2831	5.9835	5.1514	4.7194	3.7848	4.1740	3.5857	3.3130
R-404a	0.9149	0.5686	0.7704	1.3565	1.5223	1.3022	1.2626	1.5853	1.8220	1.7874
R-507c	0.2033	0.1137	0.1284	0.2087	0.3513	0.2790	0.2525	0.3171	0.3644	0.3575

Activity data on the total amount of freons imported in the country were provided through reports submitted by the companies to the Ozone Office and Climate Change Office of the Ministry of Agriculture, Regional Development and Environment. However, this information is aggregated across the country, without specifying the share used for domestic refrigeration equipment service.

Table 4-114: Cumulative Amount of Freons Charged into Domestic Refrigeration Equipment Imported in the Republic of Moldova within 1997-2016 periods, t/yr

	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
R-134a	0.0355	0.1160	0.2054	0.3987	0.8254	1.6323	3.0443	5.5408	9.3041	15.5351
R-404a	0.0005	0.0048	0.0087	0.0206	0.0485	0.0882	0.2018	0.3092	0.5215	1.0315
R-507c	NO	NO	NO	NO	NO	NO	0.0227	0.0406	0.0710	0.1347
	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
R-134a	24.8220	31.1360	36.4191	42.4026	47.5541	52.2734	56.0227	60.1162	63.6125	66.7322
R-404a	1.9465	2.5151	3.2854	4.6419	6.1642	7.4664	8.7286	10.3096	12.1277	13.9032
R-507c	0.3380	0.4517	0.5801	0.7888	1.1401	1.4192	1.6717	1.9888	2.3532	2.7106

In order to identify this information (Table 4-115), it is admitted that about 0.5 per cent of the total amount of freons charged into domestic refrigeration equipment is used for the service of this equipment, considering that circa 6 per cent (margin used by default: from 2 to 10 per cent) of the total amount of imported freon is lost through fugitive emissions during refrigerant containers management.

Table 4-115: AD on Imported Freons for Domestic Refrigeration Equipment Service in the RM within 1997-2016 periods, t/yr

	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
R-134a	0.0002	0.0006	0.0011	0.0021	0.0044	0.0087	0.0161	0.0294	0.0493	0.0823
R-404a	0.0000	0.0000	0.0000	0.0001	0.0003	0.0005	0.0011	0.0016	0.0028	0.0055
R-507c	NO	NO	NO	NO	NO	NO	0.0001	0.0002	0.0004	0.0007
	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
R-134a	0.1316	0.1650	0.1930	0.2247	0.2520	0.2770	0.2969	0.3186	0.3371	0.3537
R-404a	0.0103	0.0133	0.0174	0.0246	0.0327	0.0396	0.0463	0.0546	0.0643	0.0737
R-507c	0.0018	0.0024	0.0031	0.0042	0.0060	0.0075	0.0089	0.0105	0.0125	0.0144

II) Commercial Refrigeration

AD used to estimate HFC emissions from consumption of hydrofluorocarbons charged into commercial refrigeration equipment (vending machines, A/C window units, chest and upright freezers) were provided by the Customs Service of the RM. Between 1995 and 2016, the imports of commercial refrigeration equipment increased by circa 61 per cent (Table 4-116).

Table 4-116: AD on Imported Commercial Refrigeration Equipment in the Republic of Moldova within 1995-2016 periods, units

Equipment	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
Stand-alone commercial application	2 696	1 037	1 411	2 714	913	1 195	1 696	3 153	1 803	2 465	2 830
Medium commercial refrigeration	102	583	558	2 286	622	822	977	1 122	1 605	1 260	1 173
Total commercial refrigeration equipment	**2 798**	**1 620**	**1 969**	**5 000**	**1 535**	**2 017**	**2 673**	**4 275**	**3 408**	**3 725**	**4 003**
Equipment	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Stand-alone commercial application	3 621	8 978	8 692	4 908	4 296	4 997	4 000	5 333	3 961	837	675
Medium commercial refrigeration	1 246	1 436	478	422	403	441	224	343	252	3 565	3 832
Total commercial refrigeration equipment	**4 867**	**10 414**	**9 170**	**5 330**	**4 699**	**5 438**	**4 224**	**5 676**	**4 213**	**4 402**	**4 507**

Source: Custom Service, Official Letter No. 28/07-1893 din 23.02.2011, as a response to the request from the Ministry of Environment No. 03-07/175 dated 02.02.2011; Official 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; ; Official 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; Official 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; Official Letter No. 28/07-612 dated 12.01.2018, as a response to the request from the Climate Change Office of the Ministry of Agriculture, Regional Development and Environment No. 601/2017-12-03 dated 14.12.2017.

The share of refrigerants charged into the commercial refrigeration equipment varied from one year to another (Table 4-117).

Table 4-117: The Share of Refrigerants Charged into the Commercial Refrigeration Equipment Imported in the Republic of Moldova within 1995-2016, %

Equipment	Refrigerant	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
Commercial refrigeration equipment	R-12	100	100	76	65	55	45	40	31	25	21	17
	R-22	0	0	10	20	30	30	35	45	40	35	30
	R-134a	0	0	5	5	5	15	15	15	20	25	25
	R-404a	0	0	5	5	5	5	5	5	10	15	20
	R-407c	0	0	0	0	0	0	0	0	2	2	3
	R-507a	0	0	4	5	5	5	5	4	3	2	0
	R-290	0	0	0	0	0	0	0	0	0	0	5
Equipment	**Refrigerant**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**
Commercial refrigeration equipment	R-12	15	10	5	0	0	0	0	0	0	0	0
	R-22	25	20	15	15	5	0	0	0	0	0	0
	R-134a	25	25	30	30	30	25	25	25	20	12	10
	R-404a	25	30	35	35	40	45	45	45	50	56	58
	R-407c	5	5	5	5	5	5	5	5	5	5	5
	R-507a	0	0	0	0	0	0	0	0	0	0	0
	R-290	5	10	10	15	20	25	25	25	25	25	25

Source: Republican Association of Refrigeration Technicians of the Republic of Moldova.

The information on the share of refrigerants charged into the refrigeration equipment imported in the country (Table 4-106), the share of refrigerants charged into the commercial refrigeration equipment imported in the country over the period from 1997 through 2016 (Table 4-118), the average charge of equipment with refrigerant (Table 4-109) and statistical data on import of commercial refrigeration equipment (Table 4-116), was used to estimate the total amount of freons imported in the country within the commercial refrigeration equipment (Table 4-118) and the cumulative amount of freons used in the commercial refrigeration equipment imported in the Republic of Moldova (Table 4-119).

Table 4-118: AD on Imported Freons Charged into Commercial Refrigeration Equipment in the RM within 1997-2016 periods, t/yr

	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
R-134a	0.1956	0.7401	0.2049	0.8115	0.9811	1.1990	2.0702	2.1365	2.0425	2.2311
R-404a	0.1956	0.7401	0.2049	0.2705	0.3270	0.3997	1.0351	1.2819	1.6340	2.2311
R-407c	NO	NO	NO	NO	NO	NO	0.2070	0.1709	0.2451	0.4462
R-408a	0.1565	0.7401	0.2049	0.2705	0.3270	0.3197	0.3105	0.1709	NO	NO
R-507a	NO	NO	NO	NO	NO	NO	NO	NO	0.4085	0.4462
	2007	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**
R-134a	3.0518	1.9034	1.3486	1.2409	1.1612	0.7360	1.0478	0.6193	2.6070	2.3262
R-404a	3.6622	2.2207	1.5733	1.6546	2.0902	1.3248	1.8860	1.5482	12.1659	13.4920
R-407c	0.6104	0.3172	0.2248	0.2068	0.2322	0.1472	0.2096	0.1548	1.0862	1.1631
R-408a	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
R-507a	1.2207	0.6345	0.6743	0.8273	1.1612	0.7360	1.0478	0.7741	5.4312	5.8155

Table 4-119: Cumulative Amount of Freons Charged into Commercial Refrigeration Equipment Imported in the Republic of Moldova within 1997-2016 periods, t/yr

	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
R-134a	0.1956	0.9357	1.1406	1.9521	2.9331	4.1321	6.2023	8.3388	10.3813	12.6124
R-404a	0.1956	0.9357	1.1406	1.4111	1.7381	2.1377	3.1729	4.4548	6.0888	8.3199
R-407c	NO	NO	NO	NO	NO	NO	0.2070	0.3779	0.6230	1.0693
R-408a	0.1565	0.8966	1.1014	1.3719	1.6990	2.0187	2.3292	2.5001	2.5001	2.5001
R-507a	NO	NO	NO	NO	NO	NO	NO	NO	0.4085	0.8547
	2007	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**
R-134a	15.6642	17.5677	18.7206	19.2215	20.1778	20.1023	20.1690	19.5893	20.1261	20.3158
R-404a	11.9820	14.2027	15.5804	16.4949	18.3802	19.4345	20.9935	22.1420	33.2728	45.4829
R-407c	1.6796	1.9969	2.2216	2.4284	2.6607	2.8079	3.0174	3.1723	4.0515	5.0437
R-408a	2.5001	2.5001	2.3436	1.6036	1.3987	1.1282	0.8012	0.4815	0.1709	NO
R-507a	2.0754	2.7099	3.3842	4.2115	5.3727	6.1087	7.1565	7.9306	13.3618	19.1773

Activity data on the total amount of freons imported in the country (Table 4-120) were provided through reports submitted by the companies to the Ozone Office and Climate Change Office of the MARDE. However, this information is aggregated across the country, without specifying the share used for commercial refrigeration equipment service. In order to identify this information, it is admitted that about 16.8 per cent of the total amount of freons charged into commercial refrigeration equipment (a value provided by the economic agents in the field covering the 2011-2016 periods is used for the service of this equipment, taking into account that circa 6 per cent (margin used by default: from 2 to 10 per cent) of the total amount of imported freon is lost through fugitive emissions during refrigerant containers management.

Table 4-120: AD on Imported Freons for Commercial Refrigeration Equipment Service in the RM within 1997-2016 periods, t/yr

	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
R-134a	0.0348	0.1666	0.2031	0.3476	0.5223	0.7358	1.1045	1.4850	1.8487	2.2460
R-404a	0.0348	0.1666	0.2031	0.2513	0.3095	0.3807	0.5650	0.7933	1.0843	1.4816
R-407c	NO	NO	NO	NO	NO	NO	0.0369	0.0673	0.1110	0.1904
R-408a	0.0279	0.1597	0.1961	0.2443	0.3026	0.3595	0.4148	0.4452	0.4452	0.4452
R-507a	NO	NO	NO	NO	NO	NO	NO	NO	0.0727	0.1522
	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
R-134a	2.7895	3.1285	3.3338	3.4230	3.5933	3.5798	3.5917	3.4885	3.5841	3.6178
R-404a	2.1338	2.5292	2.7746	2.9374	3.2731	3.4609	3.7385	3.9431	5.9252	8.0996
R-407c	0.2991	0.3556	0.3956	0.4325	0.4738	0.5000	0.5373	0.5649	0.7215	0.8982
R-408a	0.4452	0.4452	0.4174	0.2856	0.2491	0.2009	0.1427	0.0857	0.0304	NO
R-507a	0.3696	0.4826	0.6027	0.7500	0.9568	1.0878	1.2744	1.4123	2.3795	3.4151

III) Industrial Refrigeration

Activity data used to estimate HFC emissions from consumption of hydrofluorocarbons charged into industrial refrigeration equipment (Table 4-121) were identified by the Ozone Office of the Ministry of Agriculture, Regional Development and Environment and the Republican Association of Refrigeration Technicians of the Republic of Moldova, through questionnaires to the economic agents in the field.

Table 4-121: AD on Use of Industrial Refrigeration Equipment in the RM within 1995-2016

	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
Industrial refrigeration, units	432	417	402	387	372	357	342	327	318	307	299
Share of refrigerants charged into the industrial refrigeration, t	101.1	98.1	95.0	92.0	88.9	85.9	82.8	79.8	77.0	74.2	71.7
	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Industrial refrigeration, units	292	285	279	278	283	289	298	309	313	321	328
Share of refrigerants charged into the industrial refrigeration, t	69.0	66.5	64.0	61.7	59.2	57.2	55.2	53.2	51.4	49.6	47.8

Source: Republican Association of Refrigeration Technicians of the Republic of Moldova.

The share of refrigerants charged into the industrial refrigeration equipment varied from one year to another (Table 4-122).

Table 4-122: The Share of Refrigerants Charged into the Industrial Refrigeration Equipment Imported in the Republic of Moldova within 1995-2016 periods, %

	Refrigerant	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
Industrial refrigeration	R-134a	0.0	0.0	1.0	1.5	1.5	1.5	2.0	2.0	2.5	3.0	3.0
	R-404a	0.0	0.0	0.5	0.5	1.0	1.0	1.5	1.5	2.0	2.5	2.5
	R-407c	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.5
	R-507c	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0
	R-22	78.0	78.0	76.5	76.5	76.5	76.5	76.0	76.0	75.5	75.0	74.0
	R-717	22.0	22.0	22.0	21.5	21.0	21.0	20.5	20.5	20.0	19.5	19.0
	Refrigerant	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Industrial refrigeration	R-134a	3.0	3.5	3.5	3.5	4.5	4.5	5.5	6.0	6.0	7.0	7.0
	R-404a	2.5	3.5	5.0	6.0	9.0	9.0	10.0	12.0	13.0	14.0	15.0
	R-407c	1.0	1.0	1.0	1.0	2.0	2.0	2.0	2.0	2.0	2.0	3.0
	R-507c	3.0	4.5	5.0	5.5	7.0	7.5	8.0	14.0	20.0	40.0	45.0
	R-22	72.0	70.0	68.0	67.0	61.0	61.0	59.0	51.0	44.0	25.0	18.0
	R-717	18.5	17.5	17.5	17.0	16.5	16.0	15.5	15.0	15.0	12.0	12.0

Source: Republican Association of Refrigeration Technicians of the Republic of Moldova.

The information on the share of refrigerants charged into the refrigeration equipment imported in the country (Table 4-106), the share of refrigerants charged into the industrial refrigeration equipment imported in the country over the period from 1995 through 2016 (Table 4-122) activity data on the charge of industrial equipment with refrigerant (Table 4-121), was used to estimate the total amount of freons depending on the type of refrigerant used within the industrial refrigeration equipment (Table 4-123) and the cumulative amount of freons used in the industrial refrigeration equipment in the Republic of Moldova (Table 4-124).

Table 4-123: AD on the Share of Freons Charged into the Industrial Refrigeration Equipment in the Republic of Moldova within 1997-2016 periods, t/yr

	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
R-134a	0.9503	1.3796	1.3338	1.2880	1.6562	1.5951	1.9259	2.2268	2.1505	2.0714
R-404a	0.4752	0.4599	0.8892	0.8587	1.2422	1.1963	1.5407	1.8557	1.7921	1.7262
R-407c	NO	NO	NO	NO	NO	NO	NO	NO	0.3584	0.6905
R-507c	NO	NO	NO	NO	NO	NO	NO	NO	0.7168	2.0714
	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
R-134a	2.3284	2.2409	2.1597	2.6654	2.5721	3.0337	3.1936	3.0818	3.4696	3.3482
R-404a	2.3284	3.2014	3.7024	5.3308	5.1442	5.5157	6.3872	6.6773	6.9393	7.1747
R-407c	0.6653	0.6403	0.6171	1.1846	1.1432	1.1031	1.0645	1.0273	0.9913	1.4349
R-507c	2.9937	3.2014	3.3938	4.1462	4.2868	4.4126	7.4518	10.2728	19.8265	21.5241

Table 4-124: Cumulative Amount of Freons Charged into Industrial Refrigeration Equipment in the Republic of Moldova within 1997-2016 periods, t/yr

	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
R-134a	0.9503	2.3299	3.6637	4.9517	6.6079	8.2030	10.1289	12.3557	14.5061	16.5775
R-404a	0.4752	0.9350	1.8242	2.6829	3.9250	5.1214	6.6620	8.5177	10.3098	12.0359
R-407c	NO	NO	NO	NO	NO	NO	NO	NO	0.3584	1.0489
R-507c	NO	NO	NO	NO	NO	NO	NO	NO	0.7168	2.7882
	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
R-134a	18.9059	21.1469	23.3066	25.9720	28.5441	31.5778	34.7714	37.8532	41.3228	44.6710
R-404a	14.3643	17.5657	21.2681	26.5988	31.7431	37.2588	43.6460	50.3233	57.2626	64.4373
R-407c	1.7141	2.3544	2.9715	4.1561	5.2992	6.4024	7.4669	8.4942	9.4855	10.9205
R-507c	5.7819	8.9833	12.3771	16.5233	20.8101	25.2227	32.6744	42.9472	62.7737	84.2978

Activity data on the total amount of freons imported in the country for industrial refrigeration equipment service (Table 4-125) were provided through reports submitted by the companies to the Ozone Office and Climate Change Office of the Ministry of Agriculture, Regional Development and Environment.

Table 4-125: AD on Imported Freons for Industrial Refrigeration Equipment Service in the RM within 1997-2016 periods, t/yr

	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
R-134a	0.1612	0.3952	0.6214	0.8398	1.1207	1.3912	1.7179	2.0955	2.4602	2.8115
R-404a	0.0806	0.1586	0.3094	0.4550	0.6657	0.8686	1.1299	1.4446	1.7485	2.0413
R-407c	NO	NO	NO	NO	NO	NO	NO	NO	0.0608	0.1779
R-507c	NO	NO	NO	NO	NO	NO	NO	NO	0.1216	0.4729
	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
R-134a	3.2064	3.5865	3.9528	4.4048	4.8411	5.3556	5.8972	6.4199	7.0084	7.5762
R-404a	2.4362	2.9791	3.6071	4.5112	5.3836	6.3191	7.4024	8.5348	9.7117	10.9286
R-407c	0.2907	0.3993	0.5040	0.7049	0.8988	1.0858	1.2664	1.4406	1.6087	1.8521
R-507c	0.9806	1.5236	2.0992	2.8023	3.5294	4.2778	5.5416	7.2839	10.6464	14.2969

However, this information is aggregated across the country, without specifying the share used for industrial refrigeration equipment service. In order to identify this information, it is admitted that about 16 per cent of the total amount of freons charged into industrial refrigeration is used for the service of this equipment, considering that circa 6 per cent (margin used by default: from 2 to 10 per cent) of the total amount of imported freon is lost through fugitive emissions during refrigerant containers management.

IV) Stationary Air Conditioning

AD used to estimate HFC emissions from consumption of hydrofluorocarbons charged into stationary air conditioning equipment were provided by the Customs Service of the RM. Between 1995 and 2016, the imports of this type of equipment increased by circa 13.8 times (Table 4-126).

Table 4-126: AD on Imported Stationary Air Conditioning Equipment in the Republic of Moldova within 1995-2016 periods, units

	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
Air conditioning equipment	2 245	424	1 247	1 177	794	1 677	1 213	2 205	5 778	5 753	7 879
	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Air conditioning equipment	11 308	38 291	36 172	8 287	17 607	28 055	25 871	32 607	17 177	12 129	30 951

Source: Custom Service, Official Letter No. 28/07-1893 din 23.02.2011, as a response to the request from the Ministry of Environment No. 03-07/175 dated 02.02.2011; Official 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; ; Official 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; Official 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; Official Letter No. 28/07-612 dated 12.01.2018, as a response to the request from the Climate Change Office of the Ministry of Agriculture, Regional Development and Environment No. 601/2017-12-03 dated 14.12.2017.

The share of refrigerants charged into the stationary air conditioning equipment varied from one year to another (Table 4-127).

Table 4-127: The Share of Refrigerants Charged into the Stationary Air Conditioning Equipment Imported in the Republic of Moldova within 1995-2016 periods, %

	Refrigerant	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
Air conditioning equipment	R-410a	0	0	3	5	5	10	10	15	20	25	30
	R-407c	0	0	0	0	0	0	0	0	1	2	3
	R-22	100	100	97	95	85	90	90	85	79	73	67
	Refrigerant	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Air conditioning equipment	R-410a	35	40	45	48	65	67	69	72	75	82	82
	R-407c	4	5	6	7	9	9	9	9	9	9	9
	R-22	61	55	49	45	25	23	20	17	12	5	5

Source: Republican Association of Refrigeration Technicians of the Republic of Moldova.

The information on the share of refrigerants charged into the refrigeration equipment imported in the country (Table 4-106), the share of refrigerants charged into the stationary air conditioning equipment imported in the country over the period from 1995 through 2016 (Table 4-127), the average charge of equipment with refrigerant (Table 4-109) and statistical data on import of stationary air conditioning equipment (Table 4-126), was used to estimate the total amount of freons imported in the country within the stationary air conditioning equipment (Table 4-128) and the cumulative amount of freons used in the stationary air conditioning equipment imported in the Republic of Moldova (Table 4-129).

Table 4-128: AD on Imported Freons Charged into Stationary Air Conditioning Equipment in the RM within 1997-2016 periods, t/yr

	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
R-410a	0.0224	0.0353	0.0238	0.1006	0.0728	0.1985	0.6934	0.8630	1.4182	2.3747
R-407c	NO	NO	NO	NO	NO	NO	0.0347	0.0690	0.1418	0.2714
	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
R-410a	9.1898	9.7664	2.3867	6.8667	11.2781	10.7106	14.0862	7.7297	5.9675	15.2279
R-407c	1.1487	1.3022	0.3481	0.9508	1.5150	1.3970	1.7608	0.9276	0.6550	1.6714

Table 4-129: Cumulative Amount of Freons Charged into Stationary Air Conditioning Equipment Imported in the Republic of Moldova within 1997-2016 periods, t/yr

	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
R-410a	0.0224	0.0578	0.0816	0.1822	0.2550	0.4534	1.1468	2.0097	3.4280	5.8026
R-407c	NO	NO	NO	NO	NO	NO	0.0347	0.1037	0.2455	0.5169
	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
R-410a	14.9925	24.7589	27.1231	33.9545	45.2088	55.8188	69.8323	77.3635	82.6376	97.0025
R-407c	1.6656	2.9678	3.3159	4.2667	5.7816	7.1787	8.9395	9.8670	10.4873	12.0896

Activity data on the total amount of freons imported in the country for stationary air conditioning equipment service (Table 4-130) were provided through reports submitted by the companies to the Ozone Office and Climate Change Office of the Ministry of Agriculture, Regional Development and Environment. However, this information is aggregated across the country, without specifying the share used for stationary air conditioning equipment service. In order to identify this information, it is admitted that about 5 per cent of the total amount of freons charged into industrial refrigeration is used for the service of this equipment, considering that circa 6 per cent (margin used by default: from 2 to 10 per cent) of the total amount of imported freon is lost through fugitive emissions during refrigerant containers management.

Table 4-130: AD on Imported Freons for Stationary Air Conditioning Equipment Service in the RM within 1997-2016 periods, t/yr

	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
R-410a	0.0012	0.0031	0.0043	0.0097	0.0135	0.0240	0.0608	0.1065	0.1817	0.3075
R-407c	NO	NO	NO	NO	NO	NO	0.0018	0.0055	0.0130	0.0274
	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
R-410a	0.7946	1.3122	1.4375	1.7996	2.3961	2.9584	3.7011	4.1003	4.3798	5.1411
R-407c	0.0883	0.1573	0.1757	0.2261	0.3064	0.3805	0.4738	0.5230	0.5558	0.6408

V) Mobile Air-Conditioning Systems

AD used to estimate HFC emissions from consumption of hydrofluorocarbons charged into mobile air-conditioning equipment were provided by the NBS of the RM (Statistical Yearbooks of the RM before 2000, respectively the Bank for Statistical Data after 2000), as well as by the State Enterprise "State Information Resources Centre "Register" (SE "CRIS "Register") (for 1995-2013 time series), respectively by the Public Services Agency of the RM (for 2014-2016 based on the information included in the State Transport Register.

In order to estimate the amount of HFCs used in mobile air-conditioning equipment, it was considered the information on the total number of transportation means registered in the country (Tables 4-131 and 4-132), as well as the share of transportation units charged with air conditioning equipment (Table 4-133).

Table 4-131: Number of Transportation Units Registered in the Republic of Moldova within 1995-2016 periods (standing for the end of the calendar year), units

	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
Passenger car	165 941	173 618	205 973	222 769	232 278	238 380	256 459	268 882	265 841	269 551	292 994
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
Trucks	59 888	57 138	56 924	57 404	52 430	46 351	45 809	46 277	46 905	73 774	81 798
	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Passenger car	319 311	338 944	366 351	386 365	404 290	426 973	456 379	487 418	512 561	529 813	546 781
Buses and Minibuses	21 056	21 095	21 491	21 346	21 395	21 349	21 433	21 344	21 359	21 134	20 968
Trucks	84 087	94 828	115 967	120 174	131 243	141 696	151 830	154 163	160 199	164 533	168 618

Source: Statistical Yearbooks of the RM for 1999 (page 390), 2003 (515-516), 2005 (page 407), 2008 (page 399); Bank for Statistical Data of the Republic of Moldova: <http://statbank.statistica.md/pxweb/pxweb/ro/40%20Statistica%20economica/40%20Statistica%20economica__19%20TRA__TRA020/TRA020100.px/?rxid=9a62a0d7-86c4-45da-b7e4-fecc26003802>

Table 4-132: Railway Transportation Vehicles Existing in the RM within 1995-2016 (standing for the end of the calendar year), units

	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
Diesel locomotives	163	163	162	162	162	162	162	160	159	156	156
Locomotives for maneuvering	114	100	75	72	50	42	44	48	54	50	56
Diesel trains	29	28	26	26	24	22	22	22	22	18	20
Passengers wagons	463	463	462	462	460	460	440	460	452	452	440
	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Diesel locomotives	154	154	152	152	152	150	139	138	138	138	138
Locomotives for maneuvering	56	56	53	39	39	67	67	67	67	67	67
Diesel trains	20	20	18	15	15	21	21	21	21	21	21
Passengers wagons	436	416	398	423	411	399	399	388	381	381	346

Source: Statistical Yearbooks of the RM for 1999 (page 390), 2003 (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/?rxid=9a62a0d7-86c4-45da-b7e4-fecc26003802>

For passenger cars it was considered the number of units produced after 1993 (in particular Euro-1, Euro-2, Euro-3, Euro-4 and Euro-5), while for trains - it was considered that these transportation units are charged with air conditioning equipment in proportion of 100 per cent.

Table 4-133: Transportation Units Charged with Air Conditioning Equipment in the RM between 1995 and 2016 (by the end of the calendar year), % of the total

	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
Passenger car	0.04	1.2	2.6	3.6	4.8	6.0	7.2	9.7	13.1	16.7	20.3
Buses and Minibuses	0.02	0.6	2.0	3.8	4.4	5.3	5.3	6.8	10.3	9.9	11.1
Trucks	0.01	0.6	2.1	3.5	5.2	8.1	11.8	17.9	18.6	16.2	19.8
	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Passenger car	22.2	24.1	28.8	29.3	36.3	34.7	36.8	38.0	39.1	40.3	41.4
Buses and Minibuses	16.8	17.7	18.0	23.5	25.2	33.6	34.2	34.8	35.4	36.1	36.7
Trucks	21.4	24.4	29.4	33.2	36.2	34.1	34.5	36.1	36.2	36.7	37.1

Table 4-134: Estimated Number of Transportation Units Charged with Air Conditioning Equipment in the Republic of Moldova between 1995 and 2016 (by the end of the year), units

	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
Passenger car	72	2 086	5 282	8 094	11 076	14 187	18 580	26 176	34 887	44 992	59 526
Buses and Minibuses	2	61	220	485	601	682	782	1 076	1 612	1 961	2 203
Trucks	6	328	1 170	1 993	2 745	3 740	5 423	8 273	8 744	11 935	16 177
	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Passenger car	70 984	81 823	105 540	113 367	146 638	148 365	168 062	184 975	200 282	213 381	226 367
Buses and Minibuses	3 530	3 741	3 875	5 019	5 390	7 173	7 330	7 428	7 567	7 637	7 705
Trucks	18 006	23 156	34 055	39 957	47 482	48 340	52 383	55 650	57 962	60 360	62 584

Based on the information on the average freon charge (HFC-134a in proportion of 100 per cent) of air conditioning equipment in mobile sources (Table 4-109), information on total number of transportation units registered in the Republic of Moldova equipped with air conditioning systems (Table 4-134), it was estimated the total amount of HFC-134a charged into the mobile air-conditioning equipment in the Republic of Moldova (Table 4-135). In order to estimate the total amount, 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 the mobile air-conditioning systems were partially functional: between 2003 and 2016, in proportion of 75 per cent for passenger cars and 60 per cent for trucks.

Table 4-135: AD on Cumulative Amount of HFC-134a Charged into Mobile Air-Conditioning Systems Registered in the Republic of Moldova within 1995-2016 periods, t

	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
HFC-134a	1.8564	2.1602	2.7318	3.3760	3.8873	4.4815	5.3585	7.0587	8.4931	10.5144	13.2340
	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
HFC-134a	15.7086	18.1102	23.1516	25.9356	31.6138	33.0463	36.2806	38.9898	62.0265	130.3255	136.1979

Activity data on the total amount of freons imported in the country for mobile air-conditioning equipment service (Table 4-136) were provided through reports submitted by the companies to the Ozone Office and Climate Change Office of the Ministry of Agriculture, Regional Development and Environment. However, this information is aggregated across the country, without specifying the share used for mobile air-conditioning equipment service. In order to identify this information, it is admitted that about 15 per cent of the total amount of freons charged into mobile air-conditioning equipment is used for the service of this equipment, considering that circa 6 per cent (margin used by default: from 2 to 10 per cent) of the total amount of imported freon is lost through fugitive emissions during refrigerant containers management.

Table 4-136: AD on Imported Freons for Mobile Air Conditioning Systems Service in the RM within 1995-2016 periods, t/yr

	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
HFC-134a	0.2785	0.3240	0.4098	0.5064	0.5831	0.6722	0.8038	1.0588	1.2740	1.5772	1.9851
	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
HFC-134a	2.3563	2.7165	3.4727	3.8903	4.7421	4.9569	5.4421	5.8485	9.3040	19.5488	20.4297

VI) Transport refrigeration

Equipment used in transportation refrigeration include: refrigerated trucks, containers, reefers and wagons. The respective equipment and systems use freon R-404a (average charge 7 kg/unit), specific to refrigerated trucks with a capacity of 20 tones and more, respectively with capacity less than 5 tones. AD used to estimate HFC emissions from consumption of hydrofluorocarbons charged into transport refrigeration systems were provided by the State Enterprise "State Information Resources Centre "Register" (SE "CRIS "Register") based on the information included in the State Transport Register. In order to estimate the amount of R-404a used in transport refrigeration systems, it was considered the information on the total number of transportation means used for transport refrigeration of fresh and frozen food (Table 4-137).

According to the information received from the International Association of Road Haulers of Moldova (AITA), about 60-65 enterprises in the country own refrigerators with a capacity of 20 tones and more (the cooling capacity represents circa 10 kw per unit), which are used predominantly for international freight transport. Refrigerators with a capacity up to 5 tones (the cooling capacity represents circa 5 kw per unit) are used predominantly on the domestic market of transport refrigerator 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 about 10-50 units each.

Table 4-137: Number of Refrigerators in the Republic of Moldova within 1995-2016 periods (by the end of calendar year), units

	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
Refrigerators ≥ 20 t	1 060	1 012	1 008	1 016	928	821	811	819	830	1 306	1 448
Refrigerators 5-20 t	178	170	169	171	156	138	136	138	139	219	243
Refrigerators < 5 t	157	149	149	150	137	121	120	121	123	193	214
Total	**1 395**	**1 331**	**1 326**	**1 337**	**1 221**	**1 080**	**1 067**	**1 078**	**1 092**	**1 718**	**1 905**
	2006	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**
Refrigerators ≥ 20 t	1 489	1 679	2 053	2 127	2 323	2 508	2 688	2 729	2 836	2 844	2 798
Refrigerators 5-20 t	250	282	345	357	390	421	451	458	476	480	471
Refrigerators < 5 t	220	248	303	314	343	371	397	403	419	399	411
Total	**1 958**	**2 209**	**2 701**	**2 799**	**3 057**	**3 300**	**3 536**	**3 590**	**3 731**	**3 723**	**3 680**

Based on the information regarding the average charge of freons (R-404a) into transport refrigeration equipment (Table 4-109) and the total number of transportation units used for transport refrigeration (Table 4-137), it was estimated the cumulative amount of R-404a charged into transport refrigeration in the Republic of Moldova (Table 4-138).

Table 4-138: AD on Cumulative Amount of R-404a Charged into Transport Refrigeration in the Republic of Moldova within 1995-2016 periods, t

	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
R-404a	9.7634	9.3151	9.2802	9.3585	8.5476	7.5565	7.4682	7.5445	7.6469	12.0273	13.3354
	2006	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**
R-404a	13.7086	15.4597	18.9059	19.5918	21.3963	23.1005	24.7526	25.1330	26.1170	26.0610	25.7600

Activity data on the total amount of freons imported in the country for transport refrigeration equipment service (Tab. 4-139) were provided through reports submitted by the companies to the Ozone Office and Climate Change Office of the Ministry of Agriculture, Regional Development and Environment. However, this information is aggregated across the country, without specifying the share used for transport refrigeration equipment service. In order to identify this information, it is admitted that about 15 per cent of the total amount of freons charged into transport refrigeration equipment is used for the service of this equipment, considering that circa 6 per cent (margin used by default: from 2 to 10 per cent) of the total amount of imported freon is lost through fugitive emissions during refrigerant containers management.

Table 4-139: AD on Imported Freons for Transport Refrigeration Service in the RM within 1995-2016 periods, t/yr

	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
R-404a	1.4645	1.3973	1.3920	1.4038	1.2821	1.1335	1.1202	1.1317	1.1470	1.8041	2.0003
	2006	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**
R-404a	2.0563	2.3189	2.8359	2.9388	3.2095	3.4651	3.7129	3.7699	3.9176	3.9092	3.8640

VII) Refrigeration and Air Conditioning – total

Based on the above information, regarding the estimates freon import for refrigeration and air conditioning equipment (domestic, commercial, industrial, transportation refrigeration, respectively stationary and mobile air-conditioning equipment), it was calculated the amount of freons imported in the RM within 1995-2016 periods (Table 4-140).

Table 4-140: Imported Freons for Refrigeration and Air Conditioning in the Republic of Moldova within 1995-2016 periods, t/yr

	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
R-134a	0.2952	0.3435	0.6306	1.0992	1.4436	1.9021	2.4994	3.2581	4.1889	5.2817	6.4625
R-404a	1.5524	1.4811	1.5910	1.8132	1.8716	1.9079	2.1629	2.4493	2.9118	4.1519	4.9559
R-407c	NO	NO	NO	NO	NO	NO	NO	NO	0.0387	0.0728	0.1848
R-408a	NO	NO	0.0279	0.1597	0.1961	0.2443	0.3026	0.3595	0.4148	0.4452	0.4452
R-410a	NO	NO	0.0012	0.0031	0.0043	0.0097	0.0135	0.0240	0.0608	0.1065	0.1817
R-507c	NO	NO	NO	NO	NO	NO	NO	NO	0.0001	0.0002	0.1947

	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
R-134a	7.6376	9.0070	10.5611	11.6034	13.0791	13.9407	14.9811	15.9852	20.0892	31.6513	33.2032
R-404a	5.7080	7.0384	8.5277	9.5141	10.8752	12.3624	13.7552	15.1833	16.6851	19.8449	23.1977
R-407c	0.3957	0.6781	0.9122	1.0753	1.3635	1.6790	1.9663	2.2775	2.5285	2.8861	3.3910
R-408a	0.4452	0.4452	0.4452	0.4174	0.2856	0.2491	0.2009	0.1427	0.0857	0.0304	0.0000
R-410a	0.3075	0.7946	1.3122	1.4375	1.7996	2.3961	2.9584	3.7011	4.1003	4.3798	5.1411
R-507c	0.6258	1.3520	2.0085	2.7049	3.5565	4.4922	5.3731	6.8249	8.7067	13.0384	17.7264

Between 2009 and 2016, Climate Change Office applied periodic questionnaires to the economic agents with a license for import, export, re-export, transit and circulation of alternative substances to chlorofluorocarbons (CFC), ozone layer depleting substances (ODS) and ODS equipment. The number of these companies was relatively low and varies insignificantly during the period under review.

Climate Change Office of the Ministry of Agriculture, Regional Development and Environment has information on freons imported in the country within 2003-2016 periods, but due to the low level of responses to these questionnaires from economic agents (Coral Ltd reported information for 2004-2005, „Frigoinds" Ltd – for 2003-2016, „Ecolux" Ltd – for 2003-2016, „Frio-Dins" Ltd – for 2010-2016, „York Regrigerent" Ltd – for 2011-2016, CS Dina-Cociug Ltd – for 2013-2016), this information is considered incomplete, especially with reference to 2003-2010 time series. For the last 6 years (2011-2016), available information is considered more complete, including the fact that starting with 01.01.2013, the former Ministry of Environment (since July 2017 – Ministry of Agriculture, Regional Development and Environment) has established the procedure for granting the import, export and re-export authorizations for chemical substances depleting ozone layer as well as for the equipment and products charged with such substances. The respective companies report annually to the Ozone Office, 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, are presented AD on actual freons imported for refrigeration and air conditioning service in the country within 2011-2016 periods, respectively the estimated AD calculated following the assessment methodology available in the 2006 IPCC Guidelines. As can be seen, the differences recorded are rather low, in particular if we compare the total amount imported between 2011 and 2016 (Table 4-141).

Table 4-141: AD on Imported Freons for Refrigeration and Air Conditioning Service in the RM within 2011-2016 periods, t/yr

	Annual imports reported by the companies to the Ozone Office							Estimated amount for equipment service calculated according to the 2006 IPCC Guidelines methodology						
	2011	2012	2013	2014	2015	2016	Total	2011	2012	2013	2014	2015	2016	Total
R-134a	12.0	13.1	16.4	23.4	36.3	32.0	**133.3**	13.9	15.0	16.0	20.1	31.7	33.2	**129.9**
R-404a	15.6	5.8	12.6	21.3	29.6	18.2	**103.1**	12.4	13.8	15.2	16.7	19.8	23.2	**101.0**
R-407c	2.0	2.3	1.5	2.1	3.0	3.7	**14.6**	1.7	2.0	2.3	2.5	2.9	3.4	**14.7**
R-410a	1.1	1.1	5.7	3.4	4.5	7.0	**22.9**	2.4	3.0	3.7	4.1	4.4	5.1	**22.7**
R-507a	4.0	2.7	7.7	6.7	18.6	16.4	**56.0**	4.5	5.4	6.8	8.7	13.0	17.7	**56.2**

2F2. Foam Blowing Agents

HFC emissions from foam blowing consumption (in particular closed cell foams) used in insulation, cushioning and packaging with blowing agents such as HFC-245fa, HFC-365mfc, HFC-134a and HFC-152a, were estimated using a Tier 2 approach. The IPCC 2006 Guidelines suggests that HFC emissions from closed cell foams should be calculated separately from open-celled foams.

For open-celled foams, HFCs used as blowing agents are likely to occur during the manufacturing process and shortly thereafter. Since no open-cell foams are produced in the RM, respectively no emissions are recorded from this category.

Emissions from closed-cell foam occur at three distinct points:

1) First year losses from foam manufacture and installation, these emissions occur where the product is manufactured;

2) Annual losses (in situ losses from foam use); closed-cell 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 from the 2006 IPCC Guidelines (Volume 3, Chapter 7.4, page 7.33).

$$Emissions_{t} = M_{t} \bullet EF_{FYL} + Bank \bullet EF_{AL} + DL_{t} - RD_{t}$$

Where:

Emissions $_t$ – emissions from closed-cell foam in year *t*, tones;

M $_t$ – total HFC used in manufacturing new closed-cell foam in *t*, tones;

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*, tones;

EF $_{AL}$ – annual loss emission factor, fraction (%);

DL $_t$ – decommissioning losses in year *t* = remaining losses of chemical at the end of service life that occur when the product/equipment is scrapped, calculated from the amount of remaining chemical and the end-of-life loss factor which depends on the type of end-of-life treatment adopted, tones;

RD $_t$ – HFC emissions prevented by recovery and destruction of foams and their blowing agents in year *t*, tones;

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 should be 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 are not available, default emission factors can be used (Table 4-142).

Table 4-142: Default EFs for 2F2 'Foam Blowing Agents'

Emission Factor	Default Values
Product Lifetime	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 is recorded since 2005. AD on the production of foam blowing are available in the Statistical Reports PRODMOLD-A „Total production, as a natural expression, in the Republic of Moldova, by product type" (Table 4-143).

Table 4-143: Produced Foam Blowing Products in the RM within 2005-2016 periods, kt

	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Polystyrene in primary forms	0.2102	0.3471	0.3428	0.1605	0.1538	0.0992	0.0932	0.1425	0.0748	0.0601	0.0382	0.0164
Cellular products of polystyrene	0.2485	0.7064	0.8043	0.5590	1.5819	1.8756	2.1692	2.0126	2.1187	2.4715	2.8058	2.4736
Polyurethane in primary forms	0.4901	0.3787	0.1472	0.5350	0.8896	0.8318	0.6823	0.3711	0.2805	0.1898	0.0992	0.0086
Cellular products of polyurethane	NO	NO	NO	NO	NO	NO	NO	0.0016	0.2064	0.3429	0.4793	0.6158

Source: Statistical Reports PRODMOLD-A "Total production, as a natural expression, in the Republic of Moldova, by product type, for 2005-2016".

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, while the polyurethane in primary forms are based on pentane (C,I,N)

AD on imported foam blowing products in the country are provided by the Customs Service of the Republic of Moldova (Table 4-144).

Table 4-144: Imported Foam Blowing Products in the Republic of Moldova within 1995-2016, t

	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
Polystyrene in primary forms, t (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
Cellular products of polystyrene, t (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
Polyurethane in primary forms, t (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
Cellular products of polyurethane, t (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
Total foam blowing products, t	**0.9237**	**0.5173**	**0.3848**	**0.3320**	**0.3411**	**0.5968**	**0.6151**	**1.1882**	**1.8867**	**2.1428**	**3.4687**
	2006	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**
Polystyrene in primary forms, t (product code: 3903 11)	2.4757	2.7488	3.0178	2.5255	3.0971	3.1368	3.2978	3.3007	3.6391	3.9539	3.6553
Cellular products of polystyrene, t (product code: 3921 11)	0.6123	0.5979	0.7121	0.6277	0.6388	0.5445	0.6879	0.7153	0.8484	1.0409	1.2934
Polyurethane in primary forms, t (product code: 3909 50)	0.3061	0.5404	0.7696	0.5989	0.6841	0.7048	0.3633	0.1630	0.1642	1.0715	0.1328
Cellular products of polyurethane, t (product code: 3921 13)	1.0061	1.5276	1.2466	0.6455	0.8602	0.8332	0.8468	0.9430	0.8133	0.9074	0.8186
Total foam blowing products, t	**4.4001**	**5.4147**	**5.7461**	**4.3975**	**5.2802**	**5.2193**	**5.1958**	**5.1220**	**5.4650**	**6.9737**	**5.9002**

Source: Custom Service, Official Letter No. 28/07-1893 din 23.02.2011, as a response to the request from the Ministry of Environment No. 03-07/175 dated 02.02.2011; Official 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; ; Official 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; Official 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; Official Letter No. 28/07-612 dated 12.01.2018, as a response to the request from the Climate Change Office of the Ministry of Agriculture, Regional Development and Environment No. 601/2017-12-03 dated 14.12.2017.

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 decided to determine it considering the expert opinions (Table 4-145 and Table 4-146), taking into consideration, the European and international experience regarding HFC emissions inventory process within the respective category, as well as, the last years trend among the producers of foam blowing products to decrease the use of HFC 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[55],[56].

Table 4-145: Share of Blowing Agents Charged into Polyurethane Products Imported in the RM within 1995-2016, %

	Blowing Agent	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
Polyurethane in primary forms	HCFC-22	50	45	40	35	30	25	20	15	10	5	0
	HCFC-141b	45	40	35	30	25	25	20	15	10	5	0
	HFC-134a	5	15	25	35	45	50	55	55	55	55	55
	HFC-365mfc	0	0	0	0	0	0	0	0	0	5	5
	HFC-245fa	0	0	0	0	0	0	0	0	0	5	5
	Pentane (C,I,N)	0	0	0	0	0	0	5	15	20	25	35
	Blowing Agent	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**
Polyurethane in primary forms	HCFC-22	0	0	0	0	0	0	0	0	0	0	0
	HCFC-141b	0	0	0	0	0	0	0	0	0	0	0
	HFC-134a	40	35	30	25	20	15	5	5	5	5	5
	HFC-365mfc	10	10	10	10	10	10	15	15	15	15	15
	HFC-245fa	10	10	10	10	10	10	15	15	15	15	15
	Pentane (C,I,N)	40	45	50	55	60	65	65	65	65	65	65

The volume of blowing agents in foam products imported in 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 per cent of the total[57], HFC-365mfc – 9 per cent, HFC-254fa – 10 per cent, and Pentane (C,I,N) – 7.5 per cent[25]; as for the polystyrene products HFC-134a has a volume of circa 13 per cent of the total, HFC-152a – 8 per cent, HCFC-22 and HFCF-142b – 12 per cent, and CO_2 + ethanol – 6 per cent of the total[58].

[55] 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. P.178.

[56] 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>.

[57] 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

[58] 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. P.178.

Table 4-146: Share of Blowing Agents Charged into Polystyrene Products Imported in the RM within 1995-2016, %

	Blowing Agent	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
Polystyrene in primary forms	HCFC-22	50	45	40	35	30	25	20	15	10	5	0
	HCFC-142b	45	40	35	30	25	20	15	10	5	5	0
	HFC-134a	5	15	25	30	35	40	45	45	45	40	40
	HFC-152a	0	0	0	5	10	15	20	25	30	35	40
	CO_2 / ethanol	0	0	0	0	0	0	0	5	10	15	20
	Blowing Agent	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**
Polystyrene in primary forms	HCFC-22	0	0	0	0	0	0	0	0	0	0	0
	HCFC-142b	0	0	0	0	0	0	0	0	0	0	0
	HFC-134a	35	30	25	20	15	10	10	5	5	5	5
	HFC-152a	40	35	35	35	35	35	35	35	35	30	30
	CO_2 / ethanol	25	35	40	45	50	55	55	60	60	65	65

Considering the AD provided in Table 4-144 as well as the share of different blowing agents used in foam products imported in the RM between 1995 and 2016 (Tables 4-145 and 4-146), respectively considering the volume of blowing agents in foams, it was estimated the share of blowing agents contained in polyurethane products (Table 4-147) and polystyrene products (Table 4-148) imported in the country within 1995-2016 periods.

Table 4-147: AD on Import of Blowing Agents Charged into the Polyurethane Products in the RM within 1995-2016 periods, kt

	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
HCFC-22	0.0095	0.0070	0.0039	0.0022	0.0025	0.0025	0.0024	0.0036	0.0032	0.0020	NO
HCFC-141b	0.0086	0.0062	0.0034	0.0019	0.0021	0.0025	0.0024	0.0036	0.0032	0.0020	NO
HFC-134a	0.0010	0.0023	0.0024	0.0022	0.0037	0.0050	0.0067	0.0130	0.0177	0.0224	0.0311
HFC-365mfc	NO	NO	NO	NO	NO	NO	NO	NO	NO	0.0031	0.0042
HFC-245fa	NO	NO	NO	NO	NO	NO	NO	NO	NO	0.0034	0.0047
Pentane (C,I,N)	NO	NO	NO	NO	NO	NO	0.0008	0.0044	0.0081	0.0127	0.0247
Total	**0.0190**	**0.0155**	**0.0097**	**0.0063**	**0.0083**	**0.0101**	**0.0123**	**0.0246**	**0.0322**	**0.0457**	**0.0647**
	2006	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**
HFC-134a	0.0283	0.0391	0.0327	0.0168	0.0167	0.0125	0.0033	0.0030	0.0026	0.0053	0.0026
HFC-365mfc	0.0106	0.0168	0.0163	0.0101	0.0125	0.0125	0.0147	0.0134	0.0119	0.0240	0.0116
HFC-245fa	0.0118	0.0186	0.0181	0.0112	0.0139	0.0138	0.0163	0.0149	0.0132	0.0267	0.0128
Pentane (C,I,N)	0.0354	0.0628	0.0680	0.0462	0.0625	0.0675	0.0531	0.0485	0.0429	0.0868	0.0417
Total	**0.0862**	**0.1373**	**0.1352**	**0.0843**	**0.1056**	**0.1062**	**0.0874**	**0.0799**	**0.0706**	**0.1429**	**0.0687**

Table 4-148: AD on Import of Blowing Agents Charged into the Polystyrene Products in the RM within 1995-2016 periods, kt

	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
HCFC-22	0.0309	0.0112	0.0089	0.0082	0.0061	0.0111	0.0084	0.0121	0.0139	0.0075	NO
HCFC-142b	0.0278	0.0100	0.0078	0.0070	0.0051	0.0089	0.0063	0.0081	0.0070	0.0075	NO
HFC-134a	0.0033	0.0041	0.0060	0.0076	0.0077	0.0192	0.0206	0.0395	0.0679	0.0650	0.1134
HFC-152a	NO	NO	NO	0.0008	0.0013	0.0044	0.0056	0.0135	0.0279	0.0350	0.0698
CO_2+ethanol	NO	NO	NO	NO	NO	NO	NO	0.0020	0.0070	0.0112	0.0262
Total	**0.0620**	**0.0253**	**0.0227**	**0.0235**	**0.0202**	**0.0436**	**0.0409**	**0.0752**	**0.1237**	**0.1262**	**0.2093**
	2006	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**
HFC-134a	0.1265	0.1175	0.1091	0.0738	0.0656	0.0431	0.0466	0.0235	0.0263	0.0292	0.0290
HFC-152a	0.0889	0.0843	0.0940	0.0795	0.0941	0.0928	0.1004	0.1012	0.1131	0.1079	0.1069
CO_2+ethanol	0.0417	0.0633	0.0806	0.0766	0.1009	0.1093	0.1184	0.1301	0.1454	0.1753	0.1737
Total	**0.2571**	**0.2651**	**0.2837**	**0.2299**	**0.2606**	**0.2452**	**0.2654**	**0.2548**	**0.2847**	**0.3124**	**0.3095**

Activity data on the cumulative amount of blowing agents charged into the foam blowing products imported between 1995 and 2016 are presented below (Tables 4-149 and 4-150).

Table 4-149: AD on the Cumulative Amount (Bank) of Blowing Agents Charged into Polyurethane Products Imported in the RM within 1995-2016 periods, kt

	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
HCFC-22	0.0095	0.0165	0.0203	0.0225	0.0250	0.0275	0.0300	0.0335	0.0367	0.0388	0.0388
HCFC-141b	0.0086	0.0147	0.0181	0.0200	0.0221	0.0246	0.0270	0.0306	0.0338	0.0358	0.0358
HFC-134a	0.0010	0.0033	0.0057	0.0079	0.0116	0.0167	0.0233	0.0363	0.0541	0.0765	0.1076
HFC-365mfc	NO	NO	NO	NO	NO	NO	NO	NO	NO	0.0031	0.0073
HFC-245fa	NO	NO	NO	NO	NO	NO	NO	NO	NO	0.0034	0.0081
Pentane (C,I,N)	NO	NO	NO	NO	NO	NO	0.0008	0.0052	0.0132	0.0260	0.0507
Total	**0.0190**	**0.0345**	**0.0441**	**0.0504**	**0.0587**	**0.0688**	**0.0811**	**0.1056**	**0.1378**	**0.1835**	**0.2483**

	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
HCFC-22	0.0388	0.0388	0.0388	0.0388	0.0388	0.0388	0.0388	0.0388	0.0388	0.0388	0.0388
HCFC-141b	0.0358	0.0358	0.0358	0.0358	0.0358	0.0358	0.0358	0.0358	0.0358	0.0358	0.0358
HFC-134a	0.1359	0.1750	0.2076	0.2244	0.2411	0.2536	0.2568	0.2598	0.2625	0.2678	0.2704
HFC-365mfc	0.0179	0.0347	0.0510	0.0611	0.0736	0.0861	0.1008	0.1142	0.1261	0.1501	0.1617
HFC-245fa	0.0199	0.0385	0.0567	0.0679	0.0818	0.0956	0.1119	0.1269	0.1401	0.1668	0.1796
Pentane (C,I,N)	0.0861	0.1490	0.2170	0.2632	0.3257	0.3932	0.4463	0.4948	0.5377	0.6246	0.6663
Total	**0.3345**	**0.4717**	**0.6069**	**0.6912**	**0.7968**	**0.9031**	**0.9905**	**1.0704**	**1.1410**	**1.2839**	**1.3526**

Table 4-150: AD on the Cumulative Amount (Bank) of Blowing Agents Charged into Polystyrene Products Imported in the RM within 1995-2016 periods, kt

	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
HCFC-22	0.0309	0.0421	0.0510	0.0591	0.0652	0.0763	0.0847	0.0969	0.1108	0.1183	0.1183
HCFC-142b	0.0278	0.0377	0.0455	0.0525	0.0576	0.0665	0.0728	0.0809	0.0878	0.0953	0.0953
HFC-134a	0.0033	0.0074	0.0134	0.0210	0.0287	0.0479	0.0684	0.1079	0.1758	0.2408	0.3542
HFC-152a	0.0000	0.0000	0.0000	0.0008	0.0021	0.0066	0.0122	0.0257	0.0535	0.0885	0.1583
CO_2+ethanol	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0020	0.0090	0.0202	0.0464
Total	**0.0620**	**0.0872**	**0.1099**	**0.1335**	**0.1536**	**0.1972**	**0.2381**	**0.3133**	**0.4370**	**0.5632**	**0.7725**
	2006	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**
HCFC-22	0.1183	0.1183	0.1183	0.1183	0.1183	0.1183	0.1183	0.1183	0.1183	0.1183	0.1183
HCFC-142b	0.0953	0.0953	0.0953	0.0953	0.0953	0.0953	0.0953	0.0953	0.0953	0.0953	0.0953
HFC-134a	0.4806	0.5981	0.7072	0.7810	0.8465	0.8896	0.9362	0.9597	0.9860	1.0152	1.0441
HFC-152a	0.2472	0.3316	0.4255	0.5050	0.5991	0.6919	0.7924	0.8936	1.0066	1.1145	1.2214
CO_2+ethanol	0.0881	0.1513	0.2319	0.3085	0.4094	0.5187	0.6371	0.7672	0.9126	1.0879	1.2616
Total	**1.0295**	**1.2946**	**1.5783**	**1.8081**	**2.0687**	**2.3139**	**2.5793**	**2.8341**	**3.1189**	**3.4313**	**3.7408**

2F4. Aerosols (Metered Dose Aerosols)

HFC emissions from consumption of aerosol (in particular – 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 per cent of the chemical is emitted into the atmosphere. The respective emissions occur within 1-2 years after sales and should be estimated using the Equation 7.6 from 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*, tones;

S_t – quantity of HFC and PFC contained in aerosol products sold in year *t*, tones;

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*, tones.

The activity data on the amount of medical substances imported in the Republic of Moldova (metered dose inhalers used in asthma and chronicle pulmonary diseases treatment, including tuberculosis) were provided by the former Ministry of Health for 2003-2016 periods (Table 4-151).

Table 4-151: Import of Metered Dose Inhalers Using HFC-134a as Propellant in the RM within 2003-2016 periods, flacons

	2003	2004	2005	2006	2007	2008	2009
Salbutamol sulphate - Salbutamol pressurized inhalation suspension, 100 mcg/dose-200 doses	-	-	-	87 200	60 640	68 960	109 500
Salbutamol sulphate - Ventolin Inhaler 100 mcg/dose-200 doses	-	4 500	7 923	12 206	5 448	12 800	13 236
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
Ipratropium bromide / Fenoterol hydrobromide - Berodual N pressurized inhalation solution 200 doses 10 ml.	-	-	-	200	500	586	1 300
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
Fluticasone propionate - Flixotide 125 Evohaler 125 µg /dose 60 doses	-	-	-	-	-	612	800
Fluticasone propionate - Flixotide 125 Evohaler 125 µg /dose 120 doses	-	282	3 170	2 650	1 370	-	1 933
Fluticasone propionate - Flixotide 250 Evohaler 250 µg /dose 60 doses	-	250	950	1 330	2 170	-	2 990
Fluticasone propionate - Flixotide 250 Evohaler 250 µg /dose 120 doses	-	-	-	-	-	850	480
Salmeterol xinafoate / Fluticasone propionate - Seretide Inhaler 25 µg + 50 µg 120 doses	-	-	-	-	-	250	299
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

	2003	2004	2005	2006	2007	2008	2009
Fluticasone propionate - Flixotide 250 Evohaler 250 µg /dose 60 doses	-	-	-	-	-	200	3 040
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
Salmeterol xinafoate / Fluticasone propionate - SeretideTM/Diskus TM Inhaler - sol 50 mcg + 100 mcg/dose, 60 doses NI	-	-	-	-	-	-	-
Salmeterol xinafoate / Fluticasone propionate - SeretideTM/Diskus TM Inhaler - sol. 50 mcg + 250 mcg/dose, 60 doses NI	-	-	-	-	-	-	-
Salmeterol xinafoate / Fluticasone propionate - SeretideTM/Diskus TM Inhaler - sol. 50 mcg + 500 mcg/dose, 60 doses NI	-	-	-	-	-	-	-
Totals Metered Dose Inhalers using HFC-134a as propellant	**3 014**	**12 080**	**17 993**	**108 800**	**75 651**	**90 579**	**143 943**
	2010	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**
Salbutamol sulphate - Salbutamol pressurized inhalation suspension, 100 mcg/dose-200 doses	100 184	118 779	109 144	85 200	90 840	-	-
Salbutamol sulphate - Ventolin Inhaler 100 mcg/dose-200 doses	19 450	14 500	10 885	14 741	33 400	132 852	142 000
Fenoterol hydrobromide - Berotec N pressurized inhalation solution 100 mcg/dose-200 doses	4 164	7 984	11 348	18 576	17 926	-	-
Ipratropium bromide / Fenoterol hydrobromide - Berodual N pressurized inhalation solution 200 doses 10 ml.	1 726	4 248	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
Fluticasone propionate - Flixotide 50 Evohaler 50 µg /dose 120 doses	1 150	1 896	3 116	2 400	2 930	3 230	7 973
Fluticasone propionate - Flixotide 125 Evohaler 125 µg /dose 60 doses	250	-	300	496	820	930	10 598
Fluticasone propionate - Flixotide 125 Evohaler 125 µg /dose 120 doses	1 400	1 650	600	3 108	4 739	5 715	7 375
Fluticasone propionate - Flixotide 250 Evohaler 250 µg /dose 60 doses	620	-	300	200	400	-	-
Fluticasone propionate - Flixotide 250 Evohaler 250 µg /dose 120 doses	2 750	3 018	-	-	-	-	-
Salmeterol xinafoate / Fluticasone propionate - Seretide Inhaler 25 µg + 50 µg 120 doses	530	-	-	-	-	-	-
Salmeterol xinafoate / Fluticasone propionate - Seretide Inhaler 25 µg + 125 µg 120 doses	-	-	-	50	50	-	-
Salmeterol xinafoate / Fluticasone propionate - Seretide Inhaler 25 µg + 250 µg 120 doses	-	-	-	-	100	-	-
Salmeterol xinafoate - Serevente Inhaler 25 µg 120 doses	2 100	-	-	-	-	-	-
Fluticasone propionate - Flixotide 250 Evohaler 250 µg /dose 60 doses	620	-	-	-	-	-	-
Fluticasone propionate - Flixotide 50 Evohaler 50 µg /dose 120 doses	-	-	-	-	-	-	-
Fluticasone propionate - Flixotide 125 Evohaler 125 µg /dose 120 doses	-	-	-	-	-	-	-
Fluticasone propionate - Flixotide 250 Evohaler 250 µg /dose 60 doses	620	-	-	-	-	-	-
Salmeterol xinafoate / Fluticasone propionate - SeretideTM/Diskus TM Inhaler - sol 50 mcg + 100 mcg/dose, 60 doses NI	-	-	-	-	-	4 207	6 049
Salmeterol xinafoate / Fluticasone propionate - SeretideTM/Diskus TM Inhaler - sol. 50 mcg + 250 mcg/dose, 60 doses NI	-	-	-	-	-	7 475	18 870
Salmeterol xinafoate / Fluticasone propionate - SeretideTM/Diskus TM Inhaler - sol. 50 mcg + 500 mcg/dose, 60 doses NI	-	-	-	-	-	2 710	13 480
Totals Metered Dose Inhalers using HFC-134a as propellant	**135 564**	**152 075**	**140 789**	**131 339**	**156 917**	**179 067**	**220 909**

Source: Ministry of Health, Official Letter No. 019/550 from March, 1, 2011, as a response to the request from the Ministry of Environment No. 03-07/175 dated 02.02.2011, regarding the period 2003-2010; Official 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, regarding the period 2005-2010; Official 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, regarding the period 2011-2012; Official 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, regarding the period 2013-2014; Official 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, regarding 2015; Agency for Medicines and Medical Devices: Official Letter No. A07.PS01.Rg02-359, dated 26.01.2018, as a response to the request from the Climate Change Office of the Ministry of Agriculture, Regional Development and Environment No. 612/2018-01-02 dated 10.01.2018, regarding 2016.

To 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, Russian Federation, India and China while recently they are imported from EU member states such as Spain, France, Germany, Poland and Great Britain. Based on activity data presented above, the amount of HFC-134a contained in metered dose aerosols was estimated (Table 4-152).

Table 4-152: Activity Data on HFC-134a Incorporated in Metered Dose Aerosols Imported in the Republic of Moldova within 2003-2016 periods, kg

	2003	2004	2005	2006	2007	2008	2009
HFC-134a	0.0603	0.2319	0.3164	2.1384	1.4941	1.7696	2.8184
	2010	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**
HFC-134a	2.7135	3.1643	2.9168	2.7674	3.2339	4.1284	4.4310

4.6.3. Uncertainty Assessment and Time-Series Consistency

2F1. 'Refrigeration and Air Conditioning'

Uncertainties associated with emission factors used to estimate HFC emissions covered by the source category 2F1 'Refrigeration and Air Conditioning' reach up to ±50 per cent. Uncertainties associated with activity data on the use of refrigeration and air conditioning equipment are considered moderate (±20 per cent). Thus, combined uncertainties for this source category represent circa ±53.85 per cent (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 Guidance.

2F2. 'Foam Blowing Agents'

Uncertainties associated with emission factors used to estimate CO_2 emissions covered by the source category 2F2 'Foam Blowing Agents' were calculated at circa 30 per cent (2006 IPCC Guidelines). Uncertainties associated with activity data on the use of foams in the RM are considered relatively large (±30 per cent), including due to the fact that current statistical system do not offer the possibility to disaggregate activity data by the type of foams (open-cell or closed-cell), respectively it is not possible to know all types of blowing agents used. Thus, combined uncertainties for this source category represent circa ±42.43 per cent (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 Guidance.

2F4. 'Aerosols'

Uncertainties associated with emission factors used to estimate CO_2 emissions covered by the source category 2F4 'Aerosols' were calculated at circa 5 per cent (2006 IPCC Guidelines). Uncertainties associated with activity data on the use of metered dose aerosols in the RM are considered low (±10 per cent). Thus, combined uncertainties for this source category represent circa ±7.07 per cent (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 Guidance.

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 2F 'Product Uses as Substitutes for ODS' category 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 sources of reference, including official sources (i.e., National Bureau of Statistics, Customs Service, former Ministries of Health, and of Information Technology and Communications, Republican Association of Refrigeration Technicians and Annual Reports submitted by individual companies to the Ozone Office and Climate Change Office of the Ministry of Agriculture, regional Development and Environment), etc. To be noted that the AD and methods used for estimating GHG emissions under the category 2F 'Product Uses as Substitutes for ODS' were documented and archived both in hard copies and electronically.

4.6.5. Recalculations

2F1. Refrigeration and Air Conditioning

For 1995-2015 periods recalculations were made for HFCs emissions from source category 2F1 'Refrigeration and Air Conditioning' due to: (a) updating and completing information on the import and consumption of HFCs in the country for the period up to 2008, including due to using the Generalized Reports 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 (from 2009 through 2016 the responsibility for collecting statistical information according to the Statistical Report No. 1-Ozone was kept by the State Ecological Inspectorate of the Republic of Moldova, but due to lack of capacities, this information was not collected); (b) completing the list of refrigerants used mostly in the RM (for example, R-407f, R-408a, R-422d, etc.); (c) updating EFs and parameters used to estimate HFCs emissions from refrigeration and air conditioning equipment imported in the country, in particular regarding the values associated with the efficiency of freon recovery (%) at end-of-life; (d) updating the share of refrigerants charged into the refrigeration and air conditioning equipment in the RM between 1995 and 2016, by considering the information available in the Generalized Reports 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; (e) updating information on the total number of transportation means registered in the country, as well as the share of transportation units charged with air conditioning equipment, provided by the State Enterprise "State Information Resources Centre "Register" (SE "CRIS "Register") (for 1995-2013), respectively by the Public Services Agency of the RM (for 2014-2016), based on the information included in the State Transport Register; (f) also, in order to transfer HFCs emissions in CO_2 equivalent, in the current inventory cycle there were used the Global Warming Potential for 100 years (GWP_{100}) values according to the Fourth Assessment Report (AR4), compared to GWP_{100} values included in the Second Assessment Report (SAR).

In comparison with the results obtained in the NC4 of the RM under UNFCCC (2018), the recalculations resulted in an increase of HFC emissions under the category 2F1 'Refrigeration and Air Conditioning' in 1996-2004, 2007-2008, 2010, respectively in 2013-2015, varying from a minimum of 0.1 per cent in 2007, to a maximum of 24.8 per cent in 2001; except for 1995, 2005-2006, 2009 and 2011-2012, with an increase varying from a minimum of 0.9 per cent in 2005 up to a maximum of 6.8 per cent in 2011 (Table 4-153).

Table 4-153: Comparative Results of HFC Emissions from 2F1 'Refrigeration and Air Conditioning' included into the NC4 and the BUR2 of the RM under the UNFCCC, kt CO_2 eq.

	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
NC4	3.6007	3.7732	4.0220	4.7701	5.1247	5.4611	5.9931	6.4983	7.4712	8.6039	9.4835
BUR2	3.6751	3.5951	3.8776	4.1996	4.1971	4.1151	4.5048	5.0760	5.7491	8.0196	9.5679
Difference, %	2.1	-4.7	-3.6	-12.0	-18.1	-24.6	-24.8	-21.9	-23.1	-6.8	0.9
	2006	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**
NC4	10.4824	13.1857	16.5057	17.7181	29.2127	29.5877	33.2089	37.6752	46.6119	66.7794	
BUR2	10.9815	13.1757	16.3707	18.5147	23.1089	31.5903	34.2235	37.1211	45.1294	66.2081	70.7568
Difference, %	4.8	-0.1	-0.8	4.5	-20.9	6.8	3.1	-1.5	-3.2	-0.9	

Abbreviations: NC4 – Fourth National Communication; BUR2 – Second Biennial Update Report.

For 2016, HFC emissions within the respective category were estimated for the first time. The obtained results allow assert that over the period 1995-2016, HFCs emissions from 2F1 'Refrigeration and Air Conditioning' source category increased by circa 19.3 times.

The table below presents HFC emissions by substances and sources (Table 4-154).

Table 4-154: HFC Emissions from the 2F1 'Refrigeration and Air Conditioning', 1995-2016

	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
	2F1a 'Domestic Refrigeration Equipment'										
HFC-125, t	NO	NO	0.0000	0.0000	0.0000	0.0000	0.0001	0.0002	0.0005	0.0007	0.0012
HFC-134a, t	NO	NO	0.0000	0.0004	0.0009	0.0019	0.0042	0.0085	0.0161	0.0294	0.0494
HFC-143a, t	NO	NO	0.0000	0.0000	0.0000	0.0001	0.0001	0.0002	0.0006	0.0009	0.0014
2F1a, kt CO_2 eq.	**NO**	**NO**	**0.0000**	**0.0007**	**0.0015**	**0.0032**	**0.0070**	**0.0140**	**0.0271**	**0.0483**	**0.0814**
	2F1b 'Commercial Refrigeration Equipment'										
HFC-32, t	NO	NO	NO	NO	NO	NO	NO	NO	0.0006	0.0011	0.0019
HFC-125, t	NO	NO	0.0013	0.0063	0.0076	0.0095	0.0117	0.0143	0.0213	0.0294	0.0424
HFC-134a, t	NO	NO	0.0027	0.0128	0.0157	0.0265	0.0396	0.0557	0.0850	0.1151	0.1446
HFC-143a, t	NO	NO	0.0023	0.0119	0.0145	0.0180	0.0223	0.0269	0.0359	0.0458	0.0597
2F1b, kt CO_2 eq.	**NO**	**NO**	**0.0186**	**0.0934**	**0.1141**	**0.1516**	**0.1970**	**0.2501**	**0.3570**	**0.4730**	**0.6234**
	2F1c 'Industrial Refrigeration Equipment'										
HFC-32, t	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0.0037
HFC-125, t	NO	NO	0.0094	0.0122	0.0238	0.0290	0.0423	0.0495	0.0642	0.0806	0.1117
HFC-134a, t	NO	NO	0.0436	0.0774	0.0970	0.1154	0.1525	0.1752	0.2153	0.2592	0.2985
HFC-143a, t	NO	NO	0.0111	0.0145	0.0281	0.0343	0.0499	0.0585	0.0759	0.0953	0.1244
2F1c, kt CO_2 eq.	**NO**	**NO**	**0.1449**	**0.2181**	**0.3474**	**0.4199**	**0.5892**	**0.6856**	**0.8721**	**1.0787**	**1.3763**
	2F1d 'Stationary Air Conditioning Equipment'										
HFC-32, t	NO	NO	0.0000	0.0001	0.0001	0.0003	0.0004	0.0008	0.0020	0.0036	0.0062
HFC-125, t	NO	NO	0.0000	0.0001	0.0001	0.0003	0.0004	0.0008	0.0020	0.0036	0.0062
HFC-134a, t	NO	NO	NO	NO	NO	NO	NO	NO	0.0001	0.0002	0.0004
2F1d, kt CO_2 eq.	**NO**	**NO**	**0.0002**	**0.0004**	**0.0006**	**0.0013**	**0.0019**	**0.0033**	**0.0085**	**0.0152**	**0.0264**

	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
	2F1e 'Mobile Air Conditioning Equipment'										
HFC-134a, t	0.2962	0.3446	0.4358	0.5386	0.6202	0.7150	0.8549	1.1261	1.3550	1.6775	2.1113
2F1e, kt CO_2 eq.	**0.4235**	**0.4928**	**0.6232**	**0.7702**	**0.8869**	**1.0224**	**1.2225**	**1.6104**	**1.9376**	**2.3988**	**3.0192**
	2F1f 'Transport Refrigeration'										
HFC-32, t	0.7788	0.7431	0.7403	0.7465	0.6818	0.6028	0.5957	0.6018	0.6100	0.9594	1.0638
HFC-125, t	0.7788	0.7431	0.7403	0.7465	0.6818	0.6028	0.5957	0.6018	0.6100	0.9594	1.0638
2F1f, kt CO_2 eq.	**3.2516**	**3.1023**	**3.0907**	**3.1167**	**2.8467**	**2.5166**	**2.4872**	**2.5126**	**2.5467**	**4.0056**	**4.4412**
	2F1 'Refrigeration and Air Conditioning'										
2F, kt CO_2 eq.	**3.6751**	**3.5951**	**3.8776**	**4.1996**	**4.1971**	**4.1151**	**4.5048**	**5.0760**	**5.7491**	**8.0196**	**9.5679**
	2006	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**
	2F1a 'Domestic Refrigeration Equipment'										
HFC-125, t	0.0024	0.0046	0.0059	0.0077	0.0109	0.0144	0.0175	0.0205	0.0251	0.0292	0.0352
HFC-134a, t	0.0827	0.1322	0.1659	0.1942	0.2263	0.2540	0.2794	0.3176	0.3626	0.3865	0.4565
HFC-143a, t	0.0029	0.0054	0.0070	0.0091	0.0128	0.0170	0.0206	0.0243	0.0297	0.0346	0.0416
2F1a, kt CO_2 eq.	**0.1394**	**0.2291**	**0.2890**	**0.3452**	**0.4190**	**0.4899**	**0.5530**	**0.6344**	**0.7389**	**0.8095**	**0.9620**
	2F1b 'Commercial Refrigeration Equipment'										
HFC-32, t	0.0032	0.0051	0.0061	0.0067	0.0074	0.0081	0.0085	0.0092	0.0096	0.0290	0.0291
HFC-125, t	0.0598	0.0912	0.1093	0.1563	0.2652	0.1889	0.2118	0.2383	0.2613	0.4802	0.6241
HFC-134a, t	0.1783	0.2247	0.2532	0.3419	0.5486	0.3690	0.5828	0.6461	0.7174	1.0879	1.1238
HFC-143a, t	0.0780	0.1112	0.1306	0.2044	0.4047	0.2404	0.2734	0.3084	0.3315	0.5561	0.6997
2F1b, kt CO_2 eq.	**0.8150**	**1.1408**	**1.3325**	**1.9541**	**3.5266**	**2.2691**	**2.8028**	**3.1428**	**3.4289**	**5.7418**	**6.9388**
	2F1c 'Industrial Refrigeration Equipment'										
HFC-32, t	0.0084	0.0105	0.0125	0.0145	0.0225	0.0261	0.0297	0.0331	0.0363	0.0395	0.0475
HFC-125, t	0.1632	0.2250	0.2869	0.3484	0.4560	0.5256	0.6056	0.7643	0.9349	1.2793	1.5250
HFC-134a, t	0.3386	0.3881	0.4266	0.4638	0.5421	0.5889	0.6599	0.7251	0.7797	0.8549	0.9241
HFC-143a, t	0.1726	0.2364	0.3020	0.3670	0.4762	0.5476	0.6313	0.7960	0.9717	1.3216	1.5678
2F1c, kt CO_2 eq.	**1.8325**	**2.4062**	**2.9727**	**3.5326**	**4.5151**	**5.1471**	**5.9051**	**7.2923**	**8.7554**	**11.6345**	**13.6993**
	2F1d 'Stationary Air Conditioning Equipment'										
HFC-32, t	0.0105	0.0274	0.0455	0.0555	0.0713	0.0892	0.1280	0.1469	0.1921	0.3295	0.4021
HFC-125, t	0.0105	0.0275	0.0457	0.0557	0.0716	0.0896	0.1285	0.1475	0.1928	0.3306	0.4037
HFC-134a, t	0.0009	0.0030	0.0054	0.0060	0.0077	0.0105	0.0130	0.0162	0.0179	0.0280	0.0398
2F1d, kt CO_2 eq.	**0.0453**	**0.1192**	**0.1982**	**0.2409**	**0.3099**	**0.3890**	**0.5548**	**0.6384**	**0.8300**	**1.4195**	**1.7412**
	2F1e 'Mobile Air Conditioning Equipment'										
HFC-134a, t	2.5062	2.8893	3.6936	4.1378	5.0437	5.9219	6.5443	7.1766	11.0773	22.1527	23.2975
2F1e, kt CO_2 eq.	**3.5838**	**4.1317**	**5.2818**	**5.9170**	**7.2124**	**8.4684**	**9.3583**	**10.2625**	**15.8406**	**31.6783**	**33.3155**
	2F1f 'Transport Refrigeration'										
HFC-32, t	1.0935	1.2332	1.5081	1.5628	1.7068	3.5513	3.6047	3.6289	3.7211	3.5747	3.3773
HFC-125, t	1.0935	1.2332	1.5081	1.5628	1.7068	3.5513	3.6047	3.6289	3.7211	3.5747	3.3773
2F1f, kt CO_2 eq.	**4.5655**	**5.1487**	**6.2964**	**6.5248**	**7.1258**	**14.8268**	**15.0495**	**15.1506**	**15.5355**	**14.9244**	**14.1001**
	2F1 'Refrigeration and Air Conditioning'										
2F, kt CO_2 eq.	**10.9815**	**13.1757**	**16.3707**	**18.5147**	**23.1089**	**31.5903**	**34.2235**	**37.1211**	**45.1294**	**66.2081**	**70.7568**

2F2. Foam Blowing

For 1995-2015 periods recalculations were made for HFCs emissions from source category 2F2 'Foam Blowing' due to considering, since 2015, the losses recorded at the end of service life of closed cell foams, noting that the emissions from these last about 20 years; also, in order to transfer HFCs emissions in CO_2 equivalent, in the current inventory cycle there were used the Global Warming Potential for 100 years (GWP_{100}) values according to the AR4, compared to GWP_{100} values included in the SAR.

For 2016, HFC emissions within the respective category were estimated for the first time. The obtained results allow assert that over the period 1995-2016, HFCs emissions increased by circa 379 times (Table 4-155).

Table 4-155: Comparative results of HFC emissions from 2F2 „Foam blowing" included into the NC4 and the BUR2 of the RM under the UNFCCC, kt CO_2 equivalent

	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
NC4	0.2512	0.6240	1.1177	1.6944	2.3704	3.8160	5.4443	8.6002	13.7861	19.3845	28.6434
BUR2	0.2763	0.6864	1.2294	1.8628	2.6045	4.1887	5.9723	9.4256	15.0924	21.1768	31.2305
Difference, %	10.0	10.0	10.0	9.9	9.9	9.8	9.7	9.6	9.5	9.2	9.0
	2006	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**
NC4	39.1864	50.3373	60.6471	67.3260	73.8215	78.7411	83.5755	86.9344	90.3730	95.1719	
BUR2	42.6149	54.6209	65.6924	72.8440	79.7528	84.9304	89.9845	93.4254	96.9516	101.5988	104.8218
Difference, %	8.7	8.5	8.3	8.2	8.0	7.9	7.7	7.5	7.3	6.8	

Abbreviations: NC4 – Fourth National Communication; BUR2 – Second Biennial Update Report.

2F4. Aerosols

For 2003-2015 periods recalculations were made for HFCs emissions from source category 2F4 ‚Aerosols', due to the erroneous calculation of the amount of the propellant HFC-134a contained in the metered dose inhaler Ipratropium bromide / Fenoterol hydrobromide - Berodual N pressurized inhalation solution 0.25 mg/dose-200 doses; also, in order to transfer HFCs emissions in CO_2 equivalent, in the current inventory cycle there were used the Global Warming Potential for 100 years (GWP_{100}) values according to the Fourth Assessment Report (AR4), compared to GWP_{100} values included in the Second Assessment Report (SAR).

In comparison with the results obtained in the NC4 of the Republic of Moldova under UNFCCC (2018), the recalculations resulted in an increase of HFC emissions under the category 2F4 'Aerosols' by circa 10 per cent between 2003-2005, respectively a decrease within 2006-2015 time periods, varying from a minimum of 39.2 per cent in 2006 up to a maximum of 97.1 per cent in 2015 (Table 4-156). For 2016, HFC emissions within the respective category were estimated for the first time. The obtained results allow assert that over the period 2003-2016, HFCs emissions increased by circa 95 times.

Table 4-156: Comparative results of HFC emissions from 2F4 'Aerosols' included into the NC4 and the BUR2 of the RM under the UNFCCC, kt CO_2 equivalent

	2003	2004	2005	2006	2007	2008	2009
NC4	0.0001	0.0002	0.0004	0.0029	0.0069	0.0091	0.0152
BUR2	0.0001	0.0002	0.0004	0.0018	0.0026	0.0023	0.0033
Difference, %	10.0	10.0	10.0	-39.2	-62.3	-74.5	-78.4
	2010	2011	2012	2013	2014	2015	2016
NC4	0.0232	0.0425	0.0644	0.0791	0.0833	0.1837	
BUR2	0.0040	0.0042	0.0043	0.0041	0.0043	0.0053	0.0061
Difference, %	-82.9	-90.1	-93.2	-94.9	-94.9	-97.1	

Abbreviations: NC4 – Fourth National Communication; BUR2 – Second Biennial Update Report.

2F. 'Product Uses as Substitutes for ODS'

For 1995-2015 periods recalculations were made for HFCs emissions under the category 2F 'Product Uses as Substitutes for ODS' due to the changes listed before. In comparison with the results obtained in the NC4 of the Republic of Moldova under UNFCCC (2018), the recalculations resulted in an increase of HFC emissions between 1996-2003, respectively in 2010, varying from a minimum of 0.6 per cent in 1997 to a maximum of 9.4 per cent in 2000; except for 1995, 2004-2009 and 2011-2015, years with an increase varying from a minimum of 2.6 per cent in 1995 up to a maximum of 7.4 per cent in 2006 (Table 4-157). For 2016, HFC emissions within the respective category were estimated for the first time. The obtained results allow assert that over the period 1995-2016, HFCs emissions increased by circa 44 times.

Table 4-157: Comparative results of HFC emissions from 2F 'Product Uses as Substitutes for ODS' category included into the NC4 and the BUR2 of the RM under the UNFCCC, kt CO_2 eq.

	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
NC4	3.8519	4.3972	5.1397	6.4645	7.4451	9.1638	11.3241	14.9852	21.1515	27.8828	38.0737
BUR2	3.9514	4.2815	5.1070	6.0624	6.8017	8.3038	10.4771	14.5015	20.8415	29.1966	40.7988
Difference, %	2.6	-2.6	-0.6	-6.2	-8.6	-9.4	-7.5	-3.2	-1.5	4.7	7.2
	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
NC4	49.9248	63.8873	77.6166	85.5586	103.6920	109.0419	117.5792	125.6277	138.0989	163.1657	
BUR2	53.5982	67.7992	82.0655	91.3620	102.8657	116.5249	124.2123	130.5506	142.0853	167.8122	175.5848
Difference, %	7.4	6.1	5.7	6.8	-0.8	6.9	5.6	3.9	2.9	2.8	

Abbreviations: NC4 – Fourth National Communication; BUR2 – Second Biennial Update Report.

The table below presents HFC emissions by substances and sources (Table 4-158).

Table 4-158: HFC emissions from the 2F 'Product Uses as Substitutes for ODS' 1995-2016

	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
	2F1 'Refrigeration and Air Conditioning'										
HFC-32, t	0.7788	0.7431	0.7403	0.7466	0.6820	0.6031	0.5962	0.6026	0.6126	0.9641	1.0755
HFC-125, t	0.7788	0.7431	0.7510	0.7651	0.7134	0.6416	0.6502	0.6666	0.6980	1.0738	1.2253
HFC-134a, t	0.2962	0.3446	0.4821	0.6293	0.7338	0.8589	1.0513	1.3656	1.6714	2.0812	2.6042
HFC-143a, t	NO	NO	0.0134	0.0263	0.0426	0.0524	0.0723	0.0857	0.1124	0.1419	0.1855
2F1, kt CO_2 eq.	**3.6751**	**3.5951**	**3.8776**	**4.1996**	**4.1971**	**4.1151**	**4.5048**	**5.0760**	**5.7491**	**8.0196**	**9.5679**

	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
	2F2 'Foam Blowing Agents'										
HFC-134a, t	0.1932	0.4800	0.8597	1.2996	1.8131	2.9036	4.1289	6.4911	10.3452	14.2770	20.7769
HFC-152a, t	NO	NO	NO	0.0350	0.0957	0.2950	0.5481	1.1553	2.4095	3.9833	7.1227
HFC-365mfc, t	NO	NO	NO	NO	NO	NO	NO	NO	NO	0.1376	0.3283
HFC-245fa, t	NO	NO	NO	NO	NO	NO	NO	NO	NO	0.1529	0.3648
2F2, kt CO_2 eq.	**0.2763**	**0.6864**	**1.2294**	**1.8628**	**2.6045**	**4.1887**	**5.9723**	**9.4256**	**15.0924**	**21.1768**	**31.2305**
	2F4 'Aerosols'										
HFC-134a, t	NO	NO	NO	NO	NO	NO	NO	NO	0.0000	0.0001	0.0003
2F4, kt CO_2 eq.	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**0.0001**	**0.0002**	**0.0004**
	2F 'Product Uses as Substitutes for ODS'										
2F, kt CO_2 eq.	**3.9514**	**4.2815**	**5.1070**	**6.0624**	**6.8017**	**8.3038**	**10.4771**	**14.5015**	**20.8415**	**29.1966**	**40.7988**
	2006	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**
	2F1 'Refrigeration and Air Conditioning'										
HFC-32, t	1.1157	1.2762	1.5722	1.6395	1.8080	3.6748	3.7709	3.8180	3.9592	3.9727	3.8560
HFC-125, t	1.3295	1.5815	1.9559	2.1309	2.5105	4.3699	4.5681	4.7995	5.1352	5.6941	5.9653
HFC-134a, t	3.1067	3.6374	4.5447	5.1436	6.3684	7.1444	8.0794	8.8815	12.9549	24.5100	25.8417
HFC-143a, t	0.2534	0.3529	0.4396	0.5804	0.8937	0.8051	0.9253	1.1287	1.3329	1.9123	2.3092
2F1, kt CO_2 eq.	**10.9815**	**13.1757**	**16.3707**	**18.5147**	**23.1089**	**31.5903**	**34.2235**	**37.1211**	**45.1294**	**66.2081**	**70.7568**
	2F2 'Foam Blowing Agents'										
HFC-134a, t	27.7426	34.7875	41.1669	45.2431	48.9440	51.4428	53.6883	54.8799	56.1800	57.5421	58.6737
HFC-152a, t	11.1246	14.9198	19.1495	22.7251	26.9617	31.1362	35.6560	40.2101	45.2989	50.1538	54.9640
HFC-365mfc, t	0.8066	1.5604	2.2953	2.7489	3.3117	3.8723	4.5340	5.1387	5.6732	6.7552	7.2754
HFC-245fa, t	0.8962	1.7337	2.5503	3.0543	3.6797	4.3026	5.0377	5.7097	6.3035	7.5057	8.0837
2F2, kt CO_2 eq.	**42.6149**	**54.6209**	**65.6924**	**72.8440**	**79.7528**	**84.9304**	**89.9845**	**93.4254**	**96.9516**	**101.5988**	**104.8218**
	2F4 'Aerosols'										
HFC-134a, t	0.0012	0.0018	0.0016	0.0023	0.0028	0.0029	0.0030	0.0028	0.0030	0.0037	0.0043
2F4, kt CO_2 eq.	**0.0018**	**0.0026**	**0.0023**	**0.0033**	**0.0040**	**0.0042**	**0.0043**	**0.0041**	**0.0043**	**0.0053**	**0.0061**
	2F 'Product Uses as Substitutes for ODS'										
2F, kt CO_2 eq.	**53.5982**	**67.7992**	**82.0655**	**91.3620**	**102.8657**	**116.5249**	**124.2123**	**130.5506**	**142.0853**	**167.8122**	**175.5848**

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 freons and refrigerant equipment. This information system will provide the Ozone Office and Climate Change Office more accurate AD that could potentially help reduce uncertainties in estimating GHG emissions from the 2F 'Product Uses as Substitutes for ODS' category 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' ('Tobacco Combustion' and 'Use of Shoes').

2G1. Electrical Equipment

Sulphur hexafluoride (SF_6) and perfluorinated hydrocarbons (in particular CF_4) are used as an insulation medium in high tension electrical equipment. SF_6 is also used in gas insulated switchgear, chemical lasers and circuit breakers.

In order to determine how sulphur hexafluoride and PFC are used in the Republic of Moldova a series of enterprises subordinated to the Ministry of Economy and Infrastructure ('Moldelectrica' SOE), Red Union Fenosa J.S.C. (part of the Gas Natural Fenosa Group), as well as the Ministry of Health, Labor and Social Protection and the Academy of Science of Moldova were surveyed. The survey of the above mentioned organizations revealed the following: no activity data is available on the application of SF_6 in gas insulated chemical lasers at the Academy of Science of Moldova and the Ministry of Health, Labor and Social Protection for the time period since 1990 to 2016; at the Ministry of Economy and Infrastructure ('Moldelectrica' S.O.E. and Red Union Fenosa J.S.C.), by 2016, SF_6 was used in 198 high tension circuit breakers, varying from 0.95 kg and 2.6 kg of SF_6, respectively 123 high tension circuit breakers, varying from 6 kg and 45 kg of SF_6. As one can see, the use of PFCs in the Republic of

Moldova, in particular CF_4 is being recorded currently 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 the source category 2G1 'Electrical Equipment' is insignificant, such emissions being reported only since 2003, and respectively since 2006.

2G3. N_2O from Product Uses

Under this category, there are estimated N_2O emissions from medical applications for anesthetic use (SNAP 060508 – N_2O for anesthetic use in medical application).

2G4. Other

Under this category, there are estimated NO_x, CO, NMVOC and indirect CO_2 emissions from tobacco combustion (SNAP 060602 – tobacco combustion) and use of shoes (SNAP 060603 – use of shoes). Between 1990 and 2016, direct GHG emissions from the 2G 'Other Product Manufacture and Use' decreased by circa 41.5 per cent (Table 4-159).

Table 4-159: Direct GHG Emissions from 2G 'Other Product Manufacture and Use' Category, by Sources, within 1990-2016 periods, kt CO_2 equivalent

	1990	1991	1992	1993	1994	1995	1996	1997	1998
2G1. Electrical equipment	NO	NO	NO	NO	NO	NO	NO	NO	NO
2G3. N_2O from product uses	0.0197	0.0164	0.0149	0.0179	0.0149	0.0003	0.0006	0.0009	0.0015
2G4. Other	3.1787	2.8632	2.2573	1.8544	1.3519	1.0947	1.0386	0.9389	0.7020
2G. Other product manufacture and use	**3.1983**	**2.8795**	**2.2722**	**1.8723**	**1.3668**	**1.0950**	**1.0392**	**0.9398**	**0.7035**
	1999	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**
2G1. Electrical equipment	NO	NO	NO	NO	0.0071	0.0071	0.0572	0.3538	0.4536
2G3. N_2O from product uses	0.0128	0.0131	0.0131	0.0131	0.0131	0.0149	0.0182	0.0176	NO
2G4. Other	0.6062	0.8987	0.7730	0.7307	0.8881	0.9656	1.0626	0.9584	0.9474
2G. Other product manufacture and use	**0.6190**	**0.9118**	**0.7861**	**0.7438**	**0.9083**	**0.9876**	**1.1379**	**1.3298**	**1.4010**
	2008	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**
2G1. Electrical equipment	0.5474	0.5904	0.7222	0.7578	0.8161	1.0173	1.1070	1.1598	1.1655
2G3. N_2O from product uses	NO	NO	NO	NO	NO	NO	NO	NO	NO
2G4. Other	0.9859	0.6998	0.9046	1.0979	1.0427	1.1438	1.0338	0.7549	0.7041
2G. Other product manufacture and use	**1.5333**	**1.2901**	**1.6268**	**1.8557**	**1.8588**	**2.1611**	**2.1409**	**1.9148**	**1.8696**

The table below presents indirect GHG emissions (NO_x, CO, NMVOC) from the respective category (Table 4-160).

Table 4-160: Indirect GHG Emissions from the 2G 'Other Product Manufacture and Use' Category within 1990-2016 periods, kt

	1990	1991	1992	1993	1994	1995	1996	1997	1998
NO_x	0.0197	0.0199	0.0186	0.0190	0.0173	0.0153	0.0210	0.0205	0.0162
CO	0.6017	0.6083	0.5686	0.5819	0.5290	0.4695	0.6414	0.6281	0.4967
NMVOC	1.4449	1.3014	1.0260	0.8429	0.6145	0.4976	0.4721	0.4268	0.3191
	1999	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**
NO_x	0.0189	0.0200	0.0203	0.0136	0.0154	0.0152	0.0134	0.0109	0.0107
CO	0.5773	0.6124	0.6229	0.4172	0.4712	0.4661	0.4096	0.3326	0.3289
NMVOC	0.2755	0.4085	0.3514	0.3321	0.4037	0.4389	0.4830	0.4356	0.4306
	2008	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**
NO_x	0.0086	0.0105	0.0135	0.0140	0.0101	0.0075	0.0050	0.0038	0.0040
CO	0.2638	0.3225	0.4140	0.4272	0.3078	0.2296	0.1535	0.1174	0.1216
NMVOC	0.4481	0.3181	0.4112	0.4990	0.4739	0.5199	0.4699	0.3432	0.3200

4.7.2. Methodological Issues, Emission Factors and Data Sources

2G1. Electrical Equipment

SF_6 and PFC emissions from use of sulphur hexafluoride as 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 SF_6 and PFC as insulation medium in high and medium tension electrical circuit breakers, tones;

M – manufacturing emissions, tones;

EF – manufacturing EF, fraction SF_6 and PFC consumption by manufacturers; default emission factors: 7 per cent 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 per cent 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, tones;

EF – installation EF, total nameplate capacity of new equipment filled on site;

EU – equipment use emissions, tones;

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 per cent 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 per cent 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, tones;

EF – equipment disposal EF; total nameplate capacity of retiring equipment, fraction of SF_6 and PFC remaining at retirement (the life expectancy of the equipment in European countries is over 35 years); default emission factors: 93 per cent 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 95 per cent for closed pressure electrical equipment (HV switchgear) containing SF_6 (2006 IPCC Guidelines, Volume 3, Chapter 8.1, Table 8.3, page 8.16).

Starting with 2003, the Moldavian 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 V), the SF_6 charge in each case varying between 0.95 and 45.0 kg. In conformity with the manufacturer's technical log, the first repairs shall take place after 35 years of operation.

The dynamic of high-tension electrical circuit breakers installation process, as well as the number of available units in bulk at the end of calendar year is provided in Table 4-161, respectively in Tables 4-162 and 4-163.

Table 4-161: The dynamic of medium and high-tension electrical circuit breakers installation process using SF_6 and CF_4 within 2003-2016 periods, units installed per year

Enterprises	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Moldelectrica S.O.E.	1	0	5	28	8	2	0	8	1	3	4	0	0	0
Red Union Fenosa J.S.C.	0	0	2	6	6	8	6	5	8	7	15	11	13	1
Total	**1**	**0**	**7**	**34**	**14**	**10**	**6**	**13**	**9**	**10**	**19**	**11**	**13**	**1**

Source: Red Union Fenosa J.S.C., Official 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, regarding the period 2005-2010; Official Letter from 13.01.2014, as a response to the request from the Climate Change Office, Ministry of Environment No. 320/2014-01-01 dated 03.01.2014, regarding the period 2011-2012; Official Letter dated 10.05.2016, as a response to the request from the Climate Change Office No. 512/2016-05-09 dated 10.05.2016, regarding 2015; Official Letter dated 23.01.2018, , as a response to the request from the Climate Change Office No. 601/2017-12-03 dated 14.12.2017, regarding 2016; 'MOLDELECTRICA' S.O.E. Official Letter No 46-47/1795 dated 23.08.2011, as a response to the request from the Ministry of Environment No. 03-07/1337 din 08.08.2011, regarding the period 2003-2010; Official Letter No 46-47/112 dated 17.01.2014, 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, regarding the period 2011-2013; Official 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, regarding 2015; Official 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, regarding 2016.

Table 4-162: Total medium-tension electrical circuit breakers available in bulk at the end of calendar year within 2003-2016 periods, units

	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Circuit breaker 10 kV, GMA-24, 2.2 kg SF_6	0	0	0	0	0	0	0	6	12	18	24	30	36	36
Circuit breaker 10 KV, THO 24/SO5/E/THO-T, 0.98 kg SF_6	0	0	6	12	18	24	30	36	42	48	54	60	64	65
Circuit breaker 10 kV, AUGUSTE 2012, 1.5 kg SF_6	0	0	0	0	0	0	0	0	0	0	0	0	7	36
Circuit breaker 10 kV, CGMCOSMOS-L, 0.605 kg SF_6	0	0	0	0	0	0	0	0	0	0	0	0	2	2
Circuit breaker 10 kV, CGMCOSMOS-P, 1.25 kg SF_6	0	0	0	0	0	0	0	0	0	0	0	0	1	1
Circuit breaker 10 kV, CGMCOSMOS-2LP, 2.46 kg SF_6	0	0	0	0	0	0	0	0	0	0	7	14	21	21

	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Circuit breaker 10 kV, PT COMPACT 1P, 0.95 kg SF_6	0	0	0	0	0	0	0	0	0	0	0	1	2	3
Circuit breaker 10 kV, PT COMPACT 2L1P, 1.3 kg SF_6	0	0	0	0	0	0	0	0	0	0	0	4	6	7
Circuit breaker 10 kV, PT COMPACT 3L1P, 1.95 kg SF_6	0	0	0	0	0	0	0	0	0	0	0	0	2	2
Circuit breaker 35 kV, GL-107X (2005), 2.6 kg SF_6	0	0	0	5	5	5	5	5	5	5	4	4	4	4
Circuit breaker 35 kV, GL-107X (2012), 2.4 kg SF_6	0	0	0	0	0	0	0	0	0	1	1	1	1	1
Circuit breaker 35 kV, VOX 36, 2.9 kg SF_6	0	0	0	0	0	0	0	0	3	6	10	14	18	18
Circuit breaker 35 kV, THO 36, 0.98 kg SF_6	0	0	0	0	0	0	0	0	0	0	0	2	2	2
Total circuit breakers installed	**0**	**0**	**6**	**17**	**23**	**29**	**35**	**47**	**62**	**78**	**100**	**130**	**166**	**198**

Table 4-163: Total high-tension electrical circuit breakers available in bulk at the end of calendar year within 2003-2016 periods, units

	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Circuit breaker 110 kV, GL-311 F1, 12 kg SF_6	1	1	6	21	29	29	29	29	29	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	4	4	4	4	4
Circuit breaker 110 kV, GL-312F1/4031 P sau VR, 7.8 kg SF6	0	0	0	0	0	0	0	1	1	1	6	6	6	6
Circuit breaker 110 kV, GL-311, 12 kg SF_6	0	0	2	6	12	20	26	31	34	36	42	42	47	47
Circuit breaker 110 kV, LTB, 12 kg SF_6	0	0	0	2	2	2	2	2	2	2	2	2	2	2
Circuit breaker 110 kV, LTB 145D / 1B, 6 kg SF_6	0	0	0	0	0	0	0	0	2	4	4	6	10	11
Circuit breaker 110 kV, Hypact, 45 kg SF_6	0	0	0	0	0	0	0	0	0	0	5	8	8	8
Circuit breaker 330 kV, GL-315 F3, 26 kg SF_6 si 15 kg CF_4	0	0	0	8	8	10	10	14	14	14	14	14	14	14
Circuit breaker 400 kV, LTB 420 E2, 30 kg SF_6	0	0	0	0	0	0	0	0	0	2	2	2	2	2
Total circuit breakers installed	**1**	**1**	**8**	**37**	**51**	**61**	**67**	**80**	**86**	**92**	**108**	**113**	**122**	**123**

The amount of insulating gas (SF_6 and CF_4) in bulk charged in the medium-tension electrical circuit breakers in the Republic of Moldova is provided in Table 4-164.

Table 4-164: Total amount of insulating gas - SF_6 available in bulk, charged in the medium-tension electrical circuit breakers in the Republic of Moldova within 2003-2016, kg

	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Circuit breaker 10 kV, GMA-24, 2.2 kg SF_6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	13.2	26.4	39.6	52.8	66.0	79.2	79.2
Circuit breaker 10 KV, THO 24/SO5/E/THO-T, 0.98 kg SF_6	0.0	0.0	5.9	11.8	17.6	23.5	29.4	35.3	41.2	47.0	52.9	58.8	62.7	63.7
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	0.0	0.0	0.0	0.0	10.5	54.0
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	0.0	0.0	0.0	0.0	1.2	1.2
Circuit breaker 10 kV, CGMCOSMOS-P, 1.25 kg SF_6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.3	1.3
Circuit breaker 10 kV, CGMCOSMOS-2LP, 2.46 kg SF_6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	17.2	34.4	51.7	51.7
Circuit breaker 10 kV, PT COMPACT 1P, 0.95 kg SF_6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	1.9	2.9
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	0.0	0.0	0.0	5.2	7.8	9.1
Circuit breaker 10 kV, PT COMPACT 3L1P, 1.95 kg SF_6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.9	3.9
Circuit breaker 35 kV, GL-107X (2005), 2.6 kg SF_6	0.0	0.0	0.0	13.0	13.0	13.0	13.0	13.0	13.0	13.0	10.4	10.4	10.4	10.4
Circuit breaker 35 kV, GL-107X (2012), 2.4 kg SF_6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.4	2.4	2.4	2.4	2.4
Circuit breaker 35 kV, VOX 36, 2.9 kg SF_6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	8.7	17.4	29.0	40.6	52.2	52.2
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	0.0	0.0	0.0	2.0	2.0	2.0
Total SF_6 in bulk	**0.0**	**0.0**	**5.9**	**24.8**	**30.6**	**36.5**	**42.4**	**61.5**	**89.3**	**119.4**	**164.7**	**220.8**	**287.1**	**333.8**

The amount of insulating gas (SF_6 and CF_4) in bulk charged in the high-tension electrical circuit breakers in the Republic of Moldova is provided in Tables 4-165 and 4-166.

Table 4-165: Total amount of insulating gas - SF_6 available in bulk, charged in the high-tension electrical circuit breakers in the Republic of Moldova within 2003-2016, kg

	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
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	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	39.6	39.6	39.6	39.6	39.6
Circuit breaker 110 kV, GL-312F1/4031 P sau VR, 7.8 kg SF6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	7.8	7.8	7.8	46.8	46.8	46.8	46.8
Circuit breaker 110 kV, GL-311, 12 kg SF_6	0.0	0.0	24.0	72.0	144.0	240.0	312.0	372.0	408.0	432.0	504.0	504.0	564.0	564.0
Circuit breaker 110 kV, LTB, 12 kg SF_6	0.0	0.0	0.0	24.0	24.0	24.0	24.0	24.0	24.0	24.0	24.0	24.0	24.0	24.0
Circuit breaker 110 kV, LTB 145D / 1B, 6 kg SF_6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	12.0	24.0	24.0	36.0	60.0	66.0
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	0.0	225.0	360.0	360.0	360.0
Circuit breaker 330 kV, GL-315 F3, 26 kg SF_6 si 15 kg CF_4	0.0	0.0	0.0	208.0	208.0	260.0	260.0	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	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	60.0	60.0	60.0	60.0	60.0
Total SF_6 in bulk	**12.0**	**12.0**	**96.0**	**556.0**	**724.0**	**872.0**	**944.0**	**1145.5**	**1203.4**	**1299.4**	**1635.4**	**1782.4**	**1866.4**	**1872.4**

Table 4-166: Total amount of insulating gas - CF_4 available in bulk, charged in the medium and high-tension electrical circuit breakers in the Republic of Moldova within 2006-2016 periods, kg

	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Circuit breaker 330 kV, GL-315 F3 / 26 kg SF_6 si 15 kg CF_4	120.0	120.0	150.0	150.0	210.0	210.0	210.0	210.0	210.0	210.0	210.0

2G3. N_2O from Product Uses

The methodology used to estimate N_2O emissions from source category 2G3 'N_2O from Product Uses' (in anesthesia) is represented by the following formula:

$$E_{pollutant} = (AR_{product} \bullet EF_{technology\ pollutant}) / 10^3$$

Where:

- $E_{pollutant}$ – pollutant gas emissions from N_2O use in anesthesia, t/yr;
- $AR_{product}$ – activity rate for N_2O consumption in anesthesia, t/yr;
- $EF_{pollutant\ technology}$ – the emission factor for this pollutant technology, t/t (by default, 100 per cent of the whole amount of N_2O used in anesthesia is deemed to be emitted into the atmosphere).

Estimation of nitrous oxide emissions from use of N_2O in anesthesia was based on activity data provided by the former Ministry of Health, as a response to the Official Letters of the former Ministry of Environment and Natural Resources (Table 4-167).

Table 4-167: Amount of Nitrous Oxide Used in Anesthesia in the Republic of Moldova within 1990-2006 periods, kg

	1990	1991	1992	1993	1994	1995	1996	1997	1998
N_2O consumption in anesthesia	66	55	50	60	50	1	2	3	5
	1999	2000	2001	2002	2003	2004	2005	2006	2007-2016
N_2O consumption in anesthesia	43	44	44	44	44	50	61	59	NO

Source: Ministry of Health, Official Letter No. 01-9/2513 dated 9.11.2007, as a response to Official Letter No. 01-07/1608 dated 15.10.2007 from the Ministry of Environment and Natural Resources; Official Letter No. 01-9/550 dated 01.03.2011, as a response to Official Letter No. 03-07/175 dated 02.02.2011 from the Ministry of Environment.

In conformity with the response to the last Letter dated 1st of March 2011, since 2007 in the Republic of Moldova N_2O is not used in anesthesia anymore.

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 (2016) and uses the following equation:

$$E_{pollutant} = (AR_{product} \bullet EF_{technology\ pollutant}) / 10^3$$

Where:

- $E_{pollutant}$ – the emission of the specified pollutant from tobacco combustion, t/yr;
- $AR_{product}$ – the activity rate for burnt tobacco products, t/yr;
- $EF_{pollutant\ technology}$ – the default emission factor, kg/t.

The EMEP/EEA Air Pollutant Emission Inventory Guidebook (2016) provides default emission factors (Table 4-168) for the Tier 2 approach.

Table 4-168: Tier 2 Default EF for 2G4 'Other' ('Tobacco Combustion')

Source Category	Gas	EF	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 (2016), Category 2.D.3.i, SNAP 060602, Table 3-14, page 20

Statistical data regarding cigars and cigarettes production are 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 2005-2016', as well as in the statistical database which can be accessed on-line on the NBS website[59].

[59] NBS, Statistical database: <http://statbank.statistica.md/pxweb/Dialog/varval.asp?ma=IND0301&ti=Productia+ principalelor+produse+industriale%2C+1997-2009&path= ../ Database/RO/14%20 IND/IND03/&lang=1>.

According to the EMEP/EEA Air Pollutant Emission Inventory Guidebook (2016) (2.D.3.i „Other solvent and product use", SNAP 060602, page 21), one cigar contains 5 g of tobacco, while one cigarettes – only 1 g.

In order to estimate the share of fermented tobacco (Table 4-169), it is considered that cigarettes represent 95 per cent of the total market, while cigars – 5 per cent of the total.

Table 4-169: AD on Cigars and Cigarettes Production in the Republic of Moldova, 1990-2016

	1990	1991	1992	1993	1994	1995	1996	1997	1998
Cigars and Cigarettes, billion units	9.100	9.200	8.600	8.800	8.000	7.100	9.700	9.500	7.512
Tobacco in cigars and cigarettes, kt	10.920	11.040	10.320	10.560	9.600	8.520	11.640	11.400	9.014
	1999	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**
Cigars and Cigarettes, billion units	8.731	9.262	9.421	6.310	7.126	7.050	6.195	5.031	4.975
Tobacco in cigars and cigarettes, kt	10.477	11.114	11.305	7.572	8.551	8.460	7.434	6.037	5.970
	2008	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**
Cigars and Cigarettes, billion units	3.990	4.878	6.261	6.462	4.656	3.472	2.322	1.776	1.839
Tobacco in cigars and cigarettes, kt	4.788	5.853	7.513	7.754	5.587	4.166	2.787	2.131	2.206

Source: NBS, 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 2005-2016".

Indirect CO_2 emissions were estimated taking into consideration the content of carbon in NMVOC emissions. The default value used represents 60 per cent (IPCC 2006 Guidelines, Volume 3, Chapter 5.5, page 5.17). By oxidizing, this carbon is converted into CO_2 in atmosphere.

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– carbon dioxide emissions from tobacco combustion, kt/yr;

NMVOC – total NMVOC emissions within the respective category, kt/yr;

CC – carbon content in NMVOC, fraction (the default value used represents 60 per cent, with a margin of 50-70 per cent; 2006 IPCC Guidelines, Volume 3, Chapter 5.5, page 5.17);

44/12 – stoichiometric ratio 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 (2016) and uses the following equation:

$$E_{pollutant} = (AR_{product} \bullet EF_{technology\,pollutant}) / 10^3$$

Where:

$E_{pollutant}$ – the emission of the specified pollutant from use of shoes, t/yr;

$AR_{product}$ – the activity rate for use of shoes, pairs/yr;

$EF_{pollutant\,technology}$ – the default emission factor, kg/t.

The EMEP/EEA Air Pollutant Emission Inventory Guidebook (2016) provides default emission factors (Table 4-170) for the Tier 2 approach.

Table 4-170: Tier 2 Default EF for 2G4 „Other" ('Use of Shoes')

Source Category	GHG	EF	Unit
2G4 'Other' (Use of Shoes)	NMVOC	60	g/pairs of shoes

Source: EMEP/EEA Air Pollutant Emission Inventory Guidebook (2016), Category 2.D.3.i, SNAP 060603, Tab. 3-15, p. 21.

Statistical data regarding shoes production (Table 4-171) are available in the Statistical Yearbooks of the ATULBD and 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 2005-2016".

Table 4-171: AD on Shoes Production in the Republic of Moldova within 1990-2016, million pairs

	1990	1991	1992	1993	1994	1995	1996	1997	1998
RM: right bank of Dniester River	11.000	10.300	6.868	4.897	2.267	1.506	1.429	1.093	0.791
RM: left bank of Dniester River	12.200	10.500	9.400	8.300	7.200	6.100	5.500	5.100	3.800
RM: total	**23.200**	**20.800**	**16.268**	**13.197**	**9.467**	**7.606**	**6.929**	**6.193**	**4.591**

	1999	2000	2001	2002	2003	2004	2005	2006	2007
RM: right bank of Dniester River	0.847	1.112	1.244	1.925	2.738	3.033	3.650	3.674	3.796
RM: left bank of Dniester River	2.900	4.800	3.700	3.000	3.300	3.600	3.800	3.100	2.900
RM: total	**3.747**	**5.912**	**4.944**	**4.925**	**6.038**	**6.633**	**7.450**	**6.774**	**6.696**
	2008	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**
RM: right bank of Dniester River	3.832	2.221	2.717	2.849	3.053	2.942	2.866	1.886	2.078
RM: left bank of Dniester River	3.251	2.608	3.530	4.843	4.395	5.387	4.741	3.661	3.078
RM: total	**7.083**	**4.829**	**6.247**	**7.692**	**7.448**	**8.329**	**7.607**	**5.547**	**5.156**

Source: Statistical Yearbooks of the ATULBD for 1998-2017; Statistical Yearbooks of the RM for 1990-2017. Statistical Reports PRODMOLD-A 'Total production, as a natural expression, in the Republic of Moldova, by product type, for 2005-2016.

Indirect CO_2 emissions were estimated taking into consideration the content of carbon in NMVOC emissions. The default value used represents 60 per cent (2006 IPCC Guidelines, Volume 3, Chapter 5.5, page 5.17). By oxidizing, this carbon is converted into CO_2 in atmosphere.

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 – carbon dioxide 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 represents 60 per cent, with a margin of 50-70 per cent; 2006 IPCC Guidelines, Volume 3, Chapter 5.5, page 5.17);

44/12 – stoichiometric ratio CO_2/C.

4.7.3. Uncertainties Assessment and Time-Series Consistency

2G1. Electrical Equipment

Uncertainties associated with emission factors used to estimate SF_6 and PFC emissions covered by the source category 2G1 'Electrical Equipment' reach up to ±20 per cent (2006 IPCC Guidelines). Uncertainties associated with activity data on the use of SF_6 and PFC are considered low (±5 per cent). Thus, combined uncertainties for this source category represent circa ±20.62 per cent (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.

2G3. N_2O from Product Uses

Uncertainties associated with emission factors used to estimate N_2O emissions covered by the source category 2G3 'N_2O from Product Uses' represent circa ±3 per cent. Uncertainties associated with activity data on the use of N_2O in medical applications in the RM are considered low (±5 per cent). Thus, combined uncertainties for this source category represent circa ±5.83 per cent (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.

2G4. Other

Uncertainties associated with emission factors used to estimate GHG emissions covered by the source category 2G4 'Other' ('Tobacco Combustion' and 'Use of Shoes') reach to ±50 per cent. Uncertainties associated with activity data on tobacco combustion and use of shoes in the RM are considered low (±5 per cent). Thus, combined uncertainties for this source category represent circa ±50.25 per cent (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.

4.7.4. 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 sources of reference, including official sources (i.e., National Bureau of Statistics, Ministry of Health, Labor and Social Protection, 'Moldelectrica' SOE, Red Union Fenosa J.S.C.), etc. To be noted that the AD and methods used for estimating GHG emissions under the 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 2005-2015 periods recalculations were made for SF_6 and CF_4 emissions under the category 2G1 'Electrical Equipment' due to updating the total number of medium-tension electrical circuit breakers, in contrast to the previous inventory cycle, in the current inventory cycle there were also considered the number of 10 kV medium-tension electrical circuit breakers.

In comparison with the results obtained in the NC4 of the RM under UNFCCC (2018), the recalculations resulted in an increase of GHG emissions from the 2G1 'Electrical Equipment' category, varying from a minimum of 0.2 per cent in 2006-2009, to a maximum of 5.6 per cent in 2015 (Table 4-172). For 2016, GHG emissions within the respective category were estimated for the first time. The obtained results allow assert that over the period 2003-2016, SF_6 and CF_4 emissions increased by circa 164 times.

Table 4-172: Comparative Results of SF_6 and CF_4 Emissions from 2G1 'Electrical Equipment' included into the NC4 and the BUR2 of the RM under the UNFCCC, kt CO_2 equivalent

	2003	2004	2005	2006	2007	2008	2009
NC4	0.0071	0.0071	0.0569	0.3532	0.4528	0.5463	0.5890
BUR2	0.0071	0.0071	0.0572	0.3538	0.4536	0.5474	0.5904
Difference, %	0.0	0.0	0.5	0.2	0.2	0.2	0.2
	2010	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**
NC4	0.7200	0.7543	0.8113	1.0104	1.0978	1.0978	
BUR2	0.7222	0.7578	0.8161	1.0173	1.1070	1.1598	1.1655
Difference, %	0.3	0.5	0.6	0.7	0.8	5.6	

Abbreviations: NC4 – Fourth National Communication; BUR2 – Second Biennial Update Report.

The table below presents SF_6 and CF_4 emissions by substances in metric tons and expressed in CO_2 equivalent (Table 4-173).

Table 4-173: SF_6 and CF_4 Emissions from 2G1 'Electrical Equipment' Source Category in the RM within 2003-2016 periods

	2003	2004	2005	2006	2007	2008	2009
	2G1„Electrical Equipment"						
SF_6, t	0.0003	0.0003	0.0025	0.0145	0.0189	0.0227	0.0246
SF_6, kt CO_2 eq.	**0.0071**	**0.0071**	**0.0572**	**0.3307**	**0.4306**	**0.5186**	**0.5615**
CF_4, t	NO	NO	NO	0.0031	0.0031	0.0039	0.0039
CF_4, kt CO_2 eq.	**NO**	**NO**	**NO**	**0.0231**	**0.0231**	**0.0288**	**0.0288**
	2010	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**
	2G1„Electrical Equipment"						
SF_6, t	0.0299	0.0315	0.0340	0.0428	0.0468	0.0491	0.0494
SF_6, kt CO_2 eq.	**0.6819**	**0.7174**	**0.7757**	**0.9770**	**1.0667**	**1.1195**	**1.1252**
CF_4, t	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**

2G3. N_2O from Product Uses

No recalculations were made for the N_2O emissions from the 2G3 'N_2O from Product Uses' category recorded between 1990 and 2006 (Table 4-174). From 2007 through 2015 there are no records of N_2O emissions within the respective category.

Table 4-174: N_2O Emissions from 2G3 'N_2O from Product Uses' in the RM within 1990-2006

	1990	1991	1992	1993	1994	1995	1996	1997	1998
N_2O, tones	0.0001	0.0001	0.0001	0.0001	0.0001	0.0000	0.0000	0.0000	0.0000
N_2O, 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, tones	0.0000	0.0000	0.0000	0.0000	0.0000	0.0001	0.0001	0.0001	-10.6
N_2O, 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 2015 due to updating AD regarding shoes production in the RM, available in the official sources of references (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", respectively in the Statistical Yearbooks of the ATULBD).

In comparison with the results obtained in the NC4 of the RM under UNFCCC (2018), the recalculations resulted in a decrease of indirect CO_2 emissions from source category 2G4 'Other' in 2015 (Table 4-175). For 2016, indirect CO_2 emissions within the respective category were estimated for the first time. The obtained results allow assert that over the period 1990-2016 the respective emissions decreased in the country by circa 77.8 per cent.

Table 4-175: Comparative Results of Indirect CO_2 Emissions from 2G4 'Other' included into the NC4 and the BUR2 of the RM under the UNFCCC, kt CO_2 equivalent

	1990	1991	1992	1993	1994	1995	1996	1997	1998
NC4	3.1787	2.8632	2.2573	1.8544	1.3519	1.0947	1.0386	0.9389	0.7020
BUR2	3.1787	2.8632	2.2573	1.8544	1.3519	1.0947	1.0386	0.9389	0.7020
Difference, %	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	1999	2000	2001	2002	2003	2004	2005	2006	2007
NC4	0.6062	0.8987	0.7730	0.7307	0.8881	0.9656	1.0626	0.9584	0.9474
BUR2	0.6062	0.8987	0.7730	0.7307	0.8881	0.9656	1.0626	0.9584	0.9474
Difference, %	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
NC4	0.9859	0.6998	0.9046	1.0979	1.0427	1.1438	1.0338	0.7840	
BUR2	0.9859	0.6998	0.9046	1.0979	1.0427	1.1438	1.0338	0.7549	0.7041
Difference, %	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-3.7	

The table below presents non-CO_2 emissions from 2G4 'Other' source category for 1990-2016 time periods (Table 4-176). During the period under review, the respective emissions recorded similar trends as for indirect CO_2 emissions.

Table 4-176: Non-CO_2 Emissions from 2G4 'Other' source category within 1990-2016, kt

	1990	1991	1992	1993	1994	1995	1996	1997	1998
NO_x, kt	0.0197	0.0199	0.0186	0.0190	0.0173	0.0153	0.0210	0.0205	0.0162
CO, kt	0.6017	0.6083	0.5686	0.5819	0.5290	0.4695	0.6414	0.6281	0.4967
NMVOC, kt	1.4449	1.3014	1.0260	0.8429	0.6145	0.4976	0.4721	0.4268	0.3191
	1999	2000	2001	2002	2003	2004	2005	2006	2007
NO_x, kt	0.0189	0.0200	0.0203	0.0136	0.0154	0.0152	0.0134	0.0109	0.0107
CO, kt	0.5773	0.6124	0.6229	0.4172	0.4712	0.4661	0.4096	0.3326	0.3289
NMVOC, kt	0.2755	0.4085	0.3514	0.3321	0.4037	0.4389	0.4830	0.4356	0.4306
	2008	2009	2010	2011	2012	2013	2014	2015	2016
NO_x, kt	0.0086	0.0105	0.0135	0.0140	0.0101	0.0075	0.0050	0.0038	0.0040
CO, kt	0.2638	0.3225	0.4140	0.4272	0.3078	0.2296	0.1535	0.1174	0.1216
NMVOC, kt	0.4481	0.3181	0.4112	0.4990	0.4739	0.5199	0.4699	0.3432	0.3200

4.7.6. Planned Improvements

Potential improvements under the 2G 'Other Product Manufacture and Use' category could include updating the activity data used to estimate GHG emissions within this category for the 1990-2016 periods. Also, regarding the collecting of AD on fireworks products consumption (code 3604 10 000 – signaling and anti-hailing missiles and similar, firecrackers and other pyrotechnic articles, such as code 3604 90 000 – other articles for fireworks), within category 2G 'Other Product Manufacture and Use' the GHG emissions from the respective sources will be estimated additionally (SNAP 060601).

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 Beverages Industry'. In the Republic of Moldova, no pulp and paper are produced, respectively there are no recorded emissions from 2H1 category, and these are reported as Not Occurring (NO).

NMVOC emissions have been reported from 2H2 „Food and Beverages Industry" source category. Between 1990 and 2016 the respective emissions decreased by circa 57.9 per cent, from 12.25 kt in 1990 to 12.25 kt in 1990 to 5.16 kt in 2016 (Table 4-177). At the same time, in comparison with the previous year, in 2016 the NMVOC emissions from 2H2 'Food and Beverages Industry' source category increased by circa 8.6 per cent.

Table 4-177: NMVOC emissions from 2H2 'Food and Beverages Industry' source category in the RM within 1990-2016 periods, kt

	1990	1991	1992	1993	1994	1995	1996	1997	1998
2H2a. 'Bread Making and Other Food'"	11.0434	9.0948	7.2053	7.8286	5.0893	5.8083	5.7982	5.5868	4.7372
2H2b. 'Alcoholic Beverages'	1.2109	1.1934	1.0524	1.8074	3.0881	4.6380	3.5746	2.7530	2.1389
2H2. 'Food and Beverages Industry'	12.2544	10.2883	8.2577	9.6360	8.1775	10.4463	9.3728	8.3398	6.8761
	1999	2000	2001	2002	2003	2004	2005	2006	2007
2H2a. 'Bread Making and Other Food'"	3.0748	2.9202	3.1034	3.4932	2.6133	2.9743	3.1437	3.1424	1.9021
2H2b. 'Alcoholic Beverages'	1.1396	0.8406	1.0877	1.3334	2.2069	3.1694	3.5807	2.3918	2.0699
2H2. 'Food and Beverages Industry'	4.2144	3.7608	4.1911	4.8266	4.8202	6.1437	6.7243	5.5342	3.9720
	2008	2009	2010	2011	2012	2013	2014	2015	2016
2H2a. 'Bread Making and Other Food'"	3.4029	2.0758	2.8726	2.7945	2.2399	3.4545	3.8966	2.6521	3.1494
2H2b. 'Alcoholic Beverages'	1.7245	1.3825	1.5763	1.8592	2.2435	2.6539	2.4336	2.0963	2.0072
2H2. 'Food and Beverages Industry'	5.1274	3.4583	4.4489	4.6537	4.4834	6.1085	6.3301	4.7483	5.1565

To be noted that in the reference year (1990), around 91.1 per cent of the total NMVOC emissions were generated from the source category 2H2a 'Bread Making and Other Food'. By 2016, the share of this category in the total NMVOC emissions decreased up to circa 61.1 per cent (Figure 4-4).

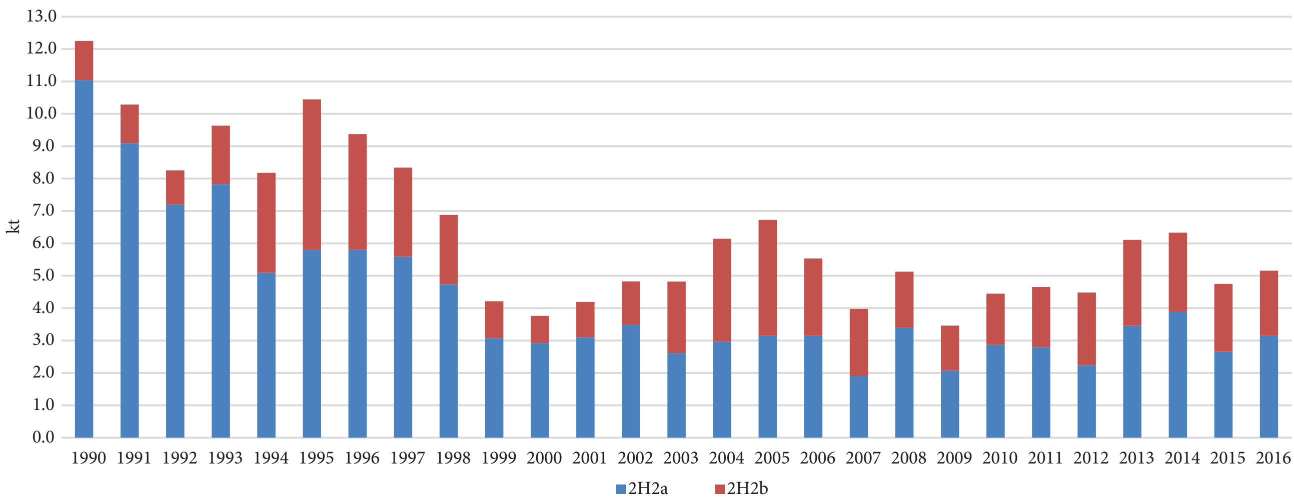


Figure 4-4: NMVOC emissions from 2H2 'Food and Beverages Industry' source category in the RM within 1990-2016 periods, kt.

4.8.2. Methodological Issues, Emission Factors and Data Sources

a) Bread Making and Other Food

Methodological issues pertaining to calculation of the NMVOC emissions from bread making and other food are addressed in the EMEP/EEA Air Pollutant Emission Inventory Guidebook (2016). The estimation method used implies multiplication of default EF values (Table 4-178) by activity data on bread making and other food available in the national statistics of the RM and of the ATULBD (Table 4-179).

Table 4-178: Default Emission Factors 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	Animal rendering	0.33
	Fish meal processing	1.0
	Grain drying	1.3
	Sugar; Margarine and solid cooking fats	10
	Cakes, biscuits and breakfast cereals; Animal Feed	1
	White Bread	4.5

Source: EMEP/EEA Atmospheric Emissions Inventory Guidebook (2016), 1 2.H.2 Food and Beverages Industry, SNAP 040605 – Bread, Tables 3-2, 3-3, 3-4, 3-11, 3-18, 3-19, 3-20, 3-21, 3-22. Pages 10-20.

Table 4-179: Activity Data on Bread Making and Other Food in the Republic of Moldova within 1990-2016 periods, kt

	1990	1991	1992	1993	1994	1995	1996	1997	1998
Meat	257.900	218.500	136.000	114.200	85.900	58.400	52.600	50.800	27.300
Fish	9.500	5.200	6.500	9.500	2.100	0.000	0.000	0.900	0.800
Dried grains in elevators	2169.760	2539.600	1725.894	2374.223	1241.296	1581.116	1264.628	1692.411	1339.292
Sugar	435.800	236.900	192.200	230.200	166.700	218.700	264.500	213.300	194.500
Confectionary Products	24.300	23.500	12.100	10.080	5.000	5.170	5.150	5.550	9.200
Bread	601.900	528.300	468.600	431.700	325.200	268.400	252.500	221.900	180.200
Animal Feed	1037.292	946.192	867.504	440.210	309.794	333.628	350.394	231.890	221.176
	1999	2000	2001	2002	2003	2004	2005	2006	2007
Meat	25.717	13.351	7.301	11.262	14.855	10.180	6.651	10.228	16.122
Fish	1.000	1.900	2.300	2.700	2.700	2.700	3.000	2.500	2.300
Dried grains in elevators	985.796	899.624	860.243	876.056	618.920	849.187	814.747	678.433	282.590
Sugar	100.500	105.400	132.600	167.600	107.100	110.900	133.472	149.046	73.964
Confectionary Products	NO	0.024	1.034	2.616	3.301	3.515	3.390	2.624	2.225
Bread	8.423	8.745	12.834	15.852	18.036	17.876	20.726	21.692	22.284
Animal Feed	147.045	138.126	133.280	130.779	144.650	145.830	142.026	144.848	154.774
Meat	108.604	59.791	31.441	41.381	28.095	46.062	50.840	64.340	46.422
	2008	2009	2010	2011	2012	2013	2014	2015	2016
Meat	12.809	16.260	24.699	28.509	31.597	35.495	44.072	45.958	45.900
Fish	4.600	3.700	1.300	7.578	7.732	8.490	8.774	9.241	9.241
Dried grains in elevators	920.742	658.146	764.898	803.125	405.367	882.585	955.221	724.700	987.601
Sugar	133.966	38.373	103.209	88.436	83.440	140.297	177.695	84.519	99.999
Confectionary Products	1.940	1.657	1.274	1.119	0.484	0.706	C	C	C
Bread	22.910	23.629	27.718	29.383	31.332	34.633	34.875	34.255	35.156
Animal Feed	169.806	161.564	160.406	162.916	161.765	165.450	160.259	161.328	157.684
Meat	51.043	60.143	74.405	75.405	96.284	97.787	98.472	80.118	96.371

Source: Statistical Yearbooks of the Republic of Moldova 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 2005-2016"; 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).

AD on the amount of dried grains in elevators were deduced from the information available in the national statistics of the RM and ATULBD (Table 4-180).

Table 4-180: Selective AD on Agricultural Crops in the RM within 1990-2016 periods

	1990	1991	1992	1993	1994	1995	1996	1997	1998
Wheat, kt	1129.0	1056.5	925.8	1392.6	658.8	1154.3	673.7	1152.6	951.9
Barley, kt	417.9	427.0	405.0	481.0	324.9	311.2	136.7	256.9	242.2
Oat, kt	3.8	5.0	6.8	10.7	7.1	9.8	4.2	10.3	9.5
Grain maize, kt	885.5	1501.2	635.6	1324.5	629.3	948.6	1006.6	1788.0	1272.7
Sunflower, kt	252.2	151.4	176.2	173.7	149.2	208.1	284.0	174.3	196.4
Soy, kt	23.8	33.4	7.9	9.3	4.0	3.3	2.5	2.7	6.0
Total cereals, kt	2712.2	3174.5	2157.4	3391.7	1773.3	2635.2	2107.7	3384.8	2678.6
Share of cereals dried in elevators, % of total	80	80	80	70	70	60	60	50	50
Cereals dried in elevators, kt	2169.8	2539.6	1725.9	2374.2	1241.3	1581.1	1264.6	1692.4	1339.3
	1999	2000	2001	2002	2003	2004	2005	2006	2007
Wheat, kt	797.8	725.0	1180.8	1113.1	102.4	861.2	1048.6	682.3	406.5
Barley, kt	203.1	152.3	248.4	241.7	74.4	284.1	240.9	214.6	125.7
Oat, kt	5.9	3.5	6.4	4.7	4.0	10.3	7.6	6.1	1.4
Grain maize, kt	1151.3	1050.4	1141.9	1206.3	1440.2	1845.1	1523.4	1327.6	363.2
Sunflower, kt	291.6	305.1	278.3	340.9	421.4	354.8	368.7	396.1	158.7
Soy, kt	13.7	11.6	10.5	12.6	19.4	40.2	66.4	80.2	40.0
Rapeseed for grains, kt	1.2	1.1	1.0	1.0	1.2	1.1	3.4	6.9	34.9
Total cereals, kt	2464.5	2249.1	2867.5	2920.2	2063.1	3396.7	3259.0	2713.7	1130.4
Share of cereals dried in elevators, % of total	40	40	30	30	30	25	25	25	25
Cereals dried in elevators, kt	985.8	899.6	860.2	876.1	618.9	849.2	814.7	678.4	282.6
	2008	2009	2010	2011	2012	2013	2014	2015	2016
Wheat, kt	1286.5	738.9	749.5	797.1	496.9	1009.6	1102.6	927.4	1302.4
Barley, kt	362.3	290.5	240.7	218.9	139.3	241.6	244.7	199.1	273.9
Oat, kt	3.9	1.6	3.1	3.6	2.0	3.8	2.9	1.6	2.8
Grain maize, kt	1484.1	1159.6	1462.1	1547.2	587.2	1546.8	1642.1	1133.6	1485.7
Sunflower, kt	387.2	310.2	440.2	497.4	339.1	602.2	627.1	562.3	789.4
Soy, kt	58.8	50.1	113.0	80.6	48.9	67.6	111.4	49.2	43.8
Rapeseed for grains, kt	100.1	81.6	51.0	67.7	8.1	58.8	90.2	25.6	52.4
Total cereals, kt	3683.0	2632.6	3059.6	3212.5	1621.5	3530.3	3820.9	2898.8	3950.4
Share of cereals dried in elevators, % of total	25	25	25	25	25	25	25	25	25
Cereals dried in elevators, kt	920.7	658.1	764.9	803.1	405.4	882.6	955.2	724.7	987.6

Source: NBS, Statistical database, 'Sown area, average yield on agricultural crops 1980-2016": <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).

It was considered only agricultural crops the production of which is dried in the elevators. The share of cereal production dried in elevators was determined by experts' judgement, based on national practices during the period under review.

b) Alcoholic Beverages

Methodological issues related to calculation of NMVOC emissions from production of alcoholic beverages are addressed in the EMEP/EEA Air Pollutant Emission Inventory Guidebook (2016). The estimation method is based on multiplying default values of emission factors (Table 4-181) by activity data on production of alcoholic beverages available in national statistics of the RM and of the AT-ULBD (Table 4-182).

Table 4-181: Default EFs Used to Calculate NMVOC Emissions from Alcoholic Beverages

Source	Alcoholic beverages	NMVOC, kg / hl
Alcoholic Beverages	Red Wine	0.080
	White Wine, Beer	0.035
	Spirits (unspecified)	15.0
	Whisky / Grain Whisky / Vodka	7.5
	Divin (Cognac) / Brandy	3.5

Source: EMEP/EEA Atmospheric Emissions Inventory Guidebook, (2016), 1 2.H.2 Food and Beverages Industry SNAP 040606 – Wine, Tables 3-24, 3-25, 3-26, 3-27, 3-28, 3-30, 3-31. Pages 21-24.

Table 4-182: Activity Data on Alcoholic Beverages Production within 1990-2016 periods

	1990	1991	1992	1993	1994	1995	1996	1997	1998
Wine, thousand hl	1630.0	1430.0	920.0	1130.0	977.8	996.9	1458.0	1941.5	1239.6
White wine, thousand hl	764.5	670.7	431.5	530.0	458.6	467.5	683.8	910.6	581.4
Red wine, thousand hl	865.5	759.3	488.5	600.0	519.2	529.4	774.2	1030.9	658.2
Wines of Porto, Madeira, Sherry, Tokay and other, thousand hl	217.7	189.0	126.0	156.7	135.4	141.5	216.1	290.7	182.6
Sparkling wine, thousand hl	80.4	78.3	85.4	88.8	74.2	94.8	141.9	134.5	51.9
Brandy, thousand hl	139.4	140.2	75.0	74.0	79.3	102.7	45.7	58.6	49.7
Grain Whisky and Liqueurs, thousand hl	55.9	55.6	67.6	139.4	264.7	412.7	335.8	237.0	174.1
Vodka, thousand hl	21.5	21.4	26.7	54.4	99.2	146.6	103.9	82.5	74.6
Beer, thousand hl	760.0	660.0	430.0	360.0	285.0	302.9	256.0	262.7	300.1
	1999	2000	2001	2002	2003	2004	2005	2006	2007
Wine, thousand hl	690.1	1092.2	1564.2	1494.0	1921.8	3351.4	3643.5	1886.8	1258.1
White wine, thousand hl	323.7	512.3	733.6	700.7	901.3	1571.8	1710.2	983.0	717.9
Red wine, thousand hl	366.4	580.0	830.6	793.3	1020.5	1779.6	1933.3	903.8	540.2
Wines of Porto, Madeira, Sherry, Tokay and other, thousand hl	101.6	163.3	235.2	225.3	289.9	301.8	323.8	133.7	75.3
Sparkling wine, thousand hl	67.5	41.6	58.4	61.3	73.9	93.8	105.1	40.2	54.1
Brandy, thousand hl	48.6	71.8	95.6	103.8	136.1	142.8	171.1	79.1	82.4
Grain Whisky and Liqueurs, thousand hl	87.0	48.9	59.4	77.9	139.8	212.9	238.8	196.3	172.2
Vodka, thousand hl	34.4	18.0	24.4	34.9	69.6	109.8	122.6	65.6	50.5
Beer, thousand hl	220.9	257.9	336.2	462.4	599.1	695.7	777.8	913.3	1014.6
	2008	2009	2010	2011	2012	2013	2014	2015	2016
Wine, thousand hl	1553.0	1263.1	1285.5	1260.6	1422.0	1551.7	1409.5	1356.5	1345.8
White wine, thousand hl	814.4	600.4	591.7	664.3	679.2	694.3	765.1	622.5	576.2
Red wine, thousand hl	738.6	662.7	693.8	596.3	742.8	857.4	644.3	734.0	769.6
Wines of Porto, Madeira, Sherry, Tokay and other, thousand hl	92.2	69.3	105.1	111.2	52.8	65.1	34.8	37.1	47.0
Sparkling wine, thousand hl	57.3	50.0	55.6	68.6	65.4	60.0	52.2	50.2	63.3
Brandy, thousand hl	103.7	69.8	74.6	91.2	109.4	118.0	93.9	70.2	50.1
Grain Whisky and Liqueurs, thousand hl	129.1	110.8	127.1	140.2	165.9	196.1	183.4	162.3	162.8
Vodka, thousand hl	35.4	26.5	32.2	49.2	65.0	84.5	81.6	68.4	65.8
Beer, thousand hl	866.6	781.7	952.6	1068.1	1118.4	1029.3	984.8	994.5	847.8

Source: Statistical Yearbooks of the Republic of Moldova 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 2005-2016'; 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).

4.8.3. Uncertainty Assessment and Time-Series Consistency

The primary uncertainties related factors pertain to methodology, EFs used to estimate GHG emissions covered by the 2H2 'Food and Beverages Industry' source category, and the quality of activity data available. Uncertainties related to the default EFs used to estimate the NMVOC emissions may be a factor of 2. Uncertainties related to activity data on bread making and other food and alcoholic beverages production in the Republic of Moldova are quite low (±5 per cent). 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 as reference source according to the EMEP/EEA Air Pollutant Emission Inventory Guidebook (2016); correct use of AD obtained from different sources of reference, including official sources (Statistical Yearbooks of the Republic of Moldova and those of the ATULBD), etc. To be noted that the AD and methods used for estimating GHG emissions under the 2H2 'Food and Beverages Industry' source category were documented and archived both in hard copies and electronically.

4.8.5. Recalculations

NMVOC emissions from the 2H2 'Food and Beverages Industry' source category were recalculated for the 2011-2012 and 2015 periods, due to updated AD regarding meat production in 2015, respectively the amounts of cereals dried in elevators between 2011 and 2012 as well as in 2015. In comparison with the results obtained in the NC4 of the RM under UNFCCC (2018), the recalculations resulted in an insignificant increase of NMVOC emissions in 2011-2012 and 2015, with a maximum increase recorded in 2015 (0.3 per cent), while the minimum increase was recorded in 2012 (0.1 per cent). For 2016, NMVOC emissions from bread making and other food and alcoholic beverages in the Republic of Moldova were estimated for the first time. The obtained results allow assert that over the period 1990-2016, the respective emissions decreased by 57.9 per cent (Table 4-183).

Table 4-183: Comparative results of NMVOC emissions from 2H2 'Food and Beverages Industry' source category included into the NC4 and the BUR2 of the RM under the UNFCCC, kt

	1990	1991	1992	1993	1994	1995	1996	1997	1998
NC4	12.2544	10.2883	8.2577	9.6360	8.1775	10.4463	9.3728	8.3398	6.8761
BUR2	12.2544	10.2883	8.2577	9.6360	8.1775	10.4463	9.3728	8.3398	6.8761
Difference, %	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	1999	2000	2001	2002	2003	2004	2005	2006	2007
NC4	4.2144	3.7608	4.1911	4.8266	4.8202	6.1437	6.7243	5.5342	3.9720
BUR2	4.2144	3.7608	4.1911	4.8266	4.8202	6.1437	6.7243	5.5342	3.9720
Difference, %	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
NC4	5.1274	3.4583	4.4489	4.6461	4.4796	6.1085	6.3301	4.7339	
BUR2	5.1274	3.4583	4.4489	4.6537	4.4834	6.1085	6.3301	4.7483	5.1565
Difference, %	0.0	0.0	0.0	0.2	0.1	0.0	0.0	0.3	

Abbreviations: NC4 – Fourth National Communication; BUR2 – Second Biennial Update Report.

a) *Bread Making and Other Food*

In comparison with the results obtained in the NC4 of the RM under UNFCCC (2018), the recalculations resulted in an insignificant increase of NMVOC emissions from source category 2H2a 'Bread Making and Other Food' in 2011-2012 and 2015, with a maximum increase recorded in 2015 (0.5 per cent), while the minimum increase was recorded in 2012 (0.2%). For 2016, NMVOC emissions from bread making and other food in the RM were estimated for the first time. The obtained results allow assert that over the period 1990-2016, the respective emissions decreased by 71.5 per cent (Table 4-184).

Table 4-184: Comparative results of NMVOC emissions from 2H2a 'Bread Making and Other Food' source category included into the NC4 and the BUR2 of the RM under the UNFCCC, kt

	1990	1991	1992	1993	1994	1995	1996	1997	1998
NC4	11.0434	9.0948	7.2053	7.8286	5.0893	5.8083	5.7982	5.5868	4.7372
BUR2	11.0434	9.0948	7.2053	7.8286	5.0893	5.8083	5.7982	5.5868	4.7372
Difference, %	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	1999	2000	2001	2002	2003	2004	2005	2006	2007
NC4	3.0748	2.9202	3.1034	3.4932	2.6133	2.9743	3.1437	3.1424	1.9021
BUR2	3.0748	2.9202	3.1034	3.4932	2.6133	2.9743	3.1437	3.1424	1.9021
Difference, %	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
NC4	3.4029	2.0758	2.8726	2.7869	2.2361	3.4545	3.8966	2.6376	
BUR2	3.4029	2.0758	2.8726	2.7945	2.2399	3.4545	3.8966	2.6521	3.1494
Difference, %	0.0	0.0	0.0	0.3	0.2	0.0	0.0	0.5	

Abbreviations: NC4 – Fourth National Communication; BUR2 – Second Biennial Update Report.

b) *Alcoholic Beverages*

No recalculations were made for the NMVOC emissions from the 2H2b 'Alcoholic Beverages' source category recorded between 1990 and 2015. For 2016, NMVOC emissions from alcoholic beverages in the RM were estimated for the first time. The obtained results allow assert that over the period 1990-2016, the respective emissions increased by circa 65.8 per cent (Table 4-185).

Table 4-185: Comparative results of NMVOC emissions from 2H2b 'Alcoholic Beverages' source category included into the NC4 and the BUR2 of the RM under the UNFCCC, kt

	1990	1991	1992	1993	1994	1995	1996	1997	1998
NC4	1.2109	1.1934	1.0524	1.8074	3.0881	4.6380	3.5746	2.7530	2.1389
BUR2	1.2109	1.1934	1.0524	1.8074	3.0881	4.6380	3.5746	2.7530	2.1389
Difference, %	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	1999	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**
NC4	1.1396	0.8406	1.0877	1.3334	2.2069	3.1694	3.5807	2.3918	2.0699
BUR2	1.1396	0.8406	1.0877	1.3334	2.2069	3.1694	3.5807	2.3918	2.0699
Difference, %	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**
NC4	1.7245	1.3825	1.5763	1.8592	2.2435	2.6539	2.4336	2.0963	
BUR2	1.7245	1.3825	1.5763	1.8592	2.2435	2.6539	2.4336	2.0963	2.0072
Difference, %	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	

Abbreviations: NC4 – Fourth National Communication; BUR2 – Second Biennial Update Report.

This increase can be explained by a substantial growth of winemaking industry's output in the RM over the period under review: vodka – by 206.6 per cent, grain whiskey and liqueurs – by 191.2 per cent and beer – by 11.6 per cent, and this was despite the fact that the production of grape wine decreased over the same period by 17.4 per cent, sparkling wine – by 21.2 per cent, brandy – by 64.0 per cent, and wines of Porto, Madeira, Sherry, Tokay and other – by 78.4 per cent (Table 4-182).

4.8.6. Planned Improvements

Possible improvements under the 2H 'Other' category aim at updating the activity data used to estimate NMVOC emissions within this category for the reporting period included within the previous inventory cycles.

5. AGRICULTURE SECTOR

Agriculture sector plays a significant role in the national economy of the Republic of Moldova, contributing with circa 12.2 per cent to its GDP (NBS, 2017). In 2016, under the agriculture sector the plant production accounted for a relatively larger share – 69.5 per cent, animal breeding – for 28.9 per cent, while the services – for circa 1.6 per cent (NBS, 2017). More than 33.7 per cent of active population is employed in this sector (NBS, 2017). The overwhelming majority of agricultural workers represent small and medium agricultural production enterprises.

On January 1, 2017, the total area of the country represented 3384.6 thousand ha, including 2499.8 thousand ha (73.9 per cent) – agricultural lands; of which 1827.3 thousand ha (54.0 per cent) – which 1822.9 thousand ha (53.9 per cent) – arable lands, 288.8 thousand ha (8.5 per cent) – perennial plantations; 344.9 thousand ha (10.2 per cent) – hayfields and pastures; 38.8 thousand ha (1.2 per cent) – fallow lands; 465.3 thousand ha (13.8 per cent) – forests and lands covered with forest vegetation; 96.1 thousand ha (2.8 per cent) – rivers, lakes, water basins and bogs, and 323.4 thousand ha (9.6 per cent) – other lands (NBS, 2017).

According to the Land Cadaster of the Republic of Moldova, in 2016 the use of agricultural land by different agribusiness entities was as it follows: 74 state agribusiness enterprises with a total area of 179.1 thousand ha (8.8 per cent); 75 scientific research and education institutions with a total area of 20.9 thousand ha (1.0 per cent); 132 of other enterprises and auxiliary households in state ownership – 72.4 thousand ha (3.6 per cent); 34.8 thousand plots in the public property of the administrative-territorial units with a total area of 55.2 thousand ha (2.7 per cent); 2058 production cooperatives with a total area of 90.5 thousand ha (4.5 per cent); 152 joint stock companies with a total area of 32.1 thousand ha (1.6 per cent); 33.7 thousand limited liability companies – 745.5 thousand ha (36.8 per cent); 366.4 thousand peasant farms – 526.8 thousand ha (26.0 per cent); 788.3 thousand plots used individually by private owners with a total area of 230.3 thousand ha (11.4 per cent); 35.5 thousand of orchard farms – 2.6 thousand ha (0.1 per cent) and 96.9 thousand of other lands with a total area of 72.0 thousand ha (3.5 per cent).

5.1. Overview

The main sources covered by Sector 3 'Agriculture' in the Republic of Moldova include methane emissions from animal breeding, in particular from 3A 'Enteric Fermentation' and 3B 'Manure Management' categories, nitrous oxide emissions from 3B 'Manure Management' and 3D 'Agricultural Soils' categories, as well as carbon dioxide emissions from 3H 'Urea Application' category. As in the Republic of Moldova rice is not cultivated and there are no savannas, no GHG emissions were reported from categories 3C 'Rice Cultivation' and 3E 'Prescribed Burning of Savannas'. Also, GHG emissions covered by the 3F 'Field Burning of Agricultural Residues' category were reported under 'Land Use, Land-Use Change and Forestry' sector, 4B1 'Cropland Remaining Cropland' source category.

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 2016, Sector 3 'Agriculture' accounted for circa 16.7 per cent of total national direct GHG emissions (without LULUCF), being the second major source of GHG emissions after the Sector 1 'Energy'. To be noted that Sector 3 'Agriculture' was a major source of CH_4 and N_2O emissions, accounting for circa 25.3 per cent and respectively 88.4 per cent of total emissions reported at national level. Between 1990 and 2016, the total GHG emissions originated from the Sector 3 'Agriculture' tended to lower values, decreasing by circa 53.5 per cent, from 5,220.6 kt CO_2 eq. recorded in 1990 to 2,428.5 kt CO_2 eq. in 2016 (Table 5-1), in particular, due to decreasing values of such indicators as: the number of domestic livestock and poultry, amount of synthetic and organic nitrogen fertilizers applied to soils, quantities of agricultural crop residues returned to soil and carbon losses from land use change and soil management practices.

Table 5-1: Direct GHG Emissions from Sector 3 'Agriculture' in the Republic of Moldova within 1990-2016 periods, kt CO_2 equivalent

	1990	1991	1992	1993	1994	1995	1996	1997	1998
CO_2	0.5820	0.5226	0.3905	0.1276	0.0537	0.0607	0.0911	1.0992	0.2721
CH_4	2 685.7899	2 445.7301	2 367.6699	2 150.2757	2 090.6519	1 827.0086	1 678.5535	1 437.2403	1 375.2311
N_2O	2 534.2021	2 416.5879	2 031.8910	2 079.2669	1 655.2645	1 775.8460	1 705.9690	1 746.8398	1 577.0224
Total	5 220.5740	4 862.8405	4 399.9514	4 229.6703	3 745.9701	3 602.9153	3 384.6136	3 185.1794	2 952.5257
	1999	2000	2001	2002	2003	2004	2005	2006	2007
CO_2	0.0034	0.4397	0.1496	0.0470	0.2381	0.3669	0.1739	0.1460	0.2631
CH_4	1 266.4842	1 170.6727	1 191.5902	1 218.5383	1 114.7492	1 043.5482	1 012.5495	984.5297	787.4367
N_2O	1 429.7300	1 309.7359	1 484.3183	1 526.2868	1 284.8654	1 548.6947	1 565.6484	1 481.7433	889.0798
Total	2 696.2176	2 480.8483	2 676.0581	2 744.8721	2 399.8528	2 592.6098	2 578.3718	2 466.4190	1 676.7796
	2008	2009	2010	2011	2012	2013	2014	2015	2016
CO_2	0.8505	0.5864	1.7443	3.6752	5.5908	4.1840	10.2058	11.2402	12.2747
CH_4	752.3781	787.7830	789.4582	743.6316	701.9100	711.2160	753.4887	724.2403	717.6111
N_2O	1 490.1625	1 286.7992	1 463.8125	1 460.6271	1 052.5989	1 537.1504	1 728.6204	1 355.6975	1 698.5781
Total	2 243.3912	2 075.1686	2 255.0151	2 207.9339	1 760.0998	2 252.5504	2 492.3149	2 091.1781	2 428.4639

To be noted that in 1990, CO_2, CH_4 and N_2O emissions accounted for 0.01 per cent, 51.45% per cent and respectively 48.54 per cent of total direct GHG emissions originated from the Sector 3 'Agriculture'. By 2016, the share of CO_2 emissions increased up to 0.51 per cent, N_2O emissions increased up to 69.94 per cent, while that of CH_4 decreased to 29.55 per cent.

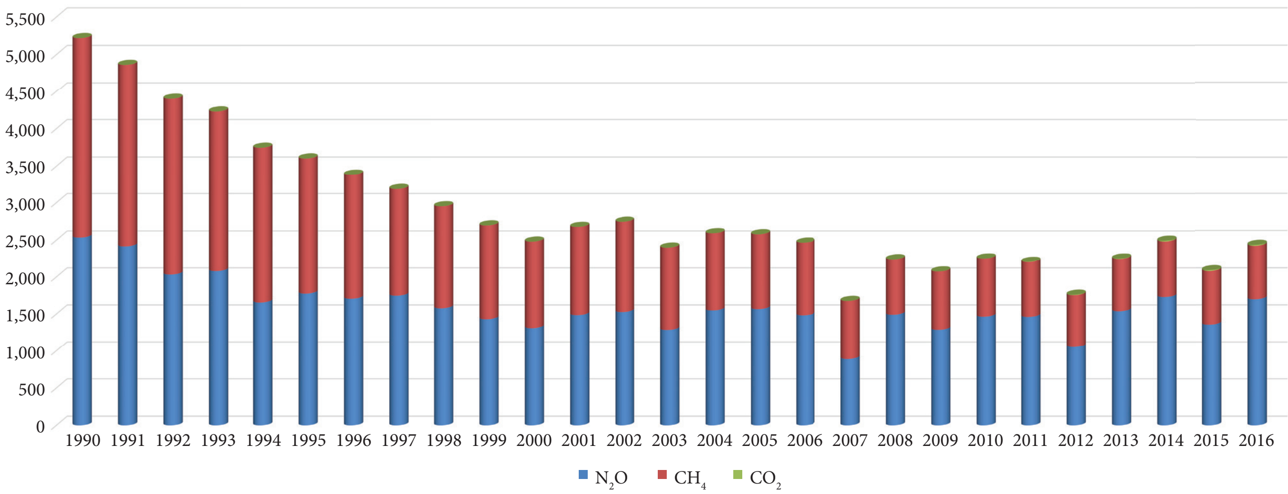


Figure 5-1: Direct GHG Emissions from Sector 3 'Agriculture' in the Republic of Moldova within 1990-2016 periods, kt CO_2 equivalent.

Over the period under review, total direct GHG emissions from the Sector 3 'Agriculture' decreased by 53.5 per cent, while CH_4 and N_2O emissions decreased respectively, by 73.3 per cent and 33.0 per cent (Figure 5-1, Table 5-2). At the same time, between 1990 and 2016, CO_2 emissions from urea application increased by circa 21 times.

Table 5-2: Total Direct GHG Emissions from Sector 3 'Agriculture' by Category, within 1990-2016 periods, kt

	1990	1991	1992	1993	1994	1995	1996	1997	1998
3H Urea Application	0.5820	0.5226	0.3905	0.1276	0.0537	0.0607	0.0911	1.0992	0.2721
Total CO_2 Emissions from Sector 3 Agriculture	**0.5820**	**0.5226**	**0.3905**	**0.1276**	**0.0537**	**0.0607**	**0.0911**	**1.0992**	**0.2721**
3A Enteric Fermentation	87.6278	81.2260	79.7785	75.0132	73.0168	64.8293	59.6463	51.4030	49.9008
3B Manure Management	19.8038	16.6032	14.9283	10.9978	10.6093	8.2510	7.4958	6.0866	5.1085
Total CH_4 Emissions from Sector 3 Agriculture	**107.4316**	**97.8292**	**94.7068**	**86.0110**	**83.6261**	**73.0803**	**67.1421**	**57.4896**	**55.0092**
3B Manure Management	3.7470	3.4991	3.1392	2.7360	2.6585	2.4596	2.5974	2.0035	1.9398
3D Agricultural Soils	4.7570	4.6102	3.6792	4.2414	2.8961	3.4996	3.1273	3.8583	3.3522
Total N_2O Emissions from Sector 3 Agriculture	**8.5040**	**8.1094**	**6.8184**	**6.9774**	**5.5546**	**5.9592**	**5.7247**	**5.8619**	**5.2920**
	1999	2000	2001	2002	2003	2004	2005	2006	2007
3H Urea Application	0.0034	0.4397	0.1496	0.0470	0.2381	0.3669	0.1739	0.1460	0.2631
Total CO_2 Emissions from Sector 3 Agriculture	**0.0034**	**0.4397**	**0.1496**	**0.0470**	**0.2381**	**0.3669**	**0.1739**	**0.1460**	**0.2631**
3A Enteric Fermentation	46.1673	43.4256	44.2270	45.1436	41.2430	38.4891	37.0587	35.8683	28.9954
3B Manure Management	4.4921	3.4013	3.4366	3.5979	3.3469	3.2528	3.4433	3.5129	2.5021
Total CH_4 Emissions from Sector 3 Agriculture	**50.6594**	**46.8269**	**47.6636**	**48.7415**	**44.5900**	**41.7419**	**40.5020**	**39.3812**	**31.4975**
3B Manure Management	1.7608	1.5712	1.5998	1.6116	1.5302	1.4804	1.5820	1.6257	1.2423
3D Agricultural Soils	3.0370	2.8239	3.3811	3.5102	2.7814	3.7166	3.6718	3.3466	1.7412
Total N_2O Emissions from Sector 3 Agriculture	**4.7978**	**4.3951**	**4.9809**	**5.1218**	**4.3116**	**5.1970**	**5.2539**	**4.9723**	**2.9835**

	2008	2009	2010	2011	2012	2013	2014	2015	2016
3H Urea Application	0.8505	0.5864	1.7443	3.6752	5.5908	4.1840	10.2058	11.2402	12.2747
Total CO_2 Emissions from Sector 3 Agriculture	**0.8505**	**0.5864**	**1.7443**	**3.6752**	**5.5908**	**4.1840**	**10.2058**	**11.2402**	**12.2747**
3A Enteric Fermentation	27.6273	28.7000	28.5028	26.8403	25.3134	25.7324	27.2385	26.1360	25.9708
3B Manure Management	2.4678	2.8113	3.0755	2.9050	2.7630	2.7162	2.9011	2.8336	2.7337
Total CH_4 Emissions from Sector 3 Agriculture	**30.0951**	**31.5113**	**31.5783**	**29.7453**	**28.0764**	**28.4486**	**30.1395**	**28.9696**	**28.7044**
3B Manure Management	1.2244	1.3794	1.4304	1.3045	1.1973	1.1203	1.2336	1.1950	1.2507
3D Agricultural Soils	3.7762	2.9387	3.4817	3.5970	2.3349	4.0379	4.5671	3.3543	4.4492
Total N_2O Emissions from Sector 3 Agriculture	**5.0005**	**4.3181**	**4.9121**	**4.9014**	**3.5322**	**5.1582**	**5.8007**	**4.5493**	**5.6999**

Table 5-3 allows to assert that 3D 'Agricultural Soils' was the largest source of total direct GHG emissions from the Sector 3 'Agriculture' in the Republic of Moldova (with a share varying from a minimum of 23.04 per cent in 1994 to a maximum of 54.61 per cent in 2014), followed by 3A 'Enteric Fermentation' (with a share between a minimum of 26.74 per cent in 2016 to a maximum of 48.73 per cent in 1994), respectively the 3B 'Manure Management' (with a share between a minimum of 17.66 per cent in 2014 to a maximum of 30.87 per cent in 1990). The share of 3H 'Urea Application' in managed soils within the period under review was insignificant, though there is a constant increasing trend, in particular in the last seven years.

Table 5-3: Breakdown of the Republic of Moldova's Sector 3 'Agriculture' Total Direct GHG Emissions within 1990-2016 periods, % of the total

	1990	1991	1992	1993	1994	1995	1996	1997	1998
3A Enteric Fermentation	41.96	41.76	45.33	44.34	48.73	44.98	44.06	40.35	42.25
3B Manure Management	30.87	29.98	29.74	25.78	28.23	26.07	28.41	23.52	23.90
3D Agricultural Soils	27.15	28.25	24.92	29.88	23.04	28.95	27.53	36.10	33.83
3H Urea Application	0.01	0.01	0.01	0.00	0.00	0.00	0.00	0.03	0.01
	1999	2000	2001	2002	2003	2004	2005	2006	2007
3A Enteric Fermentation	42.81	43.76	41.32	41.12	42.96	37.11	35.93	36.36	43.23
3B Manure Management	23.63	22.30	21.03	20.77	22.49	20.15	21.62	23.20	25.81
3D Agricultural Soils	33.57	33.92	37.65	38.11	34.54	42.72	42.44	40.43	30.95
3H Urea Application	0.00	0.02	0.01	0.00	0.01	0.01	0.01	0.01	0.02
	2008	2009	2010	2011	2012	2013	2014	2015	2016
3A Enteric Fermentation	30.79	34.58	31.60	30.39	35.95	28.56	27.32	31.25	26.74
3B Manure Management	19.01	23.20	22.31	20.90	24.20	17.84	17.66	20.42	18.16
3D Agricultural Soils	50.16	42.20	46.01	48.55	39.53	53.42	54.61	47.80	54.60
3H Urea Application	0.04	0.03	0.08	0.17	0.32	0.19	0.41	0.54	0.51

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, as well as in the Annex 1. Table 5-4 provides information on identified key categories under the Sector 3 'Agriculture'.

Table 5-4: Key Categories Identified under the Sector 3 'Agriculture'

IPCC Category	GHG	Source Category	Key Categories
3A	CH_4	CH_4 emissions from enteric fermentation	Yes (L, T)
3B	CH_4	CH_4 emissions from manure management	Yes (L, T)
3B	N_2O	Direct N_2O emissions from manure management	Yes (L)
3B	N_2O	Indirect N_2O emissions from manure management	Yes (L, T)
3D	N_2O	Direct N_2O emissions from agricultural soils	Yes (L, T)
3D	N_2O	Indirect N_2O emissions from agricultural soils	Yes (L, T)
3H	CO_2	CO_2 emissions from urea application	No

Abbreviations: L – Level Assessment; T – Trend Assessment.

5.1.3. Methodological Issues

Emissions covered by 3A 'Enteric Fermentation', 3B 'Manure Management', 3D 'Agriculture Soils' and 3H 'Urea Application' categories were estimated using both, the Tier 1 methodological approach and default EFs values, as well as the Tier 2 methodological approach and country specific emission factors, in particular for the key categories. A summary description of methods used to estimate emissions by categories is provided in Table 5-5, while a more detailed description is available in sub-chapters 5.2-5.5 of the NIR.

Table 5-5: Summary of Methods Used to Estimate GHG Emissions for the 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	T3, 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 Factors

5.1.4. Uncertainties Assessment and Time-Series Consistency

The uncertainty analysis of the GHG emissions from the Sector 3 'Agriculture' (by categories) is described in detail in sub-chapters 5.2-5.5 of the NIR, as well as in the Annex 5-3.4. Combined uncertainties as a percentage of total direct sectoral emissions were estimated at ± 23.23 per cent. The uncertainties introduced in trend in sectoral emissions were estimated at circa ±7.81 per cent. In view of ensuring time-series consistency of the results, the same approach was used for the entire period under review.

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. To be noted that the AD and methods used to estimate GHG emissions under this sector were documented and archived both in hard copies and electronically. For identifying the data entry and emission estimation process related errors there were applied verifications and quality control procedures. Following the recommendations included into the 2006 IPCC Guidelines, GHG emissions were estimated using AD and national factors and parameters from official sources of reference.

5.1.6. Recalculations

GHG emission recalculations performed under the Sector 3 'Agriculture' are due to the availability of an updated set of activity data (the Statistical Yearbooks of the RM and those of the ATULBD, other relevant publications in the field), as well as due to updating country specific EFs.

In comparison with the results recorded within the previous inventory cycle, reported in the NC4 of the RM under the UNFCCC (2018), the performed recalculations resulted in increased values of direct GHG emissions within 1990-1993, 1995, 1997-1999, 2001-2002, 2004-2006, 2008-2011 and 2013-2014 periods, varying from a minimum of 0.02 per cent in 2004, up to a maximum of 0.34 per cent in 1995, respectively a decrease of direct GHG emissions within 1994, 1996, 2000, 2003, 2007, 2012 and 2015, varying from a minimum of 0.15 per cent in 1994, up to a maximum decrease of 1.11 per cent in 2015 (Table 5-6). The results of recalculations performed at the category level are presented in sub-chapters 5.2-5.5 of the NIR.

Table 5-6: Recalculated GHG Emissions under the Sector 3 'Agriculture' for 1990-2015, included in the NC4 of the RM under the UNFCCC (2018), kt CO_2 equivalent

	1990	1991	1992	1993	1994	1995	1996	1997	1998
NC4	5 210.5504	4 856.8975	4 397.6714	4 222.7086	3 751.6719	3 590.5870	3 400.9000	3 181.0194	2 946.7437
BUR2	5 220.5740	4 862.8405	4 399.9514	4 229.6703	3 745.9701	3 602.9153	3 384.6136	3 185.1794	2 952.5257
Difference, %	0.19	0.12	0.05	0.16	-0.15	0.34	-0.48	0.13	0.20
	1999	2000	2001	2002	2003	2004	2005	2006	2007
NC4	2 689.1844	2 500.2063	2 672.8041	2 742.4530	2 424.5620	2 592.0722	2 576.5167	2 463.0747	1 684.6528
BUR2	2 696.2176	2 480.8483	2 676.0581	2 744.8721	2 399.8528	2 592.6098	2 578.3718	2 466.4190	1 676.7796
Difference, %	0.26	-0.77	0.12	0.09	-1.02	0.02	0.07	0.14	-0.47
	2008	2009	2010	2011	2012	2013	2014	2015	2016
NC4	2 238.4254	2 070.2902	2 249.7258	2 204.0293	1 775.8023	2 249.0224	2 487.8723	2 114.6937	
BUR2	2 243.3912	2 075.1686	2 255.0151	2 207.9339	1 760.0998	2 252.5504	2 492.3149	2 091.1781	2 428.4639
Difference, %	0.22	0.24	0.24	0.18	-0.88	0.16	0.18	-1.11	

Abbreviations: NC4 – Fourth National Communication; BUR2 – Second Biennial Update Report.

5.1.7. Assessment of Completeness

The current inventory covers greenhouse gas emissions from 4 categories: 3A 'Enteric Fermentation', 3B 'Manure Management', 3D 'Agricultural Soils' and 3H 'Urea Application' (Table 5-7). As in the RM rice is not cultivated and there are no savannas, respectively no GHG emissions have been registered from the 3C 'Rice Cultivation' and 3E 'Prescribed Burning of Savannas'. GHG emissions from the 3F 'Field Burning of Agricultural Residues' were reported under Sector 4 'LULUCF', specifically under the 4B 'Cropland'. CO_2 emissions from 3G 'Liming' and 3I 'Other carbon-containing fertilizers' were not estimated due to lack of such activities in the Republic of Moldova.

Table 5-7: Assessment of Completeness of GHG Emissions under the 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
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.

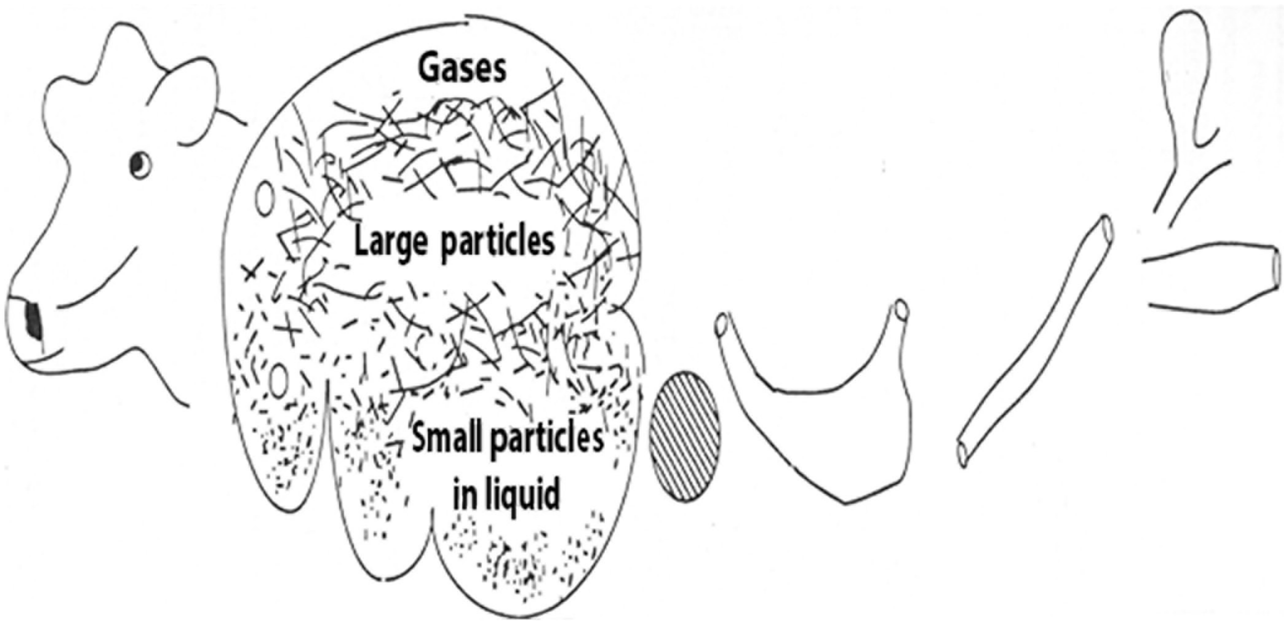
5.1.8. Planned Improvements

Planned improvements at the source categories level within the Sector 3 'Agriculture' are described in detail in respective sub-chapters (5.2-5.5) of the NIR.

5.2. Enteric Fermentation (Category 3A)

5.2.1. Source Category Description

Ruminant livestock, due to the symbiosis between macro-and microorganisms 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 (Figure 5-2). Also in the process, due to the fermentation of nutrients, significant quantities of gases are generated, containing up to 30-40 per cent of CH_4 and 60-70 per cent of CO_2[60].



[60] „Technical Guideline for Milk Production", Babcock International Institute for Dairy Research and Development, USA, 1996 (<www.animals-feed.info>)

Oral cavity	Reticulorumen	Omasum	Abomasum	Small intestine	Large intestine
From 24 up to 48 hours		From 1 up to 3 hours		From 10 up to 20 hours	
1. Chewing reduces the forage particles size. 2. Saliva production up to 180 l/ per day, the rate of saliva secretion will decrease sharply if the cow gets less cellulose. 3. Saliva is a good buffer (pH 8.2) to neutralize gastric acids in the stomach creating optimal conditions for development of the microflora.	1. The forage large particles return in the oral cavity for additional rumination. 2. Bacteria decompose forage proteins and carbohydrates. 3. Production of volatile fatty acids (VFA) as the final product of bacterial fermentation. 4. Synthesis of bacterial mass, rich in protein. 5. VFA absorption – the main energy source for ruminants. 6. Up to 1000 l gases (CO_2 and CH_4) produces per day	1. Water and VFA absorption. 2. Large particles are stopped by omasum.	1. Hydrochloric Acid (HCl) and enzymes are eliminated. 2. Digestion of those carbohydrates and proteins that have avoided the reticulorumen fermentation. 3. Digestion of microbial protein mass from the rumen (1 to 2.5 kg).	1. Enzyme secretion. 2. Receiving pancreas and liver secretion. 3. Fermentative decomposition of: -proteins, -carbohydrates and -lipids 4. Absorption of: -water, -minerals, -amino acids, -glucose and -fatty acids	1. Bacterial fermentation of unabsorbed nutrients continues. 2. Water absorption and stool formation processes continue.

Figure 5-2: Organs, processes and timing for forage digestion by ruminant livestock.

About 5 per cent of ingested feed gross energy is lost through gaseous emissions (Figure 5-3). Thus the problem of reducing the gas emissions within the feed fermentation process is important not only in terms of environmental protection, but also from economic point of view.

To be noted that both ruminant (cattle, sheep and goats) and non-ruminant livestock (pigs, horses and asses and mules) are major sources of methane emissions. However, ruminant livestock account for a larger share of total CH_4 emissions resulting from 3A 'Enteric fermentation' source category. The amount of methane that is released depends on a number of factors, such as species, age, weight of the animal, the quantity and quality of the feed intake, etc.

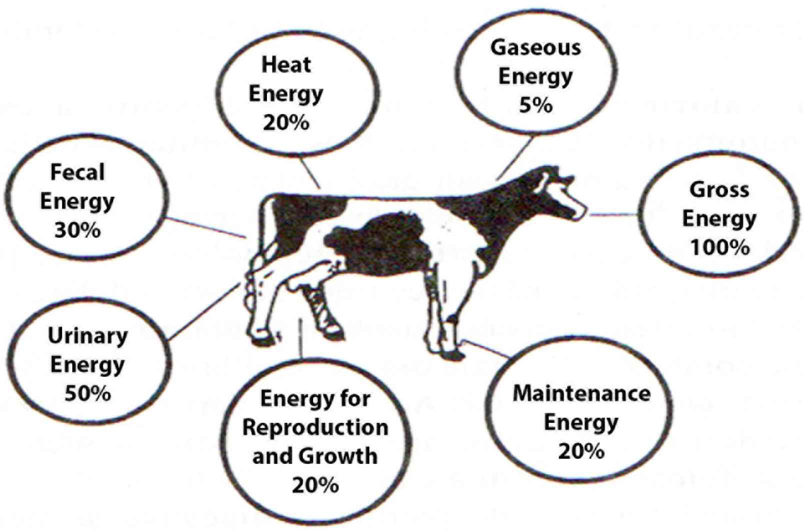


Figure 5-3: Intake Energy for Dairy Cows[61].

5.2.2. Activity Data, Methodological Issues and Emission Factors

Estimation of methane emissions covered by the 3A 'Enteric Fermentation' involved three basic steps:

(1) Divide the livestock population into subgroups and characterize each subgroup (see basic information on the livestock and poultry groups within the RM in the Annex 3-3);

(2) Estimate emission factors for each subgroup, as well as the average situation for the entire population, by age, in kilograms of CH_4/animal/year;

(3) Multiply the subgroup emission factors by the subgroup populations to estimate subgroup emissions, and sum across the subgroups to estimate total CH_4 emissions from the 3A 'Enteric Fermentation' category.

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 the 3A 'Enteric Fermentation' were estimated on the basis of equations 10.19 and 10.20 from 2006 IPCC Guidelines:

[61] Pârvu Gh, Costea Mihaela, Pârvu M., Nicolae B. „Treaty on animal nutrition", Bucuresti, 2003, p. 368.

$$Total\ CH_{4\ enteric} = \Sigma_i E_i [EF_{(T)} \bullet (N_{(T)}/10^6)]$$

Where:

$Total\ CH_{4\ enteric}$ – total CH_4 emissions from Enteric Fermentation, kt CH_4/yr;

E_i – is the emissions for the *i* livestock categories and sub-categories;

$EF_{(T)}$ – emission factor for the defined livestock population, kg CH_4/head/yr;

$N_{(T)}$ – the number of head of livestock species/category T in the country;

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 3A 'Enteric Fermentation' Source Category

Animal population by category	FE, kg CH_4/cap/an		Comments
	Western Europe	Eastern Europe	
Dairy cows	117	99	Average Milk Production: WE – 6000 kg/head/year, EE – 2550 kg/head/year
Other cattle	57	58	Beef cows, including young cattle
Sheep	8	5	Average live weight: WE - 65 kg, EE - 45 kg
Goats	5	5	Average live weight – 40 kg
Horses	18	18	Average live weight – 550 kg
Asses and mules	10	10	Average live weight – 245 kg
Swine	1.5	1	Average live weight – 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 sub-categories), maintenance requirements and feeding conditions for typical livestock under each species and sub-categories (in particular, for cattle and sheep, which have a larger share in the total CH_4 emissions from the 3A 'Enteric Fermentation').

Divide livestock population into subgroups. Following 2006 IPCC Guidelines recommendation, it is *good practice* to divide the livestock population into sub-categories (Table 5-9).

Table 5-9: Animal Population Data in the Republic of Moldova within 1990-2016, thousand heads

	1990	1991	1992	1993	1994	1995	1996	1997	1998
Cattle total, including:	1 060.7	1 000.5	970.1	882.6	832.0	729.5	646.3	549.7	532.4
...Dairy Cows	395.2	397.1	403.2	401.8	402.6	380.8	355.4	323.7	318.4
...Other Cattle	665.5	603.4	566.9	480.7	429.4	348.7	290.9	226.0	214.0
Sheep and Goats total, including:	1 281.9	1 288.8	1 357.2	1 437.3	1 501.9	1 423.0	1 372.4	1 235.3	1 147.2
…Sheep	1 244.8	1 239.3	1 294.3	1 362.4	1 409.8	1 326.6	1 271.1	1 136.3	1 046.4
…Goats	37.1	49.5	62.9	74.9	92.2	96.4	101.3	99.0	100.8
Horses	47.2	48.4	51.4	54.5	58.2	61.6	63.3	65.4	68.5
Asses and Mules	1.7	1.8	2.1	2.2	2.9	3.2	3.1	3.0	3.2
Swine	1 850.1	1 753.0	1 487.4	1 082.3	1 046.8	1 016.4	950.1	797.5	928.0
Poultry total, including:	24 625.0	23 715.0	17 128.0	12 809.2	13 448.3	13 746.4	12 364.9	12 363.9	13 046.0
...Chickens	20 234.4	19 607.1	13 271.0	9 516.6	9 957.4	10 200.6	9 137.4	9 112.0	9 557.0
...Geese	1 335.5	1 321.8	1 300.4	1 378.9	1 457.0	1 487.4	1 357.9	1 372.3	1 470.0
...Ducks	2 165.7	1 914.7	1 736.5	1 198.9	1 284.8	1 293.3	1 166.6	1 169.5	1 264.8
...Turkeys	889.3	871.3	820.2	714.8	749.0	765.2	703.0	710.1	754.2
Rabbits	283.0	250.8	298.5	262.4	237.2	209.3	189.8	176.8	185.9
	1999	2000	2001	2002	2003	2004	2005	2006	2007
Cattle total, including:	482.4	445.4	453.8	454.7	409.1	359.5	339.8	326.9	253.7
...Dairy Cows	306.9	298.5	300.1	304.8	277.7	249.0	233.1	222.0	181.1
...Other Cattle	175.5	146.9	153.7	149.9	131.5	110.5	106.7	104.9	72.6
Sheep and Goats total, including:	1 055.5	962.1	971.8	978.4	958.4	959.8	954.3	962.5	866.4
…Sheep	948.9	846.3	851.7	843.7	829.2	832.6	827.0	842.6	759.9
…Goats	106.6	115.8	120.2	134.6	129.2	127.2	127.3	119.9	106.5
Horses	72.0	76.0	81.6	82.6	81.4	75.8	72.0	69.3	60.5
Asses and Mules	3.4	3.8	4.3	4.0	4.3	4.0	3.7	3.6	3.1
Swine	751.3	492.7	490.8	550.1	476.4	422.3	493.0	568.3	320.8
Poultry total, including:	13 730.1	13 624.9	14 737.4	15 535.3	16 195.5	17 883.9	22 773.6	23 017.2	17 544.2
...Chickens	9 992.5	9 952.9	10 952.8	11 484.5	12 184.2	13 559.0	17 195.3	17 320.6	14 162.0
...Geese	1 581.6	1 550.6	1 589.9	1 777.4	1 780.2	1 828.0	2 120.3	2 111.5	1 342.2
...Ducks	1 349.4	1 325.3	1 368.2	1 423.3	1 461.9	1 592.6	2 394.1	2 551.0	1 435.5
...Turkeys	806.6	796.2	826.6	850.1	769.3	904.4	1 063.9	1 034.0	604.5
Rabbits	182.6	161.3	191.4	190.7	205.4	239.1	278.9	326.0	263.4

	2008	2009	2010	2011	2012	2013	2014	2015	2016
Cattle total, including:	238.4	243.0	236.4	224.4	210.6	208.0	210.7	204.5	199.8
...Dairy Cows	171.9	173.2	165.8	155.8	145.1	141.3	140.6	137.6	132.3
...Other Cattle	66.5	69.8	70.5	68.6	65.5	66.7	70.1	66.8	67.6
Sheep and Goats total, including:	879.6	929.7	920.6	846.2	836.9	862.0	887.0	880.8	881.8
…Sheep	767.7	809.4	793.1	714.2	699.0	717.4	733.5	722.2	714.8
…Goats	111.9	120.3	127.5	132.0	137.8	144.6	153.4	158.6	167.0
Horses	57.4	56.1	53.6	50.9	47.5	46.0	42.8	40.2	37.4
Asses and Mules	3.2	2.9	2.8	2.5	2.4	2.1	2.2	2.0	3.1
Swine	302.9	403.6	511.7	471.7	438.4	444.8	504.7	484.5	469.7
Poultry total, including:	18 830.6	22 986.6	23 782.5	19 766.7	15 897.8	11 947.9	12 520.0	12 590.6	13 172.2
...Chickens	15 464.0	18 836.1	19 456.4	16 194.1	13 252.8	10 096.2	10 438.5	10 655.6	11 337.5
...Geese	1 277.2	1 497.4	1 597.3	1 351.6	1 028.5	718.7	768.0	734.0	700.2
...Ducks	1 501.7	1 981.8	2 010.8	1 622.1	1 166.9	822.4	986.1	894.5	829.9
...Turkeys	587.8	671.4	718.1	599.0	449.6	310.6	327.4	306.5	304.7
Rabbits	248.5	274.5	277.0	277.4	267.0	296.2	326.1	350.2	366.7

Source: Statistical Annual Report No. 24-agr „Animal Breeding Sector", the number of livestock and poultry in all Households Categories as of 1st of January (annual reports for 1990-2016); Statistical Yearbooks of ATULBD for 1998 (page 224), 2002 (page 118), 2006 (page 109), 2010 (page 110), 2014 (page 104), 2017 (page 117).

Average daily feed intake per day. For each representative animal categories defined, is required the information on average daily feed intake. Generally, data on average daily feed intake are not available in statistical sources, and it was necessary to infer this information indirectly. The following general data were collected for each representative animal category: weight of a typical animal in the category (kg), average weight gain per day (g), feeding situation (confined, grazing, pasture conditions), 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 (units), and feed digestibility (%).

Weight (W) and Mature Weight (MW) in livestock and poultry. The 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 sub-categories, in the Republic of Moldova within 1990-2016 periods, kg

	1990	1991	1992	1993	1994	1995	1996	1997	1998
Average weight per head at the end of the year, kg:									
Cattles from all sub-categories, including:	325	320	316	310	295	279	264	307	308
Dairy Cows	476	443	430	415	413	412	411	452	443
Breeding Males	580	562	550	545	540	539	537	551	542
Swine from all sub-categories, including:	145	143	132	140	118	109	100	55	51
Female sows	189	186	181	185	176	169	162	144	141
Sheep and Goats	43	44	43	43	44	39	39	35	35
Horses, including:	376	326	341	344	369	356	340	276	282
Female horses older than 3 years and Stallions	433	381	396	399	414	401	382	308	314
Poultry of all species and ages	1.74	1.69	1.54	1.49	1.50	1.43	1.28	1.38	1.62
Average weight per head sold to population, kg:									
Cattles, including	81	92	107	100	139	167	182	196	187
Dairy Cows	475	430	425	414	398	396	392	387	395
Swine	10	10	10	11	11	11	12	14	13
Sheep and Goats	20	21	22	21	23	27	27	27	29
Horses	161	167	179	171	170	213	220	227	257
Poultry of all species and ages	0.15	0.11	0.14	0.20	0.24	0.21	0.18	0.15	0.14
Average weight per head bought from population, kg:									
Cattles, including	403	380	391	370	323	271	245	219	236
Dairy Cows	526	443	396	405	397	393	391	389	391
Swine	145	143	132	140	110	110	109	109	85
Sheep and Goats	43	44	43	43	44	44	44	44	37
Horses	391	316	297	344	352	329	318	306	304
Poultry of all species and ages	1.61	1.59	1.54	1.49	1.50	0.96	0.68	0.41	0.47
Average weight per head sold for slaughter, kg:									
Cattles, including	NA	NA	NA	NA	288	266	264	248	245
Dairy Cows	NA	NA	NA	NA	400	395	391	385	375
Swine	NA	NA	NA	NA	119	98	100	102	92
Sheep and Goats	NA	NA	NA	NA	31	29	29	25	24
Horses	NA	NA	NA	NA	358	355	340	306	269
Poultry of all species and ages	NA	NA	NA	NA	1.67	1.58	1.65	1.39	1.44

	1999	2000	2001	2002	2003	2004	2005	2006	2007
Average weight per head at the end of the year, kg:									
Cattles from all sub-categories, including:	303	294	297	294	290	300	293	297	284
Dairy Cows	439	435	434	434	431	435	429	427	425
Breeding Males	539	533	535	534	532	535	531	529	475
Swine from all sub-categories, including:	46	56	49	47	54	51	50	51	51
Female sows	137	145	139	137	145	141	138	140	137
Sheep and Goats	35	35	33	33	33	33	33	34	33
Horses, including:	279	285	283	277	277	282	275	297	297
Female horses older than 3 years and Stallions	311	317	315	309	309	314	307	322	339
Poultry of all species and ages	1.65	1.62	1.57	1.60	1.29	1.35	1.39	1.50	1.36
Average weight per head sold to population, kg:									
Cattles, including	239	258	193	176	246	183	161	163	229
Dairy Cows	392	394	338	391	384	365	346	373	398
Swine	23	27	18	17	32	23	13	30	33
Sheep and Goats	29	29	28	26	29	25	29	27	28
Horses	270	282	285	270	256	254	246	274	272
Poultry of all species and ages	0.16	0.14	0.17	0.21	0.21	0.20	0.27	0.35	0.41
Average weight per head bought from population, kg:									
Cattles, including	308	283	293	286	283	276	253	282	303
Dairy Cows	392	393	383	414	402	397	400	406	408
Swine	62	83	51	47	62	51	45	57	69
Sheep and Goats	34	31	30	30	31	26	32	36	32
Horses	281	284	278	285	290	254	296	332	293
Poultry of all species and ages	0.10	0.39	0.10	0.12	0.30	0.06	0.14	0.78	0.12
Average weight per head sold for slaughter, kg:									
Cattles, including	257	244	241	261	252	247	264	285	297
Dairy Cows	381	384	372	387	374	382	386	361	372
Swine	68	62	63	77	71	73	82	87	92
Sheep and Goats	26	24	25	26	24	26	25	24	26
Horses	250	307	267	365	285	261	273	309	244
Poultry of all species and ages	1.51	1.35	1.69	1.61	1.65	1.67	1.80	1.92	1.91

	2008	2009	2010	2011	2012	2013	2014	2015	2016
Average weight per head at the end of the year, kg:									
Cattles from all sub-categories, including:	286	289	291	322	318	310	344	348	344
Dairy Cows	405	409	420	421	427	430	450	463	457
Breeding Males	480	478	480	467	474	431	591	595	505
Swine from all sub-categories, including:	56	56	55	57	59	54	57	54	75
Female sows	141	137	141	155	167	176	170	172	164
Sheep and Goats	33	35	35	35	36	38	43	41	42
Horses, including:	308	302	307	304	320	326	318	316	315
Female horses older than 3 years and Stallions	342	346	345	343	342	343	338	375	293
Poultry of all species and ages	1.26	1.28	1.28	1.28	1.23	1.31	1.16	2.00	1.80
Average weight per head sold to population, kg:									
Cattles, including	170	209	176	137	169	200	163	285	223
Dairy Cows	364	423	410	394	356	408	385	387	427
Swine	22	19	27	45	32	56	38	58	51
Sheep and Goats	30	26	29	25	26	16	25	22	18
Horses	290	303	269	311	257	339	333	409	265
Poultry of all species and ages	0.39	0.34	0.30	0.37	0.45	0.69	0.35	0.65	0.69
Average weight per head bought from population, kg:									
Cattles, including	268	265	275	280	294	307	381	319	273
Dairy Cows	375	390	417	427	426	440	433	479	366
Swine	38	33	34	38	33	31	32	45	34
Sheep and Goats	32	32	30	30	43	45	46	45	46
Horses	310	265	298	312	381	347	327	400	350
Poultry of all species and ages	0.15	0.16	0.17	0.18	0.26	0.21	0.20	0.20	0.20
Average weight per head sold for slaughter, kg:									
Cattles, including	273	306	292	322	317	NA	NA	NA	NA
Dairy Cows	395	412	386	392	420	NA	NA	NA	NA
Swine	89	95	94	108	103	NA	NA	NA	NA
Sheep and Goats	24	26	28	25	43	NA	NA	NA	NA
Horses	255	316	297	264	381	NA	NA	NA	NA
Poultry of all species and ages	2.02	1.88	1.91	2.30	2.14	NA	NA	NA	NA

Source: NBS, Statistical Annual Report No. 24-agr „Animal Breeding Sector". Basic Indicators of Animal Breeding Sector Development in all Households Categories in the Republic of Moldova (annual reports for 1990-2016).

As for cattle[62], 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. To be noted that at present, most of animals in the RM is not pure blood, but rather different half-breeds obtained by crossbreeding (Bucataru, Radionov, 1999). So, the productivity indicators for half-breeds have average values.

[62] 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).

Table 5-11: Weight of the most Prevalent Cattle Breeds in the Republic of Moldova

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

Information regarding typical weight of sheets and goats at different stages of their ontogenesis (at birth, at weaning, at one year of age and at slaughtering is provided by the specialty literature (Bucataru, Radionov, Varban, 2003). According to these sources, the weight of sheep and goats at birth in the RM is circa 2-4 kg, the lambs are weaned at 3-4 months when they reach 18-23 kg, while kids at 2-3 months when they reach 13-15 kg. Growing lambs not meant for breeding are fed intensely until the age of 6-7 months when they reach the weight of 30-35 kg, and then 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)[63]*, g/day.* The information on daily actual weight gain reported in RM within 1990-2016 periods for cattle and swine is presented in Table 5-12.

Table 5-12: Average Daily Weight Gain Characteristic for Cattle and Swine in the Republic of Moldova within 1990-2016 periods

Index	Category	1990	1991	1992	1993	1994	1995	1996	1997	1998
Daily weight gain, g	Cattle	515.0	421.0	425.0	376.0	363.0	223.0	203.0	181.0	230.0
	Swine	304.0	117.0	110.0	89.0	94.0	148.0	171.0	189.0	222.0
Index	**Category**	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**
Daily weight gain, g	Cattle	192.0	217.0	260.0	287.0	262.0	275.0	321.0	323.0	297.0
	Swine	117.0	107.0	134.0	147.0	136.0	166.0	187.0	200.0	218.0
Index	**Category**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**
Daily weight gain, g	Cattle	325.0	378.0	345.0	366.0	379.0	355.0	383.0	342.0	437.0
	Swine	268.0	311.0	317.0	339.0	398.0	402.0	451.0	448.0	487.0

Source: NBS, Statistical Annual Report No. 24-agr „Animal Breeding Sector". Basic Indicators of Animal Breeding Sector Development in all Households Categories in the Republic of Moldova (annual reports for 1990-2016).

Average Annual Milk Production per One Cow. In the past 20 years, the average productivity of dairy cows in the RM varied between the 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) although the potential is much higher (Annex 3-3).

Table 5-13 shows that the average milking productivity featured over the period since 1993 to 2003 is much lower than the one reported at the beginning of '90s, comparable with milking productivity reported in the '60-'70 of the past century when the cattle stock in the RM was preponderantly represented by Red Estonian (8 per cent), Simmental (35-37 per cent) and Steppe Red (48-53 per cent) (Bucataru, Cosman, Holban, 2006).

Table 5-13: Average Annual Milk Production per one Cow within 1990-2016 periods, kg/head/yr

	1990	1991	1992	1993	1994	1995	1996	1997	1998
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	2 040
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	2 001
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	2 048
	1999	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**
Total national average annual milk production per one cow	2 030	2 039	2 072	2 111	2 126	2 480	2 800	2 807	2 871
Average annual milk production per one cow at agricultural enterprises and farm households	2 036	2 179	2 447	2 710	2 493	2 561	3 018	2 913	2 710
Average annual milk production per one cow at individual farms	2 038	2 028	2 052	2 081	2 110	2 477	2 792	2 803	2 877
	2008	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**
Total national average annual milk production per one cow	3 011	3 316	3 435	3 438	3 425	3 607	3 672	3 666	3 607
Average annual milk production per one cow at agricultural enterprises and farm households	2 743	3 098	2 993	3 224	3 380	3 225	3 742	3 468	3 939
Average annual milk production per one cow at individual farms	3 020	3 323	3 449	3 444	3 426	3 621	3 669	3 676	3 590

Source: NBS, Statistical Annual Report No. 24-agr „Animal Breeding Sector". Basic Indicators of Animal Breeding Sector Development in all Households Categories in the Republic of Moldova (annual reports for 1990-2016).

Since 1970, a massive import of Spotted Black breed started in the country. A program to crossbreed all public stock with this breed, considered to be one of the most productive in the world, was developed. As a consequence, over the following 30 years absorption crossbreeding was carried out for

[63] 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, Vol. 4, Chap.10, Tab. 10A.2).

Simmental, Estonian Red and Steppe Red breeds with Spotted Black breed. The Holstein breed was also intensely used to improve the breed, in particular in 1980'–1990' of the past century.

Thus, developing an immense stock of half-breeds of different generations and a good organization of foddering allowed obtain a national average daily milk yield of 10-11 kg per head, by 1990 in the RM (Table 5-14).

Table 5-14: Average Daily Milk Production per one Cow in the RM within 1990-2016 periods, kg/head/day

	1990	1991	1992	1993	1994	1995	1996	1997	1998
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	5.6
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	5.5
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	5.6
	1999	2000	2001	2002	2003	2004	2005	2006	2007
Total national average daily milk production per one cow	5.6	5.6	5.7	5.8	5.8	6.8	7.7	7.7	7.9
Average daily milk production per one cow at agricultural enterprises and farm households	5.6	6.0	6.7	7.4	6.8	7.0	8.3	8.0	7.4
Average daily milk production per one cow at individual farms	5.6	5.5	5.6	5.7	5.8	6.8	7.6	7.7	7.9
	2008	2009	2010	2011	2012	2013	2014	2015	2016
Total national average daily milk production per one cow	8.2	9.1	9.4	9.4	9.4	9.9	10.1	10.0	9.9
Average daily milk production per one cow at agricultural enterprises and farm households	7.5	8.5	8.2	8.8	9.2	8.8	10.3	9.5	10.8
Average daily milk production per one cow at individual farms	8.3	9.1	9.4	9.4	9.4	9.9	10.1	10.1	9.8

Source: NBS, Statistical Annual Report No. 24-agr „Animal Breeding Sector". Basic Indicators of Animal Breeding Sector Development in all Households Categories in the Republic of Moldova (annual reports for 1990-2016).

Further, once the big collective farms collapsed and the livestock concentrated in private sector (at present, according to the NBS, circa 92 per cent of total cattle of the Republic of Moldova is in the private sector[64]), the average productivity of dairy cows decreased a lot, in particular as a consequence of poor organization of foddering and inappropriate animal feeding and maintenance conditions in the private sector.

To 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 per cent of the dry matter in the feed intake. At a 20 per cent deficit of protein in the feed intake the milk yield decreases by 30 per cent, and at a 30 per cent deficit of protein, milking productivity drops by up to 50 per cent.

In the last decade, the protein deficit in the cattle diet exceeded 20 per cent (Bucataru, Cosman, Holban, 2006), being the main reason of poor productivity indicators, in particular during the 1993-2003 period. Over the 2003-2016 periods, 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 per cent, and Tsigae breed reaches a productivity of 75-120 kg of milk per year with a fat content of 6.5-7.0 per cent, while in local goats the milking potential is 224-324 kg of milk per year with an average fat content of 4.7 per cent (see Annex 3-3).

Table 5-15 provides statistical data on the average production of milk in sheep and goats at the individual farms in the Republic of Moldova, in the time series since 1990 to 2016.

Table 5-15: Average Milk Production per Sheep and Goats at the Individual Farms in the RM within 1990-2016 periods, kg/head/year

	1990	1991	1992	1993	1994	1995	1996	1997	1998
Total national average annual milk production per one goat	62.0	75.0	88.0	101.0	114.0	127.0	131.0	145.0	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	18.9
	1999	2000	2001	2002	2003	2004	2005	2006	2007
Total national average annual milk production per one goat	106.0	57.0	57.0	59.0	58.0	65.0	112.0	137.0	143.0
Total national average annual milk production per one sheep	20.0	20.0	20.0	24.0	26.0	21.0	32.0	30.0	33.0
	2008	2009	2010	2011	2012	2013	2014	2015	2016
Total national average annual milk production per one goat	139.0	147.0	149.0	136.9	168.8	201.3	167.0	178.0	179.0
Total national average annual milk production per one sheep	35.0	36.0	36.0	34.6	32.7	37.1	39.0	37.0	40.0

Source: NBS, Statistical Annual Report No. 24-agr „Animal Breeding Sector". Basic Indicators of Animal Breeding Sector Development in all Households Categories in the Republic of Moldova (annual reports for 1990-2016).

[64] NBS, on-line database: < http://statbank.statistica.md/pxweb/Database/RO/16%20AGR/AGR03/AGR03.asp>.

Average Wool Production per Sheep. The default value used is 4 kg/year/head (IPCC 2006 Guidelines). According the statistical data, in the Republic of Moldova the value of this indicator varied over the period from 1990 through 2016 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 the Individual Farms in the Republic of Moldova within 1990-2016 periods, kg/head/year

	1990	1991	1992	1993	1994	1995	1996	1997	1998
Average annual amount of wool sheared per sheep	2.30	2.30	2.10	1.90	2.00	2.00	1.90	2.00	2.00
	1999	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**
Average annual amount of wool sheared per sheep	1.90	1.80	2.30	2.20	2.00	2.10	2.20	2.00	1.80
	2008	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**
Average annual amount of wool sheared per sheep	1.70	1.80	1.76	1.66	1.25	1.64	1.93	1.51	1.53

Source: NBS, Statistical Annual Report No. 24-agr „Animal Breeding Sector". Basic Indicators of Animal Breeding Sector Development in all Households Categories in the Republic of Moldova (annual reports for 1990-2016).

Climate Conditions. Feeding situation of animals is greatly dependent on climate conditions, in particular, on average annual temperature in areas where livestock is bred. In conformity with the 2006 IPCC Guidelines, the data on the average annual temperature in areas with animal population have to be used as follows: areas with average annual temperatures <15°C are defined as cold climate areas; areas with average annual temperatures between 15°C and 25°C inclusively are defined as moderate climate areas, and areas with average annual temperatures >25°C are defined as warm climate areas. In conformity with data on the average annual temperature in Celsius degrees 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 Different Regions of the Republic of Moldova within 1990-2016 periods, in °C

Geographic areas	1990	1991	1992	1993	1994	1995	1996	1997	1998
North	9.5	8.0	8.5	7.8	9.5	8.4	7.1	7.7	8.2
Centre	11.3	9.4	10.1	9.4	11.3	10.0	9.1	9.4	10.3
South	11.4	9.3	10.2	9.3	11.3	10.0	9.1	9.1	10.1
Geographic areas	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**
North	9.2	9.7	8.8	9.5	8.6	9.0	8.7	9.7	9.6
Centre	11.0	11.2	10.3	10.8	9.8	10.3	10.5	11.3	11.4
South	10.9	11.2	10.4	11.0	10.3	10.9	10.8	11.8	11.8
Geographic areas	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**
North	8.9	9.1	9.3	9.4	9.7	9.4	9.3	10.5	9.9
Centre	10.6	10.5	11.2	11.1	11.3	11.1	10.9	12.0	11.2
South	11.2	10.6	11.7	11.5	11.8	11.5	11.3	12.1	11.8

Source: NBS, Statistical Yearbooks of the RM for 1991 (page 207), 1994 (page 31), 1999 (page 13), 2006 (page 15), 2011 (page 15), 2013 (page 15), 2014 (page 15), 2016 (page 18), 2017 (page 16).

Percentage of females that give birth in a year (%)[65]. Table 5-18 below provides statistical data on live products produced by 100 females at publicly owned agricultural enterprises in the Republic of Moldova over the period from 1990 through 2016.

Table 5-18: Live Products Produced by 100 Females at Publicly Owned Agricultural Enterprises in the Republic of Moldova within 1990-2016 periods

	1990	1991	1992	1993	1994	1995	1996	1997	1998
Calves from cows	86	80	79	75	72	66	65	58	61
Pigs from sows	1466	1317	1569	1223	989	983	1019	892	1187
Lambs from sheep giving birth	91	84	80	79	78	76	75	73	75
	1999	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**
Calves from cows	55	58	65	69	63	60	72	66	63
Pigs from sows	772	434	869	967	558	689	997	949	782
Lambs from sheep giving birth	68	71	79	81	75	79	84	80	73
	2008	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**
Calves from cows	62	67	63	71	63	56	93	71	71
Pigs from sows	1015	1222	1040	1136	1106	1173	1646	2378	2403
Lambs from sheep giving birth	81	83	73	82	89	89	126	85	64

Source: NBS, Statistical Annual Report No. 24-agr „Animal Breeding Sector". Basic Indicators of Animal Breeding Sector Development in all Households Categories in the Republic of Moldova (annual reports for 1990-2016).

To be noted, that the birth rate of some local breeds of sheep and goats is much higher than the officially reported one: featuring circa 115 lambs per 100 Karakul breed female sheep giving birth; circa

[65] Default values used for Eastern European countries: 80 per cent for dairy cows and 67 for other cattle, see IPCC 2006 Guidelines, Volume 4, Chapter 10, Table 10A.1-2, page 10.73.

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).

Feed Digestibility (DE)[66]. The portion of gross energy (GE) in the feed not excreted in the faeces is known as digestible feed. That percentage of feed that is not digested represents the per cent of dry matter intake that will be excreted as faeces (50-60 per cent for crop by-products and range lands, 60-75 per cent for high quality pastures, good preserved forages, and grain supplemented forage-based diets and 75-85 per cent for grain-based diets fed in feedlots).

In the RM, the value of this indicator varied over the years, so for the reference year, when the livestock maintenance conditions, foddering and feeding situation were optimal, the DE value was admitted DE – 69 per cent; for 1991-1992, DE – 68 per cent; for 1993, DE – 67 per cent; for 1994-1996, DE – 65 per cent; for 1997-2004, DE – 66 per cent; for 2005-2008, DE – 67 per cent; respectively for the period from 2009 through 2016, DE – 68 per cent.

Gross Energy (GE). Animal performance and diet data were collected from Statistical Yearbooks and other relevant specialty publications to estimate 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) that were used to calculate the average amount of gross energy required for animal maintenance and other relevant vital activities.

Table 5-19: Summary of Equations Used to Estimate Daily Gross Energy Intake for Cattle, Sheep and Goats for maintenance and other relevant vital activities

Metabolic Function	Equation from 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
Draft Power (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 on the basis of Equation 10.3 in 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[67], 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 conformity with Equation 10.4, while for sheep and goats in conformity with Equation 10.5 in 2006 IPCC Guidelines.

$$NE_a = C_a \bullet NE_m$$

Where:

NE_a – net energy for animal (cattle) activity, MJ/day;

C_a – coefficient corresponding to animal's feeding situation[68], default values used are as follows: C_a – 0, cattle is confined to a small area (i.e., tethered, pen, barn) with the result that they expend

[66] Default values available in 2006 IPCC Guidelines, Vol. 4, Ch. 10, Table 10.2, Page 10.14.
[67] Default values available in 2006 IPCC Guidelines, Volume 4, Chapter 10, Table 10.4, Page 10.16
[68] Default values available in 2006 IPCC Guidelines, Volume 4, Chapter 10, Table 10.5, Page 10.17.

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; keeping 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 period and C_a – 0.207 for 1992-2016;

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[69], default values used are as follows: C_a – 0.0090, when animals are confined due to pregnancy in final trimester, C_a – 0.0107, when animals walk up to 1000 meters per day and expend very little energy to acquire feed, C_a – 0.024, 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; keeping account that the grazing period for sheep and goats 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 weighted average values for C_a coefficient for conditions of the RM is 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) is the net energy needed for growth (i.e., weight gain). NE_a for cattle was calculated on the basis of 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 – a coefficient with a value of 0.8 for females, 1.0 for castrates and 1.2 for breeding bulls[70];

MW – the mature live body weight of an adult female in moderate body condition, kg;

WG – the 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} – the average weight gain (BW_f-BW_i), kg/year;

BW_i – the average live body weight at weaning, kg;

BW_f – the 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[71].

*Net energy for lactation***:** (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 conformity 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;

[69] Default values available in 2006 IPCC Guidelines, Volume 4, Chapter 10, Table 10.5, Page 10.17.
[70] Default values available in *2006 IPCC Guidelines*, Volume 4, Chapter 10, Equation 10.6, Page 10.17.
[71] Default values available in 2006 IPCC Guidelines, Volume 4, Chapter 10, Table 10.6, Page 10.18.

Fat – fat content of milk (cattle), per cent by weight.

For sheep and goats NE_l may be calculated using two possible methods. The first method used for the current inventory, 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 producing 1 kg of milk; a default value of 4.6 MJ/kg can be used, which corresponds to a milk fat content of 7 per cent by weight.

Net energy for work: (NE_{work}) is the net energy for work. It is believed that one hour of typical work of draft animals (cattle) require circa 10 per cent of the net daily energy for maintenance (NE_m). NE_{work} shall be calculated in conformity with Equation 10.11 in the 2006 IPCC Guidelines.

$$NE_{work} = 0.10 \bullet NE_m \bullet Hours$$

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[72]; this inventory cycle used 2 hours of work per day regarding the 1990-1991 time period and 3 hours of work per day for 1992-2016.

Net energy for wool production: (NE_{wool}) is the average daily net energy required for sheep to produce a year of wool. The NE_{wool} was calculated in conformity with Equation 10.12 from 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) is the energy required for pregnancy[73] and shall be calculated in conformity with Equation 10.13 in 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 per cent of NE_m. For sheep and goats, the NE_p requirement is similarly estimated for the 144-154-days gestation period, although the percentage varies with the number of lambs born[74].

$$NE_p = C_{pregnancy} \bullet NE_m$$

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 conformity 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 conformity with Equation 10.15 in the 2006 IPCC Guidelines.

[72] Default value available in 2006 IPCC Guidelines, Volume 4, Chapter 10, Table 10A-2, Page 10.73.
[73] Default value available in 2006 IPCC Guidelines, Volume 4, Chapter 10, Table 10A-7, Page 10.20.
[74] $C_{pregnancy}$ default values were estimated regarding average prolificacy of the local breeds in the RM: $C_{pregnancy}$ – 0.087 for sheep, respectively $C_{pregnancy}$ – 0.109 for goats.

$$REG = [1.164 - (5.160 \cdot 10^{-3} \cdot DE\%) + (1.308 \cdot 10^{-5} \cdot (DE\%)^2) - (37.4/DE\%)]$$

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 conformity 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);

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 for the RM are provided in Table 5-20.

Table 5-20: Gross Energy (GE) Values Calculated for Animal Categories in the Republic of Moldova following a Tier 2 Methodology, MJ/head/day

	1990	1991	1992	1993	1994	1995	1996	1997	1998
Dairy cows	245.8	229.0	227.5	219.8	217.8	213.2	211.9	211.4	212.1
Other cattle (average)	118.4	116.1	116.8	122.5	125.9	123.4	129.5	124.7	123.3
…Calves and heifers up to 1 year	100.2	94.6	95.0	95.4	96.7	78.5	75.4	69.9	77.4
…Heifers between 12 and 18 months	131.0	131.0	126.7	127.2	127.4	127.4	125.7	120.8	114.8
…Heifers between 18 and 24 months	156.8	152.3	147.2	142.7	146.4	146.4	146.4	142.7	136.1
…Heifers between 24 months and more	167.2	165.0	158.8	158.8	160.2	160.2	164.4	158.7	152.0
…Breeding males	207.9	204.9	191.9	194.2	190.4	188.3	184.2	178.2	178.2
…Work bullocks	182.5	181.8	170.7	185.5	187.0	187.0	187.0	183.0	180.5
Sheep (average)	16.9	16.9	16.3	16.2	16.3	15.6	15.6	15.2	15.1
…Mature ewes and Ewe lambs ≥ 1 year	17.4	17.3	16.7	16.7	17.0	16.0	15.9	15.6	15.6
…Breeding rams	24.9	24.3	23.9	23.8	23.9	23.1	23.1	22.9	22.4
…Growing lambs up to 1 year	13.2	12.9	12.4	12.4	12.7	12.4	12.3	11.4	10.6
Goats (average)	15.4	15.6	15.3	15.3	14.8	14.8	14.8	14.6	14.3
…Mature females ≥ 1 year	16.6	16.9	16.4	17.0	16.5	16.8	17.0	16.3	15.8
…Breeding males	16.6	16.5	15.9	15.6	14.7	14.7	14.7	13.9	14.1
…Growing kids up to 1 year	9.5	9.3	9.0	9.0	8.1	8.1	8.1	7.8	8.0
	1999	2000	2001	2002	2003	2004	2005	2006	2007
Dairy cows	212.5	213.7	216.2	218.9	219.4	227.3	229.8	228.7	230.1
Other cattle (average)	123.6	128.9	124.6	127.4	126.3	131.7	129.4	130.2	127.7
…Calves and heifers up to 1 year	71.6	75.5	81.5	85.0	81.7	83.5	86.7	87.0	83.9
…Heifers between 12 and 18 months	114.8	114.8	120.8	129.4	129.4	128.3	130.1	132.5	130.1
…Heifers between 18 and 24 months	136.1	136.1	142.7	147.9	147.9	151.5	149.2	154.1	152.1
…Heifers between 24 months and more	152.0	152.0	160.1	161.5	161.5	166.8	166.3	170.3	166.3
…Breeding males	178.2	178.2	178.2	180.3	180.3	182.3	178.5	180.4	180.4
…Work bullocks	177.9	175.3	177.9	180.5	183.0	185.5	184.1	184.1	184.1
Sheep (average)	15.2	15.1	15.2	15.3	14.9	15.3	15.7	15.5	15.6
…Mature ewes and Ewe lambs ≥ 1 year	15.6	15.6	15.6	15.8	15.5	15.7	16.4	16.3	16.3
…Breeding rams	22.3	22.3	21.9	21.9	21.3	22.4	21.4	21.6	21.5
…Growing lambs up to 1 year	11.4	10.6	11.1	11.5	10.5	11.8	10.9	10.5	11.1
Goats (average)	14.3	14.1	14.1	14.4	14.2	14.4	14.0	14.5	14.6
…Mature females ≥ 1 year	15.9	15.3	15.0	15.5	15.4	15.5	15.4	16.1	16.0
…Breeding males	14.8	16.2	16.2	16.9	16.0	16.7	15.0	14.9	14.6
…Growing kids up to 1 year	8.3	9.0	9.0	9.2	9.2	9.4	8.5	8.3	8.1

	2008	2009	2010	2011	2012	2013	2014	2015	2016
Dairy cows	231.0	232.2	237.6	238.8	239.3	242.3	255.8	254.8	253.5
Other cattle (average)	121.7	120.7	121.8	123.7	124.3	122.0	124.3	120.4	128.9
…Calves and heifers up to 1 year	87.2	90.5	87.1	89.3	90.7	88.1	91.0	86.8	96.2
…Heifers between 12 and 18 months	119.4	114.9	120.5	122.9	123.7	121.3	123.7	119.4	128.5
…Heifers between 18 and 24 months	142.1	143.3	144.6	146.6	147.6	145.1	147.6	144.6	147.6
…Heifers between 24 months and more	151.9	150.3	153.6	154.6	155.1	154.1	156.6	153.6	156.6
…Breeding males	182.4	180.6	180.6	180.6	180.6	180.6	184.6	180.6	179.6
…Work bullocks	186.6	185.2	185.2	185.2	185.2	185.2	194.6	185.2	184.0
Sheep (average)	15.5	16.2	16.2	16.0	15.7	17.1	18.2	17.3	18.0
…Mature ewes and Ewe lambs ≥ 1 year	16.2	16.9	16.8	16.7	16.6	18.3	19.6	18.5	19.3
…Breeding rams	20.7	21.3	21.3	21.2	21.1	21.2	21.3	21.2	21.2
…Growing lambs up to 1 year	10.2	10.9	11.6	10.5	10.7	10.8	12.4	11.9	12.3
Goats (average)	14.5	15.2	15.5	15.1	14.8	15.6	15.5	15.0	15.5
…Mature females ≥ 1 year	15.8	16.7	17.2	16.8	16.6	18.0	17.5	17.3	17.8
…Breeding males	14.6	15.3	15.8	15.8	13.8	14.1	15.4	14.6	14.8
…Growing kids up to 1 year	8.1	8.3	8.4	8.4	7.5	7.5	8.3	7.8	8.1

For animal categories "other cattle"[75], "sheep" and "goats"[76] GE values are weighted averages, taking into account the specific GE values for each subcategory of animals, respectively the percentage distribution of their population (Table 5-21).

Table 5-21: Distribution of Animal Population by Sub-Categories in the RM within 1990-2016, %

	1990	1991	1992	1993	1994	1995	1996	1997	1998
Other cattle, including:	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
…Calves and heifers up to 1 year	62.3	58.2	53.3	40.9	37.4	31.9	22.3	27.0	27.1
…Heifers between 12 and 18 months	17.3	19.8	21.0	25.5	27.0	26.8	31.1	18.0	14.2
…Heifers between 18 and 24 months	8.7	10.2	12.4	17.3	16.2	18.5	20.1	24.2	26.4
…Heifers between 24 months and more	11.4	11.4	12.9	14.8	17.5	20.7	23.5	27.5	28.6
…Breeding males	0.2	0.3	0.4	1.1	1.4	1.4	1.9	2.3	2.6
…Work bullocks	0.0	0.0	0.1	0.4	0.5	0.7	1.0	0.9	1.1
Sheep, including:	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
…Mature ewes and Ewe lambs ≥ 1 year	79.2	83.0	82.4	80.0	74.0	81.5	82.2	82.5	82.5
…Breeding rams	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
…Growing lambs up to 1 year	17.8	14.0	14.6	17.0	23.0	15.5	14.8	14.5	14.5
Goats, including:	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
…Mature females ≥ 1 year	80.0	80.0	81.7	76.3	78.1	75.3	73.0	77.2	79.1
…Breeding males	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
…Growing kids up to 1 year	17.0	17.0	15.3	20.7	18.9	21.7	24.0	19.8	17.9
	1999	2000	2001	2002	2003	2004	2005	2006	2007
Other cattle, including:	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
…Calves and heifers up to 1 year	24.2	16.8	32.2	34.7	33.7	29.5	34.2	34.2	34.8
…Heifers between 12 and 18 months	13.2	13.4	15.9	14.7	16.3	17.9	15.0	20.4	18.3
…Heifers between 18 and 24 months	32.3	40.0	26.6	25.8	27.0	27.4	27.0	25.7	26.2
…Heifers between 24 months and more	26.0	25.4	21.4	21.0	19.4	21.9	20.7	17.3	18.3
…Breeding males	3.1	3.0	2.8	2.7	2.6	2.4	2.2	1.8	1.7
…Work bullocks	1.3	1.3	1.1	1.0	0.9	0.8	0.9	0.5	0.7
Sheep, including:	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
…Mature ewes and Ewe lambs ≥ 1 year	81.8	82.0	82.9	81.7	81.5	81.5	81.9	79.6	80.7
…Breeding rams	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
…Growing lambs up to 1 year	15.2	15.0	14.1	15.3	15.5	15.5	15.1	17.4	16.3
Goats, including:	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
…Mature females ≥ 1 year	77.0	77.5	80.4	77.6	76.3	77.8	77.8	77.3	80.3
…Breeding males	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
…Growing kids up to 1 year	20.0	19.5	16.6	19.4	20.7	19.2	19.2	19.7	16.7
	2008	2009	2010	2011	2012	2013	2014	2015	2016
Other cattle, including:	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
…Calves and heifers up to 1 year	37.0	35.9	35.5	34.6	36.2	35.7	36.9	36.8	32.6
…Heifers between 12 and 18 months	17.2	19.6	19.1	21.2	20.2	22.0	21.0	20.6	22.2
…Heifers between 18 and 24 months	25.9	25.5	26.9	26.4	25.4	24.5	24.2	25.1	26.0
…Heifers between 24 months and more	17.6	17.0	16.7	16.3	15.7	15.2	15.4	15.4	16.9
…Breeding males	1.6	1.4	1.4	0.4	0.4	0.5	0.4	0.3	0.4
…Work bullocks	0.7	0.4	0.3	1.2	2.1	2.2	2.1	1.9	1.9
Sheep, including:	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
…Mature ewes and Ewe lambs ≥ 1 year	82.5	82.1	82.7	83.0	79.7	79.2	78.0	77.2	77.8
…Breeding rams	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
…Growing lambs up to 1 year	14.5	14.9	14.3	14.0	17.3	17.8	19.0	19.8	19.2
Goats, including:	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
…Mature females ≥ 1 year	79.8	79.8	77.5	77.9	77.3	75.2	75.7	73.8	74.0
…Breeding males	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
…Growing kids up to 1 year	17.2	17.2	19.5	19.1	19.7	21.8	21.3	23.2	23.0

Source: NBS, Statistical Annual Report No. 24-agr „Animal Breeding Sector". Basic Indicators of Animal Breeding Sector Development in all Households Categories in the Republic of Moldova (annual reports for 1990-2016).

[75] Default values used for „other cattle" category are: 30% of total – mature females, 22% – mature males, and 48% – young cattle (2006 IPCC Guidelines, Vol. 3, Ch. 10, Table 10A-2, Page 10.73).
[76] 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%.

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 CH_4 conversion factors are unavailable from country-specific research, default values provided in 2006 IPCC Guidelines were used for cattle[77]: 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[78]: Y_m – 0.045 for lambs and kids and Y_m – 0.065 for mature rams, ewes and goats.

Methane emission factors (EF). Based on information above, country specific national factors were developed for the 3A 'Enteric Fermentation' source category (for cattle, sheep and goats). The emission factor for each animal category was developed following the 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;

55.65 MJ/kg CH_4 – the energy content of methane.

Table 5-22 features country specific emission factor for cattle bred in the RM, developed by using a Tier 2 simplified methodology.

Table 5-22: Country Specific Emission Factors for Enteric Fermentation, Calculated for Cattle Population in the Republic of Moldova following a Tier 2 methodology, kg CH_4/head/year

	1990	1991	1992	1993	1994	1995	1996	1997	1998
Dairy cows	**104.8**	**97.6**	**97.0**	**93.7**	**92.8**	**90.9**	**90.3**	**90.1**	**90.4**
Other cattle (average)	**50.5**	**49.5**	**49.8**	**52.2**	**53.7**	**52.6**	**55.2**	**53.2**	**52.6**
…Calves and heifers up to 1 year	42.7	40.3	40.5	40.7	41.2	33.5	32.1	29.8	33.0
…Heifers between 12 and 18 months	55.9	55.8	54.0	54.2	54.3	54.3	53.6	51.5	49.0
…Heifers between 18 and 24 months	66.8	64.9	62.8	60.8	62.4	62.4	62.4	60.8	58.0
…Heifers between 24 months and more	71.3	70.4	67.7	67.7	68.3	68.3	70.1	67.7	64.8
…Breeding males	88.6	87.3	81.8	82.8	81.2	80.3	78.5	76.0	76.0
…Work bullocks	77.8	77.5	72.8	79.1	79.7	79.7	79.7	78.0	76.9
	1999	2000	2001	2002	2003	2004	2005	2006	2007
Dairy cows	**90.6**	**91.1**	**92.2**	**93.3**	**93.5**	**96.9**	**98.0**	**97.5**	**98.1**
Other cattle (average)	**52.7**	**55.0**	**53.1**	**54.3**	**53.9**	**56.1**	**55.2**	**55.5**	**54.4**
…Calves and heifers up to 1 year	30.5	32.2	34.8	36.3	34.8	35.6	37.0	37.1	35.8
…Heifers between 12 and 18 months	49.0	49.0	51.5	55.1	55.1	54.7	55.5	56.5	55.5
…Heifers between 18 and 24 months	58.0	58.0	60.8	63.0	63.0	64.6	63.6	65.7	64.9
…Heifers between 24 months and more	64.8	64.8	68.3	68.8	68.8	71.1	70.9	72.6	70.9
…Breeding males	76.0	76.0	76.0	76.9	76.9	77.7	76.1	76.9	76.9
…Work bullocks	75.8	74.7	75.8	76.9	78.0	79.1	78.5	78.5	78.5
	2008	2009	2010	2011	2012	2013	2014	2015	2016
Dairy cows	**98.5**	**99.0**	**101.3**	**101.8**	**102.0**	**103.3**	**109.0**	**108.6**	**108.1**
Other cattle (average)	**51.9**	**51.4**	**51.9**	**52.7**	**53.0**	**52.0**	**53.0**	**51.3**	**55.0**
…Calves and heifers up to 1 year	37.2	38.6	37.1	38.1	38.7	37.6	38.8	37.0	41.0
…Heifers between 12 and 18 months	50.9	49.0	51.4	52.4	52.8	51.7	52.8	50.9	54.8
…Heifers between 18 and 24 months	60.6	61.1	61.7	62.5	62.9	61.9	62.9	61.7	62.9
…Heifers between 24 months and more	64.8	64.1	65.5	65.9	66.1	65.7	66.8	65.5	66.8
…Breeding males	77.8	77.0	77.0	77.0	77.0	77.0	78.7	77.0	76.6
…Work bullocks	79.6	79.0	79.0	79.0	79.0	79.0	83.0	79.0	78.4

Table 5-23 features country specific emission factors calculated for sheep and goats in the Republic of Moldova.

Table 5-23: Country Specific Emission Factors for Enteric Fermentation, Calculated for Sheep and Goat Populations in the Republic of Moldova following a Tier 2 Methodology, kg CH_4/head/year

	1990	1991	1992	1993	1994	1995	1996	1997	1998
Sheep (average), including:	**6.9**	**6.9**	**6.7**	**6.6**	**6.5**	**6.4**	**6.4**	**6.3**	**6.2**
…Mature ewes and Ewe lambs ≥ 1 year	7.4	7.4	7.1	7.1	7.3	6.8	6.8	6.6	6.6
…Breeding rams	10.6	10.4	10.2	10.2	10.2	9.9	9.8	9.8	9.5
…Growing lambs up to 1 year	3.9	3.8	3.7	3.7	3.7	3.6	3.6	3.4	3.1
Goats (average), including:	**6.4**	**6.4**	**6.3**	**6.3**	**6.1**	**6.1**	**6.0**	**6.0**	**5.9**
…Mature females ≥ 1 year	7.1	7.2	7.0	7.3	7.0	7.2	7.2	7.0	6.7
…Breeding males	7.1	7.0	6.8	6.6	6.3	6.3	6.3	5.9	6.0
…Growing kids up to 1 year	2.8	2.8	2.6	2.6	2.4	2.4	2.4	2.3	2.3

[77] 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;
[78] Default values used for sheep and goats available in 2006 IPCC Guidelines, Volume 4, Chapter 10, Table 10.13, Page 10.31.

	1999	2000	2001	2002	2003	2004	2005	2006	2007
Sheep (average), including:	**6.2**	**6.2**	**6.3**	**6.3**	**6.1**	**6.3**	**6.5**	**6.4**	**6.4**
…Mature ewes and Ewe lambs ≥ 1 year	6.7	6.7	6.7	6.7	6.6	6.7	7.0	7.0	6.9
…Breeding rams	9.5	9.5	9.3	9.3	9.1	9.5	9.1	9.2	9.2
…Growing lambs up to 1 year	3.4	3.1	3.3	3.4	3.1	3.5	3.2	3.1	3.3
Goats (average), including:	**5.9**	**5.8**	**5.8**	**5.9**	**5.8**	**5.9**	**5.8**	**6.0**	**6.0**
…Mature females ≥ 1 year	6.8	6.5	6.4	6.6	6.6	6.6	6.5	6.9	6.8
…Breeding males	6.3	6.9	6.9	7.2	6.8	7.1	6.4	6.4	6.2
…Growing kids up to 1 year	2.4	2.7	2.7	2.7	2.7	2.8	2.5	2.4	2.4
	2008	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**
Sheep (average), including:	**6.4**	**6.7**	**6.7**	**6.6**	**6.5**	**7.0**	**7.5**	**7.1**	**7.4**
…Mature ewes and Ewe lambs ≥ 1 year	6.9	7.2	7.2	7.1	7.1	7.8	8.3	7.9	8.2
…Breeding rams	8.8	9.1	9.1	9.1	9.0	9.1	9.1	9.0	9.0
…Growing lambs up to 1 year	3.0	3.2	3.4	3.1	3.2	3.2	3.7	3.5	3.6
Goats (average), including:	**6.0**	**6.3**	**6.4**	**6.2**	**6.1**	**6.4**	**6.4**	**6.1**	**6.4**
…Mature females ≥ 1 year	6.8	7.1	7.3	7.1	7.1	7.7	7.5	7.4	7.6
…Breeding males	6.2	6.5	6.7	6.7	5.9	6.0	6.5	6.2	6.3
…Growing kids up to 1 year	2.4	2.5	2.5	2.5	2.2	2.2	2.4	2.3	2.4

The obtained results are intermediary to default values characteristic for developing countries – with 5 kg CH_4/head/year for sheep and goats, and developed countries – respectively with 8 kg CH_4/head/year for sheep and 5 kg CH_4/head/year for goats (2006 IPCC Guidelines).

5.2.3. Uncertainties Assessment and Time-Series Consistency

Uncertainties related to estimation of methane emissions from enteric fermentation, in particular depend on the accuracy of the livestock characteristic, and also on the emission factors used.

The uncertainties associated with the animal population in the RM are average (circa 10 per cent). The accuracy of default EFs estimated by using a Tier 1 method is around ±30 per cent (2006 IPCC Guidelines). As this methodology does not rely on country specific values and does not take account of country's livestock characteristics, general uncertainty of results obtained by using this approach could reach up to ±50 per cent (2006 IPCC Guidelines). In case of a Tier 2 approach, uncertainties will depend mostly on how accurately the characteristics of the main animal categories are used and on the extent to which estimation methods and coefficients applied in various equations used to calculate net energy comply with the national circumstances (2006 IPCC Guidelines). The accuracy of EFs estimated by using a Tier 2 methodology are likely to be in the order of ±20 per cent (2006 IPCC Guidelines). Thus, the combined uncertainties for source category 3A 'Enteric Fermentation' represent circa ±22.36 per cent (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 3A 'Enteric Fermentation' category, following a Tier 1 approach.

To be noted that the AD and methods used for estimating GHG emissions under this category were documented and archived both in hard copies and electronically. For identifying the data entry and the CH_4 emissions estimation process related errors there were applied verifications and quality control procedures. Following the recommendations included into the GPG, GHG emissions were estimated using AD from official sources of reference.

5.2.5. Recalculations

Methane emissions from the 3A 'Enteric Fermentation' were recalculated for the 1993-2015 time series, in particular due to use of an updated set of AD related to the livestock population on the LBDR (the Statistical Yearbooks of the ATULBD for 2016 and 2017 include more disaggregated data regarding 2011-2016 time periods, for example, for sheep and goats, respectively for poultry, the same trends regarding the population of these species were also applied for the rest of the analyzed period – 1993-2010); respectively due to use of an updated set of values for gross energy (GE), as well as a result of using a Tier 2 methodology and country specific EFs for several animal categories (in particular for cattle, sheep and goats).

In comparison with emissions estimates included into the NC4 of the RM under the UNFCCC (2018), the changes performed resulted in insignificant variations of methane emissions over the period 1990 through 2015 (Table 5-24).

Table 5-24: Comparative Results of CH_4 Emissions from 3A 'Enteric Fermentation' included into the NC4 and BUR2 of the RM under the UNFCCC (2018), kt

	1990	1991	1992	1993	1994	1995	1996	1997	1998
NC4	87.6278	81.2260	79.7785	75.0116	73.0146	64.8269	59.6436	51.4015	49.8990
BUR2	87.6278	81.2260	79.7785	75.0132	73.0168	64.8293	59.6463	51.4030	49.9008
Difference, %	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	1999	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**
NC4	46.1654	43.4236	44.2249	45.1422	41.2420	38.4882	37.0699	35.8771	28.9998
BUR2	46.1673	43.4256	44.2270	45.1436	41.2430	38.4891	37.0587	35.8683	28.9954
Difference, %	0.00	0.00	0.00	0.00	0.00	0.00	-0.03	-0.02	-0.02
	2008	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**
NC4	27.6323	28.7054	28.4921	26.8403	25.3516	25.7343	27.2124	26.1478	
BUR2	27.6273	28.7000	28.5028	26.8403	25.3134	25.7324	27.2385	26.1360	25.9708
Difference, %	-0.02	-0.02	0.04	0.00	-0.15	-0.01	0.10	-0.05	

Abbreviations: NC4 – Fourth National Communication; BUR2 – Second Biennial Update Report.

The table below presents the comparative results of methane emissions from 3A ‚Enteric Fermentation' included into the NC4 and BUR2 of the RM under the UNFCCC, expressed in kt CO_2 equivalent using the 100-year Global Warming Potential (GWP_{100}) values available in the Fourth IPCC Assessment Report (AR4) (GWP_{100} = 25) (Table 5-25).

Table 5-25: Comparative Results of CH_4 Emissions from 3A 'Enteric Fermentation' included into the NC4 and BUR2 and of the RM under the UNFCCC (2018), kt CO_2 equivalent

	1990	1991	1992	1993	1994	1995	1996	1997	1998
NC4	2190.6944	2030.6501	1994.4621	1875.2895	1825.3647	1620.6733	1491.0911	1285.0364	1247.4761
BUR2	2190.6944	2030.6501	1994.4621	1875.3295	1825.4206	1620.7325	1491.1578	1285.0760	1247.5198
Difference, %	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	1999	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**
NC4	1154.1351	1085.5902	1105.6220	1128.5541	1031.0491	962.2058	926.7480	896.9267	724.9947
BUR2	1154.1817	1085.6403	1105.6742	1128.5903	1031.0757	962.2286	926.4666	896.7070	724.8851
Difference, %	0.00	0.00	0.00	0.00	0.00	0.00	-0.03	-0.02	-0.02
	2008	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**
NC4	690.8077	717.6349	712.3031	671.0063	633.7909	643.3579	680.3101	653.6948	
BUR2	690.6823	717.4997	712.5704	671.0063	632.8347	643.3105	680.9618	653.4004	649.2698
Difference, %	-0.02	-0.02	0.04	0.00	-0.15	-0.01	0.10	-0.05	

Abbreviations: NC4 – Fourth National Communication; BUR2 – Second Biennial Update Report.

In 2016, CH_4 emissions resulting from 3A ‚Enteric Fermentation' were estimated for the first time. The results allow assert that within the 1990-2016 time series methane emissions from the respective category decreased by 70.4 per cent, in particular due to reduced animal population.

Over the period under review, the share of different livestock categories in the overall methane emissions from the 3A 'Enteric Fermentation' has changed significantly. By 2016, the percentage of such categories as 'other cattle' and 'swine' decreased considerable compared to 1990 year level, while the percentage of other categories such as 'dairy cows', 'sheep', 'goats', 'horses', 'asses and mules', and 'rabbits' increased (Table 5-26).

Table 5-26: Breakdown of the Methane Emissions from 3A 'Enteric Fermentation' by Livestock Category within 1990-2016 periods, %

	1990	1991	1992	1993	1994	1995	1996	1997	1998
Dairy cows	47.3	47.7	49.0	50.2	51.2	53.4	53.8	56.8	57.7
Other cattle	38.3	36.8	35.4	33.5	31.6	28.3	26.9	23.4	22.5
Sheep	9.8	10.6	10.9	12.0	12.6	13.1	13.7	13.8	13.0
Goats	0.3	0.4	0.5	0.6	0.8	0.9	1.0	1.2	1.2
Horses	1.0	1.1	1.2	1.3	1.4	1.7	1.9	2.3	2.5
Asses and mules	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.1
Swine	3.2	3.2	2.8	2.2	2.2	2.4	2.4	2.3	2.8
Rabbits	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2

	1999	2000	2001	2002	2003	2004	2005	2006	2007
Dairy cows	60.2	62.6	62.5	63.0	63.0	62.7	61.6	60.3	61.3
Other cattle	20.0	18.6	18.5	18.0	17.2	16.1	15.9	16.2	13.6
Sheep	12.8	12.1	12.1	11.8	12.4	13.6	14.5	14.9	16.8
Goats	1.4	1.5	1.6	1.8	1.8	1.9	2.0	2.0	2.2
Horses	2.8	3.2	3.3	3.3	3.6	3.5	3.5	3.5	3.8
Asses and mules	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Swine	2.4	1.7	1.7	1.8	1.7	1.6	2.0	2.4	1.7
Rabbits	0.2	0.2	0.3	0.2	0.3	0.4	0.4	0.5	0.5
	2008	2009	2010	2011	2012	2013	2014	2015	2016
Dairy cows	61.3	59.7	58.9	59.1	58.5	56.7	56.3	57.2	55.0
Other cattle	12.5	12.5	12.8	13.5	13.7	13.5	13.6	13.1	14.3
Sheep	17.8	18.8	18.6	17.6	17.8	19.6	20.1	19.5	20.3
Goats	2.4	2.6	2.9	3.1	3.3	3.6	3.6	3.7	4.1
Horses	3.7	3.5	3.4	3.4	3.4	3.2	2.8	2.8	2.6
Asses and mules	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Swine	1.6	2.1	2.7	2.6	2.6	2.6	2.8	2.8	2.7
Rabbits	0.5	0.6	0.6	0.6	0.6	0.7	0.7	0.8	0.8

It should also be noted the impact of using a Tier 2 assessment methodology at the expense of the Tier 1 methodology, which generally gave lower values of methane emissions from category 3A 'Enteric fermentation', this reduction varying from a minimum of 5.5 per cent in 2014 and a maximum of 18.4 per cent in 1999 (Table 5-27).

Table 5-27: Comparative Results of CH_4 Emissions from 3A 'Enteric Fermentation' Category, estimated using Tier 1 and Tier 2 Methodologies

	1990	1991	1992	1993	1994	1995	1996	1997	1998
Tier 1, kt	98.1242	94.6819	93.5080	88.4700	86.1070	78.3118	71.5496	62.8516	61.0890
Tier 2, kt	87.6278	81.2260	79.7785	75.0132	73.0168	64.8293	59.6463	51.4030	49.9008
Difference, %	-10.7	-14.2	-14.7	-15.2	-15.2	-17.2	-16.6	-18.2	-18.3
	1999	2000	2001	2002	2003	2004	2005	2006	2007
Tier 1, kt	56.6017	52.8901	53.6474	54.0904	49.6052	44.9070	42.8450	41.6227	33.6952
Tier 2, kt	46.1673	43.4256	44.2270	45.1436	41.2430	38.4891	37.0587	35.8683	28.9954
Difference, %	-18.4	-17.9	-17.6	-16.5	-16.9	-14.3	-13.5	-13.8	-13.9
	2008	2009	2010	2011	2012	2013	2014	2015	2016
Tier 1, kt	32.2693	33.1232	32.3301	30.3247	28.6838	28.4903	28.8193	28.1608	27.5052
Tier 2, kt	27.6273	28.7000	28.5028	26.8403	25.3134	25.7324	27.2385	26.1360	25.9708
Difference, %	-14.4	-13.4	-11.8	-11.5	-11.8	-9.7	-5.5	-7.2	-5.6

5.2.6. Planned Improvements

Planned improvements could include updating the AD and productivity indicators used to estimate GHG emissions within this source category following a Tier 2 methodology, in particular for cattle and sheep, the animal categories that account for the largest share in the structure of total methane emissions originated from the 3A 'Enteric Fermentation' category.

5.3. Manure Management (Category 3B)

The 3B 'Manure Management' category 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 amount of N_2O; while 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. Manure production depends on the amount of waste produced per year and the number of livestock and poultry, while 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, tanks, or pits), it decomposes anaerobically and can produce a significant quantity of CH_4. When manure is handled as a solid (e.g., in stacks or piles) or when it is deposited on pastures and paddocks, it tends to decompose under more aerobic conditions and CH_4 is insignificant.

In order to estimate methane emissions from manure management the total animal population was divided in subgroups to better reflect the average amount of waste produced per animal or poultry per year, as well as the way manure is managed. Average emissions 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, Assessment Methodologies and Emission Factors

While following a Tier 1 methodology, there are required livestock population data by animal species/category (identical to those used to estimate CH_4 emissions from the 3A 'Enteric Fermentation') in combination with IPCC default emission factors to estimate emissions in countries with cold climate - the average annual temperature being less than 15˚C) (see Equation 10.22, 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;

$N_{(T)}$ – the number of head of livestock species/category T in the country;

T – species/category of livestock.

Since the category 3B 'Manure Management' represents a significant share of 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, for estimating CH_4 emissions a 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 solids content per animal (VS, in kg) and the maximum methane producing capacity characteristic for 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 CH_4 forming process were identified for each type of manure management system.

CH_4 emission factors under the 3B 'Manure Management' category were calculated by using the Equation 10.23, 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 1990-2016 time series, kg dry matter/day

	1990	1991	1992	1993	1994	1995	1996	1997	1998
Dairy cows	4.15	3.98	3.95	4.03	4.10	4.01	3.99	3.87	3.89
Other cattle	1.99	2.00	2.02	2.23	2.36	2.31	2.42	2.27	2.25
Market swine	0.54	0.54	0.52	0.53	0.51	0.49	0.47	0.42	0.41
Fattening swine	0.34	0.34	0.33	0.34	0.32	0.31	0.29	0.26	0.26
	1999	2000	2001	2002	2003	2004	2005	2006	2007
Dairy cows	3.89	3.92	3.96	4.01	4.02	4.17	4.21	4.08	4.11
Other cattle	2.25	2.35	2.27	2.32	2.30	2.40	2.36	2.31	2.27
Market swine	0.40	0.42	0.40	0.40	0.42	0.41	0.40	0.40	0.40
Fattening swine	0.25	0.26	0.25	0.25	0.26	0.26	0.25	0.25	0.25
	2008	2009	2010	2011	2012	2013	2014	2015	2016
Dairy cows	4.01	4.03	4.13	4.15	4.15	4.21	4.44	4.42	4.40
Other cattle	2.10	2.08	2.10	2.14	2.15	2.11	2.15	2.08	2.23
Market swine	0.41	0.40	0.41	0.45	0.48	0.51	0.49	0.50	0.47
Fattening swine	0.26	0.25	0.26	0.28	0.30	0.32	0.31	0.31	0.30

Volatile Solids Excretion Rate (VS) was calculated in conformity with the equation below (see Equation 10.24, Chapter 10, Volume 4, 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 [79] (see country specific values in Table 5-28);

GE – gross energy intake, MJ/day; the same values as those used under the 3A 'Enteric Fermentation' category;

DE – digestibility of the feed in per cent; for cattle the same values were used as under the 3A 'Enteric Fermentation'; for fattening swine, *DE*– 85 per cent, while for market swine DE – 75 per cent;

(UE • GE) – urinary energy expressed as fraction of gross energy (GE); typically, this value is 0.04GE for cattle and 0.02GE 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 1990-2016 were used, 11 per cent for dairy cows, 11.5 per cent for other cattle, the default value of 2 per cent 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 specialty literature, there were used default values characteristic for EE countries (Tables 5-29 and 5-30).

Table 5-29: Coefficients and Default Emission Factors Used Under the 3B 'Manure Management' for Cattle and Swine

Categories	Mass, kg	Digestibility, %	Energy, MJ / day	Daily feed intake, kg	Manure, kg / day (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 Under the 3B 'Manure Management' (Developed Countries)

Categories	Mass, 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

79 Default values used as follows: for dairy cows – 4.5 kg VS/day, other cattle – 2.7 kg VS/day (2006 IPCC Guidelines , Volume 4, Ch. 10, Table 10A-4, Page 10.77, and Table 10A-5, Page 10.78); for swine: market swine – 0.5 kg VS/day, fattening swine – 0.3 kg VS/day (2006 IPCC Guidelines , Volume 4, Ch. 10, Table 10A-8, Page 10.81 and Table 10A-7, Page 10.80).

Categories	Mass, 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
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 Factors (MCF) values vary by different manure management systems and by annual average temperatures. Because of unavailability of country specific methane conversion factors (MCF), the default values provided in 2006 IPCC Guidelines were used (Table 5-31). Methane conversion factor (MCF) represents the extent to which maximum methane producing capacity (B_0) is attained. Thus, measurement of the MCF values should include the following factors: timing of storage/application; 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.

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: manure is not routinely removed from a confinement facility and is applied to cropland or pasture within 24 hours of excretion		0.1
Solid Storage: the storage of manure, typically for a period of several months, in unconfined piles or stacks; manure is able to be stacked due to the presence of a sufficient amount of bedding material or loss of moisture by evaporation		2
Dry lot: a paved or unpaved open confinement area without any significant vegetative cover where accumulating manure may be removed periodically		1
Liquid/Slurry: manure is stored as excreted or with minimal addition of water in either tanks or earthen ponds outside the animal housing, usually for periods less than one year	with natural crust cover	10
	without natural crust cover	17
Anaerobic Lagoon: a type of liquid storage system designed and operated to combine waste stabilization and storage; lagoon supernatant is usually used to remove manure from the associated confinement facilities to the lagoon; anaerobic lagoons are designed with varying lengths of storage (up to a year or greater), depending on the climate region, the volatile solids loading rate, and other operational factors; the water from lagoons may be recycled as flush water or used to irrigate and fertilize fields		66
Pit Storage below animal confinements: collection and storage of manure usually with litter or no added water typically below a slatted floor in an enclosed animal confinement, usually for periods less than one year	< 30 days	3
	> 30 days	17
Anaerobic Digester: the dung and urine in liquid/slurry are collected and anaerobically digested; methane may be burned flared or vented.		0-100
Burned for Fuel: the dung and urine are excreted on fields; the sun dried dung cakes are burned for fuel Methane emissions associated with burned manure are not included in the Agriculture Sector but were considered in the Energy Sector , within „Biomass Burning" category.		10
Composting - Intensive Windrow, in Vessel: composting in windrows with regular (at least daily) turning for mixing and aeration		0.5
Composting - Passive Windrow, in Static Pile: composting in windrows with infrequent turning for mixing and aeration		0.5
Poultry manure with litter: similar to cattle and swine deep bedding except usually not combined with a dry lot or pasture; typically used for all poultry breeder flocks and for the production of meat type chickens (broilers) and other fowl		1.5
Poultry manure without litter: may be similar to open pits in enclosed animal confinement facilities or may be designed and operated to dry the manure as it accumulates; the latter is known as a high-rise manure management system and is a form of passive windrow composting when designed and operated properly		1.5
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		0

Source: 2006 IPCC Guidelines, Volume 4, Chapter 10, Table 10.17, pages 10.44-10.47.

The default values of methane conversion factor for cattle and swine are presented in the Table 5-32, while the percentage of using different manure management systems in Eastern European Countries, respectively in the Table 5-33 below.

Table 5-32: Manure Management Systems MCFs for Different Animal Categories

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 Usage in the Eastern Europe (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**	**Pit storage <1 month**	**Pit storage>1 month**	**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 information (identical to that used for the enteric fermentation), as well as on default EFs and coefficients, there were developed country specific CH_4 EFs for 3B 'Manure Management' source category (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 private sector; the share of liquid manure management, contributing to a greater extent to generation of CH_4 emissions, decreased; while the share of solid manure management systems, less responsible for generation of CH_4 emissions, increased), as well as a consequence of non-compliance of actual manure management systems in the RM with the ones described in the 2006 IPCC Guidelines, it was not deemed necessary to use default values in terms of share of different manure management systems (MS%) characteristic to Eastern European countries.

Thus, in order to estimate CH_4 emissions from the 3B 'Manure Management' category (for cattle and swine), country specific values (Table 5-34) were used on the manure management systems usage in the Republic of Moldova, values available in a study developed in May-June 2015 by the specialists from the Scientific-Practical Institute of Biotechnology in Animal Breeding and Veterinary Medicine as well as from the National Agency for Food Security. 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 within 3B 'Manure Management' category. In the process of carrying out this study, dairy cows and other cattle farms with a herd 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. The study comprised 36 districts of the country. In total, manure management systems from 179 farms were inspected, of which 96 cattle farms, 66 pig farms and 17 poultry farms.

Table 5-34: Manure Management Systems Usage (MS%) in the RM within 1989-2016 periods

Animal categories (T) and 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 / 2016
	$MS_{(T,S)}$ values											
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**
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	24.5
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
Solid Storage	70.0	70.0	72.0	73.0	74.0	75.0	75.0	74.0	74.0	74.0	74.0	74.0
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**
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	22.0
Liquid/Slurry	34.0	26.0	18.0	10.0	4.0	4.0	4.0	6.0	6.0	6.0	6.0	6.0
Solid Storage	62.0	66.0	70.0	74.0	76.0	74.0	74.0	72.0	72.0	72.0	72.0	72.0
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**
Liquid/Slurry	73.0	65.0	60.0	55.0	40.0	30.0	30.0	32.0	32.0	35.0	35.0	37.0
Solid Storage	27.0	35.0	40.0	45.0	60.0	70.0	70.0	68.0	68.0	65.0	65.0	63.0
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**
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
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
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**
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
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
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**
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
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**
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
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

Table 5-35: Share of Different Manure Management Systems in 2015

Animal categories (T) and Manure management systems(MS)	Farms, units	Share, % of the total	Livestock, heads	Share, % of the total
Dairy cows	**94**	**100.0**	**7 149**	**100.0**
Solid storage, including:	81	86.2	4 879	68.2
On concrete platforms	12	12.8	714	10.0
Directly on the ground	69	73.4	4 165	58.3
Liquid/slurry, including:	13	13.8	2 270	31.8
Special tanks	4	4.3	591	8.3
Ponds and lakes	9	9.6	1 679	23.5
Other cattle	**96**	**100.0**	**9 179**	**100.0**
Solid storage, including:	83	86.5	5 578	60.8
On concrete platforms	10	10.4	593	6.5
Directly on the ground	73	76.0	4 985	54.3
Liquid/slurry, including:	13	13.5	3 601	39.2
Special tanks	6	6.3	1 981	21.6
Ponds and lakes	7	7.3	1 620	17.6
Swine	**66**	**100.0**	**177 186**	**100.0**
Solid storage, including:	36	54.5	17 310	9.8
On concrete platforms	2	3.0	115	0.1
Directly on the ground	34	51.5	17 195	9.7
Liquid/slurry, including:	30	45.5	159 876	90.2
Special tanks	8	12.1	54 598	30.8
Ponds and lakes	22	33.3	105 278	59.4
Poultry	**17**	**100.0**	**1 784 655**	**100.0**
Solid storage, including:	17	100.0	1 784 655	100.0
On concrete platforms	7	41.2	760 812	42.6
Directly on the ground	10	58.8	1 023 843	57.4

In order to estimate the share of manure management systems in the RM (MS%) (Table 5-34) within 1990-2016 periods, it was considered the information on livestock and poultry population (Table 5-9), respectively their share in agricultural enterprises and individual farms (Table 5-36).

Table 5-36: Livestock and Poultry Population within 1990-2016 periods, % of the total

	1990	1991	1992	1993	1994	1995	1996	1997	1998
	Agricultural enterprises								
Cattles	81.8	77.2	71.3	59.0	50.7	43.8	37.0	26.8	20.9
Cows	74.9	69.5	62.0	49.9	40.0	33.1	26.7	18.6	14.3
Other Cattles	86.0	82.2	78.0	66.8	61.0	55.8	50.1	39.0	31.2
Swine	81.0	77.4	71.1	60.3	54.0	55.1	52.0	40.2	36.9
Sheep and Goats	35.9	31.3	27.3	20.3	16.5	14.6	11.7	9.4	8.1
Sheep	37.0	32.6	28.7	21.5	17.6	15.6	12.6	10.2	8.9
Goats	0.0	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	21.9
Poultry	53.5	51.9	36.4	21.9	20.5	19.4	16.9	14.9	12.9
	Individual farms								
Cattles	18.2	22.8	28.7	41.0	49.3	56.2	63.0	73.2	79.1
Cows	25.1	30.5	38.0	50.1	60.0	66.9	73.3	81.4	85.7
Other Cattles	14.0	17.8	22.0	33.2	39.0	44.2	49.9	61.0	68.8
Swine	19.0	22.6	28.9	39.7	46.0	44.9	48.0	59.8	63.1
Sheep and Goats	64.1	68.7	72.7	79.7	83.5	85.4	88.3	90.6	91.9
Sheep	63.0	67.4	71.3	78.5	82.4	84.4	87.4	89.8	91.1
Goats	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Horses	15.3	23.6	33.8	46.4	53.7	58.1	64.2	72.0	78.1
Poultry	46.5	48.1	63.6	78.1	79.5	80.6	83.1	85.1	87.1
	1999	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**
	Agricultural enterprises								
Cattles	13.0	9.4	7.9	7.8	6.7	6.0	6.4	6.4	6.6
Cows	8.4	5.6	4.8	4.3	3.9	3.5	3.7	3.4	3.6
Other Cattles	21.6	17.6	14.3	15.3	12.9	12.0	12.9	13.0	14.8
Swine	19.6	9.2	11.1	14.6	9.2	8.5	10.0	12.6	20.6
Sheep and Goats	5.9	5.0	4.9	5.0	4.5	4.0	3.9	3.8	3.7
Sheep	6.6	5.7	5.5	5.7	5.1	4.6	4.5	4.3	4.1
Goats	0.0	0.0	0.0	0.8	0.0	0.0	0.0	0.0	0.3
Horses	11.9	8.4	6.5	6.4	5.2	4.1	4.3	3.0	2.9
Poultry	9.8	9.6	12.6	10.9	9.5	11.3	11.7	11.3	13.0

	1999	2000	2001	2002	2003	2004	2005	2006	2007
	Individual farms								
Cattles	87.0	90.6	92.1	92.2	93.3	94.0	93.6	93.6	93.4
Cows	91.6	94.4	95.2	95.7	96.1	96.5	96.3	96.6	96.4
Other Cattles	78.4	82.4	85.7	84.7	87.1	88.0	87.1	87.0	85.2
Swine	80.4	90.8	88.9	85.4	90.8	91.5	90.0	87.4	79.4
Sheep and Goats	94.1	95.0	95.1	95.0	95.5	96.0	96.1	96.2	96.3
Sheep	93.4	94.3	94.5	94.3	94.9	95.4	95.5	95.7	95.9
Goats	100.0	100.0	100.0	99.2	100.0	100.0	100.0	100.0	99.7
Horses	88.1	91.6	93.5	93.6	94.8	95.9	95.7	97.0	97.1
Poultry	90.2	90.4	87.4	89.1	90.5	88.7	88.3	88.7	87.0
	2008	2009	2010	2011	2012	2013	2014	2015	2016
	Agricultural enterprises								
Cattles	6.1	6.0	5.4	5.9	6.1	6.5	7.2	8.1	10.0
Cows	3.2	3.0	2.9	3.0	3.5	3.9	4.5	4.6	4.7
Other Cattles	14.1	13.7	11.5	12.9	12.2	12.4	13.0	15.7	20.9
Swine	23.3	25.1	29.1	27.5	34.6	37.8	41.6	41.0	43.6
Sheep and Goats	3.0	2.6	2.2	2.5	2.1	2.3	2.7	3.2	2.9
Sheep	3.3	2.9	2.5	2.9	2.5	2.6	3.1	3.7	3.3
Goats	0.4	0.4	0.3	0.4	0.4	0.7	0.8	0.7	0.8
Horses	2.7	2.2	2.1	1.8	1.7	1.3	1.2	1.0	1.0
Poultry	17.4	14.9	13.8	14.7	22.4	30.3	29.6	33.4	34.4
	Individual farms								
Cattles	93.9	94.0	94.6	94.1	93.9	93.5	92.8	91.9	90.0
Cows	96.8	97.0	97.1	97.0	96.5	96.1	95.5	95.4	95.3
Other Cattles	85.9	86.3	88.5	87.1	87.8	87.6	87.0	84.3	79.1
Swine	76.7	74.9	70.9	72.5	65.4	62.2	58.4	59.0	56.4
Sheep and Goats	97.0	97.4	97.8	97.5	97.9	97.7	97.3	96.8	97.1
Sheep	96.7	97.1	97.5	97.1	97.5	97.4	96.9	96.3	96.7
Goats	99.6	99.6	99.7	99.6	99.6	99.3	99.2	99.3	99.2
Horses	97.3	97.8	97.9	98.2	98.3	98.7	98.8	99.0	99.0
Poultry	82.6	85.1	86.2	85.3	77.6	69.7	70.4	66.6	65.6

Country specific EFs, calculated following a simplified Tier 2 approach (Equation 10.23 from the 2006 IPCC Guidelines) are provided below (Table 5-37).

Table 5-37: Country Specific CH_4 Emission Factors for the 3B 'Manure Management', calculated following a Tier 2 Methodology for Cattle and Swine Population in the Republic of Moldova

	1990	1991	1992	1993	1994	1995	1996	1997	1998
Dairy cows	13.5	11.4	11.4	8.6	8.8	6.7	6.7	6.5	5.1
Other cattle (average)	5.8	4.9	4.9	4.3	4.5	3.2	3.4	3.2	2.2
Swine (average)	5.1	4.6	4.5	4.4	4.2	3.7	3.6	3.2	2.4
Market swine	7.8	6.9	6.7	6.5	6.1	5.5	5.3	4.7	3.6
Fattening piglets	4.9	4.4	4.2	4.1	3.9	3.5	3.3	2.9	2.3
	1999	2000	2001	2002	2003	2004	2005	2006	2007
Dairy cows	5.1	4.4	4.4	4.5	4.5	4.8	4.9	4.7	4.8
Other cattle (average)	2.2	2.3	2.2	2.3	2.3	2.7	2.6	2.6	2.5
Swine (average)	2.4	2.1	2.0	1.9	2.0	2.1	2.0	2.1	2.0
Market swine	3.5	3.0	2.9	2.8	3.0	3.0	3.0	3.0	3.0
Fattening piglets	2.2	1.9	1.8	1.8	1.9	1.9	1.9	1.9	1.9
	2008	2009	2010	2011	2012	2013	2014	2015	2016
Dairy cows	4.7	4.7	4.8	4.8	4.8	4.9	5.2	5.1	5.1
Other cattle (average)	2.3	2.3	2.3	2.4	2.4	2.3	2.4	2.3	2.5
Swine (average)	2.0	2.0	2.0	2.2	2.5	2.7	2.6	2.6	2.5
Market swine	2.2	2.1	2.2	2.4	2.7	2.8	2.7	2.8	2.6
Fattening piglets	3.2	3.2	3.2	3.6	4.0	4.2	4.1	4.1	3.9

For other cattle and swine population, the share of animal population by sub-categories was taking into account for estimating average national EFs (see Table 5-21 for 'Other Cattle' and Table 5-38 for 'Swine').

Table 5-38: Swine Population Distribution by Sub-categories within 1990-2016 periods, %

	1990	1991	1992	1993	1994	1995	1996	1997	1998
Swine, total	100.0	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	14.6
…Piglets over 4 months	7.4	8.7	9.4	11.5	12.4	12.7	12.9	12.7	16.0
...Other swine	84.2	82.2	80.7	76.3	75.1	75.1	74.4	73.7	69.4

	1999	2000	2001	2002	2003	2004	2005	2006	2007
Swine, total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
…Market swine	14.5	15.3	16.6	16.3	14.7	14.9	15.5	14.2	13.2
…Piglets over 4 months	28.6	37.8	56.3	56.5	65.0	66.4	64.4	65.2	66.3
...Other swine	56.9	46.9	27.1	27.1	20.3	18.8	20.1	20.6	20.5
	2008	2009	2010	2011	2012	2013	2014	2015	2016
Swine, total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
…Market swine	13.0	12.9	12.1	12.2	11.0	10.6	10.8	11.4	12.0
…Piglets over 4 months	60.7	65.8	64.9	64.5	65.0	57.6	62.1	54.1	54.0
...Other swine	26.2	21.3	23.0	23.2	23.9	31.8	27.1	34.5	34.0

Source: NBS, Statistical Annual Report No. 24-agr 'Animal Breeding Sector', the Number of Livestock and Poultry in all Households Categories as of 1st of January (annually for 1990-2016).

5.3.1.3. Uncertainties Assessment and Time-Series Consistency

Uncertainties related to estimation of methane emissions from 3B 'Manure Management' category, depend on the accuracy of the livestock characterization, and also on the default emission factors used. The uncertainties associated with the total animal population in the Republic of Moldova are average (circa 10 per cent).

To be noted that the uncertainty range for the default emission factors calculated by using a Tier 1 method is estimated to be ±30 per cent (2006 IPCC Guidelines). Since this approach is not based on the country specific data and the characteristics of livestock from particular countries are not taken into account, the general uncertainty related to the use of this methodology can get to ±50 per cent (2006 IPCC Guidelines). If a Tier 2 methodology is to be used, uncertainties related to manure management systems to great extent depend on the characteristic features of the livestock breeding sector and how information on manure management systems is collected in the RM. Because lately the RM uses preponderantly three manure management systems (pasture/range/paddock, solid storage and, to a lesser extent, liquid/slurry), uncertainties related to manure management systems can be considered relatively small, however, due to the fact that previously a wide spectrum of manure management systems was used, the uncertainties on these are considered to be average (up to ±30 per cent). Thus, combined uncertainties account for circa ±31.62 per cent (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. To be noted, that the AD and methods used for estimating CH_4 emissions under this category were documented and archived both in hard copies and electronically. For identifying the data entry and GHG emissions estimation process related errors there were applied AD and EFs verifications and quality control procedures.

5.3.1.5. Recalculations

Methane emissions from the 3B 'Manure Management' category were recalculated for the 1990-2015 time series, in particular due to use of an updated set of AD related to the livestock population on the LBDR (the Statistical Yearbooks of the ATULBD for 2016 and 2017 include more disaggregated data regarding 2011-2016 time periods, for example, for sheep and goats, respectively for poultry, the same trends regarding the population of these species were also applied for the rest of the analyzed period – 1993-2010); respectively due to use of an updated set of values for gross energy received daily – GE (MJ/day) and for the volatile solids excretion rate – VS (kg d.m./day, in particular for other cattle, as well as a result of using a Tier 2 methodology and country specific EFs for cattle and swine.

In comparison with emissions estimates included into the NC4 of the RM under the UNFCCC (2018), the changes performed in the current inventory cycle resulted in an insignificant increase of methane emissions over the period 1990 through 2015 (Table 5-39).

Table 5-39: Comparative Results of CH_4 Emissions from 3B 'Manure Management' category included into the NC4 and the BUR2 of the Republic of Moldova under the UNFCCC, kt

	1990	1991	1992	1993	1994	1995	1996	1997	1998
NC4	19.7927	16.5955	14.9221	10.9646	10.5554	8.1887	7.4670	6.0636	5.0792
BUR2	19.8038	16.6032	14.9283	10.9978	10.6093	8.2510	7.4958	6.0866	5.1085
Difference, %	0.06	0.05	0.04	0.30	0.51	0.76	0.39	0.38	0.58
	1999	2000	2001	2002	2003	2004	2005	2006	2007
NC4	4.4567	3.3837	3.4138	3.5798	3.3334	3.2418	3.4267	3.4979	2.4883
BUR2	4.4921	3.4013	3.4366	3.5979	3.3469	3.2528	3.4433	3.5129	2.5021
Difference, %	0.79	0.52	0.67	0.51	0.41	0.34	0.48	0.43	0.55
	2008	2009	2010	2011	2012	2013	2014	2015	2016
NC4	2.4469	2.7921	3.0558	2.8892	2.7445	2.7015	2.8838	2.8145	
BUR2	2.4678	2.8113	3.0755	2.9050	2.7630	2.7162	2.9011	2.8336	2.7337
Difference, %	0.86	0.69	0.64	0.55	0.67	0.54	0.60	0.68	

Abbreviations: NC4 – Fourth National Communication; BUR2 – Second Biennial Update Report.

The table below presents the comparative results of methane emissions from 3B 'Manure Management' category included into the NC4 and BUR2 of the RM under the UNFCCC, expressed in kt CO_2 equivalent using the 100-year Global Warming Potential (GWP_{100}) values available in the Fourth IPCC Assessment Report (AR4) ($GWP_{100} = 25$) (Table 5-40).

Table 5-40: Comparative Results of CH_4 Emissions from 3B 'Manure Management' included into the NC4 and the BUR2 of the Republic of Moldova under the UNFCCC, kt CO_2 equivalent

	1990	1991	1992	1993	1994	1995	1996	1997	1998
NC4	494.8175	414.8876	373.0518	274.1139	263.8862	204.7183	186.6754	151.5907	126.9789
BUR2	495.0955	415.0799	373.2078	274.9462	265.2313	206.2761	187.3957	152.1643	127.7113
Difference, %	0.06	0.05	0.04	0.30	0.51	0.76	0.39	0.38	0.58
	1999	2000	2001	2002	2003	2004	2005	2006	2007
NC4	111.4172	84.5927	85.3462	89.4941	83.3355	81.0440	85.6682	87.4474	62.2063
BUR2	112.3024	85.0324	85.9160	89.9480	83.6736	81.3197	86.0829	87.8226	62.5516
Difference, %	0.79	0.52	0.67	0.51	0.41	0.34	0.48	0.43	0.55
	2008	2009	2010	2011	2012	2013	2014	2015	2016
NC4	61.1723	69.8017	76.3961	72.2309	68.6123	67.5387	72.0942	70.3618	
BUR2	61.6958	70.2833	76.8879	72.6254	69.0754	67.9055	72.5269	70.8399	68.3414
Difference, %	0.86	0.69	0.64	0.55	0.67	0.54	0.60	0.68	

Abbreviations: NC4 – Fourth National Communication; BUR2 – Second Biennial Update Report.

For 2016, CH_4 emissions resulting from 3B 'Manure Management' category were estimated for the first time. The results allow assert that within the 1990-2016 time series methane emissions from the respective category decreased by 86.2 per cent, in particular due to reduced animal population, and changes in the share of manure management systems (the share of liquid/slurry systems decreased significantly while the share of pasture and solid storage increased).

Over the period under review, the share of different livestock categories in the overall methane emissions from the 3B 'Manure Management' has changed significantly. By 2016, the percentage of such categories as 'Cattle' and 'Swine' decreased considerable compared to 1990 year level while the share of categories like 'Sheep', 'Goats', 'Horses', 'Asses and Mules', 'Rabbits' and 'Poultry' tended to increase (Table 5-41).

Table 5-41: Breakdown of the Methane Emissions from 3B 'Manure Management' by Livestock and Poultry Category within 1990-2016 periods, %

	1990	1991	1992	1993	1994	1995	1996	1997	1998
Cattle	46.5	45.0	49.2	50.0	51.4	44.5	44.7	46.2	41.0
Sheep	1.2	1.4	1.6	2.4	2.5	3.1	3.2	3.5	3.9
Goats	0.0	0.0	0.1	0.1	0.1	0.2	0.2	0.2	0.3
Horses	0.4	0.5	0.5	0.8	0.9	1.2	1.3	1.7	2.1
Asses and mules	0.0	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	44.5
Poultry	3.8	4.4	3.6	3.6	4.0	5.2	5.2	6.4	8.0
Rabbits	0.1	0.1	0.2	0.2	0.2	0.2	0.2	0.2	0.3
	1999	2000	2001	2002	2003	2004	2005	2006	2007
Cattle	43.5	48.6	48.9	47.7	46.4	46.1	41.3	37.7	41.9
Sheep	4.0	4.7	4.7	4.5	4.7	4.9	4.6	4.6	5.8
Goats	0.3	0.4	0.5	0.5	0.5	0.5	0.5	0.4	0.6
Horses	2.5	3.5	3.7	3.6	3.8	3.6	3.3	3.1	3.8
Asses and mules	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Swine	39.7	29.7	28.3	29.8	29.1	27.1	29.3	33.3	25.7
Poultry	9.6	12.6	13.4	13.5	14.9	17.1	20.4	20.1	21.4
Rabbits	0.3	0.4	0.4	0.4	0.5	0.6	0.6	0.7	0.8

	2008	2009	2010	2011	2012	2013	2014	2015	2016
Cattle	38.8	34.6	31.2	31.5	31.0	31.2	30.8	30.4	30.9
Sheep	5.9	5.5	4.9	4.7	4.8	5.0	4.8	4.8	5.0
Goats	0.6	0.6	0.5	0.6	0.6	0.7	0.7	0.7	0.8
Horses	3.6	3.1	2.7	2.7	2.7	2.6	2.3	2.2	2.1
Asses and mules	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Swine	27.0	30.6	36.4	39.1	42.6	46.2	47.4	47.3	45.5
Poultry	23.2	24.7	23.4	20.6	17.4	13.3	13.0	13.4	14.6
Rabbits	0.8	0.8	0.7	0.8	0.8	0.9	0.9	1.0	1.1

It should be mentioned that for animal categories 'dairy cows', 'other cattle' and 'swine', the Tier 2 impact is much greater compared to the Tier 1 methodology. The use of a Tier 2 method, an approach that reflects country specific conditions, in particular related to manure management systems (MS%), has contributed to much lower values of CH_4 emissions within 1993-2016 periods, varying between a minimum of 2.9 per cent in 1993 to a maximum of 47.0 per cent in 2001; with the exception of 1990-1992 time series when the results after using a Tier 2 method show increased values compared to those obtained after using a Tier 1 method (Table 5-42); this is explained by the fact that the productivity of livestock and poultry in the RM during the soviet period and in the next few years immediately after the independence, respectively manure management systems usage were close to similar indicators characteristic to Western European countries; also, during that period, the overwhelming majority of livestock and poultry was under collective management, respectively in large agricultural enterprises, while today the situation is virtually the opposite (see Table 5-36 above), the majority of the livestock and poultry being owned by individual farmers with much more limited opportunities, including financially, for the use of modern manure management systems.

Table 5-42: Comparative Results of CH_4 Emissions from 3B 'Manure Management' Category, estimated using Tier 1 and Tier 2 Methodologies, kt

	1990	1991	1992	1993	1994	1995	1996	1997	1998
Tier 1, kt	14.9864	14.3176	13.1911	11.3291	10.9584	10.1404	9.2643	8.0449	8.3155
Tier 2, kt	19.8038	16.6032	14.9283	10.9978	10.6093	8.2510	7.4958	6.0866	5.1085
Difference, %	32.1	16.0	13.2	-2.9	-3.2	-18.6	-19.1	-24.3	-38.6
	1999	2000	2001	2002	2003	2004	2005	2006	2007
Tier 1, kt	7.4377	6.3811	6.4811	6.7124	6.0931	5.5407	5.6963	5.7948	4.2009
Tier 2, kt	4.4921	3.4013	3.4366	3.5979	3.3469	3.2528	3.4433	3.5129	2.5021
Difference, %	-39.6	-46.7	-47.0	-46.4	-45.1	-41.3	-39.6	-39.4	-40.4
	2008	2009	2010	2011	2012	2013	2014	2015	2016
Tier 1, kt	4.0433	4.5108	4.7781	4.3961	4.0340	3.9031	4.1125	3.9983	3.9152
Tier 2, kt	2.4678	2.8113	3.0755	2.9050	2.7630	2.7162	2.9011	2.8336	2.7337
Difference, %	-39.0	-37.7	-35.6	-33.9	-31.5	-30.4	-29.5	-29.1	-30.2

5.3.1.6. Planned Improvements

Planned improvements could include continued activities focused on obtaining more precise AD and productivity indices used to estimate CH_4 emissions from the 3B 'Manure Management' category, in particular for 'cattle' and 'swine' livestock categories accounting for the largest share in the structure of total CH_4 emissions originated from this category; as well as updating the values for the main parameters used to develop CS EFs for the respective animal categories following a Tier 2 method; and also there are planned activities focused on regular updating (every 3 years) the 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. To be noted that nitrification is the aerobic oxidation of ammonia nitrogen (NH_4^+) to nitrate nitrogen (NO_3^-), while nitrites and nitrates are transformed to N_2O and dinitrogen (N_2) during the naturally occurring process of denitrification, that is an anaerobic process: $NO_3^- \rightarrow NO_2^- \rightarrow NO \rightarrow N_2O \rightarrow N_2$. The direct emission of N_2O from manure during storage and treatment depends on the nitrogen and carbon content of manure, and on the duration of the storage and type of treatment within the animal waste management systems. It is considered that sufficient supply of oxygen to 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 with increasing acidity, nitrate concentration, and reduced moisture. In summary, 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, conditions preventing reduction of nitrogen oxide (N_2O) to dinitrogen (N_2), such as a low pH or limited moisture, must be present.

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 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[80] 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, Assessment Methodologies and Emission Factors

N_2O emissions from the 3B 'Manure Management' were estimated based on a Tier 2 methodology (IPCC, 2006). To estimate direct N_2O emissions from manure management it was necessary to collect information on the total livestock population (identical to those used for the 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 3B 'Manure Management':

(i) collect livestock population data from the livestock population characterization;

(ii) develop the annual average nitrogen excretion rate per head ($Nex_{(T)}$) 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) for each manure management system type S, multiply the emission factor ($FE_{3(S)}$) by the total amount of nitrogen managed (from all livestock species/categories) in that system, to estimate N_2O emissions from that manure management system, then sum over all manure management systems.

The calculation of direct N_2O emissions from manure management is based on the following Equation 10.25 from 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;*

$Nex_{(T)}$ – *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, dimensionless;*

$FE_{3(S)}$ – *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);*

80 Leaching – the loss of mineral and organic solutes due to water or other liquids percolation from soil.

S – manure management system;

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 $Nex_{(T)}$ is based on the following equation (2006 IPCC Guidelines, Volume 4, Chapter 10, Equation 10.30):

$$Nex_{(T)} = N_{rate(T)} \bullet (TAM/1000) \bullet 365$$

Where:

$Nex_{(T)}$ *– 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/yr.*

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. Therefore, N excretion rates can be derived from N intake and N retention data. 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 of production of 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 $Nex_{(T)}$ were estimates using Equation 10.31 from 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 typical (average) weight of livestock and poultry in the Eastern European countries and default values of nitrogen excretion rate (kg N/1000 kg of animal mass/yr) characteristic for the same region, country specific $Nex_{(T)}$ 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, weigh 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: IPCC 2006 Guidelines, Volume 4, Chapter 10, Table 10.19, Page 10.59, Table 10A-9, Pages 10.82-10.83.

It was taken into consideration the amount of N fed to animals stored in straw bedding together with manure ($N_{bedding\ MS}$). It is known from the literature in the field that this amount can reach to 7 kg N/head/yr for dairy cows, to 4 kg N/head/yr for other cattle, to 0.8 kg N/head/yr for market swine, and to 5.5 kg N/head/yr for fattening swine; at the same time, if it is applied a large straw bedding, as practiced in the RM, these quantities can be doubled (Webb, 2001; Döhler et al., 2002; cited after the 2006 IPCC Guidelines).

Applying the above methodological approach, the implicitly used values 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 $Nex_{(T)}$ were also estimated (Table 5-44).

Table 5-44: Average Annual $Nex_{(T)}$ Excretion by Main Livestock and Poultry Categories in the Republic of Moldova within 1990-2016 periods, kg N/head/year

	1990	1991	1992	1993	1994	1995	1996	1997	1998
Dairy cows	62.6	59.3	58.1	56.4	56.2	56.1	56.1	60.2	59.3
Other cattle	54.4	51.5	48.6	47.0	45.5	45.8	47.1	45.8	44.6
Sheep	13.7	14.0	13.7	13.7	14.0	12.5	12.6	11.3	11.3
Goats	17.0	17.4	17.0	17.0	17.4	15.3	15.3	13.6	13.6
Horses	53.8	46.2	48.8	49.0	51.6	50.3	48.7	45.2	45.0
Asses and mules	19.3	18.8	18.7	18.8	18.6	18.1	17.6	17.5	17.4
Swine	20.5	19.1	17.7	16.9	16.2	17.7	20.2	18.1	13.7
Rabbits	6.3	6.2	6.2	6.1	6.2	6.2	42.7	6.2	6.2
Chicken	0.5	0.5	0.5	0.5	0.4	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	0.8
Ducks	0.7	0.7	0.7	0.6	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	1.2
	1999	2000	2001	2002	2003	2004	2005	2006	2007
Dairy cows	58.9	58.6	58.4	58.4	58.0	58.6	57.8	57.6	57.4
Other cattle	44.0	43.0	43.3	42.9	42.5	43.7	42.8	43.3	41.7
Sheep	11.3	11.4	10.8	10.8	10.8	10.8	10.8	11.1	10.8
Goats	13.6	13.6	12.8	12.8	12.8	12.8	12.8	13.2	12.8
Horses	42.6	43.1	42.8	43.0	43.5	42.8	44.1	47.8	44.2
Asses and mules	16.6	16.8	16.7	16.7	16.9	16.7	17.1	17.3	17.3
Swine	12.8	11.9	11.4	10.9	11.3	11.7	11.5	11.6	11.6
Rabbits	6.1	6.1	6.2	6.2	6.0	6.2	6.2	6.2	6.0
Chicken	0.4	0.4	0.5	0.4	0.4	0.5	0.5	0.5	0.5
Geese	0.8	0.8	0.9	0.8	0.8	0.9	0.9	0.9	0.9
Ducks	0.6	0.6	0.6	0.6	0.6	0.7	0.7	0.7	0.7
Turkeys	1.2	1.2	1.2	1.2	1.2	1.2	1.3	1.3	1.3
	2008	2009	2010	2011	2012	2013	2014	2015	2016
Dairy cows	55.5	55.8	56.9	57.0	57.8	57.9	60.0	61.3	60.7
Other cattle	42.1	42.3	42.6	46.3	45.9	44.8	48.9	49.3	48.9
Sheep	10.8	11.3	11.3	11.3	11.7	12.2	13.7	13.1	13.4
Goats	12.8	13.6	13.6	13.6	14.1	14.9	17.0	16.1	16.6
Horses	45.5	44.8	45.3	45.0	46.7	47.2	46.4	46.2	46.1
Asses and mules	17.6	17.3	17.5	17.7	17.9	18.1	17.7	17.5	17.4
Swine	12.6	12.6	12.4	12.8	13.2	12.2	12.8	12.2	13.2
Rabbits	6.2	6.2	6.3	6.2	6.0	6.0	6.2	6.2	6.2
Chicken	0.5	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	0.9
Ducks	0.7	0.7	0.7	0.7	0.6	0.6	0.7	0.7	0.6
Turkeys	1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.4

Based on information from 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. Although the average annual N excretion values $Nex_{(T)}$ were calculated by different methods, the obtain results are still comparable.

Table 5-45: Average Annual Nitrogen Excretion for a Typical Animal $Nex_{(T)}$ 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/tone	$N_{ex(T)}$ with/without bedding, kg N/head/yr
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.

As values featured in Table 5-45 are not available for all animal categories, respectively country specific values related to N retained (the fraction of N intake that is retained by the animal for the production of meat, milk, wool, eggs, etc.), $Nex_{(T)}$ values set forth in Table 5-44 were used to calculate the direct N_2O emissions from manure management in the RM.

Activity data on manure management systems usage are identical to that used earlier in sub-chapter 5.3.1. To 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 from the 3B 'Manure Management' source category there were used country specific information on manure management systems usage in the Republic of Moldova (Table 5-34). It is considered a *good practice* to estimate emissions from manure management systems keeping account of storage duration and treatment type. While identifying types of treatment, account should be taken of temperature and aeration. As it was not possible to use country specific EFs, the default values provided into the 2006 IPCC Guidelines were used in the Republic of Moldova (Table 5-46).

Table 5-46: Default EFs for N_2O Emissions from Manure Management Systems

Manure Management System		EF_3, kg N_2O-N / kg N excreted	Uncertainty ranges of EF_3	Source of reference
Pasture/Range/Paddock: The manure from pasture and range grazing animals is allowed to lie as is, and is not managed. Direct and indirect N_2O emissions associated with the manure deposited on agricultural soils and pasture, range, paddock systems are treated in 3D 'Agricultural soils' category	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: The storage of manure, typically for a period of several months, in unconfined piles or stacks. Manure is able to be stacked due to the presence of a sufficient amount of bedding material or loss of moisture by evaporation		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 may be removed periodically. Dry lots are most typically found in dry climates but also are used in humid climates		0.020	Factor of 2	2006 IPCC Guidelines, Table 10.21
Liquid/Slurry: Manure is stored as excreted. Liquid may be stored for a long time (months) with some minimal addition of water to facilitate handling and is stored in either tanks or earthen ponds Emissions are considered to be insignificant due to 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 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. This manure management system also is known as a bedded pack manure management system and may be combined with a dry lot or pasture	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, birds do not walk on manure		0.001	Factor of 2	2006 IPCC Guidelines, Table 10.21
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 lands. Therefore, in order to estimate the amount of nitrogen in manure which is applied to managed soils, it is necessary to omit nitrogen losses occurring through volatilization (NH_3, NO_x), as well as runoffs and leaching.

Indirect N_2O emissions from the source category 3B 'Manure Management' were estimated by 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 from 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;

$Nex_{\ (T)}$ – 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, dimensionless;

$Frac_{\ GasMS}$ – per cent of managed manure nitrogen for livestock category T that volatilizes as NH_3 and NO_x in the manure management system S, per cent (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-N)(mm) emissions to N_2O (mm) emissions.

Table 5-47: Default Values for Total Nitrogen Loss, that Volatilize in NH_3 and NO_x from Manure Management 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 by 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;

$Nex_{\ (T)}$ – 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, dimensionless;

$Frac_{\ leach\ MS}$ – per cent 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 per cent);

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 $(N_2O\text{-}N)_{L(mm)}$ emissions to $N_2O_{L(mm)}$ emissions.

The scientific literature show that in drier climates, runoff losses are smaller (circa 3-6 per cent of N excreted) than in high rainfall areas (5-19 per cent, respectively). Leaching losses of nitrogen depend on weather conditions, varying between 5 to 16 per cent (2006 IPCC Guidelines).

Table 5-48 presents 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 where applicable.

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 these are due to volatilization losses, primarily ammonia losses that occur rapidly following excretion of the manure. Losses also occur in the form of NO_3, N_2O, and N_2, in particular from leaching and runoff that occurs where manure is stored in piles. The values included in the table reflect average values for typical housing/storage combinations for each animal category.

Table 5-48: Default Values for Total Nitrogen Loss from Manure Management *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.

Following storage in any system of manure management, nearly all the manure is applied to land. The N_2O emissions that subsequently arise from application of the manure to soil should be reported under the category 3D 'Agricultural Soils'. The estimate of managed manure N available for application to managed soils was based on Equation 10.34 from 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;

$Nex_{(T)}$ – 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, dimensionless;

$Frac_{Loss\ MS}$ – amount of managed manure nitrogen for livestock category T that is lost in the manure management system S, per cent;

$N_{bedding\ MS}$ – 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 Assessment and Time-Series Consistency

Uncertainties related to estimation of N_2O emissions from 3B 'Manure Management' source category, depend on the accuracy of the livestock characterization (±10 per cent), and also on the default emission factors used. Uncertainty ranges for the default N excretion rates ($Nex_{(T)}$) are estimated at about ±50 per cent and they can be reduced to ±30 per cent using country specific values. To be noted that uncertainties associated with the default emission factors for direct N_2O emissions from manure management are large: from -50 per cent to +100 per cent. Uncertainties associated with the default emission factors for indirect N_2O emissions from manure management, in particular, uncertainties related to default values for nitrogen loss due to volatilization of NH_3 and NO_x and total nitrogen loss from manure management are also quite large. The uncertainty associated with default emission factors for nitrogen volatilization and re-deposition (EF_4), as well as for leaching and runoff (EF_5), are also quite high, from -100 per cent, to +200 per cent. Thus, the combined uncertainties associated with direct N_2O emissions from manure management represent circa ±104.40 per cent, respectively circa ±152.97 per cent for indirect N_2O emissions (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 the 'Agriculture' Sector, following a Tier 1 approaches. Also, the AD and methods used for estimating N_2O emissions under the 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 applied.

5.3.2.5. Recalculations

N_2O emissions from the 3B 'Manure Management' were recalculated for the 1993-2015 time series, in particular due to use of an updated set of AD related to the livestock population on the LBDR (the Statistical Yearbooks of the ATULBD for 2016 and 2017 include more disaggregated data regarding 2011-2016 time periods, for example, for sheep and goats, respectively for poultry, the same trends regarding the population of these species were also applied for the rest of the analyzed period – 1993-2010); respectively due to use of an updated set of AD regarding animal and poultry productivity in the country.

In comparison with emissions estimates included into the NC4 of the RM under the UNFCCC (2018), the changes performed in the current inventory cycle resulted in an insignificant increase of total nitrous oxide emissions over the period 1993 through 2015, varying from a minimum increase of 0.50 per cent in 2004, up to a maximum increase by 1.43 per cent in 1995 (Table 5-49).

Table 5-49: Comparative Results of N_2O $_{TOTAL(mm)}$ Emissions from 3B 'Manure Management' included into the NC4 and the BUR2 of the RM under the UNFCCC, kt

	1990	1991	1992	1993	1994	1995	1996	1997	1998
NC4	3.7470	3.4991	3.1392	2.7155	2.6254	2.4251	2.5789	1.9891	1.9212
BUR2	3.7470	3.4991	3.1392	2.7360	2.6585	2.4596	2.5974	2.0035	1.9398
Difference, %	0.00	0.00	0.00	0.75	1.26	1.43	0.72	0.73	0.97
	1999	2000	2001	2002	2003	2004	2005	2006	2007
NC4	1.7380	1.5597	1.5863	1.6001	1.5214	1.4730	1.5707	1.6153	1.2329
BUR2	1.7608	1.5712	1.5998	1.6116	1.5302	1.4804	1.5820	1.6257	1.2423
Difference, %	1.31	0.74	0.85	0.72	0.58	0.50	0.72	0.64	0.76
	2008	2009	2010	2011	2012	2013	2014	2015	2016
NC4	1.2103	1.3661	1.4165	1.2930	1.1839	1.1095	1.2202	1.1814	
BUR2	1.2244	1.3794	1.4304	1.3045	1.1973	1.1203	1.2336	1.1950	1.2507
Difference, %	1.17	0.97	0.98	0.89	1.13	0.97	1.10	1.15	

Abbreviations: NC4 – Fourth National Communication; BUR2 – Second Biennial Update Report.

The table below presents the comparative results of nitrous oxide emissions from 3B 'Manure Management' included into the NC4 and BUR2 of the RM under the UNFCCC, expressed in kt CO_2 equivalent using the 100-year Global Warming Potential (GWP_{100}) values available in the Fourth IPCC Assessment Report (AR4) (GWP_{100} = 298) (Table 5-50).

Table 5-50: Comparative Results of $N_2O_{TOTAL(mm)}$ Emissions from 3B 'Manure Management' included into the NC4 and the BUR2 of the RM under the UNFCCC, kt CO_2 equivalent

	1990	1991	1992	1993	1994	1995	1996	1997	1998
NC4	1 116.6179	1 042.7426	935.4783	809.2207	782.3676	722.6727	768.5050	592.7501	572.5096
BUR2	1 116.6179	1 042.7426	935.4783	815.3185	792.2223	732.9723	774.0215	597.0533	578.0598
Difference, %	0.00	0.00	0.00	0.75	1.26	1.43	0.72	0.73	0.97
	1999	2000	2001	2002	2003	2004	2005	2006	2007
NC4	517.9332	464.7815	472.7172	476.8327	453.3829	438.9507	468.0568	481.3605	367.3939
BUR2	524.7140	468.2084	476.7359	480.2456	456.0074	441.1540	471.4376	484.4637	370.1945
Difference, %	1.31	0.74	0.85	0.72	0.58	0.50	0.72	0.64	0.76
	2008	2009	2010	2011	2012	2013	2014	2015	2016
NC4	360.6617	407.0993	422.1117	385.3168	352.8017	330.6386	363.6188	352.0708	
BUR2	364.8654	411.0664	426.2558	388.7320	356.8055	333.8503	367.6124	356.1224	372.7198
Difference, %	1.17	0.97	0.98	0.89	1.13	0.97	1.10	1.15	

Abbreviations: NC4 – Fourth National Communication; BUR2 – Second Biennial Update Report.

For 2016, total N_2O emissions resulting from 3B 'Manure Management' were estimated for the first time. The results allow assert that within the 1990-2016 time series nitrous oxide emissions from the respective category decreased by 66.6 per cent, in particular due to reduced animal population, decreased in productivity and changes in the share of manure management systems (the share of liquid/slurry systems decreased significantly while 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 the 3B 'Manure Management' category were recalculated for the period included in the BUR2 of the RM under the UNFCCC.

Table 5-51: Comparative Results of Direct $N_2O_{D(mm)}$ Emissions from 3B 'Manure Management' Category included into the NC4 and the BUR2 of the RM under the UNFCCC, kt

	1990	1991	1992	1993	1994	1995	1996	1997	1998
NC4	2.9259	2.7696	2.5012	2.2016	2.1339	1.9768	2.1080	1.6217	1.5828
BUR2	2.9259	2.7696	2.5012	2.2182	2.1606	2.0047	2.1230	1.6333	1.5979
Difference, %	0.00	0.00	0.00	0.75	1.25	1.41	0.71	0.72	0.95
	1999	2000	2001	2002	2003	2004	2005	2006	2007
NC4	1.4359	1.2988	1.3208	1.3313	1.2659	1.2239	1.3011	1.3367	1.0241
BUR2	1.4543	1.3081	1.3317	1.3406	1.2731	1.2299	1.3103	1.3452	1.0317
Difference, %	1.28	0.72	0.83	0.70	0.56	0.49	0.71	0.63	0.74
	2008	2009	2010	2011	2012	2013	2014	2015	2016
NC4	1.0038	1.1301	1.1688	1.0676	0.9786	0.9202	1.0114	0.9799	
BUR2	1.0152	1.1408	1.1800	1.0769	0.9895	0.9290	1.0222	0.9909	1.0338
Difference, %	1.14	0.95	0.96	0.87	1.11	0.95	1.07	1.12	

Abbreviations: NC4 – Fourth National Communication; BUR2 – Second Biennial Update Report.

Table 5-52: Comparative Results of Indirect $N_2O_{IND(mm)}$ Emissions from 3B 'Manure Management' Category included into the NC4 and the BUR2 of the RM under the UNFCCC, kt

	1990	1991	1992	1993	1994	1995	1996	1997	1998
NC4	0.8212	0.7295	0.6380	0.5139	0.4915	0.4483	0.4709	0.3674	0.3384
BUR2	0.8212	0.7295	0.6380	0.5178	0.4978	0.4550	0.4744	0.3702	0.3419
Difference, %	0.00	0.00	0.00	0.76	1.29	1.49	0.75	0.75	1.05
	1999	2000	2001	2002	2003	2004	2005	2006	2007
NC4	0.3021	0.2609	0.2655	0.2688	0.2555	0.2491	0.2696	0.2786	0.2088
BUR2	0.3065	0.2631	0.2680	0.2710	0.2572	0.2505	0.2717	0.2806	0.2106
Difference, %	1.44	0.84	0.97	0.81	0.66	0.56	0.80	0.71	0.85
	2008	2009	2010	2011	2012	2013	2014	2015	2016
NC4	0.2065	0.2360	0.2477	0.2254	0.2053	0.1893	0.2088	0.2015	
BUR2	0.2092	0.2386	0.2504	0.2275	0.2079	0.1913	0.2114	0.2041	0.2170
Difference, %	1.30	1.07	1.07	0.97	1.25	1.08	1.22	1.29	

Abbreviations: NC4 – Fourth National Communication; BUR2 – Second Biennial Update Report.

For 2016, 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 assert that within the 1990-2016 time series direct $N_2O_{D(mm)}$ emissions from the respective category decreased by 64.7 per cent while indirect $N_2O_{IND(mm)}$ emissions decreased by circa 73.6 per cent.

To be noted that indirect $N_2O_{G(mm)}$ emissions from volatilization of ammonia (NH_3) and nitrogen oxides (NO_x) decreased by 75.1 per cent, within this period, while $N_2O_{L(mm)}$ emissions from leaching and runoff of nitrogen have decreased by 61.1 per cent (Table 5-53).

Table 5-53: Indirect N_2O Emissions from Volatilization of Ammonia and Nitrogen Oxides, as well as from Leaching and Runoff of Nitrogen, under 3B 'Manure Management' Category within 1990-2016 periods, kt

	1990	1991	1992	1993	1994	1995	1996	1997	1998
Indirect N_2O $_{(G)}$	0.7311	0.6427	0.5581	0.4442	0.4256	0.3884	0.4038	0.3158	0.2883
Indirect N_2O $_{(L)}$	0.0901	0.0868	0.0798	0.0736	0.0722	0.0666	0.0706	0.0544	0.0536
$N_2O_{IND(mm)}$	0.8212	0.7295	0.6380	0.5178	0.4978	0.4550	0.4744	0.3702	0.3419
	1999	2000	2001	2002	2003	2004	2005	2006	2007
Indirect N_2O $_{(G)}$	0.2567	0.2171	0.2210	0.2238	0.2122	0.2070	0.2255	0.2335	0.1738
Indirect N_2O $_{(L)}$	0.0498	0.0460	0.0470	0.0471	0.0449	0.0435	0.0462	0.0470	0.0367
$N_2O_{IND(mm)}$	0.3065	0.2631	0.2680	0.2710	0.2572	0.2505	0.2717	0.2806	0.2106
	2008	2009	2010	2011	2012	2013	2014	2015	2016
Indirect N_2O $_{(G)}$	0.1730	0.1984	0.2093	0.1902	0.1736	0.1592	0.1762	0.1699	0.1820
Indirect N_2O $_{(L)}$	0.0361	0.0402	0.0411	0.0374	0.0342	0.0321	0.0351	0.0342	0.0350
$N_2O_{IND(mm)}$	0.2092	0.2386	0.2504	0.2275	0.2079	0.1913	0.2114	0.2041	0.2170

This evolution was possible due to the significant decrease of animal population, to negative changes in the productivity of animal breeding sector and also due to changes in the share of animal waste management systems in the RM

Table 5-54 presents the total amounts of nitrogen generated by all manure management systems, as well as the amounts of N from animal waste available for application to managed soils in the RM, estimated in conformity with the methodology set forth in the IPCC 2006 Guidelines.

Table 5-54: Amount of Managed Manure N Available for Application to Managed Soils within 1990-2016 periods, kt N

	1990	1991	1992	1993	1994	1995	1996	1997	1998
Nex $_{(T)}$	135.1713	123.4886	110.3797	95.2995	92.4152	85.1856	88.3974	69.2488	65.7947
N_{MMS_Avb}	85.3474	77.5640	70.2188	59.9481	58.2225	52.9686	54.7989	43.1256	40.8138
Share, % from Nex $_{(T)}$	63.1	62.8	63.6	62.9	63.0	62.2	62.0	62.3	62.0
	1999	2000	2001	2002	2003	2004	2005	2006	2007
Nex $_{(T)}$	59.4772	52.6415	53.4215	54.2313	51.2960	49.5581	52.1850	53.4875	41.0368
N_{MMS_Avb}	37.1658	33.0652	33.7274	34.0138	32.2238	31.0014	32.6440	33.4153	25.7531
Share, % from Nex $_{(T)}$	62.5	62.8	63.1	62.7	62.8	62.6	62.6	62.5	62.8
	2008	2009	2010	2011	2012	2013	2014	2015	2016
Nex $_{(T)}$	40.7807	45.6589	47.2092	43.2692	40.1457	38.0213	41.8910	40.5062	42.3047
N_{MMS_Avb}	25.2695	28.1907	29.0441	26.6200	24.5905	23.3500	25.4232	24.7237	25.6553
Share, % from Nex $_{(T)}$	62.0	61.7	61.5	61.5	61.3	61.4	60.7	61.0	60.6

5.3.2.6. Planned Improvements

Regarding N_2O emissions from the 3B 'Manure Management' category, planned improvements could include collecting additional data, in particular on country specific manure management systems (historical data, starting with 1990, as well as recent information, for every 3 years), as well as those related to country specific N excreted rates for different categories (kg N/head/year).

5.4. Agricultural Soils (Category 3D)

Direct and indirect N_2O emissions are monitored under the 3D 'Agricultural Soils' category. 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 (above-ground and below-ground), including from N-fixing crops and from forages during pasture renewal; 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 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 amount of animal manure, compost, sewage sludge and other organic N additions applied to soils, kt/yr;

N_2O_{PRP} –N_2O emissions from urine and dung inputs to grazed soils, kt/yr;

N_2O_{CR} –N_2O emissions from the amount of N in crop residues (above-ground and below-ground), including N-fixing crops and from forages during pasture renewal, returned to soils, kt/yr;

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), kt/yr

To be noted, that within the 1990-2016 time series, direct N_2O emissions from 3D 'Agriculture Soils' category decreased by circa 2.5 per cent, from 3.6147 kt in 1990 to 3.5252 kt in 2016 (Figure 5-4).

The contribution of different emission sources in the structure of total direct N_2O emissions has changed significantly. The share of N_2O_{SN}, N_2O_{ON}, N_2O_{PRP} and N_2O_{CR} decreased by 51.7 per cent, 69.2 per cent, 6.8 per cent and respectively 24.4 per cent, while the share of N_2O_{SOM} increased by circa 3.6 times (Table 5-55).

Table 5-55: Breakdown of Direct N_2O Emissions from 3D 'Agriculture Soils' Category by Source within 1990-2016 periods, % of the total

	1990	1991	1992	1993	1994	1995	1996	1997	1998
N_2O_{SN}	40.0	36.9	34.7	12.5	9.9	6.0	8.5	5.9	6.0
N_2O_{ON}	24.1	22.5	25.6	18.4	26.6	19.7	23.0	14.4	15.7
N_2O_{PRP}	5.0	6.8	8.0	8.6	12.5	10.9	11.3	8.0	10.2
N_2O_{CR}	15.1	17.5	14.8	14.9	10.5	12.4	7.6	10.8	10.6
N_2O_{SOM}	15.7	16.3	16.9	45.5	40.5	51.0	49.6	60.9	57.4
	1999	2000	2001	2002	2003	2004	2005	2006	2007
N_2O_{SN}	3.9	7.2	7.4	10.2	10.5	8.5	8.7	8.2	21.9
N_2O_{ON}	15.8	15.1	12.8	12.5	15.0	10.7	11.4	12.9	19.5
N_2O_{PRP}	10.5	11.0	9.3	9.2	10.9	7.6	7.7	8.3	13.0
N_2O_{CR}	11.4	6.7	10.1	9.9	5.9	10.6	10.8	11.6	6.0
N_2O_{SOM}	58.5	60.0	60.4	58.1	57.7	62.5	61.4	59.0	39.5
	2008	2009	2010	2011	2012	2013	2014	2015	2016
N_2O_{SN}	11.5	11.5	11.7	13.8	29.5	20.7	26.7	23.0	19.4
N_2O_{ON}	8.6	12.4	10.7	9.5	13.8	7.5	7.2	9.6	7.4
N_2O_{PRP}	5.9	8.2	6.9	6.2	9.0	4.9	4.7	6.3	4.7
N_2O_{CR}	11.0	10.6	12.1	11.7	5.5	11.4	11.3	5.5	11.4
N_2O_{SOM}	63.1	57.3	58.5	58.8	42.1	55.5	50.0	55.6	57.1

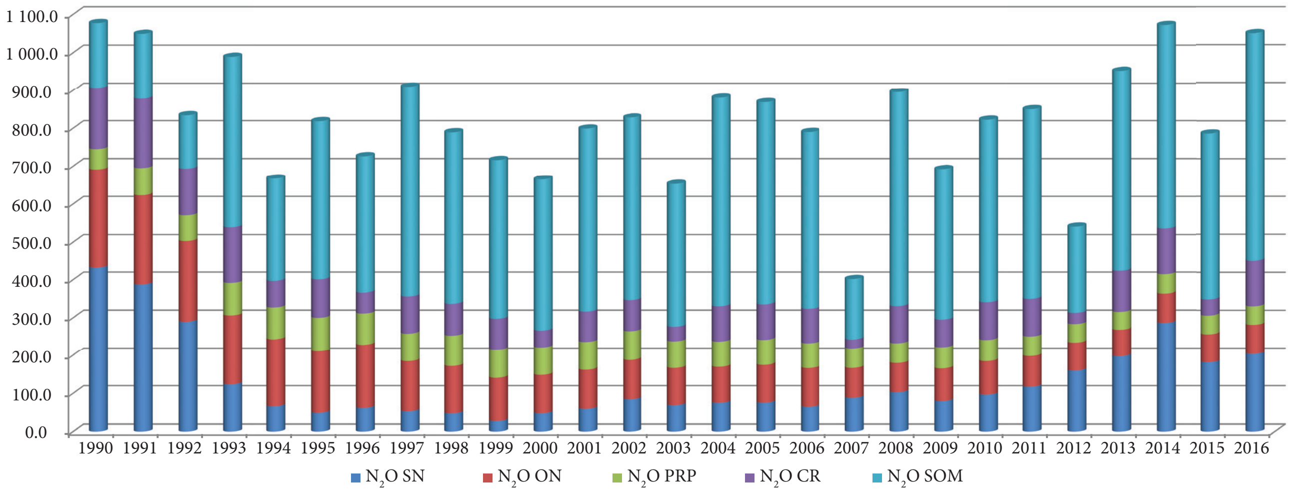


Figure 5-4: Direct N_2O emissions from the 3D 'Agricultural Soils' within 1990-2016 periods, kt.

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 leaching and runoff from land of N from synthetic and organic fertilizer additions, crop residue, 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.

Indirect N_2O emissions from managed soils were estimated 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^- onto 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.

Within the 1990-2016 time series, indirect N_2O emissions from the 3D 'Agricultural Soils' decreased by circa 19.1 per cent, from 1.1423 kt in 1990 to 0.9240 kt in 2016 (Figure 5-5).

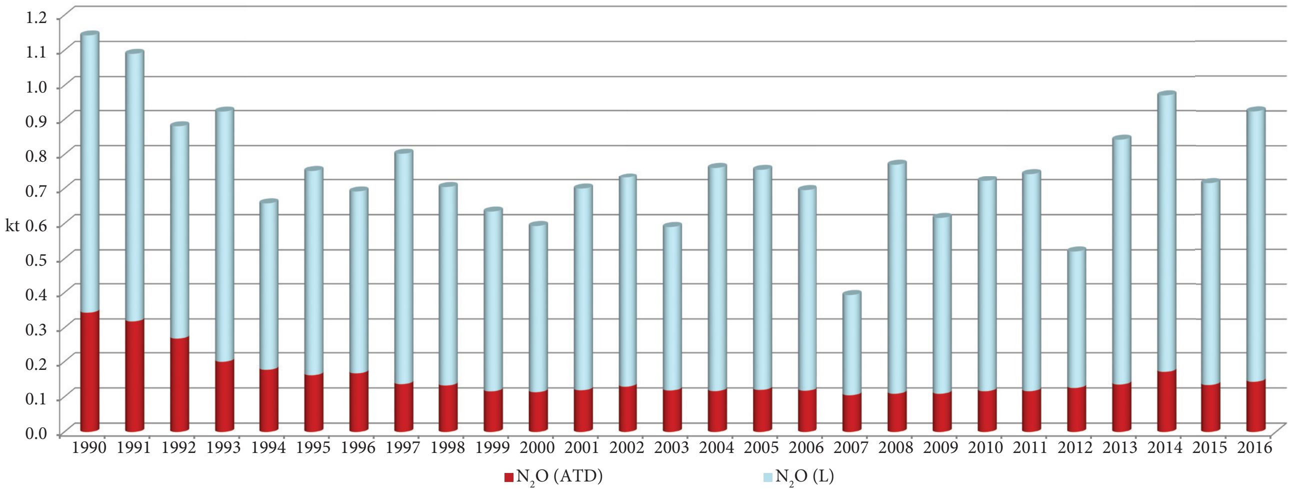


Figure 5-5: Indirect N_2O emissions from the 3D 'Agricultural Soils' within 1990-2016 periods, kt.

The contribution of emission sources in the structure of total indirect N_2O emissions has also changed within the reference period. Thus, the share of N_2O_{ATD} from atmospheric deposition of nitrogen decreased by 48.5 per cent, while the share of N_2O_L emissions from leaching and runoff from land of nitrogen increased respectively, by 20.8 per cent (Table 5-56).

Table 5-56: Breakdown of Indirect N_2O Emissions from 3D 'Agriculture Soils' Category by Source within 1990-2016 periods, %

	1990	1991	1992	1993	1994	1995	1996	1997	1998
N_2O_{ATD}	30.0	29.2	30.6	21.7	26.9	21.4	24.1	17.0	18.8
N_2O_L	70.0	70.8	69.4	78.3	73.1	78.6	75.9	83.0	81.2
	1999	2000	2001	2002	2003	2004	2005	2006	2007
N_2O_{ATD}	18.2	19.1	16.9	17.6	20.0	15.3	15.8	16.9	26.6
N_2O_L	81.8	80.9	83.1	82.4	80.0	84.7	84.2	83.1	73.4
	2008	2009	2010	2011	2012	2013	2014	2015	2016
N_2O_{ATD}	14.1	17.7	16.1	15.6	24.1	16.0	17.7	18.7	15.5
N_2O_L	85.9	82.3	83.9	84.4	75.9	84.0	82.3	81.3	84.5

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. Nitrous oxide is produced naturally in soils through the processes of nitrification and denitrification. The amount of emissions from fertilizers consumption depends on a number of factors, such as: the amount and type of N fertilizers applied, crops type, soil type, climate and other environment related conditions. N_2O emissions from synthetic N fertilizers vary a lot over a year.

Methodological Issues, Emission Factors and Data Sources

Direct N_2O emissions from applied inorganic nitrogen fertilizers were estimated by using a Tier 1 methodology (2006 IPCC Guidelines) and Equation 11.2.

$$N_2O_{SN} = F_{SN} \bullet EF_1 \bullet 44/28$$

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 N_2O emissions from N inputs; default: 0.01 kg N_2O-N/kg N applied; range: 0.003-0.03 kg N_2O-N/kg N;

[44/28] – stoichiometric 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: 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, brown soils, and phosphor deficient soils.
Nitroammophos	Complex formula	N: P: K 13-19 each	Pellets of different colors	Efficient on all soils and used for all crops.
Diammophos	Complex formula	N: P: K 10:26:26	Pellets of different colors	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 1993-2015 time series).

Table 5-58 indicates that between 1990 and 2016, there was a significant decrease by 4.0 times of the amounts of inorganic N fertilizers used in the agriculture sector of the Republic of Moldova. The amounts of inorganic N fertilizers used per one hectare decreased by circa 3.9 times, from 134 kg a.s./ha in 1990, to 34 kg a.s./ha in 2016.

Table 5-58: Applied Inorganic N Fertilizers within 1990-2016 periods, kt of N active substance

	1990	1991	1992	1993	1994	1995	1996	1997	1998
Applied Inorganic N Fertilizer, F_{SN}	92.1	82.7	61.8	26.4	14.1	10.5	13.2	11.4	10.2
Total Applied Inorganic Fertilizer	232.4	191.4	127.6	44.9	20.0	12.5	14.3	12.1	10.3
kg applied for 1 sown ha	134.1	111.5	74.6	25.2	11.7	7.2	8.3	7.0	6.0
	1999	2000	2001	2002	2003	2004	2005	2006	2007
Applied Inorganic N Fertilizer, F_{SN}	5.9	10.2	12.7	18.0	14.6	16.1	16.1	13.8	18.8
Total Applied Inorganic Fertilizer	6.1	10.3	12.8	18.4	15.4	17.5	18.0	16.6	22.4
kg applied for 1 sown ha	3.6	6.1	7.4	10.6	9.7	10.4	10.6	10.7	14.4
	2008	2009	2010	2011	2012	2013	2014	2015	2016
Applied Inorganic N Fertilizer, F_{SN}	21.9	17.0	20.6	25.0	34.1	42.1	61.1	38.7	43.4
Total Applied Inorganic Fertilizer	24.7	19.9	25.5	30.9	44.0	54.8	84.5	52.4	58.8
kg applied for 1 sown ha	15.9	12.5	15.6	19.3	26.6	32.5	49.9	30.9	34.3

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) and 2017 (page 306). 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).

The average consumption of nutrients, in kg of nitrogen per 1 tone 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 in winter wheat, 4.5-6.4 t/ha in grain maize, 2.1-3.5 t/ha in sunflower, 26.8-37.0 t/ha in sugar beets, etc.

The sharp reduction in fertilizers consumption occurred due to a number of reasons, such as: a drop in import of synthetic fertilizer in the country, lack of farmers' financial resources in certain periods of the year, in particular in the context of the breakdown of agriculture during the transition to market economy. To be noted that in conformity with the National Complex Soil Fertility Enhancing Program for 2001-2020, it is planned to increase the annual amount of synthetic N fertilizer up to 120-130 thousand tons of nitrogen by 2020.

Uncertainties Assessment and Time-Series Consistency

Uncertainties related to activity data on applied inorganic N fertilizers in the RM are considered to be low (±5 per cent). Uncertainties associated with the default emission factor (EF_1 for F_{SN}) may reach up to ±6 per cent. The combined uncertainties associated with the direct N_2O emissions from applied synthetic N fertilizers are considered to be low (±7.81 per cent) (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 3D 'Agriculture Soils' category, following a Tier 1 approach. The AD and methods used for estimating N_2O emissions originated from this source category were documented and archived both in hard copies and electronically. In order to identify the data entry and GHG emissions estimation process related errors AD and EFs verifications and quality control procedures were applied. Following the recommendations included into the 2006 IPCC Guidelines, GHG emissions were estimated using AD from official sources of reference.

Recalculations

No recalculations were made for estimating direct N_2O_{SN} emissions from applied inorganic N fertilizers in the country between1990 and 2015 (Table 5-59).

Table 5-59: Direct N_2O_{SN} Emissions from Applied Inorganic N Fertilizers included into the NC4 and BUR2 of the RM under the UNFCCC, kt

	1990	1991	1992	1993	1994	1995	1996	1997	1998
NC4	1.4473	1.2996	0.9711	0.4145	0.2217	0.1652	0.2077	0.1795	0.1600
BUR2	1.4473	1.2996	0.9711	0.4145	0.2217	0.1652	0.2077	0.1795	0.1600
Difference, %	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	1999	2000	2001	2002	2003	2004	2005	2006	2007
NC4	0.0929	0.1609	0.1994	0.2823	0.2298	0.2524	0.2530	0.2170	0.2959
BUR2	0.0929	0.1609	0.1994	0.2823	0.2298	0.2524	0.2530	0.2170	0.2959
Difference, %	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
NC4	0.3446	0.2670	0.3234	0.3928	0.5355	0.6617	0.9603	0.6078	
BUR2	0.3446	0.2670	0.3234	0.3928	0.5355	0.6617	0.9603	0.6078	0.6821
Difference, %	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	

Abbreviations: NC4 – Fourth National Communication; BUR2 – Second Biennial Update Report.

For 2016, direct N_2O_{SN} emissions resulting from applied inorganic N fertilizers on managed lands in the Republic of Moldova were estimated for the first time. The results allow assert that within the 1990-2016 time series the respective emissions decreased by circa 52.9 per cent.

The table below presents the comparative results of nitrous oxide emissions from applied inorganic N fertilizers on managed lands in the Republic of Moldova for the 1990-2016 time series included into the NC4 and BUR2 of the RM under the UNFCCC, expressed in kt CO_2 equivalent using the 100-year Global Warming Potential (GWP_{100}) values available in the Fourth IPCC Assessment Report (AR4) (GWP_{100} = 298) (Table 5-60).

Table 5-60: Comparative Results of Direct N_2O_{SN} Emissions from Applied Inorganic N Fertilizers included into the NC4 and BUR2 of the RM under the UNFCCC, kt CO_2 equivalent

	1990	1991	1992	1993	1994	1995	1996	1997	1998
NC4	431.2911	387.2723	289.4006	123.5197	66.0704	49.2215	61.8980	53.4876	47.6855
BUR2	431.2911	387.2723	289.4006	123.5197	66.0704	49.2215	61.8980	53.4876	47.6855
Difference, %	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	1999	2000	2001	2002	2003	2004	2005	2006	2007
NC4	27.6851	47.9571	59.4114	84.1182	68.4681	75.2161	75.4034	64.6623	88.1735
BUR2	27.6851	47.9571	59.4114	84.1182	68.4681	75.2161	75.4034	64.6623	88.1735
Difference, %	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
NC4	102.6997	79.5613	96.3774	117.0677	159.5721	197.1895	286.1680	181.1301	
BUR2	102.6997	79.5613	96.3774	117.0677	159.5721	197.1895	286.1680	181.1301	203.2777
Difference, %	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	

Abbreviations: NC4 – Fourth National Communication; BUR2 – Second Biennial Update Report.

Planned Improvements

No activities for improving the estimation process regarding the direct N_2O emissions from applied inorganic N fertilizers under the 3D 'Agriculture Soils' are planned for the future 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 contribute to increasing N_2O emissions from managed soils. While calculating emissions covered by this source category, activity data on generation diverse organic matter should be taken into account.

In the Republic of Moldova, the largest share of such organic matter comes from the livestock breeding sector and the food processing industry. However, the animal breeding sector is still the major provider of organic fertilizer: animal manure, poultry manure, sewage sludge applied to soil, crop residues based composts applied to soil, manure slurry, delluvial soil, alluvium from water basins, as well as other organic amendments (e.g., rendering waste, brewery waste, liquid waste from sugar beet refineries and wineries, 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 other than by grazing animals (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 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] – stoichiometric ratio of nitrogen content in N_2O-N and N_2O.

Data on total amount of organic fertilizers (preponderantly, manure with bedding[81]) applied on managed lands are available in the Statistical Yearbooks of the RM and those of the ATULBD (Table 5-61). As the table indicates, from 1990 through 2016, according to the NBS and the State Statistical Service of the ATULBD, there was a significant reduction, by circa 70 times, of the amounts of organic N fertilizers applied per hectare of sown fields, from circa 5.6 tons per sown hectare in 1990, to circa 80 kg per sown hectare in 2016.

Table 5-61: Applied Organic Fertilizers in the RM within 1990-2016 periods

	1990	1991	1992	1993	1994	1995	1996	1997	1998
Applied organic N fertilizers, kt	9740.0	8600.0	5300.0	4200.0	1620.0	1779.2	905.7	352.9	227.3
Applied organic N fertilizers, tons/ha	5.60	5.10	3.40	2.40	1.10	1.20	0.60	0.20	0.10
	1999	2000	2001	2002	2003	2004	2005	2006	2007
Applied organic N fertilizers, kt	122.1	83.3	98.2	54.2	47.3	42.2	44.2	10.5	7.9
Applied organic N fertilizers, tons/ha	0.10	0.03	0.10	0.02	0.06	0.04	0.04	0.01	0.01

[81] In early 1990', 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) was circa 26.7%, and the share of manure without bedding, respectively circa 35.4% (Turcan et al., 1984; Balteanskyi, 1986).

	2008	2009	2010	2011	2012	2013	2014	2015	2016
Applied organic N fertilizers, kt	8.0	6.9	17.7	31.5	22.9	42.6	33.8	61.2	74.6
Applied organic N fertilizers, tons/ha	0.01	0.01	0.02	0.04	0.03	0.05	0.03	0.07	0.08

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) and 2017 (page 306). 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).

It should be noted that the statistical data on the amount of organic N fertilizers applied to soils are collected through Questionnaire no. 9-agr "The use of phytosanitary products and the introduction of synthetic and organic fertilizers in 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 ha and more) 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 the 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) which, also do not report to the territorial statistical institution, it is obvious that the statistical data presented above, in Table 5-61, is much underestimated. Within the current inventory cycle, 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 managed manure nitrogen available for application to managed soils (N_{MMS_Avb}) (Table 5-54).

As can be seen from Table 5-62, the current statistical system fails to monitor the amounts of organic N fertilizers actually applied to soils in the RM, as it does not include statistically all producers and individual farmers.

Table 5-62: Amount of Organic Fertilizers Generated and Available to be Applied to Soils in the Republic of Moldova within 1990-2016 periods, in comparison to the official statistical data within the same period, kt

	1990	1991	1992	1993	1994	1995	1996	1997	1998
Organic fertilizers available to be applied to soils (estimated AD), kt	15240.6	13850.7	12539.1	10705.0	10396.9	9458.7	9785.5	7701.0	7288.2
Applied organic fertilizers (statistical data), kt	9740.0	8600.0	5300.0	4200.0	1620.0	1779.2	905.7	352.9	227.3
Applied organic fertilizers (statistical data), % of the amount of the organic fertilizers available to be applied to soils	63.9	62.1	42.3	39.2	15.6	18.8	9.3	4.6	3.1
	1999	2000	2001	2002	2003	2004	2005	2006	2007
Organic fertilizers available to be applied to soils (estimated AD), kt	6636.7	5904.5	6022.8	6073.9	5754.3	5536.0	5829.3	5967.0	4598.8
Applied organic fertilizers (statistical data), kt	122.1	83.3	98.2	54.2	47.3	42.2	44.2	10.5	7.9
Applied organic fertilizers (statistical data), % of the amount of the organic fertilizers available to be applied to soils	1.8	1.4	1.6	0.9	0.8	0.8	0.8	0.2	0.2
	2008	2009	2010	2011	2012	2013	2014	2015	2016
Organic fertilizers available to be applied to soils (estimated AD), kt	4512.4	5034.1	5186.4	4753.6	4391.2	4169.6	4539.9	4415.0	4581.3
Applied organic fertilizers (statistical data), kt	8.0	6.9	17.7	31.5	22.9	42.6	33.8	61.2	74.6
Applied organic fertilizers (statistical data), % of the amount of the organic fertilizers available to be applied to soils	0.2	0.1	0.3	0.7	0.5	1.0	0.7	1.4	1.6

The scientific literature[82] shows that 1 tone of cattle manure with bedding contain circa 5.6 kg of nitrogen. In order to estimate the F_{ON} values (Table 5-63), the applied amount of organic fertilizer (it is agreed that 65 per cent of the available amount is actually applied to soil) was multiplied by the conversion factor from bedding manure to nitrogen.

Table 5-63: Amount of N Applied to Soils with Organic Fertilizers within 1990-2016 periods, kt

	1990	1991	1992	1993	1994	1995	1996	1997	1998
Organic fertilizers available to be applied to soils (estimated AD), kt	15240.6	13850.7	12539.1	10705.0	10396.9	9458.7	9785.5	7701.0	7288.2
Applied organic fertilizers (65 per cent of the available amounts), kt	9906.4	9003.0	8150.4	6958.3	6758.0	6148.1	6360.6	5005.6	4737.3
Applied organic fertilizers (F_{ON}), kt of a.s. (N)	55.4758	50.4166	45.6422	38.9662	37.8446	34.4296	35.6193	28.0316	26.5290
	1999	2000	2001	2002	2003	2004	2005	2006	2007
Organic fertilizers available to be applied to soils (estimated AD), kt	6636.7	5904.5	6022.8	6073.9	5754.3	5536.0	5829.3	5967.0	4598.8
Applied organic fertilizers (65 per cent of the available amounts), kt	4313.9	3837.9	3914.8	3948.0	3740.3	3598.4	3789.0	3878.6	2989.2
Applied organic fertilizers (F_{ON}), kt of a.s. (N)	24.1577	21.4924	21.9228	22.1089	20.9455	20.1509	21.2186	21.7200	16.7395
	2008	2009	2010	2011	2012	2013	2014	2015	2016
Organic fertilizers available to be applied to soils (estimated AD), kt	4512.4	5034.1	5186.4	4753.6	4391.2	4169.6	4539.9	4415.0	4581.3
Applied organic fertilizers (65 per cent of the available amounts), kt	2933.1	3272.1	3371.2	3089.8	2854.3	2710.3	2950.9	2869.7	2977.8
Applied organic fertilizers (F_{ON}), kt of a.s. (N)	16.4252	18.3240	18.8786	17.3030	15.9838	15.1775	16.5251	16.0704	16.6759

[82] 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.

To be noted that in conformity with crop rotation structure the need for organic fertilizer, is 10-15 t/ha for a neutral humus balance, and 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). Based on the relevant agriculture expert opinions, the stabilization of humus content in soil on arable lands and horticultural plantations require annual application of circa 20-22 million tons of organic fertilizers, while current resources of organic matter can ensure application of as much as 4-5 million tons 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 as an organic fertilizer applied to soil to be used the green mass of the leguminous crops with highly developed semi-fascicular root system. The best suited for this use as green sidereal are the vetch, respectively winter and spring peas. The use of these crops as a green fertilizer can be achieved in two ways: (i) 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 (ii) 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. To be noted that a vetch yield (mixed with a cereal crop of circa 20 per cent) or a peas yield, annually could return to soil circa 8 t/ha dry matter of organic mass, aerial and roots, with an average N content of circa 3.4 per cent; which provides for the synthesis of 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 a 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.

Uncertainties Assessment and Time-series Consistency

Uncertainties related to activity data on applied organic N fertilizers in the RM reach to ±30 per cent. Uncertainties associated with the default emission factor (EF_1 for F_{ON}) may reach up to ±6 per cent. Thus, the combined uncertainties for this category are considered medium (±30.59 per cent) (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 3D 'Agriculture Soils' category, following a Tier 1 approach. To be noted that the AD and methods used to estimate N_2O emissions originated from applied organic fertilizers were documented and archived both in hard copies and electronically. In order to identify the data entry and GHG emissions estimation process related errors, AD and EFs verifications and quality control procedures were applied.

Recalculations

Direct N_2O_{ON} emissions from the 3D.a.2 'Applied Organic Nitrogen Fertilizers' source category were recalculated for 1993-2015 time series, in particular due to using a new set of AD, generated based on the information regarding the amount of organic N fertilizers available to apply to soil (estimated within source category 3B 'Manure Management').

In comparison with emission estimates included into the NC4 of the RM under the UNFCCC (2018), the changes performed resulted in a slow increase of N_2O_{ON} emissions from applied organic nitrogen fertilizers between 1993 and 2015, with a variation from a minimum increase of 0.42 per cent in 2004, up to a maximum increase by 1.18 per cent in 1995 (Table 5-64). For 2016, direct N_2O_{ON} emissions resulting from applied organic N fertilizers were estimated for the first time. The results allow assert that within the 1990-2016 time series the respective emissions decreased by circa 69.9 per cent, in particular due to reduced animal population.

Table 5-64: Comparative Results of Direct N_2O_{ON} Emissions from Applied Organic N Fertilizers included into the NC4 and the BUR2 of the RM under the UNFCCC, kt

	1990	1991	1992	1993	1994	1995	1996	1997	1998
NC4	0.8718	0.7923	0.7172	0.6087	0.5888	0.5347	0.5564	0.4379	0.4135
BUR2	0.8718	0.7923	0.7172	0.6123	0.5947	0.5410	0.5597	0.4405	0.4169
Difference, %	0.00	0.00	0.00	0.59	1.01	1.18	0.60	0.60	0.81
	1999	2000	2001	2002	2003	2004	2005	2006	2007
NC4	0.3755	0.3357	0.3421	0.3454	0.3276	0.3153	0.3314	0.3395	0.2614
BUR2	0.3796	0.3377	0.3445	0.3474	0.3291	0.3167	0.3334	0.3413	0.2631
Difference, %	1.09	0.62	0.71	0.60	0.48	0.42	0.61	0.54	0.64
	2008	2009	2010	2011	2012	2013	2014	2015	2016
NC4	0.2556	0.2856	0.2942	0.2699	0.2488	0.2366	0.2573	0.2501	
BUR2	0.2581	0.2879	0.2967	0.2719	0.2512	0.2385	0.2597	0.2525	0.2621
Difference, %	0.98	0.82	0.83	0.75	0.95	0.80	0.91	0.96	

Abbreviations: NC4 – Fourth National Communication; BUR2 – Second Biennial Update Report.

The table below presents the comparative results of nitrous oxide emissions from applied organic N fertilizers on managed lands in the Republic of Moldova for the 1990-2016 time series included into the NC4 and BUR2 of the RM under the UNFCCC, expressed in kt CO_2 equivalent using the GWP_{100} values available in the IPCC AR4 (GWP_{100} = 298) (Table 5-65).

Table 5-65: Comparative Results of Direct N_2O_{ON} Emissions from Applied Organic N Fertilizers included into the NC4 and the BUR2 of the RM under the UNFCCC, kt CO_2 equivalent

	1990	1991	1992	1993	1994	1995	1996	1997	1998
NC4	259.7852	236.0938	213.7359	181.3944	175.4523	159.3540	165.8088	130.4897	123.2305
BUR2	259.7852	236.0938	213.7359	182.4733	177.2211	161.2289	166.8000	131.2681	124.2314
Difference, %	0.00	0.00	0.00	0.59	1.01	1.18	0.60	0.60	0.81
	1999	2000	2001	2002	2003	2004	2005	2006	2007
NC4	111.9093	100.0280	101.9355	102.9168	97.6131	93.9690	98.7651	101.1631	77.8920
BUR2	113.1273	100.6457	102.6614	103.5330	98.0847	94.3637	99.3638	101.7115	78.3889
Difference, %	1.09	0.62	0.71	0.60	0.48	0.42	0.61	0.54	0.64
	2008	2009	2010	2011	2012	2013	2014	2015	2016
NC4	76.1714	85.1070	87.6753	80.4270	74.1473	70.5099	76.6876	74.5378	
BUR2	76.9168	85.8086	88.4060	81.0274	74.8500	71.0741	77.3846	75.2555	78.0910
Difference, %	0.98	0.82	0.83	0.75	0.95	0.80	0.91	0.96	

Abbreviations: NC4 – Fourth National Communication; BUR2 – Second Biennial Update Report.

Planned Improvements

No activities for improving the estimation process regarding the direct N_2O emissions from applied organic nitrogen fertilizers under the 3D 'Agriculture Soils' are planned for the future inventory cycle.

5.4.1.3. Urine and Dung Deposited by Grazing Animals

Source Category Description

By 2017, hayfields and pastures occupied circa 344.9 thousand ha (10.2 per cent of the country's area). Worldwide, permanent grasslands, hayfields and pastures generally occupy a surface twice as big as arable lands, in the RM however this surface is 5 times smaller (Table 5-66). Generally, the surface of land occupied by pastures vary between 0.3 and 300 ha, these being the pastures on the 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 Republic of Moldova, grazing takes place from March through November, involving a big number of cattle, regardless of weather. Nitrous oxide is produced naturally in soils through the processes of nitrification and denitrification of N inputs from urine and dung N deposited on pasture by grazing animals.

Table 5-66: Land Fund by Land Use in the Republic of Moldova within 1992-2017, thousand ha

	1992	1995	2000	2005	2010	2011	2012	2013	2014	2015	2016	2017
Total lands, including:	**3376.0**	**3385.1**	**3384.4**	**3384.6**	**3384.4**	**3384.4**	**3384.6**	**3384.6**	**3384.6**	**3384.6**	**3384.6**	**3384.6**
Agricultural lands	2565.9	2556.7	2550.3	2521.6	2501.1	2498.3	2498.0	2497.8	2500.1	2499.7	2499.6	2499.8
including:												
Arable lands	1736.3	1758.7	1813.8	1840.2	1816.7	1812.7	1810.5	1814.1	1816.1	1817.4	1822.9	1827.3
Perennial plantations	474.8	430.7	352.3	297.8	301.0	298.8	298.7	295.3	295.3	291.7	288.9	288.8
including:												
Orchards	224.5	208.3	170.8	131.9	132.5	133.3	134.5	135.1	135.8	134.5	132.5	133.5
Vineyards	215.8	202.6	168.9	155.5	153.5	149.6	147.3	142.6	141.2	137.5	132.5	135.3
Pastures	350.5	365.2	373.9	370.8	352.1	350.4	350.3	348.9	348.0	346.4	345.0	342.8

	1992	1995	2000	2005	2010	2011	2012	2013	2014	2015	2016	2017
Hayfields	4.3	2.1	2.5	2.7	2.2	2.2	2.0	2.1	2.1	2.2	2.1	2.1
Fallow lands	0.0	0.0	7.8	10.1	29.1	34.2	36.5	37.4	38.6	42.0	40.6	38.8
Forests and forest lands	421.7	425.3	422.7	439.5	462.8	463.1	462.7	464.2	465.2	464.5	465.2	465.3
Rivers, lakes and bogs	88.7	92.6	95.5	96.8	96.4	99.6	99.5	99.2	96.9	96.8	96.7	96.1
Other lands	299.7	310.5	315.9	326.7	324.3	323.6	324.4	323.4	322.4	323.6	323.1	323.4

Methodological Issues, Emission Factors and Data Sources

Direct N_2O emissions from urine and dung deposited by grazing animals were estimated by 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);

$$F_{PRP} = \Sigma_{(s)} [(N_{(T)} \bullet Nex_{(T)}) \bullet MS_{(T,\ PRP)}]$$

Where:

$N_{(T)}$ – number of head of livestock species/category T in the country (see 3A source category);

$Nex_{(T)}$ – annual average N excretion per animal of species/category T in the country (kg N/animal/yr) (see 3B source category);

$MS_{(T,\ PRP)}$ – 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 3B source category);

$EF_{3(PRP)}$ – 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] – stoichiometric 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 5-67), there were used activity data 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 1st of January' (annually for 1990-2016 periods), Statistical Yearbooks of the ATULBD (identical AD to those used under the 3A 'Enteric Fermentation' and 3B 'Manure Management'), country specific data on nitrogen excretion rate $Nex_{(T)}$ (in kg N/head/yr) and country specific values of the different manure management systems usage in the Republic of Moldova (identical to those used under the 3B 'Manure Management').

Table 5-67: Annual Amount of Urine and Dung Nitrogen Deposited by Grazing Animals on Pasture, Range and Paddock in the Republic of Moldova within 1990-2016 periods, kt

	1990	1991	1992	1993	1994	1995	1996	1997	1998
F_{PRP}	7.5735	9.4632	9.0904	11.3944	11.3683	11.6633	10.8571	9.5347	10.4221
	1999	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**
F_{PRP}	9.6861	9.3852	9.4625	9.9027	9.2932	8.8609	8.7819	8.7505	7.0606
	2008	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**
F_{PRP}	7.2414	7.7838	7.7559	7.1786	6.8286	6.7298	7.3265	7.0913	7.0646

Uncertainties Assessment and Time-Series Consistency

There is a high degree of uncertainties related to N_2O emissions estimations within this source category due to high uncertainties associated with direct N_2O emissions from N urine and dung deposited by grazing animals (±30 per cent), and uncertainties associated with the default emission factor (EF_3) specific to this process (±50 per cent). The combined uncertainties associated with direct N_2O emissions from N urine and dung deposited by grazing animals are considered to be medium (±58.31 per cent) (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 the 'Agriculture' Sector, following a Tier 1 approach. The AD and methods used for estimating

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 emissions estimation process related errors, AD and EFs verifications and quality control procedures were applied. Following the recommendations included into the 2006 IPCC Guidelines, N_2O emissions from urine and dung deposited by grazing animals were estimated using AD from official sources of reference.

Recalculations

Direct N_2O_{PRP} emissions from the 3D.a.3 'Urine and Dung Deposited by Grazing Animals' source category were recalculated for the 1993-2015 time series, in particular due to use of an updated set of AD related to the livestock population on the LBDR (the Statistical Yearbooks of the ATULBD for 2016 and 2017 include more disaggregated data regarding 2011-2016 time periods, for example, for sheep and goats, respectively for poultry, the same trends regarding the population of these species were also applied for the rest of the analyzed period).

In comparison with emissions estimates included into the NC4 of the RM under the UNFCCC (2018), the changes performed in the current inventory cycle resulted in an increasing trend of direct N_2O_{PRP} emissions from urine and dung deposited by grazing animals over the period from 1993 through 2015, varying from a minimum increase of 0.27 per cent in 2004, up to a maximum increase by 0.80 per cent in 1995 (Table 5-68).

Table 5-68: Comparative Results of Direct N_2O_{PRP} Emissions from 3D.a.3 'Urine and Dung Deposited by Grazing Animals' included into the NC4 and the BUR2 under the UNFCCC, kt

	1990	1991	1992	1993	1994	1995	1996	1997	1998
NC4	0.1807	0.2395	0.2251	0.2856	0.2786	0.2974	0.2750	0.2444	0.2696
BUR2	0.1807	0.2395	0.2251	0.2869	0.2806	0.2998	0.2763	0.2455	0.2709
Difference, %	0.00	0.00	0.00	0.44	0.72	0.80	0.48	0.42	0.49
	1999	2000	2001	2002	2003	2004	2005	2006	2007
NC4	0.2498	0.2438	0.2471	0.2559	0.2378	0.2254	0.2232	0.2203	0.1748
BUR2	0.2514	0.2447	0.2481	0.2569	0.2386	0.2260	0.2241	0.2212	0.1756
Difference, %	0.65	0.34	0.39	0.36	0.30	0.27	0.41	0.39	0.46
	2008	2009	2010	2011	2012	2013	2014	2015	2016
NC4	0.1757	0.1887	0.1885	0.1746	0.1629	0.1569	0.1691	0.1648	
BUR2	0.1770	0.1900	0.1898	0.1756	0.1641	0.1578	0.1703	0.1660	0.1643
Difference, %	0.74	0.65	0.67	0.59	0.74	0.62	0.69	0.73	

Abbreviations: NC4 – Fourth National Communication; BUR2 – Second Biennial Update Report.

For 2016, direct N_2O_{PRP} emissions resulting from urine and dung deposited by grazing animals were estimated for the first time. The results allow assert that within the 1990-2016 time series the respective emissions decreased by circa 9.1 per cent, in particular due to a significant reduction in total population of livestock over the period under review and changes in the share of manure management systems (the share of liquid/slurry systems decreased significantly while the share of pasture and solid storage increased).

The table below presents the comparative results of direct N_2O_{PRP} emissions resulting from urine and dung deposited by grazing animals in the Republic of Moldova for the 1990-2016 time series included into the NC4 and BUR2 of the RM under the UNFCCC, expressed in kt CO_2 equivalent using the GWP_{100} values available in the IPCC AR4 (GWP_{100} = 298) (Table 5-69).

Table 5-69: Comparative Results of Direct N_2O_{PRP} Emissions from 3D.a.3 'Urine and Dung Deposited by Grazing Animals' included into the NC4 and the BUR2 of the RM under the UNFCCC, kt CO_2 equivalent

	1990	1991	1992	1993	1994	1995	1996	1997	1998
NC4	53.8411	71.3567	67.0890	85.1172	83.0132	88.6241	81.9443	72.8406	80.3398
BUR2	53.8411	71.3567	67.0890	85.4882	83.6134	89.3328	82.3343	73.1452	80.7339
Difference, %	0.00	0.00	0.00	0.44	0.72	0.80	0.48	0.42	0.49
	1999	2000	2001	2002	2003	2004	2005	2006	2007
NC4	74.4272	72.6644	73.6421	76.2645	70.8785	67.1650	66.5032	65.6641	52.1020
BUR2	74.9079	72.9094	73.9328	76.5423	71.0935	67.3462	66.7788	65.9181	52.3419
Difference, %	0.65	0.34	0.39	0.36	0.30	0.27	0.41	0.39	0.46

	2008	2009	2010	2011	2012	2013	2014	2015	2016
NC4	52.3667	56.2440	56.1822	52.0290	48.5507	46.7450	50.3897	49.1035	
BUR2	52.7535	56.6075	56.5567	52.3378	48.9082	47.0343	50.7368	49.4613	48.9589
Difference, %	0.74	0.65	0.67	0.59	0.74	0.62	0.69	0.73	

Abbreviations: NC4 – Fourth National Communication; BUR2 – Second Biennial Update Report.

Planned Improvements

No activities for improving the estimation process regarding the direct N_2O emissions from urine and dung deposited by grazing animals under the 3D 'Agriculture Soils' category are planned for the future 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.

Emissions estimation require 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, burned for heating and cooking, etc.

Methodological Issues, Emission Factors and Data Sources

N_2O emissions from this source category were estimated by using the *'Methodology of determining the carbon balance in agricultural soils to assess the GHG emissions'* (see Annex A3-4.2)[83].

Equation 11.2 from 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] – stoichiometric 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[84] (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[85] (see Table 5-70);

$R_{BG\,(T)}$ – ratio of below-ground residues to harvested yield for crop T, t.d.m$_{BG}$/t dm[86] (see Table 5-70);

$Frac_{Remove\,(T)}$ – fraction of above-ground residues of crop T removed and used for other purposes[87] (see Table 5-70);

P_{CR} = amount of nitrogen in crop residues (% a.s.) (Table 5-71);

k_6 = coefficient reflecting the N in crop residues (Banaru, 2002)[88] (Table 5-71).

Indices used to estimate N_2O emissions from crop residues returned to soils come from different official sources of reference, including the 2006 IPCC Guidelines.

[83] Banaru, Anatol (2000), Methodology to Calculate CO2 Emissions from Agricultural Soils, In the collection of papers "Climate Change: Research, Studies, Solutions", Ministry of Environment / UNDP Moldova. „Bons Offices" S.R.L. Chișinău, 2000, pp. 115-123

[84] 2006, IPCC Guidelines, Volume 4, Chapter 11, Table 11.2, Page 11.17.

[85] Nicolaev N., Boincean B., Sidorov M., Vanicovici Gh., Coltun V. (2006), Agrotechnics. Ministry of Education and Youth of the RM – Balti: Presa universitara balteană, 2006, P. 298.

[86] 2006 IPCC Guidelines, Volume 4, Chapter 11, Table 11.2, Page 11.17.

[87] Expert opinion, Prof. Valerian Cerbari, Institute of Pedology, Agrochemistry and Soil Protection „Nicolae Dimo"

[88] Banaru A. (2002), Methodological Guidelines to Determine Humus Balance in Arable Soils, Ministry of Agriculture and Food Industry of the RM, Institute of Pedology, Agrochemistry and Soil Protection „Nicolae Dimo" and TACIS FDMOL 9901 Project 'Support to Developing Education, Research and Extension Services in Agriculture', Chisinau, 2002, 23 pages.

Table 5-70: Indices Used to Estimate the Amount of N 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
Sun flower	0.90	3.80	0.22	0.40
Tobacco	0.90	5.77	0.19	0.00
Rapeseed	0.88	1.17	0.22	0.00
Potatoes	0.22	0.17	0.20	0.00
Legumes	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, silage 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 5-71: Amount of N in Crop Residues (average values from the literature in the field)

Crop	P_{CR}, % (s.a.)	k_6
Winter wheat	0.50	Use of N from vegetal residues represents 25 per cent from 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	
Sun flower	0.95	
Soybeans	2.08	
Tobacco	1.30	
Grain Rapeseed	1.05	
Potatoes	0.40	
Legumes	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	

Activity data on areas sown with crops and average yield per ha for the main crops is available in Statistical Yearbooks of the RM and those of the ATULBD (Tables 5-72, 5-73 and 5-74).

Table 5-72: Areas Sown with Crops within 1990-2016 periods, thousand hectares

	1990	1991	1992	1993	1994	1995	1996	1997	1998
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**	**1 717.6**
Cereals and leguminous crops – total	**745.7**	**837.0**	**746.6**	**910.7**	**830.1**	**920.5**	**902.4**	**1 055.5**	**1 039.0**
...Wheat (Winter and Spring)	286.7	303.0	281.7	345.9	300.4	393.9	380.9	410.3	405.8
...Winter rye	0.9	0.8	0.7	1.1	1.7	2.7	4.7	3.9	3.7
...Barley (Winter and Spring)	120.4	134.0	123.0	139.0	147.0	135.0	108.7	129.5	134.0
...Oat	2.1	3.0	3.0	4.0	5.0	5.8	3.7	6.5	6.1
...Millet	0.1	0.1	0.1	0.1	0.1	0.2	0.3	0.3	0.3
...Buckwheat	3.6	6.0	7.0	7.0	8.0	5.5	7.4	7.3	11.1
...Leguminous crops	72.6	77.0	71.2	70.7	65.5	54.0	44.6	46.2	58.8
...Grain maize	258.0	310.0	259.4	342.6	283.4	321.3	350.0	450.7	416.7
...Grain sorghum	1.2	3.1	0.5	0.3	1.2	1.1	0.3	0.3	0.2
	1990	1991	1992	1993	1994	1995	1996	1997	1998
...Other cereal crops	0.1	0.0	0.0	0.0	17.8	1.0	1.8	0.5	2.2
Industrial crops – total	**295.3**	**277.0**	**275.3**	**291.5**	**293.3**	**284.0**	**333.7**	**300.0**	**344.7**
...Sugar beet	81.5	79.9	82.6	91.0	91.2	90.3	83.9	76.3	76.4
...Sun flower	134.1	126.9	130.9	146.1	160.9	163.2	225.1	199.0	234.5
...Soybeans	26.5	24.1	16.6	9.3	5.6	3.4	2.4	2.4	6.5
...Tobacco	32.1	32.5	28.1	31.4	28.6	20.1	16.4	17.3	22.0
...Grain rapeseed	0.0	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	5.2

	1990	1991	1992	1993	1994	1995	1996	1997	1998
Potatoes, vegetables and melons & gourds – total	**131.8**	**141.0**	**143.1**	**175.3**	**157.6**	**142.0**	**130.3**	**135.4**	**127.9**
...Potatoes	41.2	46.9	55.3	72.8	64.4	57.1	59.6	62.3	62.0
...Vegetables	71.1	78.0	73.7	89.2	83.3	74.0	61.4	63.5	58.6
...Melons and gourds	9.2	8.0	7.0	6.7	5.4	7.6	6.7	7.9	5.2
...Other	10.3	8.1	7.1	6.6	4.5	3.3	2.6	1.7	2.1
Forage crops – total	**560.3**	**462.0**	**546.1**	**505.1**	**551.2**	**379.0**	**351.0**	**235.4**	**206.0**
...Forage roots	26.4	30.0	29.0	30.3	26.2	24.5	17.6	16.3	15.5
...Maize for silo and green fodder	292.3	200.0	299.3	243.8	305.2	179.0	181.0	98.7	97.1
...Perennial grasses for green fodder, silage and fodder	206.3	205.2	182.9	198.4	180.5	144.7	124.0	102.6	75.2
...Annual grasses for green fodder	31.4	26.8	35.0	32.6	39.3	29.3	27.0	16.8	17.3
...Other	3.9	0.0	0.0	0.0	0.0	1.3	1.4	1.0	0.9
	1999	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**
Sown Areas – total	**1 663.8**	**1 701.4**	**1 733.4**	**1 736.2**	**1 593.1**	**1 682.5**	**1 698.1**	**1 546.9**	**1 552.4**
Cereals and leguminous crops – total	**1 024.7**	**1 077.4**	**1 172.1**	**1 165.7**	**940.6**	**1 144.6**	**1 131.7**	**953.9**	**989.2**
...Wheat (Winter and Spring)	392.1	423.8	490.0	502.8	213.2	342.4	456.1	316.1	333.6
...Winter rye	3.9	3.8	5.5	3.6	1.3	2.6	3.2	0.7	0.8
...Barley (Winter and Spring)	128.5	125.0	115.4	133.7	96.1	140.8	147.8	123.2	138.1
...Oat	4.9	4.2	4.8	4.3	4.6	5.9	6.4	4.5	4.4
...Millet	0.2	0.4	0.0	0.1	0.2	0.5	0.2	0.1	0.4
...Buckwheat	16.8	12.1	13.7	5.1	4.9	4.1	3.1	3.8	1.3
...Leguminous crops	64.7	53.6	52.2	59.9	48.3	37.9	43.3	42.2	40.1
...Grain maize	411.7	454.1	488.7	454.7	567.9	604.1	469.1	461.4	469.2
...Grain sorghum	0.1	0.4	1.0	0.5	3.1	3.8	0.7	0.4	0.2
...Other cereal crops	1.7	0.0	0.8	0.7	0.8	2.5	1.8	1.4	1.3
Industrial crops – total	**355.1**	**364.9**	**336.6**	**358.6**	**447.9**	**367.2**	**392.6**	**413.3**	**376.7**
...Sugar beet	65.5	66.6	63.3	52.0	39.7	34.9	34.4	42.4	34.3
...Sun flower	246.0	256.9	237.8	280.7	381.3	293.0	309.2	299.7	241.1
...Soybeans	17.2	11.8	9.7	10.3	18.3	28.6	36.3	55.7	50.5
...Tobacco	18.8	23.7	17.2	9.3	5.6	5.8	4.8	3.5	3.1
...Grain rapeseed	1.0	1.0	1.0	1.0	1.0	0.9	2.4	7.1	41.3
...Other industrial crops	5.9	3.9	5.8	4.2	2.0	4.1	4.9	4.7	6.0
Potatoes, vegetables and melons & gourds – total	**131.0**	**132.3**	**122.5**	**112.6**	**92.5**	**81.4**	**84.0**	**90.1**	**84.0**
...Potatoes	66.6	65.4	43.0	45.1	38.6	34.8	36.7	34.8	35.8
...Vegetables	56.3	56.8	69.6	58.7	43.7	38.2	39.8	44.4	39.7
...Melons and gourds	6.0	7.9	7.5	6.5	8.7	7.3	5.2	9.1	7.1
...Other	2.1	2.2	2.4	2.3	1.5	1.1	2.2	1.8	1.4
Forage crops – total	**153.0**	**126.8**	**102.3**	**99.3**	**112.1**	**89.3**	**89.9**	**89.6**	**102.4**
...Forage roots	14.3	11.5	4.5	4.1	4.5	3.7	2.5	3.0	1.9
...Maize for silo and green fodder	62.8	49.7	40.3	35.1	44.5	24.6	18.2	16.1	24.9
...Perennial grasses for green fodder, silage and fodder	58.3	53.1	48.4	49.8	50.9	53.6	60.2	63.5	68.4
...Annual grasses for green fodder	16.9	11.3	8.1	8.9	11.3	6.1	8.1	5.8	5.6
...Other	0.7	1.1	0.6	1.1	0.9	1.2	0.9	1.1	1.6
	2008	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**
Sown Areas – total	**1 552.0**	**1 593.0**	**1 628.2**	**1 597.3**	**1 653.5**	**1 686.3**	**1 694.3**	**1 693.8**	**1 715.1**
Cereals and leguminous crops – total	**1 034.8**	**1 033.8**	**1 020.3**	**991.6**	**1 037.3**	**1 080.0**	**1 055.1**	**1 065.3**	**1 074.2**
...Wheat (Winter and Spring)	429.6	395.8	380.8	353.2	374.2	432.7	415.0	416.9	454.8
...Winter rye	1.0	1.9	1.6	0.6	1.3	2.0	0.5	0.4	0.6
...Barley (Winter and Spring)	139.4	184.7	164.9	128.4	114.1	126.9	120.9	104.8	101.4
...Oat	2.8	2.4	3.0	2.2	2.3	2.6	2.1	1.7	1.4
...Millet	0.3	0.3	0.5	0.2	0.2	0.0	0.1	0.1	0.2
...Buckwheat	0.8	1.0	0.2	0.6	0.9	0.3	0.3	0.3	0.5
...Leguminous crops	28.3	36.1	39.5	30.2	25.2	23.5	22.5	24.9	26.3
...Grain maize	429.5	407.3	425.7	473.8	516.9	488.9	490.3	515.1	485.6
...Grain sorghum	0.2	0.2	0.2	0.1	0.1	0.1	0.1	0.2	0.2
...Other cereal crops	2.8	3.8	3.5	2.3	1.6	2.0	2.8	0.8	2.4
Industrial crops – total	**355.9**	**401.0**	**440.5**	**477.2**	**462.7**	**463.3**	**501.9**	**499.0**	**510.6**
...Sugar beet	24.7	23.4	26.5	25.4	31.2	28.7	28.0	21.9	20.9
...Sun flower	239.1	249.5	288.1	320.9	348.4	348.3	371.0	380.6	416.2
...Soybeans	30.5	48.8	59.0	58.9	62.5	42.8	56.5	69.7	41.4
...Tobacco	2.7	2.5	4.4	3.8	2.4	1.5	0.9	0.8	0.6
...Grain rapeseed	53.5	67.4	48.9	53.8	8.2	36.0	38.2	13.3	22.4
...Other industrial crops	4.9	7.2	10.4	12.2	9.8	5.8	6.9	9.4	7.5
Potatoes, vegetables and melons & gourds – total	**83.2**	**78.7**	**80.5**	**76.4**	**68.4**	**69.9**	**67.1**	**59.6**	**61.5**
...Potatoes	31.3	28.5	28.0	29.7	25.1	24.1	23.1	22.5	20.9
...Vegetables	41.7	37.0	40.6	37.4	34.9	37.0	35.5	29.4	30.5
...Melons and gourds	8.8	11.9	10.6	8.2	7.3	7.8	7.3	6.7	7.9
...Other	1.4	1.3	1.4	1.1	1.1	1.0	1.2	1.1	2.2
Forage crops – total	**78.1**	**79.5**	**86.8**	**79.7**	**85.1**	**73.2**	**70.0**	**69.9**	**68.6**
...Forage roots	1.9	1.5	1.7	1.2	1.4	1.2	1.3	1.3	1.5
...Maize for silo and green fodder	10.3	11.3	10.1	10.4	22.4	8.8	9.3	11.2	8.0
...Perennial grasses for green fodder, silage and fodder	60.2	61.5	66.9	61.8	56.7	57.7	54.6	51.6	55.0
...Annual grasses for green fodder	4.6	3.5	6.5	4.8	3.9	4.4	3.9	4.4	2.2
...Other	1.1	1.7	1.6	1.4	0.7	1.1	0.9	1.4	1.8

Source: NBS on-line database, Section 'Sown Area, crops average yield and harvest within 1980-2016: <http://statbank.statistica.md/pxweb/Database/RO/16%20AGR/AGR02/AGR02.asp>; Statistical Yearbooks for ATULBD: 1998 (page 218), 2002 (page 113), 2005 (page 101), 2009 (page 97), 2011 (page 100), 2014 (page 94), 2017 (page 111).

Table 5-73: Gross Harvest of Agricultural Crops in the Republic of Moldova within 1990-2016, kt

	1990	1991	1992	1993	1994	1995	1996	1997	1998
Cereals and leguminous crops – total	**2538.6**	**3105.9**	**2099.8**	**3340.2**	**1753.8**	**2638.6**	**1981.2**	**3512.3**	**2751.9**
...Wheat (Winter and Spring)	1129.0	1056.5	925.8	1392.6	658.8	1154.3	673.7	1152.6	951.9
...Winter rye	1.9	1.6	1.4	2.8	2.7	5.9	9.9	10.9	7.0
...Barley (Winter and Spring)	417.9	427.0	405.0	481.0	324.9	311.2	136.7	256.9	242.2
...Oat	3.8	5.0	6.8	10.7	7.1	9.8	4.2	10.3	9.5
...Millet	0.1	0.1	0.0	0.1	0.1	0.3	0.2	0.5	0.1
...Buckwheat	1.8	5.0	2.3	5.5	3.5	2.2	3.0	4.8	4.3
...Leguminous crops	97.1	105.7	121.8	121.6	70.2	55.4	31.6	63.2	76.9
...Grain maize	885.5	1501.2	635.6	1324.5	629.3	948.6	1006.6	1788.0	1272.7
...Grain sorghum	1.2	3.1	1.1	1.4	1.1	0.8	0.1	0.5	0.2
...Other cereal crops	0.3	0.7	0.0	0.0	56.1	0.3	0.2	0.0	4.7
Industrial crops – total									
...Sugar beet	2374.5	1988.6	1783.4	2048.3	1526.7	1877.9	1682.1	1674.8	1356.8
...Sun flower	252.2	151.4	176.2	173.7	149.2	208.1	284.0	174.3	196.4
...Soybeans	23.8	33.4	7.9	9.3	4.0	3.3	2.5	2.7	6.0
...Tobacco	66.2	62.8	42.4	50.2	41.5	27.1	19.8	23.9	24.6
...Grain rapeseed	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Potatoes, vegetables and melons & gourds – total									
...Potatoes	295.3	290.6	310.8	726.0	474.7	385.3	344.3	392.6	372.5
...Vegetables	1177.3	989.2	787.5	777.2	598.5	568.8	362.4	393.6	570.8
...Melons and gourds	34.4	35.6	9.3	18.6	12.6	23.3	23.3	30.4	25.9
Forage crops – total									
...Forage roots	1171.8	1416.4	922.5	988.6	547.0	597.0	336.5	310.2	286.4
...Maize for silo and green fodder	4509.0	4979.1	3025.9	3358.7	2285.7	2136.2	1212.0	1065.0	856.5
...Perennial grasses for green fodder, silage and fodder	4456.1	6053.5	3401.4	3514.6	2013.8	1704.7	1027.2	855.6	498.5
...Annual grasses for green fodder	288.9	420.7	339.0	339.1	190.7	222.3	143.4	96.7	106.6
	1999	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**
Cereals and leguminous crops – total	**2375.0**	**2070.2**	**2847.5**	**2791.2**	**1654.4**	**3178.0**	**3059.9**	**2371.2**	**932.5**
...Wheat (Winter and Spring)	797.8	725.0	1180.8	1113.1	102.4	861.2	1048.6	682.3	406.5
...Winter rye	6.3	5.0	9.3	5.9	0.8	5.1	6.1	1.1	0.8
...Barley (Winter and Spring)	203.1	152.3	248.4	241.7	74.4	284.1	240.9	214.6	125.7
...Oat	5.9	3.5	6.4	4.7	4.0	10.3	7.6	6.1	1.4
...Millet	0.0	0.1	0.0	0.1	0.1	0.3	0.2	0.0	0.1
...Buckwheat	6.1	8.0	6.4	1.4	1.6	1.2	1.1	0.5	0.4
...Leguminous crops	61.6	30.8	79.1	50.2	30.2	51.0	67.1	68.4	14.4
...Grain maize	1151.3	1050.4	1141.9	1206.3	1440.2	1845.1	1523.4	1327.6	363.2
...Grain sorghum	0.3	0.5	1.1	0.5	4.4	3.4	0.3	0.5	0.1
...Other cereal crops	6.0	3.2	5.7	4.2	0.7	3.7	12.3	15.2	1.1
Industrial crops – total									
...Sugar beet	956.4	982.5	1120.6	1157.4	660.3	911.3	996.2	1177.3	612.3
...Sun flower	291.6	305.1	278.3	340.9	421.4	354.8	368.7	396.1	158.7
...Soybeans	13.7	11.6	10.5	12.6	19.4	40.2	66.4	80.2	40.0
...Tobacco	22.6	26.3	16.3	12.4	7.2	7.9	6.7	4.9	3.6
...Grain rapeseed	1.2	1.1	1.0	1.0	1.2	1.1	3.4	6.9	34.9
Potatoes, vegetables and melons & gourds – total									
...Potatoes	330.6	330.4	388.6	326.0	303.2	321.8	391.1	384.1	200.9
...Vegetables	535.8	396.1	487.4	408.4	371.7	328.7	410.3	490.6	226.6
...Melons and gourds	33.9	31.7	39.3	29.0	72.7	57.3	49.3	92.6	41.2
Forage crops – total									
...Forage roots	170.1	125.0	63.5	67.9	55.7	52.7	41.6	34.9	13.8
...Maize for silo and green fodder	428.6	350.7	316.4	322.8	327.9	219.4	199.6	153.3	104.6
...Perennial grasses for green fodder, silage and fodder	506.8	317.4	201.5	173.4	145.4	206.7	183.8	194.9	177.0
...Annual grasses for green fodder	53.7	28.8	19.3	16.0	12.6	12.6	16.3	13.6	7.4
	2008	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**
Cereals and leguminous crops – total	**3261.6**	**2375.5**	**2674.3**	**2794.6**	**1359.0**	**3130.4**	**3341.0**	**2587.0**	**3531.9**
...Wheat (Winter and Spring)	1286.5	738.9	749.5	797.1	496.9	1009.6	1102.6	927.4	1302.4
...Winter rye	2.0	3.4	2.4	1.0	2.6	5.7	1.4	1.0	1.8
...Barley (Winter and Spring)	362.3	290.5	240.7	218.9	139.3	241.6	244.7	199.1	273.9
...Oat	3.9	1.6	3.1	3.6	2.0	3.8	2.9	1.6	2.8
...Millet	0.5	0.7	0.3	0.1	0.1	0.1	0.1	0.1	0.2
...Buckwheat	0.5	0.6	0.5	0.5	0.3	0.6	0.4	0.2	0.8
...Leguminous crops	38.0	32.0	40.1	33.1	17.3	24.1	32.9	25.1	45.1
...Grain maize	1484.1	1159.6	1462.1	1547.2	587.2	1546.8	1642.1	1133.6	1485.7
...Grain sorghum	0.1	0.2	0.2	0.1	0.1	0.4	0.3	0.2	0.3
...Other cereal crops	8.1	5.3	7.7	4.8	2.1	5.4	8.3	2.8	9.2
Industrial crops – total									
...Sugar beet	960.7	337.4	837.6	588.6	587.0	1009.0	1356.2	537.5	664.8
...Sun flower	387.2	310.2	440.2	497.4	339.1	602.2	627.1	562.3	789.4

	2008	2009	2010	2011	2012	2013	2014	2015	2016
...Soybeans	58.8	50.1	113.0	80.6	48.9	67.6	111.4	49.2	43.8
...Tobacco	3.9	4.4	7.6	5.4	2.9	2.2	1.4	1.2	0.9
...Grain rapeseed	100.1	81.6	51.0	67.7	8.1	58.8	90.2	25.6	52.4
Potatoes, vegetables and melons & gourds – total									
...Potatoes	273.7	264.8	286.7	362.9	191.5	244.0	275.7	163.8	220.3
...Vegetables	389.4	322.8	365.8	396.0	251.9	319.1	352.3	266.9	320.6
...Melons and gourds	69.9	102.4	104.9	85.2	52.6	56.6	48.3	56.7	69.3
Forage crops – total									
...Forage roots	26.4	20.0	31.7	23.2	10.6	22.2	26.1	14.6	21.0
...Maize for silo and green fodder	113.0	106.4	143.8	125.2	110.8	168.2	135.7	91.7	139.6
...Perennial grasses for green fodder, silage and fodder	364.2	213.4	323.9	238.5	97.6	198.6	275.0	118.5	144.2
...Annual grasses for green fodder	15.3	7.9	10.9	11.3	6.3	9.6	13.4	8.8	9.0

Source: NBS on-line database, Section 'Sown Area, crops average yield and harvest within 1980-2016', <http://statbank.statistica.md/pxweb/Database/RO/16%20AGR/AGR02/AGR02.asp>; Statistical Yearbooks for ATULBD: 1998 (page 218), 2002 (page 113), 2005 (page 101), 2009 (page 98), 2011 (page 101), 2014 (page 95), 2017 (page 112).

Table 5-74: Average Yield per Hectare of Agricultural Crops in within 1990-2016 periods, t/ha

	1990	1991	1992	1993	1994	1995	1996	1997	1998
Cereals and leguminous crops – total	**3.4**	**3.7**	**2.8**	**3.7**	**2.1**	**2.9**	**2.2**	**3.3**	**2.6**
...Wheat (Winter and Spring)	3.9	3.5	3.3	4.0	2.2	2.9	1.8	2.8	2.3
...Winter rye	2.1	2.0	2.0	2.6	1.6	2.2	2.1	2.8	1.9
...Barley (Winter and Spring)	3.5	3.2	3.3	3.5	2.2	2.3	1.3	2.0	1.8
...Oat	1.8	1.7	2.3	2.7	1.4	1.7	1.1	1.6	1.6
...Millet	1.0	1.0	0.4	1.0	0.6	1.4	0.7	1.6	0.4
...Buckwheat	0.5	0.8	0.3	0.8	0.4	0.4	0.4	0.7	0.4
...Leguminous crops	1.3	1.4	1.7	1.7	1.1	1.0	0.7	1.4	1.3
...Grain maize	3.4	4.8	2.5	3.9	2.2	3.0	2.9	4.0	3.1
...Grain sorghum	1.0	1.0	2.2	4.6	0.9	0.8	0.3	1.7	0.9
...Other cereal crops	3.0	3.1	2.6	2.8	2.1	0.3	1.4	0.0	2.1
Industrial crops – total									
...Sugar beet	29.1	24.9	21.6	22.5	16.7	20.8	20.0	22.0	17.8
...Sun flower	1.9	1.2	1.3	1.2	0.9	1.3	1.3	0.9	0.8
...Soybeans	0.9	1.4	0.5	1.0	0.7	1.0	1.0	1.1	0.9
...Tobacco	2.1	1.9	1.5	1.6	1.5	1.3	1.2	1.4	1.1
...Grain rapeseed	2.0	2.0	1.6	1.2	1.0	0.8	0.7	1.0	0.9
Potatoes, vegetables and melons & gourds – total									
...Potatoes	7.2	6.2	5.6	10.0	7.4	6.8	5.8	6.3	6.0
...Vegetables	16.6	12.7	10.7	8.7	7.2	7.7	5.9	6.2	9.7
...Melons and gourds	3.7	4.5	1.3	2.8	2.3	3.1	3.5	3.8	5.0
Forage crops – total									
...Forage roots	44.4	47.2	31.8	32.6	20.9	24.4	19.1	19.0	18.5
...Maize for silo and green fodder	15.4	24.9	10.1	13.8	7.5	11.9	6.7	10.8	8.8
...Perennial grasses for green fodder, silage and fodder	21.6	29.5	18.6	17.7	11.2	11.8	8.3	8.3	6.6
...Annual grasses for green fodder	9.2	15.7	9.7	10.4	4.9	7.6	5.3	5.8	6.2

	1999	2000	2001	2002	2003	2004	2005	2006	2007
Cereals and leguminous crops – total	**2.3**	**1.9**	**2.4**	**2.4**	**1.8**	**2.8**	**2.7**	**2.5**	**0.9**
...Wheat (Winter and Spring)	2.0	1.7	2.4	2.2	0.5	2.5	2.3	2.2	1.2
...Winter rye	1.6	1.3	1.7	1.6	0.6	2.0	1.9	1.6	1.1
...Barley (Winter and Spring)	1.6	1.2	2.2	1.8	0.8	2.0	1.6	1.7	0.9
...Oat	1.2	0.8	1.3	1.1	0.9	1.7	1.2	1.3	0.3
...Millet	0.1	0.2	0.8	0.5	0.5	0.7	0.9	0.5	0.1
...Buckwheat	0.4	0.7	0.5	0.3	0.3	0.3	0.4	0.1	0.3
...Leguminous crops	1.0	0.6	1.5	0.8	0.6	1.3	1.6	1.6	0.4
...Grain maize	2.8	2.3	2.3	2.7	2.5	3.1	3.2	2.9	0.8
...Grain sorghum	3.1	1.3	1.1	0.9	1.4	0.9	0.4	1.1	0.5
...Other cereal crops	3.6	1.2	7.5	6.0	0.9	1.5	2.0	2.0	0.8
Industrial crops – total									
...Sugar beet	14.6	14.8	17.7	22.3	16.6	26.1	29.0	27.8	17.9
...Sun flower	1.2	1.2	1.2	1.2	1.1	1.2	1.2	1.3	0.7
...Soybeans	0.8	1.0	1.1	1.2	1.1	1.4	1.8	1.4	0.8
...Tobacco	1.2	1.1	0.9	1.3	1.3	1.4	1.4	1.4	1.2
...Grain rapeseed	1.2	1.0	1.0	1.0	1.0	1.2	1.4	1.0	0.8
Potatoes, vegetables and melons & gourds – total									
...Potatoes	5.0	5.1	9.0	7.2	7.9	9.2	10.6	11.0	5.6
...Vegetables	9.5	7.0	7.0	7.0	8.5	8.6	10.3	11.0	5.7
...Melons and gourds	5.7	4.0	5.2	4.5	8.4	7.8	9.4	10.2	5.8
Forage crops – total									
...Forage roots	11.9	10.9	14.0	16.6	12.3	14.2	16.4	11.6	7.4
...Maize for silo and green fodder	6.8	7.1	7.8	9.2	7.4	8.9	11.0	9.6	4.2
...Perennial grasses for green fodder, silage and fodder	8.7	6.0	4.2	3.5	2.9	3.9	3.1	3.1	2.6
...Annual grasses for green fodder	3.2	2.6	2.4	1.8	1.1	2.1	2.0	2.3	1.3

	2008	2009	2010	2011	2012	2013	2014	2015	2016
Cereals and leguminous crops – total	**3.2**	**2.3**	**2.6**	**2.8**	**1.3**	**2.9**	**3.2**	**2.4**	**3.3**
...Wheat (Winter and Spring)	3.0	1.9	2.0	2.3	1.3	2.3	2.7	2.2	2.9
...Winter rye	1.9	1.8	1.5	1.8	2.0	2.8	2.8	2.3	2.9
...Barley (Winter and Spring)	2.6	1.6	1.5	1.7	1.2	1.9	2.0	1.9	2.7
...Oat	1.4	0.7	1.0	1.6	0.9	1.5	1.4	0.9	2.0
...Millet	1.7	2.5	0.5	0.7	0.6	1.1	1.5	1.1	1.0
...Buckwheat	0.6	0.6	3.2	0.8	0.3	1.7	1.5	1.0	1.7
...Leguminous crops	1.3	0.9	1.0	1.1	0.7	1.0	1.5	1.0	1.7
...Grain maize	3.5	2.8	3.4	3.3	1.1	3.2	3.3	2.2	3.1
...Grain sorghum	0.5	0.8	0.9	0.7	0.5	3.0	2.8	0.9	1.5
...Other cereal crops	2.1	1.7	1.8	1.9	1.9	2.0	2.1	2.2	2.3
Industrial crops – total									
...Sugar beet	38.9	14.4	31.6	23.2	18.8	35.2	48.4	24.5	31.8
...Sun flower	1.6	1.2	1.5	1.6	1.0	1.7	1.7	1.5	1.9
...Soybeans	1.9	1.0	1.9	1.4	0.8	1.6	2.0	0.7	1.1
...Tobacco	1.4	1.8	1.7	1.4	1.2	1.5	1.6	1.5	1.5
...Grain rapeseed	1.9	1.2	1.0	1.3	1.0	1.6	2.4	1.9	2.3
Potatoes, vegetables and melons & gourds – total									
...Potatoes	8.7	9.3	10.2	12.2	7.6	10.1	11.9	7.3	10.5
...Vegetables	9.3	8.7	9.0	10.6	7.2	8.6	9.9	9.1	10.5
...Melons and gourds	7.9	8.6	9.9	10.4	7.2	7.3	6.6	8.5	8.8
Forage crops – total									
...Forage roots	14.1	13.7	18.5	19.0	7.4	18.5	20.1	11.2	14.0
...Maize for silo and green fodder	11.0	9.4	14.2	12.0	5.0	19.2	14.5	8.2	17.4
...Perennial grasses for green fodder, silage and fodder	6.0	3.5	4.8	3.9	1.7	3.4	5.0	2.3	2.6
...Annual grasses for green fodder	3.3	2.2	1.7	2.3	1.6	2.2	3.4	2.0	4.0

Source: NBS on-line database, Section 'Sown Area, crops average yield and harvest, 1980-2015': <http://statbank.statistica.md/pxweb/Database/RO/16%20AGR/AGR02/AGR02.asp>; Statistical Yearbooks for ATULBD: 1998 (page 218), 2002 (page 113), 2005 (page 101), 2009 (page 99), 2011 (page 102), 2014 (page 96), 2017 (page 114).

Based on information provided in Tables 5-70 and 5-71, and activity data included into Tables 5-72, 5-73 and 5-74, the total amount of nitrogen in crop residues returned to soils was estimated. The results allow assert that over the period from 1990 through 2016, the total amount of nitrogen in crop residues returned to soils decreased by 26.3 per cent (Table 5-75).

Table 5-75: Amount of N in Crop Residues Returned to Soils within 1990-2016 periods, kt

	1990	1991	1992	1993	1994	1995	1996	1997	1998
$F_{(CR)}$	34.8060	39.1826	26.3044	31.5513	14.9800	21.6434	11.7885	20.9412	17.9215
	1999	2000	2001	2002	2003	2004	2005	2006	2007
$F_{(CR)}$	17.4528	9.5485	17.2165	17.5917	8.2521	19.9839	20.0496	19.4949	5.1190
	2008	2009	2010	2011	2012	2013	2014	2015	2016
$F_{(CR)}$	21.0310	15.6403	21.2771	21.2544	6.3433	23.1553	25.9598	9.1732	25.6459

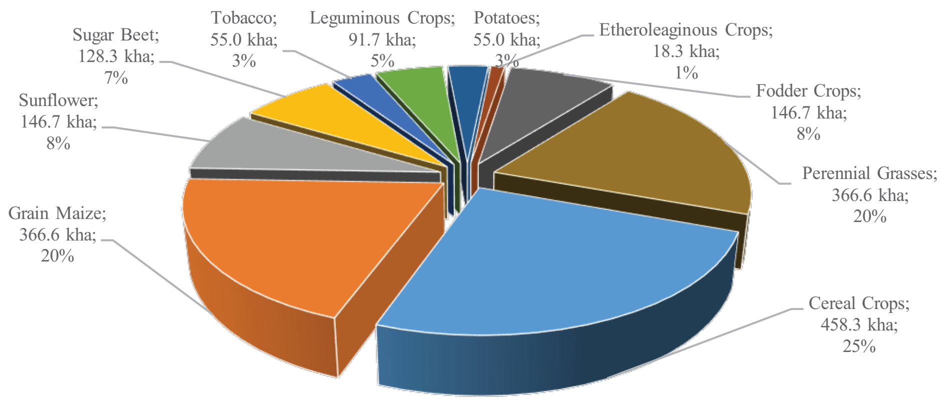


Figure 5-6: Recommended Crops Structure on Agricultural Lands in the RM [89]

To be noted that implementation of activities aimed at reasonable distribution of soil resources in function of the volume and characteristics of agricultural production, the recommended crop structure (Figure 5-6) will allow to obtain the necessary amount of grain needed to ensure the food security of population, fodder for the animal breeding sector, industrial and leguminous crops to meet the needs of population and the processing industry. At the same time this structure will allow to use soil protective crop rotation, contributing to stabilizing the humus balance in soil and soil fertility conservation.

[89] Buza, Vasile et al. (2007), Disaster Risks Management in the Republic of Moldova, National Agency for Rural Development from the RM, FAO, Chisinau, 2007, page 104

Uncertainties Assessment and Time-Series Consistency

Uncertainties related to activity data on areas sown with crops and average yield per hectare for the main crops in the Republic of Moldova are considered to be low, up to ±5 per cent. Uncertainties related to coefficients used to calculate the amount of nitrogen in agricultural crop residues returned to soils are medium and were estimated at circa ±25 per cent. Uncertainties related to default emission factor (EF_1 for F_{CR}) may reach up to ±6 per cent. The combined uncertainties associated with direct N_2O emissions from crop residues may reach to ±25.50 per cent. 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 this source category following a Tier 1 approach. The AD and methods used for estimating 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 emissions estimation process related errors, AD and EFs verifications and quality control procedures were applied.

Following the recommendations included into the 2006 IPCC Guidelines, N_2O emissions from crop residues returned to soil were estimated using AD from official sources of reference.

Recalculations

Direct N_2O_{CR} emissions from crop residues returned to soil were recalculated for those years affected by severe drought: 1994, 1996, 2000, 2003, 2007, 2012 and 2015 (see Tables 5-73 and 5-74). For the respective years the values of the fraction of above-ground residues of crop removed and used in other purposes ($Frac_{Remove(T)}$) were reconsidered.

In comparison with the last inventory cycle, the changes performed resulted in a significant decrease of N_2O_{CR} emissions from crop residues returned to soil in the following years: 1994, 1996, 2000, 2003, 2007, 2012 and 2015 (Table 5-76).

Table 5-76: Comparative Results of Direct N_2O_{CR} Emissions from Crop Residues Returned to Soils, included into the NC4 and the BUR2 of the Republic of Moldova under the UNFCCC, kt

	1990	1991	1992	1993	1994	1995	1996	1997	1998
NC4	0.5470	0.6157	0.4134	0.4958	0.3116	0.3401	0.2844	0.3291	0.2816
BUR2	0.5470	0.6157	0.4134	0.4958	0.2354	0.3401	0.1852	0.3291	0.2816
Difference, %	0.0	0.0	0.0	0.0	-24.5	0.0	-34.9	0.0	0.0
	1999	2000	2001	2002	2003	2004	2005	2006	2007
NC4	0.2743	0.2518	0.2705	0.2764	0.2552	0.3140	0.3151	0.3063	0.1293
BUR2	0.2743	0.1500	0.2705	0.2764	0.1297	0.3140	0.3151	0.3063	0.0804
Difference, %	0.0	-40.4	0.0	0.0	-49.2	0.0	0.0	0.0	-37.8
	2008	2009	2010	2011	2012	2013	2014	2015	2016
NC4	0.3305	0.2458	0.3344	0.3340	0.1903	0.3639	0.4079	0.2985	
BUR2	0.3305	0.2458	0.3344	0.3340	0.0997	0.3639	0.4079	0.1442	0.4030
Difference, %	0.0	0.0	0.0	0.0	-47.6	0.0	0.0	-51.7	

Abbreviations: NC4 – Fourth National Communication; BUR2 – Second Biennial Update Report.

The table below presents the comparative results of direct N_2O_{CR} emissions from crop residues returned to soil in the Republic of Moldova for the 1990-2016 time series included into the NC4 and BUR2 of the RM under the UNFCCC, expressed in kt CO_2 equivalent using the GWP_{100} values available in the IPCC AR4 (GWP_{100} = 298) (Table 5-77). For 2016, the respective emissions were estimated for the first time. The results allow assert that within the 1990-2016 period, direct N_2O emissions from this source category decreased by circa 26.3 per cent.

Table 5-77: Comparative Results of Direct N_2O_{CR} Emissions from Crop Residues Returned to Soils, included into the NC4 and the BUR2 of the RM under the UNFCCC, kt CO_2 equivalent

	1990	1991	1992	1993	1994	1995	1996	1997	1998
NC4	162.9926	183.4866	123.1798	147.7503	92.8712	101.3393	84.7501	98.0646	83.9239
BUR2	162.9914	183.4866	123.1798	147.7503	70.1492	101.3530	55.2041	98.0646	83.9239
Difference, %	0.0	0.0	0.0	0.0	-24.5	0.0	-34.9	0.0	0.0

	1999	2000	2001	2002	2003	2004	2005	2006	2007
NC4	81.7291	75.0494	80.6222	82.3792	76.0416	93.5817	93.8892	91.2919	38.5410
BUR2	81.7291	44.7142	80.6222	82.3792	38.6432	93.5817	93.8892	91.2919	23.9715
Difference, %	0.0	-40.4	0.0	0.0	-49.2	0.0	0.0	0.0	-37.8
	2008	2009	2010	2011	2012	2013	2014	2015	2016
NC4	98.4850	73.2411	99.6376	99.5312	56.7227	108.4321	121.5659	88.9425	
BUR2	98.4850	73.2411	99.6376	99.5312	29.7048	108.4328	121.5659	42.9569	120.0962
Difference, %	0.0	0.0	0.0	0.0	-47.6	0.0	0.0	-51.7	

Abbreviations: NC4 – Fourth National Communication; BUR2 – Second Biennial Update Report.

The decrease in emissions over the period under review is due to both less area being sown with crops over the period under review (for example, areas sown with tobacco decreased by 98.1 per cent, with fodder plants – by 87.8 per cent, with sugar beets – by 74.4 per cent, with leguminous crops – by 63.8 per cent, with vegetables – by 57.1 per cent, with potatoes – by 49.2 per cent, etc.), and lower yield per hectare of agricultural crops (for example, between 1990-2013 the average yield per hectare of perennial grasses for green fodder, silage and fodder decreased by 87.9 per cent, for forage roots – by 68.5 per cent, for annual grasses for green fodder – by 56.1 per cent, for vegetables – by 36.6 per cent, for tobacco – by 27.3 per cent, for winter wheat – by 27.3 per cent, barley – by 22.2 per cent, grain maize – by 10.9 per cent, etc.).

Despite the fact that over the respective time periods the areas sown with some crops increased: sun flower – by 210.3 per cent, grain maize – by 88.2 per cent, winter wheat – by 58.6 per cent and soybeans – by 56.2 per cent; and there was also recorded an increase in yield per hectare in other crops, such as melons and gourds – by 135.4 per cent, potatoes - by 46.8 per cent, winter rye – by 37.0 per cent, leguminous crops – by 28.5 per cent, soybeans – by 17.9 per cent, grain rapeseed - by 17.3 per cent, oat - by 11.6 per cent and sugar beet – by 9.2 per cent, it did not considerable affect the decreasing trend in N_2O emissions from crop residues returned to soils.

Planned Improvements

Planned improvements could include activities focused on obtaining more precise activity data and country specific coefficients and parameters used to estimate direct N_2O emissions from crop residues returned to soils under the 3D 'Agriculture Soils' category.

5.4.1.5. Nitrogen Mineralization Associated with Loss of Soil Organic Matter

Source Category Description

Land-use change and a variety of management practices may have a significant impact on soil organic carbon storage. Organic carbon and nitrogen are intimately linked in soil organic matter (humus). Where soil carbon is lost through oxidation as a result of land-use or management practices change, this loss will be accompanied by a simultaneous mineralization of nitrogen. Where a loss of soil carbon occurs, this mineralized nitrogen is regarded as an additional source of nitrogen available for conversion to N_2O.

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 and a simplified version of Equation 11.2 from the 2006 IPCC Guidelines:

$$N_2O_{SOM} = F_{SOM} \bullet EF_1 \bullet 44/28$$

Where:

EF_1 – default 0.01 kg N_2O-N/kg N applied (range: 0.003-0.03 kg N_2O-N/kg N);

[44/28] – stoichiometric 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);

$F_{(SOM)}$ was estimated using Equation 11.8 from 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); the 2006 IPCC Guidelines default value of 10 (range from 8 to 15) is used for arable soils; according 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 from 10.1 to 11.3);

$\Delta C_{mineral}$ *– annual change in carbon stocks in mineral soils, (t C/yr) (see Table 5-78) was estimated using the "Methodology for determining the carbon balance in agricultural lands for estimating GHG emissions" (see Annex A3-4.2)*[90].

Table 5-78: Annual Loss of Soil Carbon in the RM within 1990-2016 periods, kt C

	1990	1991	1992	1993	1994	1995	1996	1997	1998
$\Delta C_{mineral}$	386.7614	390.4232	321.3958	1027.9398	617.0007	953.5177	821.9692	1267.6381	1034.2182
	1999	2000	2001	2002	2003	2004	2005	2006	2007
$\Delta C_{mineral}$	956.5435	910.6167	1102.4410	1100.2818	860.7008	1256.7900	1218.8226	1065.9842	362.9626
	2008	2009	2010	2011	2012	2013	2014	2015	2016
$\Delta C_{mineral}$	1290.3865	906.9168	1100.1784	1142.9606	520.0540	1207.7213	1226.0762	1000.0380	1371.1426

The obtained results on the total amount of nitrogen mineralized (F_{SOM}) in mineral soils as a result of loss of soil carbon are provided in Table 5-79.

Table 5-79: The Net Annual Amount of Nitrogen Mineralized in Mineral Soils as a Result of Loss of Soil Carbon in the Republic of Moldova within 1990-2016 periods, kt

	1990	1991	1992	1993	1994	1995	1996	1997	1998
F_{SOM}	36.1459	36.4881	30.0370	96.0691	57.6636	89.1138	76.8196	118.4709	96.6559
	1999	2000	2001	2002	2003	2004	2005	2006	2007
F_{SOM}	89.3966	85.1044	103.0319	102.8301	80.4393	117.4570	113.9087	99.6247	33.9217
	2008	2009	2010	2011	2012	2013	2014	2015	2016
F_{SOM}	120.5969	84.7586	102.8204	106.8187	48.6032	112.8711	114.5866	93.4615	128.1442

Uncertainties Assessment and Time-Series Consistency

Uncertainties related to activity data on arable lands' areas in the Republic of Moldova are considered to be low, up to ±5 per cent. Uncertainties related to coefficients used to estimate N_2O from nitrogen mineralization associated with loss of soil carbon as a result of land-use or management change were estimated at circa ±25 per cent, while uncertainties related to default emission factor (EF_1 for F_{SOM}) may reach up to ±6 per cent. Combined uncertainties associated with direct N_2O emissions from N mineralization associated with loss of soil carbon as a result of land-use or management change are considered to be moderate (±25.50 per cent). 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 following a Tier 1 approach. The AD and methods used for estimating direct N_2O emissions from nitrogen mineralization associated with loss of soil carbon as a result of land-use or management change under the category 3D 'Agriculture Soils' were documented and archived both in hard copies and electronically. In order to identify the data entry and GHG emissions estimation process related errors, AD and EFs verifications and quality control procedures were applied. Following the recommendations included into the GPG, N_2O emissions originated from the 3D 'Agriculture Soils' were estimated based on AD and EFs from official sources of reference.

Recalculations

Direct N_2O emissions from nitrogen mineralization associated with loss of soil carbon as a result of land-use or management change were recalculated for the 1990 through 2015 time series, in particular due to use of an updated set of activity data on the amount of inorganic nitrogen fertilizers and organic fertilizers applied to soils in the Republic of Moldova, depending on individual crops, based on available data in the Statistical Reports 9-AGR "The Use of Phytosanitary Products and Inorganic

[90] Banaru, Anatol (2000), Methodology to Calculate CO2 Emissions from Agricultural Soils, In the collection of papers „Climate Change: Research, Studies, Solutions, Ministry of Environment / UNDP Moldova. „Bons Offices" S.R.L. Chisinau, 2000. P. 115-123.

Nitrogen Fertilizers and Organic Fertilizers Applied for Annual Crops...", respectively due to updating the amount of nitrogen returned to soil as crop residues, as well as reconsidering the fraction of crop residues removed and used for other purposes in the years with severe climatic conditions.

In comparison with the last inventory cycle, the changes performed resulted in an increase of N_2O_{SOM} emissions from nitrogen mineralization associated with loss of soil organic matter as a result of land-use or management change between 1990-1992, 1994, 1996, 2000, 2003, 2007 and 2015, with a variation from a minimum increase of 1.2 per cent in 1992 up to a maximum increase by 4.9 per cent in 1990; respectively, a decrease of direct N_2O emissions in the following years 1993, 1995, 1997-1999, 2001-2002, 2004-2006, 2008-2011 and 2013-2014, varying from a minimum decrease of 0.1 per cent in 2013 and a maximum decrease by 0.6 per cent in 1995 (Table 5-80).

Table 5-80: Comparative Results of Direct N_2O_{SOM} Emissions from Nitrogen Mineralization Associated with Loss of Soil Organic Matter, included into the NC4 and the BUR2 of the Republic of Moldova under the UNFCCC, kt

	1990	1991	1992	1993	1994	1995	1996	1997	1998
NC4	0.5413	0.5576	0.4662	1.5150	0.8851	1.4090	1.1748	1.8676	1.5254
BUR2	0.5680	0.5734	0.4720	1.5097	0.9061	1.4004	1.2072	1.8617	1.5189
Difference, %	4.93	2.83	1.25	-0.35	2.38	-0.61	2.75	-0.32	-0.43
	1999	2000	2001	2002	2003	2004	2005	2006	2007
NC4	1.4128	1.3023	1.6275	1.6231	1.2168	1.8531	1.7975	1.5681	0.5176
BUR2	1.4048	1.3374	1.6191	1.6159	1.2640	1.8458	1.7900	1.5655	0.5331
Difference, %	-0.57	2.69	-0.52	-0.44	3.89	-0.39	-0.42	-0.17	2.99
	2008	2009	2010	2011	2012	2013	2014	2015	2016
NC4	1.8984	1.3341	1.6179	1.6807	0.7282	1.7755	1.8027	1.4067	
BUR2	1.8951	1.3319	1.6157	1.6786	0.7638	1.7737	1.8006	1.4687	2.0137
Difference, %	-0.18	-0.16	-0.14	-0.13	4.88	-0.10	-0.11	4.40	

Abbreviations: NC4 – Fourth National Communication; BUR2 – Second Biennial Update Report.

For 2016, direct N_2O_{SOM} emissions from nitrogen mineralization associated with loss of soil organic matter as a result of land-use or management change in the Republic of Moldova were estimated for the first time. The results allow assert that within the 1990-2016 time series, direct N_2O_{SOM} emissions from this source category increased by circa 3.5 times.

The table below presents the comparative results of direct N_2O_{SOM} emissions from nitrogen mineralization associated with loss of soil organic matter as a result of land-use or management change in the Republic of Moldova for the 1990-2016 time series included into the NC4 and BUR2 of the RM under the UNFCCC, expressed in kt CO_2 equivalent using the GWP_{100} values available in the IPCC AR4 (GWP_{100} = 298) (Table 5-81).

Table 5-81: Comparative Results of Direct N_2O_{SOM} Emissions from Nitrogen Mineralization Associated with Loss of Soil Organic Matter, included into the NC4 and the BUR2 of the Republic of Moldova under the UNFCCC, kt

	1990	1991	1992	1993	1994	1995	1996	1997	1998
NC4	161.3093	166.1744	138.9251	451.4738	263.7523	419.8733	350.0955	556.5592	454.5658
BUR2	169.2662	170.8688	140.6590	449.8780	270.0305	417.3072	359.7350	554.7821	452.6258
Difference, %	4.93	2.83	1.25	-0.35	2.38	-0.61	2.75	-0.32	-0.43
	1999	2000	2001	2002	2003	2004	2005	2006	2007
NC4	421.0113	388.0789	484.9832	483.6695	362.5988	552.2154	535.6452	467.2998	154.2356
BUR2	418.6315	398.5316	482.4835	481.5386	376.6859	550.0344	533.4180	466.5282	158.8507
Difference, %	-0.57	2.69	-0.52	-0.44	3.89	-0.39	-0.42	-0.17	2.99
	2008	2009	2010	2011	2012	2013	2014	2015	2016
NC4	565.7332	397.5490	482.1452	500.8458	217.0111	529.1117	537.2081	419.2026	
BUR2	564.7379	396.9123	481.4933	500.2169	227.6017	528.5595	536.5925	437.6668	600.0808
Difference, %	-0.18	-0.16	-0.14	-0.13	4.88	-0.10	-0.11	4.40	

Abbreviations: NC4 – Fourth National Communication; BUR2 – Second Biennial Update Report.

Planned Improvements

Planned improvements could include activities focused on obtaining more precise activity data and country specific coefficients and parameters 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 under the 3D 'Agriculture Soils' category.

5.4.2. Indirect N_2O Emissions from Managed Soils

In addition to the direct emissions of N_2O from managed soils that occur through a direct pathway (i.e., directly from the soils to which N is applied), emissions of N_2O also take place through two indirect pathways. The first of these pathways is the volatilization of nitrogen 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, rivers and other waters. The sources of nitrogen as NH_3 and NO_x are not confined to agricultural fertilizers and manures, but also include fossil fuel combustion, biomass burning, and some industrial processes. Thus, these processes cause N_2O emissions in an exactly analogous way to those resulting from 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 the leaching and runoff from land of nitrogen from synthetic and organic fertilizer additions, crop residues, mineralization of nitrogen associated with loss of soil carbon in mineral and drained/managed organic soils through land-use change or management practices, and urine and dung deposition from grazing animals. Some of the inorganic nitrogen in or on the soil, mainly in the NO_3^- form, 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. Where NO_3^- is present in the soil in excess of biological demand, e.g., under cattle urine patches, the excess leaches through the soil profile. The nitrification and denitrification microbial processes transform some of the NH_4^+ and NO_3^- to N_2O. This may take place in the groundwater below the land to which the N was applied, or in riparian zones receiving drain or runoff water, or in the 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 waters fertilization, entailing biogenic formation of N_2O. When synthetic N or organic (manure) fertilizer are applied on 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 depend on a series of factors, such as type of fertilizer, technology and time of application, type of soils, atmospheric precipitations, temperature, soil pH, etc.

Methodological Issues, Emission Factors and Data Sources

N_2O emissions from atmospheric deposition of nitrogen volatilized from managed soil were estimated by using a Tier 1 methodology and Equation 11.9 from 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] – stoichiometric ratio of nitrogen content in N_2O-N and N_2O.

Activity data on the amount of nitrogen in inorganic and organic fertilizers, urine and dung of grazing animals applied to soils are available in Tables 5-58, 5-63 and respectively in Table 5-67.

Uncertainties Assessment and Time-Series Consistency

Uncertainties related to estimation of indirect N_2O emissions from this source are very high. Uncertainties mostly pertain to estimating the amount of volatilized fertilizer, amount of N in manure and emission factors, for which it is extremely difficult to verify to what extent they reflect the conditions specific to Republic of Moldova. Also, the uncertainties associated with the estimation of the amount of nitrogen lost through volatilization of NO_x and NH_4 are quite high. Nitrogen volatilization fraction vary a lot, from negligible to very high, depending on environment conditions, soil characteristics, climate conditions, etc. According to the 2006 IPCC Guidelines, uncertainties related to estimating indirect N_2O emissions from this source can vary up to factor of 2. In the Republic of Moldova, combined uncertainties related to indirect N_2O emissions from this source category are considered to be very high (±165.53 per cent). 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, 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 emissions estimation process related errors, AD and EFs verifications and quality control procedures were applied.

Recalculations

Indirect N_2O_{ATD} emissions from the 3D.b.1 'Atmospheric Deposition of Nitrogen Oxides (NO_x) and Ammonia (NH_4)' source category were recalculated for 1990-2015 time series, in particular due to using a new set of AD generated based on the information regarding the amount of organic N fertilizers available to apply to soil (estimated within category 3B „Manure Management"), as well as due to use of an updated set of AD related to the livestock population on the LBDR (the Statistical Yearbooks of the ATULBD for 2016 and 2017 include more disaggregated data regarding 2011-2016 time periods, for example, for sheep and goats, respectively for poultry, the same trends regarding the population of these species were also applied for the rest of the analyzed period).

In comparison with the last inventory cycle, the changes performed resulted in increased indirect N_2O_{ATD} emissions from atmospheric deposition of nitrogen oxides (NO_x) and ammonia (NH_4) between 1993 and 2015, with a variation from a minimum increase of 0.28 per cent in 2004, up to a maximum increase by 0.94 per cent in 1995 (Table 5-82).

Table 5-82: Comparative Results of Indirect N_2O_{ATD} Emissions from 3D.b.1 „Atmospheric Deposition of Nitrogen Volatilized from Managed Soils", included into the NC4 and the BUR2 of the RM under the UNFCCC, kt

	1990	1991	1992	1993	1994	1995	1996	1997	1998
NC4	0.3429	0.3182	0.2691	0.1989	0.1755	0.1599	0.1660	0.1354	0.1313
BUR2	0.3429	0.3182	0.2691	0.1997	0.1768	0.1614	0.1668	0.1360	0.1321
Difference, %	0.00	0.00	0.00	0.43	0.79	0.94	0.48	0.46	0.61
	1999	2000	2001	2002	2003	2004	2005	2006	2007
NC4	0.1147	0.1126	0.1180	0.1283	0.1176	0.1161	0.1191	0.1170	0.1040
BUR2	0.1157	0.1131	0.1186	0.1288	0.1180	0.1164	0.1196	0.1175	0.1044
Difference, %	0.86	0.44	0.50	0.40	0.33	0.28	0.42	0.39	0.40
	2008	2009	2010	2011	2012	2013	2014	2015	2016
NC4	0.1082	0.1082	0.1154	0.1157	0.1246	0.1345	0.1704	0.1330	
BUR2	0.1088	0.1088	0.1161	0.1162	0.1252	0.1350	0.1710	0.1336	0.1428
Difference, %	0.59	0.55	0.54	0.44	0.48	0.36	0.35	0.46	

Abbreviations: NC4 – Fourth National Communication; BUR2 – Second Biennial Update Report.

The table below presents the comparative results of indirect N_2O_{ATD} emissions from atmospheric deposition of nitrogen oxides (NO_x) and ammonia (NH_4) in the Republic of Moldova for the 1990-2016 time series included into the NC4 and BUR2 of the RM under the UNFCCC, expressed in kt CO_2 equivalent using the GWP_{100} values available in the IPCC AR4 (GWP_{100} = 298) (Table 5-83).

For 2016, the respective emissions were estimated for the first time. The results allow assert that, between 1990 and 2016, indirect N_2O_{ATD} emissions from atmospheric deposition of nitrogen oxides (NO_x) and ammonia (NH_4) decreased by circa 58.3 per cent. This significant decrease can be explained by a drastic drop in the amounts of synthetic nitrogen and organic fertilizer applied to soils, due to a significant reduction of the total livestock population over the period under review, and changes in the share of manure management systems in the Republic of Moldova.

Table 5-83: Comparative Results of Indirect N_2O_{ATD} Emissions from 3D.b.1 „Atmospheric Deposition of Nitrogen Volatilized from Managed Soils", included into the NC4 and the BUR2 of the RM under the UNFCCC, kt CO_2 equivalent

	1990	1991	1992	1993	1994	1995	1996	1997	1998
NC4	102.1793	94.8090	80.2010	59.2654	52.2845	47.6452	49.4804	40.3455	39.1353
BUR2	102.1793	94.8090	80.2010	59.5183	52.6985	48.0915	49.7183	40.5323	39.3759
Difference, %	0.00	0.00	0.00	0.43	0.79	0.94	0.48	0.46	0.61
	1999	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**
NC4	34.1730	33.5657	35.1601	38.2408	35.0504	34.5949	35.4894	34.8675	30.9833
BUR2	34.4657	33.7147	35.3358	38.3930	35.1675	34.6932	35.6380	35.0040	31.1079
Difference, %	0.86	0.44	0.50	0.40	0.33	0.28	0.42	0.39	0.40
	2008	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**
NC4	32.2461	32.2293	34.3971	34.4824	37.1442	40.0925	50.7786	39.6240	
BUR2	32.4354	32.4079	34.5829	34.6356	37.3227	40.2367	50.9555	39.8057	42.5624
Difference, %	0.59	0.55	0.54	0.44	0.48	0.36	0.35	0.46	

Abbreviations: NC4 – Fourth National Communication; BUR2 – Second Biennial Update Report.

Planned Improvements

No activities for improving the estimation process regarding the indirect N_2O_{ATD} emissions from atmospheric deposition of nitrogen oxides and ammonia under the 3D 'Agriculture Soils' category are planned for the future inventory cycle.

5.4.2.2. Nitrogen Leaching and Run-off

Source Category Description

A big part of nitrogen applied to soil through application of 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 through land-use change or management practices is lost through leaching and run-off. Some of the inorganic nitrogen in, or on the soil, mainly in the NO_3^- form, may bypass biological retention mechanisms in the soil/vegetation system by transport in overland water flow (run-off) and/or flow through soil macropores or pipe drains. Where NO_3^- is present in the soil in excess of biological demand; the excess leaches through the soil profile. This may take place in the groundwater below the land, to which the nitrogen was applied, or in riparian zones receiving drain or runoff water, or in the ditches, streams, rivers and estuaries into which the land drainage water eventually flows, where biogenic production of N_2O emissions is more intense.

Methodological Issues, Emission Factors and Data Sources

The indirect N_2O emissions from leaching and run-off were estimated by using a Tier 1 methodology and Equation 11.10 from 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), including N-fixing crops and forage/pasture renewal 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] – stoichiometric ratio of nitrogen content in N_2O-N and N_2O.

Activity data on the amount of soil nitrogen from application of inorganic and organic fertilizer additions, crop residues, mineralization of nitrogen associated with loss of soil carbon in mineral soils through land-use change or management practices, and from urine and dung deposition, are available in Tables 5-58, 5-63, 5-67, 5-75 and 5-79.

Uncertainties Assessment and Time-Series Consistency

Uncertainties associated with the estimation of indirect N_2O emissions from leaching and run-off are very high, being caused by estimating the amount of nitrogen applied to soil lost through leaching and run-off as well as by the emission factors, for which is extremely difficult to verify if they are representative to the conditions in the Republic of Moldova. To be noted that according to the 2006 IPCC Guidelines, uncertainties associated with 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 (±167.71 per cent). 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 Guidelines.

Quality Assurance and Quality Control

Standard verification and QC forms and checklists were filled in for the respective source category, following a Tier 1 approach. Also, the AD and methods used were documented and archived both in hard copies and electronically. In order to identify the data entry and GHG emissions estimation process related errors, AD and EFs verifications and QC procedures were applied.

Recalculations

Indirect N_2O_L emissions from the 3D.b.2 'Nitrogen Leaching and Run-off' source category were recalculated for 1990-2015 time series, in particular due to using a new set of AD generated based on the information regarding the amount of organic N fertilizers available to apply to soil (estimated within source category 3B 'Manure Management'); due to use of an updated set of AD related to the livestock population on the Left Bank of Dniester River (the Statistical Yearbooks of the ATULBD for 2016 and 2017 include more disaggregated data regarding 2011-2016 time periods, for example, for sheep and goats, respectively for poultry, the same trends regarding the population of these species were also applied for the rest of the analyzed period); respectively, due to use of an updated set of activity data on the amount of inorganic nitrogen fertilizers and organic fertilizers applied to soils in the Republic of Moldova, depending on individual crops, based on available data in the Statistical Reports 9-AGR "The Use of Phytosanitary Products and Inorganic Nitrogen Fertilizers and Organic Fertilizers Applied for Annual Crops...", as well as due to updating the amount of nitrogen returned to soil as crop residues, and reconsidering the fraction of crop residues removed and used for other purposes in the years with severe climatic conditions.

In comparison with the last inventory cycle, the changes performed resulted in increased N_2O_L emissions from soil nitrogen leaching and run-off between 1990-1992, 2009-2011 and 2013-2014, with a variation from a minimum increase of 0.02 per cent in 2013, up to a maximum increase by 0.76 per cent in 1990; respectively, a decrease within 1993-2008, 2012 and 2015 time series, varying from a minimum decrease of 0.01 per cent in 2006 and 2008 to a maximum decrease by 3.51 per cent in 2003 (Table 5-84).

Table 5-84: Comparative Results of Indirect $N_2O_{(L)}$ Emissions from Soil Nitrogen Leaching and Runoff, included into the NC4 and the BUR2 of the Republic of Moldova under the UNFCCC, kt

	1990	1991	1992	1993	1994	1995	1996	1997	1998
NC4	0.7934	0.7681	0.6099	0.7228	0.4916	0.5920	0.5385	0.6668	0.5723
BUR2	0.7994	0.7717	0.6112	0.7226	0.4807	0.5917	0.5244	0.6661	0.5718
Difference, %	0.76	0.46	0.21	-0.03	-2.21	-0.04	-2.62	-0.10	-0.10
	1999	2000	2001	2002	2003	2004	2005	2006	2007
NC4	0.5190	0.4945	0.5822	0.6035	0.4894	0.6466	0.6378	0.5778	0.2958
BUR2	0.5184	0.4800	0.5810	0.6025	0.4722	0.6453	0.6366	0.5777	0.2888
Difference, %	-0.13	-2.92	-0.21	-0.17	-3.51	-0.20	-0.18	-0.01	-2.38
	2008	2009	2010	2011	2012	2013	2014	2015	2016
NC4	0.6620	0.5072	0.6055	0.6277	0.4071	0.7072	0.7971	0.6016	
BUR2	0.6620	0.5074	0.6057	0.6278	0.3954	0.7073	0.7973	0.5815	0.7812
Difference, %	-0.01	0.04	0.03	0.02	-2.88	0.02	0.03	-3.34	

Abbreviations: NC4 – Fourth National Communication; BUR2 – Second Biennial Update Report.

The table below presents the comparative results of indirect N_2O_L emissions from soil nitrogen leaching and run-off between 1990 and 2015 included into the NC4 and BUR2 of the RM under the UNFCCC, expressed in kt CO_2 equivalent using the GWP_{100} values available in the IPCC AR4 (GWP_{100} = 298) (Table 5-85).

Table 5-85: Comparative Results of Indirect $N_2O_{(L)}$ Emissions from Soil Nitrogen Leaching and Run-off, included into the NC4 and the BUR2 of the RM under the UNFCCC, kt CO_2 equivalent

	1990	1991	1992	1993	1994	1995	1996	1997	1998
NC4	236.4399	228.9020	181.7573	215.3949	146.4933	176.4111	160.4692	198.6964	170.5521
BUR2	238.2299	229.9582	182.1474	215.3204	143.2592	176.3389	156.2579	198.5067	170.3862
Difference, %	0.76	0.46	0.21	-0.03	-2.21	-0.04	-2.62	-0.10	-0.10
	1999	2000	2001	2002	2003	2004	2005	2006	2007
NC4	154.6758	147.3604	173.5001	179.8451	145.8284	192.6854	190.0537	172.1836	88.1504
BUR2	154.4696	143.0546	173.1353	179.5369	140.7151	192.3053	189.7197	172.1635	86.0509
Difference, %	-0.13	-2.92	-0.21	-0.17	-3.51	-0.20	-0.18	-0.01	-2.38
	2008	2009	2010	2011	2012	2013	2014	2015	2016
NC4	197.2796	151.1363	180.4404	187.0477	121.3292	210.7352	237.5440	179.2867	
BUR2	197.2687	151.1941	180.5027	187.0784	117.8339	210.7733	237.6045	173.2988	232.7913
Difference, %	-0.01	0.04	0.03	0.02	-2.88	0.02	0.03	-3.34	

Abbreviations: NC4 – Fourth National Communication; BUR2 – Second Biennial Update Report.

The results allow assert that, between 1990 and 2016, the respective emissions decreased by circa 2.3 per cent. This decrease can be explained by a drastic drop in the amounts of inorganic nitrogen fertilizers and organic fertilizers applied to soils, a significant reduction in total population of livestock over the period under review and changes in the share of manure management systems; respectively, due to smaller amounts of crop residues returned to soils (as a consequence of irrational soil management and failure to respect the recommended crop rotation, with a strong negative effect on the stabilization of humus balance in soils), and due to significant soil carbon losses resulting from inefficient management of agricultural lands.

Planned Improvements

No activities for improving the estimation process regarding the indirect $N_2O_{(L)}$ emissions from soil N leaching and run-off under the 3D 'Agriculture Soils' category are planned for the future inventory cycle.

5.5. CO_2 Emissions from Urea Application (Category 3H)

5.5.1. Source Category Description

Adding urea ($CO(NH_2)_2$) to soils during fertilization leads to a loss of CO_2 that was fixed 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 by 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, tons C/tons urea (default value: 0.2 t C/t urea);
[44/12] – stoichiometric 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 5-86). It was considered that the annual consumption of urea is equal to the total urea imports minus exports. As the Customs Service database does not cover the 1990-1994 time series, information regarding urea consumption during the respective period was generated based on the trend of using inorganic fertilizers between 1990 and 1995. As can be seen from Table 5-86, in the last decade was recorded an obvious trend of increased urea consumption in the Republic of Moldova, although the annual consumption varies significantly from year to year.

Table 5-86: Urea Consumption in the RM within 1990-2016 periods

	1990	1991	1992	1993	1994	1995	1996	1997	1998
Imports, t	793.6	712.6	532.5	174.1	73.2	82.7	124.3	1 499.0	371.1
Exports, t	0.0	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	371.1
	1999	2000	2001	2002	2003	2004	2005	2006	2007
Imports, t	4.6	599.7	204.0	64.2	324.8	500.7	237.2	199.1	358.7
Exports, t	0.0	0.0	0.0	0.0	0.1	0.4	0.0	0.0	0.0
Annual urea consumption in the RM, t	4.6	599.7	204.0	64.1	324.7	500.3	237.2	199.1	358.7
	2008	2009	2010	2011	2012	2013	2014	2015	2016
Imports, t	1 159.8	799.6	2 385.5	5 022.2	7 634.2	5 705.4	13 917.0	15 327.6	16 738.2
Exports, t	0.0	0.0	6.9	10.6	10.4	0.0	0.0	0.0	0.0
Annual urea consumption in the RM, t	1 159.8	799.6	2 378.6	5 011.6	7 623.8	5 705.4	13 917.0	15 327.6	16 738.2

Source: Customs Service of the RM, Official 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 MoEN; Customs Service of the RM, Official 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 Agriculture, Regional Development and Environment.

5.5.3. Uncertainties Assessment and Time-Series Consistency

Uncertainties related to activity data on urea application in the RM reach to ±30 per cent. According to the 2006 IPCC Guidelines, uncertainties associated with default EFs represent circa ±50 per cent. Thus, combined uncertainties from this source category are considered moderate (±58.31 per cent) (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 were documented and archived both in hard copies and electronically. In order to identify the data entry and GHG emissions estimation process related errors, AD and EFs verifications and quality control procedures were applied.

5.5.5. Recalculations

For 2015, CO_2 emissions from 3H 'Urea Application' category were recalculated, due to receiving an updated set of AD from the Customs Service of the Republic of Moldova. For 2016, the respective emissions were estimated for the first time. The obtained results allow assert that within 1990-2016 periods, the respective emissions increased by circa 21 times (Table 5-87).

Table 5-87: CO_2 Emissions from Urea Application in the RM within 1990-2016 periods, kt

	1990	1991	1992	1993	1994	1995	1996	1997	1998
3H. CO_2 emissions from urea application	0.5820	0.5226	0.3905	0.1276	0.0537	0.0607	0.0911	1.0992	0.2721
	1999	2000	2001	2002	2003	2004	2005	2006	2007
3H. CO_2 emissions from urea application	0.0034	0.4397	0.1496	0.0470	0.2381	0.3669	0.1739	0.1460	0.2631
	2008	2009	2010	2011	2012	2013	2014	2015	2016
3H. CO_2 emissions from urea application	0.8505	0.5864	1.7443	3.6752	5.5908	4.1840	10.2058	11.2402	12.2747

5.5.6. Planned Improvements

Potential improvements could include updating AD used to estimate CO_2 emissions from urea application in the Republic of Moldova.

6. LAND USE, LAND-USE CHANGE AND FORESTRY SECTOR

6.1. Overview

Estimation of GHG removals/emissions covered by the Sector 4 'Land Use, Land-Use Change and Forestry' are described below in the respective chapter. GHG removals/emissions within this sector were estimated following the 2006 IPCC Guidelines for National Greenhouse Gas Inventories methodologies.

The evolution of removals/emissions reported for the time period from 1990 through 2016 was greatly affected, in addition to the state of forests and other vegetation types, by the social-political and economic changes that occurred over the 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 90's of the 20th century, the land use in the Republic of Moldova was relatively stable in the last 10-15 years. The forest area is growing steadily. According to data provided by the General Land Cadaster, by 01.01.2017, forest lands accounted for 386.5 thousand ha or 11.8 per cent of the country's territory.

6.1.1. Summary of CO_2 Removals Trends

Over the period from 1990 through 2016, CO_2 removals from Sector 4 'LULUCF' tended to decrease significantly (Figure 6-1). In comparison with the reference year, net CO_2 removals from Sector 4 'LULUCF' decreased by 2016 by circa 35.3 per cent (Table 6-1).

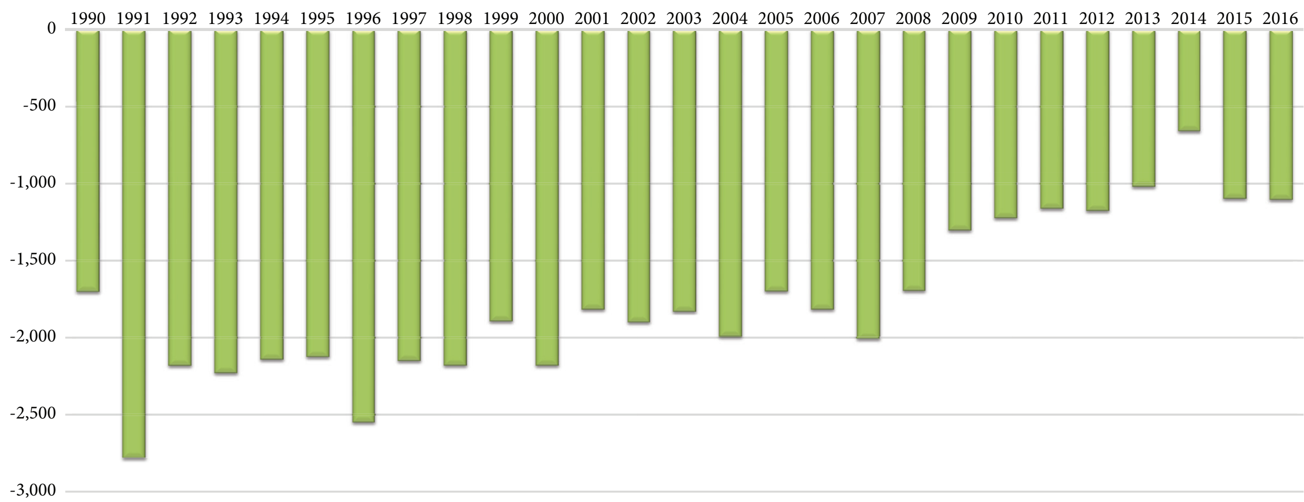


Figure 6-1: CO_2 removals within the Sector 4 'LULUCF' in the RM within 1990-2016 periods, kt.

The main sources of removals reduction are forest lands, grasslands and lands with wood vegetation from croplands, in particular such categories as: 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). The following categories represent a constant source of CO_2 emissions due to a profoundly negative balance as a result of land conversion and a significant decrease (by circa 38.6 per cent) of perennial plantations areas: 4B1 „Cropland Remaining Cropland", 4E2 „Land Converted to Settlements" and 4F2 „Land Converted to Other Land".

Table 6-1: CO_2 Emissions/Removals within the Sector 4 'LULUCF' in the Republic of Moldova, by Source and Sink Categories within 1990-2016 periods, kt

Year	Forest Land		Cropland		Grassland		Wetlands		Settlements		Other land		HWP	Total LULUCF	Compared to 1990, %
	4A1	4A2	4B1	4B2	4C1	4C2	4D1	4D2	4E1	4E2	4F1	4F2	4G		
1990	-1579.04	-984.39	2602.98	-94.02	0.00	-1205.69	0.00	-555.38	0.00	84.75	0.00	152.36	-122.18	-1700.61	100.0
1991	-1352.65	-990.66	1489.86	-109.40	0.00	-1414.32	0.00	-526.46	0.00	88.71	0.00	152.36	-113.61	-2776.16	163.2
1992	-1290.42	-893.82	1571.41	-252.62	0.00	-1428.48	0.00	-595.55	0.00	386.62	0.00	418.78	-94.30	-2178.38	128.1
1993	-1367.44	-826.08	1707.84	-126.69	0.00	-1303.52	0.00	-525.84	0.00	114.62	0.00	164.02	-63.45	-2226.54	130.9
1994	-1355.18	-752.83	1479.70	-101.19	0.00	-1577.33	0.00	-497.64	0.00	130.49	0.00	549.46	-14.65	-2139.17	125.8
1995	-1350.20	-694.87	1652.62	-173.73	0.00	-1601.10	0.00	-469.44	0.00	106.92	0.00	401.13	5.97	-2122.70	124.8

Year	Forest Land		Cropland		Grassland		Wetlands		Settlements		Other land		HWP	Total LU-LUCF	Compared to 1990, %
	4A1	4A2	4B1	4B2	4C1	4C2	4D1	4D2	4E1	4E2	4F1	4F2	4G		
1996	-1559.05	-631.39	1489.36	-177.25	0.00	-1548.08	0.00	-441.24	0.00	101.59	0.00	217.33	1.78	-2546.94	149.8
1997	-1639.49	-592.79	1802.84	-174.79	0.00	-1400.86	0.00	-413.03	0.00	100.80	0.00	188.24	-19.24	-2148.33	126.3
1998	-1732.32	-556.17	1838.57	-181.41	0.00	-1436.27	0.00	-384.83	0.00	99.04	0.00	185.01	-9.13	-2177.51	128.0
1999	-1840.91	-495.94	1814.62	-136.95	0.00	-1433.29	0.00	-356.63	0.00	111.83	0.00	425.16	18.54	-1893.57	111.3
2000	-1881.45	-425.98	1618.81	-153.43	0.00	-1291.95	0.00	-328.42	0.00	100.18	0.00	178.52	5.81	-2177.92	128.1
2001	-1873.56	-400.15	1999.82	-188.59	0.00	-1290.65	0.00	-300.22	0.00	67.09	0.00	178.52	-6.26	-1814.00	106.7
2002	-1913.58	-354.04	1568.81	-161.19	0.00	-1235.14	0.00	-272.02	0.00	67.09	0.00	456.24	-56.69	-1900.51	111.8
2003	-1863.87	-406.25	1645.16	-156.06	0.00	-1007.18	0.00	-243.82	0.00	67.86	0.00	201.66	-65.11	-1827.60	107.5
2004	-1904.34	-430.44	1589.75	-135.56	0.00	-1120.48	0.00	-215.61	0.00	53.67	0.00	223.82	-53.47	-1992.66	117.2
2005	-1966.00	-443.52	1630.93	-102.65	0.00	-1058.12	0.00	-187.41	0.00	53.67	0.00	416.50	-41.11	-1697.71	99.8
2006	-1882.93	-483.58	1666.31	-100.41	0.00	-1056.37	0.00	-159.21	0.00	53.67	0.00	189.50	-40.59	-1813.61	106.6
2007	-1985.96	-474.43	1621.17	-93.04	0.00	-1031.24	0.00	-131.00	0.00	49.27	0.00	83.11	-44.59	-2006.70	118.0
2008	-1985.38	-477.41	1603.36	-103.57	0.00	-932.15	0.00	-102.80	0.00	49.27	0.00	291.00	-35.61	-1693.28	99.6
2009	-2008.95	-517.12	1744.06	-91.58	0.00	-447.69	0.00	-74.60	0.00	45.57	0.00	79.94	-28.47	-1298.85	76.4
2010	-1964.09	-520.08	1618.99	-80.99	0.00	-691.99	0.00	-46.40	0.00	45.57	0.00	441.48	-22.80	-1220.30	71.8
2011	-1871.43	-519.14	1610.58	-118.05	0.00	-638.17	0.00	-75.31	0.00	62.04	0.00	393.73	-4.38	-1160.14	68.2
2012	-1702.27	-592.56	1593.58	-97.57	0.00	-562.75	0.00	-15.47	0.00	11.89	0.00	114.14	76.84	-1174.15	69.0
2013	-1531.88	-609.99	1689.48	-281.28	0.00	-360.17	0.00	-106.10	0.00	13.75	0.00	103.45	61.88	-1020.86	60.0
2014	-1484.67	-650.06	1696.17	-250.44	0.00	-341.11	0.00	-139.75	0.00	18.98	0.00	436.65	58.02	-656.22	38.6
2015	-1496.39	-663.05	1700.40	-308.02	0.00	-418.46	0.00	-82.79	0.00	39.16	0.00	86.82	49.24	-1093.09	64.3
2016	-1451.33	-662.22	1775.41	-382.17	0.00	-402.37	0.00	-82.79	0.00	19.31	0.00	85.65	0.88	-1099.64	64.7

This trend is due, first of all, to changes in land use and land management practices (Category 4B "Cropland"), which contributed to the significant decrease of organic carbon stocks in croplands[91], thus changing the balance of humus, from a positive one, in a negative and/or profoundly negative one. The respective process was also influenced by some changes in forest management and forest use (Category 4A "Forest Land"), such as increasing authorized harvesting of wood mass, significant increase of illegal logging, increased conversion of croplands to forest land etc.

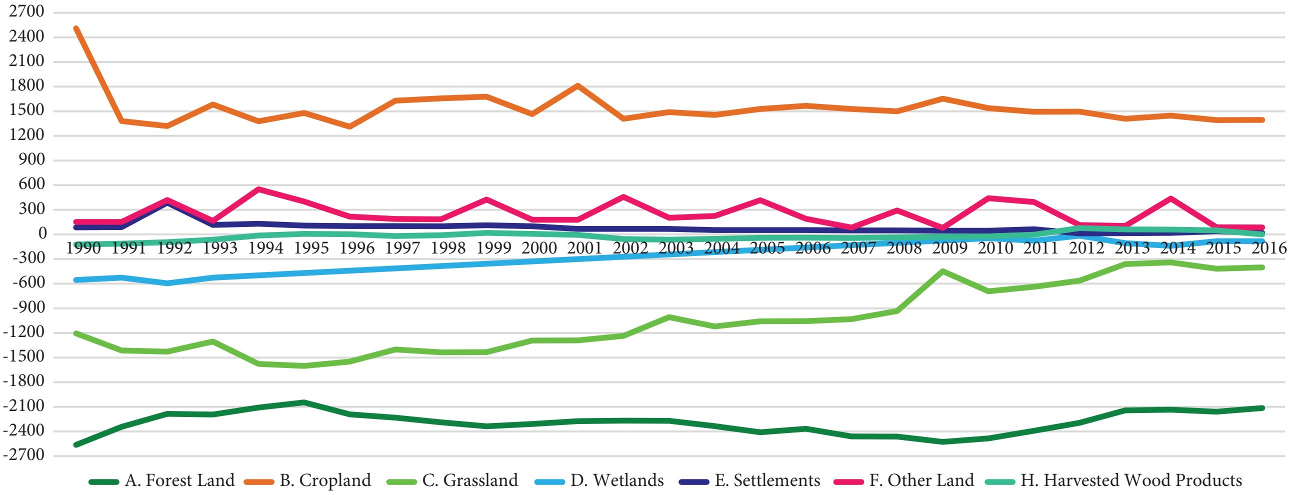


Figure 6-2: CO_2 Emissions/Removals within the Sector 4 'LULUCF' in the RM, kt.

Table 6-2 shows net CO_2 emissions/removals within the Sector 4 'LULUCF' in the Republic of Moldova within 1990-2016 periods.

Table 6-2: Net Direct GHG Emissions/Removals within the Sector 4 'LULUCF' in the Republic of Moldova within 1990-2016 periods, kt CO_2 equivalent

	1990	1991	1992	1993	1994	1995	1996	1997	1998
CO_2	-1 700.6120	-2 776.1620	-2 178.3822	-2 226.5422	-2 139.1679	-2 122.7016	-2 546.9382	-2 148.3338	-2 177.5062
CH_4	2.6534	2.3998	2.1973	2.9467	1.6555	2.2396	1.5410	2.6880	2.4720
N_2O	170.3740	183.8820	204.6518	222.5703	236.5414	251.5155	262.2576	272.1818	284.3568
Total net	**-1 527.5846**	**-2 589.8802**	**-1 971.5330**	**-2 001.0251**	**-1 900.9711**	**-1 868.9465**	**-2 283.1395**	**-1 873.4640**	**-1 890.6774**
	1999	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**
CO_2	-1 893.5700	-2 177.9243	-1 813.9954	-1 900.5120	-1 827.6049	-1 992.6605	-1 697.7069	-1 813.6146	-2 006.6996
CH_4	2.3889	0.9123	1.2702	0.2659	0.0612	0.2009	0.2482	0.2505	1.5179
N_2O	293.8604	296.3244	296.5454	296.9504	294.3382	290.1214	286.5410	282.6021	278.0203
Total net	**-1 597.3208**	**-1 880.6877**	**-1 516.1797**	**-1 603.2957**	**-1 533.2054**	**-1 702.3382**	**-1 410.9177**	**-1 530.7620**	**-1 727.1614**

[91] Organic carbon and nitrogen in soil are closely related to the humus content of soil; carbon loss through oxidation due to changes in soil management and agricultural land use are accompanied by the simultaneous nitrogen mineralization (biochemical decomposition).

	2008	2009	2010	2011	2012	2013	2014	2015	2016
CO_2	-1 693.2806	-1 298.8485	-1 220.3031	-1 160.1391	-1 174.1542	-1 020.8558	-656.2221	-1 093.0947	-1 099.6373
CH_4	0.7701	0.3145	0.1390	0.1592	1.1675	0.8718	0.1169	0.6532	0.3568
N_2O	272.0280	265.3313	258.2142	251.9572	233.4235	217.2511	202.4681	190.2644	179.2669
Total net	**-1 420.4825**	**-1 033.2027**	**-961.9499**	**-908.0226**	**-939.5632**	**-802.7329**	**-453.6371**	**-902.1771**	**-920.0136**

6.1.2. Key Categories

The results of key category analysis carried out following a Tier 1 approach (IPCC, 2006), by level and trend, are provided in Table 6-3 under the Sector 4 'LULUCF'.

Table 6-3: Key Source Categories under the Sector 4 'LULUCF'

IPCC Category	Gases	Source and Sink Categories	Key Categories
4A1	CO_2	Forest Land Remaining Forest Land	Yes (L, T)
4A1	non-CO_2	Forest Land Remaining Forest Land	No
4A2	CO_2	Land Converted to Forest Land	Yes (L, T)
4A2	non-CO_2	Land Converted to Forest Land	No
4B1	CO_2	Cropland Remaining Cropland	Yes (L, T)
4B1	non-CO_2	Cropland Remaining Cropland	No
4B2	CO_2	Land Converted to Cropland	Yes (L, T)
4B2	non-CO_2	Land Converted to Cropland	No
4C1	CO_2	Grassland Remaining Grassland	No
4C2	CO_2	Land Converted to Grassland	Yes (L, T)
4D1	CO_2	Wetlands Remaining Wetlands	No
4D2	CO_2	Land Converted to Wetlands	Yes (L, T)
4E1	CO_2	Settlements Remaining Settlements	No
4E2	CO_2	Land Converted to Settlements	No
4E2	non-CO_2	Land Converted to Settlements	Yes (L, T)
4F1	CO_2	Other Land Remaining Other Land	No
4F2	CO_2	Land Converted to Other Land	No
4G	CO_2	Harvested Wood Products	Yes (T)

6.1.3. Methodological Issues and Data Sources

Tier 1 and Tier 2 methodologies (2006 IPCC Guidelines), as well as default and country specific emissions/removals factors (ex.: current biomass growth factors, basic wood density; carbon fraction of dry matter, biomass decrease/increase and/or carbon in soils due to conversion etc.) were employed to estimate emissions/removals under Sector 4 'LULUCF'. At the same time, in order to estimate the emissions reduction achieved in the implementation of afforestation projects through the Clean Development Mechanism (CDM) under 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 sub-chapters 6.2-6.8 of the NIR).

The main sources of reference for the activity data used under the Sector 4 'LULUCF' were: data pertaining to Reports of State Accounting of Forest Resources: areas occupied by forests, distribution by species, volume of standing wood mass, etc.; forest planning materials: areas occupied and dendrometrical features of forests and other types of forest vegetation; General Land Cadasters – forest areas, areas occupied by forest vegetation not included in forestry resources, grasslands, perennial plantations, arable lands, settlement lands, other land categories, etc.; Statistical Reports of the "Moldsilva" Agency: the volumes of woody mass harvested during forest clearings (by categories and species); illegal felling from the forestry resources managed by the Agency, as well as from forests and forest vegetation managed by other owners; Reports of the Inspectorate for Environmental Protection (former State Ecological Inspectorate): illegal felling revealed by its territorial sub-divisions; the volumes of wood mass subjected to authorized harvesting from forests and forest vegetation managed by local and central public authorities; National Environment Reports of the Republic of Moldova: areas where the stubble fields were burnt; 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: Summary of Methods Used to Estimate CO_2 Emissions/Removals from the Sector 4 'LULUCF'

IPCC Categories	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), carbon losses (carbon losses / gains due to conversion)
4B Cropland	B1. Cropland Remaining Cropland	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 from 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)
	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)
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)
4F Other Lands	F1. Other Land Remaining Other Land	T1	D	Neutral balance
	F2. Land Converted to Other Land Category	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 Harvested Wood Products	Harvested Wood Products	T1	D	Harvested wood products / processed, imported or exported (raw round wood; 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 Assessment and Time-Series Consistency

The uncertainty analysis of the CO_2 emissions/removals from the Sector 4 'LULUCF' (by source and sink categories) is described in detail in the sub-chapters 6.2-6.8 of the NIR, as well as in the Annex 5-3.4. Combined uncertainties as a percentage of net sectoral emissions / removals were estimated at circa ±40.42 per cent. The uncertainties introduced in trend in sectoral emissions / removals were estimated at circa ±28.77 per cent. 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 categories were filled in for each category under the Sector 4 'LULUCF', following a Tier 1 approach. The AD and methods used for estimating CO_2 emissions/removals under the Sector 4 'LULUCF' were documented and archived both in hard copies and electronically. In order to identify the data entry, as well as GHG emissions/removals estimation related errors, AD and EFs verifications and quality control procedures were applied. Following the sustainable practices, GHG emissions/removals under the Sector 4 'LULUCF' were estimated based on AD and EFs from official sources of reference. Also, an important factor that positively influenced the quality of the GHG inventory was the elaboration of a Land Use and Land Use-Change Matrix for 1970-2016 time series.

6.1.6. Recalculations

Net GHG emissions/removals under the Sector 4 'LULUCF' were recalculated due to use of updated AD and country specific EFs for most of category sources. The details and arguments regarding the need for recalculations are presented in the respective sub-chapters (6.2-6.8) of the current NIR.

Thus, comparison to the results included into the NC4 of the RM under the UNFCCC (2018), the performed recalculation resulted in a significant decrease of net CO_2 removals between 1990 and 2015, varying from a minimum of 56.2 per cent in 2004 up to a maximum of 83.0 per cent in 2014 (Table 6-5). The results of recalculations performed at the category level are presented in sub-chapters 6.2-6.8 of the NIR.

Table 6-5: Recalculated CO_2 Emissions/Removals within the Sector 4 'LULUCF' included into the NC4 of the Republic of Moldova under the UNFCCC (2018), kt CO_2 equivalent

	1990	1991	1992	1993	1994	1995	1996	1997	1998
NC4	-5 819.6508	-7 577.3481	-7 051.4260	-7 136.6461	-6 345.5445	-6 482.0548	-6 226.2331	-6 088.6293	-6 141.3696
BUR2	-1 527.5846	-2 589.8802	-1 971.5330	-2 001.0251	-1 900.9711	-1 868.9465	-2 283.1395	-1 873.4640	-1 890.6774
Difference, %	-73.8	-65.8	-72.0	-72.0	-70.0	-71.2	-63.3	-69.2	-69.2
	1999	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**
NC4	-6 112.0606	-6 057.0210	-5 792.8332	-4 866.9638	-4 927.3318	-3 884.6483	-4 764.3654	-5 035.4959	-5 024.2053
BUR2	-1 597.3208	-1 880.6877	-1 516.1797	-1 603.2957	-1 533.2054	-1 702.3382	-1 410.9177	-1 530.7620	-1 727.1614
Difference, %	-73.9	-69.0	-73.8	-67.1	-68.9	-56.2	-70.4	-69.6	-65.6
	2008	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**
NC4	-4 487.5510	-3 852.1313	-3 230.1116	-2 644.0178	-2 945.1468	-2 547.0470	-2 661.0447	-2 845.3994	
BUR2	-1 420.4825	-1 033.2027	-961.9499	-908.0226	-939.5632	-802.7329	-453.6371	-902.1771	-920.0136
Difference, %	-68.3	-73.2	-70.2	-65.7	-68.1	-68.5	-83.0	-68.3	

Abbreviations: NC4 – Fourth National Communication; BUR2 – Second Biennial Update Report.

6.1.7. Assessment of Completeness

The current inventory covers CO_2 emissions/removals from 13 source and sink categories under the Sector 4 'LULUCF' (Table 6-6).

Table 6-6: Assessment of Completeness under the Sector 4 'LULUCF' in the RM

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 agricultural residues burning on field (CH_4; N_2O) were estimated under the 4A2 „Land Converted to Forest Land" and 4B1 „Cropland Remaining Cropland" categories, however these emissions being quite insignificant in the Republic of Moldova. 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".

In the context of information presented in Table 6-6, there are also defined the ways to represent land use within the cadaster evidence system in the estimation process of sectoral emissions reduction. Data on land areas and use categories are provided by land cadastral reports issued by the Agency of Land Relations and Cadaster (ALRC), subsequently approved by Government decisions. Additionally, information on forest land is available at "Moldsilva" Agency, the institution responsible to present sectoral statistical reports to the National Bureau of Statistics.

The time series begin with 1970 and include about 25 national categories of aggregate use within 11 major categories which are highlighted in Table 6-7, including correspondence with IPCC categories. According to the table, there were considered national circumstances, including the national statistical system and land cadastral records in force, regarding the land use categories applied in the Republic of Moldova, as well as their correspondence with the 2006 IPCC Guidelines categories.

Table 6-7: Correspondence of Land Categories in the National Classification and in the 2006 IPCC Guidelines

IPCC Categories	National classification according to land cadaster (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

Current inventory covers the entire area of the country (3,384.63 thousand ha). Data in Table 6-8 confirms that the inventory includes all the land within 1990-2015 periods.

Table 6-8: Land Area Included in the National Inventory System According to the 2006 IPCC Guidelines Use Categories

IPCC Categories	Area, thousand ha						
	1990	1995	2000	2005	2010	2015	2016
I. Forest Land (4A), total	**371.40**	**369.80**	**372.30**	**392.82**	**411.07**	**414.10**	**413.62**
1.1. Forests	368.57	369.24	371.95	388.45	410.63	413.48	412.03
1.2. Afforested land (conversions)	2.83	0.56	0.35	4.38	0.44	0.62	1.58
II. Cropland (4B), total	**2258.40**	**2241.80**	**2212.50**	**2198.52**	**2197.76**	**2203.59**	**2206.53**
2.1. Forest vegetation	47.00	55.20	50.50	50.47	52.03	51.15	51.65
2.2. Vineyards	218.80	195.90	162.20	157.34	149.58	136.17	135.29
2.3. Orchards	251.80	216.70	172.70	141.68	149.21	152.73	153.54
2.4. Cropland	1740.80	1774.00	1827.10	1849.03	1846.95	1863.53	1866.05
III. Grassland (4C), total	**390.70**	**400.60**	**412.80**	**399.14**	**380.92**	**373.87**	**371.51**
IV. Wetlands (4D), total	89.40	92.40	96.60	96.08	99.64	96.66	96.14
V. Settlements (4E), total	**218.43**	**234.10**	**236.10**	**235.78**	**233.64**	**236.48**	**236.76**
VI. Other land (4F), total	56.30	45.93	54.33	62.28	61.60	59.93	60.08
4. LULUCF Sector, total	**3384.63**	**3384.63**	**3384.63**	**3384.63**	**3384.63**	**3384.63**	**3384.63**

Source: Land Cadasters of the Republic of Moldova within 1990-2017 periods. Land Use and Land Use-Change Matrix for 1970-2016.

6.1.8. Planned Improvements

Planned improvements at the source and sink category level within the Sector 4 'LULUCF' are described in detail in sub-chapters 6.2-6.8 of the NIR.

6.2. Forest Land (Category 4A)

6.2.1. Source Category Description

The 4A "Forest Land" category covers estimation 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.), carbon losses (carbon losses / gains due to conversion). The respective estimations were made separately for two categories: 4A1 "Forest Lands Remaining Forest Lands" 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 per cent. The consistency requirement should apply only to trees and shrubbery with a natural potential to reach a minimum height of 5 meters at maturity.

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[92], recovering to 386.5 thousand ha in 2016 or circa 11.8 per cent of the country's territory (Figure 6-3). This indicator is well below the European average (around 30 per cent). According to the scientific research studies, the current areas covered with forests are obviously insufficient to meet the ecological and social-economic needs of the Republic

[92] Gh. Vdovâi, D. Galupa et al. (1997), National Report on the Conditions of the Forest Resources of Republic of Moldova; Galupa D., Talmaci I., Spitoc L. (2006), Forest Land Sector in the Republic of Moldova – issues, accomplishments, perspectives; Galupa Dumitru, Platon Ion et al. (2011), Report on the Conditions of the Forest Resources of Republic of Moldova: 2006-2010. 'Moldsilva' Agency; Ch., 48 p.; Official Monitor No. 265-276 dated 19.08.2016, Art. No. 1054: Government Decision No. 971 dated 12.08.2016 on Land Cadasters approval in the RM as from January 1 2016.

of Moldova. In order to ensure a constant ecological equilibrium and a stronger effect on the climate and hydrological conditions, enhance productivity of agricultural lands, forest lands should occupy at least 15 percent of the country's territory. The dispersion and fragmentation of forest resources, their uneven distribution across the country represent negative aspects for exercising beneficial eco-protective influences on the environment, creating comfortable living conditions for the population and providing wood and non-wood products.

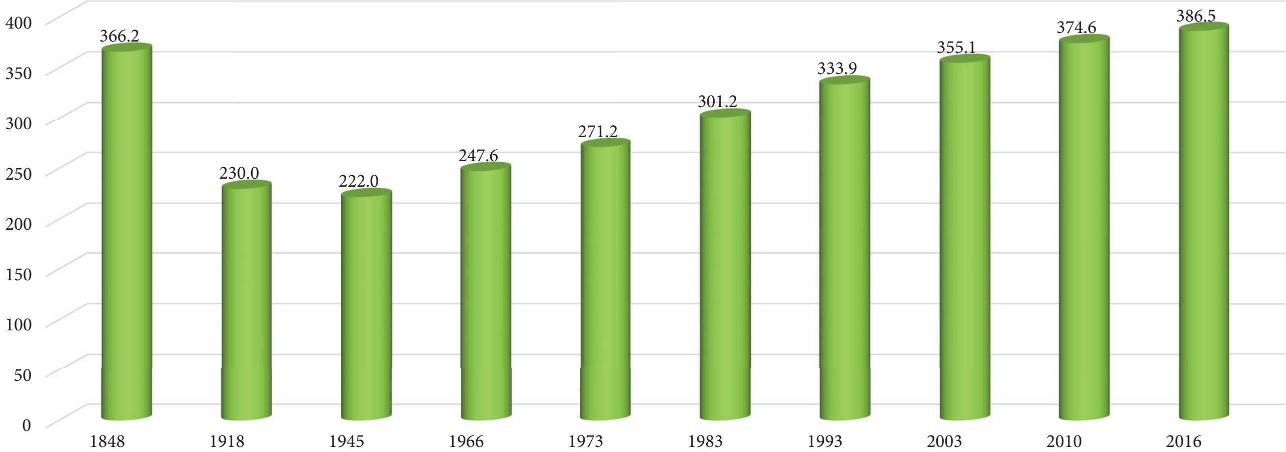


Figure 6-3: Evolution of Areas Covered with Forests in the RM, 1848-2016, kha.

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 1,468.7 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, in particular in those of low productivity.

6.2.2. Methodological Issues, Emission Factors and Data Sources

To estimate CO_2 emissions/removals from the sink category 4A1 "Forest Land Remaining Forest Land", current biomass increments in forests values were used (in conformity with production tables and forest planning materials on annual growth of species from the forests of the Republic of Moldova) as well as from losses from authorized and illegal harvesting of wood. The estimation process followed two steps:

1. Annual changes in carbon stocks due to biomass increment 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 changes in carbon stocks due to biomass increment in forest land remaining forest land, t C/yr;

A – area of forest land remaining forest land, ha;

CF – carbon fraction of dry matter;

G_{total} – annual biomass increment above and below-ground (t d.m.[93]/yr/ha), calculated using the following equation:

$$G_{total} = \Sigma\ \{Iv \bullet BCEF_I \bullet (1 + R)\}$$

Where:

Iv – net annual increment of growing stock, m^3/yr/ha;

R – below-ground biomass to above-ground biomass ratios;

$BCEF_I$ – biomass conversion and expansion factors.

In order to convert the total current increments (including tree bark) in above-ground biomass increment for the appropriate group of species/vegetation (t of above-ground biomass increment/m^3 total current increments), estimated by the following formula:

[93] Dry Matter.

$$BCEF_I = BEF_I \bullet D$$

Where:

BEF_I – biomass expansion factors for conversion of annual net increment to above-ground tree biomass increment;

D – basic wood density, t MC/m^3 volume for standing wood.

2. Annual decrease in carbon mass through biomass removals (from authorized felling and illegal logging, and disturbances (diseases and pests, natural calamities, mass droughts), estimated by the following formula:

$$\Delta C_L = L_{felling} + L_{fuelwood} + L_{perturbations}$$

Where:

ΔC_L – annual decrease in carbon stocks due to biomass loss (felling and other losses), t C/yr;

$L_{felling}$ – annual carbon loss due to commercial felling, t C/yr;

$L_{fuelwood}$ – annual carbon loss due to fuel wood gathering, 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:

$$L_{felling} = \{H \bullet BCEF_R \bullet (1+R)\} \bullet CF$$

Where:

H – annual wood removals, m^3;

$BCEF_R$ – biomass conversion and expansion factors for extracted round wood 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 MC/m^3 volume for standing wood);

BEF_R – biomass expansion factor for extracted round wood;

$$L_{fuelwood} = [\{FG_{trees} \bullet BCEF_R \bullet (1+R)\} + FG_{parts\ of\ trees} \bullet D] \bullet CF$$

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;

$BCEF_R$ – 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 d.m/m^3 volume for standing wood);

BEF_R – biomass expansion factor for fuel wood removals;

$$L_{perturbations} = \{A_{perturbations} \bullet BW \bullet (1 + R) \bullet CF \bullet fd\}$$

Where:

$A_{perturbations}$ – areas affected by disturbances (diseases and pests, natural calamities, mass droughts etc.), ha/yr;

BW – average of above-ground biomass of forest areas affected by disturbances, t d.m/ha;

R – below-ground biomass to above-ground biomass ratios;

CF – carbon fraction of dry matter;

fd – fraction of above-ground biomass lost in disturbance, t d.m/ha;

The volumes from $L_{perturbations}$ were included in $L_{felling}$ and $L_{fuelwood}$, as the forests in the Republic of Moldova are intensively managed, being regularly draw in cleaning cuttings (including selective sanitation treatments), final harvesting (including clean sanitation cuttings) and various cuttings (including cleaning from fallen trees etc.).

In principle, for both stages, the methodologies described in the 2006 IPCC Guidelines are applicable under the conditions of the RM. At the same time, country specific emission/removals factors were used, regarding annual biomass increment, the share of carbon in biomass etc., as well as sectoral activity data (forest land areas by species/categories of species, afforestation, wood mass harvesting etc.). In order to simplify the inventory development process, eleven groups of species were formed, to include 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 Republic of Moldova

No.	Groups of species by name		Species included in categories	Abbreviations
	Scientific	Common		
	Quercus spp.	Oak tree	Ilex, durmast, oak, red oak	QU
	Carpinus ssp.	Hornbeam	Hornbeam (*Carpinus betulus*)	CA
	Fraxinus spp.	Ash tree	Ash tree	FR
	Acer spp.	Sycamore maple	Field maple, Common maple, Mountain 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	TI
	Salix spp.	Willow	Willow, Osier, etc.	SA
	Pinus spp.	Pine	Pine silvestre, Black pine, Spruce fir, Fir tree	PI
	Populus spp.	Poplar	Trembling poplar, Black poplar, Aspen tree	PO
	Robinia spp.	Acacia	Acacia, Honey locust, Sofora	RB
	Other species	Other species	Apple tree, Peer, Sweet cherry tree, Mahaleb cherry tree, Apricot tree, Tatar maple, Weeping willow, Ash-leaved maple, etc.	OS

In order to estimate biomass increments in forests and implicitly, resulting in CO_2 removals, there were used data on the areas of forest land in the Republic of Moldova, in the time series from 1990 through 2016, available into a series of national/sectoral reports on forestry resources (Table 6-10). At the same time, beginning with 2013, information on the distribution of predominant forest species were taken from Forestry Research and Management Institute (ICAS) database.

Table 6-10: Forest Land Areas in the Republic of Moldova within 1990-2016 periods, 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

Source: National Report on Forestry Resources of the Republic of Moldova (2011), General Land Cadasters for 1990-2017 periods; OSC Report on updating basic indicators for forest and other types of forest vegetation in the Republic of Moldova (2016).

Final data on species distribution over the period of time under review was obtained by modelling using the primary data set obtained from the Statistical Records and Reports of Agency "Moldsilva", which featured the following distribution of forest species planted over the reference period: *Robinia species* – accounted for circa 80 per cent, *Juglans spp.* (*Regia and Nigra*) – for 8 per cent, *Quercus species* – for 3 per cent, *Populus* and *Salix species* – for 3 per cent, *other species* – for 6 per cent.

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 between 1970 and 2016. As a result, relevant data were gathered for the GHG inventory in 4A1 "Forest land remaining forest land" category (Table 6-11).

Table 6-11: Forest land areas remaining forest land in the RM within 1990-2016 periods, kha

Species	1990	1991	1992	1993	1994	1995	1996	1997	1998
Quercus spp.	97.76	99.33	103.72	107.53	110.63	113.35	116.52	118.55	120.54
Carpinus spp.	6.54	6.61	6.87	7.16	7.63	8.08	8.59	9.01	9.45
Fraxinus spp.	11.54	11.74	12.27	12.74	13.33	13.88	14.50	14.99	15.48
Acer spp.	2.02	2.04	2.19	2.26	2.32	2.37	2.43	2.47	2.50
Ulmus spp.	2.16	2.20	2.26	2.34	2.40	2.45	2.51	2.55	2.58
Tilia spp.	2.02	2.04	2.12	2.19	2.24	2.29	2.35	2.38	2.42
Salix spp.	1.32	1.41	1.53	1.66	1.74	1.81	1.89	1.96	2.02
Pinus spp.	4.80	4.85	5.04	5.20	5.34	5.45	5.59	5.67	5.75
Populus spp.	3.96	4.15	4.38	4.60	4.76	4.91	5.09	5.21	5.34
Robinia spp.	86.22	88.37	93.06	97.28	100.51	103.40	106.73	109.03	111.31
Other Species	7.93	8.01	8.33	8.67	8.43	8.22	7.94	7.65	7.25
Grooves	31.99	32.11	30.53	29.99	27.64	25.98	25.54	25.87	26.77
Total	**258.25**	**262.85**	**272.30**	**281.60**	**286.95**	**292.20**	**299.67**	**305.34**	**311.41**
Species	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**
Quercus spp.	123.36	126.75	128.28	128.06	128.32	130.51	131.76	130.54	131.44
Carpinus spp.	9.95	10.52	10.94	11.23	10.90	10.67	10.38	10.26	10.06
Fraxinus spp.	16.08	16.77	17.23	17.45	17.38	17.38	17.41	17.39	17.64
Acer spp.	2.55	2.62	2.64	2.63	2.77	2.93	3.17	3.39	3.49
Ulmus spp.	2.64	2.70	2.73	2.72	2.77	2.93	3.26	3.22	3.32
Tilia spp.	2.47	2.53	2.55	2.54	2.68	2.75	2.92	2.88	2.98
Salix spp.	2.10	2.19	2.25	2.28	2.16	2.06	2.06	2.04	2.05
Pinus spp.	5.87	6.02	6.08	6.05	5.97	5.94	6.00	5.94	5.97
Populus spp.	5.50	5.69	5.79	5.82	5.79	5.85	5.92	5.94	5.97
Robinia spp.	114.36	117.97	119.87	120.18	119.24	119.39	119.81	120.37	123.09
Other Species	6.89	6.63	6.16	5.61	6.74	7.23	8.41	8.48	8.52
Grooves	24.63	24.32	24.48	24.97	27.76	27.79	25.84	28.69	30.43
Total	**316.42**	**324.71**	**329.01**	**329.57**	**332.48**	**335.43**	**336.94**	**339.15**	**344.96**
Species	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**
Quercus spp.	131.78	131.96	132.60	131.93	127.64	122.80	129.17	128.69	125.80
Carpinus spp.	10.14	10.29	10.32	10.27	9.93	9.55	12.64	12.59	12.31
Fraxinus spp.	17.72	17.78	17.92	17.82	17.24	16.59	16.81	16.75	16.37
Acer spp.	3.49	3.49	3.50	3.48	3.37	3.24	4.42	4.41	4.31
Ulmus spp.	3.32	3.32	3.33	3.31	3.20	3.09	3.20	3.19	3.12
Tilia spp.	2.98	2.98	2.99	2.97	2.88	2.76	4.41	4.39	4.29
Salix spp.	2.04	2.04	2.05	2.04	1.97	1.90	3.02	3.01	2.94
Pinus spp.	5.88	5.87	5.89	5.85	5.66	5.40	4.88	4.86	4.75
Populus spp.	6.05	6.04	6.06	6.02	5.83	5.64	5.81	5.79	5.66
Robinia spp.	124.96	124.98	126.29	125.60	121.51	116.89	97.10	96.73	94.65
Other Species	8.52	8.51	8.62	8.57	8.29	7.98	11.82	11.65	11.39
Grooves	30.42	34.73	33.39	30.49	30.27	33.54	26.26	20.94	20.03
Total	**347.30**	**352.00**	**352.95**	**348.34**	**337.79**	**329.39**	**319.53**	**312.99**	**305.62**

Source: General Land Cadasters for 1990-2017 periods; Land Use and Land Use-Change Matrix for 1970-2016 periods.

The volume of commercial timber, as well as the quantity of fuel wood gathered in the RM, were identified based on statistical data and reports on commercial felling in managed forest land (by species and sort categories, etc.), revealed illegal logging (on other owners lands, inclusively), data being provided by the "Moldsilva" Agency, and the Inspectorate for Environmental Protection, on authorized felling and illegal logging in forests and other woody vegetation areas managed by local public authorities, as well as data available in the Statistical Yearbooks of the ATULBD on fuel wood harvests in forests on the left bank of Dniester river (Table 6-12).

Table 6-12: Trends in Wood Harvests in the RM within 1990-2016 periods, thousand m³

Sort categories	1990	1991	1992	1993	1994	1995	1996	1997	1998
Commercial timber	39.42	27.00	27.39	31.50	39.80	68.49	51.69	52.70	38.00
Fuel wood	184.80	376.50	490.29	489.18	538.70	531.42	450.43	423.85	398.55
Total	**224.22**	**403.50**	**517.68**	**520.68**	**578.50**	**599.91**	**502.12**	**476.55**	**436.55**
Sort categories	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**
Commercial timber	38.79	39.68	37.28	50.41	46.99	43.47	39.01	46.51	44.44
Fuel wood	368.62	393.34	432.47	381.98	420.20	415.37	394.79	430.10	390.92
Total	**407.41**	**433.02**	**469.75**	**432.39**	**467.19**	**458.84**	**433.80**	**476.61**	**435.36**
Sort categories	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**
Commercial timber	42.79	37.34	40.63	33.91	31.69	29.92	25.60	28.00	50.16
Fuel wood	401.84	396.82	429.89	485.45	541.47	587.20	624.33	607.32	567.42
Total	**444.63**	**434.16**	**470.52**	**519.36**	**573.16**	**617.12**	**649.93**	**635.32**	**617.57**

Source: Statistical Records/Reports of "Moldsilva" Agency and of the State Ecological Inspectorate for the 1990-2016 time series; D. Galupa, I. Talmaci, L. Spitoc, Study for the Republic of Moldova "Ensuring sustainability of forests and livelihoods through improving governance and control of illegal logging". Chisinau, Editorial Center of UASM, 2005, 116 pages; Statistical Yearbooks of the ATULBD (2000-2017); Galupa Dumitru, Ciobanu Anatol, Scobioala Marian et al. (2011), Illegal logging of forest vegetation in the Republic of Moldova. Analytical study, Chisinau, "Moldsilva" Agency, 38 pages.

The "Moldsilva" Agency keeps records of harvested wood by species (except for some species suitable for industrial processing, ex.: (1) hardwood - oak, durmast, hornbeam, ash tree, sycamore maple tree, 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 provided data of acceptable quality (the difference between the estimated volume and harvested volume is on average 5-10 per cent). Distribution by species of wood suitable for industrial processing and fuel wood is presented in Tables 6-13 and 6-14 and refers to the 1990-2016 time series.

Table 6-13: Trends in Commercial Timber Harvest in the RM within 1990-2016, thousand m³

Species	1990	1991	1992	1993	1994	1995	1996	1997	1998
Quercus spp.	7.16	4.32	4.09	4.41	6.88	9.59	10.05	10.26	7.40
Carpinus spp.	1.05	0.71	0.72	0.83	1.04	1.79	1.35	1.39	1.00
Fraxinus spp.	3.65	2.99	3.24	3.94	4.03	8.56	4.47	4.47	3.23
Acer spp.	0.31	0.23	0.23	0.27	0.34	0.58	0.45	0.44	0.32
Ulmus spp.	0.17	0.1	0.1	0.12	0.15	0.26	0.19	0.21	0.15
Tilia spp.	3.78	2.48	2.52	2.9	3.66	6.31	4.70	4.91	3.54
Salix spp.	0.26	0.19	0.19	0.22	0.28	0.48	0.37	0.36	0.26
Pinus spp.	0.28	0.17	0.18	0.2	0.26	0.44	0.32	0.35	0.25
Populus spp.	4.87	3.2	3.26	3.74	4.73	8.14	6.07	6.33	4.56
Robinia spp.	16.74	12.02	12.26	14.18	17.54	30.83	22.66	22.70	16.37
Other species	1.15	0.59	0.6	0.69	0.89	1.51	1.06	1.28	0.92
Total	**39.42**	**27.00**	**27.39**	**31.50**	**39.80**	**68.49**	**51.69**	**52.70**	**38.00**
Species	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**
Quercus spp.	7.51	7.77	5.18	10.12	10.31	9.34	7.63	9.26	7.49
Carpinus spp.	0.99	1.07	1.09	1.85	1.00	0.92	1.05	1.28	0.92
Fraxinus spp.	3.49	3.17	2.96	4.45	3.41	3.03	3.12	5.57	5.94
Acer spp.	0.37	0.28	0.30	0.42	0.26	0.19	0.28	0.28	0.28
Ulmus spp.	0.13	0.18	0.19	0.24	0.22	0.22	0.18	0.27	0.31
Tilia spp.	3.34	3.97	4.86	4.82	4.22	4.47	3.90	4.06	3.45
Salix spp.	0.30	0.24	0.32	0.29	0.20	0.21	0.24	0.31	0.42
Pinus spp.	0.22	0.30	0.33	0.00	0.00	1.10	0.30	0.79	1.60
Populus spp.	4.32	5.11	2.89	5.82	8.28	6.62	5.02	7.81	6.44
Robinia spp.	17.67	16.13	18.19	19.94	16.43	15.93	15.85	15.68	16.58
Other species	0.45	1.46	0.97	2.46	2.66	1.44	1.44	1.22	1.01
Total	**38.79**	**39.68**	**37.28**	**50.41**	**46.99**	**43.47**	**39.01**	**46.51**	**44.44**
Species	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**
Quercus spp.	7.17	5.84	7.16	5.68	4.77	6.28	6.05	6.62	12.15
Carpinus spp.	1.13	0.77	0.87	0.74	0.49	0.52	0.33	0.36	0.40
Fraxinus spp.	6.02	5.70	5.83	4.03	4.52	4.76	4.26	4.66	7.49
Acer spp.	0.25	0.15	0.20	0.14	0.11	0.15	0.06	0.06	0.14
Ulmus spp.	0.20	0.17	0.19	0.24	0.12	0.17	0.06	0.06	0.07
Tilia spp.	3.84	3.24	3.42	3.17	2.67	2.21	2.00	2.19	5.46
Salix spp.	0.38	0.38	0.14	0.19	0.24	0.25	0.07	0.08	0.37
Pinus spp.	0.60	0.89	1.19	1.95	1.35	0.73	0.62	0.68	0.49
Populus spp.	6.09	4.87	6.32	5.61	5.26	5.06	4.69	5.13	9.52
Robinia spp.	16.01	14.34	14.41	11.47	11.69	9.43	7.09	7.76	13.50
Other species	1.10	0.98	0.89	0.69	0.47	0.36	0.37	0.40	0.56
Total	**42.79**	**37.34**	**40.63**	**33.91**	**31.69**	**29.92**	**25.60**	**28.00**	**50.16**

Source: Statistical Records/Reports of "Moldsilva" Agency and of the State Ecological Inspectorate for the 1990-2016 time series.

Data on the volume of fuel wood gathered also include the volume of twigs, boughs, branches, etc., which are used as fuel as well. 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 *Robinia* group of species.

Table 6-14: Trends in Fuel Wood Harvest in the RM within 1990-2016 periods, thousand m^3

Species	1990	1991	1992	1993	1994	1995	1996	1997	1998
Quercus spp.	30.10	50.35	49.29	51.15	39.07	63.60	58.99	49.12	64.60
Carpinus spp.	12.50	17.96	13.24	13.15	10.05	11.30	15.45	20.41	26.84
Fraxinus spp.	15.80	38.99	56.52	73.07	55.81	71.97	73.74	25.80	33.93
Acer spp.	8.70	11.39	6.65	6.19	4.73	5.30	5.00	14.12	18.57
Ulmus spp.	3.50	6.19	6.54	10.23	7.81	8.76	2.26	5.72	7.52
Tilia spp.	10.60	18.97	20.40	29.23	22.32	20.10	19.50	17.29	22.73
Salix spp.	3.40	6.68	7.95	12.42	9.49	10.64	4.14	5.57	7.33
Pinus spp.	0.40	2.10	4.09	6.58	5.02	5.63	3.80	0.70	0.92
Populus spp.	11.80	34.34	55.04	73.07	55.81	74.35	70.09	19.21	25.26
Robinia spp.	76.80	172.62	256.75	198.01	316.31	246.00	184.48	247.59	166.76
Other species	11.20	16.91	13.82	16.08	12.28	13.77	12.98	18.32	24.09
Total	**184.80**	**376.50**	**490.29**	**489.18**	**538.70**	**531.42**	**450.43**	**423.85**	**398.55**
Species	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**
Quercus spp.	55.32	53.71	48.34	56.93	65.45	64.16	56.64	71.56	57.00
Carpinus spp.	24.10	23.40	22.46	23.41	23.07	25.30	24.68	27.49	23.70
Fraxinus spp.	30.09	29.22	28.35	28.91	32.38	30.63	30.81	48.42	47.74
Acer spp.	16.64	16.16	14.17	17.49	16.50	17.13	17.04	23.05	21.44
Ulmus spp.	6.38	6.19	5.78	6.36	8.32	7.07	6.53	10.45	10.47
Tilia spp.	19.59	19.02	18.93	18.35	21.63	23.40	20.06	27.66	24.71
Salix spp.	6.32	6.13	5.48	6.55	6.28	8.22	6.47	9.95	8.43
Pinus spp.	0.74	0.72	1.41	0.00	0.00	2.09	0.76	3.06	2.80
Populus spp.	20.32	19.73	17.37	21.29	28.96	28.19	20.80	27.11	23.26
Robinia spp.	168.74	199.28	252.20	181.90	190.09	187.09	190.14	164.27	155.19
Other species	20.38	19.78	17.98	20.79	27.52	22.09	20.86	17.08	16.17
Total	**368.62**	**393.34**	**432.47**	**381.98**	**420.20**	**415.37**	**394.79**	**430.10**	**390.92**
Species	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**
Quercus spp.	59.84	59.35	65.69	79.64	83.02	98.39	106.84	100.82	103.58
Carpinus spp.	27.73	26.27	30.17	34.86	40.26	43.26	45.93	44.15	44.61
Fraxinus spp.	49.05	52.75	62.33	51.55	63.35	71.66	76.71	74.44	73.67
Acer spp.	23.48	23.33	23.79	22.06	12.98	21.90	17.27	31.63	30.81
Ulmus spp.	8.55	9.90	12.74	20.56	21.48	20.25	19.15	15.12	17.29
Tilia spp.	25.19	22.43	22.98	22.18	28.72	29.86	30.30	31.28	38.27
Salix spp.	7.85	4.75	5.42	7.79	9.24	10.71	10.90	12.82	11.92
Pinus spp.	2.74	3.91	4.78	10.27	8.92	10.87	17.02	5.59	4.91
Populus spp.	25.04	23.82	26.00	30.91	33.72	39.37	42.69	40.88	41.78
Robinia spp.	153.64	148.00	156.80	182.12	200.93	208.77	208.91	222.77	164.35
Other species	18.74	22.32	19.20	23.51	38.85	32.16	48.61	27.82	36.23
Total	**401.84**	**396.83**	**429.89**	**485.45**	**541.47**	**587.20**	**624.33**	**607.32**	**567.42**

Source: Statistical Records/Reports of "Moldsilva" Agency and of the State Ecological Inspectorate for the 1990-2016 time series; Arcadie Capcelea, Aurel Lozan, Ion Lupu et al. (2011), Analytical study on wood mass consumption in the RM. "Moldsilva" Agency, Chisinau, 48 pages; Statistical Yearbooks of the ATULBD for 2000-2017.

In order to estimate annual biomass increments and losses, country specific emission factors were calculated/developed (Tables 6-15 and 6-16). For estimating/developing these, production tables were used, as well as data on actual productivity of stands, according to the forest planning records.

Table 6-15: Coefficients Used to Estimate CO_2 Emissions/Removals from the 4A1 "Forest Land Remaining Forest Land" Sink Category

Species	Average annual net increments, m^3/ha	Basic wood density, t.d.m./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); National Report on Forestry Resources of the Republic of Moldova, 1997; Osadcev V.G., Ivankov P.T., Sergovskii P.S. et al. (1955), 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); 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; 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 the 4A1 "Forest Land Remaining Forest Land" Sink Category

Species	Root-shoot ratio appropriate to increments	Carbon fraction of dry matter	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. (1955), Guidebook on Woodworking (for Forest Farms Consumer Goods Manufacturing Workshops). Moscow, 1955 (in Russian); Giurgiu V., Decei I., Armasescu S. Biometriy 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. (1949), Wood Science, Moscow (in Russian).

In order to estimate CO_2 removals from 4A2 "Land Converted to Forest Land" the same principles were applied as for 4A1 "Forest Land Remaining Forest Land" – establishing current biomass increments (according to the results from the international monitoring and certification of MSCP and MCFDP). For estimations it was used Equation 2.15 from 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, fuel wood gathering and disturbances on land converted to forest land, disturbances t C/yr

Initial changes in carbon stocks in biomass on land converted to forest land ($\Delta C_{Conversion}$) 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, t d.m./ha;

B_{Before} – biomass stocks on land before the conversion, t d.m./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 wood (litter) and in organic soil carbon since afforestation is primarily done on degraded land with a low fertility, with forest vegetation contributing substantially to carbon gain.

AD in 4A2 "Land Converted to Forest Land" were taken from the Land Use and Land-Use Change Matrix for the 1970-2016 periods (Table 6-17).

Table 6-17: Annual Successful Afforestation Included in Forest Land in Cadastral Records within 1970-2016 periods, ha

Land Categories	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981
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
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
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
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
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**

Land Categories	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993
Arable lands	227.2	222.4	225.4	227.7	168.4	197.7	298.9	280.0	216.1	80.8	87.5	43.0
Orchards, Vineyards	119.1	116.5	118.1	119.3	88.3	103.6	156.6	146.7	113.2	42.4	45.9	22.5
Grassland	2625.1	2569.7	2604.7	2630.3	1945.8	2284.1	3453.4	3234.8	2496.4	933.9	1011.3	496.3
Other land	0.0	0.0	0.0	0.0	0.0	3229.6	291.0	1038.5	1174.0	1443.0	0.0	338.5
Total	**2971.3**	**2909.0**	**2948.0**	**2977.0**	**2202.0**	**5815.0**	**4199.9**	**4700.0**	**3999.7**	**2500.1**	**1145.0**	**900.3**
Land Categories	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**
Arable lands	49.5	42.5	24.9	29.6	33.1	30.3	27.1	23.5	344.3	347.4	336.8	334.7
Orchards, Vineyards	25.9	22.3	13.0	15.5	17.3	15.9	14.2	12.3	180.4	182.0	176.5	175.4
Grassland	572.1	491.0	287.6	341.5	382.3	349.8	312.7	271.9	3978.5	4013.9	3891.4	3866.6
Other land	0.0	0.0	1.2	1113.0	1667.9	0.0	146.0	1067.2	0.0	4193.4	996.0	0.8
Total	**647.5**	**555.8**	**326.7**	**1499.5**	**2100.6**	**396.0**	**500.0**	**1375.0**	**4503.3**	**8736.7**	**5400.6**	**4377.4**
Land Categories	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**
Arable lands	352.4	355.7	372.3	221.7	33.3	23.4	19.4	19.6	22.0	47.2	121.0	NA
Orchards, Vineyards	184.7	186.4	195.1	116.2	17.5	12.3	10.1	10.3	11.5	24.7	63.4	NA
Grassland	4071.4	4110.1	4302.0	2561.9	384.8	270.3	223.7	226.3	253.7	544.9	1397.5	NA
Other land	2383.6	223.0	0.0	3076.3	0.0	1886.4	8916.1	2573.0	4833.0	1894.1	176.4	NA
Total	**6992.1**	**4875.2**	**4869.0**	**5976.1**	**436.0**	**2191.4**	**9169.3**	**2829.2**	**5120.2**	**2510.9**	**1758.3**	**NA**

Source: General Land Cadasters for 1970-2017 periods; Land Use and Land Use-Change Matrix for 1970-2016 periods.

The conversion to forest land during the reference period included afforestation under the Moldova Soil Conservation Project (MSCP) and Moldova Community Forestry Development Project (MCFDP). Both projects are implemented under the Clean Development Mechanism (CDM) of the Kyoto Protocol, and have completed all national and international validation and registration procedures. Several goals are achieved within the respective projects: restoration of degraded land, improvement of local population supply with forest products and GHG absorption gain. The total area planted within these projects represent circa 28.8 thousand ha (Table 6-18).

Table 6-18: Annual Afforestation under the CDM Projects in the RM within 2002-2015 periods, ha

Afforestation 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 CDM Projects	**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: PDD for MSCP and MCFDP; Annual Reports from "Moldsilva" Agency to the World Bank for 2004-2015 time series; Monitoring Reports from "Moldsilva" Agency for MSCP and MCFDP (2012; 2013; 2017; 2018).

In addition to harvested forest products, the net CO_2 emissions reduction into the atmosphere will account for circa 4.8 million tons (MSCP – 3.6 million t; MCFDP – 1.2 million t). The main participants in the implementation process of these projects are "Moldsilva" Agency, the World Bank, the Forestry Research and Management Institute (FRMI), territorial forestry entities, public authorities that have allocated land for afforestation (over 500). In order to establish annual biomass gains/losses in forest land, national EFs were estimated/developed based on the respective projects outputs (MSCP and MCFDP) (Table 6-19).

Table 6-19: Indicators Used to Estimate CO_2 Emissions/Removals from 4A2 "Land Converted to Forest Land"

Indicators	Units	Value
Annual average carbon gains in biomass (trees and shrubs)	Mg C/ha/yr	1.74
Annual average carbon gains in dead wood (litter)	Mg C/ha/yr	0.41
Annual average organic carbon gains in soil	Mg C/ha/yr	0.32
Conversion period	years	20

The methodology used to estimate non-CO_2 emissions from 4A2 "Land Converted to Forest Land" is a Tier 1 method (2006 IPCC Guidelines), applying the following formula:

$$L_{fire} = A \bullet M_B \bullet C_f \bullet G_{ef} \bullet 10^{-3}$$

Where:

L_{fire} – amount of GHG emissions (including non-CO_2) from fires, t/yr;

A – area burnt, ha/yr;

M_B – mass of fuel available for combustion, t/ha;

Cf – 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 d.m./ha;

G_{ef} – emission factor, kg/t d.m. burnt.

Table 6-20: EFs for different forest types, kg GHG / t d.m

	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, in particular in the vicinity of croplands. Activity data on forest land affected by fires are available in 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 within1990-2016 periods, ha

	1990	1991	1992	1993	1994	1995	1996	1997	1998
Right bank of Dniester river	120.10	20.10	22.00	1.50	33.50	1.40	0.00	0.00	9.70
Left bank of Dniester river	IE	IE	IE	IE	IE	0.53	11.20	3.40	24.00
Total in the RM	**120.10**	**20.10**	**22.00**	**1.50**	**33.50**	**1.93**	**11.20**	**3.40**	**33.70**
	1999	2000	2001	2002	2003	2004	2005	2006	2007
Right bank of Dniester river	0.00	0.00	41.60	12.50	10.50	42.00	5.50	32.60	683.30
Left bank of Dniester river	25.20	0.90	15.40	18.10	23.00	46.00	2.90	58.20	108.00
Total in the RM	**25.20**	**0.90**	**57.00**	**30.60**	**33.50**	**88.00**	**8.40**	**90.80**	**791.30**
	2008	2009	2010	2011	2012	2013	2014	2015	2016
Right bank of Dniester river	31.00	126.00	20.00	25.90	636.60	460.00	9.50	338.20	119.00
Left bank of Dniester river	24.00	8.20	26.90	36.90	35.80	7.10	28.90	18.00	59.8
Total in the RM	**55.00**	**134.20**	**46.90**	**62.80**	**672.40**	**467.10**	**38.40**	**356.20**	**178.8**

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); NBS, Statistics for Geography and Environment (Forest Fires, as of November 1 (2010-2016); 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).

6.2.3. Uncertainties Assessment and Time-Series Consistency

4A1. "Forest Land Remaining Forest Land"

Uncertainties associated with the process of estimating the CO_2 removals from the 4A1 "Forest Land Remaining Forest Land" sink category at the beginning of the reference period (1990), were rather low, circa ±5 per cent. Since 1991, due to social-political developments, the level of uncertainties increased significantly. For 2016, the level of precision of activity data related to the production processes reached circa ±15 per cent. Uncertainties related to removal factors in both cases are of circa ±5 per cent. Combined uncertainties within source category 4A1 account for circa ±15.81 per cent.

General uncertainties on CO_2 removals from the 4A "Forest Land" sink category are affected by a number of factors. Thus, part of data needed to estimate GHG removals from forests in the Republic of Moldova need to be updated. The uncertainties by sections are also determined by the volumes of wood mass actually harvested by local public authorities and other forests owners. There is no accurate statistic on the volumes of wood mass harvested during forest clearings. Some consolidated information in this field is available to the Inspectorate for Environmental Protection only, as an institution that authorizes felling of any type of forest vegetation (based on Article 40 of the Law on Environment Protection, Article 22 of the Forest Code dealing with state control and state control data). According to some estimative studies, the annual volume of wood mass from unidentified sources represent circa 400-800 thousand m^3. The current system of monitoring and control of production processes in forestry sector is applied only in forests managed by the Agency "Moldsilva". The forest resources managed by local public authorities are practically beyond these activities. A considerable part 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 the 4A2 "Land Converted to Forest Land" category represent circa ±15 per cent, while uncertainties associated to removal/emission factors – circa ±5 per cent. Combined uncertainties for this source category reach to ±15.81 per cent.

Uncertainties related to estimation of non-CO_2 emissions from forest areas affected by fires result from uncertainties related to the mass of fuel available for combustion, as well as those related to emission factors.

Uncertainties related to annual activity data on forest areas affected by fires are considered relatively small, up to ±10 per cent. Uncertainties related to default emission factors for different types of burnings (dry matter burnt), are moderate for CH_4 (±30 per cent) and medium for N_2O (±50 per cent).

Combined uncertainties related to non-CO_2 emissions (CH_4 and N_2O) from 4A2 "Land Converted to Forest Land" sink category are considered relatively high (±31.62 per cent for both CH_4 as well as 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 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 Cadaster by years, annual forest lands balance drafted annually by the state forest authorities, periodical records (once in 5 years) of forests, forest planning materials, etc. At the same time, data quality was assured through the creation, for the entire Sector 4 'LULUCF', of a Land Use and Land Use-Change Matrix for 1970-2016 periods.

Annual biomass increments were taken from production tables, periodical state records (once in 5 years) of forests, forest planning materials, by-laws and technical regulations in forestry, as well as 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 statistical reports by branches: Statistical Report 3 g.s. "Statistic Report on volumes of standing wood withdrawn from forest"; Statistical Report 5 g.s. "Statistic Report on volumes of illegal logging" and Statistical Report 2 g.s. "Statistical Report on attaining production indicators in forestry" (Section "Wood mass movement"). At the same time data on illicit logging were provided by the study "*Illegal logging of forest vegetation in the Republic of Moldova*"[94], and were revealed by the Inspectorate for Environment Protection and "Moldsilva" Agency annual reports.

Standard verification and quality control forms and checklists were filled in for 4A "Forest Land" category, 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

For 1990-2015 time series, recalculations were performed for CO_2 removals within both 4A1 "Forest Land Remaining Forest Land" and 4A2 "Land Converted to Forest Land" categories, as well as for non-CO_2 emissions from 4A2 "Land Converted to Forest Land". Recalculations performed for both 4A1 and 4A2 are due to updating and refined activity data for the respective categories within the Land Use and Land Use-Change Matrix for 1970-2016 periods.

The comparative analysis for CO_2 removals/emissions from the 4A1 "Forest Land Remaining Forest Land" category within 1990-2016 periods is presented in Table 6-22. Data in the respective table reveal an insignificant decrease for 4A1 (with the exception of 2007-2009 and 2011-2013). The maximum deviations represented -1.0 per cent and +0.8 per cent.

Table 6-22: Comparative Evolution for CO_2 Removals/Emissions from the 4A1 "Forest Land Remaining Forest Land" Category, included into the NC4 and the BUR2 of the RM under the UNFCCC, kt

	1990	1991	1992	1993	1994	1995	1996	1997	1998
NC4	-1591.2275	-1364.8477	-1302.7299	-1379.8005	-1367.6689	-1362.7847	-1571.6869	-1652.1452	-1744.9666
BUR2	-1579.0396	-1352.6491	-1290.4237	-1367.4361	-1355.1762	-1350.1974	-1559.0470	-1639.4910	-1732.3177
Difference, %	-0.8	-0.9	-0.9	-0.9	-0.9	-0.9	-0.8	-0.8	-0.7
	1999	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**
NC4	-1853.6589	-1894.2503	-1886.3663	-1926.3824	-1876.5708	-1917.0446	-1978.7520	-1895.5814	-1973.3929
BUR2	-1840.9058	-1881.4545	-1873.5555	-1913.5787	-1863.8705	-1904.3372	-1965.9956	-1882.9327	-1985.9585
Difference, %	-0.7	-0.7	-0.7	-0.7	-0.7	-0.7	-0.6	-0.7	0.6
	2008	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**
NC4	-1970.5529	-1994.2669	-1969.5519	-1871.2941	-1702.1310	-1531.7430	-1499.6258	-1511.5589	
BUR2	-1985.3822	-2008.9453	-1964.0859	-1871.4295	-1702.2662	-1531.8805	-1484.6747	-1496.3946	-1451.3266
Difference, %	0.8	0.7	-0.3	0.0	0.0	0.0	-1.0	-1.0	

Abbreviations: NC4 – Fourth National Communication; BUR2 – Second Biennial Update Report.

[94] Galupa Dumitru, Ciobanu Anatol, Scobioala Marian et al. (2011), Illegal logging of forest vegetation in the Republic of Moldova. Analytical study, Chisinau, "Moldsilva" Agency, 38 pages.

Table 6-23 presents the comparative analysis for CO_2 removals/emissions from the 4A2 "Land Converted to Forest Land" category within 1990-2016 periods. Data in the respective table reveal a constant increase for 4A2. The maximum deviations represented +28.6 per cent in 2015, while the minimum were less than 1.0 per cent between 2008 and 2010.

Table 6-23: Comparative Evolution for CO_2 Removals/Emissions from the 4A2 "Land Converted to Forest Land" Category, included into the NC4 and the BUR2 of the RM under the UNFCCC, kt

	1990	1991	1992	1993	1994	1995	1996	1997	1998
NC4	-952.5127	-958.7836	-861.9363	-794.1905	-720.9410	-662.9847	-599.4909	-560.8987	-524.2643
BUR2	-984.3932	-990.6641	-893.8167	-826.0754	-752.8259	-694.8696	-631.3866	-592.7944	-556.1680
Difference, %	3.3	3.3	3.7	4.0	4.4	4.8	5.3	5.7	6.1
	1999	2000	2001	2002	2003	2004	2005	2006	2007
NC4	-464.0373	-394.0803	-368.2418	-322.1317	-374.3474	-398.5398	-411.6163	-451.6773	-471.7680
BUR2	-495.9410	-425.9839	-400.1473	-354.0371	-406.2471	-430.4396	-443.5229	-483.5841	-474.4270
Difference, %	6.9	8.1	8.7	9.9	8.5	8.0	7.8	7.1	0.6
	2008	2009	2010	2011	2012	2013	2014	2015	2016
NC4	-477.3833	-517.1006	-520.0570	-502.0372	-505.9393	-523.3781	-519.6830	-515.7307	
BUR2	-477.4052	-517.1206	-520.0768	-519.1417	-592.5559	-609.9898	-650.0643	-663.0493	-662.2202
Difference, %	0.0	0.0	0.0	3.4	17.1	16.5	25.1	28.6	

Abbreviations: NC4 – Fourth National Communication; BUR2 – Second Biennial Update Report.

The comparative analysis for non-CO_2 emissions from the 4A2 "Land Converted to Forest Land" category within 1990-2016 periods is presented in Table 6-24. Data in the respective table reveal a constant decrease of non-CO_2 emissions from 4A2 (by 7.3 per cent). Recalculations performed are due to updating and refining activity data for the mass of fuel available for combustion (vegetal mass) in the process of forest burning within the monitoring procedures for Moldova Soil Conservation Project (MSCP) and Moldova Community Forestry Development Project (MCFDP).

Table 6-24: Comparative Evolution for non-CO_2 Emissions from the 4A2 "Land Converted to Forest Land" Category, included into the NC4 and the BUR2 of the RM under the UNFCCC, kt CO_2 equivalent

	1990	1991	1992	1993	1994	1995	1996	1997	1998
NC4	0.3711	0.0621	0.0680	0.0046	0.1035	0.0060	0.0346	0.0105	0.1041
BUR2	0.3439	0.0576	0.0630	0.0043	0.0959	0.0055	0.0321	0.0097	0.0965
Difference, %	-7.3	-7.3	-7.3	-7.3	-7.3	-7.3	-7.3	-7.3	-7.3
	1999	2000	2001	2002	2003	2004	2005	2006	2007
NC4	0.0779	0.0028	0.1761	0.0946	0.1035	0.2719	0.0260	0.2806	2.4453
BUR2	0.0722	0.0026	0.1632	0.0876	0.0959	0.2520	0.0241	0.2600	2.2657
Difference, %	-7.3	-7.3	-7.3	-7.3	-7.3	-7.3	-7.3	-7.3	-7.3
	2008	2009	2010	2011	2012	2013	2014	2015	2016
NC4	0.1700	0.4147	0.1449	0.1941	2.0779	1.4435	0.1187	1.1007	
BUR2	0.1575	0.3842	0.1343	0.1798	1.9252	1.3374	0.1099	1.0199	0.5119
Difference, %	-7.3	-7.3	-7.3	-7.3	-7.3	-7.3	-7.3	-7.3	

Abbreviations: NC4 – Fourth National Communication; BUR2 – Second Biennial Update Report.

Between 1990 and 2016, CO_2 removals from 4A "Forest Land" category decreased continuously (Figure 6-4). Thus, compared to the reference year, in 2016 there was a decrease by 17.6 per cent or a difference by circa 450 kt (Table 6-25). This is due to an increase in the volume of wood officially harvested from national forests.

Table 6-25: Net CO_2 Removals from 4A "Forest Land" in the RM within 1990-2016 periods, kt

	1990	1991	1992	1993	1994	1995	1996	1997	1998
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	-1 732.3177
4A2	-984.3932	-990.6641	-893.8167	-826.0754	-752.8259	-694.8696	-631.3866	-592.7944	-556.1680
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	-2 288.4857
	1999	2000	2001	2002	2003	2004	2005	2006	2007
4A1	-1 840.9058	-1 881.4545	-1 873.5555	-1 913.5787	-1 863.8705	-1 904.3372	-1 965.9956	-1 882.9327	-1 985.9585
4A2	-495.9410	-425.9839	-400.1473	-354.0371	-406.2471	-430.4396	-443.5229	-483.5841	-474.4270
4A	-2 336.8468	-2 307.4384	-2 273.7027	-2 267.6159	-2 270.1176	-2 334.7768	-2 409.5185	-2 366.5168	-2 460.3855
	2008	2009	2010	2011	2012	2013	2014	2015	2016
4A1	-1 985.3822	-2 008.9453	-1 964.0859	-1 871.4295	-1 702.2662	-1 531.8805	-1 484.6747	-1 496.3946	-1 451.3266
4A2	-477.4052	-517.1206	-520.0768	-519.1417	-592.5559	-609.9898	-650.0643	-663.0493	-662.2202
4A	-2 462.7874	-2 526.0659	-2 484.1627	-2 390.5712	-2 294.8221	-2 141.8702	-2 134.7390	-2 159.4439	-2 113.5468

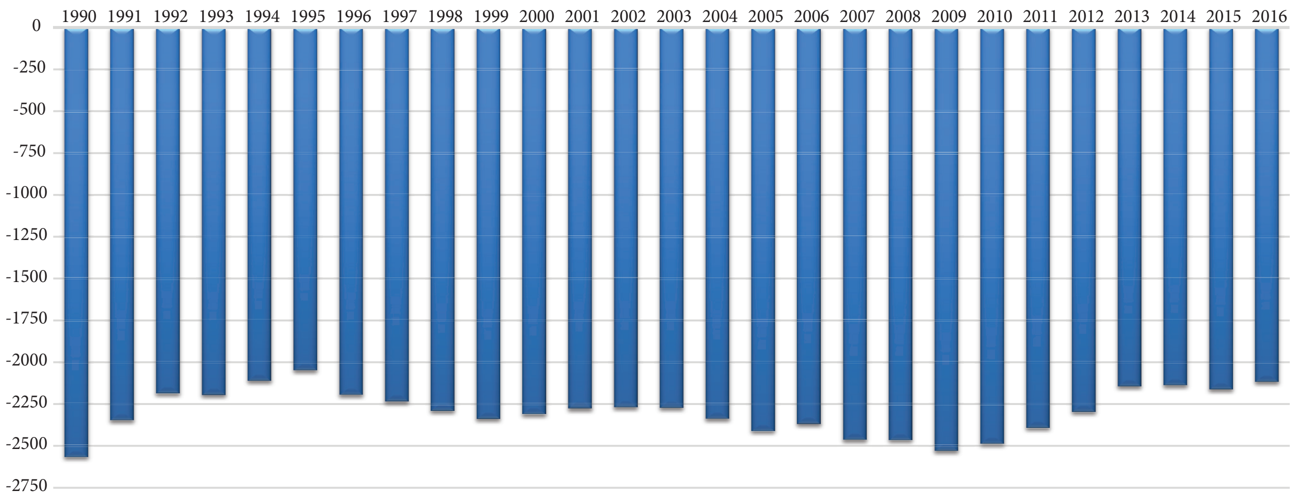


Figure 6-4: Net CO_2 Removals from 4A "Forest Land" in the RM within 1990-2016 periods, kt.

As for the individual contribution of each of the categories (4A1 and 4A2), it should be noted that the share of 4A1 "Forest Land Remaining Forest Land" is dominant, accounting for circa 61.6 per cent in 1990, respectively circa 68.7 per cent in 2016 (Figure 6-5).

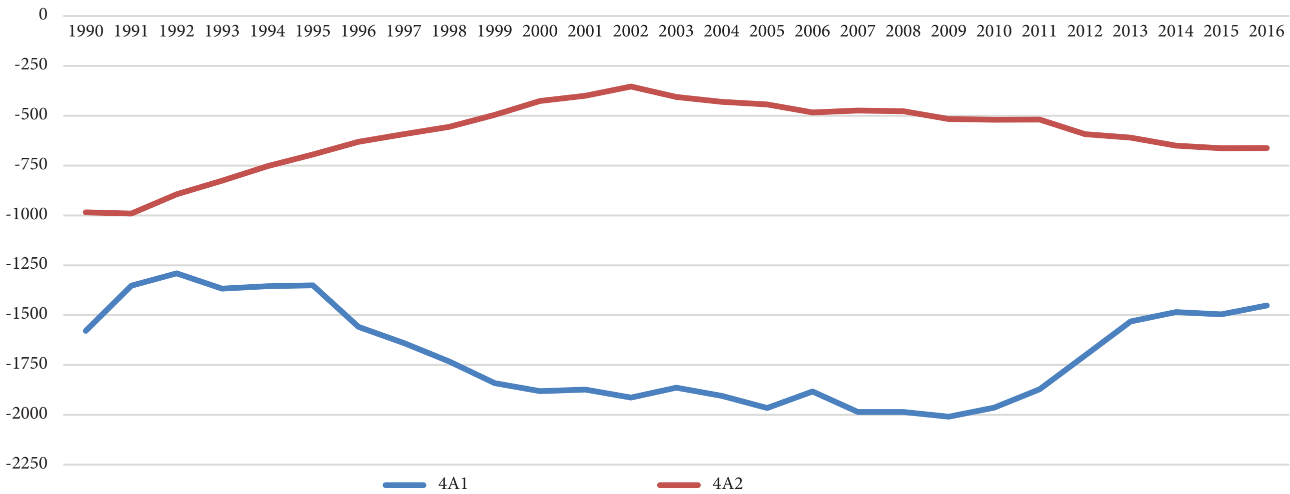


Figure 6-5: Evolution of CO_2 Removal by Each Subcategory in the RM within 1990-2016, kt.

Within the reference period, non-CO_2 emissions (CH_4 and N_2O) from the 4A "Forest Land" category were relatively constant, with the exception of 2007 and 2012, when due to severe droughts, the forest areas affected by fires recorded an historical maximum of 791.0 ha and 672.4 ha or 7 times increase compared to the reference year (1990) level. At the same time, in comparison to the reference year, by 2016 the non-CO_2 emissions from forest areas affected annually by fires within the category 4A "Forest Land" increased by circa 1.6 times (Table 6-26).

Table 6-26: Non-CO_2 Emissions from Forest Areas Annually Affected by Fires in the Republic of Moldova within 1990-2016 periods

	1990	1991	1992	1993	1994	1995	1996	1997	1998
CH_4, kt	0.0083	0.0014	0.0015	0.0001	0.0023	0.0001	0.0008	0.0002	0.0023
N_2O, kt	0.0005	0.0001	0.0001	0.0000	0.0001	0.0000	0.0000	0.0000	0.0001
Total, kt CO_2 equivalent	**0.3162**	**0.0529**	**0.0579**	**0.0039**	**0.0882**	**0.0051**	**0.0295**	**0.0090**	**0.0887**
	1999	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**
CH_4, kt	0.0017	0.0001	0.0039	0.0021	0.0023	0.0061	0.0006	0.0063	0.0546
N_2O, kt	0.0001	0.0000	0.0002	0.0001	0.0001	0.0003	0.0000	0.0003	0.0030
Total, kt CO_2 equivalent	**0.0663**	**0.0024**	**0.1501**	**0.0806**	**0.0882**	**0.2317**	**0.0221**	**0.2391**	**2.0833**
	2008	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**
CH_4, kt	0.0038	0.0093	0.0032	0.0043	0.0464	0.0322	0.0027	0.0246	0.0123
N_2O, kt	0.0002	0.0005	0.0002	0.0002	0.0026	0.0018	0.0001	0.0014	0.0007
Total, kt CO_2 equivalent	**0.1448**	**0.3533**	**0.1235**	**0.1653**	**1.7703**	**1.3373**	**0.1099**	**1.0198**	**0.5119**

In the context of the attributed competencies, the “Moldsilva” Agency produces regular reports on CO_2 emissions reduction following the implementation of CDM Projects (MSCP and MCFDP). These calculations are based on the AR-AM0002 Methodology “Restoration of Degraded Lands through Afforestation/Reforestation” (Version 01 and 03), based on the initial modules and documentation of the MSCP and MCFDP projects, 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 2016, the removals by circa 2.4 Mt of CO_2 equivalent within the MSCP and MCFDP projects was recorded (Table 6-27).

Table 6-27: CO_2 emissions reductions in the RM within the CDM Projects (MSCP and MCFDP) within 2004-2016 periods, kt

	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Net Removals in MSCP	-31.39	-37.36	-86.53	-93.32	-123.30	-138.40	-151.06	-190.60	-191.85	-216.49	-214.77	-221.90	-203.08
Net Removals in MCFDP	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-328.81	-58.15	-39.00	-36.00	-41.00
Total	**-31.39**	**-37.36**	**-86.53**	**-93.32**	**-123.30**	**-138.40**	**-151.06**	**-190.60**	**-520.66**	**-274.64**	**-253.78**	**-257.90**	**-244.08**

Source: “Moldsilva” Agency Reports on MSCP and MCFDP monitoring from 2012, 2013, 2017 and 2018; Annual Reports from “Moldsilva” Agency to the World Bank for 2004-2017 time series.

6.2.6. Planned Improvements

For the next inventory cycles, it will be considered to improve data regarding the actual consumption of fuel wood from the managed forest land of the RM, as well as updating national emission/removal factors (basic wood density, biomass expansion factors, emission factors from forest fires etc.).

6.3. Cropland (Category 4B)

6.3.1. Source Category Description

The 4B “Cropland” category includes a wide range of arable lands with the primary goal of cultivating different types of crops and/or protecting them against unfavorable climatic factors. Thus, within this category the following types of arable lands are included: perennial plantations (vineyards and orchards, including fruit trees nurseries, woody vegetation in individual gardens); other forest vegetation, including forest protection stripes and green areas; arable soils.

Under the 4B category there are reported CO_2 emissions/removals estimates originated from two sub-categories: 4B1 “Cropland Remaining Cropland” and 4B2 “Land Converted to Cropland”, including non-CO_2 emissions from post-harvest field burning of agricultural residues (stubble fields burning).

4B1. Cropland Remaining Cropland

For a clearer exposition of the calculation exercise for the 4B1 “Cropland Remaining Cropland” category, the obtained results are presented separately for three subcategories: 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 fields burning)”.

4B1.1. Cropland Covered with Woody Vegetation

The 4B1.1 “Cropland Covered with Woody Vegetation” category comprises CO_2 removals/emissions from cropland covered with woody vegetation, including above-ground and below-ground biomass in protection forest strips, trees and shrubs 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 quite important in the total balance per sector, as the quantitative share in the general land structure per country of these sources reach up to 10 per cent thus having an essential contribution to maintaining the environmental balance.

In conformity with records available in the Republic of Moldova, forest vegetation not regarded as forest resources includes the following categories: protection forest strips by the side of agricultural fields; protection forest strips and trees and shrubs plantations along the communication ways; water protection forest strips; and groups of trees and separately standing trees within the urban and settlement areas.

According to the general definition, protection forest strips 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

Under the 4B1.2 "Annual Change in Carbon Stocks in Mineral Soils" category there are reported CO_2 emissions from mineral soils. This source has a significant share in the total emissions from the sector 4 'LULUCF', as according the General Land Cadaster of the Republic of Moldova (standing as of 01.01.2017), this source includes arable lands with a share of over 55.1 per cent of the total, which is 1866.05 thousand ha. It should be mentioned that over the period from 1990 through 2016, the areas of arable lands remained relatively constant, increasing only by 7 per cent.

Cropland change and soil management change can considerably affect the organic carbon stocks in mineral soils[95]. Thus, for example, the conversion of native "Grassland" and "Forest Land" to "Cropland", could determine the loss of 20-40 per cent of the original soil carbon stocks (2006 IPCC Guidelines). Soil organic C stocks can change with management or disturbance if the net balance between C inputs (such as organic fertilizers, agricultural residues) and C losses (due to mineralization of organic substances in soil) from soil is altered. Carbon stocks also depend on the intensity of the humification process, which is directly influenced by the climatic conditions, in particular the humidity and temperature regime.

4B1.3. Non-CO_2 Emissions from Post-Harvest Field Burning of Agricultural Residues (Stubble Fields Burning)

"Post-Harvest Field Burning of Agricultural Residues" or stubble fields burning is a rather frequent practice, in particular, in developing countries. According to more recent estimations, in some developing countries, up to 40 per cent of crop residues are burnt in fields (in developed countries this percentage is much smaller, less than 10 percent). It should be noted that in cases when crop residues are removed from fields to be used as fuel for heating and cooking, 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 (as CO_2 emissions are not regarded as a source of emissions, carbon emitted in atmosphere is considered to be re-absorbed in the following agricultural cycle). The amount of crops residues vary in different years, and depend on crops and management technologies. It should be noted that though burning of stubble fields is prohibited by law, this practice still persists in the RM. 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 reaping of wheat and barley) and to prepare the fields for the next agricultural cycle.

4B2. Land Converted to Cropland

The 4B2 "Land Converted to Cropland" subcategory includes lands subject to conversion which previously had a certain volume of biomass (forests, grasslands, perennial plantations, forest stripes) or lacked vegetation (settlements, wetlands).

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 4B1 "Cropland Remaining Cropland" were those available in the 2006 IPCC Guidelines. At the same time, country specific

[95] According the FAO classification: mineral soils are soils with moderate content of organic matter; unlike organic soils which contain 12-20 per cent of organic matter from total mass, it should be noted that there are no such types of soils in the Republic of Moldova.

emission/removal factors were used regarding the annual biomass increments, the share of carbon in biomass etc., as well as AD by sector (area covered with forest stripes, trees and shrubs plantations, orchards, vineyards, wood harvesting, area of mineral soils used for agriculture).

4B1.1. Cropland Covered with Woody Vegetation

For estimating CO_2 removals/emissions within the source 4B1.1 "Cropland Covered with Woody Vegetation" under the 4B1 "Cropland Remaining Cropland", it was necessary to determine current biomass increments in woody vegetation not included in forestry resources and perennial plantations, according to production tables, forest planning, scientific sources, data from "Moldova Agricultural Competitiveness Project" (MACP).

The calculation was done based on annual change in carbon stocks as a result of perennial woody crops growth (in stem, shoots, leaves and roots), by using Equations 2.9 – 2.14 from the 2006 IPCC Guidelines (pages 2.14 – 2.18). The process had two steps:

1. Annual change in carbon stocks as a result of perennial woody crops growth (in stem, shoots, leaves and roots), using the general equation:

$$\Delta C_G = \sum (A \bullet G_{total} \bullet CF)$$

Where:

ΔC_G – annual increase in biomass carbon stocks due to biomass growth in land remaining in the same land-use category (perennial plantations), t C/yr;

A – area of perennial plantations remaining in the same land-use category, ha;

CF – carbon fraction of dry matter;

G_{total} – total annual biomass growth (t d.m./yr/ha).

2. Annual decrease in carbon stocks due to biomass losses (from wood removal (harvest)/authorized and illegal logging), using the general equation:

$$\Delta C_L = L_{felling} + L_{fuelwood} + L_{perturbations}$$

Where:

ΔC_L – annual decrease in carbon stocks due to biomass loss (harvesting/felling and other types of removals), t C/yr;

$L_{felling}$ – annual biomass loss due to wood removals, t C/yr;

$L_{fuelwood}$ – annual biomass carbon loss due to fuelwood removals, t C/yr;

$L_{perturbations}$ – annual biomass carbon loss due to disturbances (diseases, pests, natural disasters, mass droughts etc.), t C/yr.

The estimation of these indicators was performed according to the algorithm and intermediate equations described in chapter 6.2.2 of this Report, the difference being in the removal/emission factors used in the process.

Annual wood harvesting from orchards and vineyards occurs during the cleaning cuttings. For wood harvesting from forest strips and other types of vegetation, 90 per cent of which are managed by local public authorities, the volume of wood harvested was included in the total volume authorized annually by the Inspectorate for Environmental Protection for local authorities and other institutions (art. 40 of the Environmental Protection Law; art. 22 of the Forestry Code on state control and its data), since other national records for this type of vegetation are not available. Thus, between 2014 and 2015, SEI authorized the harvesting of 53.8 thousand m^3 of wood from the forestry fund and forest vegetation owned by local authorities and other public institutions (except for "Moldsilva" Agency). The respective volume is not separated by forest vegetation categories. In order to overcome this situation, the data from the MACP was used, including the harvesting of a certain volume of wood (2014-2015 – circa 9.7 thousand m^3). From this information it appears that the wood harvested from forest stripes represent circa 18 per cent from the total volume authorized by SEI in the RM (Table 6-28).

Table 6-28: Estimated Wood Harvested from Other Types of Woody Vegetation in the RM

	Indicators	2014	2015	Total	Share, %
Other types of woody vegetation from the MACP project	Area, ha	906.53	747.99	1654.52	-
	Wood harvested, m^3	5316.28	4370.02	9686.3	18.0
Total wood approved for harvesting by the SEI for the local authorities	Wood approved for harvesting, m^3	25112.85	28667.61	53780.46	100.0

Based on the respective relation and on the data provided by the Inspectorate for Environmental Protection on the volume of wood approved for harvesting by local authorities and other public institutions (except for "Moldsilva" Agency), the annual volumes harvested were estimated (Table 6-29). At the same time, it should be noted that for 2016, the Inspectorate for Environmental Protection presented data separated by categories of woody vegetation.

Table 6-29: Evolution of Wood Harvested from Other Types of Woody Vegetation in the RM within 1990-2016 periods, thousand m^3

	1990	1991	1992	1993	1994	1995	1996	1997	1998
Wood harvested volume	0.00	24.98	37.8	58.52	36.9	36.18	32.47	2.95	10.75
	1999	2000	2001	2002	2003	2004	2005	2006	2007
Wood harvested volume	3.08	1.37	0.48	0.30	0.40	2.74	2.11	3.11	1.78
	2008	2009	2010	2011	2012	2013	2014	2015	2016
Wood harvested volume	2.36	2.48	5.20	2.10	2.91	3.49	8.57	9.51	43.49

In order to estimate the biomass increments in perennial woody crops on croplands, and implicitly, the resulting CO_2 removals, there were used activity data available in the General Land Cadaster of the RM on areas occupied by such crops over the period from 1990 through 2016 (Table 6-30).

Table 6-30: Areas of Land Covered with Woody Vegetation from 4B1 "Cropland Remaining Cropland" within 1990-2016 periods, ha

Land Category	1990	1991	1992	1993	1994	1995	1996	1997	1998
Perennial plantations	288 955.4	299 617.5	290 817.5	278 922.5	279 873.4	267 483.4	278 702.1	265 402.1	250 302.1
Other forest vegetation	23 950.0	23 950.0	23 950.0	22 450.0	22 450.0	22 450.0	21 850.0	18 750.0	16 650.0
Total woody vegetation	**312 905.4**	**323 567.5**	**314 767.5**	**301 372.5**	**302 323.4**	**289 933.4**	**300 552.1**	**284 152.1**	**266 952.1**
Land Category	1999	2000	2001	2002	2003	2004	2005	2006	2007
Perennial plantations	231 902.1	226 234.3	197 070.3	203 977.4	211 223.7	219 946.8	219 771.4	219 586.8	219 400.3
Other forest vegetation	22 600.0	22 300.0	23 084.0	23 384.0	21 615.0	21 615.0	30 615.0	34 315.0	34 315.0
Total woody vegetation	**254 502.1**	**248 534.3**	**220 154.3**	**227 361.4**	**232 838.7**	**241 561.8**	**250 386.4**	**253 901.8**	**253 715.3**
Land Category	2008	2009	2010	2011	2012	2013	2014	2015	2016
Perennial plantations	228 261.4	226 224.1	288 530.4	281 941.6	278 612.7	272 655.4	250 631.5	242 116.3	217 331.4
Other forest vegetation	35 415.0	34 115.1	34 115.1	34 856.0	35 532.4	33 705.8	39 839.8	40 939.8	40 939.8
Total woody vegetation	**263 676.4**	**260 339.3**	**322 645.5**	**316 797.6**	**314 145.1**	**306 361.2**	**290 471.3**	**283 056.1**	**258 271.2**

Source: General Land Cadaster for 1970-2017; Land Use and Land Use-Change Matrix for 1970-2016 periods.

According to recorded data, between 1990 and 2016 the area of other types of woody vegetation had a positive trend, increasing by 9.9 per cent. Within the same periods, perennial plantations constantly decreased (Table 6-8), the total area decreasing by 38.6%: the area of orchards decreased by 39.0 per cent while vineyards – by 38.2 per cent. At the same time, it should be mentioned that the respective category 4B1.1 "Cropland Covered with Woody Vegetation" also includes lands that are subject to internal conversion generating certain changes in carbon stocks (Table 6-31).

Table 6-31: Evolution of Lands Subject to Internal Conversion from 4B1.1 "Cropland Covered with Woody Vegetation" Category within 1970-2016 periods, ha

Land Category	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981
Perennial plantations to cropland	0.0	391.8	19923.5	3269.4	0.0	0.0	0.0	5178.6	5948.0	3255.2	0.0	1347.6
Forest vegetation to cropland	0.0	72.4	72.0	72.4	72.0	181.0	145.0	36.0	778.0	0.0	0.0	0.0
Cropland to forest vegetation	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2153.0	36.0	434.0
Cropland to perennial plantations	0.0	10511.8	0.0	5798.7	18118.8	5607.2	24273.7	0.0	0.0	0.0	11521.0	0.0
Total	**0.0**	**10975.9**	**19995.5**	**9140.5**	**18190.8**	**5788.2**	**24418.7**	**5214.6**	**6726.0**	**5408.2**	**11557.0**	**1781.6**
Land Category	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993
Perennial plantations to cropland	0.0	0.0	0.0	23450.9	19160.3	1076.3	0.0	1034.5	0.0	0.0	8596.6	17457.5
Forest vegetation to cropland	0.0	0.0	72.4	0.0	0.0	1157.9	0.0	0.0	470.0	0.0	0.0	542.8
Cropland to forest vegetation	109.0	0.0	0.0	3257.0	1338.8	0.0	398.0	615.0	0.0	289.0	253.0	0.0
Cropland to perennial plantations	11606.3	9934.5	8757.6	0.0	0.0	0.0	8893.1	0.2	63352.0	4166.0	0.0	0.0
Total	**11715.3**	**9934.5**	**8830.0**	**26707.9**	**20499.1**	**2234.2**	**9291.2**	**1649.7**	**63822.0**	**4455.0**	**8849.6**	**18000.3**

Land Category	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
Perennial plantations to cropland	17159.5	17752.3	13244.2	13045.4	14811.2	18053.2	17072.9	28626.9	4646.4	2639.8	18.2	0.0
Forest vegetation to cropland	0.0	0.0	217.1	1121.7	759.9	0.0	144.7	150.5	0.0	640.1	0.0	0.0
Cropland to forest vegetation	2569.1	398.0	0.0	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	0.0	0.0	0.0	1415.4
Total	**19728.7**	**18150.4**	**13461.3**	**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**	**2015**	**2016**	**2017**
Perennial plantations to cropland	0.0	0.0	0.0	1886.7	2150.1	112.4	3259.0	41.2	3497.4	2730.5	2.9	NA
Forest vegetation to cropland	0.0	0.0	0.0	1085.5	0.0	21.4	8.5	660.9	349.5	0.0	0.0	NA
Cropland to forest vegetation	244.2	116.9	223.0	0.0	1066.3	0.0	0.0	0.0	0.0	724.0	178.9	NA
Cropland to perennial plantations	2929.0	1107.1	453.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	NA
Total	**3173.2**	**1224.0**	**676.7**	**2972.2**	**3216.4**	**133.8**	**3267.6**	**702.2**	**3846.9**	**3454.5**	**181.7**	**NA**

Source: General Land Cadaster for 1970-2017; Land Use and Land Use-Change Matrix for 1970-2016 periods.

In order to estimate annual biomass increments and losses in perennial woody crops, country specific emission factors were developed. Calculation of such factors was based on production tables, data on productivity of protection forest belts taken from data accounting and forest planning records, as well as data from scientific literature on perennial plantations management (Table 6-32).

Table 6-32: Emission/Removal Factors used under the 4B1.1 "Cropland Covered with Woody Vegetation" Category

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 4B1.1 category (Table 6-33).

Table 6-33: Emission/Removal Factors used for Internal Conversion under the 4B1.1 "Cropland Covered with Woody Vegetation" Category

Internal Conversion	Indicators	Period, years	Units	Indicators Value[97]
Perennial plantations to cropland	Annual average carbon increments in biomass	year 1	Mg C/ha/yr	0.57
	Annual average carbon increments in DOM and SOC	years 1-20	Mg C/ha/yr	0.00
Forest vegetation to cropland	Annual average carbon increments in biomass	year 1	Mg C/ha/yr	-24.80
	Annual average carbon increments in dead organic matter (litter/DOM)	year 1	Mg C/ha/yr	-1.15
	Annual average increments in soil organic carbon (SOC/SOM)	years 1-20	Mg C/ha/yr	-1.1988
Cropland to forest vegetation	Annual average carbon increments in biomass (trees and shrubs)	year 1	Mg C/ha/yr	-3.26
	Annual average carbon increments in biomass (trees and shrubs)	years 2-20	Mg C/ha/yr	1.74
	Annual average carbon increments in dead organic matter (litter/DOM)	years 1-20	Mg C/ha/yr	0.41
	Annual average increments in soil organic carbon (SOC/SOM)	years 1-20	Mg C/ha/yr	0.32
Cropland to perennial plantations	Annual average carbon increments in biomass (trees and shrubs)	year 1	Mg C/ha/yr	-4.68
	Annual average carbon increments in biomass (trees and shrubs)	years 2-20	Mg C/ha/yr	0.32
	Annual average carbon increments in dead organic matter (litter/DOM)	years 1-20	Mg C/ha/yr	0.00
	Annual average increments in 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 within the category 4B1.2 "Annual Change in Carbon Stocks in Mineral Soils" it was used a Tier 2 approach and Equation 2.25 from the 2006 IPCC Guidelines (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, 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;

D – 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).

[96] Where used the „minus" sign, it is consider to be losses

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] – stoichiometric ration between carbon content in CO_2 and C.

In the process of assessing the annual change in carbon stocks in mineral soils in the RM, the following aspects were considered:

- The agricultural practices applied on the arable land of the RM and the pedo-climatic conditions allow to highlight 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 2016 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 substantially decreased, in particular 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 soil organic carbon stocks 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 per cent of the accumulated carbon: in 1877 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 (Napadova village, Floresti district) represented 5.72 per cent (200.7 t humus/ha or 116.4 t C/ha); in 1960 the content of humus in the same area represented 3.68 per cent (129.0 t humus/ha or 74.8 t C/ha); by 2003 – 3.36 per cent (117.9 t humus/ha or 68.4 t C/ha), while in 2010 – 3.11 per cent (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 from the northern part of the country, it was established that over 60 years of exploitation the soils lost about 37 per cent of the accumulated carbon, and the annual average represented 300 kg C/ha/yr (Soils of Moldova, Volume 1, 1989); within the long-term experiments (circa 40 years) of the Institute of Pedology, Agrochemistry and Soil Protection „Nicolae Dimo", in the main pedo-climatic areas of the country, located on the chernozems subtypes dominant in soils cover, it was established that annual rates of carbon losses are very close to zone and chernozem subtype, representing circa 325 kg C/ha/yr (Ecopedological Monitoring Bulletin, 7th Edition, 2000); very close rates were established through the oldest long-term experiments in the country organized by the Agrarian State University of Moldova in the Chetrosu village, Anenii Noi district, on carbonate chernozem (Zagorcea, 1990); values between 300-330 kg C/ha/yr for carbon losses in cropland have been established by other researchers too (Ungureanu et al., 1997; Andries, 1999; Banaru, 2001);
- Soil organic carbon stocks 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 represented circa 3.46 per cent (121.3 t humus/ha or 70.3 t C/ha); at the same time, in the southern part of the country (Lebedenco village, 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 per cent (127.3 t humus/ha or 73.9 t C/ha); under these circumstances, the country average ($SOC_{(0-T)}$) represented circa 124.3 t humus/ha or circa 72.1 t C/ha;
- Soil organic carbon stocks in the last year of the inventory cycle (SOC_0) were identified in the scientific field literature; according to the specialists from the Institute of Pedology, Agrochemistry and Soil Protection „Nicolae Dimo", in 2015 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 (Napadova village, Floresti district)

represented circa 3.0 per cent (105.3 t humus/ha or 61.1 t C/ha); at the same time, in the southern part of the country (Lebedenco village, 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 2.89 per cent (112.7 t humus/ha or 65.4 t C/ha), the country average (SOC_0) represented circa 109.0 t humus/ha or circa 63.2 t C/ha, which corresponds to annual average losses of circa 354.9 kg C/ha/yr, within 1990-2016 periods.

In order to estimate CO_2 emissions within the category 4B1.2 "Annual Change in Carbon Stocks in Mineral Soils", based on the General Land Cadaster of the RM, there were identified areas of cropland remaining cropland through the period under review (Table 6-34).

Table 6-34: Areas of Cropland Remaining Cropland in the RM within 1990-2016 periods, kha

Land Category	1990	1991	1992	1993	1994	1995	1996	1997	1998
Cropland Remaining Cropland, kha	1631.8	1624.7	1632.6	1634.2	1633.4	1631.2	1632.1	1640.2	1645.4
Land Category	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**
Cropland Remaining Cropland, kha	1642.3	1630.6	1622.6	1622.5	1623.1	1620.4	1643.4	1660.3	1659.8
Land Category	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**
Cropland Remaining Cropland, kha	1659.2	1660.0	1659.6	1657.5	1647.7	1654.9	1669.5	1685.0	1694.0

Source: General Land Cadaster for 1970-2017; Land Use and Land Use-Change Matrix for 1970-2016 periods.

Based on the respective AD, annual change in carbon stocks in mineral soils were estimated (Table 6-35). The results show certain changes between 1990 and 2016 equal to circa 354.9 kg C/ha/year. This value is close to the results recorded previously by different specialists in the RM in their long-term experiments (Zagorcea, 1990; Ungureanu et al., 1997; Andries, 1999; Banaru, 2001; Cerbari, 2010, 2012).

Table 6-35: Annual Change in Carbon Stocks in Mineral Soils in the RM within 1990-2016 periods

	1990	1991	1992	1993	1994	1995	1996	1997	1998
$\Delta C_{mineral}$, t C/yr	-476 529.7	-470 457.1	-477 779.1	-476 406.6	-476 511.0	-476 485.6	-478 086.8	-487 330.9	-492 829.9
	1999	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**
$\Delta C_{mineral}$, t C/yr	-493 125.7	-489 617.6	-488 467.3	-487 776.2	-487 506.2	-486 942.7	-500 226.5	-512 415.1	-511 969.1
	2008	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**
$\Delta C_{mineral}$, t C/yr	-511 668.6	-511 957.1	-512 076.2	-510 944.5	-501 531.4	-511 133.1	-518 142.4	-528 323.0	-534 030.3

4B1.3. Non-CO_2 Emissions from Post-Harvest Field Burning of Crop Residues (stubble fields burning)

Non-CO_2 emissions from post-harvest field burning of crop residues (stubble fields burning) within the 4B "Cropland" were estimated by using a Tier 1 methodology (2006 IPCC Guidelines, Vol. 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 vegetation fires (field burning of crop residues or stubble fields burning), t/yr;

A – area burnt, ha/yr;

M_B – mass of fuel available for combustion, t/ha;

C_f – combustion factor; IPCC default value is 0.90 (2006 IPCC Guidelines);

$M_B \bullet C_f$ – amount of fuel actually burnt; default for "Crop Residues" (post-harvest field burning), in particular, for wheat and barley residues, which are more frequently burned in the Republic of Moldova, is 4 t.d.m./ha;

G_{ef} – default EF (g/kg d.m.) (see Table 6-36).

Table 6-36: EFs for Field Burning of Crop Residues, g/kg d.m.

Category	CO	CH_4	N_2O	NO_x
Field Burning of Agricultural Residues	92	2.7	0.07	2.5

The activity data on areas sown with grain crops (wheat and barley) are available in the Statistical Yearbooks of the Republic of Moldova and those of ATULBD (the information is similar to that presented in Chapter 5 "Agriculture Sector" of the NIR). The information on post-harvest field burning of crop residues (stubble fields burning) cases in the RM is reported annually by the State Ecological Inspectorate's territorial inspectors and it is provided in the Table 6-37.

Table 6-37: Stubble Fields Burning in the Republic of Moldova within1990-2016 periods

	1990	1991	1992	1993	1994	1995	1996	1997	1998
Burnt stubble fields, thousand ha	12.213	13.110	12.141	14.547	13.422	15.800	18.600	20.700	21.500
Burnt stubble fields, % from total	3.00	3.00	3.00	3.00	3.00	2.99	3.80	3.83	3.98
	1999	2000	2001	2002	2003	2004	2005	2006	2007
Burnt stubble fields, thousand ha	24.000	11.500	9.500	1.960	0.100	0.400	2.200	0.890	2.650
Burnt stubble fields, % from total	4.61	2.10	1.57	0.31	0.03	0.08	0.36	0.20	0.56
	2008	2009	2010	2011	2012	2013	2014	2015	2016
Burnt stubble fields, thousand ha	4.465	0.892	0.627	0.475	0.106	0.575	0.400	0.346	0.321
Burnt stubble fields, % from total	0.78	0.15	0.11	0.10	0.02	0.10	0.07	0.08	0.06

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, Figure2.19, 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 - 20134"„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).

As activity data were not available for the period of time from 1990 through 1994, these data were extrapolated based on the assumption that the areas of stubble fields combusted annually make circa 3 percent of the total areas under the respective cereals (wheat and barley).

The activity data on the amount of crop residues available to be combusted on field (Table 6-38) 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). While estimating 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, actually reported in the Republic of Moldova over the reference period.

Table 6-38: Amount of Crop Residues Available for Combustion on Field in the Republic of Moldova within 1990-2016 periods, t d.m./ha

	1990	1991	1992	1993	1994	1995	1996	1997	1998
Winter wheat	3.5047	3.1033	2.9248	3.5832	1.9518	2.6079	1.5741	2.5002	2.0877
Barley	3.0891	2.8360	2.9305	3.0798	1.9671	2.0518	1.1193	1.7656	1.6085
Average	**3.2969**	**2.9696**	**2.9277**	**3.3315**	**1.9594**	**2.3298**	**1.3467**	**2.1329**	**1.8481**
	1999	2000	2001	2002	2003	2004	2005	2006	2007
Winter wheat	1.8109	1.5225	2.1448	1.9703	0.4274	2.2386	2.0463	1.9211	1.0847
Barley	1.4064	1.0846	1.9163	1.6088	0.6894	1.7958	1.4511	1.5503	0.8103
Average	**1.6086**	**1.3036**	**2.0305**	**1.7895**	**0.5584**	**2.0172**	**1.7487**	**1.7357**	**0.9475**
	2008	2009	2010	2011	2012	2013	2014	2015	2016
Winter wheat	2.6653	1.6617	1.7518	2.0084	1.1817	2.0765	2.3645	1.9798	2.5489
Barley	2.3134	1.3993	1.2991	1.5180	1.0862	1.6944	1.8011	1.6910	2.4043
Average	**2.4893**	**1.5305**	**1.5254**	**1.7632**	**1.1340**	**1.8855**	**2.0828**	**1.8354**	**2.4766**

4B2. Land Converted to Cropland

In order to estimate CO_2 removals/emissions from the 4B2 "Land Converted to Cropland" category there were calculated carbon stock in biomass (losses and increments) due to the conversion of land from natural conditions and other uses to cropland, including deforestation, conversion of pasture and grazing lands as well as perennial plantations to cropland etc. At the same time, estimates for this category also included N_2O emissions resulting from conversion of grassland to cropland.

In the process of assessing 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 the land-use conversion, 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 forest land ($\Delta C_{Conversion}$) 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, t d.m.//ha;

B_{Before} – biomass stocks on land before the conversion, t d.m./ha;

$\Delta A_{TO\ OTHERS}$ – area of land-use converted to cropland in a certain year, ha/yr;

CF – carbon fraction of dry matter.

At the same time, the estimation process considered increases in 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):

$$F_{SOM} = \Sigma_{LU}[(\Delta C_{Mineral,LU} \bullet 1/R) \bullet 1000]$$

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*), tones 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, in the absence of more specific data for the area. A default value of 10 may be used for situations involving management changes on Cropland Remaining Cropland;

LU – land-use and/or management system type.

AD on areas subject to conversion to this category are available in the General Land Cadaster of the RM, and are included in the Land Use and Land Use-Change Matrix for 1970-2016 periods. The main types of land converted to cropland are grassland and settlements (Table 6-39).

Table 6-39: Areas of Land Converted to Cropland in the RM within 1970-2016 periods, ha

Conversion	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981
Grassland to cropland	0.0	212.7	737.0	0.0	2749.0	0.0	3967.8	5699.0	238.3	0.0	0.0	935.1
Grassland to forest vegetation	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3797.0	64.0	766.0
Grassland to perennial plantations	0.0	192.7	0.0	106.3	332.1	102.8	444.9	0.0	0.0	0.0	211.2	0.0
Wetlands to cropland	0.0	600.0	0.0	0.0	0.0	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	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	3583.9	10181.9	0.0
Total	**0.0**	**1087.1**	**737.0**	**106.3**	**3081.1**	**102.8**	**6169.8**	**7456.0**	**1995.3**	**7380.9**	**10457.1**	**1701.1**
Conversion	**1982**	**1983**	**1984**	**1985**	**1986**	**1987**	**1988**	**1989**	**1990**	**1991**	**1992**	**1993**
Grassland to cropland	0.0	1324.5	489.5	0.0	476.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Grassland to forest vegetation	191.0	0.0	0.0	5743.0	2361.2	0.0	702.0	1085.0	0.0	511.0	447.0	0.0
Grassland to perennial plantations	212.7	182.1	160.5	0.0	0.0	0.0	163.0	0.0	1161.2	76.4	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	0.0	0.0	0.0
Settlements to cropland	490.1	0.0	0.0	1715.5	1470.4	0.0	408.5	0.0	245.1	0.0	0.0	163.4
Other land to cropland	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	7460.9	0.0
Total	**893.9**	**1506.6**	**650.1**	**7458.5**	**4308.1**	**0.0**	**1273.4**	**1085.0**	**1406.3**	**587.4**	**7907.9**	**163.4**
Conversion	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**
Grassland to cropland	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1039.4	0.0	496.2
Grassland to forest vegetation	4530.9	702.0	0.0	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	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	0.0	0.0	0.0
Settlements to cropland	0.0	571.8	163.4	0.0	326.8	0.0	0.0	58.0	35.1	0.0	236.1	343.9
Other land to cropland	618.2	0.0	0.0	0.0	0.0	0.0	0.0	2231.0	1126.5	0.5	0.6	0.6
Total	**5149.0**	**1273.8**	**163.4**	**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**	**2015**	**2016**	**2017**
Grassland to cropland	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	NA
Grassland to forest vegetation	430.8	206.1	394.0	0.0	1880.5	0.0	0.0	0.0	0.0	1277.0	315.5	NA
Grassland to perennial plantations	53.7	20.3	8.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	NA
Wetlands to cropland	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	NA
Settlements to cropland	1016.2	283.5	113.8	314.3	19.8	0.0	30.6	0.0	0.0	0.0	0.0	NA
Other land to cropland	0.6	0.6	1004.5	318.7	330.1	926.6	0.0	10036.4	10591.3	14595.4	17633.0	NA
Total	**1501.2**	**510.4**	**1520.6**	**633.0**	**2230.4**	**926.6**	**30.6**	**10036.4**	**10591.3**	**15872.4**	**17948.5**	**NA**

Source: General Land Cadaster for 1970-2017; Land Use and Land Use-Change Matrix for 1970-2016 periods.

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. Calculation of such factors was based on production tables including data on productivity of protection forest belts taken from data accounting and forest planning records, “Moldsilva” Agency Monitoring Reports on MSCP and MCFDP from 2012; 2013; 2017; 2018, as well as data from scientific literature on biomass increments and perennial plantations management (Table 6-40).

Table 6-40: Removal/Emission Factors Used in the Estimation Process for 4B2 “Land Converted to Cropland” Category

Conversion	Indicators	Period, years	Units	Indicators Value
Grassland to cropland	Annual average carbon increments in biomass	year 1	Mg C/ha/yr	1.22
	Annual average carbon increments in dead organic matter (litter/DOM)	year 1	Mg C/ha/yr	0.00
	Annual average increments in soil organic carbon (SOC/SOM)	years 1-20	Mg C/ha/yr	-2.2650
Grassland to forest vegetation	Annual average carbon increments in biomass (trees and shrubs)	year 1	Mg C/ha/yr	-2.69
	Annual average carbon increments in biomass (trees and shrubs)	years 2-20	Mg C/ha/yr	1.74
	Annual average carbon increments in dead organic matter (litter/DOM)	years 1-20	Mg C/ha/yr	0.41
	Annual average increments in soil organic carbon (SOC/SOM)	years 1-20	Mg C/ha/yr	0.32
Grassland to perennial plantations	Annual average carbon increments in biomass (trees and shrubs)	year 1	Mg C/ha/yr	-3.46
	Annual average carbon increments in biomass (trees and shrubs)	years 2-14, 16-20	Mg C/ha/yr	0.32
	Annual average carbon increments in biomass (trees and shrubs)	year 15	Mg C/ha/yr	-4.43
	Annual average carbon increments in dead organic matter (litter/DOM)	years 1-20	Mg C/ha/yr	0.00
	Annual average increments in soil organic carbon (SOC/SOM)	years 1-20	Mg C/ha/yr	-2.2650
Wetlands to cropland	Annual average carbon increments in biomass (trees and shrubs)	year 1	Mg C/ha/yr	0,8
	Annual average carbon increments in dead organic matter (litter/DOM)	year 1	Mg C/ha/yr	0.0
	Annual average increments in soil organic carbon (SOC/SOM)	year 1	Mg C/ha/yr	-2.2650
Settlements to cropland	Annual average carbon increments in biomass	year 1	Mg C/ha/yr	5.00
	Annual average carbon increments in dead organic matter (litter/DOM)	year 1	Mg C/ha/yr	0.00
	Annual average increments in soil organic carbon (SOC/SOM)	years 1-20	Mg C/ha/yr	0.2168
Other land to cropland	Annual average carbon increments in biomass	year 1	Mg C/ha/yr	5.00
	Annual average carbon increments in dead organic matter (litter/DOM)	year 1	Mg C/ha/yr	0.00
	Annual average increments in soil organic carbon (SOC/SOM)	year 1	Mg C/ha/yr	0.0108

Source: “Soil Quality Monitoring in the Republic of Moldova (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; “Moldsilva” Agency Reports on MSCP and MCFDP monitoring from 2012; 2013; 2017; 2018.

6.3.3. Uncertainties Assessment and Time-Series Consistency

4B1. Cropland Remaining Cropland

Uncertainties related to CO_2 emissions/removals from the 4.B1.1 “Cropland Remaining Cropland” may be considered relatively acceptable, falling within the values reported for other categories under the Sector 4 ‘LULUCF’. Thus, for production processes and emissions/removals factors these uncertainties account for circa ±10 per cent. The main uncertainty pertains to the actual volume of wood mass harvested from woody vegetation managed by local public authorities and other owners, as for this category there is no accurate official statistics on the volume of wood mass harvested during forest clearings. The situation was overcome by additional calculations based on the experience of the MACP and the Inspectorate for Environmental Protection (IEP) data. As a consequence, for this category, was included wood harvest authorized by IEP annually from the forestry fund and forest vegetation owned by local authorities and other public institutions (except for “Moldsilva” Agency). At the same time, it should be noted that for 2016, the IEP presented records separately by vegetation categories.

Uncertainties related to activity data used to estimate CO_2 emissions/removals from 4B1.2 “Annual Change in Carbon Stocks in Mineral Soils” category are deemed to be low (±10 per cent). 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 per cent. Thus, combined uncertainties related to CO_2 emissions from the “Annual Change in Carbon Stocks in Mineral Soils” are estimated at ±14.14 per cent (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

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 areas occupied by cereals and average yield per hectare reported for these crops are considered relatively small, up to ±10 per cent. At the same time uncertainties related to estimation the areas of stubble fields actually burnt are considered to be medium, up to ±50 per cent. Uncertainties associated with the default emission factors for various types of burning are moderate for CH_4 (±30 per cent) and medium for N_2O (±50 per cent), however, in agricultural seasons with high humidity these uncertainties can increase to higher levels. Thus, combined uncertainties related to non-CO_2 emissions from post-harvest field burning of agricultural residues are regarded to be relatively high: ±31.62 per cent for CH_4, respectively ±50.99 per cent 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 the 4B2 "Land Converted to Cropland" at the beginning and at the end of the reference period (1990 and 2016) may be considered relatively low, being estimated at circa ±10 per cent while uncertainties related to emission/removal factors are in both cases of circa ±10 per cent. Combined uncertainties for this source category were estimated at circa ±14.14 per cent (see Annex 5-3.4).

As for non-CO_2 emissions from the 4B2 category, uncertainties related to activity data are estimated at circa ±10 per cent, while uncertainties related to emission factors represent circa ±30 per cent. Combined uncertainties for non-CO_2 emissions from the 4B2 category are estimated at circa ±31.62 per cent (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

The quality of assessment for 4B1.1 "Cropland covered with woody vegetation" category is provided by the fact that most of the AD used is taken from official records[97]. At the same time, the quality of estimates increased due to the development of the Land Use and Land Use-Change Matrix for 1970-2016 periods. 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 following the 2006 IPCC Guidelines, correct use of national factors, 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 estimations related errors, on AD and EFs verifications and quality control procedures, etc. To be noted that AD and methods used for estimating 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 included into the 2006 IPCC Guidelines, CO_2 emissions within this sector resulting from land-use change and management practices were estimated based on AD from official sources of reference (General Land Cadasters of the Republic of Moldova, Statistical Yearbooks etc.), respectively the results of multiannual research from the scientific institutions in the country.

4B1.3. Non-CO_2 Emissions from Post-Harvest Field Burning of Crop Residues

[97] I.e., the total area of protection forest strips and other types of forest vegetation, perennial plantations is provided annually by the General Land Cadasters, while data on annual biomass increment are provided by the Production Tables, Forest State Records – once in 5 years for forests, Forest Planning Materials, Legislative, Normative and Technical Forestry Regulations Acts.

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 estimations related errors, on AD and EFs verifications and quality control procedures, etc. To be noted that AD and methods used for 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 1990-2015 time periods, recalculations were made for both subcategories 4B1 "Cropland Remaining Cropland" and 4B2 "Land Converted to Cropland". The recalculations for the respective categories are due to updating activity data that emerged from the improvement of the Land Use and Land Use-Change Matrix for 1970-2016 periods. At the same time, for 4B1.1 "Cropland Covered with Woody Vegetation" (source "Perennial Plantations") the estimation algorithm was revised, excluding overestimation of emissions' decreasing.

4B1. Cropland Remaining Cropland

4B1.1. Cropland Covered with Woody Vegetation

The comparative analysis of the CO_2 removals/emissions from the category 4B1.1 "Cropland Covered with Woody Vegetation" within 1990-2016 periods is presented in Table 6-41. The obtained results show a significant decrease with maximum deviations of -114.4 per cent in 1990, while the minimum deviations reached -81.1 per cent in 2004.

Table 6-41: Comparative Evolution for CO_2 Removals/Emissions from the 4B1.1 "Cropland Covered with Woody Vegetation" Category, included into the NC4 and the BUR2 of the RM under the UNFCCC, kt

	1990	1991	1992	1993	1994	1995	1996	1997	1998
NC4	-3331.0003	-4801.4045	-4840.0166	-4714.0567	-4481.1975	-4682.7670	-4371.7019	-4250.1710	-4192.9686
BUR2	479.3100	-624.5145	-553.3445	-418.9188	-646.0762	-470.2610	-634.6691	-331.7911	-302.7888
Difference, %	-114.4	-87.0	-88.6	-91.1	-85.6	-90.0	-85.5	-92.2	-92.8
	1999	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**
NC4	-4345.7620	-4280.1837	-4194.7085	-3890.6260	-3878.4909	-2739.7479	-3614.6135	-3589.5789	-3595.0674
BUR2	-322.7101	-503.2714	-111.9496	-542.8150	-467.1950	-519.0901	-507.8433	-494.4273	-538.9725
Difference, %	-92.6	-88.2	-97.3	-86.0	-88.0	-81.1	-86.0	-86.2	-85.0
	2008	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**
NC4	-3532.2814	-3391.1851	-3431.7251	-3440.3478	-3519.3132	-3507.4181	-3544.4010	-3648.5358	
BUR2	-555.9583	-416.3142	-540.8834	-546.5834	-550.7287	-464.2803	-476.5187	-492.5544	-429.2418
Difference, %	-84.3	-87.7	-84.2	-84.1	-84.4	-86.8	-86.6	-86.5	

Abbreviations: NC4 – Fourth National Communication; BUR2 – Second Biennial Update Report.

4B1.2. Annual Change in Carbon Stocks in Mineral Soils

No recalculations were performed for the 4B1.2 "Annual Change in Carbon Stocks in Mineral Soils" category.

4B1.3. Non-CO_2 Emissions from Post-Harvest Field Burning of Crop Residues

No recalculations were performed for the 4B1.3 "Non-CO_2 Emissions from Post-Harvest Field Burning of Crop Residues" (stubble fields burning).

4B2. Land Converted to Cropland

The comparative analysis of the CO_2 removals/emissions from the category 4B2 "Land Converted to Cropland" within 1990-2016 periods is presented in Table 6-42. The obtained results show a significant change for this category – from a source of CO_2 emissions it became a source of CO_2 removals. The maximum deviations represented 131.3 per cent in 2015, while the minimum deviations reached 107.0 per cent in 2010.

Table 6-42: Comparative Evolution for CO_2 Removals/Emissions from the 4B2 "Land Converted to Cropland" Category, included into the NC4 and the BUR2 of the Republic of Moldova under the UNFCCC, kt

	1990	1991	1992	1993	1994	1995	1996	1997	1998
NC4	1 005.5978	978.9688	856.4881	888.5966	912.7487	1 015.6958	1 083.1337	1 012.0184	1 037.7153
BUR2	-94.0174	-109.3980	-252.6231	-126.6896	-101.1878	-173.7295	-177.2498	-174.7878	-181.4135
Difference, %	-109.3	-111.2	-129.5	-114.3	-111.1	-117.1	-116.4	-117.3	-117.5

	1999	2000	2001	2002	2003	2004	2005	2006	2007
NC4	1 124.3353	1 200.2264	1 297.2536	1 405.8276	1 444.9642	1 478.8082	1 291.2109	1 102.4055	1 156.5592
BUR2	-136.9493	-153.4270	-188.5893	-161.1900	-156.0563	-135.5600	-102.6473	-100.4120	-93.0370
Difference, %	-112.2	-112.8	-114.5	-111.5	-110.8	-109.2	-107.9	-109.1	-108.0
	2008	2009	2010	2011	2012	2013	2014	2015	2016
NC4	1 138.2331	1 140.7945	1 154.8436	1 166.4621	1 203.9295	1 174.6617	1 062.1085	983.9336	
BUR2	-103.5677	-91.5818	-80.9948	-118.0546	-97.5672	-281.2757	-250.4380	-308.0154	-382.1704
Difference, %	-109.1	-108.0	-107.0	-110.1	-108.1	-123.9	-123.6	-131.3	

Abbreviations: NC4 – Fourth National Communication; BUR2 – Second Biennial Update Report.

No recalculations were performed for N_2O emissions resulting from the conversion of grassland to cropland included in 4B2 "Land Converted to Cropland" category within 1990-2016 periods as these were estimated separately for the first time.

Below are presented CO_2 removals/emissions from the 4B "Cropland" category from 1990 through 2016.

4B1. Cropland Remaining Cropland

4B1.1. Cropland Covered with Woody Vegetation

Within the reference period, CO_2 removals from the respective category were relatively constant, with significant fluctuations in 1990-2002 time series due to internal conversions.

Towards the end of the period, an increase by circa 189.6 per cent of total CO_2 removals was recorded, compared to 1990.

The evolution of CO_2 removals within the source category 4B1.1 "Cropland Covered with Woody Vegetation" between 1990 and 2016 is presented in Table 6-43.

Table 6-43: CO_2 Removals from "Cropland Covered with Woody Vegetation" in the Republic of Moldova within 1990-2016 periods, kt

	1990	1991	1992	1993	1994	1995	1996	1997	1998
Perennial plantations	621.0776	-470.8458	-412.0377	-359.7555	-532.4280	-311.5310	-488.2169	-256.3340	-213.2668
Forest vegetation	-141.7676	-153.6687	-141.3068	-59.1633	-113.6482	-158.7300	-146.4522	-75.4572	-89.5220
Total	**479.3100**	**-624.5145**	**-553.3445**	**-418.9188**	**-646.0762**	**-470.2610**	**-634.6691**	**-331.7911**	**-302.7888**
	1999	2000	2001	2002	2003	2004	2005	2006	2007
Perennial plantations	-145.0914	-329.9127	61.4331	-356.7158	-349.4031	-343.8840	-316.4868	-291.7716	-326.2119
Forest vegetation	-177.6188	-173.3587	-173.3827	-186.0992	-117.7919	-175.2060	-191.3565	-202.6557	-212.7606
Total	**-322.7101**	**-503.2714**	**-111.9496**	**-542.8150**	**-467.1950**	**-519.0901**	**-507.8433**	**-494.4273**	**-538.9725**
	2008	2009	2010	2011	2012	2013	2014	2015	2016
Perennial plantations	-341.7083	-318.5139	-350.9427	-334.2057	-336.9199	-323.2828	-304.9532	-293.4707	-259.0135
Forest vegetation	-214.2500	-97.8004	-189.9407	-212.3777	-213.8088	-140.9975	-171.5655	-199.0837	-170.2283
Total	**-555.9583**	**-416.3142**	**-540.8834**	**-546.5834**	**-550.7287**	**-464.2803**	**-476.5187**	**-492.5544**	**-429.2418**

The graphical illustration of CO_2 removals evolution within the source category 4B1.1 "Cropland Covered with Woody Vegetation" is provided in Figure 6-6.

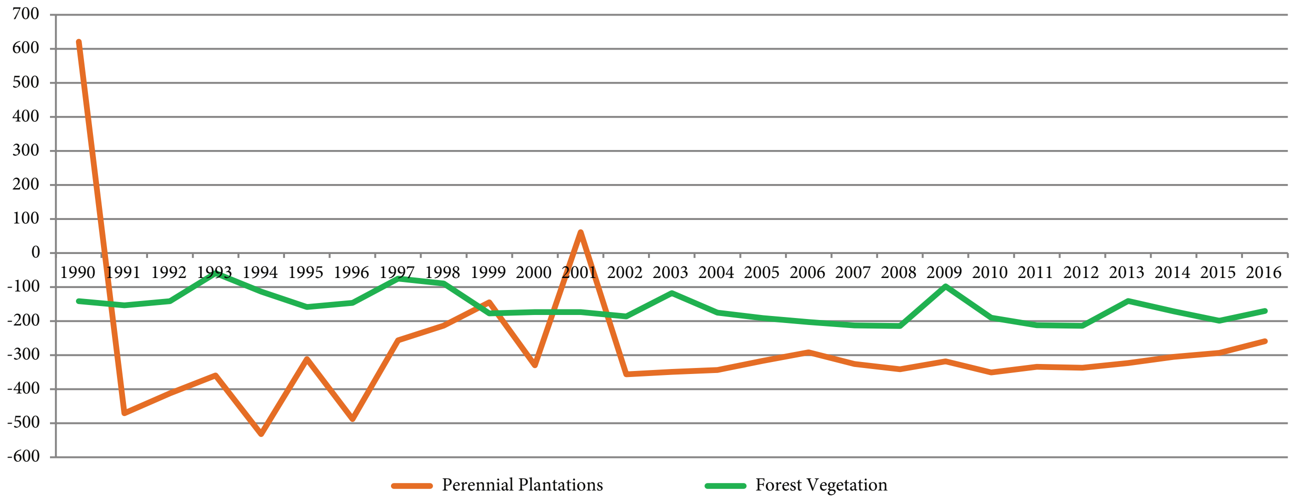


Figure 6-6: CO_2 Removals from "Cropland Covered with Woody Vegetation" in the Republic of Moldova within 1990-2016 periods, kt.

4B1.2. Annual Change in Carbon Stocks in Mineral Soils

CO_2 emissions from 4B1.2 "Annual Change in Carbon Stocks in Mineral Soils" category between 1990 and 2016 were relatively constant, with insignificant fluctuations in certain years (Table 6-44). At the same time, due to the above-mentioned factors, CO_2 emissions from 4B1.2 category increased by 2016 with circa 12.1 per cent, in comparison with the reference year.

Table 6-44: CO_2 Removals from 4B1.2 "Annual Change in Carbon Stocks in Mineral Soils" Category in the Republic of Moldova within 1990-2016 periods, kt

	1990	1991	1992	1993	1994	1995	1996	1997	1998
Emissions from mineral soils	1747.2754	1725.0092	1751.8566	1746.8240	1747.2071	1747.1140	1752.9849	1786.8799	1807.0429
	1999	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**
Emissions from mineral soils	1808.1277	1795.2647	1791.0468	1788.5129	1787.5228	1785.4564	1834.1640	1878.8552	1877.2201
	2008	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**
Emissions from mineral soils	1876.1181	1877.1759	1877.6128	1873.4630	1838.9486	1874.1545	1899.8555	1937.1842	1958.1110

The graphical illustration of CO_2 emissions evolution within the source category 4B1.2 "Annual Change in Carbon Stocks in Mineral Soils" is provided in Figure 6-7.

Maintaining the existing system of agricultural exploitation of arable soils will lead to maintaining the same rate of CO_2 emissions from the humus reserves in soils as well as to the progressive degradation of their physical, chemical, biological and fertility qualities. To be noted that attempts to increase the soils productivity by increasing the amount of synthetic fertilizers, as seen in recent years, will not generate a positive result, since in the Republic of Moldova there are mostly argillaceous soils and the reduce flow of organic matter will lead to the degradation of their physical qualities, respectively will decrease the productivity potential. Thus, for arable soils, any action leading to increased flow of organic matter will lead, at the same time, to long-term preservation of soil fertility, respectively to decreased CO_2 emissions.

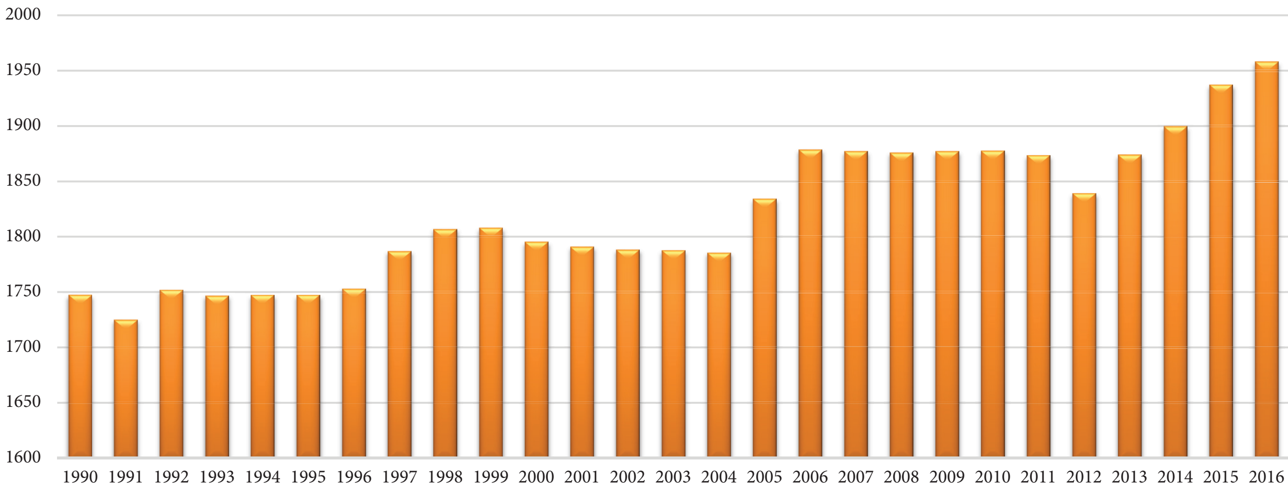


Figure 6-7: CO_2 Emissions from "Annual Change in Carbon Stocks in Mineral Soils" Category in the Republic of Moldova within 1990-2016 periods, kt.

4B1.3. Non-CO_2 Emissions from Post-Harvest Field Burning of Crop Residues

The evolution of non-CO_2 emissions from 4B1.3 "Non-CO_2 Emissions from Post-Harvest Field Burning of Crop Residues" (stubble fields burning) between 1990 and 2016 is presented in Table 6-45. By the end of the period under review, the volume decreased significantly, representing only 2.0 per cent compared to 1990. At the same time, to be noted that from year to year, the volume fluctuates significantly due to adverse weather conditions and anthropogenic factors.

Table 6-45: Non-CO_2 Emissions from Stubble Fields Burning in the RM within 1990-2016 periods

	1990	1991	1992	1993	1994	1995	1996	1997	1998
CH_4, kt	0.0978	0.0946	0.0864	0.1178	0.0639	0.0895	0.0609	0.1073	0.0966
N_2O, kt	0.0025	0.0025	0.0022	0.0031	0.0017	0.0023	0.0016	0.0028	0.0025
Total, kt CO_2 equivalent	**3.2021**	**3.0960**	**2.8267**	**3.8540**	**2.0914**	**2.9274**	**1.9920**	**3.5110**	**3.1598**
	1999	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**
CH_4, kt	0.0938	0.0364	0.0469	0.0085	0.0001	0.0020	0.0093	0.0038	0.0061
N_2O, kt	0.0024	0.0009	0.0012	0.0002	0.0000	0.0001	0.0002	0.0001	0.0002
Total, kt CO_2 equivalent	**3.0702**	**1.1921**	**1.5340**	**0.2789**	**0.0044**	**0.0642**	**0.3059**	**0.1228**	**0.1997**

	2008	2009	2010	2011	2012	2013	2014	2015	2016
CH_4, kt	0.0270	0.0033	0.0023	0.0020	0.0003	0.0026	0.0020	0.0015	0.0019
N_2O, kt	0.0007	0.0001	0.0001	0.0001	0.0000	0.0001	0.0001	0.0000	0.0001
Total, kt CO_2 equivalent	**0.8839**	**0.1086**	**0.0761**	**0.0666**	**0.0096**	**0.0862**	**0.0663**	**0.0505**	**0.0632**

4B2. Land Converted to Cropland

Between 1990-2016 time series, CO_2 removals from 4B2 "Land Converted to Cropland" category fluctuated (Table 6-46), being influenced by the conversion process of different types of land to cropland, including before 1990 (see Table 6-39).

Table 6-46: CO_2 Removals from 4B2 "Land Converted to Cropland" Category in the Republic of Moldova within 1990-2016 periods, kt

	1990	1991	1992	1993	1994	1995	1996	1997	1998
4B2. CO_2 Removals	-94.0174	-109.3980	-252.6231	-126.6896	-101.1878	-173.7295	-177.2498	-174.7878	-181.4135
	1999	2000	2001	2002	2003	2004	2005	2006	2007
4B2. CO_2 Removals	-136.9493	-153.4270	-188.5893	-161.1900	-156.0563	-135.5600	-102.6473	-100.4120	-93.0370
	2008	2009	2010	2011	2012	2013	2014	2015	2016
4B2. CO_2 Removals	-103.5677	-91.5818	-80.9948	-118.0546	-97.5672	-281.2757	-250.4380	-308.0154	-382.1704

By the end of the period under review it stabilized, increasing by 406.5 per cent compared to the reference year.

The graphical illustration of CO_2 emissions evolution within the source category 4B2 "Land Converted to Cropland" is provided in Figure 6-8.

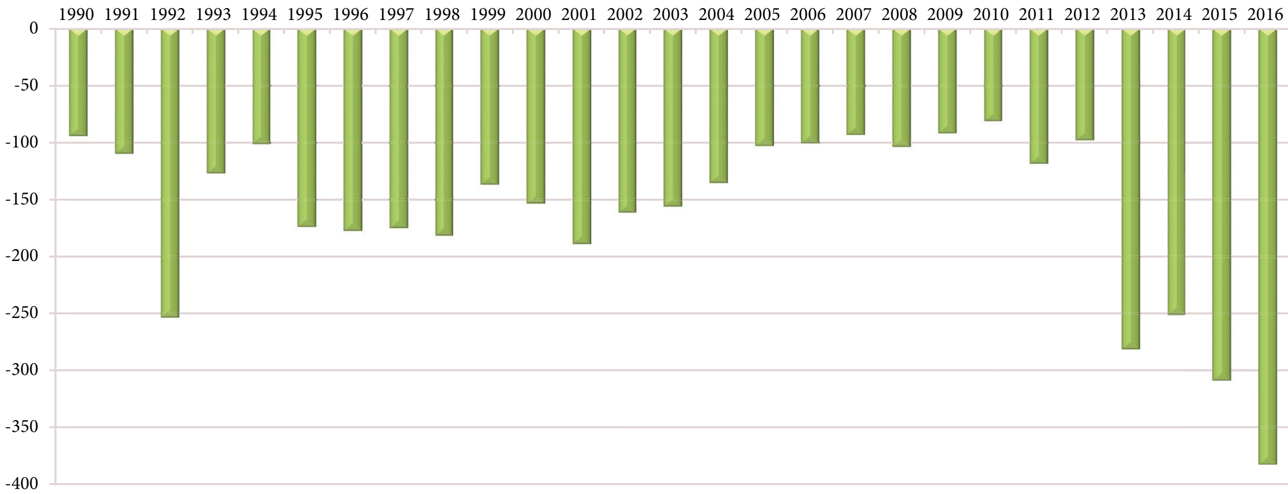


Figure 6-8: CO_2 Emissions from 4B2 "Land Converted to Cropland" Category in the Republic of Moldova within 1990-2016 periods, kt.

N_2O emissions resulting from the conversion of grassland to cropland included in 4B2 "Land Converted to Cropland" category within 1990-2016 periods fluctuated, with the exception of 1990-1995 time series, when important values were recorded (Table 6-47). By the end of the period under review, the volume decreased by 12.6 times compared to 1990.

Table 6-47: N_2O Emissions Resulting from the Conversion of Grassland within 4B2 "Land Converted to Cropland" Category in the RM,1990-2016

	1990	1991	1992	1993	1994	1995	1996	1997	1998
N_2O, kt	0.0325	0.0310	0.0299	0.0297	0.0249	0.0247	0.0178	0.0088	0.0085
Total, kt CO_2 equivalent	**9.6848**	**9.2497**	**8.9048**	**8.8551**	**7.4135**	**7.3655**	**5.3009**	**2.6346**	**2.5231**
	1999	2000	2001	2002	2003	2004	2005	2006	2007
N_2O, kt	0.0085	0.0081	0.0067	0.0063	0.0056	0.0046	0.0054	0.0047	0.0048
Total, kt CO_2 equivalent	**2.5231**	**2.4243**	**1.9868**	**1.8873**	**1.6691**	**1.3645**	**1.6090**	**1.4110**	**1.4205**
	2008	2009	2010	2011	2012	2013	2014	2015	2016
N_2O, kt	0.0045	0.0045	0.0027	0.0026	0.0026	0.0026	0.0026	0.0026	0.0026
Total, kt CO_2 equivalent	**1.3481**	**1.3481**	**0.8048**	**0.7691**	**0.7691**	**0.7691**	**0.7691**	**0.7691**	**0.7691**

Net CO_2 removals/emissions aggregated at the category level are presented in Table 6-48 and Figure 6-9.

Table 6-48: CO_2 Removals/Emissions from 4B "Cropland" Category in the Republic of Moldova within 1990-2016 periods, kt

	1990	1991	1992	1993	1994	1995	1996	1997	1998
4B1	2 602.9804	1 489.8617	1 571.4108	1 707.8393	1 479.6972	1 652.6167	1 489.3644	1 802.8445	1 838.5706
4B2	-94.0174	-109.3980	-252.6231	-126.6896	-101.1878	-173.7295	-177.2498	-174.7878	-181.4135
4B	2 508.9630	1 380.4637	1 318.7877	1 581.1497	1 378.5094	1 478.8872	1 312.1146	1 628.0567	1 657.1571
	1999	2000	2001	2002	2003	2004	2005	2006	2007
4B1	1 814.6174	1 618.8065	1 999.8174	1 568.8050	1 645.1586	1 589.7492	1 630.9279	1 666.3069	1 621.1746
4B2	-136.9493	-153.4270	-188.5893	-161.1900	-156.0563	-135.5600	-102.6473	-100.4120	-93.0370
4B	1 677.6681	1 465.3794	1 811.2281	1 407.6151	1 489.1023	1 454.1892	1 528.2806	1 565.8949	1 528.1376
	2008	2009	2010	2011	2012	2013	2014	2015	2016
4B1	1 603.3550	1 744.0569	1 618.9873	1 610.5807	1 593.5785	1 689.4814	1 696.1650	1 700.3970	1 775.4060
4B2	-103.5677	-91.5818	-80.9948	-118.0546	-97.5672	-281.2757	-250.4380	-308.0154	-382.1704
4B	1 499.7873	1 652.4751	1 537.9925	1 492.5261	1 496.0113	1 408.2056	1 445.7270	1 392.3816	1 393.2356

According to the results obtained, it is observed that during the entire period under review, the 4B category represented a source of CO_2 emissions. The level of emissions recorded relatively fluctuated, with the exception of 2002-2014 time series, when was relatively constant. By the end of the period under review, the volume decreased significantly, in 2016 reaching -44.5 per cent compared to 1990.

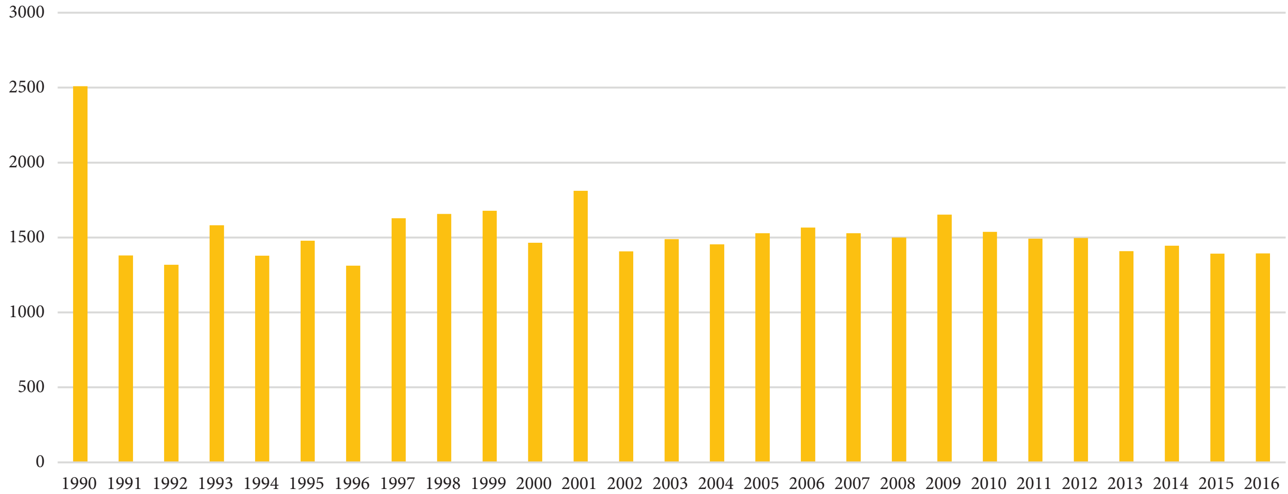


Figure 6-9: CO_2 Removals/Emissions from 4B "Cropland" Category in the RM within 1990-2016 periods, kt.

Figure 6-10 presents the individual contribution of the two subcategories (4B1 and 4B2) to CO_2 removals/emissions. As can be seen, due to the land-use change and management practices, as well as the conversion process of different types of land to cropland, 4B1 is a constant source of CO_2 emissions, while 4B2 – a source of removals.

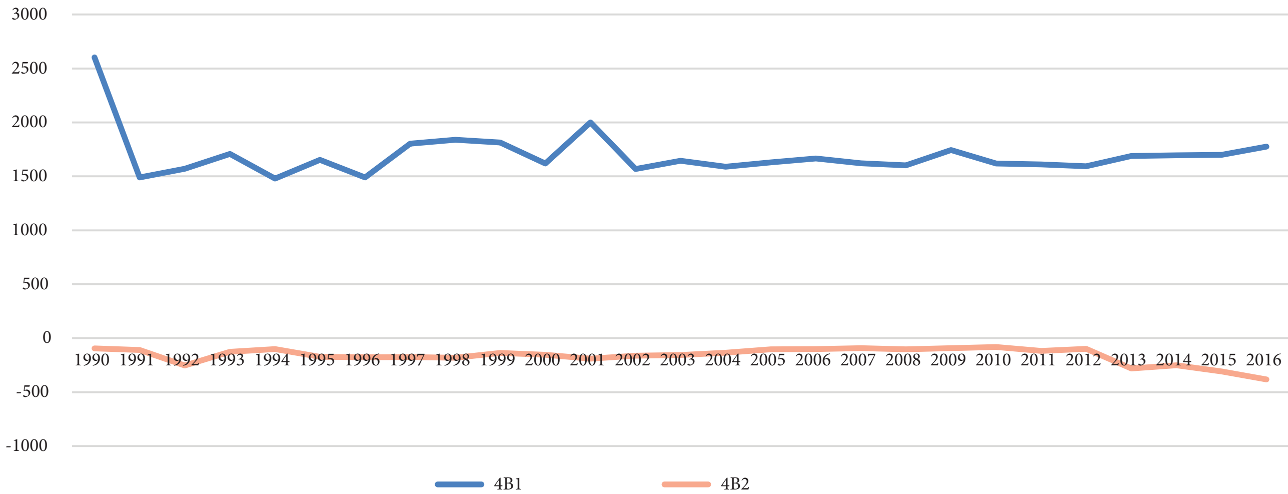


Figure 6-10: Evolution of CO_2 Removals/Emissions from 4B "Cropland" Category by Each Subcategory in the RM within 1990-2016, kt.

6.3.6. Planned Improvements

4B1. Cropland Remaining Cropland

4B1.1. Cropland Covered with Woody Vegetation

For the next inventory cycle it will be considered the possibility to improve records pertaining to actual volume of wood from forest stripes management as well as other types of forest vegetation and also activities aimed at verification of emission/removal factors specific to perennial plantations (current biomass increments, biomass harvesting during the cleaning cuttings).

4B1.2. Annual Change in Carbon Stocks in Mineral Soils

It is planned to carry out activities aimed at reducing uncertainties associated with the results obtained under the respective source category, including by improving the country specific methodology (Banaru, 2000) and improving the quality of used activity data, in order to make possible estimation of CO_2 emissions/removals from "Annual Change in Carbon Stocks in Mineral Soils".

4B1.3. Non-CO_2 Emissions from Post-Harvest Field Burning of Crop Residues

No improvements are planned for this category.

4B2. Land Converted to Cropland

No improvements are planned for this category.

6.4. Grassland (Category 4C)

6.4.1. Source Category Description

Category 4C "Grassland" comprises CO_2 emissions/removals originated 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 the LULUCF sector, in 1990 year the grassland accounted for 26.6 per cent of the total CO_2 removals, being an important source within this sector.

Subcategory 4C1 "Grassland Remaining Grassland" includes land which has always been covered with perennial herbaceous vegetation and used as pastures or hayfields, land covered with perennial herbaceous vegetation from other categories of use (land under improvement and fertility restoration; landslides) as well as land transformed into pastures more than 20 years ago. The main source of references for the areas of these lands is the General Land Cadaster of the RM for the reporting period.

Within the 4C2 "Land Converted to Grassland" subcategory, are estimated CO_2 emissions/removals resulting from the restoration of natural vegetation on land excluded from agriculture use and transformed to grassland as well as from land that previously was covered with forest vegetation now converted to grassland. Conversion of cropland to grassland is a regular process over the past 50 years in the Republic of Moldova, because a considerable part of cropland is severely affected by erosion and reached to an extremely low level of economic efficiency of cropping.

Another negative process that started in the 1990' along with the social-political changes is conversion of lands with woody vegetation into arable areas. This process mostly affected lands managed by local public authorities and agricultural enterprises previously (in particular in the time period from 1991 through 1996). Over 80 per cent of such vegetation is *Robinia pseudoacacia* stands. In most cases (90 per cent of the total), the wood mass harvested on these lands is used as fuel used for heating and cooking. Only 10 per cent (shoots, bark etc.) remain on the cutting site. Brush burning on site is not practiced. This process started in 1991, the highest indicators being reported for the time period from 1993 through 1996.

Activity data used within the development of inventory for the period of time from 1990 through 2017 are available in the General Land Cadasters of the Republic of Moldova, as well as in the Reports of the "Moldsilva" Agency and the Inspectorate for Environmental Protection (forest land converted to grassland).

6.4.2. Methodological Issues, Emission Factors and Data Sources

4C1. Grassland Remaining Grassland

Within the 4C1 "Grassland Remaining Grassland" category, were estimated CO_2 emissions / removals resulting from the following categories of national use (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.

The main source of references for the areas of these lands is the General Land Cadaster of the RM for the reporting period. The evolution of areas included in this category between 1990 and 2016 is presented in Table 6-49.

Table 6-49: Grassland Area in the Republic of Moldova within 1990-2016 periods, thousand ha

Land Category	1990	1991	1992	1993	1994	1995	1996	1997	1998
Grassland	243.30	241.90	237.35	244.19	237.60	236.73	236.30	235.79	236.49
Land Category	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**
Grassland	242.07	247.80	258.02	266.51	265.20	261.04	264.06	259.07	259.99
Land Category	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**
Grassland	269.66	300.88	304.84	310.26	309.63	305.92	308.06	305.45	305.92

Source: Land Use and Land Use-Change Matrix for 1970-2016 periods; General Land Cadaster for 1970-2017.

Country specific emission factors were used, in order to establish annual biomass growth/loss rates on grassland. Thus, the annual biomass growth rate was estimated considering the distribution of grasslands by categories and productivity (meadows and grasslands on slopes with high, medium or low productivity), respectively data from scientific literature in the RM (Table 6-50).

Table 6-50: Annual Biomass Growth Rates Used to Estimate Emissions/Removals within the 4C1 'Grassland Remaining Grassland' Category

Categories	Productivity	Annual Biomass Growth, t d.m./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 the Orhei National Park [64-66].

CO_2 emissions/removals from grassland remaining grassland are related to how they are managed and management change, while the estimation process involves assessing the impact of change in carbon stocks management practices.

Based on the inventory surveys of the grasslands from the National Park Orhei (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 is observed that grasslands (pastures and hayfields) in these areas, like most in the RM are managed traditionally in an extensive and unsystematic way. The practiced system is characterized by minimal care work, or even by total lack and by the lack of correlation between the production capacity of grasslands and their loading with animals. For this reason, grasslands cannot be fully used due to under-exploitation/sub-loading with animals (which is why the invasion of grassland with spontaneous shrubby vegetation occurs) or can be overloaded, failing to provide sufficient food for the entire livestock.

It should be noted that regarding the grasslands with a relatively constant productivity over time, where has been no intervention in order to increase the productivity, the Tier 1 approach from the 2006 IPCC Guidelines considers the biomass stock in balance, respectively, the stock does not change in time and space on a national scale. Thus, CO_2 emissions/removals from grassland remaining grassland are not estimated.

4C2. Land Converted to Grassland

The "Land Converted to Grassland" category includes land with forest vegetation, arable land, perennial plantations (vineyards and orchards), as well as wetlands (marshes, wetlands saturated by water), settlements converted to grasslands in the last 20 years. GHG emissions/removals from this category result from land-use change, changes in land management thus eliminating the existing vegetation and its replacement with grassland vegetation. In order to estimate CO_2 emissions/removals from the conversion of different land categories in grassland, from the General Land Cadaster of the RM, as well as the Reports of the "Moldsilva" Agency and the Reports of the Inspectorate for Environmental Protection, have been taken the areas of cropland and wetlands converted to grassland, as well as forest areas and other types of forest vegetation destroyed by illegal logging (Table 6-51).

Table 6-51: Area of Lands Converted to Grassland in the RM within 1970-2016 periods, ha

Category of Use	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981
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
arable lands	*0.0*	*0.0*	*0.0*	*8051.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*
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*
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*
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
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
IV. Other land	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	9027.1	16419.7	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**

Category of Use	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993
I. Cropland converted to grassland, total	13719.0	0.0	127.6	7211.5	351.2	7046.2	15818.4	36651.3	21077.0	3800.8	157.6	3037.1
arable lands	*13719.0*	*0.0*	*0.0*	*6781.7*	*0.0*	*4984.4*	*15818.4*	*36632.3*	*20247.0*	*3800.8*	*0.0*	*1759.9*
forest vegetation	*0.0*	*0.0*	*127.6*	*0.0*	*0.0*	*2042.1*	*0.0*	*0.0*	*830.0*	*0.0*	*0.0*	*957.2*
vineyards and orchards	*0.0*	*0.0*	*0.0*	*429.9*	*351.2*	*19.7*	*0.0*	*19.0*	*0.0*	*0.0*	*157.6*	*320.0*
II. Wetlands converted to grassland	0.0	500.0	0.0	0.0	0.0	0.0	0.0	0.0	200.0	700.0	0.0	0.0
III. Settlements converted to grassland	109.8	0.0	0.0	384.5	329.5	0.0	91.5	0.0	54.9	0.0	0.0	36.6
IV. Other land	26895.7	33104.2	34252.4	43629.7	49532.5	47818.2	46326.6	43488.1	31613.8	33171.0	33154.5	34877.1
Total	**40724.5**	**33604.2**	**34380.0**	**51225.7**	**50213.2**	**54864.4**	**62236.6**	**80139.4**	**52945.8**	**37671.8**	**33312.1**	**37950.8**

Category of Use	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
I. Cropland converted to grassland, total	314.5	2290.9	5582.4	4873.3	3376.3	7039.4	17713.1	790.2	85.2	1177.3	0.3	0.0
arable lands	*0.0*	*1965.5*	*4956.8*	*2655.9*	*1764.7*	*6708.5*	*17144.9*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*
forest vegetation	*0.0*	*0.0*	*382.9*	*1978.3*	*1340.1*	*0.0*	*255.3*	*265.5*	*0.0*	*1128.9*	*0.0*	*0.0*
vineyards and orchards	*314.5*	*325.4*	*242.8*	*239.1*	*271.5*	*330.9*	*312.9*	*524.7*	*85.2*	*48.4*	*0.3*	*0.0*
II. Wetlands converted to grassland	0.0	200.0	0.0	0.0	0.0	0.0	0.0	43.0	0.0	1121.0	0.0	731.0
III. Settlements converted to grassland	0.0	100.0	36.6	0.0	73.2	0.0	0.0	13.0	7.9	0.0	52.9	77.1
IV. Other land	46680.4	47554.4	44423.0	42409.5	38942.2	26984.1	11947.5	6222.2	8402.9	0.0	0.0	0.0
Total	**46995.0**	**50145.3**	**50042.0**	**47282.7**	**42391.7**	**34023.5**	**29660.6**	**7068.4**	**8496.0**	**2298.3**	**53.2**	**808.1**

Category of Use	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
I. Cropland converted to grassland, total	0.0	407.7	0.0	1949.0	39.4	39.8	5259.4	1166.4	680.6	50.1	0.1	NA
arable lands	*0.0*	*407.7*	*0.0*	*0.0*	*0.0*	*0.0*	*5184.6*	*0.0*	*0.0*	*0.0*	*0.0*	NA
forest vegetation	*0.0*	*0.0*	*0.0*	*1914.4*	*0.0*	*37.8*	*15.0*	*1165.6*	*616.5*	*0.0*	*0.0*	NA
vineyards and orchards	*0.0*	*0.0*	*0.0*	*34.6*	*39.4*	*2.1*	*59.7*	*0.8*	*64.1*	*50.1*	*0.1*	NA
II. Wetlands converted to grassland	0.0	0.0	0.0	0.0	0.0	175.4	234.0	2405.0	79.0	131.0	526.0	NA
III. Settlements converted to grassland	227.8	63.5	25.5	70.4	4.4	0.0	6.9	0.0	0.0	0.0	0.0	NA
IV. Other land	0.0	1714.6	3921.3	4039.2	19829.4	18524.4	11761.2	5166.2	0.0	2474.6	4486.8	NA
Total	**227.8**	**2185.8**	**3946.8**	**6058.6**	**19873.3**	**18739.7**	**17261.5**	**8737.5**	**759.6**	**2655.6**	**5012.8**	**NA**

Source: General Land Cadasters of the Republic of Moldova for 1990-2017, Reports of "Moldsilva" Agency and Reports of State Ecological Inspectorate on the area of forest land and other types of forest vegetation cleared through illegal logging for 1990-2016; Land Use and Land Use-Change Matrix for 1970-2016 periods.

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 CO_2 removals in biomass on land converted to grassland, the annual increments in 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 stocks due to current biomass growth in the new grasslands, and uses Equation 2.15 from the 2006 IPCC Guidelines (Volume 4, Chapter 2, Page 2.22):

$$\Delta C_B = \Delta C_G + \Delta C_{Conversion} - \Delta C_L$$

Where:

ΔC_B – annual change in carbon stocks in biomass on land converted to grassland, t C/yr;

ΔC_G – annual increase in carbon stocks in biomass due to growth on land converted to grassland, t C/yr;

$\Delta C_{Conversion}$ – initial change in carbon stocks in biomass on land converted to grassland, t C/yr;

ΔC_L – annual decrease in biomass carbon stocks on land converted to grassland, due to grass/ biomass harvest, disturbances t C/yr.

Initial changes in carbon stocks in biomass on land converted to grassland ($\Delta C_{Conversion}$) were estimated using Equation 2.16 from the 2006 IPCC Guidelines (Volume 4, Chapter 2, Page 2.20):

$$\Delta C_{Conversion} = \sum\{(B_{After} - B_{Before}) \bullet \Delta A_{TO\ OTHERS}\} \bullet CF$$

Where:

B_{After} – biomass stocks on land immediately after the conversion, t d.m.//ha;

B_{Before} – biomass stocks on land before the conversion, t d.m./ha;

$\Delta A_{TO\ OTHERS}$ – area of land-use converted to land use category in a certain year, ha/yr;

CF – carbon fraction of dry matter.

The EFs used in the assessment process are presented in Table 6-52.

Table 6-52: EFs Used to Estimate Emissions/Removals from the 4C2 "Lands Converted to Grassland" Category

Conversion	Indicators	Period, years	Units	Indicators Value
Cropland Converted to Grassland	Annual average carbon increments in biomass	year 1	Mg C/ha/yr	-1.22
	Annual average carbon increments in dead organic matter (litter/DOM)	year1	Mg C/ha/yr	0.00
	Annual average increments in soil organic carbon (SOC/SOM)	years 1-20	Mg C/ha/yr	2.2650
Forest Land Converted to Grassland	Annual average carbon increments in biomass	year 1	Mg C/ha/yr	-26.02
	Annual average carbon increments in dead organic matter (litter/DOM)	year1	Mg C/ha/yr	-1.15
	Annual average increments in soil organic carbon (SOC/SOM)	years 1-20	Mg C/ha/yr	1.0662
Perennial Plantations Converted to Grassland	Annual average carbon increments in biomass	year 1	Mg C/ha/yr	-0.65
	Annual average carbon increments in dead organic matter (litter/DOM)	year1	Mg C/ha/yr	0.00
	Annual average increments in soil organic carbon (SOC/SOM)	years 1-20	Mg C/ha/yr	2.2650
Wetlands Converted to Grassland	Annual average carbon increments in biomass	year 1	Mg C/ha/yr	0.00
	Annual average carbon increments in dead organic matter (litter/DOM)	year1	Mg C/ha/yr	0.00
	Annual average increments in soil organic carbon (SOC/SOM)	years 1-20	Mg C/ha/yr	2.4818
Settlements Converted to Grassland	Annual average carbon increments in biomass	year 1	Mg C/ha/yr	3.78
	Annual average carbon increments in dead organic matter (litter/DOM)	year1	Mg C/ha/yr	0.00
	Annual average increments in soil organic carbon (SOC/SOM)	years 1-20	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 Nr. 46-49, Government Resolution Nr. 367 from 13.04.2000, 'On approval 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 Assessment and Time-Series Consistency

4C1. Grassland Remaining Grassland

Uncertainties associated with the CO_2 emissions/removals from 4C1 "Grassland Remaining Grassland", pertain mainly to the actual grassland productivity in the Republic of Moldova. Being situated in different pedoclimatic conditions the grassland productivity ranges from 1.2 to 3.2 t d.m./ha. By using the weighted average grasses productivity, the uncertainties have been reduced in some extent to relatively acceptable values: ±15 per cent for production processes and ±10 per cent for emission/ removal factors. The rest of uncertainties have not been calculated since it was established that CO_2 emissions/removals from 4C1 "Grassland Remaining Grassland" are in balance, respectively the stock does not change in time and space on national level.

4C2. Land Converted to Grassland

Uncertainties associated with the CO_2 emissions/removals resulted from 4C2 "Land Converted to Grassland" are higher, however, within acceptable limits.

Land conversion (cropland, forest vegetation etc.) to grassland is a normal process in the RM, having a different magnitude between 1970 and 2016. In the reference year (1990), the accuracy degree represented circa ±5 per cent for "production processes", what is explained by the fact that state forestry institutions and environmental protection entities practiced a full revision of forests and forest vegetation owned by local authorities/ agricultural enterprises in spring and autumn, thus the cadastral records registered systematically changes in land-use categories, etc. By the end of the reference period

(2016), the accuracy degree of the results decreased up ±15 per cent, what is explained by the lack of veridical records on evolution of land use of forest land damaged by illegal logging (grazing, cropping etc.). In both cases, emission/removal factors have an uncertainty level of circa ±10 per cent.

In conformity with current practices, most of converted forest land are continuously used for grazing, because most of such lands are degraded, or situated on slopes over 7°, where cropping is economically inefficient. Conversion of cropland was a contradictory process, as uncertainties associated with area of grassland were conditioned both by conversion of arable lands, and their afforestation and planting perennial vegetation (orchards, vineyards).

Land Cadasters after 1994 contain only general information in this sense, without specifying to what categories the cropland (arable lands, perennial plantations, etc.) were converted to. One part of them was converted to forest land, while the other (depending on condition) was transferred to other categories (grassland, ravines, landslides, etc.). Practically, only the land-use category (in many cases determined by local traditions) to some extent reflects the condition of such land after conversion.

Thus, combined uncertainties related to CO_2 emissions/removals from the 4C2 "Land Converted to Grassland" can be regarded as medium, and is estimated at ±18.0 per cent.

6.4.4. Quality Assurance and Quality Control

The quality of assessment for 4C "Grassland" category is provided by the fact that most of the AD used is taken from official records. Thus, the total area of grassland is provided by the General Land Cadasters of the Republic of Moldova for each year.

Data regarding area of forest land converted to grassland are available in the sectoral records of the state forestry institutions (Statistical Report 5 "Statistic 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 are provided by "Production Tables" and concrete "Records/Measurements". For grassland, data were taken from the scientific literature in the field, from the normative and technical regulations acts, as well as from the grassland inventory reports of the Forest Research and Management Institute within the Orhei National Park.

Within this category, verification was focused, following the recommendations included in the 2006 IPCC Guidelines, on various aspects such as: 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 1970-2016 periods.

Standard verification and quality control forms and checklists were filled in for this category, following a Tier 1 approach. To be noted that according to the recommendations included into the 2006 IPCC Guidelines, CO_2 emissions/removals from grassland use processes within this sector were estimated based on AD from official sources of reference (General Land Cadasters 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

For 4C2 "Land Converted to Grassland" category recalculations were performed for the period 1990-2015, due to the change of approaches made for the Land Use and Land Use-Change Matrix for 1970-2016, in particular regarding the conversion of other land to grassland. According to the new approaches for this type of conversion, it was established a conversion period of 1 year, since it is a provisional/conventional and the respective land is than converted to other land use categories for a longer period of time (orchards, forests and forest vegetation).

The comparative analysis of CO_2 removals/emissions between 1990 and 2016 within the source category 4C2 "Land Converted to Grassland" is presented in Table 6-53. According to the obtained data, it is noted a significant decrease for this category (maximum deviations – -60.2 per cent in 2009; minimum deviations – -46.7 per cent in 1996), with the exception of 2010-2015 time series, when were recorded positive differences (maximum deviations – +44.2 per cent in 2011; minimum deviations – +24.5 per cent in 2010).

Table 6-53: Comparative Evolution for CO_2 Removals/Emissions from 4C2 "Land Converted to Grassland" Category, included into the NC4 and the BUR2 of the RM under the UNFCCC, kt

	1990	1991	1992	1993	1994	1995	1996	1997	1998
NC4	-2850.2941	-3317.4207	-3383.3454	-3109.7949	-3104.1950	-3088.4744	-2903.6947	-2771.9741	-2848.0605
BUR2	-1205.6938	-1414.3167	-1428.4835	-1303.5202	-1577.3332	-1601.1004	-1548.0826	-1400.8607	-1436.2698
Difference, %	-57.7	-57.4	-57.8	-58.1	-49.2	-48.2	-46.7	-49.5	-49.6
	1999	2000	2001	2002	2003	2004	2005	2006	2007
NC4	-2972.0904	-2844.3351	-2755.9956	-2512.2749	-2277.6455	-2316.5028	-2240.7618	-2227.5442	-2164.3852
BUR2	-1433.2865	-1291.9495	-1290.6541	-1235.1380	-1007.1842	-1120.4767	-1058.1239	-1056.3692	-1031.2350
Difference, %	-51.8	-54.6	-53.2	-50.8	-55.8	-51.6	-52.8	-52.6	-52.4
	2008	2009	2010	2011	2012	2013	2014	2015	2016
NC4	-1883.4658	-1123.9641	-555.7508	-442.6724	-426.1414	-277.4696	-271.1606	-306.2291	
BUR2	-932.1498	-447.6932	-691.9874	-638.1726	-562.7510	-360.1740	-341.1085	-418.4569	-402.3693
Difference, %	-50.5	-60.2	24.5	44.2	32.1	29.8	25.8	36.6	

Abbreviations: NC4 – Fourth National Communication; BUR2 – Second Biennial Update Report.

The results of CO_2 removals within the source category 4C2 "Land Converted to Grassland" is presented in Table 6-54. At the beginning of the period under review (1990) removals are quite significant at sectoral level, due to the massive conversion of different land to grassland (see Table 6-51). Towards the end of the period (2016) removals within the source category 4C2 decrease significantly, representing only 33.4 per cent of the reference year level.

Table 6-54: CO_2 Removals from 4C2 "Land Converted to Grassland" Category in the RM within 1990-2016 periods, kt

Category	1990	1991	1992	1993	1994	1995	1996	1997	1998
4C1	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
4C	**-1205.6938**	**-1414.3167**	**-1428.4835**	**-1303.5202**	**-1577.3332**	**-1601.1004**	**-1548.0826**	**-1400.8607**	**-1436.2698**
Category	1999	2000	2001	2002	2003	2004	2005	2006	2007
4C1	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
4C2	-1433.2865	-1291.9495	-1290.6541	-1235.1380	-1007.1842	-1120.4767	-1058.1239	-1056.3692	-1031.2350
4C	**-1433.2865**	**-1291.9495**	**-1290.6541**	**-1235.1380**	**-1007.1842**	**-1120.4767**	**-1058.1239**	**-1056.3692**	**-1031.2350**
Category	2008	2009	2010	2011	2012	2013	2014	2015	2016
4C1	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
4C2	-932.1498	-447.6932	-691.9874	-638.1726	-562.7510	-360.1740	-341.1085	-418.4569	-402.3693
4C	**-932.1498**	**-447.6932**	**-691.9874**	**-638.1726**	**-562.7510**	**-360.1740**	**-341.1085**	**-418.4569**	**-402.3693**

The graphical illustration of CO_2 removals evolution within the source category 4C2 "Land Converted to Grassland" is provided in Figure 6-11.

Figure 6-11: CO_2 removals from 4C2 "Land Converted to Grassland" category in the RM within 1990-2016 periods, kt.

6.4.6. Planned Improvements

The possibility to improve the cadastral records (as the main reference sources for AD) pertaining to specification of land use categories to which converted lands are transferred to, will be considered for the next inventory cycles in the Republic of Moldova.

6.5. Wetlands (Category 4D)

6.5.1. Source Category Description

The 4D "Wetlands" category include any land that is covered or saturated by water for all or only a part of the year (for example, marshes), and does not fall into the Forest Land, Cropland, Grassland or Settlements categories.

It also includes storage water reservoirs - managed ponds, as well as unmanaged natural lakes and rivers. 4D "Wetlands" comprises two categories: 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 the 4D1 "Wetlands Remaining Wetlands" category (land without forest/herbaceous vegetation and/or no management activities contributing to essential changes in carbon stocks) a neutral balance was established in the main carbon stocks (above- and below-ground biomass, dead organic matter, soils).

AD on areas within this category are available in the General Land Cadaster of the RM and are also included in the Land Use and Land Use-Change Matrix for 1970-2016 periods. 4D1 "Wetlands Remaining Wetlands" also includes lands subject to internal conversion, not generating essential changes in carbon stocks, maintaining a steady balance (Table 6-55).

Table 6-55: Area of Land Included in 4D1 "Wetlands Remaining Wetlands" Category in the RM within 1990-2016 periods, ha

Land Category	1990	1991	1992	1993	1994	1995	1996	1997	1998
Wetlands with vegetation (marshes)	9200.0	9300.0	9000.0	10000.0	10000.0	9900.0	10200.0	10200.0	10200.0
Wetlands saturated by water	54600.0	55500.0	53800.0	56399.7	57400.0	59500.0	61100.0	62100.0	62100.0
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
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
Total	**68100.0**	**69100.0**	**67200.0**	**70899.7**	**70900.0**	**72100.0**	**74000.0**	**74700.0**	**74700.0**
Land Category	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**
Wetlands with vegetation (marshes)	10400.0	10400.0	11800.0	12400.0	10911.0	11911.0	11617.0	12017.0	11833.0
Wetlands saturated by water	64900.0	65600.0	65425.0	67325.0	67325.0	67925.0	68488.0	68688.0	68688.0
Wetlands with vegetation (marshes) converted to wetlands saturated by water	2200.0	1800.0	1800.0	1800.0	2168.0	2168.0	1768.0	1768.0	2152.0
Wetlands saturated by water converted to wetlands with vegetation (marshes)	200.0	200.0	532.0	532.0	532.0	532.0	532.0	532.0	432.0
Total	**77700.0**	**78000.0**	**79557.0**	**82057.0**	**80936.0**	**82536.0**	**82405.0**	**83005.0**	**83105.0**
Land Category	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**
Wetlands with vegetation (marshes)	12833.0	13126.4	12910.4	12910.4	13262.7	12162.7	13053.7	12902.7	12510.7
Wetlands saturated by water	70788.0	70888.0	71988.0	70112.6	71585.8	67581.6	67780.8	65580.8	63946.8
Wetlands with vegetation (marshes) converted to wetlands saturated by water	2152.0	2158.6	1274.6	1274.6	1220.6	1120.6	2150.6	2970.6	2970.6
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
Total	**86205.0**	**86605.0**	**86605.0**	**84729.6**	**86501.1**	**81296.9**	**83417.1**	**81886.1**	**79860.1**

Source: General Land Cadaster for 1970-2017; Land Use and Land Use-Change Matrix for 1970-2016 periods.

4D2. Land Converted to Wetlands

In order to estimate CO_2 removals/emissions from the 4D2 "Land Converted to Wetlands" category a biomass loss was establish due to conversion of different land types which were previously covered by a certain amount of biomass (forest vegetation, grassland, perennial plantations etc.). At the same time, were estimated biomass increments due to conversion of different land types 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 2.22):

$$\Delta C_B = \Delta C_G + \Delta C_{Conversion} - \Delta C_L$$

Where:

ΔC_B – annual change in carbon stocks in biomass on land converted to wetlands, t C/yr;

ΔC_G – annual increase in carbon stocks in biomass due to growth on land converted to wetlands, t C/yr;

$\Delta C_{Conversion}$ – initial change in carbon stocks in biomass on land converted to wetlands, t C/yr;

ΔC_L – annual decrease in biomass carbon stocks on land converted to wetlands, due to grass/biomass harvest, disturbances t C/yr.

Initial changes in carbon stocks in biomass on land converted to wetlands ($\Delta C_{Conversion}$) were estimated using Equation 2.16 from the 2006 IPCC Guidelines (Volume 4, Chapter 2, Page 2.20):

$$\Delta C_{Conversion} = \sum\{(B_{After} - B_{Before}) \bullet \Delta A_{TO\ OTHER}\} \bullet CF$$

Where:

B_{After} – biomass stocks on land immediately after the conversion, t d.m./ha;

B_{Before} – biomass stocks on land before the conversion, t d.m./ha;

$\Delta A_{TO\ OTHERS}$ – area of land-use converted to land use category in a certain year, ha/yr;

CF – carbon fraction of dry matter.

AD on areas subject to conversion within this category are available in the General Land Cadaster of the RM and are also included in the Land Use and Land Use-Change Matrix for 1970-2016 periods. The main land categories converted to wetlands are croplands and grasslands (Table 6-56).

Table 6-56: Area of Lands Converted to Wetlands in the RM within 1970-2016 periods, ha

Conversion	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981
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
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
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**
Conversion	**1982**	**1983**	**1984**	**1985**	**1986**	**1987**	**1988**	**1989**	**1990**	**1991**	**1992**	**1993**
Grassland to Wetlands	2500	0	1600	600	600	100	3100	400	0	0	800	900
Other land to Wetlands	3099	3099	3099	3099	3099	3099	3099	3099	3099	1399	3699	0
Total	**5599.2**	**3099.2**	**4699.2**	**3699.2**	**3699.2**	**3199.2**	**6199.2**	**3499.2**	**3099.2**	**1399.2**	**4499.2**	**900.0**
Conversion	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**
Grassland to Wetlands	2200.0	0.0	400.0	300.0	400.0	2000.0	1100.0	0.0	905.0	0.0	472.0	0.0
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
Total	**2200.0**	**0.0**	**400.0**	**300.0**	**400.0**	**2000.0**	**1100.0**	**0.0**	**905.0**	**0.0**	**472.0**	**0.0**
Conversion	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**
Grassland to Wetlands	178.0	80.0	40.5	28.8	3231.0	63.0	47.2	32.0	0.0	3698.9	0.0	NA
Other land to Wetlands	0.0	0.0	0.0	0.0	0.0	1700.0	0.0	3699.2	3698.8	0.0	0.0	NA
Total	**178.0**	**80.0**	**40.5**	**28.8**	**3231.0**	**1763.0**	**47.2**	**3731.2**	**3698.8**	**3698.9**	**0.0**	**NA**

Source: General Land Cadaster for 1970-2017; Land Use and Land Use-Change Matrix for 1970-2016 periods.

Country specific emission factors were developed in order to estimate annual biomass increments/losses on land converted to wetlands as presented in Table 6-57.

Table 6-57: EFs Used to Estimate CO_2 Emissions/Removals from the 4D2 "Land Converted to Wetlands" Category

Conversion	Indicators	Period, years	Units	Indicators Value
Grassland to Wetlands	Annual average carbon increments in biomass (herbaceous cover)	year 1	Mg C/ha/yr	0.0
	Annual average carbon increments in dead organic matter (litter)	year 1	Mg C/ha/yr	0.0
	Annual average increments in soil organic carbon	years 1-20	Mg C/ha/yr	0.0
Other land to Wetlands	Annual average carbon increments in biomass (herbaceous cover)	year 1	Mg C/ha/yr	4.2
	Annual average carbon increments in dead organic matter (litter)	year 1	Mg C/ha/yr	0.0
	Annual average increments in soil organic carbon	years 1-20	Mg C/ha/yr	2.4818

6.5.3. Uncertainties Assessment and Time-Series Consistency

4D1. Wetlands Remaining Wetlands

Uncertainties associated with the CO_2 emissions/removals from 4D1 "Wetlands Remaining Wetlands" are not estimated, since a neutral balance was established in the main carbon stocks (above- and below-ground biomass, dead organic matter, soil).

4D2. Land Converted to Wetlands

Uncertainties associated with the CO_2 emissions/removals from 4D2 "Land Converted to Wetlands" at the beginning and the end of the reference period (1990 and 2016) are quite low, and are estimated at circa ±10 per cent. In both cases emission/removal factors have an uncertainty level of ±10 per cent. Combined uncertainties from the 4D2 "Land Converted to Wetlands" represent circa ±14.14 per cent (see Annex 5-3.4).

6.5.4. Quality Assurance and Quality Control

The quality of assessment for 4D "Wetlands" category is provided by the fact that most of the AD used is taken from official records (the General Land Cadasters of the Republic of Moldova).

Annual biomass increment/loss for lands converted to wetlands was 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 1970-2016 periods.

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, following the recommendations included in the 2006 IPCC Guidelines (Volume 4 "AFOLU"), on various aspects such as: ensuring correct use of national factors, their accuracy, as well as comparing them to the values used by other Eastern and Central European countries.

6.5.5. Recalculations

4D1. Wetlands Remaining Wetlands

No recalculations were performed in the current inventory cycle for category 4D1 "Wetlands Remaining Wetlands".

4D2. Land Converted to Wetlands

For 4D2 "Land Converted to Wetlands" category recalculations were performed for the period 1990-2015, due to the change of approaches related to estimation of CO_2 emissions/removals made for the Land Use and Land Use-Change Matrix for 1970-2016, in particular regarding the conversion of other land to wetlands. According to the new approaches for this type of conversion were established carbon increments in biomass and soil.

The comparative analysis of CO_2 removals/emissions between 1990 and 2016 within the source category 4D2 "Land Converted to Wetlands" is presented in Table 6-58. According to the obtained data, it is noted a significant increase of removals for this category (maximum deviations – 3322.3 per cent in 1992; minimum deviations – 2921.7 per cent in 1993).

Table 6-58: Comparative Evolution for CO_2 Removals/Emissions from 4D2 "Land Converted to Wetlands" Category, included into the NC4 and the BUR2 of the RM under the UNFCCC, kt

	1990	1991	1992	1993	1994	1995	1996	1997	1998
NC4	-17.4020	-17.4020	-17.4020	-17.4020	0.0	0.0	0.0	0.0	0.0
BUR2	-555.3798	-526.4627	-595.5455	-525.8447	-497.6418	-469.4389	-441.2360	-413.0332	-384.8303
Difference, %	3091.5	2925.3	3322.3	2921.7	NA	NA	NA	NA	NA
	1999	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**
NC4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
BUR2	-356.6274	-328.4245	-300.2217	-272.0188	-243.8159	-215.6130	-187.4101	-159.2073	-131.0044
Difference, %	NA	NA	NA	NA	NA	NA	NA	NA	NA
	2008	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**
NC4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
BUR2	-102.8015	-74.5986	-46.3958	-75.3129	-15.4700	-106.0998	-139.7535	-82.7917	-82.7917
Difference, %	NA	NA	NA	NA	NA	NA	NA	NA	

Abbreviations: NC4 – Fourth National Communication; BUR2 – Second Biennial Update Report.

CO_2 emissions/removals within the source category 4D "Wetlands" between 1990 and 2016 were influenced by the conversion process of different type of land to wetlands as presented in Table 6-59.

Table 6-59: CO_2 Removals from 4D "Wetlands" Category in the RM within 1990-2016 periods, kt

	1990	1991	1992	1993	1994	1995	1996	1997	1998
4D1	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
4D	-555.3798	-526.4627	-595.5455	-525.8447	-497.6418	-469.4389	-441.2360	-413.0332	-384.8303
	1999	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**
4D1	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
4D2	-356.6274	-328.4245	-300.2217	-272.0188	-243.8159	-215.6130	-187.4101	-159.2073	-131.0044
4D	-356.6274	-328.4245	-300.2217	-272.0188	-243.8159	-215.6130	-187.4101	-159.2073	-131.0044
	2008	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**
4D1	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
4D2	-102.8015	-74.5986	-46.3958	-75.3129	-15.4700	-106.0998	-139.7535	-82.7917	-82.7917
4D	-102.8015	-74.5986	-46.3958	-75.3129	-15.4700	-106.0998	-139.7535	-82.7917	-82.7917

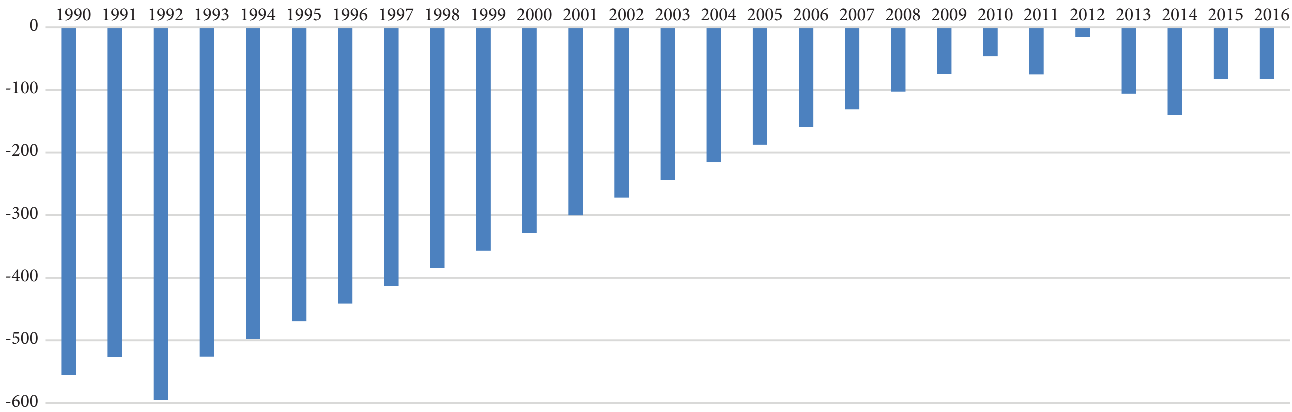


Figure 6-12: CO_2 removals from 4D "Wetlands" Category in the RM within 1990-2016 periods, kt.

Subcategory 4D2 "Land Converted to Wetlands" became a constant source of CO_2 removals. At the beginning of the period under review (1990) removals are quite significant at sectoral level, due to the massive conversion of different land to wetlands (Table 6-56). Towards the end of the period (2016) removals within the source category 4D2 decrease significantly, representing only 14.9 per cent of the reference year level. The graphical illustration of CO_2 removals evolution within the source category 4D "Wetlands" is provided in Figure 6-12.

6.5.6. Planned Improvements

The possibility to improve the cadastral records (as the main reference sources for AD) pertaining to specification of initial land use categories from which they were converted to wetlands, will be considered for the next inventory cycles in the Republic of Moldova.

6.6. Settlements (Category 4E)

6.6.1. Source Category Description

The 4E "Settlements" category include all developed land (constructions, streets, yards, markets and parks, roads etc.), including transportation infrastructure and all size settlements if they are not accounted in another land-use category. Basically, all that land includes areas covered with vegetation. Depending on the type of vegetation, a part of land inside settlements was included in 4B "Cropland" (parks, public gardens, green areas, perennial plantations etc.) and 4C "Grassland" (pastures and hayfields) categories. 4E "Settlements" comprises two categories: 4E1 "Settlements Remaining Settlements" and 4E2 "Land Converted to Settlements".

6.6.2. Methodological Issues, Emission Factors and Data Sources

4E1. Settlements Remaining Settlements

The 4E1 "Settlements Remaining Settlements" category includes lands without forest/herbaceous vegetation and/or no management activities contributing to essential changes in carbon stocks); thus, a neutral balance was established in the main carbon stocks (above- and below-ground biomass, dead organic matter, soils). AD on areas within this category are available in the General Land Cadaster of the RM and are also included in the Land Use and Land Use-Change Matrix for 1970-2016 periods (Table 6-60).

Table 6-60: Area of Land Included in 4E1 "Settlements Remaining Settlements" Category in the RM within 1990-2016 periods, ha

	1990	1991	1992	1993	1994	1995	1996	1997	1998
Settlements	181 826.1	181 826.1	181 826.1	184 126.1	187 326.0	187 926.0	190 025.9	191 225.9	190 825.9
	1999	2000	2001	2002	2003	2004	2005	2006	2007
Settlements	194 725.9	203 425.7	207 055.1	207 012.1	211 012.1	213 023.1	212 602.1	211 358.1	212 911.1
	2008	2009	2010	2011	2012	2013	2014	2015	2016
Settlements	212 771.8	213 987.1	213 962.9	214 162.9	229 325.5	226 824.6	224 798.7	223 498.7	221 199.7

Source: General Land Cadaster for 1970-2017; Land Use and Land Use-Change Matrix for 1970-2016 periods.

4E2. Land Converted to Settlements

In order to estimate CO_2 removals/emissions from the 4E2 "Land Converted to Settlements" category a biomass loss of carbon in soils was established due to conversion of different land types which were previously covered by a certain amount of biomass (forest vegetation, 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):

$$\Delta C_B = \Delta C_G + \Delta C_{Conversion} - \Delta C_L$$

Where:

ΔC_B – annual change in carbon stocks in biomass on land converted to settlements, t C/yr;

ΔC_G – annual increase in carbon stocks in biomass due to growth on land converted to settlements, t C/yr;

$\Delta C_{Conversion}$ – initial change in carbon stocks in biomass on land converted to settlements, t C/yr;

ΔC_L – annual decrease in biomass carbon stocks on land converted to settlements, due to grass/biomass harvest, disturbances t C/yr.

Initial changes in carbon stocks in biomass on land converted to settlements ($\Delta C_{Conversion}$) 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, t d.m.//ha;

B_{Before} – biomass stocks on land before the conversion, t d.m./ha;

$\Delta A_{TO\ OTHERS}$ – area of land-use converted to land use category in a certain year, ha/yr;

CF – carbon fraction of dry matter.

Non-CO_2 emissions (N_2O) 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):

$$F_{SOM} = \Sigma[(\Delta C_{Mineral,LU} \bullet 1/R) \bullet 1000]$$

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*), tones 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, in the absence of more specific data for the area. A default value of 10 may be used for situations involving management changes on Cropland Remaining Cropland;

LU – land-use and/or management system type.

AD on areas subject to conversion within this category are available in the General Land Cadaster and are also included in the Land Use and Land Use-Change Matrix for 1970-2016 periods. The main land categories converted to settlements are croplands and grasslands (Table 6-61).

Table 6-61: Area of Lands Converted to Settlements in the RM within 1970-2016 periods, ha

Conversion	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981
Cropland to Settlements	0.0	0.0	0.0	2042.3	2614.1	1062.0	1878.9	980.3	0.0	3185.9	7107.0	3022.5
Grassland to Settlements	0.0	0.0	0.0	457.7	585.9	238.0	421.1	219.7	0.0	714.0	1592.8	677.4
Other land to Settlements	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.5
Total	**0.0**	**0.0**	**0.0**	**2500.0**	**3199.9**	**1300.0**	**2300.0**	**1200.0**	**0.0**	**3899.9**	**8699.8**	**3700.5**
Conversion	**1982**	**1983**	**1984**	**1985**	**1986**	**1987**	**1988**	**1989**	**1990**	**1991**	**1992**	**1993**
Cropland to Settlements	0.0	3267.6	1878.9	0.0	0.0	1552.1	0.0	1307.0	0.0	163.4	12416.9	0.0
Grassland to Settlements	0.0	732.3	421.1	0.0	0.0	347.9	0.0	292.9	0.0	36.6	2782.8	0.0
Other land to Settlements	0.5	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.9	0.0
Total	**0.5**	**4000.5**	**2300.6**	**0.6**	**0.6**	**1900.6**	**0.6**	**1600.6**	**0.6**	**200.6**	**15200.6**	**0.0**
Conversion	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**
Cropland to Settlements	959.0	0.0	0.0	81.7	0.0	898.6	1143.7	0.0	0.0	413.4	0.0	0.0
Grassland to Settlements	214.9	0.0	0.0	18.3	0.0	201.4	256.3	0.0	0.0	92.6	0.0	0.0
Other land to Settlements	0.0	0.0	0.9	0.9	0.5	0.5	1.0	0.0	0.0	0.0	0.0	0.0
Total	**1174.0**	**0.0**	**0.9**	**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**	**2015**	**2016**	**2017**
Cropland to Settlements	0.0	0.0	0.0	0.0	1.0	677.2	0.0	0.0	395.4	1180.4	224.6	NA
Grassland to Settlements	0.0	0.0	0.0	0.0	0.0	151.8	0.0	0.0	88.6	264.6	50.3	NA
Other land to Settlements	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.9	1.0	1.2	0.7	NA
Total	**0.0**	**0.0**	**0.0**	**0.0**	**1.0**	**829.0**	**0.0**	**0.9**	**485.0**	**1446.1**	**275.7**	**NA**

Source: General Land Cadaster for 1970-2017; Land Use and Land Use-Change Matrix for 1970-2016 periods.

Country specific emission factors were developed (within EU/UNDP "Clima East" Project, respectively based on two other CDM Projects: MSCP and MCFDP, as well as from other relevant information) in order to estimate annual biomass increments / losses on land converted to settlements as presented in Table 6-62.

Table 6-62: EFs Used to Estimate CO_2 Emissions/Removals from the 4E2 "Land Converted to Settlements" Category

Conversion	Indicators	Period, years	Units	Indicators Value
Cropland to Settlements	Annual average carbon increments in biomass (crops)	year 1	Mg C/ha/yr	-5.0
	Annual average carbon increments in dead organic matter (litter)	year 1	Mg C/ha/yr	0.0
	Annual average increments in soil organic carbon	years 1-20	Mg C/ha/yr	-0.2168
Grassland to Settlements	Annual average carbon increments in biomass (herbaceous cover)	year 1	Mg C/ha/yr	-3.78
	Annual average carbon increments in dead organic matter (litter)	year 1	Mg C/ha/yr	0.0
	Annual average increments in soil organic carbon	years 1-20	Mg C/ha/yr	-2.4818
Other land to Settlements	Annual average carbon increments in biomass (herbaceous cover)	year 1	Mg C/ha/yr	0.0
	Annual average carbon increments in dead organic matter (litter)	year 1	Mg C/ha/yr	0.0
	Annual average increments in soil organic carbon	years 1-20	Mg C/ha/yr	0.0

6.6.3. Uncertainties Assessment and Time-Series Consistency

4E1. Settlements Remaining Settlements

Uncertainties associated with the CO_2 emissions/removals from 4E1 "Settlements Remaining Settlements" are not estimated, since a neutral balance was established in the main carbon stocks (above- and below-ground biomass, dead organic matter, soils).

4E2. Land Converted to Settlements

Uncertainties associated with the CO_2 emissions/removals from 4E2 "Land Converted to Settlements" at the beginning and the end of the reference period (1990 and 2016) are quite low, and are estimated at circa ±10 per cent. In both cases emission/removal factors have an uncertainty level of ±10 per cent. Combined uncertainties from the 4E2 "Land Converted to Settlements" represent circa ±14.14 per cent. For non-CO_2 emissions, uncertainties related to AD represent circa ±10 per cent, while emission/removal factors have an uncertainty level of circa ±30 per cent. Combined uncertainties are estimated at circa ±31.62 per cent (see Annex 5-3.4)

6.6.4. Quality Assurance and Quality Control

The quality of assessment for 4E "Settlements" category is provided by the fact that most of the AD used is taken from official records (the General Land Cadasters of the Republic of Moldova). Annual biomass increment/loss for lands converted to settlements was 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 1970-2016 periods. 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, following the recommendations included in the 2006 IPCC Guidelines (Volume 4 "AFOLU"), on various aspects such as: verification of correct application of assessment methods set out in the 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.

6.6.5. Recalculations

4E1. Settlements Remaining Settlements

No recalculations were performed for estimating CO_2 emissions/removals from 4E1 "Settlements Remaining Settlements" category.

4E2. Land Converted to Settlements

For 4E2 "Land Converted to Settlements", CO_2 emissions/removals were recalculated for 2011-2015 time series due to updating AD for this category, changes that affected the estimating process within the Land Use and Land Use-Change Matrix for 1970-2016 periods. The comparative analysis of CO_2 removals/emissions between 1990 and 2016 within the source category 4E2 "Land Converted to Settlements" is presented in Table 6-63. According to the obtained data, it is noted a small increase of CO_2 emissions for this category from 2011 through 2015 (maximum deviations – 16.2 per cent in 2013; minimum deviations – 0.5 per cent in 2012).

Table 6-63: Comparative Evolution for CO_2 Removals/Emissions from 4E2 "Land Converted to Settlements" Category, included into the NC4 and the BUR2 of the RM under the UNFCCC, kt

	1990	1991	1992	1993	1994	1995	1996	1997	1998
NC4	84.7480	88.7139	386.6196	114.6181	130.4883	106.9167	101.5910	100.7954	99.0440
BUR2	84.7480	88.7139	386.6196	114.6181	130.4883	106.9167	101.5910	100.7954	99.0440
Difference, %	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	1999	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**
NC4	111.8259	100.1768	67.0898	67.0898	67.8615	53.6737	53.6737	53.6737	49.2742
BUR2	111.8259	100.1768	67.0898	67.0898	67.8615	53.6737	53.6737	53.6737	49.2742
Difference, %	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**
NC4	49.2742	45.5694	45.5885	61.5457	11.8308	11.8308	18.7098	38.8867	
BUR2	49.2742	45.5694	45.5694	62.0438	11.8882	13.7512	18.9848	39.1617	19.3071
Difference, %	0.0	0.0	0.0	0.8	0.5	16.2	1.5	0.7	

Abbreviations: NC4 – Fourth National Communication; BUR2 – Second Biennial Update Report.

Between 1990-2016 time series, CO_2 emissions/removals from 4E2 "Land Converted to Settlements" category fluctuated, being influenced in particular, by the impermanence of the conversion of different land categories to settlements (Table 6-64). During the period under review only emissions were recorded, with the largest volumes registered in 1992 – circa 386.6 kt, while the lowest – in 2012 and 2013 – circa 11.8 kt.

Table 6-64: CO_2 Emissions from 4E "Settlements" in the RM within 1990-2016 periods, kt

	1990	1991	1992	1993	1994	1995	1996	1997	1998
4E1	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
4E2	84.7480	88.7139	386.6196	114.6181	130.4883	106.9167	101.5910	100.7954	99.0440
4E	**84.7480**	**88.7139**	**386.6196**	**114.6181**	**130.4883**	**106.9167**	**101.5910**	**100.7954**	**99.0440**
	1999	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**
4E1	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
4E2	111.8259	100.1768	67.0898	67.0898	67.8615	53.6737	53.6737	53.6737	49.2742
4E	**111.8259**	**100.1768**	**67.0898**	**67.0898**	**67.8615**	**53.6737**	**53.6737**	**53.6737**	**49.2742**
	2008	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**
4E1	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
4E2	49.2742	45.5694	45.5694	62.0438	11.8882	13.7512	18.9848	39.1617	19.3071
4E	**49.2742**	**45.5694**	**45.5694**	**62.0438**	**11.8882**	**13.7512**	**18.9848**	**39.1617**	**19.3071**

The graphical illustration of CO_2 emissions evolution within the source category 4E "Settlements" in the RM is provided in Figure 6-13.

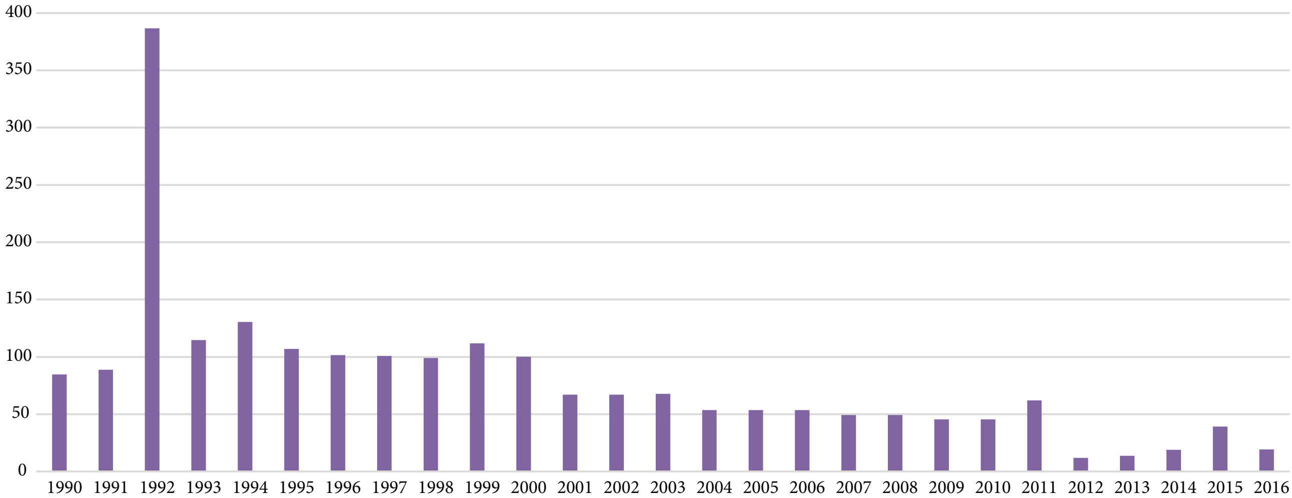


Figure 6-13: CO_2 Emissions from 4E "Settlements" in the RM within 1990-2016 periods, kt.

N_2O emissions from 4E2"Land Converted to Settlements" category were estimated for the first time. The results obtained are presented in Table 6-65.

Table 6-65: N_2O Emissions from 4E2 "Land Converted to Settlements" Category in the Republic of Moldova within 1990-2016 periods

	1990	1991	1992	1993	1994	1995	1996	1997	1998
4E.2.2 Cropland to Settlements, kt	0.5257	0.5729	0.6396	0.6999	0.7535	0.8037	0.8480	0.8894	0.9308
4E.2.3 Grassland to Settlements, kt	0.0105	0.0106	0.0149	0.0142	0.0136	0.0133	0.0126	0.0123	0.0123
4E.2 Land converted to Settlements, kt	0.5362	0.5835	0.6545	0.7141	0.7671	0.8170	0.8606	0.9017	0.9431
4E.2 Land converted to Settlements, kt CO_2 equivalent	**159.7967**	**173.8786**	**195.0547**	**212.8037**	**228.5960**	**243.4567**	**256.4737**	**268.7144**	**281.0494**
	1999	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**
4E.2.2 Cropland to Settlements, kt	0.9636	0.9759	0.9787	0.9815	0.9747	0.9619	0.9492	0.9365	0.9189
4E.2.3 Grassland to Settlements, kt	0.0115	0.0094	0.0083	0.0083	0.0073	0.0067	0.0067	0.0067	0.0061
4E.2 Land converted to Settlements, kt	0.9751	0.9853	0.9870	0.9898	0.9820	0.9686	0.9559	0.9432	0.9250
4E.2 Land converted to Settlements, kt CO_2 equivalent	**290.5838**	**293.6176**	**294.1316**	**294.9625**	**292.6299**	**288.6416**	**284.8502**	**281.0588**	**275.6524**
	2008	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**
4E.2.2 Cropland to Settlements, kt	0.9013	0.8796	0.8579	0.8368	0.7767	0.7231	0.6753	0.6328	0.5965
4E.2.3 Grassland to Settlements, kt	0.0061	0.0057	0.0057	0.0058	0.0015	0.0015	0.0013	0.0017	0.0018
4E.2 Land converted to Settlements, kt	0.9074	0.8853	0.8636	0.8426	0.7781	0.7246	0.6766	0.6345	0.5983
4E.2 Land converted to Settlements, kt CO_2 equivalent	**270.4086**	**263.8049**	**257.3381**	**251.1010**	**231.8871**	**215.9302**	**201.6397**	**189.0781**	**178.2795**

6.6.6. Planned Improvements

The possibility to improve the cadastral records (as the main reference sources for AD) pertaining to specification of initial land use categories from which they were converted to settlements, will be considered for the next inventory cycles in the Republic of Moldova.

6.7. Other Land (Category 4F)

6.7.1. Source Category Description

The 4F "Other Land" category includes in particular bare soil, ravines, pits, rock, etc., as well as all land that do not fall into any of the other categories 4A-4E (for example, river banks, rocks).

This category is also used to close the sum of areas from the total official land of the country. 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 RM included in the 4F1 "Other Land Remaining Other Land" category (land without forest/herbaceous vegetation and/or no management activities contributing to essential changes in carbon stocks) a neutral balance was established in the main carbon stocks (above- and belowground biomass, dead organic matter, soil). AD on areas within this category are available in the General Land Cadaster of the RM and are also included in the Land Use and Land Use-Change Matrix for 1970-2016 periods (Table 6-66).

Table 6-66: Area of Land Included in 4F1 "Other Land Remaining Other Land" Category in the RM within 1990-2016 periods, ha

	1990	1991	1992	1993	1994	1995	1996	1997	1998
Other Land, ha	56 300.0	53 300.0	45 855.0	51 255.5	41 078.0	40 822.0	45 444.0	48 200.3	50 226.0
	1999	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**
Other Land, ha	51 330.0	52 230.0	56 459.0	55 383.0	54 510.1	57 649.4	51 984.3	52 532.2	61 311.9
	2008	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**
Other Land, ha	60 290.5	60 620.4	58 553.4	55 818.4	57 268.9	60 198.0	52 389.0	58 031.5	60 077.9

Source: General Land Cadaster for 1970-2017; Land Use and Land Use-Change Matrix for 1970-2016 periods.

4F2. Land Converted to Other Land

In order to estimate CO_2 removals/emissions from the 4F2 "Land Converted to Other Land" category a biomass loss was establish due to conversion of different land types which were previously covered by a certain amount of biomass (forest vegetation, grassland, perennial plantations etc.). AD on areas subject to conversion within this category are available in the General Land Cadaster of the RM and are also included in the Land Use and Land Use-Change Matrix for 1970-2016 periods. The main land categories converted to other land are forest lands, grasslands and croplands – arable soils (Table 6-67).

Table 6-67: Area of Lands Converted to Other Land within 1970-2016 periods, ha

Conversion	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981
Forest Land to Other Land	0.0	0.0	0.0	0.0	0.0	0.0	0.0	664.0	622.0	1654.0	1691.0	0.0
Cropland to Other Land	0.0	0.0	6275.0	4614.4	0.0	1112.0	0.0	0.0	0.0	0.0	0.0	0.0
Grassland to Other Land	0.0	0.0	0.0	0.0	8433.0	1557.8	0.0	3436.0	3078.0	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	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**	**1654.0**	**1691.0**	**0.0**
Conversion	**1982**	**1983**	**1984**	**1985**	**1986**	**1987**	**1988**	**1989**	**1990**	**1991**	**1992**	**1993**
Forest Land to Other Land	1571.7	4308.3	248.5	8177.0	8802.0	1615.0	0.0	0.0	0.0	0.0	2245.0	0.0
Cropland to Other Land	228.6	0.0	0.0	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	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	0.0	0.0	0.0
Total	**1800.4**	**4308.3**	**248.5**	**8177.0**	**8802.0**	**1615.0**	**0.0**	**0.0**	**0.0**	**0.0**	**2245.0**	**0.0**
Conversion	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**
Forest Land to Other Land	3248.0	1856.0	226.0	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	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	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	0.0	0.0	0.0
Total	**3248.0**	**1856.0**	**226.0**	**0.0**	**0.0**	**2096.0**	**0.0**	**0.0**	**2409.0**	**2874.9**	**3712.6**	**10294.7**
Conversion	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**
Forest Land to Other Land	0.0	0.0	1860.0	0.0	3046.6	2511.0	0.0	0.0	1900.0	0.0	0.0	NA
Cropland to Other Land	705.6	698.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	NA
Grassland to Other Land	6836.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	8702.9	0.0	0.0	NA
Wetlands to Other Land	0.0	0.0	0.0	0.0	0.0	0.0	694.5	0.0	0.0	0.0	0.0	NA
Total	**7542.4**	**698.1**	**1860.0**	**0.0**	**3046.6**	**2511.0**	**694.5**	**0.0**	**10602.9**	**0.0**	**0.0**	**NA**

Source: General Land Cadaster for 1970-2017; Land Use and Land Use-Change Matrix for 1970-2016 periods.

The calculation process of CO_2 removals/emissions from the 4F2 "Land Converted to Other Land" category 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):

$$\Delta C_B = \Delta C_G + \Delta C_{Conversion} - \Delta C_L$$

Where:

ΔC_B – annual change in carbon stocks in biomass on land converted to other land, t C/yr;

ΔC_G – annual increase in carbon stocks in biomass due to growth on land converted to other land, t C/yr;

$\Delta C_{Conversion}$ – initial change in carbon stocks in biomass on land converted to other land, t C/yr;

ΔC_L – annual decrease in biomass carbon stocks on land converted to other land, due to grass/biomass harvest, disturbances t C/yr.

Initial changes in carbon stocks in biomass on land converted to other land ($\Delta C_{Conversion}$) were estimated using Equation 2.16 from the 2006 IPCC Guidelines (Volume 4, Chapter 2, Page 2.20):

$$\Delta C_{Conversion} = \sum\{(B_{After} - B_{Before}) \cdot \Delta A_{TO\ OTHERS}\} \cdot CF$$

Where:

B_{After} – biomass stocks on land immediately after the conversion, t d.m.//ha;

B_{Before} – biomass stocks on land before the conversion, t d.m./ha;

$\Delta A_{TO\ OTHERS}$ – area of land-use converted to land use category in a certain year, ha/yr;

CF – carbon fraction of dry matter

Country specific emission factors were developed within two 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 as presented in Table 6-68.

Table 6-68: EFs Used to Estimate CO_2 Emissions/Removals from the 4F2 "Land Converted to Other Land" Category

Conversion	Indicators	Period, years	Units	Indicators Value
Forest Land to Other Land	Annual average carbon increments in biomass (trees and shrubs)	year 1	Mg C/ha/yr	-29.8
	Annual average carbon increments in dead organic matter (litter)	year 1	Mg C/ha/yr	-1.15
	Annual average increments in soil organic carbon	years 1-20	Mg C/ha/yr	-1.4156
Cropland to Other Land	Annual average carbon increments in biomass (crops)	year 1	Mg C/ha/yr	-5.0
	Annual average carbon increments in dead organic matter (litter)	year 1	Mg C/ha/yr	0.0
	Annual average increments in soil organic carbon	years 1-20	Mg C/ha/yr	-0.2168
Grassland to Other Land	Annual average carbon increments in biomass (crops)	year 1	Mg C/ha/yr	-3.78
	Annual average carbon increments in dead organic matter (litter)	year 1	Mg C/ha/yr	0.0
	Annual average increments in soil organic carbon	years 1-20	Mg C/ha/yr	-0.1241
Wetlands to Other Land	Annual average carbon increments in biomass (crops)	year 1	Mg C/ha/yr	-4.2
	Annual average carbon increments in dead organic matter (litter)	year 1	Mg C/ha/yr	0.0
	Annual average increments in soil organic carbon	years 1-20	Mg C/ha/yr	-2.4818

6.7.3. Uncertainties Assessment 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 stocks (above- 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 2016) are quite low, and are estimated at circa ±10 per cent. In both cases emission/removal factors have an uncertainty level of ±10 per cent. Combined uncertainties from the 4F2 "Land Converted to Other Land" represent circa ±14.14 per cent (see Annex 5-3.4).

6.7.4. Quality Assurance and Quality Control

The quality of assessment for 4F "Other Land" category is provided by the fact that most of the AD used is taken from official records (the General Land Cadasters of the RM). Annual biomass increment/loss for lands converted to settlements was 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 1970-2016 periods.

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, following the recommendations included in the 2006 IPCC Guidelines (Volume 4 "AFOLU"), on various aspects such as: verification of correct application of assessment methods set out in the 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.

6.7.5. Recalculations

CO_2 emissions from category 4F2 "Land Converted to Other Land" were recalculated for the 1990-2015 time series (Table 6-69).

Table 6-69: Recalculated CO_2 Emissions from 4F2 "Land Converted to Other Land" Category, included into the NC4 and the BUR2 of the Republic of Moldova under the UNFCCC, kt

	1990	1991	1992	1993	1994	1995	1996	1997	1998
NC4	8.6217	8.6217	203.2923	8.6217	281.6438	160.9393	19.5971	0.0	0.0
BUR2	152.3638	152.3638	418.7786	164.0168	549.4579	401.1281	217.3293	188.2363	185.0077
Difference, %	1667.2	1667.2	106.0	1802.4	95.1	149.2	1009.0	NA	NA
	1999	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**
NC4	181.7504	0.0	0.0	208.8916	0.0	0.0	126.6010	0.0	0.0
BUR2	425.1554	178.5246	178.5246	456.2431	201.6619	223.8177	416.5012	189.4964	83.1072
Difference, %	133.9	NA	NA	118.4	NA	NA	229.0	NA	NA
	2008	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**
NC4	161.2836	0.0	37.8069	280.5166	0.0	0.0	0.0	0.0	
BUR2	291.0044	79.9357	441.4824	393.7285	114.1449	103.4500	436.6463	86.8192	85.6461
Difference, %	80.4	NA	1067.7	40.4	NA	NA	NA	NA	

Abbreviations: NC4 – Fourth National Communication; BUR2 – Second Biennial Update Report.

The obtained results are essentially different compared to the previous estimates, including due to updating certain AD. The minimum difference was recorded in 2011 – 40.4 per cent, while the maximum difference represented in 1993 – 1802.4 per cent. Between 1990-2016 time series, CO_2 emissions from category 4F "Other Land" (Table 6-70) fluctuated in the Republic of Moldova, being influenced in particular, by the conversion process of different land categories to other land.

Table 6-70: CO_2 Emissions from 4F "Other Land" Category within 1990-2016 periods, kt

Category	1990	1991	1992	1993	1994	1995	1996	1997	1998
4F1	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
4F2	152.3638	152.3638	418.7786	164.0168	549.4579	401.1281	217.3293	188.2363	185.0077
4F	**152.3638**	**152.3638**	**418.7786**	**164.0168**	**549.4579**	**401.1281**	**217.3293**	**188.2363**	**185.0077**
Category	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**
4F1	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
4F2	425.1554	178.5246	178.5246	456.2431	201.6619	223.8177	416.5012	189.4964	83.1072
4F	**425.1554**	**178.5246**	**178.5246**	**456.2431**	**201.6619**	**223.8177**	**416.5012**	**189.4964**	**83.1072**
Category	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**
4F1	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
4F2	291.0044	79.9357	441.4824	393.7285	114.1449	103.4500	436.6463	86.8192	85.6461
4F	**291.0044**	**79.9357**	**441.4824**	**393.7285**	**114.1449**	**103.4500**	**436.6463**	**86.8192**	**85.6461**

The graphical illustration of CO_2 emissions evolution within the source category 4F "Other Land" in the RM is provided in Figure 6-14.

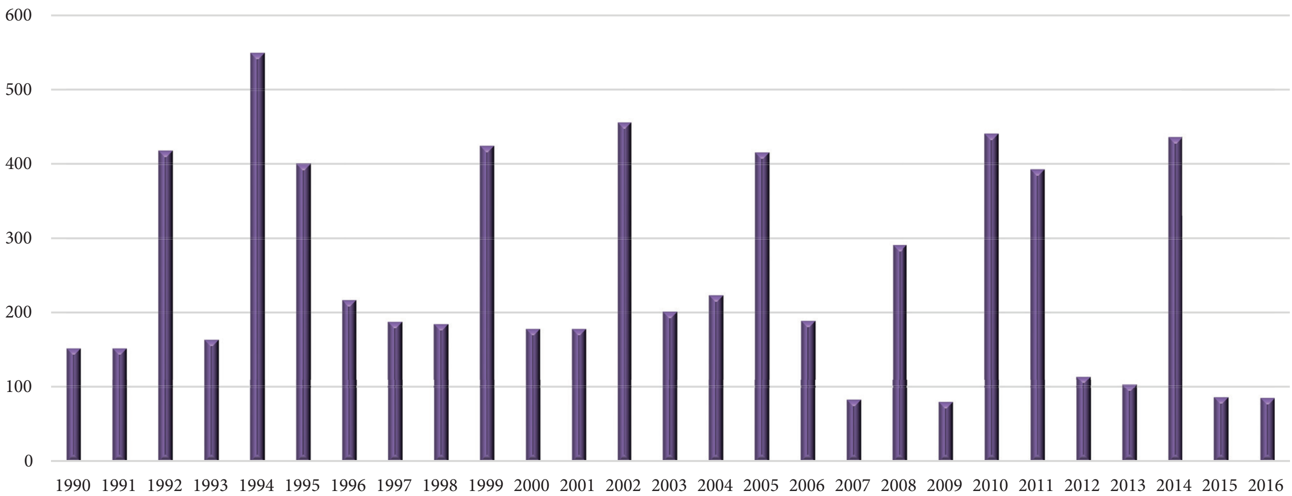


Figure 6-14: CO_2 Emissions from 4F "Other Land" Category within 1990-2016 periods, kt.

6.7.6. Planned Improvements

The possibility to improve the cadastral records (as the main reference sources for AD) pertaining to specification of initial land use categories from which they were converted to other land, will be considered for the next inventory cycles in the RM. At the same time, it is necessary to analyze the input and output process of land within the 4F "Other Land" category, including in terms of establishing the average conversion period.

6.8. Harvested Wood Products (Category 4G)

6.8.1. Source Category Description

The 4G "Harvested Wood Products" category includes CO_2 removals/emissions from wood products harvested/processed, imported or exported (rough round wood; saw logs, timber, wood panels) used in the national economy. In the RM, wood harvesting from forests takes place during the process of tending cutting (spacing, cleaning, thinning and hygiene cuts), final harvesting (regeneration cuts, preservation, hygiene) and ecological reconstruction. These works are carried out according to forestry arrangements plans, the volumes of harvested wood being authorized annually by the Inspectorate for Environmental Protection based on the legislation in force. Due to the classification of the RM forests in the 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 observed, including the share of commercial wood in the total volume of the harvested wood. Thus, according to the official records, between 1990 and 2016, the share of commercial wood in the total volume of the harvested wood was the largest in 1990 (17.6 per cent), while the lowest – in 2014 (3.9 per cent).

6.8.2. Methodological Issues, Emission Factors and Data Sources

For 4G "Harvested Wood Product" category a Tier 1 approach was used (2006 IPCC Guidelines), respectively default emission/removal factors. For the calculations, the IPCC „HWP Calculator" module ("Production Approach") was used. AD regarding 1961-2016 time series on wood products included in 4G "Harvested Wood Products" are partly available in the official statistics of the RM, in particular for 1961-1993 periods. For 1994-2016 time series AD from FAOSTAT database were used. The evolution of wood products volume included in category 4G "Harvested Wood Product" within 1961-2016 periods is presented in Table 6-71.

Table 6-71: Evolution of Wood Products Volume Included in Source Category 4G "Harvested Wood Products" within 1961-2016 periods

Wood Products by Category	Source	1961	1962	1963	1964	1965	1966	1967	1968	1969	1970	1971	1972
Rough round wood, m³	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 round wood, m³	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
Timber, m³	Produced	42370	55720	69070	82420	95770	107700	119650	131550	142060	154070	154070	152920
	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
Wood panels, m³	Produced	660	1320	1980	2640	3300	4540	5780	7020	8260	9500	18540	27580
	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
Rough round wood, m³	Produced	11800	10150	8480	8620	8760	8900	9040	9200	11750	8160	21080	26170
	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
Other types of round wood, m³	Produced	14130	12140	10160	10340	10520	10700	10880	11050	14080	9780	25260	27160
	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
Paper and cardboard, t	Produced	68390	69700	71010	72320	73630	74940	76250	77560	78870	80180	81490	84000
	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
Timber, m³	Produced	151780	150730	149700	136260	122820	109400	95970	82530	80180	79380	86440	87610
	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
Wood panels, m³	Produced	36620	45660	54700	56260	57820	59380	60940	62500	64800	67100	71600	86000
	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
Rough round wood, m³	Produced	31260	36350	41440	46530	51620	56710	61800	66890	71980	77070	82200	71800
	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
Other types of round wood, m³	Produced	29060	30960	32860	34760	36660	38560	40460	42360	44260	46160	48100	41700
	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
Paper and cardboard, t	Produced	82690	81380	80070	78760	77450	74140	68830	54470	40110	25750	11360	11010
	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
Timber, m³	Produced	86080	83860	81640	79320	77190	74970	72740	70520	68300	63480	59100	59300
	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
Wood panels, m³	Produced	81670	77340	73010	68680	64350	60020	55690	51360	47000	14000	10000	10000
	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
Rough round wood, m³	Produced	82600	67400	74500	80800	71000	92500	94000	86600	83800	45000	43000	43000
	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
Other types of round wood, m³	Produced	46900	37600	41300	47100	39200	49400	53800	49500	49500	17900	17000	17000
	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
Paper and cardboard, t	Produced	13640	12220	5930	12220	14460	19220	31040	30530	26530	84200	97500	97500
	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
Timber, m³	Produced	65300	59700	39000	39100	46800	74100	71200	68100	65300	58040	60480	60480
	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
Wood panels, m³	Produced	10000	10000	10000	10000	10000	10000	10000	10000	10000	18000	2800	2800
	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
Rough round wood, m³	Produced	43000	43000	43000	32600	29900	25600	25600	52000	NA	NA	NA	NA
	Imported	39000	39000	45448	49980	36252	29100	29100	29100	NA	NA	NA	NA
	Exported	2548	2548	134	150	56	56	56	56	NA	NA	NA	NA
Other types of round wood, m³	Produced	17000	17000	17000	12800	8600	8800	8800	15000	NA	NA	NA	NA
	Imported	25020	24050	23080	22110	21140	20170	18900	29652	NA	NA	NA	NA
	Exported	0	0	0	0	0	0	0	56	NA	NA	NA	NA
Paper and cardboard, t	Produced	97500	97500	97500	4410	14100	11800	11700	26000	NA	NA	NA	NA
	Imported	80001	80001	40066	35840	34929	36066	36066	101456	NA	NA	NA	NA
	Exported	6100	6100	19898	17860	16406	14833	14833	17621	NA	NA	NA	NA
Timber, m³	Produced	60480	60480	60480	50834	37580	31700	33317	53000	NA	NA	NA	NA
	Imported	155100	155100	151113	132290	137595	150517	150517	153900	NA	NA	NA	NA
	Exported	4000	4000	1678	1980	1378	2081	2081	2081	NA	NA	NA	NA
Wood panels, m³	Produced	2800	2800	2800	15055	15270	15000	15000	0	NA	NA	NA	NA
	Imported	122	122	161514	167030	169818	212560	212560	145001	NA	NA	NA	NA
	Exported	122	122	161514	167030	169818	212560	212560	3164	NA	NA	NA	NA

Source: Statistical Yearbooks of the RM for 1961-2016; FAOSTAT database for 1994-2016 etc.

In order to estimate annual carbon increments/losses due to use of wood products included in source category 4G "Harvested Wood Products", emission/removal factors were used according to the 2006 IPCC Guidelines as presented in Table 6-72.

Table 6-72: EFs Used to Estimate CO_2 Emissions/Removals from the 4G "Harvested Wood Products" in the Republic of Moldova

Categories	Indicators	Units	Indicators Value
Period of use	Solid wood products (timber, saw logs and veneer, rough round wood, wood panels etc.)	years	30.0
	Paper products	years	3.0
Conversion factor	Timber, other types of round wood (saw logs and veneer, etc.)	t C/m³	0.5
	Wood panels	t C/m³	0.295
	Paper and cardboards	t C/t	0.45

6.8.3. Uncertainties Assessment and Time-Series Consistency

Uncertainties associated with the CO_2 emissions/removals from 4G "Harvested Wood Products" at the beginning and the end of the reference period (1990 and 2015) are quite large, and are estimated at circa ±30 per cent. In both cases emission/removal factors have an uncertainty level of ±10 per cent. Combined uncertainties from the 4G "Harvested Wood Products" represent circa ±31.62 per cent, while the uncertainties introduced in trend in total sectoral emissions/removals were estimated as insignificant, at circa ±0.018 per cent (see Annex 5-3.4)

6.8.4. Quality Assurance and Quality Control

The quality of assessment for 4G "Harvested Wood Products" category is provided by the fact that most of the AD used is taken from official records (the Statistical Yearbooks of the RM; FAOSTAT database). At the same time, it should be noted that the export and import data for the 1961-1993 time series (while the RM was part of the USSR and in the first years after the independence) were calculated indirectly, considering the estimated needs in 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, following the recommendations included in the 2006 IPCC Guidelines (Volume 4 "AFOLU"), on various aspects such as: verification of correct application of assessment methods set out in the Guidelines, ensuring correct use of national factors and indices, their accuracy, as well as comparing them to the values used by other Eastern and Central European countries.

6.8.5. Recalculations

CO_2 removals/emissions from category 4G "Harvested Wood Products" were recalculated for the 1990-2015 time series due to updating certain AD (Table 6-73).

Table 6-73: Recalculated CO_2 Removals/Emissions from 4G "Harvested Wood Products" Category, included into the NC4 and the BUR2 of the Republic of Moldova under the UNFCCC, kt

	1990	1991	1992	1993	1994	1995	1996	1997	1998
NC4	-130.0504	-124.5885	-115.9639	-96.5980	-65.6972	-16.8419	3.8273	-0.3171	-21.2914
BUR2	-122.1804	-113.6108	-94.2986	-63.4504	-14.6464	5.9727	1.7792	-19.2429	-9.1293
Difference, %	-6.1	-8.8	-18.7	-34.3	-77.7	-135.5	-53.5	5967.6	-57.1
	1999	2000	2001	2002	2003	2004	2005	2006	2007
NC4	-11.1310	16.5854	3.8960	-8.1271	-58.5123	-66.8962	-55.2171	-42.8125	-42.2503
BUR2	18.5414	5.8073	-6.2594	-56.6873	-65.1129	-53.4745	-41.1098	-40.5864	-44.5936
Difference, %	-266.6	-65.0	-260.7	597.5	11.3	-20.1	-25.5	-5.2	5.5
	2008	2009	2010	2011	2012	2013	2014	2015	2016
NC4	-46.2195	-37.1965	-30.0233	-24.3184	-5.8631	75.3959	60.4660	56.6377	
BUR2	-35.6078	-28.4708	-22.8014	-4.3808	76.8444	61.8814	58.0208	49.2353	0.8816
Difference, %	-23.0	-23.5	-24.1	-82.0	-1410.6	-17.9	-4.0	-13.1	

The obtained results are essentially different compared to the previous estimates, the minimum difference was recorded in 2014 (-4.0 per cent), while the maximum difference – in 1997 (+5967.6 per cent). Between 1990 and 2016, CO_2 removals/emissions from 4G "Harvested Wood Products" significantly fluctuated and were influenced in particular, by the impermanence of the wood harvesting/producing process. The largest volumes were registered in 1990 (122.2 kt), while the lowest – in 2011 (4.4 kt) (Table 6-74).

Table 6-74: CO_2 Removals/Emissions from 4G "Harvested Wood Products" Category in the Republic of Moldova within 1990-2016 periods, kt

	1990	1991	1992	1993	1994	1995	1996	1997	1998
4G. CO_2 Removals/Emissions	-122.1804	-113.6108	-94.2986	-63.4504	-14.6464	5.9727	1.7792	-19.2429	-9.1293
	1999	2000	2001	2002	2003	2004	2005	2006	2007
4G. CO_2 Removals/Emissions	18.5414	5.8073	-6.2594	-56.6873	-65.1129	-53.4745	-41.1098	-40.5864	-44.5936
	2008	2009	2010	2011	2012	2013	2014	2015	2016
4G. CO_2 Removals/Emissions	-35.6078	-28.4708	-22.8014	-4.3808	76.8444	61.8814	58.0208	49.2353	0.8816

At the same time, CO_2 emissions were recorded during 9 years (1995-1996, 1999-2000, 2012-2016) – with a minimum of 0.9 kt in 2016, and a maximum of 76.8 kt in 2012 (Figure 6-13).

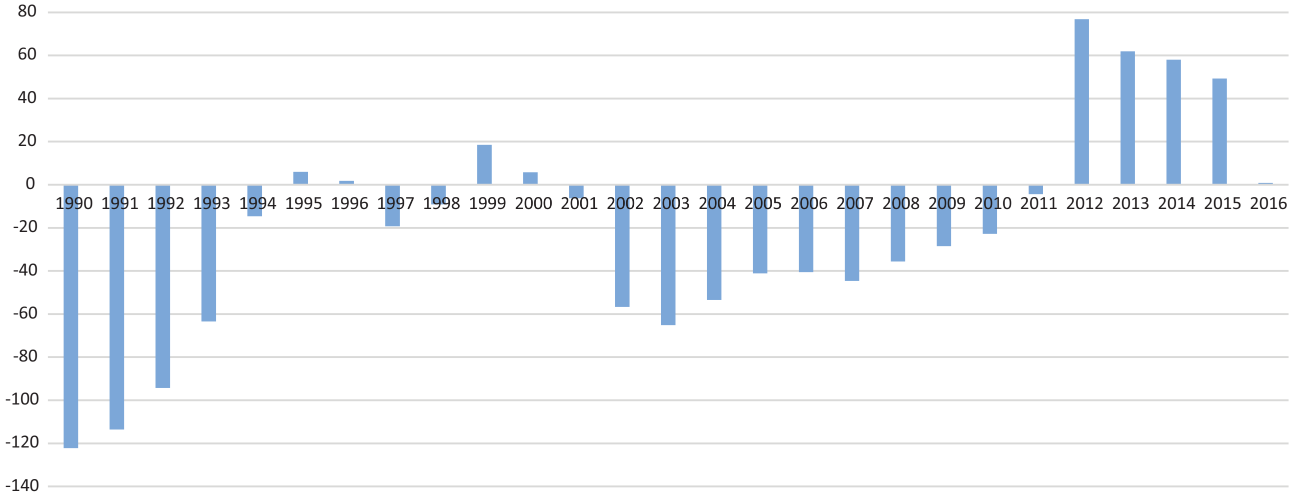


Figure 6-15: CO_2 Removals/Emissions from 4G "Harvested Wood Products" within 1990-2016, kt.

6.8.6 Planned Improvements

The possibility to improve the statistical records (as the main reference sources for AD) pertaining to wood products production/export/import from 4G "Harvested Wood Products" category will be considered for the next inventory cycles in the Republic of Moldova.

7. WASTE SECTOR

7.1. Overview

Within Sector 5 'Waste' there are monitored direct GHG emissions (CO_2, CH_4 and N_2O) handling domestic and industrial wastewater, incineration and open burning of waste as well as from wastewater treatment and discharge, estimated based on the 2006 IPCC Guidelines.

The source categories covered by this sector are: 5A "Solid Waste Disposal", 5C "Incineration and Open Burning of Waste" and 5D "Wastewater Treatment and Discharge".

A brief overview, methodological issues and data sources, key categories, uncertainties assessment 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 2016, Sector 5 'Waste' accounted for circa 10.0 per cent of total national direct GHG emissions (without LULUCF), being the third major source of GHG emissions in the Republic of Moldova, following the Sector 1 'Energy' and Sector 3 'Agriculture'. To be noted that Sector 5 'Waste' represents a major source of CH_4 emissions, accounting for circa 48.5 per cent of total methane emissions reported at the national level.

Between 1990 and 2016, the total GHG emissions originated from the Sector 5 'Waste' tended to lower values, decreasing from circa 1,515.4 kt CO_2 equivalent in 1990 to circa 1,460.3 kt CO_2 equivalent in 2016 (Table 7-1), in particular due to economic decline in the Republic of Moldova during the transition to a market economy. The economic growth recorded in the last 15 years resulted in a higher level of welfare, an increase in consumption and a greater capacity for waste generation. All these changes have contributed to an increasing trend of direct GHG emissions within the Sector 5 'Waste', in particular following 2006 year.

Table 7-1: Total Direct GHG Emissions from Sector 5 'Waste', by Gas, within 1990-2016 periods

Year	CO_2, kt	CH_4, kt CO_2 equivalent	N_2O, kt CO_2 equivalent	Total, kt CO_2 equivalent	CO_2, % from the total	CH_4, % from the total	N_2O, % from the total
1990	17.1060	1,408.4745	89.7870	1,515.3675	1.1	92.9	5.9
1991	17.1256	1,448.9932	83.0085	1,549.1274	1.1	93.5	5.4
1992	17.1291	1,457.8123	76.2137	1,551.1552	1.1	94.0	4.9
1993	17.1013	1,524.5190	71.6016	1,613.2220	1.1	94.5	4.4
1994	17.1330	1,509.5166	69.5580	1,596.2076	1.1	94.6	4.4
1995	17.1216	1,507.2070	70.3974	1,594.7260	1.1	94.5	4.4
1996	17.1083	1,512.5072	69.3613	1,598.9768	1.1	94.6	4.3
1997	17.0610	1,507.6573	70.5918	1,595.3101	1.1	94.5	4.4
1998	17.0846	1,482.6368	71.6384	1,571.3598	1.1	94.4	4.6
1999	17.0578	1,478.6359	70.1287	1,565.8223	1.1	94.4	4.5
2000	17.0226	1,452.9783	71.7506	1,541.7515	1.1	94.2	4.7
2001	17.0025	1,425.0738	72.5302	1,514.6064	1.1	94.1	4.8
2002	16.9466	1,390.9720	74.3548	1,482.2734	1.1	93.8	5.0
2003	16.8812	1,358.3092	71.8685	1,447.0589	1.2	93.9	5.0
2004	16.8147	1,344.8576	74.8987	1,436.5710	1.2	93.6	5.2
2005	15.8340	1,339.7714	73.1482	1,428.7535	1.1	93.8	5.1
2006	15.8420	1,331.6548	72.1031	1,419.5998	1.1	93.8	5.1
2007	15.9412	1,333.5346	69.8876	1,419.3635	1.1	94.0	4.9
2008	15.8898	1,352.4402	70.1439	1,438.4739	1.1	94.0	4.9
2009	15.8568	1,370.6168	66.1929	1,452.6665	1.1	94.4	4.6
2010	15.8271	1,398.0624	69.4101	1,483.2997	1.1	94.3	4.7
2011	15.8962	1,416.3424	68.6726	1,500.9112	1.1	94.4	4.6
2012	15.8744	1,407.1480	68.0807	1,491.1032	1.1	94.4	4.6
2013	15.8530	1,352.9558	68.7417	1,437.5505	1.1	94.1	4.8
2014	15.8047	1,350.7338	69.5152	1,436.0537	1.1	94.1	4.8
2015	15.6434	1,345.8578	69.7911	1,431.2923	1.1	94.0	4.9
2016	15.4600	1,374.8879	69.9257	1,460.2737	1.1	94.2	4.8
1990-2016, %	-9.6	-2.4	-22.1	-3.6	-6.2	1.3	-19.2

In 1990, CO_2, CH_4 and N_2O emissions accounted for circa 1.1 per cent, 92.9 and 5.9 per cent of the total GHG emissions from the Sector 5 'Waste'.

By 2016, the share of pollutants have not changed significantly, representing about circa 1.1 per cent, 94.2 per cent and 4.8 per cent of the total sectoral emissions.

At the same time, between the 1990-2016 time series, the total direct GHG emissions originated from the Sector 5 'Waste' decreased by circa 3.6 per cent, CO_2 emissions by 9.6 per cent, CH_4 and N_2O emissions decreased respectively, by 2.4 per cent and 22.2 per cent (Figure 7-1).

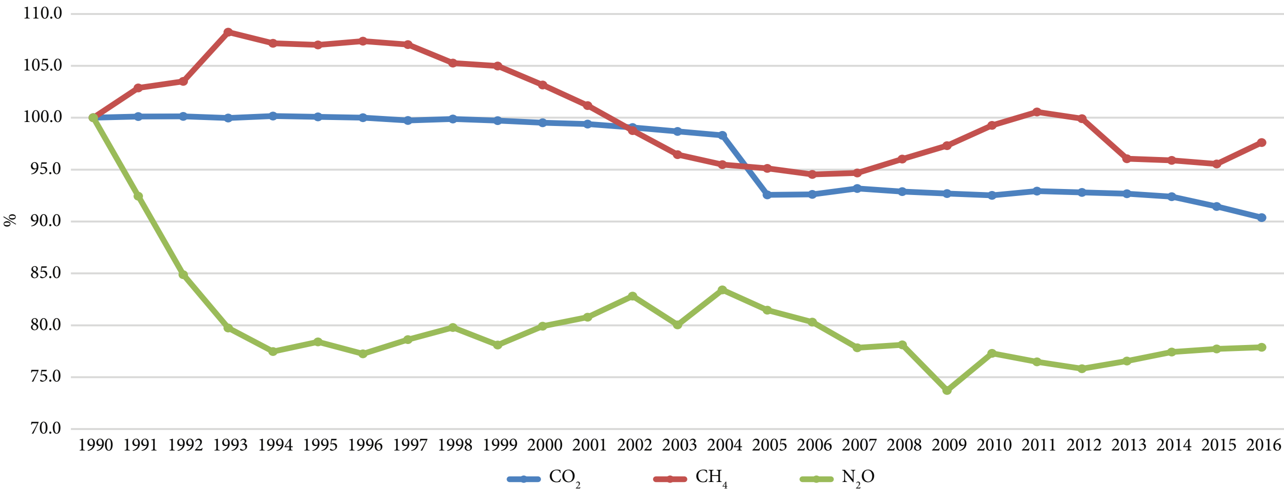


Figure 7-1: Direct GHG Emissions from Sector 5 'Waste' by Gas in the Republic of Moldova within 1990-2016 time periods, where 1990 represent 100 per cent.

The 5A "Solid Waste Disposal" was the largest source of direct GHG emissions in the time period from 1990 through 2016, with a share varying between a minimum of 69.1 per cent of the total in 1990 and a maximum of 77.0 per cent of the total in 2011; followed by the 5D "Wastewater Treatment and Discharge" with a share varying between a minimum of 21.3 per cent of the total in 2011 and a maximum of 29.1 per cent of the total in 1990; respectively by the 5C "Incineration and Open Burning of Waste", with a share varying between 1.7 and 1.9 per cent of the total sectoral emissions within 1990-2016 periods.

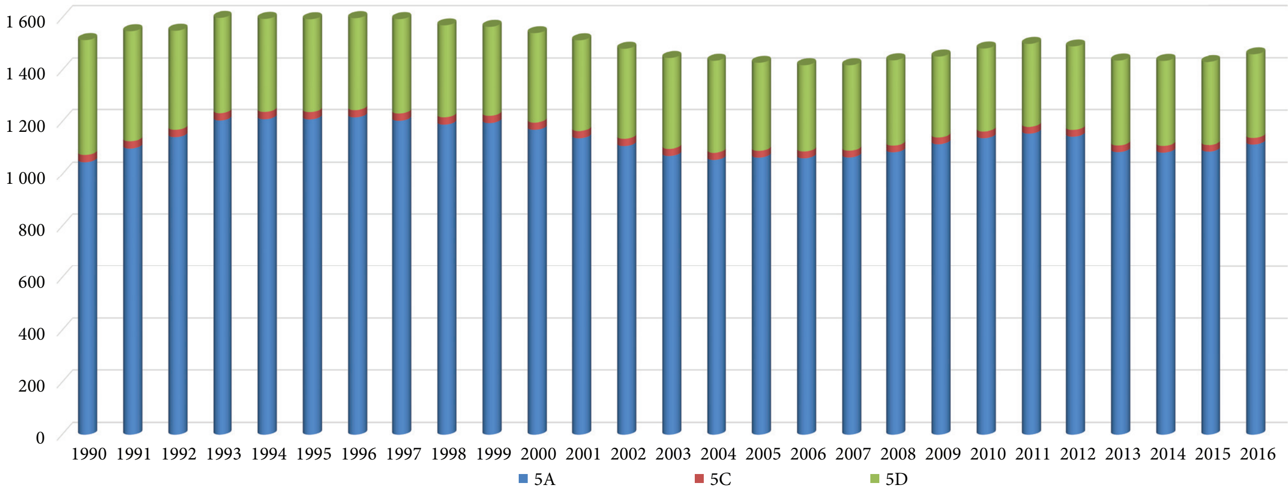


Figure 7-2: Breakdown of Direct GHG Emissions by Category under the Sector 5 'Waste' within 1990-2016 periods, kt CO_2 equivalent.

Within the reference period, direct GHG emissions from the 5A "Solid Waste Disposal" category increased by circa 6.5 per cent, from 5C "Incineration and Open Burning of Waste" category decreased by circa 9.8 per cent, while emissions from the 5D "Wastewater Treatment and Discharge" category decreased by circa 27.4 per cent (Figure 7-2, Table 7-2).

Table 7-2: Breakdown of Direct GHG Emissions by Category within Sector 5 'Waste' and their Share in the Total Sectoral Emissions in the Republic of Moldova within 1990-2016 periods

Year	5A, kt CO_2 eq.	5C, kt CO_2 eq.	5D, kt CO_2 eq.	5, Total, kt CO_2 eq.	5A, % from the total	5C, % from the total	5D, % from the total
1990	1 046.7277	27.7249	440.9149	1 515.3675	69.1	1.8	29.1
1991	1 098.6185	27.7559	422.7530	1 549.1274	70.9	1.8	27.3
1992	1 141.9561	27.7607	381.4383	1 551.1552	73.6	1.8	24.6
1993	1 204.7183	27.7148	380.7889	1 613.2220	74.7	1.7	23.6
1994	1 209.8012	27.7652	358.6413	1 596.2076	75.8	1.7	22.5
1995	1 209.1757	27.7458	357.8046	1 594.7260	75.8	1.7	22.4
1996	1 216.7829	27.7232	354.4707	1 598.9768	76.1	1.7	22.2
1997	1 203.8019	27.6455	363.8628	1 595.3101	75.5	1.7	22.8
1998	1 189.3544	27.6826	354.3228	1 571.3598	75.7	1.8	22.5
1999	1 195.2267	27.6378	342.9578	1 565.8223	76.3	1.8	21.9
2000	1 169.5330	27.5796	344.6389	1 541.7515	75.9	1.8	22.4
2001	1 137.4743	27.5456	349.5865	1 514.6064	75.1	1.8	23.1
2002	1 108.0606	27.4536	346.7591	1 482.2734	74.8	1.9	23.4
2003	1 070.2330	27.3461	349.4798	1 447.0589	74.0	1.9	24.2
2004	1 055.1514	27.2367	354.1830	1 436.5710	73.4	1.9	24.7
2005	1 064.3081	25.6447	338.8006	1 428.7535	74.5	1.8	23.7
2006	1 061.8430	25.6560	332.1009	1 419.5998	74.8	1.8	23.4
2007	1 064.8219	25.8151	328.7264	1 419.3635	75.0	1.8	23.2
2008	1 084.1973	25.7298	328.5468	1 438.4739	75.4	1.8	22.8
2009	1 115.0489	25.6744	311.9432	1 452.6665	76.8	1.8	21.5
2010	1 137.8491	25.6241	319.8265	1 483.2997	76.7	1.7	21.6
2011	1 155.0806	25.7171	320.1134	1 500.9112	77.0	1.7	21.3
2012	1 143.6162	25.6814	321.8055	1 491.1032	76.7	1.7	21.6
2013	1 084.7685	25.6468	327.1351	1 437.5505	75.5	1.8	22.8
2014	1 083.0800	25.5716	327.4022	1 436.0537	75.4	1.8	22.8
2015	1 087.1715	25.3128	318.8081	1 431.2923	76.0	1.8	22.3
2016	1 115.1732	25.0183	320.0822	1 460.2737	76.4	1.7	21.9
1990-2016, %	6.5	-9.8	-27.4	-3.6	10.6	-6.4	-24.7

The table below presents direct GHG emissions from Sector 5 'Waste' in the Republic of Moldova by sources and gas (Table 7-3).

Table 7-3: Direct GHG Emissions from Sector 5 'Waste', by Source and Gas, in the Republic of Moldova within 1990-2016 periods, kt CO_2 equivalent

Year	5A	5C			5D		5
	CH_4, 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	1 046.7277	17.1060	8.7818	1.8371	352.9650	87.9499	1 515.3675
1991	1 098.6185	17.1256	8.7912	1.8391	341.5835	81.1694	1 549.1274
1992	1 141.9561	17.1291	8.7923	1.8394	307.0640	74.3744	1 551.1552
1993	1 204.7183	17.1013	8.7772	1.8363	311.0235	69.7653	1 613.2220
1994	1 209.8012	17.1330	8.7926	1.8396	290.9228	67.7185	1 596.2076
1995	1 209.1757	17.1216	8.7859	1.8382	289.2454	68.5592	1 594.7260
1996	1 216.7829	17.1083	8.7782	1.8367	286.9461	67.5246	1 598.9768
1997	1 203.8019	17.0610	8.7529	1.8315	295.1025	68.7603	1 595.3101
1998	1 189.3544	17.0846	8.7641	1.8339	284.5183	69.8045	1 571.3598
1999	1 195.2267	17.0578	8.7492	1.8309	274.6600	68.2978	1 565.8223
2000	1 169.5330	17.0226	8.7300	1.8270	274.7153	69.9236	1 541.7515
2001	1 137.4743	17.0025	8.7185	1.8247	278.8810	70.7055	1 514.6064
2002	1 108.0606	16.9466	8.6885	1.8185	274.2228	72.5363	1 482.2734
2003	1 070.2330	16.8812	8.6536	1.8113	279.4227	70.0571	1 447.0589
2004	1 055.1514	16.8147	8.6180	1.8040	281.0883	73.0947	1 436.5710
2005	1 064.3081	15.8340	8.1123	1.6984	267.3509	71.4498	1 428.7535
2006	1 061.8430	15.8420	8.1149	1.6991	261.6968	70.4040	1 419.5998
2007	1 064.8219	15.9412	8.1643	1.7095	260.5483	68.1781	1 419.3635
2008	1 084.1973	15.8898	8.1362	1.7038	260.1067	68.4401	1 438.4739
2009	1 115.0489	15.8568	8.1175	1.7000	247.4503	64.4928	1 452.6665
2010	1 137.8491	15.8271	8.1003	1.6966	252.1130	67.7135	1 483.2997
2011	1 155.0806	15.8962	8.1190	1.7019	253.1427	66.9707	1 500.9112
2012	1 143.6162	15.8744	8.1074	1.6996	255.4244	66.3812	1 491.1032
2013	1 084.7685	15.8530	8.0965	1.6973	260.0907	67.0444	1 437.5505
2014	1 083.0800	15.8047	8.0744	1.6924	259.5794	67.8228	1 436.0537
2015	1 087.1715	15.6434	7.9940	1.6754	250.6923	68.1157	1 431.2923
2016	1 115.1732	15.4600	7.9023	1.6560	251.8125	68.2697	1 460.2737
1990-2016, %	6.5	-9.6	-10.0	-9.9	-28.7	-22.4	-3.6

Within the current inventory cycle, indirect GHG emissions, ozone and aerosol precursors (NO_x, CO, NMVOC and SO_2), from Sector 5 'Waste' were recorded for the first time (Table 7-4), according to the assessment methods available in the EMEP/EEA Air Pollutant Emission Inventory Guidebook (2016).

Table 7-4: Indirect GHG Emissions from Sector 5 'Waste' in the RM within 1990-2016 periods, kt

	1990	1991	1992	1993	1994	1995	1996	1997	1998
NOx	0.1713	0.1714	0.1714	0.1711	0.1714	0.1712	0.1710	0.1705	0.1706
CO	3.0070	3.0097	3.0095	3.0038	3.0084	3.0055	3.0021	2.9927	2.9958
NMVOC	3.0981	2.9195	2.8132	1.7663	1.6023	1.4716	1.4378	1.3445	1.3383
SO_2	0.0059	0.0059	0.0059	0.0059	0.0059	0.0059	0.0059	0.0059	0.0059
	1999	2000	2001	2002	2003	2004	2005	2006	2007
NOx	0.1703	0.1699	0.1696	0.1690	0.1682	0.1675	0.1575	0.1575	0.1584
CO	2.9899	2.9824	2.9776	2.9664	2.9534	2.9401	2.7653	2.7650	2.7808
NMVOC	1.2121	1.2086	1.0954	1.1538	1.3069	1.3945	1.5484	1.6769	2.1000
SO_2	0.0059	0.0059	0.0059	0.0058	0.0058	0.0058	0.0054	0.0054	0.0055
	2008	2009	2010	2011	2012	2013	2014	2015	2016
NOx	0.1578	0.1573	0.1569	0.1565	0.1563	0.1561	0.1558	0.1543	0.1526
CO	2.7698	2.7621	2.7548	2.7484	2.7441	2.7405	2.7350	2.7093	2.6796
NMVOC	2.3948	2.1787	2.0074	2.0356	2.0117	2.1768	2.3028	2.3051	2.0978
SO_2	0.0055	0.0054	0.0054	0.0054	0.0054	0.0054	0.0054	0.0053	0.0053

7.1.2. Key Categories

The results of key category analysis under the 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 the Sector 5 'Waste'

IPCC Category	GHGs	Source Category	Key Categories
5A	CH_4	Solid Waste Disposal	Yes (L, T)
5C	CO_2	Incineration and Open Burning of Waste	No
5C	CH_4	Incineration and Open Burning of Waste	No
5C	N_2O	Incineration and Open Burning of Waste	No
5D	CH_4	Wastewater Treatment and Discharge	Yes (L, T)
5D	N_2O	Wastewater Treatment and Discharge (Human Sewage)	Yes (T)

Abbreviations: L – Level Assessment; T – Trend Assessment.

7.1.3. Methodological Issues

In order to estimate GHG emissions from the 5A "Solid Waste Disposal", 5C "Incineration and Open Burning of Waste" and 5D "Wastewater Treatment and Discharge" categories, there were used both a Tier 1 and a Tier 3 approach, default EFs values 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 sub-chapters of the NIR (7.2-7.4).

Table 7-6: Assessment Methods Used to Estimate GHG Emissions from the Sector 5 'Waste'

IPCC Category	Source Category	CO_2		CH_4		N_2O	
		Method	EF	Method	EF	Method	EF
5A	Solid Waste Disposal	NA	NA	T3	D, CS	NA	NA
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 2; CS – country specific; D – default; NA – Not Applicable; NO – Not Occurring.

7.1.4. Uncertainties Assessment and Time-Series Consistency

The uncertainty analysis of the GHG emissions from the Sector 5 'Waste' (including by source categories) is described in detail in the sub-chapters 7.2-7.4, as well as in the Annex 5-3.5 of the NIR. Combined uncertainties as a percentage of total direct sectoral emissions were estimated at circa ±39.24 per cent. The uncertainties introduced in trend in total direct sectoral emissions were estimated at circa ±32.28 per cent. 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 the Sector 5 'Waste', following a Tier 1 approach. To be noted that AD and methods used for estimating GHG emissions under the Sector 5 'Waste' were documented and archived both in hard copies and electronically. In order to identify the data entry, as well GHG emissions estimation related errors, AD and EFs verifications and QC procedures were applied. Following the recommendations included into the 2006 IPCC Guidelines, GHG emissions from the Sector 5 'Waste' were estimated based on AD and EFs from official sources of reference.

7.1.6. Recalculations

GHG emission recalculations under the Sector 5 'Waste' are due to use of new methodological approach according to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories, respectively due to the use of an updated set of AD and country specific EFs values. In comparison with the results recorded in the previous inventory cycle, the performed recalculation revealed a decreasing trend of direct GHG emissions between 1990 and 2015, varying from a minimum of 3.0 per cent in 1999 and a maximum of 23.4 per cent in 1990 (Table 7-7). The results are presented in the respective sub-chapters of the NIR (7.2-7.4).

Table 7-7: Recalculated Direct GHG Emissions from the Sector 5 'Waste' within 1990-2015 periods, included into the NC4 of the RM under UNFCCC, kt CO_2 equivalent

	1990	1991	1992	1993	1994	1995	1996	1997	1998
NC4	1977.7062	1947.9094	1803.0181	1849.7299	1747.0538	1720.1979	1709.8232	1719.0952	1651.4447
BUR2	1515.3675	1549.1274	1551.1552	1613.2220	1596.2076	1594.7260	1598.9768	1595.3101	1571.3598
Difference, %	-23.4	-20.5	-14.0	-12.8	-8.6	-7.3	-6.5	-7.2	-4.8
	1999	2000	2001	2002	2003	2004	2005	2006	2007
NC4	1614.4255	1600.6911	1591.0731	1550.2532	1535.6336	1526.1783	1557.3015	1536.9452	1528.2475
BUR2	1565.8223	1541.7515	1514.6064	1482.2734	1447.0589	1436.5710	1428.7535	1419.5998	1419.3635
Difference, %	-3.0	-3.7	-4.8	-4.4	-5.8	-5.9	-8.3	-7.6	-7.1
	2008	2009	2010	2011	2012	2013	2014	2015	2016
NC4	1552.1963	1541.6738	1580.1262	1604.4245	1601.8279	1566.1229	1561.9373	1538.6611	
BUR2	1438.4739	1452.6665	1483.2997	1500.9112	1491.1032	1437.5505	1436.0537	1431.2923	1460.2737
Difference, %	-7.3	-5.8	-6.1	-6.5	-6.9	-8.2	-8.1	-7.0	

Abbreviations: NC4 – Fourth National Communication; BUR2 – Second Biennial Update Report.

7.1.7. Assessment of Completeness

The current inventory covers direct GHG emissions from three categories under the Sector 5 'Waste' (Table 7-8). Though the RM does not own waste incinerators, GHG emissions from 5C "Incineration and Open Burning of Waste" category were estimated within the last two inventory cycles (under the NC4 and BUR2 of the RM under the UNFCCC).

Table 7-8: Assessment of Completeness under the Sector 5 'Waste' in the Republic of Moldova

IPCC Category	Source Categories	CO_2	CH_4	N_2O
5A	Solid Waste Disposal	NE	X	NE
5B	Biological Treatment of Solid Waste	NA	NO, NE	NO, NE
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 in the inventory; NO – Not Occurring; NE – Not Estimated; NA – Not Applicable.

7.1.8. Planned Improvements

Planned improvements at the source categories level within the Sector 5 'Waste' are described in detail in sub-chapters 7.2-7.4 of the NIR.

7.2. Solid Waste Disposal (Category 5A)

7.2.1. Source Category Description

Current situation with the management of "Municipal Solid Waste" (MSW) in the Republic of Moldova is similar to the situation in other developing countries; it is in the budding stage and includes two basic elements: municipal solid waste generating sources and the landfills. The generating process of municipal solid waste is influenced by multiple factors, the most relevant being the population income, consumer behaviour, the use of new packed 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 the World Bank's studies, between 0.3 and 0.4 kg/per capita/day in rural areas and around 0.9 kg/per capita/per day in urban areas. These data were taking into consideration during the development of the Republic of Moldova's Waste Management Strategy for 2013-2027[98]. Food consumption currently generates more and more waste. The introduction of new packages, plastic in particular, produces a significant negative impact on the environment. The polyethylene terephthalate (PET) packaging have replaced in the last years the glass packaging; while the polyethylene (PE) sacks, bags or boxes have replaced paper packaging, thus influencing the amount and composition of generated waste. The increasing number of markets, shops and supermarkets, along with an increase in welfare, respectively in purchasing power of packed products led to a greater capacity to generate waste, in particular in urban areas. Waste generation indicators were revised in the Republic of Moldova during the completing process of 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, respectively 0.9 kg/per capita/day for small urban areas and district centers, 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 waste collection services.

Currently, the most used method of treating waste is waste disposal on sites, which often is a major source of soil pollution and groundwater contamination. In this context, sanitation and waste management services represent an important goal for local and governmental structures. According to the "State Ecological Inspectorate Yearbook for 2016 – Environment Protection in the RM", the total area of SWDS in urban areas represent circa 1,229.71 ha. In 2016 the area of authorized SWDS represented only 168.6 ha (NBS, 2017), therefore circa 1,061 ha were occupied by the so called "dump sites" (unauthorized landfills) situated especially in the rural areas of the RM. From the existing 1,151 landfills, about ¾ do not comply with sanitary and environment protection requirements and, the total amount of solid wastes accumulated on these sites cannot be estimated.

It should be noted that between 2010 and 2017 the construction of several landfills started in the country, in particular in district centres, serving the neighbourhood villages. Thus, for example, new landfills became operational in 2013-2015 in Nisporeni, Telenesti and Hincesti. Within 2000-2016, time periods, through urban sanitation services, about 1,144 and 2,915.5 thousand m^3 of waste was transported to solid waste disposal sites. No statistical records on disposed waste volume is being made, there are only some visual estimates of environment inspectors, who appreciate the total volume of MSW disposed at approximately 35 million tons. To be noted that only 10 per cent of SWDS are enacted but even these are far from meeting environmental requirements since they are not operated properly: without compacting and using intermediary cover material to prevent the spread of fires and odours; lacking a strict control through weighing of disposed waste quality and quantity; there are no facilities to recover biogas produced or to recover/treat the filtrate; access road to and within the disposal sites are not maintained, vehicles are not washed on leaving the landfill; these sites do not have proper fences, an appropriate entry and warning signs. In most district towns the dump sites are overfilled, the disposed waste layer being 7-8 m deep (ex., in Ungheni, Cahul, Ocnita, etc.), at some landfills the layer is circa 10-15 m deep (ex., in Briceni, Balti, Ialoveni, etc.) and even 25-30 m deep (Cretoaia and Orhei municipality). Circa 3/4 of district town's landfills are being explored for circa 25-35 years at over 80 per cent of their capacity.

In recent years there have been changes in waste management in Chisinau municipality. The landfill situated in Cretoaia village that serves Chisinau municipality became operational by the end of 1990 (de facto exploitation began in 1991); this landfill has an area of about 24.95 ha, of which net area represents 20.89 ha. According to the project, it was designed to storage until the end of 2010 about 44 million m^3 of solid waste. By 2011, when its use stopped, only 19 million m^3 of solid waste were stored, which is less than half the capacity of the landfill. Since 2011 to 2017, Chisinau municipality has storied its waste near the waste transshipment station, located in Bubuieci village. The new location, was treated as a temporary solution, and became a serious environmental problem since waste was disposed on an unmanaged land, lacking environment protection measures such as sealing foundation, collecting storage gas, collecting and treating leachate, rainwater deviation etc. Since summer 2017, Chisinau municipality is storing again its waste at the Crețoaia landfill, after negotiating with the local

[98] <http://lex.justice.md/index.php?action=view&view=doc&lang=1&id=347341>.

public authorities the conditions for reusing the landfill, including the solutions for the environmental protection problems. Rehabilitation and remediation measures for the environment pollution caused by the waste transshipment station in Bubuieci village are currently in progress. The impact of waste on the environment increased significantly in recent years, and inappropriate management entails soil, phreatic water contamination and atmospheric air by emissions of CH_4, CO_2 and other toxic gases, directly affecting the human health and the environment.

Between 1990 and 2016, the methane emissions from the 5A "Solid Waste Disposal" source category increased by circa 6.5 per cent, from circa 41.87 kt in 1990, up to circa 44.61 kt in 2016 (Figure 7-3).

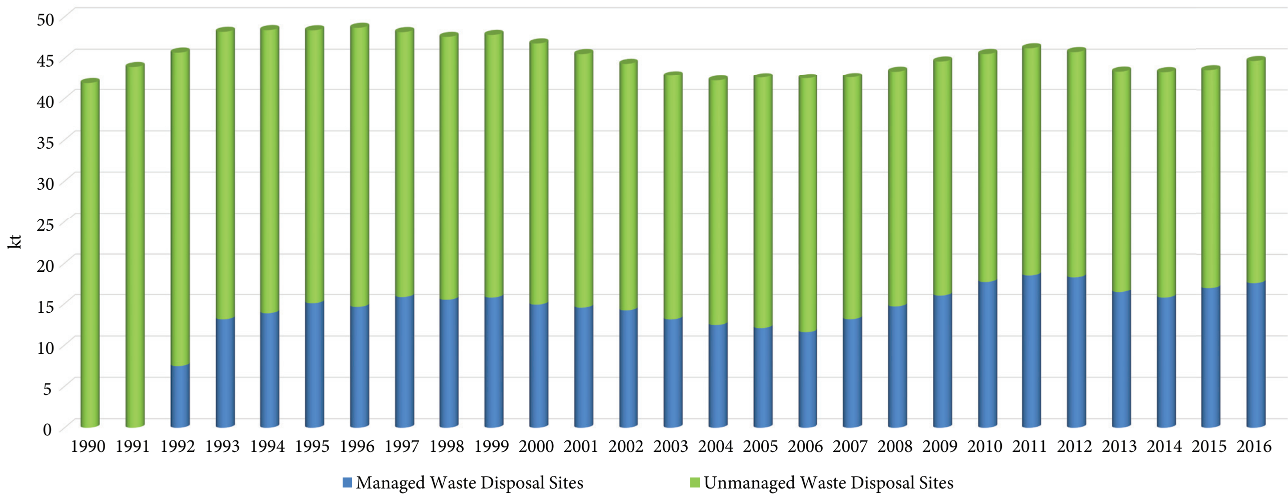


Figure 7-3: Methane Emissions from 5A "Solid Waste Disposal" within 1990-2016, kt.

7.1.2. Methodological Issues, Emission Factors and Data Sources

In order to estimate methane emissions from solid waste disposal, 2006 IPCC Guidelines recommends using the First Order Decay Method, with three alternative methodological approaches – Tier 1, 2 and 3; the Tier 1 method uses mainly default activity data and default EFs; the Tier 2 method uses only partially 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 (for example, longer than 25 years), with country-specific EF and parameters resulting from measurements and research conducted periodically at national level (for example, fraction DOC or degradable organic carbon in year x; fraction DOCf or fraction DOC dissimilated; L_o – methane generation potential, etc.).

Assessment 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.

The methane emissions from solid waste disposal were estimated using Equation 3.1 from the 2006 IPCC Guidelines (Vol. 5, Chapter. 3, page 3.8):

$$Emissions\ CH_4 = [\Sigma_x CH_4\ generated_{x,T} - R_T] \bullet (1-OX_T)$$

Where:

- Emissions CH_4 – 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 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 calculation is the amount of Decomposable Degradable Organic Carbon DDOCm). DDOCm is the part of the organic carbon that will degrade under the anaerobic conditions in SWDS.

The amount of DDOCm (where the index m is used for mass) can be estimated using Equation 3.2 provided by the 2006 IPCC Guidelines (Vol. 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 – methane correction factor for aerobic decomposition in the year of deposition (fraction).

Using DDOCm, it can be estimated the methane generation potential (L_o), by applying Equation 3.3 provided by the 2006 IPCC Guidelines (Vol. 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).

DDOCm accumulated in the 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, respectively using Equation 3.5 provided by the 2006 IPCC Guidelines (Vol. 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 is found by multiplying the CH_4 fraction in generated landfill gas and the CH_4/C molecular weight ratio and can be estimated using Equation 3.6 provided by the 2006 IPCC Guidelines (Vol. 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 (ratio).

Emission Factors

Degradable organic carbon (DOC) is the organic carbon in waste that is accessible to biochemical decomposition and can be estimated using Equation 3.7 provided by the 2006 IPCC Guidelines (Vol. 5, Chapter. 3, Page 3.13):

$$DOC = \sum_i (DOC_i \bullet W_i)$$

Where,

DOC – fraction of degradable organic carbon in bulk waste, kt C/kt 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);

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 (Vol. 5, Chapter. 2, Page 2.14), while for industrial waste by industry in Table 2.5 in the 2006 IPCC Guidelines (Vol. 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 is 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 important when estimating the total amount of DOC in MSW. Therefore it is advised not to use IPCC default waste composition data together with country-specific MSW disposal data, without checking that the inert part is close to the inert part in the IPCC default data. The use of country-specific values is encouraged if data are available.

Country-specific values can be obtained by performing waste generation studies, sampling at SWDS combined with analysis of the degradable carbon content within the country.

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 in the respective disposal sites, a larger fraction of waste decomposes aerobically in the top layer. 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	SWDS
Managed – anaerobic[1]	1.0	Chisinau municipality, 1991-2015.
Managed – semi-aerobic[2]	0.5	NA
Unmanaged – deep (> 5 m)[3]	0.8	Chisinau municipality, up to 1990. Balti municipality and district towns.
Unmanaged – shallow (< 5 m)[4]	0.4	Rural areas of the Republic of Moldova.
Uncategorised SWDS [5]	0.6	NA

Notes: 1 Anaerobic managed solid waste disposal sites include the following: cover material, mechanical compacting or levelling of the 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 morphologic composition studies performed between 1986 and 2016 years, there were calculated the country specific DOC values. Figure 7-4 illustrates the shares of biodegradable fractions in the waste stream in the RM, indicating a decrease from circa 77.0 per cent in 1986, to circa 54.0 per cent in 2001 with a further increase to 72.4 per cent in 2005 and a subsequent decrease to circa 58.9 per cent in 2016.

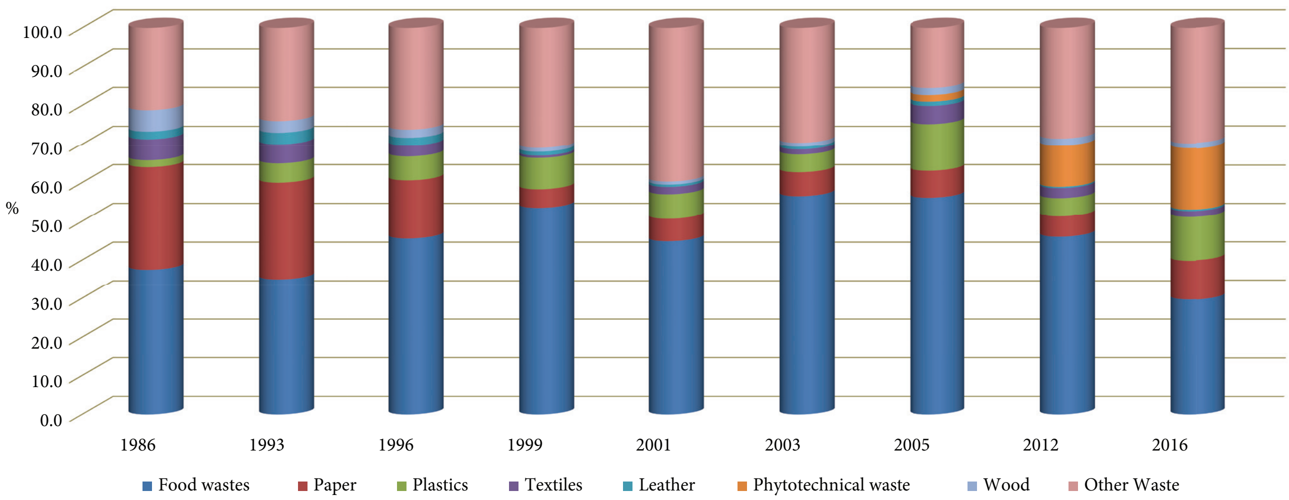


Figure 7-4: Biodegradable Waste in the Major Waste Streams in the RM within 1986-2016, %.

Within the current inventory cycle, a new study was conducted on solid waste morphologic composition. The technical team within the State Centre for Ecological Investigations, previously trained in similar waste management analysis, in fully cooperation with project experts from Climate Change Office and Prevention of Environment Pollution of the MARDE, have determined during 2016 the morphology of household waste generated in Chisinau, and respectively in Causeni and Straseni municipalities (Table 7-10).

Table 7-10: Average annual WDS Morphological Composition in 2016

Waste Type		Morphological Composition of Municipal Waste, %			
		Chisinau	Causeni	Straseni	National Average
Recyclable Waste	Paper, cardboard	6.5	8.0	15.8	10.1
	Glass	5.5	6.0	5.7	5.7
	Plastics	7.0	14.2	12.8	11.3
	Metals and non-metals	1.5	1.8	1.5	1.6
Organic Waste	Food waste	26.4	33.6	29.2	29.7
	Phytotechnical Waste	19.5	11.8	16.3	15.9
	Textiles	2.9	0.3	1.3	1.5
	Shoes	0.1	0.8	0.3	0.4
Bulky Waste	Furniture	2.0	0.0	0.0	0.7
	Electronic and Electrical Equipment	0.3	0.5	0.0	0.3
Other Waste	Wood	1.7	0.2	0.0	0.6
	Construction and Demolition Waste	26.6	22.8	17.0	22.1

Fraction of Degradable Organic Carbon Which Decomposes (DOC_f)

Fraction of *DOCf* which decomposes is an estimate of the fraction of carbon that is ultimately degraded from SWDS, and reflects the fact that some degradable organic carbon does not degrade, or degrades very slowly, under anaerobic conditions in the SWDS. It is considered that DOC_f value is dependent of the temperature from 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 (Vol. 5, Chapter 3, Page 3.13) is 0.5. In the RM, the country-specific values for DOC and DOC_f fractions (Table 7-11) were calculated using the "MSW Learning Tool" created by the University from Florida (1996) based on the laboratory experiments made by Dr. Morton Barlaz (1987, 1997) and further investigations by Chandler, Van Soest (1980).

Table 7-11: Country-specific Values for DOC and DOC_f Fractions Used to Estimate CH_4 Emissions from SWDS within 1985-2016 periods

	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 (Vol. 5, Chapter 3, Page 3.15) recommends the use of a default value for the fraction of CH_4 in landfill gas (*F*) of 0.5. Still, it is known that F value can vary between 0.4 and 0.6, depending on several factors that can influence the process of degradation 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 7-12 and Figure 7-5), using AD on the waste morphologic composition, which also served as basis to estimate *DOC* and DOC_f values.

Table 7-12: Country-specific Values on Biogas Composition in Landfill Gas in the Republic of Moldova within 1986-2016 periods, Based on Extended Buswell Equation, %

	1986	1993	1996	1999	2001	2003	2005	2012	2016
C --> CH_4	53.1	54.0	54.5	55.4	55.1	54.5	55.6	54.2	55.2
C --> CO_2	46.9	46.0	45.5	44.6	44.9	45.5	44.4	45.8	44.8

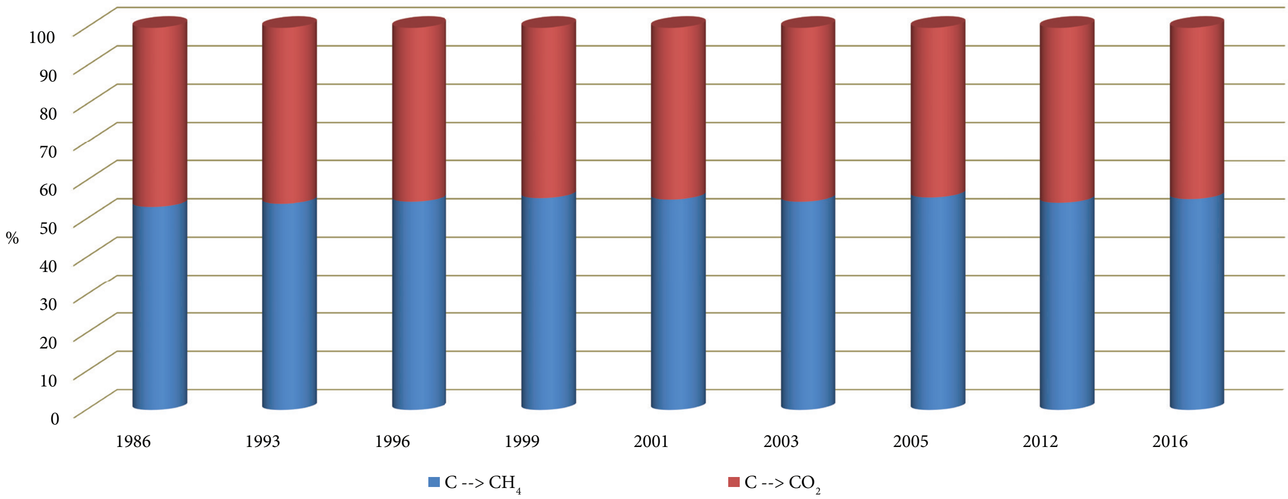


Figure 7-5: Biogas Composition in Landfill Gas in the Republic of Moldova within 1986-2016 periods, Based on Extended Buswell Equation.

At the same time, between 2000 and 2005, several studies were conducted in the RM on biogas composition from the landfills in the country, including those in Cretoaia village, Anenii Noi district. Table 7-13 presents the results of the studies.

Table 7-13: Fractions of Gases in the Landfill Gas Composition from Different SWDS in the Republic of Moldova and Other Countries

Gases	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 in a flare or energy device. The amount of methane recovered is expressed as *R* in Equation 3.1 from the 2006 IPCC Guidelines (Vol. 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.

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[99] (which contains activity data on the amount of electricity generated annually from the biogas recovered at the SWDS in Tintareni by LTD "Tevas Grup" that manages the respective site).

[99] <http://anre.md/ro/reports/8>.

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 is not occurring but if the value of oxidation factor is 1, methane oxidation represents 100 per cent. Well-managed SWDS tend to have higher oxidation rates than unmanaged dump sites. The default value for oxidation factor is zero, according to the 2006 IPCC Guidelines (Volume 5, Chapter 3, Page 3.15) (Table 7-14).

Table 7-14: Oxidation Factor

Type of SDWS	Oxidation Factor (OX)
Managed[1], unmanaged and uncategorised SWDS.	0.0
Managed, covered with CH_4 oxidising material[2].	0.1

Notes: 1 – Managed but not covered with aerated material; 2 – Examples: soil, 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 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 the 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 constant *k* as well as the half-life value $t_{1/2}$ are available in Tables 3.3 and 3.4 from the 2006 IPCC Guidelines (Volume 5, Chapter 3, Pages 3.17 and 3.18).

NMVOC Emissions

NMVOC emissions from SWDS were estimated using the methodological approach available in the EMEP/EEA Air Pollutant Emission Inventory Guidebook (2016):

$$NMVOC\ Emissions = W \bullet EF \bullet 10^{-6}$$

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 (2016), 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 waste management records were examined, such as, Statistical Forms: F-1 "Toxic Waste" and F-2 "Waste" and Statistical Form "Special Road Transport", while since 2003, also the Statistical Form Nr.2–gc "Urban Settlements Sanitation" reflecting the amounts of municipal solid waste transported to landfills and approved by the Order of the Department of Statistics and Sociology, No. 83, from 01.08.2003.

The performed analyses revealed that only municipal solid waste is being transported to dumps by means of sanitation services, while other organic types of waste such as waste from food processing industry, from animal breeding and phytotechnical waste are disposed as well to the dumps, however, due to the fact that these types of waste are transported to the landfills through beneficiary transport units and are not included in the Statistical Form Nr.2–gc "Urban Settlements Sanitation". In these conditions, data on the amount of waste from food processing industry, from animal breeding and phytotechnical waste disposed were collected through the Statistical Form F-2 "Waste". Under the current inventory cycle, the same approach regarding data sources was adopted, collecting data on solid waste disposed through the Statistical Form Nr.2–gc "Urban Settlements Sanitation".

Table 7-15 refers only to the urban landfills were sanitation services exist and provide activity data to the National Bureau of Statistics of the Republic of Moldova. Historical AD regarding 1959-1984 time periods were deduced based on population number, the social-economic development conditions as well as waste generation trends. At the same time, the average value of the MCF was estimated considering the SWDS characteristics, such as managed or unmanaged SWDS and the deep of the disposed waste layer. By the end of 1990, the landfill in Cretoaia village became operational and serving Chisinau municipality (de facto use of this landfill started in 1991), while the GHG emissions generated by this landfill began in 1992, using the MCF = 1.

Table 7-15: Activity Data on the Amount of Solid Waste Disposed on Land and Industrial Waste Disposed on Land in the Republic of Moldova within 1959-2016

	Total	MSW			D_{ind}, kt	DDMS			Average MCF
	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
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

	Total	MSW			D_{ind}, kt	DDMS			Average MCF
	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	
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	745.22	555.28	39.5	35.0	25.5	32.5

Since 2001, the trends in waste generation per capita are steadily growing, in Chisinau city this level even exceeded the level recorded in the early 90s of the twentieth century. While in 1990 just 20 per cent of the waste was generated in Chisinau city, in the last four or five years the share of Chisinau city represents already about 30 per cent of the total amount of waste disposed in landfills.

It should be mentioned also that statistical information sometimes does not reflect the real situation regarding the solid municipal waste management. Thus, for example, the amount of solid municipal waste disposed in rural areas are not subject to statistical evidence, as no sanitation services exist there. Also, although waste processing enterprises operate in the RM, information on the amount of recycled waste is not always subjected to a strict statistical evidence. Given the RM's intention to align to EU standards, the waste sector will be essentially restructured. In this context, the majority of SWDS are to be recovered and their number – drastically reduced.

7.2.3. Uncertainties Assessment and Time-Series Consistency

For countries with efficient statistical systems, the 2006 IPCC Guidelines recommends using values implying circa ±10-30 per cent of uncertainties associated with AD, while for countries with poor quality data, the uncertainties can be more than a factor of two. In the Republic of Moldova it was deemed rational to use the value of ±30 per cent for uncertainties related to "Managed Waste Disposal on Land". It was taken into consideration that some types of waste (ex., waste from food processing industry, accounting for approximately 10 per cent of the total amount of solid waste generated in the country), were not completely taken into account while estimating the methane emissions from the 5A "Solid Waste Disposal" category. Another important issue, is associated with the fact that according to the data gathered through the Statistical Form F-2 "Waste", a bigger amount of solid waste are disposed to land, than if consider the data gathered through the Statistical Form No. 2 – gc "Urban Settlements Sanitation". Taking into account the results of the studies undertaken in the Republic of Moldova to identify the waste morphologic composition, respectively the country specific values for Degradable Organic Carbon (*DOC*), Fraction of Degradable Organic Carbon Dissimilated (DOC_f), Fraction of Methane in Landfill Gas (F), it was deemed opportune to use the value of ±40 per cent for uncertainties related to emission factors. Therefore, combined uncertainties for 5A "Solid Waste Disposal" category represent circa ±50 per cent (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: on 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 sources of reference, etc. The AD and methods used for estimating GHG emissions under the category 5A "Solid Waste Disposal" were documented and archived both in hard copies and electronically.

7.2.5. Recalculations

The CH_4 emissions from the category 5A "Solid Waste Disposal" were recalculated for the 1993 through 2015 time series, due to updated AD and country-specific EF. In comparison with the results reported in the NC4 of the RM under the UNFCCC (2018), the changes performed within the current inventory cycle resulted in an insignificant fluctuation of CH_4 emissions originated from the 5A

"Solid Waste Disposal" between 1993-2015 (Tab. 7-16 and 7-17), varying from a minimum decrease of 0.0024 per cent in 2012, to a maximum increase of 0.0021 per cent in 2000.

Table 7-16: Comparative Results of CH_4 Emissions from 5A "Solid Waste Disposal" Category included into the NC4 and the BUR2 of the RM under the UNFCCC, kt

	1990	1991	1992	1993	1994	1995	1996	1997	1998
NC4	41.8691	43.9447	45.6782	48.1882	48.3920	48.3674	48.6714	48.1514	47.5737
BUR2	41.8691	43.9447	45.6782	48.1887	48.3920	48.3670	48.6713	48.1521	47.5742
Difference, %	0.0000	0.0000	0.0000	0.0011	0.0001	-0.0007	-0.0001	0.0013	0.0009
	1999	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**
NC4	47.8085	46.7803	45.4984	44.3221	42.8091	42.2062	42.5718	42.4729	42.5927
BUR2	47.8091	46.7813	45.4990	44.3224	42.8093	42.2061	42.5723	42.4737	42.5929
Difference, %	0.0013	0.0021	0.0012	0.0006	0.0006	-0.0003	0.0013	0.0020	0.0005
	2008	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**
NC4	43.3686	44.6029	45.5148	46.2036	45.7457	43.3916	43.3232	43.4861	
BUR2	43.3679	44.6020	45.5140	46.2032	45.7446	43.3907	43.3232	43.4869	44.6069
Difference, %	-0.0017	-0.0022	-0.0019	-0.0008	-0.0024	-0.0019	-0.0001	0.0018	

Abbreviations: NC4 – Fourth National Communication; BUR2 – Second Biennial Update Report.

Table 7-17: Comparative Results of CH_4 Emissions from 5A "Solid Waste Disposal" Category included into the NC4 and the BUR2 of the RM under the UNFCCC, kt CO_2 equivalent

	1990	1991	1992	1993	1994	1995	1996	1997	1998
NC4	1 046.7277	1 098.6185	1 141.9561	1 204.7053	1 209.7998	1 209.1845	1 216.7840	1 203.7861	1 189.3434
BUR2	1 046.7277	1 098.6185	1 141.9561	1 204.7183	1 209.8012	1 209.1757	1 216.7829	1 203.8019	1 189.3544
Difference, %	0.0000	0.0000	0.0000	0.0011	0.0001	-0.0007	-0.0001	0.0013	0.0009
	1999	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**
NC4	1 195.2115	1 169.5079	1 137.4601	1 108.0536	1 070.2266	1 055.1542	1 064.2940	1 061.8223	1 064.8166
BUR2	1 195.2267	1 169.5330	1 137.4743	1 108.0606	1 070.2330	1 055.1514	1 064.3081	1 061.8430	1 064.8219
Difference, %	0.0013	0.0021	0.0012	0.0006	0.0006	-0.0003	0.0013	0.0020	0.0005
	2008	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**
NC4	1 084.2157	1 115.0733	1 137.8702	1 155.0902	1 143.6432	1 084.7888	1 083.0811	1 087.1519	
BUR2	1 084.1973	1 115.0489	1 137.8491	1 155.0806	1 143.6162	1 084.7685	1 083.0800	1 087.1715	1 115.1732
Difference, %	-0.0017	-0.0022	-0.0019	-0.0008	-0.0024	-0.0019	-0.0001	0.0018	

Abbreviations: NC4 – Fourth National Communication; BUR2 – Second Biennial Update Report.

For 2016, CH_4 emissions from 5A "Solid Waste Disposal" category were estimated for the first time. The results allow assert that within 1990-2016 periods CH_4 emissions from this category increased by circa 6.5 per cent, as a result of the increase in the per capita waste generation rate, the appearance of new types of waste, the introduction of new types of packaging, especially plastic (for example, the packaging made of polyethylene terephthalate replaced the glass packaging during the reference period and the polyethylene bags or boxes replaced the paper packaging), thus influencing both the quantities of waste generated in the country and the morphological composition of the stored solid waste. The increase of the population welfare, respectively the purchasing capacity of the packaged products, implicitly led to a higher generation of waste by the population, respectively to the increase of the CH_4 emissions from the respective source category.

The table below presents NMVOC emissions from the 5A "Solid Waste Disposal" category from 1990 through 2016. The results allow assert that in the RM within the period of reference the respective emissions decreased by circa 32.2 per cent (Tab. 7-18).

Table 7-18: NMVOC Emissions from 5A "Solid Waste Disposal" Category within 1990-2016, included into the BUR2 of the RM under the UNFCCC, kt

	1990	1991	1992	1993	1994	1995	1996	1997	1998
NMVOC	2.9908	2.8159	2.7135	1.6703	1.5088	1.3847	1.3509	1.2600	1.2568
	1999	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**
NMVOC	1.1343	1.1318	1.0191	1.0781	1.2315	1.3194	1.4772	1.6057	2.0285
	2008	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**
NMVOC	2.3236	2.1076	1.9364	1.9649	1.9411	2.1063	2.2326	2.2355	2.0288

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 the environmental issues, complying 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 accounting of the generated waste, focused on the main criterion of relevance and comparability among the member states. At the same time, European environmental legislation is a benchmark for other numerous countries in developing national legislation on environment, thus representing an efficient model of interstate collaboration. Taking into account the international practice in municipal solid waste management and political declarations on the intended aligning to EU standards, the waste management in the RM has to be essentially restructured. In this context, it is deemed appropriate to transpose the Resolution of the EU Commission 2000/532/EC regarding the waste list, including hazardous waste.

Adoption of the Waste List, including hazardous waste, will contribute to improving national statistical records on waste management, to comply with the EU requirements, and will allow fulfilling the commitments under the international environmental treaties, ratified by the Republic of Moldova, and efficient reporting on consistent implementation. In this context it is planned to improve the quality of activity data pertaining to the amount of generated and disposed municipal solid waste and industrial waste. Strategic actions, including the modernization of legal and regulatory framework for waste management are included in recently developed documents related to strategic politics, such as the *Waste Management Strategy of the Republic of Moldova for 2013-2027 years*, which foresees the development of integrated municipal waste management through the harmonization of legal, institutional and regulatory framework to the EU standards, based on a regional approach (geographical position, economic development, the existence of access roads, pedological and hydrogeological conditions, population, etc.). The goal is to promote and implement selective collection in all areas both in household sector and in the production sector, as well as sorting, composting and recycling facilities; and the development of waste disposal capacity by creating 7 new SWDS (landfills) at a regional level and 2 new mechanical-biological treatment plants.

7.3. Incineration and Open Burning of Waste (Category 5C)

7.3.1. 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 both developed and developing countries to incinerate clinical waste.

Emissions from waste incineration without energy recovery are reported within the Sector 5 'Waste', while those from waste incineration with energy recovery are included in the Sector 1 'Energy'.

The methodology described in this chapter applies for both categories. Co-firing of specific waste fractions with other fuels is reported only within the Sector 1 'Energy' (for example, emissions from the incineration of tires in the kilns from cement plants will be reported only within the Sector 1 'Energy'). At the same time, emissions from agricultural residue burning are considered in the Sector 3 'Agriculture' or in the 4B "Cropland" category within the Sector 4 'LULUCF'.

Open burning of waste can be defined as the combustion of unwanted 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 while 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 represents a waste management practice sometimes used in some developing countries. Emissions resulting from this practice and those from unintentional fires on SWDL will be estimated and reported according to the methodology and guidance provided for open burning of waste.

7.3.2. Methodological Issues, Emission Factors and Data Sources

Within the 5C "Incineration and open burning of waste" category were estimated CO_2, CH_4 and N_2O emissions from the open burning of MSW and clinical waste.

The amount of waste open-burned each year was estimated using Equation 5.7 from the 2006 IPCC Guidelines (Vol. 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 per 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 Dniester River) is presented below in Table 7-19.

Table 7-19: Total Population of the Republic of Moldova within 1990-2016 periods, million people

	1990	1991	1992	1993	1994	1995	1996	1997	1998
Left Bank of Dniester River	0.7310	0.7307	0.7303	0.7296	0.7025	0.7017	0.6916	0.6791	0.6708
Right Bank of Dniester River	3.6306	3.6356	3.6288	3.6182	3.6502	3.6462	3.6428	3.6409	3.6550
Republic of Moldova, Total	4.3616	4.3663	4.3591	4.3478	4.3527	4.3479	4.3344	4.3200	4.3258
	1999	2000	2001	2002	2003	2004	2005	2006	2007
Left Bank of Dniester River	0.6657	0.6600	0.6518	0.6425	0.6336	0.6238	0.5544	0.5475	0.5406
Right Bank of Dniester River	3.6493	3.6435	3.6345	3.6272	3.6177	3.6068	3.3860	3.3956	3.4328
Republic of Moldova, Total	4.3150	4.3035	4.2863	4.2697	4.2513	4.2306	3.9404	3.9431	3.9734
	2008	2009	2010	2011	2012	2013	2014	2015	2016
Left Bank of Dniester River	0.5335	0.5275	0.5225	0.5180	0.5134	0.5094	0.5052	0.5007	0.4745
Right Bank of Dniester River	3.4244	3.4194	3.4156	3.4130	3.4126	3.4143	3.4132	3.3841	3.3691
Republic of Moldova, Total	3.9579	3.9469	3.9381	3.9310	3.9260	3.9237	3.9184	3.8848	3.8436

According to the 2006 IPCC Guidelines, open burning includes regularly burning and sporadically burning. Regularly burning means that this is the only practice used to eliminate waste. Sporadically 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 whether any fossil carbon is open-burned.

In developed countries, P_{frac} can be assumed to be the rural population for a rough estimate. In a region where urban population exceeds 80 per cent of total population, one can assume no open burning of waste occurs. In a developing country, mainly in urban areas, P_{frac} can be roughly estimated as being the sum of population whose waste is not collected by collection structures and population whose waste is collected and disposed in open dumps that are burned.

In the RM, the share of urban population varied within 1990-2016 periods between 42.8 and 47.5 per cent, while the rural population, respectively, between 57.2 and 52.5 per cent (Table 7-20).

Table 7-20: Urban and Rural Population of the RM within 1990-2016 periods, million people

	1990	1991	1992	1993	1994	1995	1996	1997	1998
Urban population	2.0693	2.0736	2.0522	2.0392	2.0366	2.0330	2.0041	1.9953	2.0016
Rural population	2.2923	2.2927	2.3069	2.3086	2.3161	2.3149	2.3303	2.3247	2.3242
Share of urban population, %	47.4	47.5	47.1	46.9	46.8	46.8	46.2	46.2	46.3
Share of rural population, %	52.6	52.5	52.9	53.1	53.2	53.2	53.8	53.8	53.7

	1999	2000	2001	2002	2003	2004	2005	2006	2007
Urban population	1.9907	1.9834	1.9488	1.9401	1.9325	1.9192	1.6859	1.6952	1.7289
Rural population	2.3243	2.3201	2.3375	2.3296	2.3188	2.3115	2.2545	2.2479	2.2445
Share of urban population, %	46.1	46.1	45.5	45.4	45.5	45.4	42.8	43.0	43.5
Share of rural population, %	53.9	53.9	54.5	54.6	54.5	54.6	57.2	57.0	56.5
	2008	2009	2010	2011	2012	2013	2014	2015	2016
Urban population	1.7225	1.7180	1.7185	1.7203	1.7214	1.7282	1.7325	1.7261	1.7114
Rural population	2.2354	2.2289	2.2196	2.2106	2.2046	2.1955	2.1858	2.1587	2.1322
Share of urban population, %	43.5	43.5	43.6	43.8	43.8	44.0	44.2	44.4	44.5
Share of rural population, %	56.5	56.5	56.4	56.2	56.2	56.0	55.8	55.6	55.5

The incineration of waste practice 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 burn waste in open-air (P_{frac}) is equivalent to the rural population ($P_{frac\ rural}$) plus the urban population ($P_{frac\ urban}$) that do not benefit from sanitation services ($P_{frac} = P_{frac\ rural} + P_{frac\ urban}$).

It is worth mentioning that specialized waste collection and disposal services exist in the municipalities of the country as well as in the district centres, but this system covers only about 60-90 per cent of the total urban population generating solid municipal waste. Therefore, the share of the population that does not benefit from waste collection services is about 10-30 per cent, or on average about 20 per cent. In the absence of official data on per capita waste generation, it was used the value of 0.5 kg/capita/day for rural population, respectively 0.9 kg/capita/day for the urban population of the Republic of Moldova.

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, respectively in the district centres, such as Leova and Causeni, usually ranging from the purchasing power of the population. 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 (Table 7-9).

It was considered that circa 20 per cent of the urban population that does not benefit from waste disposal services uses to burn in open-air the organogenic solid waste, while the fraction for solid waste burned (B_{frac}) from the total amount of treated waste in urban areas represents 0.15 (15 per cent of the total). In rural areas, it was considered that 40 per cent of the population uses to burn in open-air the organogenic solid waste, and the B_{frac} represents 0.2 (20 per cent 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) • 0.5 kg/capita/day • 0.20 • 365 • 10^{-6}

$MSW_{B\ urban\ RM}$ (kt) = P_{urban} (inhabitants) • 0.9 kg/capita/day • 0.15 • 365 • 10^{-6}

CO_2 emissions from open burning of waste were estimated using Equation 5.1 from the 2006 IPCC Guidelines (Vol. 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:

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 per cent for MSW and 90 per cent for clinical waste are available in Table 2.4 from the 2006 IPCC Guidelines, Vol. 5, Chapter 2, page 2.14);

CF_i – fraction of carbon in the dry matter (total carbon content) (default values used – 47 per cent for MSW and 60 per cent for clinical waste are available in Table 2.4 from the 2006 IPCC Guidelines, Vol. 5, Chapter 2, page 2.14, respectively in Table 5.2 from the 2006 IPCC Guidelines, Vol. 5, Chapter 5, page 5.18);

FCF_i – fraction of fossil carbon in the total carbon (default values used – 90 per cent for industrial waste, 42 per cent for MSW and 40 per cent for clinical waste are available in Table 2.4 from the 2006 IPCC Guidelines, Vol. 5, Chapter 2, page 2.14, respectively in Table 5.2 from the 2006 IPCC Guidelines, Vol. 5, Chapter 5, page 5.18);

OF_i – oxidation factor (default value used – 58 per cent is available in Table 5.2 from the 2006 IPCC Guidelines, Vol. 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 from the 2006 IPCC Guidelines, Vol. 5, Chapter 5, page 5.7); ISW: industrial solid waste; SS: sewage sludge; HW: hazardous waste; CW: clinical waste, others (to be specified).

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 method by the "TRISUMG" LTD[100]. Medical institutions in the RM practice the burning of clinical waste by three methods: 1) open burning; 2) closed burning in heating boilers or metal barrels; and 3) transport for pyrolysis treatment. Activity data 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 the open burning of the clinical waste were available in the National Mercury Emissions Inventory. The National Public Health Centre of the Ministry of Health of the Republic of Moldova[101] provided data on clinical waste treated by medical institutions across the country through the three methods mentioned above. Historical data for 1990-2009 periods have been deducted from the data provided for the 2010-2016 time series.

For the MSW, it is considered good practice to estimate CO_2 emissions separately for different types of solid organogenic waste (paper, wood waste, plastics) within the incinerated or open-burned waste. In this case, it is recommended to use Equation 5.2 from the 2006 IPCC Guidelines, Vol. 5, Chapter 5, pages 5.7-5.8):

$$CO_2\ Emissions = MSW \bullet \Sigma_j (WF_j \bullet dm_j \bullet CF_j \bullet FCF_j \bullet OF_j) \bullet 44/12$$

Where:

CO_2 Emissions – CO_2 emissions in inventory year, kt / yr;

MSW – total amount of municipal solid waste as wet weight incinerated or open-burned, kt/yr;

WF_j – fraction of waste type/material of component *j* in the MSW as wet weight incinerated or open-burned;

dm_j – dry matter content in the component *j* of the MSW incinerated or open-burned (default values used – 76 per cent for MSW and 90 per cent for clinical waste are available in Table 2.4 from the 2006 IPCC Guidelines, Vol. 5, Chapter 2, page 2.14);

CFj_i – fraction of carbon in the dry matter (carbon content) of component *j* (default values used – 47 per cent for MSW and 60 per cent for clinical waste are available in Table 2.4 from the 2006 IPCC Guidelines, Vol. 5, Chapter 2, page 2.14, respectively in in Table 5.2 from the 2006 IPCC Guidelines, Vol. 5, Chapter 5, page 5.18);

FCF_j – fraction of fossil carbon in the total carbon of component *j* (default values used – 90 per cent for industrial waste, 42 per cent for MSW and 40 per cent for clinical waste are available in Table 2.4 from the 2006 IPCC Guidelines, Vol. 5, Chapter 2, page 2.14, respectively in Table 5.2 from the 2006 IPCC Guidelines, Vol. 5, Chapter 5, page 5.18);

OF_j – oxidation factor (default value used – 58 per cent is available in Table 5.2 from the 2006 IPCC Guidelines, Vol. 5, Chapter 5, page 5.18);

44/12 – conversion factor from C to CO_2.

When: $\Sigma\ WF_j = 1$,

[100] Authorization of the Ministry of Environment no. 047/2013 on the collection and marketing of rubber and plastic waste. Authorization no. 061/2015 on the processing of rubber and plastic waste by the pyrolysis method.

[101] Letter from the Ministry of Health no. 06t-3/2521 as of 30.10.2015, in response to the letter of the Ministry of Environment no. 05-07 / 1425 as of 13.08.2015.

j – component of the MSW incinerated/open-burned such as paper and cardboard, textiles, food waste, wood, garden (yard) and park waste, disposable nappies, rubber and leather, plastics, metal, glass, other inert waste.

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).

In large and well-functioning 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, in particular where wastes are wet, stored for long periods and not well agitated. Where the storage are gases are fed into the air supply of the incineration chamber, they will be incinerated and emissions will be reduced to insignificant levels.

The calculation of methane emissions is based on Equation 5.4 from the 2006 IPCC Guidelines, Vol. 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, Vol. 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 from the 2006 IPCC Guidelines, Vol. 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, Vol. 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 (2016):

$$Indirect\ GHG\ Emissions = \Sigma_i\ (IW_i \bullet EF_i) \bullet 10^{-6}$$

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 7-21);

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).

Table 7-21: Default EFs for Estimating Indirect GHG Emissions from 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 (2016), Source Category 5.C.2 "Open Burning of Waste", Table 3-1, page 6; 2 EMEP/EEA Atmospheric Emissions Inventory Guidebook (2016), 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 7-22.

Table 7-22: AD Used to Estimate Direct and Indirect GHG Emissions from Source Category 5C "Incineration and open burning of waste"

	Urban Population, thousand inhabitants	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 on urban areas, kt	Amount of MSW burnt on rural areas, kt	Total amount of MSW burnt, kt	Amount of clinical waste incinerated, kt
1990	2 069.3	2 292.3	0.9	0.5	20.4	33.5	53.9	0.1815
1991	2 073.6	2 292.7	0.9	0.5	20.4	33.5	53.9	0.1911
1992	2 052.2	2 306.9	0.9	0.5	20.2	33.7	53.9	0.2011
1993	2 039.2	2 308.6	0.9	0.5	20.1	33.7	53.8	0.2117
1994	2 036.6	2 316.1	0.9	0.5	20.1	33.8	53.9	0.2228
1995	2 033.0	2 314.9	0.9	0.5	20.0	33.8	53.8	0.2346
1996	2 004.1	2 330.3	0.9	0.5	19.8	34.0	53.8	0.2469
1997	1 995.3	2 324.7	0.9	0.5	19.7	33.9	53.6	0.2599
1998	2 001.6	2 324.2	0.9	0.5	19.7	33.9	53.7	0.2736
1999	1 990.7	2 324.3	0.9	0.5	19.6	33.9	53.6	0.2880
2000	1 983.4	2 320.1	0.9	0.5	19.5	33.9	53.4	0.3031
2001	1 948.8	2 337.5	0.9	0.5	19.2	34.1	53.3	0.3191
2002	1 940.1	2 329.6	0.9	0.5	19.1	34.0	53.1	0.3359
2003	1 932.5	2 318.8	0.9	0.5	19.0	33.9	52.9	0.3536
2004	1 919.2	2 311.5	0.9	0.5	18.9	33.7	52.7	0.3722
2005	1 685.9	2 254.5	0.9	0.5	16.6	32.9	49.5	0.3918
2006	1 695.2	2 247.9	0.9	0.5	16.7	32.8	49.5	0.4124
2007	1 728.9	2 244.5	0.9	0.5	17.0	32.8	49.8	0.4341
2008	1 722.5	2 235.4	0.9	0.5	17.0	32.6	49.6	0.4569
2009	1 718.0	2 228.9	0.9	0.5	16.9	32.5	49.5	0.4810
2010	1 718.5	2 219.6	0.9	0.5	16.9	32.4	49.3	0.5063
2011	1 720.3	2 210.6	0.9	0.5	17.0	32.3	49.2	0.7348
2012	1 721.4	2 204.6	0.9	0.5	17.0	32.2	49.2	0.7403
2013	1 728.2	2 195.5	0.9	0.5	17.0	32.1	49.1	0.7387
2014	1 732.5	2 185.8	0.9	0.5	17.1	31.9	49.0	0.7017
2015	1 726.1	2 158.7	0.9	0.5	17.0	31.5	48.5	0.6666
2016	1 711.4	2 132.2	0.9	0.5	16.9	31.1	48.0	0.6333

7.3.3. Uncertainties Assessment and Time-Series Consistency

The main factors affecting uncertainties assessment regard the assessment 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 within this category reach to ±25 per cent for CO_2, to ±50 per cent for CH_4 and to ±100 per cent for N_2O. Uncertainties associated with the activity data on the estimated amount of waste burnt by the rural and urban population could reach to ±40 per cent. Therefore, combined uncertainties for source category 5C "Incineration and open burning of waste" represent circa ±47.17 per cent for CO_2 emissions, respectively circa ±64.03 per cent for CH_4 and circa ±107.70 per cent for N_2O emissions (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.

7.3.4. 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 sources of reference, including the Statistical Yearbooks of the RM and the ATULBD, on ensuring correct use of the default emission factors available in the 2006 IPCC Guidelines. The AD and methods used for estimating GHG emissions under the category 5C "Incineration and open burning of waste" were documented and archived both in hard copies and electronically etc.

7.3.5. Recalculations

Within the current inventory cycle, direct and indirect GHG emissions from incineration and open burning of household and clinical waste were recalculated, in particular due to the need of adjusting AD with the number of population, considering the results of the population census from 2014, carried out in parallel on the LBDR and RBDR (the results of the census on the RBDR were published later, only in 2017). Also, adjustments have also been made in the calculation formula used to estimate N_2O emissions, this being correlated to the dry matter fraction of waste burned.

In comparison with the previously obtained results included in the NC4 of the RM under the UNFCCC (2018), the above mentioned changes resulted in an decrease of direct GHG emissions (CO_2, CH_4 and N_2O) from 5C "Incineration and open burning of waste" category within 1990-2015 periods (Table 7-23), with a variation from a minimum decrease of 0.7 per cent in 2004, to a maximum decrease by 6.3 per cent in 2005.

Table 7-23: Comparative Results of Direct GHG Emissions from 5C "Incineration and open burning of waste" Category Included into the BUR2 and NC4 under the UNFCCC, kt CO_2 equivalent

	1990	1991	1992	1993	1994	1995	1996	1997	1998
NC4	28.3035	28.3351	28.3399	28.2929	28.3443	28.3243	28.3012	28.2217	28.1338
BUR2	27.7249	27.7559	27.7607	27.7148	27.7652	27.7458	27.7232	27.6455	27.6826
Difference, %	-2.0	-2.0	-2.0	-2.0	-2.0	-2.0	-2.0	-2.0	-1.6
	1999	2000	2001	2002	2003	2004	2005	2006	2007
NC4	28.0813	28.0229	28.1086	28.0151	27.9006	27.4363	27.3593	27.2667	27.1505
BUR2	27.6378	27.5796	27.5456	27.4536	27.3461	27.2367	25.6447	25.6560	25.8151
Difference, %	-1.6	-1.6	-2.0	-2.0	-2.0	-0.7	-6.3	-5.9	-4.9
	2008	2009	2010	2011	2012	2013	2014	2015	2016
NC4	27.0691	27.0065	26.9649	27.0530	27.0156	26.9722	26.8791	26.6656	
BUR2	25.7298	25.6744	25.6241	25.7171	25.6814	25.6468	25.5716	25.3128	25.0183
Difference, %	-4.9	-4.9	-5.0	-4.9	-4.9	-4.9	-4.9	-5.1	

Abbreviations: NC4 – Fourth National Communication; BUR2 – Second Biennial Update Report.

For 2016, direct GHG emissions from 5C "Incineration and open burning of waste" were estimated for the first time. The results allow assert that within the 1990-2016 time series, direct GHG emissions from the respective source category decreased in the RM by circa 9.8 per cent, in particular due to the decrease of population, respectively due to a decrease in the amount of open burnt waste across the country.

The table below presents the evolution of direct and indirect GHG emissions from incineration and open burning of household and clinical waste between 1990 and 2016. The results allow assert that within the reference period, the respective emissions decreased by circa 9.6 per cent for CO_2 emissions, by 10.0 per cent for CH_4, by 9.9 per cent for N_2O, by 10.3 per cent for NO_x, by 10.9 per cent for CO, by 10.4 per cent for NMVOC, respectively by circa 6.7 per cent for SO2 (Table 7-24).

Table 7-24: Direct and Indirect GHG Emissions from Source Category 5C "Incineration and open burning of waste" in the RM within 1990-2016 periods, kt

	1990	1991	1992	1993	1994	1995	1996	1997	1998
CO_2	17.1060	17.1256	17.1291	17.1013	17.1330	17.1216	17.1083	17.0610	17.0846
CH_4	0.3513	0.3516	0.3517	0.3511	0.3517	0.3514	0.3511	0.3501	0.3506
N_2O	0.0062	0.0062	0.0062	0.0062	0.0062	0.0062	0.0062	0.0061	0.0062
NOx	0.1717	0.1719	0.1719	0.1716	0.1719	0.1717	0.1716	0.1711	0.1713
CO	3.0071	3.0098	3.0096	3.0038	3.0085	3.0055	3.0022	2.9928	2.9958
NMVOC	0.0664	0.0664	0.0664	0.0663	0.0664	0.0664	0.0663	0.0661	0.0662
SO_2	0.0060	0.0060	0.0060	0.0060	0.0060	0.0060	0.0060	0.0060	0.0061

	1999	2000	2001	2002	2003	2004	2005	2006	2007
CO_2	17.0578	17.0226	17.0025	16.9466	16.8812	16.8147	15.8340	15.8420	15.9412
CH_4	0.3500	0.3492	0.3487	0.3475	0.3461	0.3447	0.3245	0.3246	0.3266
N_2O	0.0061	0.0061	0.0061	0.0061	0.0061	0.0061	0.0057	0.0057	0.0057
NOx	0.1710	0.1706	0.1703	0.1697	0.1690	0.1683	0.1584	0.1584	0.1594
CO	2.9899	2.9825	2.9776	2.9664	2.9534	2.9402	2.7653	2.7651	2.7809
NMVOC	0.0661	0.0659	0.0658	0.0656	0.0653	0.0650	0.0612	0.0612	0.0616
SO_2	0.0060	0.0060	0.0060	0.0060	0.0060	0.0060	0.0057	0.0057	0.0057
	2008	2009	2010	2011	2012	2013	2014	2015	2016
CO_2	15.8898	15.8568	15.8271	15.8962	15.8744	15.8530	15.8047	15.6434	15.4600
CH_4	0.3254	0.3247	0.3240	0.3248	0.3243	0.3239	0.3230	0.3198	0.3161
N_2O	0.0057	0.0057	0.0057	0.0057	0.0057	0.0057	0.0057	0.0056	0.0056
NOx	0.1588	0.1584	0.1581	0.1582	0.1580	0.1578	0.1574	0.1559	0.1541
CO	2.7699	2.7622	2.7549	2.7486	2.7443	2.7406	2.7351	2.7094	2.6797
NMVOC	0.0613	0.0612	0.0610	0.0611	0.0610	0.0609	0.0607	0.0602	0.0595
SO_2	0.0057	0.0057	0.0057	0.0058	0.0058	0.0058	0.0058	0.0057	0.0056

7.3.6. Planned Improvements

The effort to transpose the Resolution of the EU Commission 2000/532/EC regarding the waste list, including hazardous waste, according to the Law on Waste no. 209 from 29.07.2016 will contribute to improving national statistical records on waste management. Thus, in the next years, the economical agents that thermally treat wastes will be required to report the data on waste management practices in an automated information system. Therefore, it will be possible to improve the quality of activity data used to estimate the emissions from the 5C "Incineration and open burning of waste" category.

7.4. 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 access of the population to quality sewage services.

The connection rate of the population to centralized sewage systems differs comparing to the country-wide connection rate, which is estimated at 22.2 per cent. In the Center Development Region, 100 per cent of the urban areas and 6 per cent of the rural areas have centralized sewage systems. Only 46 per cent of the urban population and circa 0.5-1.0 per cent of the rural population are connected to centralized sewage systems in the North Development Region, while the total share of population connected to sewage systems in the area is estimated at about 16 per cent. In the South Development Region only 52 per cent of the urban population and circa 1.0 per cent of the rural population are connected to centralized sewage systems, while the total share of population connected to sewage systems in the area is estimated at about 14 per cent.[102]

During the recent decades, a decrease in the volume of wastewater discharged into surface water basins was recorded. For example, between 1990 and 2016, the respective volume decreased by approximately 75.6 per cent, from 2,731 million m^3 to 666 million m^3 (Table 7-25). Due to insufficient functioning of wastewater treatment plants, the amount of pollutants in the wastewater discharged from managed sources, as well as the maximum allowable concentration permitted by current standards, are still above the limit established by the environmental authority. During this period, the volume of insufficient treated wastewater discharged into water bodies decreased by circa 70.8 per cent, from 89 million m^3 in 1990, to 26 million m^3 in 2016. Simultaneously, it can be noticed that the situation regarding the operation of treatment and pre-treatment plants did not improve in this periods, on the contrary, it got worse.

[102] Government Decision No. 1063 as of 16.09.2016 on the approval of the National Programme for the implementation of the Protocol on Water and Health in the Republic of Moldova for 2016-2025. Published on: 20.09.2016 in the Official Monitor No. 314, article No: 1141, changed GD1090 as of 18.12.17, OM440/20.12.17 article 1214, <http://lex.justice.md/index.php?action=view&view=doc&lang=1&id=366749>.

Table 7-25: Wastewater Discharged into Surface Water Basins within 1990-2016, million m³

	1990	1991	1992	1993	1994	1995	1996	1997	1998
Discharged wastewater – total	2731	2486	2231	1993	1810	1381	1384	1239	1030
Conventional pure water (untreated)	2424	2173	1935	1717	1547	1120	1133	1007	802
Polluted wastewater	90	69	41	21	16	15	12	11	12
..untreated	1.0	1.0	0.0	0.0	0.4	0.4	0.5	0.3	0.4
..insufficiently treated	89	68	41	21	15	14.6	11.5	10.7	11.6
Treated water according to normative requirements	216	244	255	255	247	245	238	222	215
Treated water according to normative, in % compared to the total volume of wastewater needing treatment	70	78	86	92	94	94	95	95	94
	1999	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**
Discharged wastewater – total	794	740	708	695	685	688	689	688	680
Conventional pure water (untreated)	593	569	557	560	558	561	556	562	551
Polluted wastewater	10	9	13	19	48	42	9	7	10
..untreated	0.4	0.5	0.3	0.5	0.8	0.5	0.6	0.5	0.7
..insufficiently treated	9.6	8.2	12.6	18.9	47.5	41.4	8.3	6.7	9.2
Treated water according to normative requirements	191	162	138	116	79	85	124	119	119
Treated water according to normative, in % compared to the total volume of wastewater needing treatment	95	95	91	86	62	67	93	94	92
	2008	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**
Discharged wastewater – total	679	678	683	678	675	672	664	666	666
Conventional pure water (untreated)	550	552	556	555	553	551	545	546	544
Polluted wastewater	14	10	8	8	9	9	10	8	28
..untreated	0.8	0.8	0.9	1.0	1.5	1.0	1.4	1.0	2.0
..insufficiently treated	13.3	9.5	7.5	7.2	7.4	7.9	8.7	7.0	26.0
Treated water according to normative requirements	115	116	119	115	113	112	109	112	94
Treated water according to normative, in % compared to the total volume of wastewater needing treatment	89	92	94	93	93	93	92	93	77

Source: NBS, Statistical Yearbooks of the RM for 1994 (page 41), 1999 (page 23), 2006 (page 27), 2011 (page 24) 2014 (page 24); Statistical database: <http://statbank.statistica.md/pxweb/pxweb/ro/10%20Mediul%20inconjurator/10%20Mediul%20inconjurator__MED020/MED020200.px/table/tableViewLayout1/?rxid=b2ff27d7-0b96-43c9-934b-42e1a2a9a774>.

The sewage systems remain underdeveloped and require major investment in order to extend the collecting networks, the rehabilitation of wastewater pumping stations, as well as sewage treatment plants. Sewage services in rural areas are absolutely undeveloped or at an early stage of development.

Until the 90's of the last century, in the Republic of Moldova over 580 plants for wastewater biological treatment (WBTP) were built, but by 2001, only 330 were operational, the rest being demolished[103]. In 2002, 106 WBTP[104] operated, while in 2003 only 104 treatment plants existed (they used only a third of capacity, about 198 thousand m³/day being treated, at a total capacity of circa 614 thousand m³/day)[105]. In 2004, 252 WBTP existed, most of them presenting a high attrition rate regarding the buildings. In reality, only 93 plants functioned, of which 89 were bellow normative requirements (partial mechanical, partial biological treatment, with wastewater storage and/or discharge)[106]. By 2005, 84 WBTP functioned, of which 79 were bellow normative requirements: 59 performed insufficient wastewater treatment, another 17 performed wastewater storage without discharging, while another 3 received wastewater and discharged them without treatment[107]. To be noted that between 1998 and 2005 the share of population connected to the sewage system in the total water supply system has not exceeded 39 per cent[108]. In 2006, 131 WBTP existed, but functioned only 78 and just one was according to normative requirements; another 53 WBTP were closed[109]. The closed plants presented a high rate of attrition and the restoration required major capital investments.

In 2007, 99 treatment plants functioned, of which only one according to normative requirements, the other 98 performed insufficient wastewater treatment[110]. Of the 103 plants that were not operational, 44 only received and storage wastewater without discharging into natural receivers and this fact contributed to soil pollution and groundwater contamination, infiltrating through the walls and the bottom of the storage units, biological ponds and filtration fields), 21 were receiving wastewater and discharged them into natural receivers without treatment, while 27 were not operational since the respective enterprises did not functioned or due to lack of wastewater. In 2008, 154 wastewater treatment plants functioned, most of them performed only insufficient treatment and only 28 plants performed wastewater treatment

[103] State of the Environment in the Republic of Moldova in 2002: (National Report): [addressed to users working or studying in the field] – Ch.: Mediul Ambiant, 2003, - 116 p. (see page 55).
[104] State of the Environment in the Republic of Moldova in 2003: (National Report): [addressed to users working or studying in the field] – Ch.: National Institute of Ecology, 2004, - 130 p. (see page 49).
[105] State of the Environment in the Republic of Moldova in 2004: (National Report): [addressed to users working or studying in the field] – Ch.: National Institute of Ecology, 2005, - 123 p. (see page 54-55).
[106] State of the Environment in the Republic of Moldova in 2005: (National Report) – Ch.: Institute of Ecology and Geography, 2006, - 116 p. (see page 54).
[107] State of the Environment in the Republic of Moldova in 2006: (National Report) – Ch.: S.n., 2007, - 103 pages (see page 50).
[108] State of the Environment in the Republic of Moldova: 2007-2010. (National Report) – Ch.: S.n. („Nova-Imprim" SRL). – 2011. – 192 pages (see page 92).
[109] Environment Protection in the Republic of Moldova: (National Report for the Ministerial Conference in Belgrade, Serbia) – Chisinau, 2008, - 64 pages (see page 32).
[110] SEI Yearbook „Quality of the Environment and the State Ecological Inspectorate Activity – 2007" – Chisinau, 2008 – 202 pages (see page 8).

according to normative requirements[111]. Approximately 106 wastewater treatment plants were destroyed and another 116 plants required capital reconstruction including the technological modernization of treatment stages. In 2009, 172 water pipelines were provided with sewage systems, of which functioned 110 systems and 128 sewage systems were provided with wastewater treatment plants[112].

Between 2010 and 2011, 79 wastewater treatment plants had project documentation, 17 units operated according to normative requirements, 112 units performed insufficient treatment while 69 did not functioned[113]. In 2012, 73 wastewater treatment plants had project documentation, 30 units operated according to normative requirements, 116 units – performed insufficient treatment[114]. In 2013, 84 wastewater treatment plants had project documentation, 39 units operated according to normative requirements, 134 units – performed insufficient treatment while 51 did not functioned[115]. In 2014, 81 wastewater treatment plants had project documentation, 24 units operated according to normative requirements, 138 units performed insufficient treatment[116]. During the respective year, only few examples of discharged waters followed the DLA norm (the maximum mass of pollutants in wastewater, permissible for their discharge in a set regime at the given point in a unit of time) – the discharged water from wastewater treatment plants in Balti municipality, Anenii-Noi, Criuleni, Floresti and Orhei districts. In 2014 new wastewater treatment plants were constructed in: Holercani, Dubasari district; Chiperceni, Putuntei, Sarcani villages and Tabara Miorita from Orhei district; Ecaterinovca village, Cimislia district; Corjova village, Criuleni district, Crocmaz village, Ștefan Vodă district; Bădiceni village, Soroca district, Sireti and Vorniceni villages, Strășeni district and Otaci municipality. Several wastewater treatment plants were in the design phase in the following localities: Saratica Noua village, Leova district, Sadaclia, Carabetovca, Iordanovca and Abaclia villages, Basarabeasca district, Sait and Ucrainca villages, Causeni district, Cociulia village, Cantemir district, Ghiduleni and Horodiste villages, Rezina district, Cioburciu, Festelita, Copciac and Popeasca villages, Stefan Voda district, Oniscani and Sipoteni villages, Calarasi district and Briceni municipality.

The sewage systems have a high rate of attrition, physical degradation and are morally obsolete, since it operates for more than 30 years without reconstruction, requiring thus, a technological modernization of treatment stages. Most of the existing plants offer only mechanical treatment, while the biological systems with higher energy consumption were not used due to higher costs. The disastrous situation within this sector is determined primarily by divesting the wastewater plants to local public authorities, which lack the infrastructure, the professional staff with expertise and the financial resources needed to ensure proper operation; as well as by the essential decrease of wastewater volumes. Insufficient volume of wastewater and the excessive concentration of noxious substances received disturb the optimal functioning of the wastewater treatment plants. At the same time, in recent years, a clear trend of increasing the number of operational wastewater treatment plants was recorded.

In 2015, 97 wastewater treatment plants had project documentation, 21 units operated according to normative requirements, 143 units performed insufficient treatment[117]. During the respective year, only few examples of discharged waters followed the DLA norm (the maximum mass of pollutants in wastewater, permissible for their discharge in a set regime at the given point in a unit of time) – the discharged water from wastewater treatment plants in Calarasi, Edinet, Floresti, Criuleni and Orhei districts. The efficient operation of the treatment plants is due to actions and measures taken to maintain the technological treatment regime. Steps have been taken in order to maintain the operation of the wastewater treatment at several local stations: Leova, Balti, Cimislia, Basarabeasca, Causeni, and others.[118] During the same year, construction works have started on new wastewater treatment plants in Ungheni, Anenii Noi, Leova, Ialoveni, Telenesti, Cahul, Soldanesti and Rezina districts.

[111] State Ecological Inspectorate (2009), SEI Yearbook – 2008 "Environment protection in the Republic of Moldova" / Iurie Stamatin, Alexandru Apostol, Mihai Mustea [et al.]. – Ch. : "A.V.i.T. Publ" SRL, 2009 ("Continental-Grup" SRL). – 288 pages (see pages 85-86).
[112] State Ecological Inspectorate (2011), SEI Yearbook - 2010 "Environment protection in the Republic of Moldova" / editorial board: Grigore Prisacaru, Valentina Tapis, Vadim Stingaci [et al.]. – Ch.: S.n., 2011 ("Sirius" SRL) – 232 pages (see page 39).
[113] State Ecological Inspectorate (2012), SEI Yearbook – 2011 „Environment protection in the Republic of Moldova" / editorial board: Gr. Prisacaru, V. Tapis, V. Stangaci [et al.]. – Ch. : Continental Grup, 2012. – 248 pages (see pages 55-56).
[114] State Ecological Inspectorate (2013), SEI Yearbook – 2012 „Environment Protection in the Republic of Moldova" / editorial board V. Untilă [et al.]. – Ch. : Pontos, 2013. – 256 pages (see pages 78-79).
[115] State Ecological Inspectorate (2014), SEI Yearbook – 2013 „Environment Protection in the Republic of Moldova"/ editorial board V. Curarari [et al.]. – Ch. : Pontos, 2014. – 300 pages (see pages 77-78).
[116] State Ecological Inspectorate (2015), SEI Yearbook – 2014 „Environment Protection in the Republic of Moldova"/ editorial board. V. Stîngaci [et al.]. – Ch. : Pontos, 2015. – 336 pages. (see pages 60-61).
[117] State Ecological Inspectorate (2016), SEI Yearbook – 2015 „Environment Protection in the Republic of Moldova"/ editorial board.: I. Talmazan [et al.]; coord.: D. Osipov. – Ch. : Pontos, 2016. – 348 p. (see pages 63-64).
[118] State Ecological Inspectorate (2016), SEI Yearbook – 2015 „Environment Protection in the Republic of Moldova"/ editorial board.: I. Talmazan [et al.]; coord.: D. Osipov. – Ch. : Pontos, 2016. – 348 p. (see pages 63-64).

Currently, a strong reason for concern represents the ecological situation created by untreated wastewater discharged from Cantemir town into Prut river, from Cimislia town into Cogalnic river, from Rezina town into Dniester river, from Straseni town into Bic river, from Tvardita village, Taraclia district into Chirghij-Chitai river, as well as from Soroca town into Dniester river (since 2002, the wastewater treatment plant in Soroca is inoperable due to the deterioration of Soroca-Tekinovca (Ukraine) pressure manifold, therefore, the Soroca wastewater, accounting for circa 1000 m^3/day, are discharged to the main pumping plant through the sewage system and without treatment is subsequently discharged into the Dniester river.

At national level, there are no centralized records of data regarding the population connected to sewage services, and its lack makes it difficult to develop policies and to plan measures in order to improve services in this area. The NBS gathers data only for centralized sewage systems, while centralized information on access to other individual sources (water discharge into decentralized systems, septic tanks, EcoSan toilets, toilets with later discharge of wastewater) are not available. The low share of population connected to sewage systems is conditioned by the fact that the operational and technical state of the sanitation infrastructure is insufficient and can not cover the entire population, especially in rural areas. In urban areas (large cities such as Chisinau and Balti), the percentage of population connected reaches up to 90 per cent, in small towns – up to 58 per cent, while in rural areas circa 9-10 per cent have access to sewage systems. [119]

According to the Republic of Moldova's Strategy for Water Supply and Sanitation (2014-2028)[120], the number of population with access to sewage services in 2012 reached 761 thousand people, representing 21.4 per cent of the total population, including 50.1 per cent in urban areas and only 1.0 per cent in rural areas. The technical condition of sewage networks was considered satisfactory in 25 per cent, required repairs – 13 per cent, needed full rehabilitation – 40 per cent, showed serious damaged – 15 per cent and were under construction – 7 per cent. The infrastructure of sewage networks made up about 2548.5 km of sewage pipelines of which 2141.9 in urban areas, respectively 406 km in rural areas. In 2012, from the total of existing water pipelines - 742 158 were provided with sewage systems, of which functioned 110 systems or by 3 units more compared to 2011. During 2012, 3 sewage systems became operational, while 9 have been decommissioned. Of the total existing sewage systems, 124 were equipped with wastewater treatment plants.

Currently, in the Republic of Moldova there is a lack of implementation of new technologies, as well as a lack of experience in the field. Only recently, with the investments in the water supply and sewage systems, well-known practices in European countries began to be applied. These relate to the implementation of new technologies for treating wastewater, drinking water, the use of new materials (plastics) for water and sewage pipes, which are superior to metal corrosive and expensive pipes.

An important issue in the wastewater treatment process greatly influencing the environment is the lack of modern sludge processing facilities within the wastewater plants. In order to overcome the existing situation, in 2009, the wastewater treatment plant in Chisinau implemented the pilot-project for raw sludge dewatering using the "Geotube" method, the general goal being to process the sludge and to eliminate odour. The sludge dewatering project implied reconstructing 8 sludge platforms. This project implying the use of "Geotube" bags has reduced the number of sludge platforms, as well as the odour emitted during the process of sludge fermentation. The annual capacity of the sludge dewatering process is 584 thousand m^3 with 95 per cent humidity, which, after dewatering has a capacity of 97.3 thousand m^3 and a 70 per cent humidity. Two open storage facilities were built to storage the sludge from the "Geotube" bags after the dewatering process.

It should be noted that in 2018 rehabilitation works of the Wastewater Treatment Plant in Chisinau were initiated. The project includes the construction of a new sludge treatment facility, the renovation of the infrastructure, the construction of several specialized facilities as well as the installation of the wastewater filtering equipment. It is planned to build a power plant using the sludge as raw material.

[119] Government Decision No. 1063 as of 16.09.2016 on the approval of the National Programme for the implementation of the Protocol on Water and Health in the Republic of Moldova for 2016-2025. Published on: 20.09.2016 in the Official Monitor No. 314, article No: 1141, changed GD1090 as of 18.12.17, OM440/20.12.17 article 1214, <http://lex.justice.md/index.php?action=view&view=doc&lang=1&id=366749>.

[120] Government Decision No. 199 as of 20.03.2014 on the approval of the Strategy for Water Supply and Sanitation (2014 – 2028), Published on: 28.03.2014 in the Official Monitor No. 72-77, article No: 222, changed GD 1089 as of 18.12.17, OM440/20.12.17 article 1213, <http://lex.justice.md/md/352311/>.

As a result of biogas production, electricity will be produced, providing 50 per cent of the electricity used at the wastewater treatment plant.

7.4.1. Source Category Description

The 5D "Wastewater treatment and discharge" category deals with CH_4 and N_2O emissions from 5D1 "Domestic wastewater", as well as CH_4 emissions from 5D2 "Industrial wastewater".

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, in a smaller amount – NMVOC. The wastewater treatment scheme is a classic one and has a different level of treatment 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 degradation), 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 do not fully cover the settlements in the country's regions. The quality of sewage services provided to the population is poor. All urban areas in the developed regions have wastewater treatment facilities, but most of them are damaged 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 higher 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 CBO_5. Only 97 per cent of the urban areas in the developed regions have wastewater treatment facilities, while in rural areas, only 3-8 per cent of the population has access to sewage services for domestic wastewater. Some urban areas (for exemple, Soroca) do not own wastewater treatment facilities and untreated wastewater is discharged directly into the cross-border river Dniester[121].

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 degree to which population is covered by services of centralized sewer systems and wastewater treatment scope. The most widespread wastewater treatment method used in the RM is the classical biological aerobic treatment. Another source of GHG emissions is represented by the sludge from the wastewater treatment process, subject to aerobic and anaerobic treatment, by storage on sludge fields.

As mentioned above, in the time period from 1990 to 1998, domestic wastewater treatment systems were managed by state enterprise "Apa-Canal". Later, these systems were divested to local public authorities, which were not ready to take over management of these systems, as they lacked the infrastructure and the financial resources needed to ensure proper operation. Under such circumstances the treatment facilities fell into disrepair and most of them are out of operation. Currently, domestic wastewater is treated in most urban settlements of the Republic of Moldova, but only partially. It should be mentioned that in most rural settlements sewage systems are also deteriorated.

In urban areas, where wastewater treatment facilities are operational, sludge is treated by placing it on sludge platforms. Starting from the point that project capacities of all existent treatment facilities, as a rule are bigger (by 2 to 10 times, and in some places even more) than the amount of actually generated wastewaters, all such facilities have spare space for sludge depositing. Only in big cities, such as Chisinau, Balti and Cahul, due to lack of sludge treatment technologies, sludge is deposited in layers thicker than 50 cm, what generates anaerobic processes and induces methane emissions. However, in comparison with the total area of deposited sludge, the areas with deposited sludge are insignificant and are not taken into account for emissions calculation.

[121] Government Decision No.1063 as of 16.09.2016 on the approval of the National Programme for the implementation of the Protocol on Water and Health in the Republic of Moldova for 2016-2025. Published on: 20.09.2016 in the Official Monitor No. 314, article Nr: 1141, changed GD1090 as of 18.12.17, MO440/20.12.17 article 1214, <http://lex.justice.md/index.php?action=view&view=doc&lang=1&id=366749>.

Domestic wastewater from individual households in urban and rural areas not connected to a sewage system are usually collected in latrines.

5D2 "Industrial Wastewater"

In the Republic of Moldova the industrial wastewater are released into municipal sewer lines where it combines with domestic wastewater. Industrial wastewater are redirected to sewage systems on the basis of 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 to urban sewage systems of several economic agents from the industrial sector due to insufficient volume of wastewater needed for the proper functioning of domestic wastewater treatment plants, which has the effect of reducing the industrial production and, respectively, the volume of industrial wastewater treated at local stations. Within the industrial sector, the processing industries contribute most to the generation of wastewater with an increased content of organic biodegradable substances.

7.4.2. Methodological Issues, Emission Factors and Data Sources

Methane emissions from the 5D "Wastewater treatment and discharge" category were estimated according to 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)

Estimating 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, connected or not to the sewage system. The value of this index is influenced, in particular, 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):

$$TOW = P \cdot BOD \cdot 0.001 \cdot I \cdot D$$

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).

Table 7-26: AD Used to Estimate CH_4 Emissions from the 5D1 "Domestic Wastewater" in the RM within 1990-2016 periods

	1990	1991	1992	1993	1994	1995	1996	1997	1998
TOW_{rural}, kt BOD_5/yr	50.2014	50.2101	50.6595	50.5583	50.7226	50.6963	51.1734	50.9109	50.9000
TOW_{urban}, kt BOD_5/yr	45.3177	45.4118	45.0663	44.6585	44.6015	44.5227	44.0100	43.6971	43.8350
TOW_{total}, kt BOD_5/yr	95.5190	95.6220	95.7258	95.2168	95.3241	95.2190	95.1834	94.6080	94.7350
	1999	2000	2001	2002	2003	2004	2005	2006	2007
TOW_{rural}, kt BOD_5/yr	50.9022	50.9494	51.1913	51.0182	50.7817	50.7605	49.3736	49.2290	49.1546
TOW_{urban}, kt BOD_5/yr	43.5963	43.5555	42.6787	42.4882	42.3218	42.1456	36.9212	37.1249	37.8629
TOW_{total}, kt BOD_5/yr	94.4985	94.5049	93.8700	93.5064	93.1035	92.9062	86.2948	86.3539	87.0175

	2008	2009	2010	2011	2012	2013	2014	2015	2016
TOW_{rural}, kt BOD_5/yr	49.0894	48.8129	48.6092	48.4121	48.4133	48.0816	47.8696	47.2752	46.8231
TOW_{urban}, kt BOD_5/yr	37.8261	37.6242	37.6352	37.6746	37.8017	37.8482	37.9423	37.8016	37.5823
TOW_{total}, kt BOD_5/yr	86.9155	86.4371	86.2444	86.0867	86.2150	85.9299	85.8119	85.0768	84.4055

Step II: Selecting wastewater treatment systems and discharge pathways

The second step consists in 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) one can obtain the EFs for each wastewater treatment system and discharge pathway.

The emission factor depends of methane producing capacity (B_0), respectively the methane correction factor (MCF) specific to the respective wastewater treatment system and discharge pathway. B_0 represents the maximum methane producing capacity in a certain amount of organic substances (expressed in BOD) within 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 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 7-27).

Table 7-27: EFs Used to Estimate CH_4 Emissions from the 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	Sea, 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 in estimating total methane emissions from 5D1 "Domestic Wastewater" category 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.

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 the localities (Table 7-28), of which depends the access to wastewater collection and treatment systems, as well as the efficiency of these systems.

Table 7-28: Share of Different Groups from the Total Population in the RM (U_i fraction, where 100 per cent = 1.0), within 1990-2016 periods

	1990	1991	1992	1993	1994	1995	1996	1997	1998
U_{rural}	0.526	0.525	0.529	0.531	0.532	0.532	0.538	0.538	0.537
$U_{urban, low income}$	0.186	0.185	0.183	0.184	0.183	0.184	0.180	0.180	0.182
$U_{urban, high income}$	0.289	0.290	0.287	0.286	0.285	0.284	0.282	0.282	0.280
	1999	2000	2001	2002	2003	2004	2005	2006	2007
U_{rural}	0.539	0.539	0.545	0.546	0.545	0.546	0.572	0.570	0.565
$U_{urban, low income}$	0.181	0.182	0.177	0.177	0.178	0.184	0.142	0.143	0.152
$U_{urban, high income}$	0.280	0.279	0.277	0.277	0.277	0.270	0.286	0.287	0.283
	2008	2009	2010	2011	2012	2013	2014	2015	2016
U_{rural}	0.565	0.565	0.564	0.562	0.562	0.560	0.558	0.556	0.555
$U_{urban, low income}$	0.150	0.150	0.151	0.151	0.151	0.152	0.154	0.155	0.153
$U_{urban, high income}$	0.285	0.286	0.286	0.286	0.287	0.288	0.289	0.289	0.292

In the Republic of Moldova the population was divided in the following groups:

- population with high urbanization rate and high incomes; within this group is included the population of Chisinau, Balti, Tiraspol, Bender, Ribnita and Cahul municipalities (Table 7-29); the respective population is connected to sewage 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 sewage system, the wastewater being collected in latrines and septic systems (with or without discharge);
- population with low urbanization rate and low incomes; within this group is included the population of other cities in the RM; the respective 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; within this group is included the rural population of the RM; the income of this group is generally much 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, with wastewater being collected in latrines (usually without discharge).

Table 7-29: Population of the Republic of Moldova with High Urbanization Rate and High Income, within 1990-2016 periods, thousand inhabitants

	1990	1991	1992	1993	1994	1995	1996	1997	1998
Chisinau	675.5	676.7	667.1	663.4	661.6	661.5	661.9	664.7	663.2
Balti	161.7	161.8	159.0	157.5	156.1	154.8	153.5	153.4	152.4
Bender	132.2	133.0	132.7	129.3	128.6	126.8	124.7	123.4	122.4
Tiraspol	183.7	186.0	186.2	185.1	185.6	183.1	176.8	173.1	170.5
Ribnita	62.2	62.9	63.0	62.4	63.2	63.4	62.5	62.0	61.6
Cahul	44.0	44.3	44.6	43.6	43.7	43.4	43.1	43.0	42.7
Total, $P_{urban, high income}$	1259.3	1264.7	1252.6	1241.3	1238.8	1233.0	1222.5	1219.6	1212.8
	1999	2000	2001	2002	2003	2004	2005	2006	2007
Chisinau	663.6	663.4	662.0	662.0	660.7	662.2	661.2	660.2	658.4
Balti	152.0	151.3	146.7	146.5	145.9	144.3	144.2	143.2	142.2
Bender	121.2	119.6	117.6	116.0	114.8	96.9	85.8	95.0	94.4
Tiraspol	168.0	164.9	161.9	159.2	155.8	144.0	142.1	140.4	138.6
Ribnita	61.1	60.5	59.6	58.5	57.5	53.5	52.8	52.2	51.4
Cahul	42.6	42.4	41.2	41.2	41.1	41.0	40.8	40.7	39.2
Total, $P_{urban, high income}$	1208.5	1202.1	1189.0	1183.4	1175.8	1141.9	1126.9	1131.7	1124.2

	2008	2009	2010	2011	2012	2013	2014	2015	2016
Chisinau	663.1	663.2	663.4	664.7	667.6	671.8	674.5	678.2	681.1
Balti	143.2	143.2	143.3	144.0	144.3	144.8	144.9	145.3	145.8
Bender	94.1	93.8	93.3	93.0	92.4	91.9	91.0	84.7	83.8
Tiraspol	137.3	137.8	136.8	135.7	134.8	133.8	132.9	128.9	128.2
Ribnita	50.8	50.1	49.4	48.8	48.5	47.9	47.6	45.4	44.8
Cahul	39.0	39.4	39.4	39.7	39.8	39.8	39.6	39.6	39.6
Total, $P_{urban, high\ income}$	1127.5	1127.5	1125.6	1125.9	1127.4	1130.0	1130.5	1122.1	1123.3

Sursa: <http://statbank.statistica.md/pxweb/pxweb/ro/20%20Populatia%20si%20procesele%20demografice/?rxid=b2ff27d7-0b96-43c9-934b-42e1a2a9a774>; Statistical Yearbooks of the ATULBD for 1998-2017.

Thus, considering the level of economic development of the localities of the RM, the degree of urbanization, respectively the degree of connection to the wastewater collection and treatment systems, according to statistical data on the access to sewage systems and to expert opinion, were established the values of country-specific 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 (1990-2016) (Table 7-30).

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 (tons/yr), wastewater generation W (m^3/ton of product) and degradable organics concentration in the wastewater COD (kg COD/m^3).

The amount of total organically degradable carbon in wastewater (TOW) for industrial sector was estimated using Equation 6.6 from the 2006 IPCC Guidelines (Volume 5, Chapter 6, page 6.22):

$$TOW_i = P_i \bullet W_i \bullet COD_i$$

Where,

- TOW_i = total organically degradable material in wastewater for industry *i*, kg COD/yr[122];
- i = industrial sector;
- P_i = total industrial product for industrial sector *i*, t/yr;
- W_i = wastewater generated, $m^3/t_{product}$;
- COD_i = chemical oxygen demand (industrial degradable organic component in wastewater), kg COD/m^3.

For this purpose, activity data on the generation of industrial wastewater (by industry branches) and their discharging into the sewage systems were used.

Each industry branch was assigned a certain value of the degradable organic component expressed in kg COD/m^3 industrial wastewater, the amount of wastewater generated per industrial production output unit expressed in m^3/tonnes of product (Table 7-31), as well as the amount of annual output for each industry branch (Table 7-33).

Table 7-30: Country-specific Factors used to Estimate CH_4 Emissions from 5D1 "Domestic Wastewater" within 1990-2016 periods

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	Latrine, 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	Latrine, 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	Latrine, ground water table lower than latrine, (3-5 persons)	Septic tanks
1990	0.289	0.289	0.900	0.000	0.100	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	0.290	0.882	0.020	0.098	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	0.287	0.874	0.030	0.096	0.183	0.260	0.340	0.400	0.000	0.000	0.529	0.080	0.000	0.920	0.000
1993	0.286	0.286	0.866	0.040	0.094	0.184	0.240	0.360	0.400	0.000	0.000	0.531	0.060	0.000	0.940	0.000
1994	0.285	0.285	0.858	0.050	0.092	0.183	0.220	0.380	0.400	0.000	0.000	0.532	0.040	0.000	0.960	0.000
1995	0.284	0.284	0.850	0.060	0.090	0.184	0.180	0.400	0.420	0.000	0.000	0.532	0.020	0.000	0.980	0.000

[122] COD – chemical oxygen demand.

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	Latrine, 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	Latrine, 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	Latrine, ground water table lower than latrine, (3-5 persons)	Septic tanks
1996	0.282	0.282	0.842	0.070	0.088	0.180	0.140	0.420	0.440	0.000	0.000	0.538	0.010	0.000	0.990	0.000
1997	0.282	0.282	0.834	0.080	0.086	0.180	0.090	0.440	0.460	0.000	0.010	0.538	0.000	0.015	0.985	0.000
1998	0.280	0.280	0.826	0.090	0.084	0.182	0.060	0.460	0.460	0.000	0.020	0.537	0.000	0.015	0.985	0.000
1999	0.280	0.280	0.818	0.100	0.082	0.181	0.020	0.480	0.460	0.000	0.040	0.539	0.000	0.017	0.983	0.000
2000	0.279	0.279	0.820	0.100	0.080	0.182	0.010	0.490	0.440	0.000	0.060	0.539	0.000	0.018	0.982	0.000
2001	0.277	0.277	0.822	0.100	0.078	0.177	0.010	0.510	0.400	0.000	0.080	0.545	0.001	0.019	0.980	0.000
2002	0.277	0.277	0.824	0.100	0.076	0.177	0.020	0.520	0.370	0.000	0.090	0.546	0.002	0.020	0.978	0.000
2003	0.277	0.277	0.826	0.100	0.074	0.178	0.030	0.510	0.360	0.000	0.100	0.545	0.003	0.021	0.976	0.000
2004	0.270	0.270	0.828	0.100	0.072	0.184	0.040	0.490	0.360	0.000	0.110	0.546	0.004	0.022	0.974	0.000
2005	0.286	0.286	0.840	0.090	0.070	0.142	0.040	0.480	0.360	0.000	0.120	0.572	0.005	0.023	0.972	0.000
2006	0.287	0.287	0.852	0.080	0.068	0.143	0.060	0.470	0.340	0.000	0.130	0.570	0.007	0.023	0.970	0.000
2007	0.283	0.283	0.864	0.070	0.056	0.152	0.070	0.450	0.340	0.000	0.140	0.565	0.009	0.023	0.968	0.000
2008	0.285	0.285	0.877	0.060	0.053	0.150	0.080	0.435	0.330	0.005	0.150	0.565	0.011	0.023	0.966	0.000
2009	0.286	0.286	0.877	0.060	0.053	0.150	0.090	0.420	0.325	0.015	0.150	0.565	0.013	0.023	0.959	0.005
2010	0.286	0.286	0.879	0.050	0.061	0.151	0.110	0.420	0.310	0.020	0.140	0.564	0.014	0.023	0.956	0.007
2011	0.286	0.286	0.881	0.050	0.059	0.151	0.150	0.390	0.300	0.030	0.130	0.562	0.015	0.024	0.946	0.015
2012	0.287	0.287	0.886	0.050	0.054	0.151	0.170	0.380	0.290	0.040	0.120	0.562	0.016	0.025	0.941	0.018
2013	0.288	0.288	0.888	0.050	0.047	0.152	0.200	0.360	0.280	0.050	0.110	0.560	0.017	0.026	0.937	0.020
2014	0.289	0.289	0.888	0.050	0.047	0.154	0.230	0.340	0.270	0.060	0.100	0.558	0.018	0.028	0.932	0.022
2015	0.289	0.289	0.889	0.050	0.046	0.155	0.260	0.340	0.250	0.060	0.090	0.556	0.019	0.028	0.928	0.025
2016	0.292	0.292	0.892	0.050	0.043	0.153	0.280	0.340	0.240	0.060	0.080	0.555	0.020	0.028	0.922	0.030

Table 7-31: EFs Used to Estimate CH_4 Emissions from the 5D2 "Industrial Wastewater"

Industry Production by Type	COD_i – industrial degradable organic component, kg COD/m³	W_i – amount of wastewater generated per industrial production output unit, m³/t
Canned meat	4.1	13.0
Canned vegetables and fruits	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
Milk 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 All Union Scientific Research Institute for Water Supply, Sewage, Hydraulic Engineering Works and Engineering Hydrogeology (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 7-32: Activity Data on Industrial Output Used to Estimate CH_4 Emissions from the 5D2 "Industrial Wastewater", kt

	1990	1991	1992	1993	1994	1995	1996	1997	1998
Canned meat	15.000	9.600	5.808	3.269	1.723	1.750	1.500	3.100	2.350
Canned vegetables and fruit	499.300	462.400	394.650	403.400	244.250	176.700	126.200	200.100	135.400
Fruit and vegetable juices	273.600	260.000	89.100	104.600	50.800	44.800	49.400	88.300	67.400
Canned vegetables	149.600	143.000	74.300	72.000	62.400	41.100	20.500	26.600	27.200
Processed and canned fruit	76.100	59.400	48.200	53.900	17.600	10.600	17.600	18.200	6.600
Beer	76.000	66.000	43.000	36.000	28.500	30.290	25.600	26.270	30.010
Grapes wine	163.000	143.000	92.000	103.000	97.780	99.690	145.800	194.150	123.960
Sparkling wine	8.040	7.830	8.540	8.880	7.420	9.480	14.190	13.450	5.190
Cognac	13.940	14.020	7.500	7.400	7.930	10.270	4.570	5.860	4.970
Brandy and liqueurs	5.590	5.560	6.760	13.940	26.470	41.270	33.580	23.700	17.410
Meat	257.900	218.500	136.000	114.200	85.900	58.400	52.600	50.800	27.300
Sausages	50.000	52.900	27.300	14.700	9.000	8.900	8.000	9.600	8.000
Butter	27.000	21.833	18.803	11.052	9.660	6.800	4.700	2.956	2.895
Margarine	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

	1990	1991	1992	1993	1994	1995	1996	1997	1998
Cheese and cottage cheese	12.200	10.000	5.400	4.900	3.200	2.100	1.700	1.213	1.328
Curd, curd cream, yogurt, kefir, sour cream	138.000	115.400	70.100	65.100	48.800	21.700	11.900	20.500	26.800
Ice cream	11.520	9.600	6.400	2.900	2.500	2.400	3.000	3.251	4.389
Milk and whipped cream with a fat content <6 %	454.800	382.600	180.500	175.100	86.700	39.500	36.100	26.600	32.400
Milk and whipped cream in solid form	15.500	12.000	9.200	4.300	4.700	4.400	3.100	2.647	2.389
Crude oil, not chemically modified	125.600	117.900	57.300	60.300	50.400	50.700	39.400	35.200	28.700
Granulated sugar	435.800	236.900	208.000	230.200	166.700	218.700	264.500	213.300	194.500
Fish and fish products	9.500	5.200	6.500	9.500	2.100	0.000	0.000	0.900	0.800
Mineral and aerated water	51.924	34.616	19.774	13.749	11.382	10.003	10.120	9.772	18.578
Other non-alcoholic drinks	131.330	86.220	32.407	18.703	17.081	20.490	15.080	14.330	15.570
Paper and corrugated cardboard	5.340	4.650	1.110	1.020	0.240	0.420	0.510	0.720	0.390
Synthetic resins	17.500	14.600	5.839	4.792	1.510	1.424	0.000	0.000	0.000
Paint and Varnishes	11.700	8.800	6.000	3.100	1.200	0.800	0.700	0.509	0.370
Soap	11.700	8.000	4.800	2.700	0.700	0.600	0.500	0.608	0.301
Washing and cleaning products	15.000	10.100	9.900	4.900	1.200	1.400	1.600	0.293	0.172
Rough leather goods	0.439	0.404	0.106	0.064	0.027	0.047	0.054	0.053	0.055
Leather boxing clothes	1.174	1.173	0.897	0.611	0.182	0.143	0.177	0.214	0.095
Cotton yarn	31.600	32.600	16.668	8.561	4.252	2.655	6.524	5.364	10.552
Fabrics	33.540	16.770	11.372	7.575	5.048	3.761	7.681	7.297	13.644
Polymer film	5.200	4.400	2.600	2.300	1.200	0.712	1.896	1.285	1.268
	1999	2000	2001	2002	2003	2004	2005	2006	2007
Canned meat	1.860	2.845	2.071	2.213	3.192	2.200	0.739	1.062	1.377
Canned vegetables and fruit	98.592	93.852	113.875	80.861	111.194	80.406	86.264	99.896	93.952
Fruit and vegetable juices	32.100	46.700	59.700	31.256	56.884	36.872	30.023	29.732	53.777
Canned vegetables	44.527	22.119	28.876	22.724	25.534	22.739	51.341	44.409	22.701
Processed and canned fruit	5.216	6.116	5.423	5.231	16.076	18.596	18.332	17.276	16.524
Beer	22.090	25.790	33.620	46.240	59.910	69.570	77.780	91.327	101.463
Grapes wine	69.010	109.224	156.423	149.398	192.183	335.140	364.350	188.677	125.812
Sparkling wine	6.752	4.162	5.843	6.130	7.385	9.383	10.513	4.016	5.407
Cognac	4.859	7.177	9.556	10.381	13.611	14.280	17.108	7.914	8.236
Brandy and liqueurs	8.700	4.890	5.940	7.790	13.980	21.291	23.876	19.625	17.216
Meat	25.717	13.351	7.301	11.262	14.855	10.180	6.651	10.228	16.122
Sausages	9.434	10.168	11.655	13.842	15.026	15.566	17.241	18.035	20.775
Butter	2.374	2.844	3.360	2.717	2.863	3.840	3.593	3.521	3.587
Margarine	0.000	0.024	1.034	2.616	3.301	3.515	3.390	2.624	2.225
Cheese and cottage cheese	1.325	1.212	1.484	1.895	1.895	1.941	2.435	2.081	2.311
Curd, curd cream, yogurt, kefir, sour cream	20.700	17.100	21.900	16.839	22.262	20.958	26.532	28.278	32.351
Ice cream	4.264	4.395	5.182	6.321	8.073	7.287	8.105	8.609	8.228
Milk and whipped cream with a fat content <6 %	25.984	26.764	35.171	43.060	16.925	16.049	20.784	50.349	55.271
Milk and whipped cream in solid form	1.962	3.114	5.000	4.186	3.709	5.059	4.565	3.806	2.676
Crude oil, not chemically modified	24.264	31.343	43.486	53.632	77.007	96.092	83.394	81.471	84.967
Granulated sugar	100.500	105.400	132.600	167.600	107.100	110.900	133.472	149.046	73.964
Fish and fish products	1.000	1.900	2.300	2.700	2.700	2.700	3.000	2.500	2.300
Mineral and aerated water	24.585	30.917	39.039	54.222	62.804	75.273	97.310	108.489	136.518
Other non-alcoholic drinks	15.140	19.180	30.910	51.370	63.450	69.743	69.438	81.344	101.594
Paper and corrugated cardboard	0.180	0.168	0.385	0.189	0.185	0.471	0.605	1.950	2.700
Synthetic resins	0.000	0.000	0.979	0.776	0.708	0.910	1.048	0.825	1.026
Paint and Varnishes	0.674	2.054	2.870	4.095	3.443	5.136	6.269	8.319	11.045
Soap	0.231	0.231	0.280	0.232	0.339	0.386	0.317	0.526	0.562
Washing and cleaning products	0.258	0.386	0.821	0.255	0.243	0.493	0.533	0.769	1.034
Rough leather goods	0.018	0.013	0.012	0.004	0.002	0.000	0.000	0.000	0.000
Leather boxing clothes	0.040	0.043	0.060	0.135	0.042	0.000	0.000	0.000	0.000
Cotton yarn	8.131	13.030	12.400	12.501	13.300	16.200	18.537	18.728	21.319
Fabrics	11.486	17.064	16.342	16.837	19.292	20.625	23.823	23.661	26.440
Polymer film	0.701	1.734	2.141	3.324	4.211	3.300	4.464	3.985	4.048
	2008	2009	2010	2011	2012	2013	2014	2015	2016
Canned meat	1.555	1.195	1.598	1.433	1.654	0.969	0.825	0.769	0.809
Canned vegetables and fruit	102.669	60.237	75.977	71.009	81.109	100.844	104.250	70.864	86.085
Fruit and vegetable juices	39.042	28.163	31.852	34.758	55.428	60.119	58.835	46.860	59.204
Canned vegetables	41.939	26.505	29.890	26.336	24.291	25.114	30.395	15.674	0.000
Processed and canned fruit	17.781	3.738	7.985	6.758	0.436	10.741	7.598	7.895	9.400
Beer	86.659	78.174	95.260	106.812	111.844	102.927	98.475	99.454	84.784
Grapes wine	155.297	126.305	128.550	126.057	142.202	155.166	140.946	135.653	134.575
Sparkling wine	5.720	4.997	5.561	6.864	6.539	5.955	5.140	5.023	6.292
Cognac	10.373	6.978	7.465	9.118	10.940	11.797	9.395	7.016	7.722
Brandy and liqueurs	12.911	11.080	12.711	14.021	16.586	19.614	18.338	16.234	16.278
Meat	12.809	16.260	24.699	28.509	31.597	35.495	44.072	45.735	45.900
Sausages	22.466	17.057	16.697	17.963	19.633	21.265	20.824	20.915	21.240
Butter	4.697	4.222	4.586	4.258	4.392	5.811	5.008	5.062	6.138

	2008	2009	2010	2011	2012	2013	2014	2015	2016
Margarine	1.940	1.657	1.274	1.119	0.484	0.706	0.200	0.200	0.200
Cheese and cottage cheese	2.609	1.463	1.828	2.153	2.250	2.525	2.481	2.500	2.497
Curd, curd cream, yogurt, kefir, sour cream	32.373	32.961	32.999	35.412	39.283	41.212	40.890	41.840	43.346
Ice cream	7.679	7.010	8.490	8.313	9.436	10.173	10.477	10.706	11.076
Milk and whipped cream with a fat content <6 %	66.597	61.398	65.056	62.921	62.397	65.313	78.723	79.970	85.957
Milk and whipped cream in solid form	2.693	1.821	1.217	0.625	0.536	0.439	1.042	1.357	1.675
Crude oil, not chemically modified	79.307	83.881	80.705	89.787	96.828	65.502	113.223	109.534	79.963
Granulated sugar	133.966	38.373	103.209	88.436	83.440	140.297	177.695	84.519	99.999
Fish and fish products	4.600	3.700	1.300	7.578	7.732	8.490	8.774	9.241	7.275
Mineral and aerated water	130.358	117.804	122.668	114.370	114.375	100.470	115.695	126.312	132.573
Other non-alcoholic drinks	87.526	67.617	73.043	80.746	79.734	70.545	70.700	70.413	50.792
Paper and corrugated cardboard	1.140	0.870	1.290	2.520	1.324	2.467	2.000	2.000	2.000
Synthetic resins	0.961	0.777	1.516	1.657	1.774	1.842	1.739	0.929	1.453
Paint and Varnishes	11.557	11.822	12.864	18.011	17.907	12.345	17.685	26.858	32.746
Soap	0.399	0.380	0.538	0.523	0.570	0.637	0.786	0.993	0.995
Washing and cleaning products	0.451	0.482	0.618	0.727	0.798	1.892	1.416	1.760	2.821
Rough leather goods	0.000	0.000	0.000	0.000	0.000	0.007	0.000	0.000	13.547
Leather boxing clothes	0.000	0.000	0.000	0.000	0.000	0.035	0.000	0.000	0.000
Cotton yarn	20.635	14.867	16.155	13.078	14.290	14.886	13.193	10.445	13.547
Fabrics	26.787	18.129	21.777	17.544	19.628	24.239	18.287	13.980	17.671
Polymer film	3.384	2.973	3.498	3.708	3.175	2.528	1.671	1.640	1.635

Source: NBS, Official Letter No. 06-39/08 dated 23.02.2011 (AD for 1992-2010 time series); Statistical Reports PRODMOLD-A "Total production, as a natural expression, in the Republic of Moldova, by product type, for 2005-2015"; Statistical Yearbooks of the ATULBD for 1998 (pages 176-184), 2000 (pages 99-100), 2002 (pages 103-104), 2006 (pages 93-94), 2009 (pages 92-93), 2011 (pages 94-96) 2014 (pages 89-90), 2015 (pages 89-90), 2016 (pages 98-99).

Table 7-33: Total Industrial Organic Wastewater (TOW_i) by Industry Branches in the RM within 1990-2016, kt COD/yr

	1990	1991	1992	1993	1994	1995	1996	1997	1998
Food industry	158.6281	138.7174	91.0192	94.2480	64.9960	58.3199	51.3862	60.9473	44.9792
Paper and cardboard	7.7857	6.7797	1.6184	1.4872	0.3499	0.6124	0.7436	1.0498	0.5686
Plastics in primary forms	0.0389	0.0324	0.0130	0.0106	0.0034	0.0032	0.0020	0.0020	0.0020
Paint and Varnishes	2.3517	1.7688	1.2060	0.6231	0.2412	0.1608	0.1407	0.1023	0.0744
Soap, detergenţs and beauty care products	0.0401	0.0272	0.0221	0.0114	0.0029	0.0030	0.0032	0.0014	0.0007
Leather goods	0.0474	0.0464	0.0295	0.0198	0.0062	0.0056	0.0068	0.0078	0.0044
Cotton yarn and fabrics	2.7750	2.1032	1.1945	0.6874	0.3962	0.2733	0.6051	0.5393	1.0308
Plastic plates, sheets, tubes and poles	0.0115	0.0098	0.0058	0.0051	0.0027	0.0016	0.0042	0.0029	0.0028
TOW_i, total	**171.6784**	**149.4848**	**95.1084**	**97.0926**	**65.9984**	**59.3797**	**52.8898**	**62.6507**	**46.6608**
	1999	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**
Food industry	31.4643	30.9406	38.7096	34.4597	43.6393	45.7879	52.0304	44.4083	39.6450
Paper and cardboard	0.2624	0.2449	0.5616	0.2756	0.2699	0.6867	0.8822	2.8431	3.9366
Plastics in primary forms	0.0000	0.0000	0.0022	0.0017	0.0016	0.0020	0.0023	0.0018	0.0023
Paint and Varnishes	0.1355	0.4129	0.5769	0.8231	0.6920	1.0323	1.2601	1.6722	2.2201
Soap, detergenţs and beauty care products	0.0007	0.0009	0.0017	0.0007	0.0009	0.0013	0.0013	0.0019	0.0024
Leather goods	0.0017	0.0016	0.0021	0.0041	0.0013	0.0000	0.0000	0.0000	0.0000
Cotton yarn and fabrics	0.8357	1.2820	1.2244	1.2498	1.3884	1.5687	1.8045	1.8058	2.0346
Plastic plates, sheets, tubes and poles	0.0016	0.0038	0.0048	0.0074	0.0093	0.0073	0.0099	0.0088	0.0090
TOW_i, total	**32.7019**	**32.8868**	**41.0832**	**36.8221**	**46.0028**	**49.0863**	**55.9908**	**50.7420**	**47.8500**
	2008	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**
Food industry	43.5225	28.9018	35.3565	35.5787	35.5787	39.7981	46.9019	47.9241	37.5024
Paper and cardboard	1.6621	1.2685	1.8808	3.6749	1.9309	3.5971	0.0000	0.0000	0.0000
Plastics in primary forms	0.0021	0.0017	0.0034	0.0037	0.0039	0.0041	0.0039	0.0021	0.0032
Paint and Varnishes	2.3230	2.3763	2.5857	3.6203	3.5994	2.4813	3.5547	5.3984	6.5819
Soap, detergenţs and beauty care products	0.0013	0.0013	0.0017	0.0019	0.0021	0.0038	0.0033	0.0041	0.0057
Leather goods	0.0000	0.0000	0.0000	0.0000	0.0000	0.0012	0.0000	0.0000	0.0000
Cotton yarn and fabrics	2.0202	1.4056	1.6159	1.3045	1.4449	1.6667	1.3410	1.0405	1.3299
Plastic plates, sheets, tubes and poles	0.0075	0.0066	0.0078	0.0082	0.0070	0.0056	0.0037	0.0036	0.0036
TOW_i, total	**49.5387**	**33.9618**	**41.4518**	**44.1921**	**46.7863**	**54.6617**	**54.8307**	**45.9512**	**50.9326**

Step II: Selecting wastewater treatment systems and discharge pathways for industrial wastewater

The second step consists in 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) one can obtain the EFs for each wastewater treatment system and discharge pathway.

The emission factor depends of methane producing capacity (B_0), respectively the methane correction factor (MCF) specific to the respective wastewater treatment system and discharge pathway. B_0 represents the maximum methane producing capacity in a certain amount of organic substances (expressed in COD) within industrial 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 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 7-34).

Table 7-34: EFs Used to Estimate CH_4 Emissions from the 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	Sea, 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 in estimating total methane emissions from 5D2 "Industrial wastewater" category 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, urban high income and 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.

To 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 between different wastewater management practices was performed through the allocation to the urban population, subsequently divided into two sub-categories: the population with a high level of urbanization and the population with a low level of urbanization, considering only the centralized wastewater collecting systems and direct wastewater discharge into rivers and lakes (a situation present in certain cities in the country).

Thus, similar to domestic wastewater, by considering the level of economic development of the localities of the RM, the degree of urbanization, respectively the degree of connection to the wastewater collection and treatment systems, according to expert opinion, were established the values of country-specific factors used to estimate CH_4 emissions from industrial wastewater during the reference period (1990-2016) (Table 7-35). These values are based on the statistical data related to the number of economic agents by economic activity type in the territory.

Table 7-35: Country-Specific Factors Used to Estimate CH_4 Emissions from 5D2 "Industrial wastewater" within 1990-2016 periods

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
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

N_2O Emissions from 5D1 "Domestic Wastewater" Source Category

Wastewater disposal into natural waterways represent an important source of nitrous oxide emissions. These could be direct emissions from treatment plants or indirect emissions from wastewater after disposal of effluent into rivers, lakes or the sea.

Nitrous oxide emissions from the 5D1 "Domestic Wastewater" were estimated by following recommendations set forth 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):

$$N2O\ Emissions = N_{EFFLUENT} \bullet EF_{EFFLUENT} \bullet 44/28$$

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 to wastewater, kg N_2O-N/kg N; the default value used represent 0.005 kg N_2O-N/kg N (2006 IPCC Guidelines, Volume 5, Chapter 6, Table 6.11, page 6.27);

[44/28] – stoichiometric ratio of N_2O-N to N_2O.

The activity data that are needed for estimating N_2O emissions are nitrogen content in the wastewater effluent, country population and average annual per capita protein generation (kg/person/yr).

In order to estimate average annual per capita protein generation it will be considered in addition the „non-consumed" protein, as well as industrial and commercial protein discharged into the sewer systems.

Food and food waste that is not consumed but can be washed down the drain, as well as bath and laundry water, respectively industrial production waste and commercial food waste from grocery stores and butchers 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 smaller 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 steps.

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):

$$N_2O_{PLANT} = P \bullet T_{PLANT} \bullet F_{IND\_COM} \bullet EF_{PLANT}$$

Where:

N_2O_{PLANT} – total N_2O emissions from plants in inventory year, kg N_2O/yr;

P – human population;

T_{PLANT} – degree of utilization 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/year (2006 IPCC Guidelines, Volume 5, Chapter 6, page 6.26).

If we consider to include N_2O emissions from modern, centralized plants (N_2O_{PLANT}), the amount of nitrogen associated with these emissions (N_{WWT}) will be back calculated and subtracted from the $N_{EFFLUENT}$. The N_{WWT} can be calculated by multiplying N_2O_{PLANTS} by 28/44 (stoichiometric ratio of N_2O to N_2O-N) using the molecular weights).

Activity data on average per capita protein consumption in the RM is provided by the FAO (Table 7-36). For the RM, AD are 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 at the time of compiling the national GHG emissions inventory, activity data for 2014-2015 were not available on the FAO website, they were extrapolated considering the evolution of that indicator during 2012-2013.

Table 7-36: Activity Data Used to Estimate N_2O Emissions from Domestic Wastewater Treatment and Discharge

	1990	1991	1992	1993	1994	1995	1996	1997	1998
P, inhabitants[1]	4 361 600	4 366 300	4 359 100	4 347 800	4 352 700	4 347 900	4 334 400	4 320 000	4 325 800
Proteins, g/per capita/day	84.27	77.69	71.11	67.06	65.02	65.90	64.93	66.52	67.44
Proteins, kg/per capita/day	30.76	28.36	26.03	24.48	23.73	24.05	23.76	24.28	24.62
	1999	2000	2001	2002	2003	2004	2005	2006	2007
P, inhabitants[1]	4 315 000	4 303 500	4 286 300	4 269 700	4 251 300	4 230 600	3 940 400	3 943 100	3 973 400
Proteins, g/per capita/day	66.15	67.72	68.94	71.00	68.87	72.01	75.78	74.62	71.71
Proteins, kg/per capita/day	24.14	24.79	25.16	25.92	25.14	26.36	27.66	27.24	26.17
	2008	2009	2010	2011	2012	2013	2014	2015	2016
P, inhabitants[1]	3 957 900	3 946 900	3 938 100	3 931 000	3 926 002	3 923 739	3 918 353	3 884 786	3 843 600
Proteins, g/per capita/day	72.07	68.29	71.86	71.20	70.47	71.41	72.34	73.28	74.23
Proteins, kg/per capita/day	26.38	24.93	26.23	25.99	25.79	26.06	26.40	26.75	27.09

Source: 1 Statistical Yearbooks of the RM for 1990 (page 20), 1993 (page 60), 1994 (page 52), 1995 (page 49), 1997 (page 59), 1999 (page 42), 2003 (page 45), 2006 (page 37), 2008 (page 32), 2010 (page 32), 2012 (page 32), 2014 (page 32), 2016 (page 47); Statistical Yearbooks of the ATULBD for 2000 (page 27), 2006 (page 27), 2007 (page 27), 2009 (page 28), 2011 (page 28), 2013 (page 29), 2016 (page 26); 2 FAO database, FAOSTAT, FAO Statistics Division 2017, 13 June 2018, <http://www.fao.org/faostat/en/#data/CL>.

NMVOC Emissions Source Category 5D1 "Domestic Wastewater"

NMVOC emissions from the 5D1 "Domestic Wastewater" source category were estimated by following recommendations set forth in the EMEP/EEA Air Pollutant Emission Inventory Guidebook (2016).

$$NMVOC\ Emissions = AR \bullet EF \bullet 10^{-6}$$

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 7-25);

EF – emission factor, mg NMVOC/m^3 wastewater discharged (according to EMEP/EEA Air Pollutant Emission Inventory Guidebook (2016), 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.

7.4.3. Uncertainties Assessment and Time-Series Consistency

The quality of GHG emissions estimates for wastewater handling is directly related to the assessment methodology, the emissions factors used to estimate CH_4 and N_2O emissions under this source category and to the quality and availability of data used to derive these estimates. According to the information available in the 2006 IPCC Guidelines (Volume 5, Chapter 6, pages 6-17 and 6-23), uncertainties associated with maximum methane producing capacity (B_0) could reach to circa ±30 per cent; uncertainties associated with methane correction factor (fraction) (MCF) for well managed plants could reach to circa ±10 per cent, for not well managed plants – to circa ±30 per cent, while for latrines – circa ±50 per cent. Uncertainties related to population (P) could reach up to ±5 per cent; uncertainties related to BOD values (g/per capita/day) – circa ±30 per cent; uncertainties related to the fraction of population devised depending on income level – circa ±15 per cent; uncertainties related to the urbanisation level and access to wastewater treatment systems and discharge pathways could vary from ±3 per cent for countries that have good records, up to ±50 per cent for countries with poorly developed statistical systems. Uncertainties related to activity data regarding industrial production for countries with poorly developed statistical systems could reach to circa ±25 per cent; while those related to the W product (water consumption per unit of production) and COD (kg COD per cubic meter of wastewater) could reach magnitude two (-50 per cent, +100 per cent). 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" was considered to be circa ±30 per cent, while total uncertainties related to emission factors – circa ±40 per cent for methane emissions, respectively circa ±50 per cent for nitrous oxide emissions. Thus, combined uncertainties for methane emissions represent circa ±50.00 per cent, while for nitrous oxide emissions – circa ±58.3 per cent (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

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 EFs available in the 2006 IPCC Guidelines; correct use of AD obtained from different sources of reference, including the Statistical Yearbooks of the Republic of Moldova and of those of the ATULBD, as well as 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 under the category 5D "Wastewater treatment and discharge" were documented and archived both in hard copies and electronically.

7.4.5. Recalculations

The CH_4 emissions from the category 5D "Wastewater treatment and discharge" were recalculated for the 1990-2015 time series, in particular as a result of the transition to the calculation methodologies available in the 2006 IPCC Guidelines and due to use of an updated set of activity data and country specific EFs. The methodological approach used in the current inventory cycle allowed to estimate methane emissions for domestic and industrial wastewater, without converting industrial wastewater in domestic wastewater by considering the „equivalent number of population" index. Industrial wastewater have been distributed according to the management practices applied in the Republic of Moldova by allocating them to the urban population, later subdivided into two sub-categories: population with high urbanization rate and population with low urbanization rate, considering only the centralized wastewater collecting systems and direct wastewater discharge into rivers and lakes. The use of this approach presented a decrease of methane emissions, including due to the fact that industrial wastewater is usually collected and treated only in centralized systems causing thus, lower CH_4 emissions.

In comparison with the results reported in the NC4 of the RM under the UNFCCC (2018), the changes performed in this inventory cycle resulted in a decrease of CH_4 emissions from the 5D "Wastewater treatment and discharge" between 1990 and 2015, varying from a minimum decrease by circa 15.0 per cent in 1999, up to a maximum decrease by 56.7 per cent in 1990 (Tables 7-37 and 7-38).

Table 7-37: Comparative Results of CH_4 Emissions from 5D "Wastewater Treatment and Discharge" Category included into the BUR2 and the NC4 of the RM under the UNFCCC, kt

	1990	1991	1992	1993	1994	1995	1996	1997	1998
NC4	32.5890	29.5915	22.3339	21.8787	17.6476	16.5652	15.8885	16.7331	14.5801
BUR2	14.1186	13.6633	12.2826	12.4409	11.6369	11.5698	11.4778	11.8041	11.3807
Difference, %	-56.7	-53.8	-45.0	-43.1	-34.1	-30.2	-27.8	-29.5	-21.9
	1999	2000	2001	2002	2003	2004	2005	2006	2007
NC4	12.9273	13.3438	14.1977	13.6716	14.7040	14.8673	15.6174	14.9642	14.6272
BUR2	10.9864	10.9886	11.1552	10.9689	11.1769	11.2435	10.6940	10.4679	10.4219
Difference, %	-15.0	-17.6	-21.4	-19.8	-24.0	-24.4	-31.5	-30.0	-28.7
	2008	2009	2010	2011	2012	2013	2014	2015	2016
NC4	14.8004	13.3105	13.8043	14.1151	14.4948	15.3964	15.2693	14.1671	
BUR2	10.4043	9.8980	10.0845	10.1257	10.2170	10.4036	10.3832	10.0277	10.0725
Difference, %	-29.7	-25.6	-26.9	-28.3	-29.5	-32.4	-32.0	-29.2	

Abbreviations: NC4 – Fourth National Communication; BUR2 – Second Biennial Update Report.

Table 7-38: Comparative Results of CH_4 Emissions from 5D "Wastewater Treatment and Discharge" Category included into the BUR2 and the NC4 of the RM under the UNFCCC, kt CO_2 equivalent

	1990	1991	1992	1993	1994	1995	1996	1997	1998
NC4	814.7250	739.7863	558.3477	546.9664	441.1912	414.1298	397.2135	418.3272	364.5035
BUR2	352.9650	341.5835	307.0640	311.0235	290.9228	289.2454	286.9461	295.1025	284.5183
Difference, %	-56.7	-53.8	-45.0	-43.1	-34.1	-30.2	-27.8	-29.5	-21.9
	1999	2000	2001	2002	2003	2004	2005	2006	2007
NC4	323.1832	333.5941	354.9424	341.7891	367.6009	371.6817	390.4359	374.1062	365.6796
BUR2	274.6600	274.7153	278.8810	274.2228	279.4227	281.0883	267.3509	261.6968	260.5483
Difference, %	-15.0	-17.6	-21.4	-19.8	-24.0	-24.4	-31.5	-30.0	-28.7
	2008	2009	2010	2011	2012	2013	2014	2015	2016
NC4	370.0107	332.7629	345.1085	352.8773	362.3704	384.9097	381.7317	354.1764	
BUR2	260.1067	247.4503	252.1130	253.1427	255.4244	260.0907	259.5794	250.6923	251.8125
Difference, %	-29.7	-25.6	-26.9	-28.3	-29.5	-32.4	-32.0	-29.2	

Abbreviations: NC4 – Fourth National Communication; BUR2 – Second Biennial Update Report.

For 2016, CH_4 emissions from 5D "Wastewater Treatment and Discharge" category were estimated for the first time. The results allow assert that in the RM between 1990 and 2016, methane emissions from the respective source category decreased by circa 28.7 per cent.

N_2O emissions from the 5D "Wastewater treatment and discharge" were recalculated for the 1990 through 2015 years, due to updating AD regarding the population of the RM after the census carried out in 2014 and the revision of the population number on the LBDR and RBDR for 1998-2015 time series.

In comparison with the results reported in the NC4 of the RM under the UNFCCC (2018), the changes performed in this inventory cycle resulted in an insignificant increase of nitrous oxide emissions from the 5D "Wastewater treatment and discharge" between 1998 and 2004, varying from a minimum increase by 0.2 per cent in 2001-2003, up to a maximum increase by 1.7 per cent in 2004, respectively a decrease of N_2O emissions between 2005 and 2015, varying from a minimum decrease of 3.4 per cent in 2007 and 2014, up to a maximum decrease of 5.0 per cent in 2005 (Tables 7-39 and 7-40).

For 2016, N_2O emissions from 5D "Wastewater Treatment and Discharge" category were estimated for the first time. The results allow assert that in the RM between 1990 and 2016, nitrous oxide emissions from the respective source category decreased by circa 22.4 per cent.

Table 7-39: Comparative Results of N_2O Emissions from 5D "Wastewater Treatment and Discharge" Category included into the BUR2 and the NC4 of the RM under the UNFCCC, kt

	1990	1991	1992	1993	1994	1995	1996	1997	1998
NC4	0.2951	0.2724	0.2496	0.2341	0.2272	0.2301	0.2266	0.2307	0.2331
BUR2	0.2951	0.2724	0.2496	0.2341	0.2272	0.2301	0.2266	0.2307	0.2342
Difference, %	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.5
	1999	2000	2001	2002	2003	2004	2005	2006	2007
NC4	0.2280	0.2334	0.2368	0.2429	0.2346	0.2413	0.2524	0.2475	0.2369
BUR2	0.2292	0.2346	0.2373	0.2434	0.2351	0.2453	0.2398	0.2363	0.2288
Difference, %	0.5	0.5	0.2	0.2	0.2	1.7	-5.0	-4.5	-3.4
	2008	2009	2010	2011	2012	2013	2014	2015	2016
NC4	0.2379	0.2243	0.2355	0.2329	0.2309	0.2331	0.2357	0.2371	
BUR2	0.2297	0.2164	0.2272	0.2247	0.2228	0.2250	0.2276	0.2286	0.2291
Difference, %	-3.5	-3.5	-3.5	-3.5	-3.5	-3.5	-3.4	-3.6	

Abbreviations: NC4 – Fourth National Communication; BUR2 – Second Biennial Update Report.

Table 7-40: Comparative Results of N_2O Emissions from 5D "Wastewater Treatment and Discharge" Category included into the BUR2 and the NC4 of the RM under the UNFCCC, kt CO_2 equivalent

	1990	1991	1992	1993	1994	1995	1996	1997	1998
NC4	87.9499	81.1694	74.3744	69.7653	67.7185	68.5592	67.5246	68.7603	69.4640
BUR2	87.9499	81.1694	74.3744	69.7653	67.7185	68.5592	67.5246	68.7603	69.8045
Difference, %	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.5
	1999	2000	2001	2002	2003	2004	2005	2006	2007
NC4	67.9495	69.5662	70.5620	72.3953	69.9055	71.9060	75.2123	73.7500	70.6009
BUR2	68.2978	69.9236	70.7055	72.5363	70.0571	73.0947	71.4498	70.4040	68.1781
Difference, %	0.5	0.5	0.2	0.2	0.2	1.7	-5.0	-4.5	-3.4
	2008	2009	2010	2011	2012	2013	2014	2015	2016
NC4	70.9008	66.8311	70.1826	69.4041	68.7987	69.4522	70.2455	70.6672	
BUR2	68.4401	64.4928	67.7135	66.9707	66.3812	67.0444	67.8228	68.1157	68.2697
Difference, %	-3.5	-3.5	-3.5	-3.5	-3.5	-3.5	-3.4	-3.6	

Abbreviations: NC4 – Fourth National Communication; BUR2 – Second Biennial Update Report.

Thus, in comparison with the results reported in the NC4 of the RM under the UNFCCC (2018), the changes performed in this inventory cycle resulted in a significant decrease of total direct GHG emissions from the 5D "Wastewater treatment and discharge" between 1990 and 2015, varying from a minimum decrease of 12.3 per cent in 1999, to a maximum decrease of 51.2 per cent in 1990 (Table 7-41).

Table 7-41: Comparative Results of Direct GHG Emissions from 5D "Wastewater Treatment and Discharge" Category included into the BUR2 and the NC4 under the UNFCCC, kt CO_2 equivalent

	1990	1991	1992	1993	1994	1995	1996	1997	1998
NC4	902.6749	820.9558	632.7221	616.7317	508.9097	482.6890	464.7381	487.0875	433.9675
BUR2	440.9149	422.7530	381.4383	380.7889	358.6413	357.8046	354.4707	363.8628	354.3228
Difference, %	-51.2	-48.5	-39.7	-38.3	-29.5	-25.9	-23.7	-25.3	-18.4

	1999	2000	2001	2002	2003	2004	2005	2006	2007
NC4	391.1327	403.1602	425.5045	414.1844	437.5064	443.5877	465.6482	447.8563	436.2804
BUR2	342.9578	344.6389	349.5865	346.7591	349.4798	354.1830	338.8006	332.1009	328.7264
Difference, %	-12.3	-14.5	-17.8	-16.3	-20.1	-20.2	-27.2	-25.8	-24.7
	2008	2009	2010	2011	2012	2013	2014	2015	2016
NC4	440.9115	399.5940	415.2911	422.2813	431.1691	454.3619	451.9772	424.8436	
BUR2	328.5468	311.9432	319.8265	320.1134	321.8055	327.1351	327.4022	318.8081	320.0822
Difference, %	-25.5	-21.9	-23.0	-24.2	-25.4	-28.0	-27.6	-25.0	

Abbreviations: NC4 – Fourth National Communication; BUR2 – Second Biennial Update Report.

The table below presents the evolution of NMVOC emissions from 5D "Wastewater treatment and discharge" between 1990 and 2016. The results allow assert that in the RM within this time period, NMVOC emissions from the respective source category decreased by circa 75.6 per cent (Table 7-42).

Table 7-42: NMVOC Emissions from 5D "Wastewater Treatment and Discharge" Category included into the BUR2 of the Republic of Moldova under the UNFCCC

	1990	1991	1992	1993	1994	1995	1996	1997	1998
NMVOC Emissions, kt	0.0410	0.0373	0.0335	0.0299	0.0272	0.0207	0.0208	0.0186	0.0155
	1999	2000	2001	2002	2003	2004	2005	2006	2007
NMVOC Emissions, kt	0.0119	0.0111	0.0106	0.0104	0.0103	0.0103	0.0103	0.0103	0.0102
	2008	2009	2010	2011	2012	2013	2014	2015	2016
NMVOC Emissions, kt	0.0102	0.0102	0.0102	0.0102	0.0101	0.0101	0.0100	0.0100	0.0100

7.4.6. Planned Improvements

In order to improve the population's access to quality water supply and sanitation services, in the Republic of Moldova various actions of sector planning at different levels are adopted.

At the national level, it was recently approved through the Government Decision No. 199 as of 20.03.2014 the Strategy on water supply and sanitation for 2014–2028[123]. Although the strategy denotes the impact of climate change combined with water scarcity in the country, noting that securing water supply in the future requires integrated urban planning, it does not include actions to reduce GHG emissions from wastewater management. Thus, the general goal of the Strategy is to ensure gradual access to quality water supply and sanitation services for all in the RM, contributing to the improvement of health, dignity and quality of life as well as to the economic development of the country.

The Regulation on Wastewater Discharge in Water Bodies, approved through the Government Decision No. 802 as of 09.10.2013 aims to regulate the conditions of discharge, the introduction of specific substances into a body of surface water, groundwater or water fields. 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.

At the regional level (Central, Southern and Northern Development Regions) there were created and approved *Regional Sectoral Plans for Water and Sanitation Supply*. All these actions will ensure improvements within the wastewater handling sector, by applying clearly defined regulatory, institutional and economic instruments.

Regulatory instruments will focus on a set of normative laws (the Water Law No. 272 as of 23.12.2011[124], Law No. 303 as of 13.12.2013 on *Public Service for Water and Sanitation Supply*[125], the Regulation on Requirements for Wastewater Collection, Treatment and Discharge in the Sewage System and/or in Water Basins for Urban and Rural Areas, Government Decision No. 950 as of 25.11.2013 on the approval of the Regulation on Requirements for Wastewater Collection, Treatment and Discharge in the Sewage System and/or in Water Basins for Urban and Rural Areas[126], Regional Sectoral Plans related to water and sanitation and other). These regulatory instruments through their provisions will im-

[123] <http://lex.justice.md/index.php?action=view&view=doc&lang=1&id=352311>.

[124] Water Law No. 272 as of 23.12.2011 approved by the Parliament of the RM, published on the 26.04.2012 in the Official Monitor No. 81, article Nr : 264, date of entry into force: 26.10.2013, <http://lex.justice.md/md/342978/>.

[125] Law No. 303 as of 13.12.2013 on Public Service for Water and Sanitation Supply, published on the 4.03.2014 in the Official Monitor No. 60-65, article No: 123, date of entry into force: 14.09.2014, changed LP19 as of 22.02.18, OM84-93/16.03.18 article 175; date of entry into force 16.03.18, LP185 as of 21.09.17, OM371-382/27.10.17 article.632; date of entry into force 27.10.17, HCC28 as of 11.10.16, OM459-471/23.12.16 article 109; date of entry into force 11.10.16, HCC30 as of 01.11.16, MO478-490/30.12.16 article 111; date of entry into force 01.11.16, <http://lex.justice.md/index.php?action=view&view=doc&lang=1&id=352073>

[126] Government Decision No. 950 as of 25.11.2013 on the aapproval of the Regulation on Requirements for Wastewater Collection, Treatment and Discharge in the Sewage System and/or in Water Basins for Urban and Rural Areas, published: 06.12.2013 in the Official Monitor No. 284-289, article No: 1061, changed through GD722 as of 08.06.16, MO163-168/17.06.16 article 793, <http://lex.justice.md/md/350537/>.

prove the quality of water and sanitation services, of wastewater, rain water and sludge management, improving thus, the quality of services within the sector.

Institutional instruments will focus on the regionalization of services within this sector which will encourage the providers of water supply and sanitation services to group together and create 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-sanitation providers will be accompanied by tariff adjustment to ensure proper operation and maintenance of systems, for expanding the services to new users. Currently, it entered into force the Action Plan for 2018-2028 on the regionalization of water supply and sanitation services[127], 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 actions to establish regional operators and, implicitly, to delegate the water supply and sewage systems mananagement to the Agency, which represents 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 sewage systems services 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, Acva-North, Centre, South-West and ATU Gagauzia:

- 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 municipality;
- South-West Operator – Leova, Cimislia, Causeni, Stefan-Voda, Cantemir and Cahul districts;
- ATU Gagauzia Operator.

Economic instruments will focus on the concept of "sustainable recovery of cost services" with three main characteristics: an appropriate combination of tariffs, taxes and transfers to finance recurrent and capital costs and to boost other forms of funding; the predictability of public subsidies in order to facilitate investments (planning); tariff policies to make services accessible to all, including to the poorest citizens, while, at the same time, ensuring the sustainability of service providers.

Sector planning can essentially improve the wastewater and sludge management from the 5D "Wastewater treatment and discharge" category. Sludge handling actions will reduce the risk of water contamination, a problem that becomes increasingly sensitive to climate change. All these changes listed above will help the RM to fulfil its commitments within the Protocol on Water and Health, as well as within other international documents on reducing the share of population that lack the connection to drinking water sources and sewage systems, an, at the same time, the provisions under the UNFCCC.

Planning the actions to achieve the harmonization of nation legislation on water with the EU Directives, represents a strong instrument enhancing the implementation of best practices, of wastewater and sludge handling technologies, which would allow capturing and sustainable using of methane emissions from sludge platforms (including for heat and electric power production).

For the next inventory cycle, it will be assessed the possibilities of using country-specific information on the fraction of BOD removed with the sludge, maximum methane producing capacity, methane correction factor and other relevant parameters used to estimate emissions from the 5D "Wastewater treatment and discharge" category.

[127] <http://particip.gov.md/proiectview.php?l=ro&idd=4693>.

8. RECALCULATIONS AND PLANNED IMPROVEMENTS

This chapter summarizes the explanations and justification for direct GHG emissions recalculations performed to the Republic of Moldova's GHG Inventory for the 1990-2015 time series, included in the NC4 of the RM under the UNFCCC (2018), as well as planned improvements for the future inventory cycles. Specific information on the level of source and sink categories associated with respective recalculations and planned improvements can also be found in Chapters 3-7 of the NIR: 1990-2016.

8.1. Explanations and Justifications for Recalculations

The National Inventory Team revised and recalculated GHG emissions and removals for each calendar year covered by the inventory for the period from 1990 through 2015, a component part of the NC4 of the RM under the UNFCCC (2018). These activities were carried out during the on-going process of improving the quality of the National GHG Inventory.

Thus, under the current inventory cycle, improvements were made in all sectors (including, revision of previously used methodological approaches and emission factors, updated activity data, updating country specific emission factors used and correcting identified errors etc.), entailing the need to make recalculations of national GHG emissions for the time period from 1990 through 2015, reported in the NC4 of the RM under the UNFCCC (2018) (Chapter 2 "National GHG Inventory").

In comparison with the results reported in the NC4 of the RM under the UNFCCC (2018), the changes made during the development of the current inventory, revealed an increasing trend of total direct GHG emissions in 1990-1993, 1995 and 1999-2015 years, respectively resulted in slightly decreased values in 1994 and 1996-1998 years (Table 8-1).

Table 8-1: Recalculations of Total Direct GHG Emissions included into the NC4 of the RM under the UNFCCC (2018), Mt CO_2 equivalent

	1990	1991	1992	1993	1994	1995	1996	1997	1998
NC4	43.4000	38.9878	28.3850	22.9386	21.2027	17.6498	17.7123	16.3028	14.4061
BUR2	44.9188	40.7762	32.9006	24.7408	21.0382	17.8055	17.5224	16.1683	14.3515
Difference, %	3.5	4.6	15.9	7.9	-0.8	0.9	-1.1	-0.8	-0.4
	1999	2000	2001	2002	2003	2004	2005	2006	2007
NC4	12.1228	11.2078	11.9762	11.8020	12.2221	12.9717	13.4141	12.5625	12.2087
BUR2	12.5913	11.6256	12.4024	12.1971	12.5502	13.5394	13.8478	12.9467	12.7101
Difference, %	3.9	3.7	3.6	3.3	2.7	4.4	3.2	3.1	4.1
	2008	2009	2010	2011	2012	2013	2014	2015	2016
NC4	13.4685	13.4743	14.2635	14.5031	13.7486	11.4349	14.1995	13.9533	
BUR2	13.8693	14.4220	14.5256	14.9033	14.0006	13.4784	14.3801	14.3705	14.5778
Difference, %	3.0	7.0	1.8	2.8	1.8	17.9	1.3	3.0	

Abbreviations: NC4 – Fourth National Communication; BUR2 – Second Biennial Update Report.

With reference to the net direct GHG emissions included into the NC4 of the RM under the UNFCCC (2018), changes made in the development of the current inventory, resulted in increased emissions between 1990 and 2015, varying from a minimum increase of 15.5 per cent in 1990 to a maximum increase of 89.2 per cent in 2000 (Table 8-2).

Table 8-2: Recalculations of the Total Net Direct GHG Emissions included into the NC4 of the RM under the UNFCCC (2018), Mt CO_2 equivalent

	1990	1991	1992	1993	1994	1995	1996	1997	1998
NC4	37.5804	31.4104	21.3336	15.8020	14.8571	11.1677	11.4861	10.2141	8.2647
BUR2	43.3912	38.1864	30.9290	22.7398	19.1372	15.9366	15.2393	14.2949	12.4608
Difference, %	15.5	21.6	45.0	43.9	28.8	42.7	32.7	40.0	50.8
	1999	2000	2001	2002	2003	2004	2005	2006	2007
NC4	6.0108	5.1507	6.1833	6.9351	7.2948	9.0870	8.6497	7.5270	7.1845
BUR2	10.9940	9.7449	10.8863	10.5938	11.0170	11.8371	12.4369	11.4159	10.9829
Difference, %	82.9	89.2	76.1	52.8	51.0	30.3	43.8	51.7	52.9
	2008	2009	2010	2011	2012	2013	2014	2015	2016
NC4	8.9809	9.6222	11.0334	11.8591	10.8034	8.8878	11.5384	11.1079	
BUR2	12.4489	13.3888	13.5637	13.9953	13.0611	12.6757	13.9265	13.4683	13.6578
Difference, %	38.6	39.1	22.9	18.0	20.9	42.6	20.7	21.2	

Abbreviations: NC4 – Fourth National Communication; BUR2 – Second Biennial Update Report.

8.1.1. Energy Sector

Recalculations of direct GHG emissions from the Sector 1 'Energy' were performed based on the following considerations:

1A1. Energy Industries

- The transition from an average NCV for a longer period of time (1990-2015) to an annual average NCV for natural gases, based on the information provided by J.S.C. „Moldovagaz" for 1997-2016 time series (for 1990-1996 periods, were used annual average values characteristic to 1997);
- The AD on coal and residual fuel oil consumption at the MTPP Dnestrovsk were updated based on the information available in the NC1 of the RM under the UNFCCC (2000);
- When estimating fuel consumption for source category 1Alai 'Electricity Generation', it has been ensured that fuel consumption from renewable energy sources is not included;
- With the publication of the EBs of the RM in a MS Excel form for 2015 and 2016, it became easier to monitor and allocate fuel consumption within 1A1aii and 1A1aiii sources, thus avoiding the misallocation in other categories of the sector (for example, within 1A2);
- For years 1991 and 1992, when the EBs of the RM have not been published, the consumption values for a series of fuels (other types of coal, diesel oil, residual fuel oil, natural gas) were restored by the interpolation method;
- Within the current inventory cycle, GHG emission under the 1A1 'Energy Industries' category were estimated for the first time, both aggregated at national level, as well as separately for the RBDR and LBDR.

1A2. Manufacturing Industries and Construction

- GHG emissions from this category were estimated separately for the RBDR and LBDR, respectively for each industrial branch;
- For a series of industrial branches, the missing values have been restored using the interpolation method for 1991-1992 (during these years, the EBs were not published);
- The recalculations for 2010-2015 time series were made taking into account the new structure of the EBs of the RM and the reallocations made between categories 1A2 and 1A1;
- Also, the transition from an average NCV for a longer period of time (1990-2015) to an annual average NCV for natural gases, based on the information provided by J.S.C. „Moldovagaz" for 1997-2016 time series (for 1990-1996 periods, were used annual average values characteristic to 1997).

1A3a Civil Aviation (1A3aii Domestic Aviation)

- In order to convert fuel consumption from natural units to energy units a NCV of 43.66 TJ/kt (specific to aviation gasoline) was used to the detriment of the NCV of 43.13 TJ/kt (specific to aviation kerosene), thus resulting an increase of GHG emissions by circa 1.23 per cent within 2001-2015 time period;
- AD expressed in energy units for 1990 and 1993 were updated based on the information available in the Energy Balances of the RM for the respective years;
- The missing AD for 1991 and 1992 were restored by extrapolation based on the information available for 1990 and 1993.

1A3b. Road Transportation

- AD expressed in energy units (TJ) were updated based on the information available in the Energy Balances of the RM; unlike the previous inventory cycle when activity data used were considered in natural units (kt or million m^3);
- AD for 1991 and 1992 were updated (during the respective years, the Energy Balances have not been published);
- For those years when AD are not available in energy units (TJ), but only in natural units, the conversion was possible by using country specific NCVs;

- AD on fuel consumption for transport on the LBDR were updated, based on the specific fuel consumption per capita for the population on the RBDR.

1A3c. Railways

- AD for 1991 and 1992 were also updated (during the respective years, the Energy Balances have not been published);
- An error regarding the introduction of activity data on diesel oil consumption for the railways sector in 2009 was corrected.

1A3d. Domestic Navigation

- GHG emissions from this source category were recalculated only for 2015, due to updating activity data for the respective year.

1A3e. Pipeline Transport

- For certain years – 1990-1992, 2002 and 2009, when AD are not available in energy units (TJ), but only in natural units, the conversion was possible by using country specific NCVs;
- An error regarding the introduction of activity data on natural gas consumption for the pipeline transport sector in 2000 was corrected.

1A4. Other Sectors

- The GHG emissions from this category were estimated separately for the RBDR and LBDR, respectively for each source;
- For a series of sources, the missing values for certain types of fuel consumption have been restored using the interpolation method for 1991-1992 (during these years, the Energy Balances have not been published);
- Also, the transition from an average NCV for a longer period of time (1990-2015) to an annual average NCV for natural gases, based on the information provided by J.S.C. „Moldovagaz" for 1997-2016 time series (for 1990-1996 periods, were used annual average values characteristic to 1997).

1A5. Other

- GHG emissions from this category were estimated separately for the RBDR and LBDR, respectively for each source category;
- For a series of sources, the missing values for certain types of fuel consumption have been restored using the interpolation method for 1991-1992 (during these years, the Energy Balances have not been published);
- AD pertaining to the LPG consumption were updated for 1993-2015 time series;
- Also, the transition from an average NCV for a longer period of time to an annual average NCV for natural gases, based on the information provided by J.S.C. „Moldovagaz".

1B2. Fugitive Emissions from Oil and Natural Gas

- GHG emissions from this source category were estimated separately for the RBDR and LBDR;
- For a series of sources, the missing values for certain types of fuel consumption have been restored using the interpolation method for 1991-1992 (during these years, the Energy Balances have not been published);
- AD pertaining to the LPG consumption were updated for 1993-2015 time series;
- Also, the transition from an average NCV for a longer period of time to an annual average NCV for natural gases, based on the information provided by J.S.C. „Moldovagaz".

International Aviation (Memo Items)

- The missing values for AD regarding 1991-1992 were restored using the interpolation method (during the respective years, the Energy Balances have not been generated), GHG emissions were estimated using a Tier 1 approach;

- for 1995-2016 periods, GHG emissions from 'International Aviation' source category were estimated using two alternative approaches: Tier 1 and Tier 2b; after that, through the overlapping method, GHG emissions from 1990 to 1994 estimated by using the Tier 2b approach were restored (there are no AD on the number of operated flights for these years);
- Also, AD on the number of flights operated in 2014 and 2015 were updated.

CO_2 Emissions from Biomass (Memo Items)

- The missing values for AD regarding 1991-1992 were restored using the interpolation method (during the respective years, the Energy Balances have not been generated);
- The errors related with correct insertion of AD into the spreadsheet were reviewed and corrected (for example, for 1996, it was mistakenly inserted a value associated with fuel consumption under the 1A5 category, while in 2002 – under 1A4a);
- The errors associated with the use of EFs related to wood waste consumption in 1990 under the 1A2 and 1A4b categories were corrected;
- Errors were corrected in the estimation equations used to assess indirect GHG emissions (CH_4, N_2O, NO_x, CO and NMVOC) from biofuels combustion;
- AD on biofuels consumption from 1A1 were updated for 2010-2015 time series.

In comparison with the results included into the NC4 of the RM under the UNFCCC (2018), these recalculations resulted in an increase of direct GHG emissions within 1990-1993, 1995, 1998-2015, varying from a minimum increase by 0.2 per cent in 1998 up to a maximum of circa 22.3 per cent in 1992, respectively in an insignificant decrease in 1994 and 1996-1997 (Table 8-3).

Table 8-3: Recalculations of Total Direct GHG Emissions within the Sector 1 'Energy' included into the NC4 of the RM under the UNFCCC (2018), Mt CO_2 equivalent

	1990	1991	1992	1993	1994	1995	1996	1997	1998
NC4	34.6308	30.7803	21.3699	16.1330	15.1511	11.8855	12.1887	10.9476	9.4270
BUR2	36.6105	32.9696	26.1405	18.1730	15.1473	12.1574	12.1291	10.9364	9.4505
Difference, %	5.7	7.1	22.3	12.6	0.0	2.3	-0.5	-0.1	0.2
	1999	2000	2001	2002	2003	2004	2005	2006	2007
NC4	7.4725	6.7878	7.3880	7.1323	7.8500	8.3637	8.6817	7.8533	8.0245
BUR2	7.9883	7.2889	7.8927	7.5977	8.2968	9.0248	9.2488	8.3586	8.6524
Difference, %	6.9	7.4	6.8	6.5	5.7	7.9	6.5	6.4	7.8
	2008	2009	2010	2011	2012	2013	2014	2015	2016
NC4	8.6140	9.3023	9.8287	9.9961	9.6545	8.5633	9.3447	9.5049	
BUR2	9.1322	9.9117	10.1950	10.4985	10.0362	9.0257	9.6569	10.0638	9.9272
Difference, %	6.0	6.6	3.7	5.0	4.0	5.4	3.3	5.9	

Abbreviations: NC4 – Fourth National Communication; BUR2 – Second Biennial Update Report.

The results of recalculations performed by categories are presented also in the respective sub-chapters (3.2-3.9) of the NIR: 1990-2016.

8.1.2. Industrial Processes and Product Use Sector

Recalculations of total direct GHG emissions from the Sector 2 'Industrial Processes and Product Use' were performed based on the following considerations:

2A3. Glass Production

- CO_2 emissions from the glass production were calculated for 2011-2015 time series due to updated AD regarding the number of conventional glass jars for the canning industry equivalent 0.5 l of the total glass produced. Until 2010, this information is available in the Statistical Yearbooks of the Republic of Moldova, respectively in the Statistical Reports PRODMOLD-A "Total production, as a natural expression, in the Republic, by product type", while more recent information is not included in statistical publications due to confidentiality terms and, in these conditions, the respective AD activity data are collected directly from the glass factories.

2A4. Other Process Uses of Carbonates

'Ceramics'

- CO_2 emissions from the production of ceramics were recalculated for the 1990-2015 periods due to use of an updated conversion factor for the weight of a conventional brick (in the current inventory cycle a value of 2.87 kg was used, while during the previous inventory cycle – a value of 3.27 kg).

'Other Uses of Soda Ash'

- CO_2 emissions from the other uses of soda ash were recalculated for the 1990-2015 time series due to updating information on annual consumption of soda ash in glass industry (in the current inventory cycle it is considered that circa 85 per cent of the annual consumption of soda ash is recorded in glass production, while during the previous inventory cycle – 90 per cent, considering that between 1990 and 1995, soda ash use in glass production represented 250 kg of soda ash per ton of glass produced[128], within 1996-2011 time periods – it represented 187.2 kg, in 2012-2014 soda ash use in glass production represented 175.5 kg, while between 2015 and 2017 it reached to circa 150.0 kg), respectively due to updating information on glass production in the Republic of Moldova for 2011-2015 time series.

2C1. Iron and Steel Production

- CO_2 emissions from the 2C1 'Iron and Steel Production' source category were recalculated for 2014-2015, due to updating the AD on steel production on the Right Bank of Dniester River, available in the Statistical Reports PRODMOLD-A "Total production, as a natural expression, in the Republic, by product type".

2D1. Lubricant Use

- CO_2 emissions from lubricant use were recalculated for 1990-1994, 1997-2002, 2004-2015 time periods, due to updating AD on lubricants use on the RBDR, available in the EBs of the RM, respectively due to reconsidering the AD on lubricants use on the LBDR.

2D2. Paraffin Wax Use

- CO_2 emissions from paraffin wax use were recalculated for 1990-2015 time series, due to updating AD on paraffin wax use on the RBDR, available in the Energy Balances of the RM for 2004-2015 (in the Energy Balances of the RM for 1990 and 1993-2003 paraffin wax use was not included until 2004), respectively due to generating AD on paraffin wax use for 1990-2003 time periods, considering 2004 as the reference year, the evolution of lubricants use between 1990 and 2003. Additionally, for the first time there were considered the AD on paraffin wax use on the LBDR (determined indirectly based on paraffin wax use on the RBDR).

2D3. Solvent Use

- GHG emissions from the 2D3 'Solvent Use' source category were recalculated for 1998-2015 time period due to use of an updated set of activity data available in the Statistical Yearbooks of the ATULBD and of the RM, as well as in the Statistical Reports PRODMOLD-A 'Total production, as a natural expression, in the Republic, by product type for 2005-2015", in particular were updated AD on asphalt production in 1999-2002, production of glues from 2003 to 2004, on the processing of polyurethane products in 2015, imports of vehicles in 2015 and the number of population for 1998-2015 time series (it was considered the number of stable population at the beginning of the year on RBDR and LBDR; it should also be noted that the NBS reconsidered in 2017 the data series regarding the number of population resulting from the 2004 and 2014 population censuses carried out in parallel on RBDR and LBDR).

2D4. Other (Use of Urea-Based Catalysts)

- CO_2 emissions from use of urea-based catalysts were recalculated for 1990-2015 time periods due to use of an updated set of activity data related to Diesel Oil consumption in the RM (in the current inventory cycle was considered total diesel oil consumption as energy and fuel, while in the previous inventory cycle it was considered total national diesel oil consumption, including for non-energy use).

2F1. Refrigeration and Air Conditioning

[128] Russian Center for Foreign Trade. Conjuncture. Goods and Markets. Soda Ash on the World Market. http://www.rusimpex.ru/Content/Economics/Conjuncture/99_11002.htm>.

- HFCs emissions from source category 2F1 'Refrigeration and Air Conditioning' were recalculated for 1990-2015 time periods due to:
  - updating and completing information on the import and consumption of HFCs in the country for the period up to 2008, including due to using the Generalized Reports 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 (from 2009 through 2016 the responsibility for collecting statistical information according to the Statistical Report No. 1-Ozone was kept by the State Ecological Inspectorate of the Republic of Moldova, but due to lack of capacities, this information was not collected);
  - completing the list of refrigerants used mostly in the RM (for example, R-407f, R-408a, R-422d, etc.);
  - updating EFs and parameters used to estimate HFCs emissions from refrigeration and air conditioning equipment imported in the country, in particular regarding the values associated with the efficiency of freons recovery (%) at end-of-life;
  - updating the share of refrigerants charged into the refrigeration and air conditioning equipment in the RM between 1995 and 2016, by considering the information available in the Generalized Reports 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;
  - updating information on the total number of transportation means registered in the country, as well as the share of transportation units charged with air conditioning equipment, provided by the State Enterprise "State Information Resources Centre "Register" (SE "CRIS "Register") (for 1995-2013), respectively by the Public Services Agency of the RM (for 2014-2016), based on the information included in the State Transport Register;
  - also, in order to transfer HFCs emissions in CO_2 equivalent, in the current inventory cycle there were used the Global Warming Potential for 100 years (GWP_{100}) values according to the Fourth Assessment Report (AR4), compared to GWP_{100} values included in the Second Assessment Report (SAR).

2F2. Foam Blowing Agents

- HFCs emissions from foam blowing agents were recalculated due to considering, since 2015, the losses recorded at the end of service life of closed cell foams, noting that the emissions from these last about 20 years;
- Also, in order to transfer HFCs emissions in CO_2 equivalent, in the current inventory cycle there were used the Global Warming Potential for 100 years (GWP_{100}) values according to the AR4, compared to GWP_{100} values included in the SAR.

2F4. Aerosols

- HFCs emissions from aerosols were recalculated for 2003-2015 time periods, due to the erroneous calculation of the amount of the propellant HFC-134a contained in the metered dose inhaler Ipratropium bromide / Fenoterol hydrobromide - Berodual N pressurized inhalation solution 0.25 mg/dose-200 doses;
- Also, in order to transfer HFCs emissions in CO_2 equivalent, in the current inventory cycle there were used the Global Warming Potential for 100 years (GWP_{100}) values according to the Fourth Assessment Report (AR4), compared to GWP_{100} values included in the Second Assessment Report (SAR).

2G1. Electrical Equipment

- SF_6 and CF_4 emissions from source category 2G1 „Electrical Equipment" were recalculated for 2005-2015 periods due to updating the total number of medium-tension electrical circuit breakers, in contrast to the previous inventory cycle, in the current inventory cycle there were also considered the number of 10 kV medium-tension electrical circuit breakers.

2G4. Other

- Indirect CO_2 emissions from category 2G4 'Other' were recalculated for 2015 due to updating AD regarding shoes production in the RM, available in the official sources of references (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", respectively in the Statistical Yearbooks of the ATULBD).

In comparison with the results included into the NC4 of the RM under the UNFCCC (2018), the performed recalculation resulted in a decrease of direct GHG emissions between 1990 and 2015, varying from a minimum of 0.4 per cent in 2011, up to a maximum of 2.1 per cent in 2010 (Table 8-4).

Table 8-4: Recalculations of Total Direct GHG Emissions within the Sector 2 'Industrial Processes and Product Use' included into the NC4 of the RM under the UNFCCC (2018), Mt CO_2 equivalent

	1990	1991	1992	1993	1994	1995	1996	1997	1998
NC4	1.5810	1.4026	0.8144	0.7331	0.5529	0.4535	0.4129	0.4550	0.3809
BUR2	1.5723	1.3947	0.8089	0.7249	0.5488	0.4505	0.4097	0.4514	0.3771
Difference, %	-0.6	-0.6	-0.7	-1.1	-0.7	-0.7	-0.8	-0.8	-1.0
	1999	2000	2001	2002	2003	2004	2005	2006	2007
NC4	0.3452	0.3190	0.3243	0.3770	0.4119	0.4897	0.5986	0.7092	0.9713
BUR2	0.3410	0.3141	0.3190	0.3723	0.4065	0.4854	0.5919	0.7020	0.9616
Difference, %	-1.2	-1.5	-1.6	-1.2	-1.3	-0.9	-1.1	-1.0	-1.0
	2008	2009	2010	2011	2012	2013	2014	2015	2016
NC4	1.0639	0.5601	0.6050	0.6985	0.7164	0.7703	0.8049	0.7951	
BUR2	1.0553	0.5558	0.5923	0.6960	0.7132	0.7626	0.7949	0.7842	0.7619
Difference, %	-0.8	-0.8	-2.1	-0.4	-0.4	-1.0	-1.3	-1.4	

Abbreviations: NC4 – Fourth National Communication; BUR2 – Second Biennial Update Report.

The results of recalculations performed by categories are presented also in the sub-chapters 4.2-4.8 of the NIR: 1990-2016.

8.1.3. Agriculture Sector

Recalculations of total direct GHG emissions from the Sector 3 'Agriculture' were performed based on the following considerations:

3A. Enteric Fermentation

- Methane emissions from the 3A 'Enteric Fermentation' category were recalculated for the 1993-2015 time series, in particular due to use of an updated set of AD related to the livestock population on the LBDR (the Statistical Yearbooks of the ATULBD for 2016 and 2017 include more disaggregated data regarding 2011-2016 time periods, for example, for sheep and goats, respectively for poultry, the same trends regarding the population of these species were also applied for the rest of the analyzed period – 1993-2010); respectively due to use of an updated set of values for gross energy (GE), as well as a result of using a Tier 2 methodology and country specific EFs for several animal categories (in particular for cattle, sheep and goats).

3B. Manure Management

- Methane and nitrous oxide emissions from the 3B 'Manure Management' category were recalculated for the 1990-2015 time series, in particular due to use of an updated set of AD related to the livestock population on the LBDR (the Statistical Yearbooks of the ATULBD for 2016 and 2017 include more disaggregated data regarding 2011-2016 time periods, for example, for sheep and goats, respectively for poultry, the same trends regarding the population of these species were also applied for the rest of the analyzed period); respectively due to use of an updated set of values for gross energy received daily – GE (MJ/day) and for the volatile solids excretion rate – VS (kg d.m./day, in particular for other cattle, as well as a result of using a Tier 2 methodology and country specific EFs for cattle and swine.

3Da2. Applied Organic Nitrogen Fertilizers

- Direct N_2O_{ON} emissions from the 3D.a.2 'Applied Organic Nitrogen Fertilizers' source category were recalculated for 1993-2015 time series, in particular due to using a new set of AD, generated based on the information regarding the amount of organic N fertilizers available to apply to soil (estimated within source category 3B 'Manure Management')

3Da3. Urine and Dung Deposited by Grazing Animals

- Direct N_2O_{PRP} emissions from the 3D.a.3 'Urine and Dung Deposited by Grazing Animals' source category were recalculated for the 1993-2015 time series, in particular due to use of an updated set of AD related to the livestock population on the LBDR (the Statistical Yearbooks of the ATULBD for 2016 and 2017 include more disaggregated data regarding 2011-2016 time periods, for example, for sheep and goats, respectively for poultry, the same trends regarding the population of these species were also applied for the rest of the analyzed period).

3Da4. Crop Residues Returned to Soils

- Direct N_2O_{CR} emissions from crop residues returned to soil were recalculated for those years affected by severe drought: 1994, 1996, 2000, 2003, 2007, 2012 and 2015. For the respective years the values of the fraction of above-ground residues of crop removed and used in other purposes ($Frac_{Remove(T)}$) were reconsidered.

3Da5. Nitrogen Mineralization Associated with Loss of Soil Organic Matter

- Direct N_2O emissions from nitrogen mineralization associated with loss of soil carbon as a result of land-use or management change were recalculated for the 1990 through 2015 time series, in particular due to use of an updated set of activity data on the amount of inorganic nitrogen fertilizers and organic fertilizers applied to soils in the Republic of Moldova, depending on individual crops, based on available data in the Statistical Reports 9-AGR "The Use of Phytosanitary Products and Inorganic Nitrogen Fertilizers and Organic Fertilizers Applied for Annual Crops...", respectively due to updating the amount of nitrogen returned to soil as crop residues, as well as reconsidering the fraction of crop residues removed and used for other purposes in the years with severe climatic conditions.

3Db1. Atmospheric Deposition of Nitrogen Oxides (NO_x^-) and Ammonia (NH_4)

- Indirect N_2O_{ATD} emissions from the 3D.b.1 'Atmospheric Deposition of Nitrogen Oxides (NO_x) and Ammonia (NH_4)' source category were recalculated for 1990-2015 time series, in particular due to using a new set of AD generated based on the information regarding the consumption of organic N fertilizers available to apply to soil (estimated within category 3B „Manure Management"); as well as due to use of an updated set of AD related to the livestock population on the LBDR (the Statistical Yearbooks of the ATULBD for 2016 and 2017 include more disaggregated data regarding 2011-2016 time periods, for example, for sheep and goats, respectively for poultry, the same trends regarding the population of these species were also applied for the rest of the analyzed period).

3Db2. Nitrogen Leaching and Run-off

- Indirect N_2O_L emissions from the 3D.b.2 'Nitrogen Leaching and Run-off' source category were recalculated for 1990-2015 time series, in particular due to using a new set of AD generated based on the information regarding the amount of organic N fertilizers available to apply to soil (estimated within category 3B 'Manure Management'); due to use of an updated set of AD related to the livestock population on the LBDR (the Statistical Yearbooks of the ATULBD for 2016 and 2017 include more disaggregated data regarding 2011-2016 time periods, for example, for sheep and goats, respectively for poultry, the same trends regarding the population of these species were also applied for the rest of the analyzed period); respectively, due to use of an updated set of activity data on the amount of inorganic nitrogen fertilizers and organic fertilizers applied to soils in the Republic of Moldova, depending on individual crops, based on available data in the Statistical Reports 9-AGR "The Use of Phytosanitary Products and Inorganic Nitrogen Fertilizers and Organic Fertilizers Applied for Annual Crops...", as well as due to updating the amount of nitrogen returned to soil as crop residues, and reconsidering the fraction of crop residues removed and used for other purposes in the years with severe climatic conditions.

3H. Urea Application

- CO_2 emissions from 3H 'Urea Application' category were recalculated for 2015, due to receiving an updated set of AD from the Customs Service of the Republic of Moldova.

In comparison with the results recorded within the previous inventory cycle, reported in the NC4 of the RM under the UNFCCC (2018), the performed recalculations resulted in increased values of direct GHG emissions within 1990-1993, 1995, 1997-1999, 2001-2002, 2004-2006, 2008-2011 and 2013-2014 periods, varying from a minimum of 0.02 per cent in 2004, up to a maximum of 0.3 per cent in 1995, respectively a decrease of direct GHG emissions within 1994, 1996, 2000, 2003, 2007, 2012 and 2015, varying from a minimum of 0.2 per cent in 1994, up to a maximum decrease of 1.1 per cent in 2015 (Table 8-5).

Table 8-5: Recalculations of Direct GHG Emissions within the Sector 3 'Agriculture' included into the NC4 of the RM under the UNFCCC (2018), Mt CO_2 equivalent

	1990	1991	1992	1993	1994	1995	1996	1997	1998
NC4	5.2106	4.8569	4.3977	4.2227	3.7517	3.5906	3.4009	3.1810	2.9467
BUR2	5.2206	4.8628	4.4000	4.2297	3.7460	3.6029	3.3846	3.1852	2.9525
Difference, %	0.2	0.1	0.1	0.2	-0.2	0.3	-0.5	0.1	0.2
	1999	2000	2001	2002	2003	2004	2005	2006	2007
NC4	2.6892	2.5002	2.6728	2.7425	2.4246	2.5921	2.5765	2.4631	1.6847
BUR2	2.6962	2.4808	2.6761	2.7449	2.3999	2.5926	2.5784	2.4664	1.6768
Difference, %	0.3	-0.8	0.1	0.1	-1.0	0.0	0.1	0.1	-0.5
	2008	2009	2010	2011	2012	2013	2014	2015	2016
NC4	2.2384	2.0703	2.2497	2.2040	1.7758	2.2490	2.4879	2.1147	
BUR2	2.2434	2.5018	2.2550	2.2079	1.7601	2.2526	2.4923	2.0912	2.4285
Difference, %	0.2	20.8	0.2	0.2	-0.9	0.2	0.2	-1.1	

Abbreviations: NC4 – Fourth National Communication; BUR2 – Second Biennial Update Report.

The results of recalculations performed by categories are presented also in the sub-chapters 5.2-5.5 of the NIR: 1990-2016.

8.1.4. Land Use, Land-Use Change and Forestry Sector

Recalculations of total net GHG emissions from the Sector 4 'LULUCF' were performed based on the following considerations:

4A. Forest Land

- For 1990-2015 time series, recalculations were performed for CO_2 removals within both 4A1 'Forest Land Remaining Forest Land' and 4A2 'Land Converted to Forest Land' categories, as well as for non-CO_2 emissions from 4A2 'Land Converted to Forest Land'. Recalculations performed for both 4A1 and 4A2 are due to updating and refined activity data for the respective categories within the Land Use and Land Use-Change Matrix for 1970-2016 periods.

4B. Cropland

- For 1990-2015 time periods, recalculations were made for both subcategories 4B1 'Cropland Remaining Cropland' and 4B2 'Land Converted to Cropland'. The recalculations for the respective categories are due to updating activity data that emerged from the improvement of the Land Use and Land Use-Change Matrix for 1970-2016 periods. At the same time, for 4B1.1 'Cropland Covered with Woody Vegetation' ('Perennial Plantations') the estimation algorithm was revised, excluding overestimation of emissions' decreasing.

4C. Grassland

- For 4C2 'Land Converted to Grassland' category recalculations were performed for the period 1990-2015, due to the change of approaches made for the Land Use and Land Use-Change Matrix for 1970-2016, in particular regarding the conversion of other land to grassland. According to the new approaches for this type of conversion, it was established a conversion period of 1 year, since it is a provisional/conventional and the respective land is than converted to other land use categories for a longer period of time (orchards, forests, forest vegetation).

4D. Wetlands

- For 4D2 'Land Converted to Wetlands' category recalculations were performed for the period 1990-2015, due to the change of approaches related to estimation of CO_2 emissions/removals made for the Land Use and Land Use-Change Matrix for 1970-2016, in particular regarding the conversion of other land to wetlands. According to the new approaches for this type of conversion were established carbon increments in biomass and soil.

4E. Settlements

- For 4E2 'Land Converted to Settlements', CO_2 emissions/removals were recalculated for 2011-2015 time series due to updating AD for this category, changes that affected the estimating process within the Land Use and Land Use-Change Matrix for 1970-2016 periods.

4F. Other Land

- For 4F2 'Land Converted to Other Land', CO_2 emissions were recalculated for the 1990-2015 time series, being influenced in particular, by the conversion process of different land categories to other land.

4G. Harvested Wood Products

- CO_2 removals/emissions from category 4G 'Harvested Wood Products' were recalculated for the 1990-2015 time series due to updating certain AD.

Compared with the results recorded in the NC4 of the RM under the UNFCCC (2018), changes performed in the current inventory cycle resulted in a significant decrease of total net CO_2 removals in 1990-2015 time series, with a variation from a minimum of 56.2 per cent in 2004 to a maximum of 83.0 per cent in 2014 (Table 8-6).

Table 8-6: Recalculations of Net CO_2 Removals within the Sector 4 'Land Use, Land-Use Change and Forestry' included into the NC4 of the RM under the UNFCCC (2018), Mt CO_2

	1990	1991	1992	1993	1994	1995	1996	1997	1998
NC4	-5.8197	-7.5773	-7.0514	-7.1366	-6.3455	-6.4821	-6.2262	-6.0886	-6.1414
BUR2	-1.5276	-2.5899	-1.9715	-2.0010	-1.9010	-1.8689	-2.2831	-1.8735	-1.8907
Difference, %	-73.8	-65.8	-72.0	-72.0	-70.0	-71.2	-63.3	-69.2	-69.2
	1999	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**
NC4	-6.1121	-6.0570	-5.7928	-4.8670	-4.9273	-3.8846	-4.7644	-5.0355	-5.0242
BUR2	-1.5973	-1.8807	-1.5162	-1.6033	-1.5332	-1.7023	-1.4109	-1.5308	-1.7272
Difference, %	-73.9	-69.0	-73.8	-67.1	-68.9	-56.2	-70.4	-69.6	-65.6
	2008	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**
NC4	-4.4876	-3.8521	-3.2301	-2.6440	-2.9451	-2.5470	-2.6610	-2.8454	
BUR2	-1.4205	-1.0332	-0.9619	-0.9080	-0.9396	-0.8027	-0.4536	-0.9022	-0.9200
Difference, %	-68.3	-73.2	-70.2	-65.7	-68.1	-68.5	-83.0	-68.3	

Abbreviations: NC4 – Fourth National Communication; BUR2 – Second Biennial Update Report.

The results of recalculations performed by categories are presented also in the sub-chapters 6.2-6.8 of the NIR: 1990-2016.

8.1.5. Waste Sector

Recalculations of total direct GHG emissions from the Sector 5 'Waste' were performed based on the following considerations:

5A. Solid Waste Disposal

- The CH_4 emissions were recalculated for the 1993 through 2015 time series, due to updated AD and country-specific EF.

5C. Incineration and open burning of waste

- Direct and indirect GHG emissions from incineration and open burning of household and clinical waste were recalculated, in particular due to the need of adjusting AD with the number of population, considering the results of the population census from 2014, carried out in parallel on the LBDR and RBDR (the results of the census on the RBDR were published later, only in 2017). Also, adjustments have also been made in the calculation formula used to estimate N_2O emissions, this being correlated to the dry matter fraction of waste burned.

5D. Wastewater treatment and discharge

- The CH_4 emissions from the category 5D "Wastewater treatment and discharge" were recalculated for the 1990-2015 time series, in particular as a result of the transition to the calculation methodologies available in the 2006 IPCC Guidelines and due to use of an updated set of activity data and country specific EFs. The methodological approach used in the current inventory cycle allowed to estimate methane emissions for domestic and industrial wastewater, without converting industrial wastewater in domestic wastewater by considering the „equivalent number of population" index. Industrial wastewater have been distributed according to the management practices applied in the Republic of Moldova by allocating them to the urban population, later subdivided into two sub-categories: population with high urbanization rate and population with low urbanization rate, considering only the centralized wastewater collecting systems and direct wastewater discharge into rivers and lakes. The use of this approach presented a decrease of methane emissions, including due to the fact that industrial wastewater is usually collected and treated only in centralized systems causing thus, lower CH_4 emissions.
- N_2O emissions from the 5D "Wastewater treatment and discharge" were recalculated for the 1990 through 2015 time series, due to updating AD regarding the population of the RM after the census carried out in 2014 and the revision of the population number on the LBDR and RBDR for 1998-2015 time series.

Compared with the results recorded in the previous inventory process, changes performed in the current inventory cycle resulted in a decreasing trend of direct GHG emissions between 1990 and 2015, with a variation from a minimum of 3.1 per cent in 1999 and a maximum of 23.4 per cent in 1990 (Table 8-7).

Table 8-7: Recalculations of Direct GHG Emissions within the Sector 5 'Waste' included into the NC4 of the RM under the UNFCCC (2018), Mt CO_2 equivalent

	1990	1991	1992	1993	1994	1995	1996	1997	1998
NC4	1.9777	1.9479	1.8030	1.8497	1.7471	1.7202	1.7098	1.7191	1.6514
BUR2	1.5154	1.5491	1.5512	1.6132	1.5962	1.5947	1.5990	1.5953	1.5714
Difference, %	-23.4	-20.5	-14.0	-12.8	-8.6	-7.3	-6.5	-7.2	-4.8
	1999	2000	2001	2002	2003	2004	2005	2006	2007
NC4	1.6144	1.6007	1.5911	1.5503	1.5356	1.5262	1.5573	1.5369	1.5282
BUR2	1.5658	1.5418	1.5146	1.4823	1.4471	1.4366	1.4288	1.4196	1.4194
Difference, %	-3.0	-3.7	-4.8	-4.4	-5.8	-5.9	-8.3	-7.6	-7.1
	2008	2009	2010	2011	2012	2013	2014	2015	2016
NC4	1.5522	1.5417	1.5801	1.6044	1.6018	1.5661	1.5619	1.5387	
BUR2	1.4385	1.4527	1.4833	1.5009	1.4911	1.4376	1.4361	1.4313	1.4603
Difference, %	-7.3	-5.8	-6.1	-6.5	-6.9	-8.2	-8.1	-7.0	

Abbreviations: NC4 – Fourth National Communication; BUR2 – Second Biennial Update Report.

The results of recalculations performed by categories are presented also in the sub-chapters 7.2-7.4 of the NIR: 1990-2016.

8.2. Planned Improvements

A series of improvements is planned for the next inventory cycles. Below are presented the planned procedural and institutional improvements, as well as planned improvements by sectors.

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:

- Strengthening institutional arrangements in order to ensure the constant development of GHG national inventories, through a legislative/regulatory framework to be considered and approved by the Government of the Republic of Moldova;
- Enhancing the level of knowledge of national experts and institutions involved in developing the national GHG emission inventory by organizing a series of thematic trainings;

- Enhancing the professional skills of national experts and institutions involved in developing the inventory process, with the purpose of realizing the gradual transition from default EFs and Tier 1 methodologies to country specific EFs and Tier 2 and 3 methodologies, particularly in the case of key categories;
- Enhancing the data management system used in each inventory cycle, as well as the periodic archiving of the inventory and the documentation on which inventory was drawn up, in order to comply with the principle of transparency.

8.2.2. Planned Improvements

Sector 1 'Energy'

- Potential improvements within the 1A1 'Energy Industries', 1A2 'Manufacturing Industries and Construction', 1A3 'Transport', 1A4 'Other Sectors', 1A5 'Other' and 'CO_2 emissions from biomass' (Memo Items) categories could be possible once the updated AD regarding the fuel consumption with energy purposes for the territory on the LBDR are available, thus filling the gaps for certain years. Also, another potential improvement could be identifying additional AD sources or updating AD from official statistical publications;
- Regarding the 1A3a 'Civil Aviation' (1A3ii 'Domestic Aviation'), the opportunity to collect missing AD for 1994-2000 time series will be considered, and alternatively, if this is not possible, the gaps will be filled according to the methodologies available in the 2006 IPCC Guidelines;
- Also, for 1A3a 'Civil Aviation' and 1A3c 'Railways', it would be possible to use higher-tier methods (Tier 2b, respectively Tier 2), but since these sources are not key categories, this activity is not cost-efficient and cost-effective for the national inventory team;
- For 1A3b 'Road Transportation', potential improvements could be the result of collecting additional AD for 1990-2013 time series, required to use the COPERT 4.9 model. Due to their absence, for now it was possible to run the program only for 2014-2016 years;
- Potential improvements within the 1B2 'Fugitive Emissions from Oil and Natural Gas' source category could be possible regarding the availability of new data related to 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 for the final consumers; from equipment functioning, evaporation and flashing losses, flaring, accidental releases from pipeline dig-ins), respectively in the case of adopting a higher-ranking assessment methodology. It will also be estimated the possibility to obtain AD associated to LPG consumption on the territory of the LBDR for the entire period under review;
- Within the 'International Aviation' (Memo Items) source category, 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 (2016), which considers the real values of emissions for each type of aircraft depending on the flight distance. Also, it could be used the emission calculator available in the updated version of the EMEP/EEA Air Pollutant Emission Inventory Guidebook (July 2017);
- Potential improvements within the 'CO_2 emissions from biomass' (Memo Items) could be achieved by expanding the more efficient method of recording the biomass consumption used in the „Research on household energy consumption" developed by the NBS of the Republic of Moldova with the support of the Energy Community experts in 2015 for the remaining years 1990-2009, allowing thus, the consistency of results under this source category for the entire period under review.

Sector 2 'Industrial Processes and Product Use'

Monitoring the GHG emissions from the Sector 2 'Industrial Processes and Product Use' is planned to be improved along with:

- Updating the activity data used to estimate GHG emissions within 2A "Mineral Industry", 2D „Non-Energy Products from Fuels and Solvent Use" and 2G „Other Product Manufacture and Use" for 1990-2016 categories for 1990-2015 time series;

- Updating the activity data regarding the consumption of raw materials per ton of production, as well as the specific consumption of electrodes per ton of steel produced (category 2C1 ”Iron and Steel Production”) by the national enterprises in the Republic of Moldova;
- 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 Ozone Office and Climate Change Office more accurate AD that could potentially help reduce uncertainties in estimating GHG emissions from the 2F “Product Uses as Substitutes for ODS” category in the Republic of Moldova;
- Collecting AD on fireworks products consumption (code 3604 10 000 – signaling and anti-hailing missiles and similar, firecrackers and other pyrotechnic articles, such as code 3604 90 000 – other articles for fireworks) (SNAP 060601), to be considered additionally within category 2G “Other Product Manufacture and Use”.

Sector 3 'Agriculture'

Monitoring the GHG emissions from the Sector 3 'Agriculture' is planned to be improved along with:

- Updating AD and productivity indicators used to estimate GHG emissions within category 3A „Enteric Fermentation” following a Tier 2 methodology, in particular for cattle and sheep, the animal categories that account for the largest share in the structure of total methane emissions originated from this source category;
- Updating AD and productivity indicators used to estimate CH_4 emissions from the 3B 'Manure Management', in particular for 'cattle' and 'swine' livestock categories accounting for the largest share in the structure of total CH_4 emissions originated from this category; as well as updating the values for the main parameters used to develop CS EFs for the respective animal categories following a Tier 2 method;
- Collecting data regarding N_2O emissions from the 3B 'Manure Management' category, in particular the share of manure management systems in the livestock breeding sector (every 3 years), as well as those related to country specific N excreted rates for different categories (kg N/head/year);
- Updating activity data and country specific coefficients and parameters used to estimate direct N_2O emissions from crop residues returned to soils under the 3D 'Agriculture Soils' category;
- Updating activity data and 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;
- Updating activity data used to estimate CO_2 emissions from urea application on managed soils.

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

Monitoring the CO_2 emissions/removals from the Sector 4 'Land Use, Land-Use Change and Forestry' is planned to be improved along with:

- Improving data regarding the actual consumption of fuel wood from the managed forest land of the RM, as well as updating national emission/removal factors (basic wood density, biomass expansion factors, emission factors from forest fires etc.) (category 4A 'Forest Land');
- Improving records pertaining to actual volume of wood from forest stripes management as well as other types of forest vegetation and also activities aimed at verification of emission/removal factors specific to perennial plantations (current biomass increments, biomass harvesting during the cleaning cuttings) (source category 4B1.1 Cropland Covered with Woody Vegetation);
- Improving the country specific methodology (Banaru, 2000) and improving the quality of used activity data, in order to make possible estimation of CO_2 emissions/removals from source category 4B1.2 Annual Change in Carbon Stocks in Mineral Soils;
- Improving the cadastral records (as the main reference sources for AD) pertaining to specification of initial land use categories to which converted lands are transferred to (categories 4A 'Forest Land', 4B 'Cropland', 4C 'Grassland', 4D 'Wetlands', 4E 'Settlements' and 4F 'Other Land');

- Also, analyzing the input and output process of lands within the 4F 'Other Land' category, inclusive in terms of establishing the average conversion period;
- Improving the statistical records (as the main reference sources for AD) pertaining to wood products production/export/import from 4G 'Harvested Wood Products' category.

Sector 5 'Waste'

Monitoring the direct GHG emissions from the Sector 5 'Waste' is planned to be improved along with:

- Adopting a new approach needed to address the environmental issues in the RM, complying with the commitments under the ratified international conventions and agreements, respectively considering sustainable development, as well as the EU integration perspective;
- The need to promote statistical accounting of the generated waste and the essentially restructuration of the waste management in the Republic of Moldova taking into account international practice and EU standards in municipal solid waste management;
- Adoption of the Waste List, including hazardous waste, will contribute to improving national statistical records on waste management, to comply with the EU requirements, and will allow fulfilling the commitments under the international environmental treaties, ratified by the Republic of Moldova, and efficient reporting on consistent implementation. In this context it is planned to improve the quality of activity data pertaining to the amount of generated and disposed municipal solid waste and industrial waste;
- The modernization of legal and regulatory framework for waste management, according to the Waste Management Strategy of the Republic of Moldova for 2013-2027 years, which foresees the development of integrated municipal waste management through the harmonization of legal, institutional and regulatory framework to the EU standards, based on a regional approach (geographical position, economic development, the existence of access roads, pedological and hydrogeological conditions, population, etc.). The goal is to promote and implement selective collection in all areas both in household sector and in the production sector, as well as sorting, composting and recycling facilities; and the development of waste disposal capacity by creating 7 new SWDS (landfills) at a regional level and 2 new mechanical-biological treatment plants;
- It is deemed appropriate to transpose the Resolution of the EU Commission 2000/532/EC regarding the waste list, including hazardous waste, according to the Law on Waste no. 209 from 29.07.2016 will contribute to improving national statistical records on waste management. Thus, in the next years, the economical agents that thermally treat wastes will be required to report the data on waste management practices in an automated information system. Therefore, it will be possible to improve the quality of activity data used to estimate the emissions from the 5C "Incineration and open burning of waste" category;
- Improving the population's access to quality water supply and sanitation services, in the context of implementing the Government Decision No. 199 as of 20.03.2014 the Strategy on water supply and sanitation (2014-2028), ensuring gradual access to quality water supply and sanitation services for all in the Republic of Moldova, contributing to the improvement of health, dignity and quality of life as well as to the economic development of the country;
- To offer access to the entire population to improved sanitation systems by 2025, including up to 50 per cent to sewage systems; to increase the performance levels of collective systems of water supply, sanitation and other types; to increase the degree of implementation of good practices recognized in the field of integrated water management as well as water and sanitation supply; to decrease by 50 per cent the amount of untreated wastewater discharged as well as reduction of untreated rainwater discharged into natural receptors; to improve the sludge managements and the quality of treated wastewater from centralized sewage systems or other sanitation systems, in the context of fully implementing the Government Decision No. 1063 as of 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 sanitation systems, and a level of efficiency

for managing the collective sanitation systems as well as other systems; to ensure by 2025 effective collective sewage systems in 7 cities in the country, the application of good practices in the field of water supply management, water and sanitation management, to ensure sludge disposal or reuse from centralized collective sewage systems or other types of sewage systems;

- Regulate 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 the Government Decision No. 802 as of 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 the AD and respectively, a decrease of emissions from source category 5D "Wastewater treatment and discharge";
- Regulate the conditions for wastewater collection, treatment and discharge in the sewage system and/or in water basins, in the context of implementing the Regulation on Requirements for Wastewater Collection, Treatment and Discharge in the Sewage System and/or in Water Basins for Urban and Rural Areas, approved through the Government Decision No. 950 as of 25.11.2013; the Regulation provides for the maximum allowable limit values for pollutants in discharged water into natural water basins, which will contribute to a safe decrease of emissions within 5D "Wastewater treatment and discharge" category;
- Implementing *Regional Sectoral Plans for Water and Sanitation Supply* (Central, Southern and Northern Development Regions) by applying clearly defined regulatory, institutional and economic instruments:
  - *Regulatory instruments* - will focus on a set of normative laws (the Water Law No. 272 as of 23.12.2011[129], Law No. 303 as of 13.12.2013 on *Public Service for Water and Sanitation Supply*[130], the Regulation on Requirements for Wastewater Collection, Treatment and Discharge in the Sewage System and/or in Water Basins for Urban and Rural Areas, Government Decision No. 950 as of 25.11.2013 on the approval of the Regulation on Requirements for Wastewater Collection, Treatment and Discharge in the Sewage System and/or in Water Basins for Urban and Rural Areas[131], 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, improving thus, the quality of services within the sector);
  - *Institutional instruments* - will focus on the regionalization of services within this sector which will encourage the providers of water supply and sanitation services to group together and create 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-sanitation providers will be accompanied by tariff adjustment to ensure proper operation and maintenance of systems, for expanding the services to new users. Currently, it entered into force the Action Plan for 2018-2028 on the regionalization of water supply and sanitation services[132], 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 actions to establish regional operators and, implicitly, to delegate the water supply and sewage systems management to the Agency, which represents 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

[129] Water Law No. 272 as of 23.12.2011 approved by the Parliament of the RM, published on the 26.04.2012 in the Official Monitor No. 81, article No.: 264, date of entry into force: 26.10.2013, <http://lex.justice.md/md/342978/>.

[130] Law No. 303 as of 13.12.2013 on Public Service for Water and Sanitation Supply, published on the 4.03.2014 in the Official Monitor No. 60-65, article No: 123, date of entry into force: 14.09.2014, changed LP19 as of 22.02.18, OM84-93/16.03.18 article 175; date of entry into force 16.03.18, LP185 as of 21.09.17, OM371-382/27.10.17 article.632; date of entry into force 27.10.17, HCC28 as of 11.10.16, OM459-471/23.12.16 article 109; date of entry into force 11.10.16, HCC30 as of 01.11.16, MO478-490/30.12.16 article 111; date of entry into force 01.11.16, <http://lex.justice.md/index.php?action=view&view=doc&lang=1&id=352073>

[131] Government Decision No. 950 as of 25.11.2013 on the approval of the Regulation on Requirements for Wastewater Collection, Treatment and Discharge in the Sewage System and/or in Water Basins for Urban and Rural Areas, published: 06.12.2013 in the Official Monitor No. 284-289, article No: 1061, changed through GD722 as of 08.06.16, MO163-168/17.06.16 article 793, <http://lex.justice.md/md/350537/>.

[132] <http://particip.gov.md/proiectview.php?l=ro&idd=4693>.

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 sewage systems services 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 municipality; South-West Operator – Leova, Cimislia, Causeni, Stefan-Voda, Cantemir and Cahul districts; ATU Gagauzia Operator;

  - *Economic instruments* - will focus on the concept of "sustainable recovery of cost services" with three main characteristics: an appropriate combination of tariffs, taxes and transfers to finance recurrent and capital costs and to boost other forms of funding; the predictability of public subsidies in order to facilitate investments (planning); tariff policies to make services accessible to all, including to the poorest citizens, while, at the same time, ensuring the sustainability of service providers.

- Planning the actions to achieve the harmonization of nation legislation on water with the EU Directives, represents a strong instrument enhancing the implementation of best practices, of wastewater and sludge handling technologies, which would allow capturing and sustainable using of methane emissions from sludge platforms (including for heat and electric power production);
- For the next inventory cycle, in order to estimate CH_4 emissions, it is planned also to use country-specific information on BOD_5 values in wastewater; on the fraction of BOD removed with the sludge, maximum methane producing capacity, methane correction factor and other relevant parameters within the 5D "Wastewater treatment and discharge" category.

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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 the identification of key categories of emissions and removals. The intent is to help inventory agencies prioritize their efforts to improve overall estimates. 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 conducted for the Republic of Moldova's inventory covering the 1990-2016 periods. 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 guidelines:

- 2006 IPCC categories should be used with emissions specified in CO_2 equivalent units according to standard GWPs (IPCC AR4, 2013);
- A category should be identified for each gas emitted by the source, since the methods, emission factors, and related uncertainties differ for each gas;
- Source categories that use the same emission factors based on common assumptions should be aggregated before analysis.

The analysis of key source and sink categories proceeds according to the Tier 1 approach of 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 the emission contribution that each category makes to the national total. The second perspective analyses the trend of emission contributions from each category to identify where the greatest absolute changes (either increases or reductions) have taken place over a given time. The per cent 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 has determined that a cumulative contribution threshold of 95 per cent for both level and trend assessments is a reasonable approximation of 90 per cent uncertainty for Tier 1 method of determining key categories. The 95 per cent cumulative contribution threshold has been used in this analysis to define an upper boundary for key category identification. Therefore, when source and/or sink contributions are sorted in decreasing order of importance, those that contribute to 95 per cent of the cumulative total are considered quantitatively to be key.

When using a Tier 1 approach, level contribution of each source is calculated according to Equation A1-1.1 (Equation 4.1 from 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:

$L_{x,t}$ = the level assessment for source or sink x in latest inventory year t

$|E_{x,t}|$ = absolute value of emission or removal estimate (CO_2 eq.) of source or sink category x in year t;

$\Sigma |E_{y,t}|$ = 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 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 from the 2006 IPCC Guidelines, Volume 1, Chapter 4.3.1):

Equation A1-1.2:

$$\mathbf{T_{x,t} = |E_{x,0}| / \Sigma |E_{y,0}| \bullet |[(E_{x,t} - E_{x,0})/E_{x,0}] - [(\Sigma E_{y,t} - \Sigma E_{y,0}) / |\Sigma E_{y,0}|]|}$$

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;

$E_{x,t}$ și $E_{x,0}$ = real values of estimates of source or sink category *x* in years *t* and respectively 0;

$\Sigma E_{y,t}$ și $\Sigma E_{y,0}$ = total inventory estimates in years *t* and respectively 0.

Equation A1-1.3 describes the Tier 2 Approach level assessment including uncertainty (Equation 4.4 from the 2006 IPCC Guidelines, Volume 1, Chapter 4.3.2):

Equation A1-1.3:

$$\mathbf{LU_{x,t} = (L_{x,t} \bullet U_{x,t}) / \Sigma [(L_{y,t} \bullet U_{y,t})]}$$

Where:

$LU_{x,t}$ = level assessment for category *x* in latest inventory year (year *t*) with uncertainty;

$L_{x,t}$ = the level assessment for source or sink x in latest inventory year t ;

$U_{x,t}$ = category percentage uncertainty in year *t* calculated as described in the 2006 IPCC Guidelines, Volume 1, Chapter 3 (and reported in Column G in Table 3.3); to be noted, if the uncertainty reported in Table 3.3 is asymmetrical, the larger uncertainty should be used; the relative uncertainty will always have a positive sign.

When using a Tier 2 approach (considering GHG emissions uncertainty), a cumulative contribution threshold of 90 per cent of the sum of all $LU_{x,t}$ was used in this analysis in order to define the limits in identifying the key categories. Thus, when $LU_{x,t}$ contributions are sorted in decreasing order of importance, those that contribute to 90 per cent of the cumulative total are considered quantitatively to be key.

Trend contribution of each source is calculated according to Equation A1-1.4 (Equation 4.5 from the 2006 IPCC Guidelines, Volume 1, Chapter 4.3.2):

Equation A1-1.4:

$$\mathbf{TU_{x,t} = (T_{x,t} \bullet U_{x,t})}$$

Where:

$TU_{x,t}$ = trend assessment for category *x* in latest inventory year *t* with uncertainty;

$T_{x,t}$ = trend assessment of source or sink category *x* in year *t* compared to the base year (year 0) computed as in Equation 4.2 from the 2006 IPCC Guidelines, Volume 1, Chapter 4.3.1;

$U_{x,t}$ = category percentage uncertainty in year *t* calculated as described in the 2006 IPCC Guidelines, Volume 1, Chapter 3 (and reported in Column G in Table 3.3); the relative uncertainty will always have a positive sign.

When using a Tier 2 approach (considering GHG emissions uncertainty), a cumulative contribution threshold of 90 per cent 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 are sorted in decreasing order of importance, those that contribute to 90 per cent of the cumulative total are considered quantitatively to be key.

The key category analysis was performed using the Key Categories 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. The Results of Key Category Analysis, following the Tier 1 and Tier 2 methodologic approach, without LULUCF

1990 Year Level Assessment

Key Categories from Tier 1 Base Year Level Assessment	Base Year Emissions Estimate (Gg CO_2 Eq.)	Level assessment	Cumulative Sum (%)
1A1 - Fuel Combustion Activities - Energy Industries - CO2	21 244.31	0.47	47.3%
1A4 - Fuel Combustion Activities - Other Sectors - CO2	7 372.26	0.16	63.7%
1A3b - Fuel Combustion Activities - Transport - Road transportation - CO2	3 826.36	0.09	72.2%
1A2 - Fuel Combustion Activities - Manufacturing Industries and Construction - CO2	2 204.85	0.05	77.1%
3A - Enteric Fermentation - CH4	2 190.69	0.05	82.0%
3Da - Direct N2O Emissions from Managed Soils - N2O	1 077.18	0.02	84.4%
5A - Solid Waste Disposal - CH4	1 046.73	0.02	86.7%
2A1 - Mineral industry - Cement Production - CO2	971.70	0.02	88.9%
3Ba - Manure Management - N2O	871.91	0.02	90.8%
1B2 - Fugitive Emissions from Fuels - Oil and Natural Gas - CH4	640.63	0.01	92.3%
3B - Manure Management - CH4	495.10	0.01	93.4%
1A3c - Fuel Combustion Activities - Transport - Railways - CO2	403.48	0.01	94.3%
3Db - Indirect N2O Emissions from Managed Soils - N2O	340.41	0.01	95.0%

2016 Year Level Assessment

Key Categories from Tier 1 Current Year Level Assessment	Current Year Emissions Estimate (Gg CO_2 Eq.)	Level assessment	Cumulative Sum (%)
1A1 - Fuel Combustion Activities - Energy Industries - CO2	4 518.97	0.31	31.0%
1A3b - Fuel Combustion Activities - Transport - Road transportation - CO2	2 271.25	0.16	46.6%
1A4 - Fuel Combustion Activities - Other Sectors - CO2	1 677.57	0.12	58.1%
5A - Solid Waste Disposal - CH4	1 115.17	0.08	65.7%
3Da - Direct N2O Emissions from Managed Soils - N2O	1 050.50	0.07	72.9%
3A - Enteric Fermentation - CH4	649.27	0.04	77.4%
1B2 - Fugitive Emissions from Fuels - Oil and Natural Gas - CH4	611.09	0.04	81.6%
1A2 - Fuel Combustion Activities - Manufacturing Industries and Construction - CO2	500.70	0.03	85.0%
2A1 - Mineral industry - Cement Production - CO2	433.90	0.03	88.0%
3Ba - Manure Management - N2O	308.06	0.02	90.1%
3Db - Indirect N2O Emissions from Managed Soils - N2O	275.35	0.02	92.0%
5D - Wastewater Treatment and Discharge: Domestic - CH4	215.67	0.01	93.5%
1A4 - Fuel Combustion Activities - Other Sectors - CH4	116.73	0.01	94.3%
2F2 - Product Uses as Substitutes for ODS - Foam Blowing Agents - HFCs	104.82	0.01	95.0%

Tier 1 Trend Assessment

Key Categories from Tier 1 Trend Assessment	Current Year Emissions Estimate (Gg CO_2 Eq.)	Trend assessment	Cumulative Sum (%)
1A1 - Fuel Combustion Activities - Energy Industries - CO2	4 518.97	0.05	32.0%
1A3b - Fuel Combustion Activities - Transport - Road transportation - CO2	2 271.25	0.02	45.8%
5A - Solid Waste Disposal - CH4	1 115.17	0.02	56.2%
1A4 - Fuel Combustion Activities - Other Sectors - CO2	1 677.57	0.02	65.9%
3Da - Direct N2O Emissions from Managed Soils - N2O	1 050.50	0.02	75.3%
1B2 - Fugitive Emissions from Fuels - Oil and Natural Gas - CH4	611.09	0.01	80.7%
1A2 - Fuel Combustion Activities - Manufacturing Industries and Construction - CO2	500.70	0.00	83.6%
3Db - Indirect N2O Emissions from Managed Soils - N2O	275.35	0.00	85.8%
5D - Wastewater Treatment and Discharge: Domestic - CH4	215.67	0.00	87.7%
2A1 - Mineral industry - Cement Production - CO2	433.90	0.00	89.3%
2F2 - Product Uses as Substitutes for ODS - Foam Blowing Agents - HFCs	104.82	0.00	90.7%
3B - Manure Management - CH4	68.34	0.00	92.0%
1A3c - Fuel Combustion Activities - Transport - Railways - CO2	45.48	0.00	93.1%
2F1 - Product Uses as Substitutes for ODS - Refrigeration and Air Conditioning - HFCs	70.76	0.00	94.1%
3A - Enteric Fermentation - CH4	649.27	0.00	94.9%
2A2 - Mineral Industry - Lime Production - CO2	21.58	0.00	95.6%

Tier 2 1990 Year Level Assessment

Key Categories from Tier 2 Base Year Level Assessment	Base Year Emissions Estimate (Gg CO_2 Eq.)	Relative level assessment with uncertainty	Cumulative Sum (%)
1A1 - Fuel Combustion Activities - Energy Industries - CO2	21 244.31	0.22	22.2%
3Ba - Manure Management - N2O	871.91	0.13	35.7%
3Db - Indirect N2O Emissions from Managed Soils - N2O	340.41	0.08	44.0%
5A - Solid Waste Disposal - CH4	1 046.73	0.08	51.8%
1A4 - Fuel Combustion Activities - Other Sectors - CO2	7 372.26	0.08	59.5%
3A - Enteric Fermentation - CH4	2 190.69	0.07	66.7%
3Bb - Indirect N2O Emissions from Manure Management - N2O	244.71	0.06	72.3%
3Da - Direct N2O Emissions from Managed Soils - N2O	1 077.18	0.04	76.3%
1A3b - Fuel Combustion Activities - Transport - Road transportation - CO2	3 826.36	0.04	80.3%
1B2 - Fugitive Emissions from Fuels - Oil and Natural Gas - CH4	640.63	0.03	83.7%
3B - Manure Management - CH4	495.10	0.02	86.0%
1A2 - Fuel Combustion Activities - Manufacturing Industries and Construction - CO2	2 204.85	0.02	88.3%
1A4 - Fuel Combustion Activities - Other Sectors - CH4	289.60	0.02	90.5%

Tier 2 2016 Year Level Assessment

Key Categories from Tier 2 Current Year Level Assessment	Current Year Emissions Estimate (Gg CO_2 Eq.)	Relative level assessment with uncertainty	Cumulative Sum (%)
5A - Solid Waste Disposal - CH4	1 115.17	0.18	17.5%
3Db - Indirect N2O Emissions from Managed Soils - N2O	275.35	0.14	31.8%
3Ba - Manure Management - N2O	308.06	0.10	42.0%
1A1 - Fuel Combustion Activities - Energy Industries - CO2	4 518.97	0.10	52.0%
3Da - Direct N2O Emissions from Managed Soils - N2O	1 050.50	0.08	60.4%
1B2 - Fugitive Emissions from Fuels - Oil and Natural Gas - CH4	611.09	0.07	67.2%
1A3b - Fuel Combustion Activities - Transport - Road transportation - CO2	2 271.25	0.05	72.3%
3A - Enteric Fermentation - CH4	649.27	0.05	76.8%
1A4 - Fuel Combustion Activities - Other Sectors - CO2	1 677.57	0.04	80.5%
5D - Wastewater Treatment and Discharge: Domestic - CH4	215.67	0.03	83.9%
3Bb - Indirect N2O Emissions from Manure Management - N2O	64.66	0.03	87.0%
1A4 - Fuel Combustion Activities - Other Sectors - CH4	116.73	0.02	88.9%
2F2 - Product Uses as Substitutes for ODS - Foam Blowing Agents - HFCs	104.82	0.01	90.3%

Tier 2 Trend Assessment

Key Categories from Tier 2 Trend Assessment	Current Year Emissions Estimate (Gg CO_2 Eq.)	Relative Trend assessment with uncertainty	Cumulative Sum (%)
5A - Solid Waste Disposal - CH4	1 115.17	0.23	23.4%
3Db - Indirect N2O Emissions from Managed Soils - N2O	275.35	0.16	39.9%
3Da - Direct N2O Emissions from Managed Soils - N2O	1 050.50	0.11	50.7%
1A1 - Fuel Combustion Activities - Energy Industries - CO2	4 518.97	0.10	60.9%
1B2 - Fugitive Emissions from Fuels - Oil and Natural Gas - CH4	611.09	0.09	69.5%
1A3b - Fuel Combustion Activities - Transport - Road transportation - CO2	2 271.25	0.04	73.9%
5D - Wastewater Treatment and Discharge: Domestic - CH4	215.67	0.04	78.1%
1A4 - Fuel Combustion Activities - Other Sectors - CO2	1 677.57	0.03	81.2%
2F2 - Product Uses as Substitutes for ODS - Foam Blowing Agents - HFCs	104.82	0.03	83.9%
2F1 - Product Uses as Substitutes for ODS - Refrigeration and Air Conditioning - HFCs	70.76	0.02	86.2%
3B - Manure Management - CH4	68.34	0.02	87.9%
3Ba - Manure Management - N2O	308.06	0.02	89.5%
5D - Wastewater Treatment and Discharge - N2O	68.27	0.01	90.9%

Key Category Summary Table

Key Categories Summary Table based on the Results of the Level and Trend Assessments
1A1 - Fuel Combustion Activities - Energy Industries - CO2
1A2 - Fuel Combustion Activities - Manufacturing Industries and Construction - CO2
1A3b - Fuel Combustion Activities - Transport - Road transportation - CO2
1A3c - Fuel Combustion Activities - Transport - Railways - CO2
1A4 - Fuel Combustion Activities - Other Sectors - CO2
1A4 - Fuel Combustion Activities - Other Sectors - CH4
1B2 - Fugitive Emissions from Fuels - Oil and Natural Gas - CH4
2A1 - Mineral industry - Cement Production - CO2
2A2 - Mineral Industry - Lime Production - CO2
2F1 - Product Uses as Substitutes for ODS - Refrigeration and Air Conditioning - HFCs
2F2 - Product Uses as Substitutes for ODS - Foam Blowing Agents - HFCs
3A - Enteric Fermentation - CH4
3B - Manure Management - CH4
3Ba - Manure Management - N2O
3Bb - Indirect N2O Emissions from Manure Management - N2O
3Da - Direct N2O Emissions from Managed Soils - N2O
3Db - Indirect N2O Emissions from Managed Soils - N2O
5A - Solid Waste Disposal - CH4
5D - Wastewater Treatment and Discharge - N2O
5D - Wastewater Treatment and Discharge: Domestic - CH4

Annex 1-3. The Results of Key Category Analysis, following the Tier 1 and Tier 2 methodologic approach, with LULUCF

1990 Year Level Assessment

Key Categories from Tier 1 Base Year Level Assessment	Base Year Emissions Estimate (Gg CO_2 Eq.)	Level assessment	Cumulative Sum (%)
1A1 - Fuel Combustion Activities - Energy Industries - CO2	21 244.3119	0.40	40.5%
1A4 - Fuel Combustion Activities - Other Sectors - CO2	7 372.2624	0.14	54.5%
1A3b - Fuel Combustion Activities - Transport - Road transportation - CO2	3 826.3625	0.07	61.8%
4B1 - Cropland Remaining Cropland (Emissions) - CO2	2 602.9804	0.05	66.8%
1A2 - Fuel Combustion Activities - Manufacturing Industries and Construction - CO2	2 204.8457	0.04	71.0%
3A - Enteric Fermentation - CH4	2 190.6944	0.04	75.2%
4A1 - Forest Land Remaining Forest Land (Removals) - CO2	-1 579.0396	0.03	78.2%
4C2 - Land Converted to Grassland (Removals) - CO2	-1 205.6938	0.02	80.5%
3Da - Direct N2O Emissions from Managed Soils - N2O	1 077.1750	0.02	82.5%
5A - Solid Waste Disposal - CH4	1 046.7277	0.02	84.5%
4A2 - Land Converted to Forest Land (Removals) - CO2	-984.3932	0.02	86.4%
2A1 - Mineral industry - Cement Production - CO2	971.6967	0.02	88.2%
3Ba - Manure Management - N2O	871.9076	0.02	89.9%
1B2 - Fugitive Emissions from Fuels - Oil and Natural Gas - CH4	640.6250	0.01	91.1%
4D2 - Land Converted to Wetlands (Removals) - CO2	-555.3798	0.01	92.2%
3B - Manure Management - CH4	495.0955	0.01	93.1%
1A3c - Fuel Combustion Activities - Transport - Railways - CO2	403.4834	0.01	93.9%
3Db - Indirect N2O Emissions from Managed Soils - N2O	340.4092	0.01	94.6%
1A4 - Fuel Combustion Activities - Other Sectors - CH4	289.6015	0.01	95.1%

2016 Year Level Assessment

Key Categories from Tier 1 Current Year Level Assessment	Current Year Emissions Estimate (Gg CO_2 Eq.)	Level assessment	Cumulative Sum (%)
1A1 - Fuel Combustion Activities - Energy Industries - CO2	4 518.9699	0.23	23.0%
1A3b - Fuel Combustion Activities - Transport - Road transportation - CO2	2 271.2546	0.12	34.6%
4B1 - Cropland Remaining Cropland (Emissions) - CO2	1 775.4060	0.09	43.7%
1A4 - Fuel Combustion Activities - Other Sectors - CO2	1 677.5744	0.09	52.2%
4A1 - Forest Land Remaining Forest Land (Removals) - CO2	-1 451.3266	0.07	59.6%
5A - Solid Waste Disposal - CH4	1 115.1732	0.06	65.3%
3Da - Direct N2O Emissions from Managed Soils - N2O	1 050.5045	0.05	70.6%
4A2 - Land Converted to Forest Land (Removals) - CO2	-662.2202	0.03	74.0%
3A - Enteric Fermentation - CH4	649.2698	0.03	77.3%

Key Categories from Tier 1 Current Year Level Assessment	Current Year Emissions Estimate (Gg CO_2 Eq.)	Level assessment	Cumulative Sum (%)
1B2 - Fugitive Emissions from Fuels - Oil and Natural Gas - CH4	611.0903	0.03	80.4%
1A2 - Fuel Combustion Activities - Manufacturing Industries and Construction - CO2	500.7010	0.03	83.0%
2A1 - Mineral industry - Cement Production - CO2	433.9022	0.02	85.2%
4C2 - Land Converted to Grassland (Removals) - CO2	-402.3693	0.02	87.3%
4B2 - Land Converted to Cropland (Removals) - CO2	-382.1704	0.02	89.2%
3Ba - Manure Management - N2O	308.0594	0.02	90.8%
3Db - Indirect N2O Emissions from Managed Soils - N2O	275.3538	0.01	92.2%
5D - Wastewater Treatment and Discharge: Domestic - CH4	215.6716	0.01	93.3%
4E2 - Land Converted to Settlements - N2O	178.2795	0.01	94.2%
1A4 - Fuel Combustion Activities - Other Sectors - CH4	116.7297	0.01	94.8%
2F2 - Product Uses as Substitutes for ODS - Foam Blowing Agents - HFCs	104.8218	0.01	95.3%

Tier 1 Trend Assessment

Key Categories from Tier 1 Trend Assessment	Current Year Emissions Estimate (Gg CO_2 Eq.)	Trend assessment	Cumulative Sum (%)
1A1 - Fuel Combustion Activities - Energy Industries - CO2	4 518.9699	0.04	16.1%
4C2 - Land Converted to Grassland (Removals) - CO2	-402.3693	0.03	28.3%
4A1 - Forest Land Remaining Forest Land (Removals) - CO2	-1 451.3266	0.02	37.3%
1A3b - Fuel Combustion Activities - Transport - Road transportation - CO2	2 271.2546	0.02	45.2%
4A2 - Land Converted to Forest Land (Removals) - CO2	-662.2202	0.02	52.6%
4B1 - Cropland Remaining Cropland (Emissions) - CO2	1 775.4060	0.02	59.7%
4D2 - Land Converted to Wetlands (Removals) - CO2	-82.7917	0.02	66.1%
5A - Solid Waste Disposal - CH4	1 115.1732	0.01	71.9%
3Da - Direct N2O Emissions from Managed Soils - N2O	1 050.5045	0.01	77.2%
1A4 - Fuel Combustion Activities - Other Sectors - CO2	1 677.5744	0.01	82.0%
1B2 - Fugitive Emissions from Fuels - Oil and Natural Gas - CH4	611.0903	0.01	85.0%
4B2 - Land Converted to Cropland (Removals) - CO2	-382.1704	0.00	86.7%
4G - Harvested Wood Products - CO2	0.8816	0.00	88.2%
1A2 - Fuel Combustion Activities - Manufacturing Industries and Construction - CO2	500.7010	0.00	89.7%
3Db - Indirect N2O Emissions from Managed Soils - N2O	275.3538	0.00	90.9%
5D - Wastewater Treatment and Discharge: Domestic - CH4	215.6716	0.00	92.0%
2A1 - Mineral industry - Cement Production - CO2	433.9022	0.00	92.9%
4E2 - Land Converted to Settlements (Emissions) - N2O	178.2795	0.00	93.9%
2F2 - Product Uses as Substitutes for ODS - Foam Blowing Agents - HFCs	104.8218	0.00	94.7%
3B - Manure Management - CH4	68.3414	0.00	95.3%

Tier 2 1990 Year Level Assessment

Key Categories from Tier 2 Base Year Level Assessment	Base Year Emissions Estimate (Gg CO_2 Eq.)	Relative level assessment with uncertainty	Cumulative Sum (%)
1A1 - Fuel Combustion Activities - Energy Industries - CO2	21 244.3119	0.19	18.8%
3Ba - Manure Management - N2O	871.9076	0.11	30.3%
3Db - Indirect N2O Emissions from Managed Soils - N2O	340.4092	0.07	37.3%
5A - Solid Waste Disposal - CH4	1 046.7277	0.07	43.9%
1A4 - Fuel Combustion Activities - Other Sectors - CO2	7 372.2624	0.07	50.4%
3A - Enteric Fermentation - CH4	2 190.6944	0.06	56.6%
3Bb - Indirect N2O Emissions from Manure Management - N2O	244.7103	0.05	61.3%
4B1 - Cropland Remaining Cropland (Emissions) - CO2	2 602.9804	0.05	65.9%
3Da - Direct N2O Emissions from Managed Soils - N2O	1 077.1750	0.03	69.3%
1A3b - Fuel Combustion Activities - Transport - Road transportation - CO2	3 826.3625	0.03	72.7%
4A1 - Forest Land Remaining Forest Land (Removals) - CO2	-1 579.0396	0.03	75.9%
1B2 - Fugitive Emissions from Fuels - Oil and Natural Gas - CH4	640.6250	0.03	78.7%
4C2 - Land Converted to Grassland (Removals) - CO2	-1 205.6938	0.03	81.4%
3B - Manure Management - CH4	495.0955	0.02	83.4%
1A2 - Fuel Combustion Activities - Manufacturing Industries and Construction - CO2	2 204.8457	0.02	85.4%
4A2 - Land Converted to Forest Land (Removals) - CO2	-984.3932	0.02	87.3%
1A4 - Fuel Combustion Activities - Other Sectors - CH4	289.6015	0.02	89.1%
5D - Wastewater Treatment and Discharge: Domestic - CH4	234.0455	0.01	90.6%

Tier 2 2016 Year Level Assessment

Key Categories from Tier 2 Current Year Level Assessment	Current Year Emissions Estimate (Gg CO_2 Eq.)	Relative level assessment with uncertainty	Cumulative Sum (%)
5A - Solid Waste Disposal - CH4	1 115.1732	0.14	14.0%
3Db - Indirect N2O Emissions from Managed Soils - N2O	275.3538	0.11	25.5%
3Ba - Manure Management - N2O	308.0594	0.08	33.6%
1A1 - Fuel Combustion Activities - Energy Industries - CO2	4 518.9699	0.08	41.6%
3Da - Direct N2O Emissions from Managed Soils - N2O	1 050.5045	0.07	48.3%
4B1 - Cropland Remaining Cropland (Emissions) - CO2	1 775.4060	0.06	54.6%
4A1 - Forest Land Remaining Forest Land (Removals) - CO2	-1 451.3266	0.06	60.4%
1B2 - Fugitive Emissions from Fuels - Oil and Natural Gas - CH4	611.0903	0.05	65.8%
1A3b - Fuel Combustion Activities - Transport - Road transportation - CO2	2 271.2546	0.04	69.9%
3A - Enteric Fermentation - CH4	649.2698	0.04	73.5%
1A4 - Fuel Combustion Activities - Other Sectors - CO2	1 677.5744	0.03	76.5%
5D - Wastewater Treatment and Discharge: Domestic - CH4	215.6716	0.03	79.2%
4A2 - Land Converted to Forest Land (Removals) - CO2	-662.2202	0.03	81.9%
3Bb - Indirect N2O Emissions from Manure Management - N2O	64.6604	0.02	84.3%
4C2 - Land Converted to Grassland (Removals) - CO2	-402.3693	0.02	86.2%
1A4 - Fuel Combustion Activities - Other Sectors - CH4	116.7297	0.01	87.6%
4E2 - Land Converted to Settlements (Emissions) - N2O	178.2795	0.01	89.1%
4B2 - Land Converted to Cropland (Removals) - CO2	-382.1704	0.01	90.4%

Tier 2 Trend Assessment

Key Categories from Tier 2 Trend Assessment	Current Year Emissions Estimate (Gg CO_2 Eq.)	Relative Trend assessment with uncertainty	Cumulative Sum (%)
5A - Solid Waste Disposal - CH4	1 115.1732	0.15	14.6%
4C2 - Land Converted to Grassland (Removals) - CO2	-402.3693	0.11	25.5%
3Db - Indirect N2O Emissions from Managed Soils - N2O	275.3538	0.10	35.8%
4A1 - Forest Land Remaining Forest Land (Removals) - CO2	-1 451.3266	0.07	42.9%
3Da - Direct N2O Emissions from Managed Soils - N2O	1 050.5045	0.07	49.6%
4A2 - Land Converted to Forest Land (Removals) - CO2	-662.2202	0.06	55.4%
1A1 - Fuel Combustion Activities - Energy Industries - CO2	4 518.9699	0.06	61.1%
1B2 - Fugitive Emissions from Fuels - Oil and Natural Gas - CH4	611.0903	0.05	66.5%
4B1 - Cropland Remaining Cropland (Emissions) - CO2	1 775.4060	0.05	71.5%
4D2 - Land Converted to Wetlands (Removals) - CO2	-82.7917	0.04	76.0%
1A3b - Fuel Combustion Activities - Transport - Road transportation - CO2	2 271.2546	0.03	78.8%
5D - Wastewater Treatment and Discharge: Domestic - CH4	215.6716	0.03	81.4%
4G - Harvested Wood Products - CO2	0.8816	0.02	83.8%
1A4 - Fuel Combustion Activities - Other Sectors - CO2	1 677.5744	0.02	85.5%
2F2 - Product Uses as Substitutes for ODS - Foam Blowing Agents - HFCs	104.8218	0.02	87.2%
4E2 - Land Converted to Settlements (Emissions) - N2O	178.2795	0.02	88.7%
2F1 - Product Uses as Substitutes for ODS - Refrigeration and Air Conditioning - HFCs	70.7568	0.01	90.1%

Key Category Summary Table

Key Categories Summary Table based on the Results of the Level and Trend Assessments
1A1 - Fuel Combustion Activities - Energy Industries - CO2
1A2 - Fuel Combustion Activities - Manufacturing Industries and Construction - CO2
1A3b - Fuel Combustion Activities - Transport - Road transportation - CO2
1A3c - Fuel Combustion Activities - Transport - Railways - CO2
1A4 - Fuel Combustion Activities - Other Sectors - CH4
1A4 - Fuel Combustion Activities - Other Sectors - CO2
1B2 - Fugitive Emissions from Fuels - Oil and Natural Gas - CH4
2A1 - Mineral industry - Cement Production - CO2
2F1 - Product Uses as Substitutes for ODS - Refrigeration and Air Conditioning - HFCs
2F2 - Product Uses as Substitutes for ODS - Foam Blowing Agents - HFCs
3A - Enteric Fermentation - CH4
3B - Manure Management - CH4
3Ba - Manure Management - N2O

Key Categories Summary Table based on the Results of the Level and Trend Assessments
3Bb - Indirect N2O Emissions from Manure Management - N2O
3Da - Direct N2O Emissions from Managed Soils - N2O
3Db - Indirect N2O Emissions from Managed Soils - N2O
4A1 - Forest Land Remaining Forest Land (Removals) - CO2
4A2 - Land Converted to Forest Land (Removals) - CO2
4B1 - Cropland Remaining Cropland (Emissions) - CO2
4B2 - Land Converted to Cropland (Removals) - CO2
4C2 - Land Converted to Grassland (Removals) - CO2
4D2 - Land Converted to Wetlands (Removals) - CO2
4E2 - Land Converted to Settlements (Emissions) - N2O
4G - Harvested Wood Products - CO2
5A - Solid Waste Disposal - CH4
5D - Wastewater Treatment and Discharge: Domestic - CH4

Annex 2. Energy Balances of the Republic of Moldova for 2016 (in natural units) (without ATULBD)

SUPPLY AND CONSUMPTION	Coal, including														Peat and peat products, kt	Shale, kt	Natural gas, thousand 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, gas from generator and similar gas, except for the gas from wells, and other gaseous hidrocarbons, thousandm³	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																	0
Inputs from other sources																	
Import	60	0	31			0				0				8	0		1038
Export																	
Stock variation	-21		-5	0		0		0						0			2
Stock at the start of the year	58		21	0		0		0						0	0		15
Stock at the end of the year	37		16	0		0		0		0				0	0		17
Gross domestic consumption calculated	**81**	**0**	**36**	**0**		**0**		**0**						**8**	**0**		**1036**
Real gross domestic consumption	**81**	**0**	**36**	**0**		**0**		**0**						**8**	**0**		**1036**
TRANSFORMATION, INPUTS	**3**		**1**														**457**
Power Plants																	0
Combined Heat Plants – Public energy producers																	346
Combined Heat Plants – Autoproducers																	14
Heat Plants – Public energy producers																	54
Heat Plants – Autoproducers	3		1														43
Oil Refineries																	
Petrochemical plants																	
Liquefaction plants																	
Charcoal production plants																	
Other transformation installations																	
TRANSFORMATION, OUTPUT																	
Power Plants																	
Combined Heat Plants – Public energy producers																	
Combined Heat Plants – Autoproducers																	
Heat Plants – Public energy producers																	
Heat Plants – Autoproducers																	
Oil Refineries																	
Petrochemical plants																	
Liquefaction plants																	
Charcoal production plants																	
Other transformation installations																	
Energy used for other purposes																	**0**
Oil Refineries																	
Petrochemical Plants																	0

SUPPLY AND CONSUMPTION	Coal, including														Peat and peat products, kt	Shale, kt	Natural gas, thousand 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, gas from generator and similar gas, except for the gas from wells, and other gaseous hidrocarbons, thousandm³	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
Power, Heat and Electrical Plants																	0
Pumping Storage Plants																	
Unspecified elsewhere																	0
Losses																	**62**
FINAL CONSUMPTION	**78**	**0**	**35**	**0**		**0**		**0**						**8**	**0**		**517**
FINAL ENERGY CONSUMPTION	**78**	**0**	**35**	**0**		**0**		**0**						**8**	**0**		**517**
INDUSTRY	**2**		**33**			**0**		**0**						**6**			**74**
Mining																	
Food Processing, Beverages and Tobacco	2					0											27
Textiles and leather industry																	1
Wood Processing, manufacture of wood and cork products, except furniture; manufacture of straw products and from other vegetal plaiting materials																	0
Printing and reproduction of recorded media																	1
Chemical and petrochemical industry (including the pharmaceutical industry)														0			1
Non-metallic minerals	0		33											6			41
Metal industry																	0
Car engineering industry								0						0			0
Production of trailers, semitrailers and other transport means																	0
Other industries n.c.a.																	2
For construction																	1
TRANSPORT																	**32**
Railways																	
Terrestrial passenger and cargo transport by autovehicles																	24
Pipeline transportation																	8
Navigation																	
Aviation																	
Other supplementary activities for transport																	
Other	**76**	**0**	**2**	**0**										**2**	**0**		**411**
Agriculture/Forestry/Fishing	1																3
Commercial/Institutional	1		0	0													12
For communal services	25		2	0										2	0		104
Residential	49	0	0	0						0							292
Not specified elsewhere																	
CONSUMED FOR NON-ENERGY PURPOSES														0			
Statistical differences																	

SUPPLY AND CONSUMPTION	Oil Products, including																					
	Oil, kt	Other gaseous hidro-carbons (ethylene, propylene, butylene, butadiene and other), thousand m3 stand.**	Raw materials for refineries, kt	Additives and oxyge-nated compounds, kt	Other hidrocarbons, kt	Gas from wells, thou-sand m3	Ethane, million m3	Liquefied (petroleum) gases, kt	Naphta, kt	Aviation gasoline, kt	Gasoline, kt	Gasoline for jet engi-nes, kt	Kerosen pentru motoare reactive, mii tone	Other kerosene gas, kt	Diesel oil,, kt	Residual fuel oil, kt	White-spirit Petro-leum, 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					0			77		0	166		33	0	555	29	0	9	0	1	29	0
Export					0						0				7	9		0			0	0
Stock variation	-1			0	0			-1	0	0	-1		1	0	6	16		0	0	-3	0	0
Stock at the start of the year	1			0	0			7	0	0	18		2	0	54	28	0	3	0	9	2	0
Stock at the end of the year	0			0	0			6		0	17		3	0	60	44	0	3	0	6	2	0
Gross domestic consumption calculated	**7**			**0**	**0**			**78**	**0**	**0**	**167**		**32**	**0**	**542**	**4**	**0**	**9**	**0**	**4**	**29**	**0**
Real gross domestic consumption	**7**			**0**	**0**			**78**	**0**	**0**	**167**		**32**	**0**	**542**	**4**	**0**	**9**	**0**	**4**	**29**	**0**
TRANSFORMATION, INPUTS	**7**			**0**	**0**					**0**	**0**				**6**	**15**		**0**				**1**
Power Plants										0	0				0							0
Combined Heat Plants – Public energy producers																						
Combined Heat Plants – Autoproducers																11						
Heat Plants – Public energy producers																						
Heat Plants – Autoproduceres															0	1						0
Oil Refineries																						
Petrochemical plants	7			0	0					0	0				6	3		0				1
Liquefaction plants																						
Charcoal production plants																						
Other transformation installations																						
TRANSFORMATION, OUTPUT											0				2	13						1
Power Plants																						
Combined Heat Plants – Public energy producers																						
Combined Heat Plants – Autoproducers																						
Heat Plants – Public energy producers																						
Heat Plants – Autoproducers																						
Oil Refineries																						
Petrochemical plants											0				2	13						1
Liquefaction plants																						
Charcoal production plants																						
Other transformation installations																						
Energy used for other purposes																**0**						
Oil Refineries																						
Petrochemical Plants																0						
Power, Heat and Electrical Plants																						
Pumping Storage Plants																						

SUPPLY AND CONSUMPTION	Oil Products, including																					
	Oil, kt	Other gaseous hidro-carbons (ethylene, propylene, butylene, butadiene and other), thousand m3 stand.**	Raw materials for refineries, kt	Additives and oxyge-nated compounds, kt	Other hidrocarbons, kt	Gas from wells, thou-sand m3	Ethane, million m3	Liquefied (petroleum) gases, kt	Naphta, kt	Aviation gasoline, kt	Gasoline, kt	Gasoline for jet engi-nes, kt	Kerosen pentru motoare reactive, mii tone	Other kerosene gas, kt	Diesel oil,, kt	Residual fuel oil, kt	White-spirit Petro-leum, 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
Unspecified elsewhere																						
Losses	**0**				**0**			**1**			**1**				**1**			**0**				
FINAL CONSUMPTION								**77**	**0**	**0**	**166**		**32**	**0**	**537**	**2**	**0**	**9**	**0**	**4**	**29**	**0**
FINAL ENERGY CONSUMPTION								**77**		**0**	**166**		**32**		**537**	**2**				**4**		**0**
INDUSTRY								**0**			**0**				**5**	**2**				**4**		**0**
Mining								0			0				1							
Food Processing, Beverages and Tobacco								0			0				0	2						
Textiles and leather industry											0				0							
Wood Processing, manufacture of wood and cork products, except furniture; manufacture of straw products and from other vegetal plaiting materials								0			0				0							
Printing and reproduction of recorded media								0							0							
Chemical and petrochemical industry (including the pharmaceutical industry)								0			0				0							0
Non-metallic minerals								0			0				1	0				4		
Metal Industry															0							
Car engineering industry								0			0				0							
Production of trailers, semitrailers and other trans-port means																						
Other industries n.c.a.								0			0				0							
For construction								0			0				3	0						
TRANSPORT								**12**		**0**	**166**		**32**		**459**							**0**
Railways															13							
Terrestrial passenger and cargo transport by autove-hicles								13			166				444							0
Pipeline transportation																						
Navigation															1							
Aviation										0			32									
Other supplementary activities for transport								0			0		0		1							0
Other								**65**			**0**				**73**	**0**						**0**
Agriculture/Forestry/Fishing								0			0				71							0
Commercial/Institutional								0			0				1							0
For communal services								1							1	0						
Residential								63														
Not specified elsewhere															0							
CONSUMED FOR NON-ENERGY PURPOSES								0	0		0			0		0	0	9	0		29	0
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 peletts and other vegetal waste, kt	**Fuel wood m³ comp.*****	**Wood waste, kt**	**Animal waste, kt**	**Black wood, kt**	**Agricultural fuel residues, kt**	**Charcoal, kt**	**Biogasoline, kt**	**Biodiesel oil, kt**	**Biodiesel oil for jet engines, kt**	**Other types of liquid fuel, kt CC**	**Gas from organic waste, million m³**	**Gas from sewage sludge, million m3**	**Other types of biogas 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**
Primary Production	16	1721	21	1		47						7				3		44		
Inputs from other sources																		3321		
Import	0		0				0											4		
Export								0										0		
Stock variation	0	-10	1				0	0												
Stock at the start of the year	5	65	2			2	0	0												
Stock at the end of the year	5	55	3			2	0													
Gross domestic consumption calculated	**16**	**1731**	**20**	**1**		**47**	**0**					**7**				**3**		**3369**		
Real gross domestic consumption	**16**	**1731**	**20**	**1**		**47**	**0**					**7**				**3**		**3369**		
TRANSFORMATION, INPUTS	**5**	**10**	**1**			**22**						**7**						**44**		
Power Plants												0						44		
Combined and Heat Plants – Public energy producers																				
Combined and Heat Plants - Autoproduceres												7								
Heat Plants - Public energy producers	1																			
Heat Plants – Autoproduceres	4	2	1			22														
Oil Refineries																				
Petrochemical plants																				
Liquefaction plants																				
Charcoal production plants		8																		
Other transformation installations																				
TRANSFORMATION, OUTPUT							1											906	2531	
Power Plants																		45		
Combined and Heat Plants – Public energy producers																		820	1475	
Combined and Heat Plants – Autoproduceres																		41	175	
Heat Plants – Public energy producers																			473	
Heat Plants – Autoproduceres																			408	
Oil Refineries																				
Petrochemical plants																				
Liquefaction plants																				
Charcoal production plants							1													
Other transformation installations																				
Energy used for other purposes																		**181**	**21**	
Oil Refineries																				
Petrochemical Plants																		0	6	
Power, Heat and Electrical Plants																		137	9	
Pumping Storage Plants																				

SUPPLY AND CONSUMPTION	Biofuels and waste, including															Waste, including		Electricity, million kWh	Heat, thousand Gcal.	Other types of fuel, kt
	Briquettes and wood peletts and other vegetal waste, kt	Fuel wood m^3 comp.***	Wood waste, kt	Animal waste, kt	Black wood, kt	Agricultural fuel residues, kt	Charcoal, kt	Biogasoline, kt	Biodiesel oil, kt	Biodiesel oil for jet engines, kt	Other types of liquid fuel, kt CC	Gas from organic waste, million m^3	Gas from sewage sludge, million m3	Other types of biogas from anaerobic fermentation, million m^3	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
Unspecified elsewhere																		44	6	
Losses	**0**	**0**																**428**	**374**	
FINAL CONSUMPTION	**11**	**1721**	**19**	**1**		**25**	**1**									**3**		**3622**	**2136**	
FINAL ENERGY CONSUMPTION	**11**	**1720**	**14**			**8**	**1**											**3622**	**2136**	
INDUSTRY	**1**	**2**	**0**			**0**	**0**											**751**	**448**	
Mining																		13		
Food Processing, Beverages and Tobacco	1	1	0			0												396	420	
Textiles and leather industry	0	0																38	17	
Wood Processing, manufacture of wood and cork products, except furniture; manufacture of straw products and from other vegetal plaiting materials	0	1	0															40		
Printing and reproduction of recorded media																		9	6	
Chemical and petrochemical industry (including the pharmaceutical industry)		0																45	2	
Non-metallic minerals		0					0											134	1	
Metal industry																		2		
Car engineering industry		0																46	1	
Production of trailers, semitrailers and other transport means	0																	3		
Other industries n.c.a.	0	0	0															19	1	
For construction		0																6	0	
TRANSPORT																		**62**		
Railways																				
Terrestrial passenger and cargo transport by autovehicles																		42		
Pipeline transportation																		20		
Navigation																				
Aviation																				
Other supplementary activities for transport																				
Other	**10**	**1718**	**14**			**8**	**1**											**2809**	**1688**	
Agriculture/Forestry/Fishing	0	5	0			0	0											47	0	
Commercial/Institutional	0	1	0				0											223	27	
For communal services	6	29	2			4	1											905	432	
Residential	4	1683	12			4	0											1634	1229	
Not specified elsewhere																				
CONSUMED FOR NON-ENERGY PURPOSES		1	5	1		17										3				
Statistical differences																				

Annex 3. Additional Information Associated to Activity Data, Country Specific Coefficients/Parameters and Methodologies Used to Estimate Sectoral GHG Emissions

Annex 3-1. Additional Methodologies and Data Sources for Sector 1 'Energy'

Annex 3-1.1. Additional Data Sources Used to Estimate GHG Emissions within the Sector 1 'Energy' for the ATULBD

Table A3-1.1.1: Fuel Consumption for Heat and Power Generation (1A1 'Energy Industries') in the ATULBD within 1994-2016

	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
Natural Gas, million m^3, including:	1297.95	1098.40	1281.50	1261.40	1081.33	1028.50	1030.80	1187.80	862.50	931.50	970.50	972.10
MTPP Dnestrovsk	1030.00	1098.40	1231.80	1113.30	856.60	841.30	768.40	937.40	719.30	756.20	838.70	805.40
Other plants in energy sector	267.95	0.00	49.70	148.10	224.73	187.20	262.40	250.40	143.20	175.30	151.80	166.70
Residual Fuel Oil, kt	228.000	26.100	23.600	6.055	26.919	NA	NA	NA	NA	NA	NA	NA
Other bituminous coal, kt	1686.600	882.900	806.338	281.873	182.417	NA	NA	NA	NA	NA	NA	NA
	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	%
Natural Gas, million m^3, including:	611.10	885.70	995.20	1448.30	1549.90	1428.80	1458.80	958.40	1350.70	1539.00	1504.00	15.9
MTPP Dnestrovsk	429.40	719.00	766.20	1267.20	1339.40	1220.00	1255.80	754.30	1162.60	1348.00	1312.00	27.4
Other plants in energy sector	181.70	166.70	189.00	181.10	210.10	208.30	203.10	204.10	188.10	191.00	192.00	-28.3
Residual Fuel Oil, kt	NA	NA	7.6057	19.7749	19.5171	16.2301	13.8776	12.268	14.0393	14.9647	13.0847	-94.3
Other bituminous coal, kt	NA	NA	115.4448	230.8896	201.1057	160.6408	159.9969	180.8061	178.3061	176.0424	169.1010	-90.0

Table A3-1.1.2: Fuel Consumption within the 1A2 'Manufacturing Industries and Construction' for the AT-ULBD within 1994-2016

	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
Natural Gas, million m^3	275.10	71.72	52.11	151.50	146.50	136.10	143.90	174.50	73.20	79.00	71.90	102.50
	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	%
Natural Gas, million m^3	133.90	232.60	250.50	121.90	113.50	123.00	134.90	110.80	129.70	108.00	120.0	-56.4
Residual Fuel Oil, kt			0.8715	0.5705	0.3208	0.3098	0.2581	0.3713	0.3713	0.3713	0.3713	NA
Other bituminous coal, kt			0.0737	0.1473	0.1108	0.1102	0.0840	0.0324	0.0772	0.0641	0.0622	NA

Source: Official Letter from "Moldova Gaz" No. 604 dated 01.04.1999, answer to Letter No. 02-541 dated 28.05.2001; Letter No. 02-156 dated 06.02.2004, answer to Letter No. 257-01-07 dated 26.01.2004; Letter No. 06-1253 dated 27.09.2006, answer to Letter No.01-07/1400 dated 25.08.2006; Letter No. 07-730 dated 6.6.2007, answer to Letter No. 47/21-103 dated 31.05.2007; Letter No. 02/1-476 dated 23.02.2011, answer to Letter No. 03-07/175 dated 02.02.2011; Letter No. 02/1-288 dated 22.01.2014, answer to Letter No. 320/2014-01-01 dated 03.01.2014; Letter No. 02/1-507 dated 10.02.2015, answer to Letter No. 407/2015-01-09 dated 29.01.2015; Letter No. 02/1-2183 dated 03.06.2016, answer to Letter No. 512/2016-05-01 dated 10.05.2016; Letter No. 03/2-74 dated 12.01.2018, answer to Letter No. 601/2017-12-03 dated 14.12.2017; 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, 81p.; 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, 2011, Chapter 4 «Energy Resources», page 23*. Tiraspol, 2012. 85 p.; State Statistical Service of the Transnistrian Moldovan Republic (2011), *Socio-economic development of the TMR, 2010, Chapter 4 «Material Resources», page 21*. Tiraspol, 2011. 79 p.; State Statistical Service of the Transnistrian Moldovan Republic (2010), *Socio-economic development of the TMR, 2009 , Chapter 4 «Material Resources», page 20*. Tiraspol, 2010. 75 p.

Table A3-1.1.3: Fuel Consumption within the 1A3b 'Road Transportation' for the ATULBD within 2009-2016

	2009	2010	2011	2012	2013	2014	2015	2016
Compressed Natural Gas, million m^3	4.1	6.9	1.8	2.2	5.2	4.8	5.0	5.0

Source: Official Letter from „Moldova Gaz" No. 02/1-476 dated 23.02.2011, answer to Letter No. 03-07/175 dated 02.02.2011; Letter No. 02/1-288 dated 22.01.2014, answer to Letter No. 320/2014-01-01 dated 03.01.2014; Letter No. 02/1-507 dated 10.02.2015, answer to Letter No. 407/2015-01-09 dated 29.01.2015; Letter No. 02/1-2183 dated 03.06.2016, answer to Letter No. 512/2016-05-01 dated 10.05.2016; Letter No. 03/2-74 dated 12.01.2018, answer to Letter No. 601/2017-12-03 dated 14.12.2017.

Table A3-1.1.4: Fuel Consumption within the 1A4a 'Commercial/Institutional' for the ATULBD within 1999-2016

	1999	2000	2001	2002	2003	2004	2005	2006	2007
Natural Gas, million m^3	6.8	9.3	13.6	81.8	87.4	229.0	181.6	151.9	14.4
	2008	2009	2010	2011	2012	2013	2014	2015	2016
Natural Gas, million m^3	19.8	16.1	37.7	209.2	202.3	99.9	105.1	27.0	17.6852
Other bituminous coal, kt	0.0620	0.0626	0.01270	0.0412	0.0087	0.0356	0.0127	0.0050	0.0027
Residual Fuel Oil, kt	0.0868	0.1369	0.1063	0.0399	0.0400	0.0430	0.0620	0.0283	0.0776
LPG, kt				0.0026	0.0011	0.0012	0.0011	0.0012	0.0657

Table A3-1.1.5: Fuel Consumption within the 1A4b 'Residential' for the ATULBD within 1995-2016

	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
LPG, kt *	2.5	2.3	1.4	1.3	0.8	0.5	0.3	0.4	0.5	0.5	0.5
Natural Gas, million m^3 *	216.6	163.4	354.8	321.6	293.2	NA	196.4	175.4	176.6	162.8	164.8
Natural Gas, million m^3 **					294.2	217.9	196.4	163.5	176.6	132.0	144.2
	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
LPG, kt *	0.5000	0.4486	0.4962	0.3869	0.5798	0.6060	0.4770	0.3836	0.3525	0.2753	0.2310
Natural Gas, million m^3 *	161.2	150.8	150.0	156.0	174.3	184.5	184.1	180.6	180.1	175.0	185.7
Natural Gas, million m^3 **	157.0	149.2	148.7	154.7	173.0	184.5	184.1	180.6	180.1	175.4	185.7
Fire Wood, thousand m^3 ***				10.1793	10.8175	9.2527	5.5379	4.8690	7.6844	10.9011	6.8596

Table A3-1.1.6: Fuel Consumption within the 1A4c 'Agriculture/Forestry/Fishing' for the ATULBD within 1995-2016

	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
Diesel Oil, kt *	29.7480	23.8190	31.7730	24.5220	22.6700	16.1760	15.9490	12.4040	8.6010	7.7080	5.3940
Gasoline, kt *	9.6830	6.1160	8.8580	5.7920	3.0730	1.7550	1.6930	1.2220	1.2580	0.7810	0.6120
Natural Gas, mln.m^3 **									0.9	0.7	0.4
	2006	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**
Diesel Oil, kt *	4.4710	3.2590	2.9450	3.8930	8.2350	9.3260	10.2722	11.6636	11.3853	10.7971	10.2089
Gasoline, kt *	0.5740	0.3980	0.3340	0.4230	0.6608	0.5818	0.6126	0.8485	0.7207	0.6431	0.5655
Natural Gas, mln.m^3 **	0.1	0.0	0.1	0.0	0.1	0.1	0.2	0.0	0.0	0.0	0.0
Residual Fuel Oil, kt ***			0.0032	0.0032	0.0032	0.1930	0.0032	0.0032	0.0	0.0	0.0
Coal, kt ***			0.0153	0.0115	0.0090	0.0310	0.0240	0.0240	0.0240	0.0220	0.0373

Table A3-1.1.7: Fuel Consumption within the Source Category 1A5 'Other' for the ATULBD within 1995-2016

	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
Lubricants, kt *	1.0650	1.1190	1.5740	1.1880	1.1330	0.6050	0.7560	0.6150	0.4030	0.3160	0.2200
	2006	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**
Lubricants, kt *	0.1480	0.1530	0.0790	0.1070	0.1944	0.1932	0.2055	0.2042	0.2132	0.1997	0.1862
Bituminous coal, kt **			2.0299	1.1388	1.1101	0.9823	0.6502	0.6441	0.3769	0.4485	0.3764
Residual Fuel Oil, kt **			0.048	0.036							

Source: * Statistical Yearbooks of the ATULBD for 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); 2016 (page 105); ** Official Letter from „Moldova Gaz" No. 06-1253 dated 27.09.2006, answer to Letter No.01-07/1400 dated 25.08.2006; Letter No. 07-730 dated 6.6.2007, answer to Letter No. 47/21-103 dated 31.05.2007; Letter No. 02/1-476 dated 23.02.2011, answer to Letter No. 03-07/175 dated 02.02.2011; Letter No. 02/1-288 dated 22.01.2014, answer to Letter No. 320/2014-01-01 dated 03.01.2014; Letter No. 02/1-507 dated 10.02.2015, answer to Letter No. 407/2015-01-09 dated 29.01.2015; Letter No. 02/1-2183 dated 03.06.2016, answer to Letter No. 512/2016-05-01 dated 10.05.2016; Letter No. 03/2-74 dated 12.01.2018, answer to Letter No. 601/2017-12-03 dated 14.12.2017; *** State Statistical Service of the Transnistrian Moldovan Republic (2017), *Socio-economic development of the TMR for 2016*. Tiraspol, 2017, 81 p.; State Statistical Service of the Transnistrian Moldovan Republic (2016), *Socio-economic development of the TMR for 2015*. Tiraspol, 2016, 81p.; 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, 2011, Chapter 4 «Energy Resources», page 23*. Tiraspol, 2012. 85 p.; State Statistical Service of the Transnistrian Moldovan Republic (2011), *Socio-economic development of the TMR, 2010, Chapter 4 «Material Resources», page 21*. Tiraspol, 2011. 79 p.; State Statistical Service of the Transnistrian Moldovan Republic (2010), *Socio-economic development of the TMR, 2009 , Chapter 4 «Material Resources», page 20*. Tiraspol, 2010. 75 p.

Note: in the current inventory cycle, lubricants and grease use were reallocated from 1A5 "Other" category from the Energy Sector to the 2D1 "Lubricants Use" category within Sector 2 "Industrial Processes and Product Use".

Annex 3-2. Additional Data Sources for Sector 2 'Industrial Processes and Product Use'

Table A3-2.1: Raw Materials and Energy Balance for Cement Production at Cement Plant "LAFARGE CIMENT (Moldova)" J.S.C. 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 A3-2.2: Average Concentration of CaO and MgO in Clay Used for Bricks Production at State Enterprises "Macon" J.S.C. in Chisinau within 1990-2016 periods

Year	Average Concentration of CaO in Clay Used, %				Average Concentration of MgO in Clay Used, %			
	From Malo-Haruza Quarry	From Pruncul Quarry	From Micăuţi Quarry	From Purcel Quarry	From Malo-Haruza Quarry	From Pruncul Quarry	From Micăuţi Quarry	From Purcel Quarry
1990-1996	6.915	4.080	8.220	8.440	2.670	3.210	3.570	3.030
1997-2004	6.915	4.080	8.220	8.440	2.670	3.210	3.570	3.210
2005-2010	5.87-7.96	4.080	8.220	8.440	2.16-3.18	3.210	3.570	3.030
2011-2016	6.660	4.080	6.700	8.440	2.600	3.210	2.930	3.030

Annex 3-3. Features of Races of Livestock and Poultry Bred in the Republic of Moldova, used to estimate GHG emissions from Sector 3 'Agriculture'

Cattle

In early 1990', *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 races, but also bred as pure blood) were the most widely bred races in the RM; *Holstein, Ayrshire* and *Jersey* were not bred as pure blood, but used for cross-breeding (Bucataru, Radionov, 1997; Bucataru, Radionov, Urzica, 2002; Bivol, Ciubotaru, 2005) (Table A3-3.1).

Table A3-3.1: Features of Cattle Races Bred in the Republic of Moldova

Cattle Race	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

At present most cattle bred in the RM are not pure blood, but represent half-breeds from crossbreeding. It should be mentioned that lately, a new kind of cattle *Moldovan Spotted Black*[134] has been crossbred as a result of crossbreeding of *Steppe Red* and *Simmental* with the improved races *Spotted Black* and *Holstein*.

Swine

The following races and types of swine are bred in the country: *Big White* (as pure blood and as maternal form in industrial crosses and in crossbreeding), *Bacon Estonian* (used for industrial crosses with *Big White*, *Steppe White Ukrainian* and other for crossbreeding), *Steppe White Ukrainian* (boars are used for industrial crosses with other races), *Southern Moldavian type for meat 'Sudic'* (Southern) (used in crossbreeding as paternal form) (Bucataru, Radionov, Urzica, 2002; Bivol, Ciubotaru, 2005) (Table A3-3.2).

Table A3-3.2: Features of Swine Races and Types Bred in the Republic of Moldova

Races 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

Races more often used for crossbreeding in the RM are *Landrace* (used in crossbreeding with other races to obtain half breed gilts F_1), *Duroc* (used as a paternal race in three-racial and tetra-racial crossbreeding), and *Hampshire* (used as paternal form in various crossbreeding schemes).

Sheep

The sheep bred in the Republic of Moldova are represented by races *Karakul, Tsigaie, Turcana* and *Frisian* (Table A3-3.3).

Table A3-3.3: Features of Sheep Races Bred in the Republic of Moldova

Sheep Races	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 colors of *Karakul* race are black and frosty. This race 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. The sheep of *Tsigaie* race are well adaptable to warm climate, are bred in the South of the country and are a race of sheep with semi-fine wool and has considerable fattening abilities. In comparison with other races, *Frisian* race has high milk yield indicators and high fertility performance at crossbreeding and improves these features in crossbreeds on condition special feeding and maintenance conditions are provided (Bucataru, Radionov, Urzica, 2002; Bucataru, Radionov, Varban, 2003; Bivol, Ciubotaru, 2005).

[134] The features of the type Moldovan Spotted Black are 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 has a daily weight gain of 1200 g, slaughtering efficiency being of 55%.

Goats

Most of the native goats (90 per cent) have thick and short hairy caver, consisting of thick and long fibbers (over 70 per cent) and down (less than 30 per cent) of white (21.2 per cent), red (20.9 per cent), black (25.2 per cent), color and spotted (32.7 per cent), with horns (73.0 per cent) and with no 'ear rings' (73.3 per cent). The research made revealed that the goats gene pool to a large extent is represented by less productive crossbreeds, however, well adapted to the climate conditions of the country. Among the improved races, recommended for improving goats productivity in the Republic of Moldova are *Saanen* (a race with remarkable milking abilities high fertility performance and longevity, which is used for crossbreeding aimed to improve the milking abilities 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 race of wool goats, may be used for crossbreeding with other races in view of improving the quality of the hairy caver) (Bucataru, Radionov, Urzica, 2002; Bucataru, Radionov, Varban, 2003; Bivol, Ciubotaru, 2005) (Table A3-3.4).

Table A3-3.4: Features of Goat Races in the Republic of Moldova

Goat Races	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 races 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 Central and Southern part of the country (Bucataru, Radionov, Urzica, 2002).

Rabbits

Races of rabbits bred 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 A3-3.5: Features of Rabbit Races Bred in the Republic of Moldova

Rabbit races	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 Chinchila	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
White New Zeeland	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 widely spread races of chicken bred 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 A3-3.6).

[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 pest resistant, 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.

Table A3-3.6: Features of Chicken Races Bred in the Republic of Moldova

Chicken Races	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
Cornisch	meat	4.5-5.0	3.4-4.0	100-130	60-65

Turkeys

Turkeys of preponderantly three races are bred in the Republic of Moldova: *Suntanned with Large Chest, White with Large Chest* and *North-Caucasian Suntanned* (Bucataru, Radionov, Urzica, 2002) (Table A3-3.7).

Table A3-3.7: Features of Turkey Races Bred in the Republic of Moldova

Turkey Races	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 widely spread races of geese bred in the Republic of Moldova are: *Holmogor, White Italian, Kuban* and *Chinese* (Bucataru, Radionov, Urzica, 2002) (Table A3-3.8).

Table A3-3.8: Features of Geese Races Bred in the Republic of Moldova

Geese Races	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

Ducks

Preponderantly four races of ducks are bred in the Republic of Moldova: *Beijing, Mirror, Grey Ukrainian* and *Polish* (Bucataru, Radionov, Urzica, 2002) (Table A3-3.9).

Table A3-3.9: Features of Ducks Races Bred in the Republic of Moldova

Ducks Races	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	meat-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 Methodologies and Data Sources for Sector 4 'LULUCF'

Annex 3-4.1. Additional Information Associated with 4A 'Forest Land'

Table 3-4.1.1: The General Structure of the Forestry Fund in the Republic of Moldova

Structure Elements	Total / average	Species							
		QU	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, year	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
Forest fund per 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, year	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
Forest fund per 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 3-4.2. Methodology for determining the carbon balance in agricultural soils for the evaluation of GHG emissions

The methodology for determining the carbon balance in agricultural soils for the evaluation of GHG emissions (Banaru, 2000)[136] was used by the Republic of Moldova to compile its GHG emissions inventories within the Second National Communications (2010), Third National Communications (2014) and the First Biennial Update (2016).

In 2010, the methodology was updated[137], due to the availability of new scientific data, as well as considering available data within the 2006 IPCC Guidelines.

Principles laid at the basis of the method are, as follows:

- Carbon balance represent the difference between the carbon entering the soil (humification of vegetal residues and organic fertilizers) and the 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 a 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). It was considered the close link between carbon emissions and the amount of N released from soils due to the biochemical decomposition of organic matter. The content of carbon and nitrogen in humus is stable with minor variations within the pedogeographic zones' limits. The soils humus in the RM present a carbon – nitrogen ratio of 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 at the same time with the nitrogen, in other words, the carbon released through carbon dioxide emissions.

[136] Banaru, Anatol (2000), Methodology to Calculate CO_2 Emissions from Arable Soils, In the collection of papers „Climate Change. Research, Studies, Solutions, Ministry of Environment / UNDP Moldova. „Bons Offices" S.R.L. Chisinau, 2000. P. 115-123.

[137] Cerbari, V., Scorpan, V., Ţăranu, M. (2010), The potential for reducing the CO_2 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.

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, it should be determined the amount of CO_2 entered and fixed in the soil with the crop yield that was not removed and with the organic fertilizers used. 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 (the balance) should consider CO_2 emissions if 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, related to their variation according to pedologic and climatic factors.

The developed methodology aims to estimating CO_2 emissions from croplands. 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 above mentioned, the carbon balance can be estimated using the following equation:

$$BC \pm = (VI - CO) \bullet Area(T)$$

Where:

- B_C – carbon balance, tone;
- V_I – carbon entered into the soil through crop yield and organic matter humification, tons/yr;
- C_O – carbon coming out from the soil through CO_2 emissions as a result of humus mineralization, tons/yr;
- $Area_{(T)}$ – area covered with T crop, ha.

The amount of carbon entered in soil (V) can be estimated using the following equation:

$$V = V1 + V2$$

Where:

- V_1 – carbon returned to soils with crop residues, tons/yr;
- V_2 – carbon returned to soils with organic fertilizers, tons/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.d.m./ha;

$$Crop_{(T)} = Yield\ Fresh_{(T)} \bullet DRY$$

Where:

$Yield\ Fresh_{(T)}$ – harvested fresh yield for crop T, t/ha;

[138] Arinushkina E.V. Guidelines for Chemical Analysis of Soils (in Russian). Moscow, Moscow State University Press, 1961. p.136.

DRY – dry matter fraction of harvested crop *T*, kg d.m./t of yield[139];

$R_{AG\ (T)}$ – ratio of above-ground residues dry matter to harvested yield for crop *T* (Crop(*T*)), t.d.m$_{AG}$/t.d.m[140];

$R_{BG\ (T)}$ – ratio of below-ground residues to harvested yield for crop *T*, t.d.m$_{BG}$/t dm[141];

$Frac_{Remove\ (T)}$ – fraction of above-ground residues of crop *T* removed and used for other purposes[142]

k_1– coefficient reflecting the humificatin 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 sources of reference, 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
Soybeans	0.91	1.30	0.19	0.00	0.25
Sugar beet	0.22	0.29	0.20	0.00	0.10
Sun flower (crop residues returned to soils without N inputs during stubble-turning)	0.90	3.80	0.22	0.40	0.08
Sun flower (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
Rapeseed	0.88	1.17	0.22	0.00	0.11
Potatoes	0.22	0.17	0.20	0.00	0.13
Legumes	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 (oat and vetch) for green fodder	0.22	0.25	0.40	0.78	0.22
Annual grasses (oat and peas) 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:

$$V_2 = (F_{ON} \bullet k_2) / 1.724$$

Where:

F_{ON} – Total annual amount of organic N applied to soils other than by grazing animals, (t/yr);

[139] 2006, IPCC Guidelines, Volume 4, Chapter 11, Table 11.2, Page 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: Presa universitara balteană, 2006, P. 298.
[141] 2006 IPCC Guidelines, Volume 4, Chapter 11, Table 11.2, Page 11.17.
[142] Expert opinion, Prof. Valerian Cerbari, Institute of Pedology, Agrochemistry and Soil Protection „Nicolae Dimo"
[143] Rusu M., Mărghitaş M., Oroian I., Mihăilescu T., Dumitraş 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.

$$F_{ON} = F_{AM} + F_{SEW} + F_{COMP} + F_{OOA}$$

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 humificatin 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: Normative of humus accumulation in the country's soils on the account of applied organic fertilizers and their humification

Organic Fertilizers	Applied dose, t/ha	Humus Accumulation		k_2
		from the applied dose, t/ha	from 1t 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:

$$Er\ (T) = (Yield\ Fresh_{\ (T)} \bullet k_{3\ (T)}) / 10^3$$

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 t 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
Oats	30
Grain maize	28
Peas	44
Beans	40
Vetch, vetch mixtures	50
Sorghum	30
Sugar beat	6
Sunflower	49
Soy	65
Tobacco	36
Potatoes	7

[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. Institute of Pedology, Agrochemistry and Soil Protection "Nicolae Dimo" 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
Vegetables	3
Fodder roots	3
Silo maize	4
Annual herbs for hay	21
Annual herbs for green mass	5
Perennial herbs for hay	30
Perennial herbs for green mass	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, tons 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 per cent of the applied quantity (Banaru, 2002).

Table 3-4.2.4: Nitrogen content in inorganic fertilizers applied more frequently in the country

Chemical 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
Nitrate of ammonia	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 cyanide	$CaCN_2$	21.0
Ammonium phosphate	$NH_4H_2PO_4$	11.0
Diammonium phosphate	$(NH_4)_2HPO_4$	16.0
Superfphosphate	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 3-4.2.6, enables the AD conversion related to the use of various organic fertilizers in stable waste with bed.

Table 3-4.2.6: Coefficients for re-calculation of different forms and types of organic fertilizers in stable waste with bed

Type and Form of Organic Fertilizers	Recalculation Coefficients
Animal manure with bedding (moisture up to 77%), solid fraction	1.00
Manure without bed and semiliquid manure (90-93%)	0.50
Liquid manure (moisture 93-97%)	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 1t)	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.d.m./ha;

$R_{AG\,(T)}$ – ratio of above-ground residues dry matter to harvested yield for crop *T* (Crop(*T*)), t.d.m_{AG}/t.d.m.[148];

$R_{BG\,(T)}$ – ratio of below-ground residues to harvested yield for crop *T*, t.d.m_{BG}/t d.m.[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: Presa universitara balteana, 2006, - p. 298
[149] 2006 IPCC Guidelines, Volume 4, Chapter 11, Table 11.2, Page 11.17.
[150] Expert opinion, Prof. Valerian Cerbari, Institute of Pedology, Agrochemistry and Soil Protection „Nicolae Dimo"

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, % from total
Winter wheat	0.50	
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	
Sun flower	0.95	Amount of used N from crop residues represents 25 per cent from the total
Soybeans	2.08	
Tobacco	1.30	
Grain Rapeseed	1.05	
Potatoes	0.40	
Legumes	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:

$$E_{S(T)} = Yield\ Fresh_{\ (T)} \bullet (k_{7\ (T)} / 10^3) \bullet (k_{8\ (T)} / 10^2)$$

Where:

Yield Fresh $_{(T)}$ – 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, % from 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 the soils granulometry[151] (Table 3-4.2.9).

Table 3-4.2.9: Coefficient of humus mineralization correction 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 by the crops technology[152] (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: Coefficient of humus mineralization correction based on crops' technology (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 Republic of Moldova is 10.7 (range from 10.1 to 11.3).

CO_2 emissions from soils engaged in agricultural circuit can be estimated using the following equation:

$$CO_2 = \pm B \bullet 44/12$$

Where:

B – carbon balance, tons;

[44/12] – stoichiometric 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 is mainly based on the exploitation of soils natural fertility (and/or the existing humus content in the soils). As a result, any increase in harvest (as happened for example in 1997, 2004, 2008, 2013, 2014 or 2016), caused in particular by favorable climatic factors, not followed by the compensation of carbon losses with the yield crop, 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 of soil quality and fertility.

The significant decrease between 1990 and 2016 of carbon returned to soil with manure (by 42.1 per cent), respectively with above- and below-ground crop residues (by 69.9 per cent), led to a shift from a positive carbon balance (+0.32 t/ha in 1990, +0.31 t/ha in 1991 și +0.25 t/ha in 1992: the period before the agrarian reform in the country) to a deep negative balance (maximum -0.61 t/ha in 2008; -0.58 t/ha in 2016) (Table 3-4.2.11).

Table 3-4.2.11: Carbon Balance in Cropland Remaining Cropland in the RM within 1990-2016

Indicators	1990	1991	1992	1993	1994	1995	1996	1997	1998
Carbon introduced in soil with organic fertilizers, kt	364.6	409.4	281.4	363.2	119.6	182.2	92.7	177.5	150.0
Carbon introduced in soil with above- and below-ground residues, kt	566.0	514.4	465.7	397.6	386.1	351.3	363.4	286.0	270.7
Carbon losses from soil due to humus mineralization, kt	-386.8	-390.4	-321.4	-1 027.9	-617.0	-953.5	-822.0	-1 267.6	-1 034.2
Carbon balance in cropland remaining cropland, kt	543.8	533.4	425.7	-267.2	-111.3	-420.0	-365.9	-804.2	-613.6
Carbon balance in cropland remaining cropland, t/ha	0.32	0.31	0.25	-0.14	-0.06	-0.25	-0.21	-0.47	-0.36
Indicators	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**
Carbon introduced in soil with organic fertilizers, kt	142.3	76.9	148.5	148.3	62.1	165.3	169.4	157.3	44.4
Carbon introduced in soil with above- and below-ground residues, kt	246.5	219.3	223.7	225.6	213.7	205.6	216.5	221.6	170.8
Carbon losses from soil due to humus mineralization, kt	-956.5	-910.6	-1 102.4	-1 100.3	-860.7	-1 256.8	-1 218.8	-1 066.0	-363.0
Carbon balance in cropland remaining cropland, kt	-567.8	-614.5	-730.3	-726.4	-584.9	-885.9	-832.9	-687.0	-147.8
Carbon balance in cropland remaining cropland, t/ha	-0.34	-0.36	-0.42	-0.42	-0.37	-0.53	-0.49	-0.45	-0.10
Indicators	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**
Carbon introduced in soil with organic fertilizers, kt	184.2	134.9	174.8	175.0	53.6	189.2	213.5	80.7	211.1
Carbon introduced in soil with above- and below-ground residues, kt	167.6	187.0	192.6	176.5	163.1	154.9	168.6	164.0	170.1
Carbon losses from soil due to humus mineralization, kt	-1 290.4	-906.9	-1 100.2	-1 143.0	-520.1	-1 207.7	-1 226.1	-1 000.0	-1 371.1
Carbon balance in cropland remaining cropland, kt	-938.6	-585.0	-732.7	-791.4	-303.3	-863.7	-844.0	-755.3	-989.9
Carbon balance in cropland remaining cropland, t/ha	-0.61	-0.37	-0.45	-0.49	-0.18	-0.52	-0.50	-0.45	-0.58

To be noted that if the carbon balance in the arable land represented in average -0.31 t/ha per year between 1990 and 2003, for the 2004-2016 time series it already reached an average of circa -0.44 t/ha per year (Table 3-4.2.12).

Table 3-4.2.12 presents other relevant information in the calculation process, including total area of cropland, as well as data on crop yields recorded within 1990-2016 period.

Regarding the "*Methodology to Calculate CO_2 Emissions from Agricultural Soils*" (Banaru, 2000), it should also be mentioned the following:

- The balance (difference) between the carbon entered and coming out of the soil, related to one unit of area (ha), is multiplied to the crop total area ($Area_{(T)}$);
- In the described order, the carbon balance is estimated for each crop (T);
- The estimation of the carbon balance for the total area of croplands is performed by adding the data for each crop (T);
- The positive and negative values are summed;
- In the case where the sum has a positive value, the carbon balance should be considered positive, and proves that the croplands represent a source of CO_2 removals;
- In the case where the sum has a negative value, the carbon balance should be considered negative and proves that the croplands represent a source of CO_2 emissions.

Table 3-4.2.12: Carbon Balance and CO_2 Emissions from Cropland (total area of arable lands) in the Republic of Moldova within 1990-2016

Years	Area of cropland, ha	Crop yields, t	Crop yields, t d.m.	Carbon					CO_2 Emissions' balance	
				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			
							t	t/ha	t	t/ha
1990	1 697 900	17 189 930	5 923 368	364 570	565 997	-386 761	543 806	0.32	-1 993 956	-1.17
1991	1 695 500	19 530 115	6 811 085	409 413	514 381	-390 423	533 371	0.31	-1 955 693	-1.15
1992	1 687 100	12 909 003	4 557 686	281 414	465 669	-321 396	425 688	0.25	-1 560 854	-0.93
1993	1 862 500	15 347 391	5 923 798	363 192	397 557	-1 027 940	-267 191	-0.14	979 701	0.53
1994	1 820 800	9 599 140	3 510 846	119 636	386 114	-617 001	-111 251	-0.06	407 921	0.22
1995	1 713 686	10 244 904	4 156 050	182 229	351 271	-953 518	-420 018	-0.25	1 540 065	0.90
1996	1 707 600	7 306 583	3 101 268	92 657	363 409	-821 969	-365 903	-0.21	1 341 645	0.79
1997	1 718 700	8 318 533	4 186 320	177 459	285 995	-1 267 638	-804 184	-0.47	2 948 674	1.72
1998	1 709 300	6 871 339	3 391 871	149 993	270 665	-1 034 218	-613 560	-0.36	2 249 721	1.32
1999	1 654 300	5 583 312	2 953 880	142 264	246 472	-956 544	-567 808	-0.34	2 081 963	1.26
2000	1 693 100	4 885 494	2 630 067	76 860	219 278	-910 617	-614 479	-0.36	2 253 089	1.33
2001	1 722 510	5 621 814	3 229 053	148 467	223 670	-1 102 441	-730 304	-0.42	2 677 783	1.55
2002	1 726 900	5 495 606	3 205 702	148 343	225 569	-1 100 282	-726 370	-0.42	2 663 355	1.54
2003	1 588 474	4 057 652	2 290 355	62 085	213 698	-860 701	-584 917	-0.37	2 144 695	1.35
2004	1 676 100	5 579 823	3 530 408	165 334	205 592	-1 256 790	-885 865	-0.53	3 248 171	1.94
2005	1 689 463	5 640 911	3 471 787	169 437	216 485	-1 218 823	-832 901	-0.49	3 053 969	1.81
2006	1 538 851	5 345 640	3 043 778	157 349	221 600	-1 065 984	-687 035	-0.45	2 519 129	1.64
2007	1 542 886	2 534 568	1 331 746	44 403	170 787	-362 963	-147 773	-0.10	541 833	0.35
2008	1 544 025	5 948 617	3 802 219	184 168	167 580	-1 290 386	-938 639	-0.61	3 441 675	2.23
2009	1 580 392	4 054 261	2 676 943	134 921	186 952	-906 917	-585 043	-0.37	2 145 159	1.36
2010	1 611 156	5 223 762	3 230 241	174 835	192 611	-1 100 178	-732 732	-0.45	2 686 683	1.67
2011	1 607 731	5 088 336	3 287 993	174 994	176 536	-1 142 961	-791 431	-0.49	2 901 912	1.80
2012	1 641 371	2 955 044	1 751 176	53 633	163 077	-520 054	-303 344	-0.18	1 112 263	0.68
2013	1 652 276	5 596 081	3 607 829	189 184	154 850	-1 207 721	-863 688	-0.52	3 166 854	1.92
2014	1 684 380	6 348 421	3 974 007	213 503	168 599	-1 226 076	-843 974	-0.50	3 094 572	1.84
2015	1 678 469	4 187 800	2 873 545	80 738	163 960	-1 000 038	-755 340	-0.45	2 769 580	1.65
2016	1 700 837	5 597 487	3 903 307	211 084	170 138	-1 371 143	-989 921	-0.58	3 629 709	2.13
1990-2016	**1 672 085**	**7 298 577**	**3 568 753**	**173 043**	**262 537**	**-941 536**	**-505 956**	**-0.31**	**1 855 171**	**1.12**
1990-2003	1 714 169	9 497 201	3 990 811	194 184	337 839	-839 389	-307 366	-0.18	1 127 008	0.66
2004-2016	**1 626 764**	**4 930 827**	**3 114 229**	**150 276**	**181 444**	**-1 051 541**	**-719 822**	**-0.44**	**2 639 347**	**1.62**

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: 1990-2016. Greenhouse Gas Sources and Sinks in the Republic of Moldova)

Document: National Inventory Report: 1990-2016. 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 the 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 send to the National Inventory Team Leader on the electronic address: <clima@clima.md>, together with copies on paper, signed and personally presented at the following address: 156A Mitropolit Dosoftei Str., Office No. 37, MD 2004, Chisinau, Republic of Moldova.

The first page of this form summarizes the results of the checks (once completed) and highlights any significant findings or actions. The expert takes personal responsibility for the process of inventory quality assurance and control at the sectoral level (separate chapter of the National Inventory Report for 1990-2016). Checks/rows that are not relevant or not available should indicate "n/r" or "n/a" (not be left blank or deleted).

All sources of information 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: 1990-2016. 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:	Any residual problems after corrective actions are taken:

Quality Assurance and Quality Control Form: National Inventory Report: 1990-2016. Greenhouse Gas Sources and Sinks in the Republic of Moldova.

Chapter: ____

	Item	**Check Completed**			**Corrective Action**		**Supporting documents (provide reference)**
		Date	**Individual (first name, last name)**	**Errors (Y/N)**	**Date**	**Individual (first name, last name)**	
TABLES AND FIGURES							
1	Check that numbers in tables in the respective chapter match numbers in reported tables (the reporting format provided by the 2006 IPCC Guidelines and/or the decisions of the COP)						
2	Check that numbers in tables specific to source categories (see the respective sub chapters of the Report) match numbers in tables from „Overview" of the sector						
3	Check that numbers in the text are consistent with numbers in tables						
4	Check that table formatting is consistent						
5	Check that the information presented in figures is consistent with tables and the content						
6	Check that table titles and the 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 multiplied sign use the • symbol, and not the letter x or * symbol						
9	Equation is to be centered						
10	After an equation, use: Where, and define the variables						
11	Defining variables is paragraphed with the following style „Table No.: Text" (the first word with bold)						

REFERENCES							
12	Check consistency of references used in multiple sections (ex.: the 2006 IPCC Guidelines and not the IPCC Guidelines)						
13	Check consistency of text citations and references with final references						
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 first time and not subsequent times throughout each chapter						
17	Check that all lines are similar, use the symbol „insert" to insert a line (–)						
18	Check that all fonts in text, headings, titles, and subheadings are consistent						
19	Check that notes and comments are removed from document						
20	Check that all references to annexes in the text match the appropriate number of annexes						
21	Check that the name of all gases, such as CO_2 and N_2O uses letter „O" and not number „0"						
22	All numbers in the GHG formulas are to be subscribed, (ex.: CO_2, SF_6, CH_4, N_2O etc.)						
23	Notes under tables need to be written with a smaller font than the text						
24	Check that the number of decimal points used in text and tables are consistent						
25	Check that the size, style and indenting of the chapters and subchapters numbers are consistent						
26	Check that spell check is complete						
27	Check that the numbering of tables, figures, annexes and references in the text is correct						
OTHER ASPECTS							
28	Other (to specify):						

Annex 4.2. Category-Specific Tier 1 Quality Control Procedures

National Inventory Report: 1990-2016

Source Categories included in check: ______________________________

Surname and first name of the 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).

The form should be completed electronically. Once completed, the form should be send to the National Inventory Team Leader on the electronic address: <clima@clima.md>, together with copies on paper, signed and personally presented at the following address: 156A Mitropolit Dosoftei Str., Office No. 37, MD 2004, Chisinau, Republic of Moldova.

The first page of this form summarizes the results of the checks (once completed) and highlights any significant findings or actions. The expert takes personal responsibility for the process of inventory quality assurance and control at the sectoral level (separate chapter of the National Inventory Report for 1990-2016). Checks/rows that are not relevant or not available should indicate "n/r" or "n/a" (not be left blank or deleted). All sources of information associated with the inventory compilation process for each sector 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:	Any residual problems after corrective actions are 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 (provide reference)
		Date	Individual (first name, last name)	Errors (Y/N)	Date	Individual (first name, last name)	
Data Gathering, Input, and Handling Checks							
1	Check that assumptions and criteria for the selection of AD and EFs 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 (MDD report) • Cross-check a sample of input data from each category (either measurements or 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 - Build in automated checks, such as computational checks for calculations, or range checks for input data						
3	Check that emissions/removals are calculated correctly: • Reproduce a representative sample of emissions/removals calculations • If models are used, selectively mimic complex model calculations with abbreviated calculations to judge relative accuracy						
4	Check that parameter and emission/removal units are correctly recorded and that appropriate conversion factors are used: • Check that units are properly labelled in calculation sheets and MDD template report • Check that units are correctly carried through from beginning to end of calculations • Check that conversion factors are correct • Check that temporal and spatial adjustment factors are used correctly						
5	Check the integrity of database files: • Confirm that the appropriate data processing steps are correctly represented in the database • Confirm that data relationships are correctly represented in the database • Ensure that data fields are properly labelled and have the correct design specifications • Ensure that adequate documentation of database and model structure and operation are archived						
6	Check for consistency in data between categories: • Identify parameters (e.g., activity data, constants) that are common to multiple categories and confirm that there is consistency in the values used for these parameters in the emissions/removals calculations						
7	Check that the movement of inventory data among processing steps is correct: • Check that emissions/removals data are correctly aggregated from lower reporting levels to higher reporting levels when preparing summaries • Check that emissions/removals data are correctly transcribed between different intermediate products						
DATA DOCUMENTATION							
8	Review of internal documentation and archiving: • Check that 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 of notation). • Check that inventory data, supporting data, and inventory records are archived and stored to facilitate detailed review • Check that 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							
9	Check methodological and data changes resulting in recalculations: • 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 • Check that 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 appropriate base year over the period of the current inventory • For subcategories, confirm that the entire category is being covered • Proved clear definition of 'Other' type categories • Check that known data gaps that result in incomplete category emissions/removals estimates are documented, including qualitative evaluation of the importance of the estimate in relation to total net emissions (e.g. subcategories classified as 'not estimated')						
12	Trend checks: • For each category, compare current inventory estimates to previous estimates, if available. If there are significant changes or departures from expected trends, re-check estimates and explain any difference. Significant changes in emissions or removals from previous years may indicate possible input or calculation errors. • Check value of implied emission factors (aggregate emissions/removals divided by activity data) across time series. Are changes in emissions or removals being captured? • Check if there any unusual or unexplained trends noticed for activity data or other parameters across the time series						

Annex 4.3. Category-Specific Tier 2 Quality Control Procedures

National Inventory Report: 1990-2016

Source Categories included in check: ____

Surname and first name of the 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),

The form should be completed electronically. Once completed, the form should be send to the National Inventory Team Leader on the electronic address: <clima@clima.md>, together with copies on paper, signed and personally presented at the following address: 156A Mitropolit Dosoftei Str., Office No. 37, MD 2004, Chisinau, Republic of Moldova.

The first page of this form summarizes the results of the checks (once completed) and highlights any significant findings or actions. The expert takes personal responsibility for the process of inventory quality assurance and control at the sectoral level (separate chapter of the National Inventory Report for 1990-2016). Checks/rows that are not relevant or not available should indicate "n/r" or "n/a" (not be left blank or deleted). All sources of information associated with the inventory compilation process for each sector 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:	Suggested checks to be performed in the future:

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 (provide reference)
		Date	Individual (first name, last name)	Errors (Y/N)	Date	Individual (first name, last name)	
1	Assess the applicability of IPCC default factors: • Evaluate whether national conditions are similar to those used to develop the IPCC default factors • Compare default factors to site or plant-level factors • 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 secondary studies used to develop country-specific factors used Tier 1 QC activities • Compare country-specific factors to IPCC defaults; document any significant discrepancies • Compare country-specific factors to site or plant-level factors • Compare to factors from other countries (using IPCC Emission Factor Database) • Document results of this assessment						
3	Review measurements: • Determine if 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 factor; document any significant discrepancies						
4	Evaluate time series consistency: • Review significant (> 10%) changes in year-over-year estimates for categories and sub-categories • Compare top-down and bottom-up estimates for similar orders of magnitude • Conduct reference calculations that use stoichiometric ratios and conservation of mass and land						
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 • 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 experts consulted						
8	Verify GHG estimates: • Compare estimates to other national or international estimates at the national, gas, sector, or sub-sector level as available						

Annex 5. Uncertainty Analysis

Annex 5-1. Overall Inventory Uncertainty in the Republic of Moldova for 2016

IPCC category/Group	Gas	Base year emissions or removals	Year 2016 emissions or removals	Activity data uncertainty (1)	Emission factor / estimation parameter uncertainty (1)	Combined uncertainty	Contribution to variance by category in year 2016	Type A sensitivity	Type B sensitivity	Uncertainty in trend in national emissions introduced by emission factor / estimation parameter uncertainty (2)	Uncertainty in trend in national emissions introduced by activity data uncertainty (3)	Uncertainty introduced into the trend in total national emissions
		kt CO_2 equivalent	kt CO_2 equivalent	%	%	%		%	%	%	%	%
		input data	input data	input data Note A	input data Note A	$\sqrt{E^2+F^2}$	$\frac{(G \bullet D)^2}{(\sum D)^2}$	Note B	$\left\lvert\frac{D}{\sum C}\right\rvert$	I*F Note C	J*E*sqrt(2) Note D	K^2 + L^2
1.A.1. Energy industries	CO_2	21 244.3119	4 518.9699	5	5	7.0711	5.4738	0.0497	0.1041	0.2486	0.7364	0.6041
1.A.1. Energy industries	CH_4	12.2564	2.2700	5	50	50.2494	0.0001	0.0000	0.0001	0.0018	0.0004	0.0000
1.A.1. Energy industries	N_2O	51.6374	4.8207	3	50	50.0899	0.0003	0.0003	0.0001	0.0132	0.0005	0.0002
1.A.2. Manufacturing industries and construction	CO_2	2 204.8457	500.7010	5	5	7.0711	0.0672	0.0045	0.0115	0.0223	0.0816	0.0072
1.A.2. Manufacturing industries and construction	CH_4	2.4619	0.4963	5	50	50.2494	0.0000	0.0000	0.0000	0.0003	0.0001	0.0000
1.A.2. Manufacturing industries and construction	N_2O	5.1008	0.7988	5	50	50.2494	0.0000	0.0000	0.0000	0.0009	0.0001	0.0000
1.A.3. Transport	CO_2	4 344.7615	2 331.5969	5	5	7.0711	1.4572	0.0222	0.0537	0.1110	0.3800	0.1567
1.A.3. Transport	CH_4	33.0652	12.0472	5	50	50.2494	0.0020	0.0000	0.0003	0.0019	0.0020	0.0000
1.A.3. Transport	N_2O	101.6275	39.2820	5	50	50.2494	0.0209	0.0002	0.0009	0.0084	0.0064	0.0001
1.A.4. Other sectors	CO_2	7 372.2624	1 677.5744	5	5	7.0711	0.7543	0.0148	0.0387	0.0740	0.2734	0.0802
1.A.4. Other sectors	CH_4	289.6015	116.7297	5	50	50.2494	0.1844	0.0006	0.0027	0.0295	0.0190	0.0012
1.A.4. Other sectors	N_2O	27.8496	18.4881	5	50	50.2494	0.0046	0.0002	0.0004	0.0112	0.0030	0.0001
1.A.5. Other	CO_2	113.9722	2.1005	5	5	7.0711	0.0000	0.0008	0.0000	0.0039	0.0003	0.0000
1.A.5. Other	CH_4	0.2726	0.0061	5	50	50.2494	0.0000	0.0000	0.0000	0.0001	0.0000	0.0000
1.A.5. Other	N_2O	1.3253	0.0223	5	50	50.2494	0.0000	0.0000	0.0000	0.0005	0.0000	0.0000
1.B.2. Oil and natural gas and other emissions from energy production	CO_2	0.6377	1.6704	25	25	35.3553	0.0000	0.0000	0.0000	0.0008	0.0014	0.0000
1.B.2. Oil and natural gas and other emissions from energy production	CH_4	640.6250	611.0903	25	25	35.3553	2.5024	0.0094	0.0141	0.2359	0.4979	0.3036
1.B.2. Oil and natural gas and other emissions from energy production	N_2O	163.9000	88.5637	25	25	35.3553	0.0526	0.0009	0.0020	0.0213	0.0722	0.0057
2.A.1. Cement production	CO_2	971.6967	433.9022	2	3	3.6056	0.0131	0.0030	0.0100	0.0089	0.0283	0.0009
2.A.2. Lime production	CO_2	232.4996	21.5797	10	2	10.1980	0.0003	0.0012	0.0005	0.0024	0.0070	0.0001
2.A.3. Glass production	CO_2	25.2212	30.1307	15	10	18.0278	0.0016	0.0005	0.0007	0.0051	0.0147	0.0002
2.A.4. Other processes uses of carbonates	CO_2	76.8231	14.9649	20	5	20.6155	0.0005	0.0002	0.0003	0.0011	0.0098	0.0001
2.C.1. Iron and steel production	CO_2	28.5023	5.2203	5	10	11.1803	0.0000	0.0001	0.0001	0.0009	0.0009	0.0000
2.D.1. Lubricant use	CO_2	24.7987	4.9177	5	50	50.2494	0.0003	0.0001	0.0001	0.0033	0.0008	0.0000
2.D.2. Paraffin wax use	CO_2	0.1138	0.0449	20	100	101.9804	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
2.D.3. Solvent use	CO_2	204.1460	70.7300	20	35	40.3113	0.0436	0.0001	0.0016	0.0052	0.0461	0.0022
2.D.4. Other (urea-based catalysts)	CO_2	5.3005	2.9202	20	2	20.0998	0.0000	0.0000	0.0001	0.0001	0.0019	0.0000
2.F.1. Refrigeration and air conditioning	HFCs		70.7568	20	50	53.8516	0.0778	0.0016	0.0016	0.0815	0.0461	0.0088
2.F.2. Foam blowing agents	HFCs		104.8218	30	30	42.4264	0.1060	0.0024	0.0024	0.0725	0.1025	0.0158
2.F.4. Aerosols	HFCs		0.0061	5	5	7.0711	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
2.G.1. Electrical equipment	SF_6		1.1252	5	20	20.6155	0.0000	0.0000	0.0000	0.0005	0.0002	0.0000
2.G.1. Electrical equipment	PFC		0.0403	5	20	20.6155	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
2.G.3. 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
2.G.4. Other product use	CO_2	3.1787	0.7041	5	50	50.2494	0.0000	0.0000	0.0000	0.0003	0.0001	0.0000
3.A. Enteric fermentation	CH_4	2 190.6944	649.2698	10	20	22.3607	1.1299	0.0009	0.0150	0.0186	0.2116	0.0451

IPCC category/Group	Gas	Base year emissions or removals	Year 2016 emissions or removals	Activity data uncertainty (1)	Emission factor / estimation parameter uncertainty (1)	Combined uncertainty	Contribution to variance by category in year 2016	Type A sensitivity	Type B sensitivity	Uncertainty in trend in national emissions introduced by emission factor / estimation parameter uncertainty (2)	Uncertainty in trend in national emissions introduced by activity data uncertainty (3)	Uncertainty introduced into the trend in total national emissions
		kt CO_2 equivalent	kt CO_2 equivalent	%	%	%		%	%	%	%	%
3.B. Manure management	CH_4	495.0955	68.3414	10	30	31.6228	0.0250	0.0020	0.0016	0.0605	0.0223	0.0042
3.B.a. Direct N_2O emissions from manure management	N_2O	871.9076	308.0594	30	100	104.4031	5.5454	0.0008	0.0071	0.0775	0.3012	0.0967
3.B.b. Indirect N_2O emissions from manure management	N_2O	244.7103	64.6604	30	150	152.9706	0.5245	0.0003	0.0015	0.0427	0.0632	0.0058
3.D.a.1. Synthetic N Fertilizers Application	N_2O	431.2911	203.2777	5	6	7.8102	0.0135	0.0016	0.0047	0.0093	0.0331	0.0012
3.D.a.2. Organic N Applied as Fertilizer	N_2O	259.7852	78.0910	30	6	30.5941	0.0306	0.0001	0.0018	0.0005	0.0764	0.0058
3.D.1.3. Urine and Dung N Deposited on Pasture	N_2O	53.8411	48.9589	30	50	58.3095	0.0437	0.0007	0.0011	0.0369	0.0479	0.0037
3.D.a.4. N in Crop Residue	N_2O	162.9914	120.0962	5	25	25.4951	0.0503	0.0016	0.0028	0.0396	0.0196	0.0020
3.D.a.5. N Mineralization	N_2O	169.2662	600.0808	5	25	25.4951	1.2548	0.0126	0.0138	0.3150	0.0978	0.1088
3.D.b.1. Atmospheric Deposition of N volatilized	N_2O	102.1793	42.5624	70	150	165.5295	0.2661	0.0002	0.0010	0.0360	0.0971	0.0107
3.D.b.2. N Leaching/Runoff from Managed Soils	N_2O	238.2299	232.7913	75	150	167.7051	8.1708	0.0036	0.0054	0.5455	0.5690	0.6214
3.H. Urea application	CO_2	0.5820	12.2747	30	50	58.3095	0.0027	0.0003	0.0003	0.0139	0.0120	0.0003
4.A.1. Forest Land Remaining Forest Land	CO_2	-1 579.0396	-1 451.3266	15	5	15.8114	2.8230	0.0220	0.0334	0.1100	0.7095	0.5155
4.A.2. Land Converted to Forest Land	CO_2	-984.3932	-662.2202	15	5	15.8114	0.5877	0.0081	0.0153	0.0406	0.3237	0.1065
4.A.2.Land Converted to Forest Land. Non-CO_2 Emissions from Vegetation Fires	CH_4	0.2072	0.3085	10	30	31.6228	0.0000	0.0000	0.0000	0.0002	0.0001	0.0000
4.A.2.Land Converted to Forest Land. Non-CO_2 Emissions from Vegetation Fires	N_2O	0.1366	0.2034	10	30	31.6228	0.0000	0.0000	0.0000	0.0001	0.0001	0.0000
4.B.1. Cropland Remaining Cropland	CO_2	2 602.9804	1 775.4060	10	10	14.1421	3.3796	0.0220	0.0409	0.2202	0.5786	0.3833
4.B.1. Cropland Remaining Cropland. Non-CO_2 Emissions from Vegetation Fires	CH_4	2.4461	0.0483	10	30	31.6228	0.0000	0.0000	0.0000	0.0005	0.0000	0.0000
4.B.1. Cropland Remaining Cropland. Non-CO_2 Emissions from Vegetation Fires	N_2O	0.7559	0.0149	10	50	50.9902	0.0000	0.0000	0.0000	0.0003	0.0000	0.0000
4.B.2. Land Converted to Cropland	CO_2	-94.0174	-382.1704	10	10	14.1421	0.1566	0.0081	0.0088	0.0813	0.1246	0.0221
4.B.2. Land Converted to Cropland. Non-CO2 Emissions from converted lands	N_2O	9.6848	0.7691	10	30	31.6228	0.0000	0.0001	0.0000	0.0016	0.0003	0.0000
4.C.1. Grassland Remaining Grassland	CO_2	0.0000	0.0000	15	10	18.0278	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
4.C.2. Land Converted to Grassland	CO_2	-1 205.6938	-402.3693	15	10	18.0278	0.2821	0.0005	0.0093	0.0053	0.1967	0.0387
4.D.1. Wetlands Remaining Wetlands	CO_2	0.0000	0.0000	10	10	14.1421	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
4.D.2. Land Converted to Wetlands	CO_2	-555.3798	-82.7917	10	10	14.1421	0.0073	0.0021	0.0019	0.0212	0.0270	0.0012
4.E.1. Settlements Remaining Settlements	CO_2	0.0000	0.0000	10	10	14.1421	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
4.E.2. Land Converted to Settlements	CO_2	84.7480	19.3071	10	10	14.1421	0.0004	0.0002	0.0004	0.0017	0.0063	0.0000
4.E.2. Land Converted to Settlements. Non-CO_2 Emissions	N_2O	159.7967	178.2795	10	30	31.6228	0.1704	0.0029	0.0041	0.0885	0.0581	0.0112
4.F.1. Other Land Remaining Other Land	CO_2	0.0000	0.0000	10	10	14.1421	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
4.F.2. Land Converted to Other Land	CO_2	152.3638	85.6461	10	10	14.1421	0.0079	0.0009	0.0020	0.0087	0.0279	0.0009
4.H. HWP	CO_2	-122.1804	0.8816	30	10	31.6228	0.0000	0.0009	0.0000	0.0091	0.0009	0.0001
5.A. Solid waste disposal	CH_4	1 046.7277	1 115.1732	30	40	50.0000	16.6672	0.0181	0.0257	0.7241	1.0904	1.7133
5.C. Incineration and open burning of waste	CO_2	17.1060	15.4600	40	25	47.1699	0.0029	0.0002	0.0004	0.0058	0.0202	0.0004
5.C. Incineration and open burning of waste	CH_4	8.7818	7.9023	40	50	64.0312	0.0014	0.0001	0.0002	0.0059	0.0103	0.0001
5.C. Incineration and open burning of waste	N_2O	1.8371	1.6560	40	100	107.7033	0.0002	0.0000	0.0000	0.0025	0.0022	0.0000
5.D. Waste water treatment and discharge	CH_4	352.9650	251.8125	30	40	50.0000	0.8498	0.0032	0.0058	0.1297	0.2462	0.0774
5.D. Waste water treatment and discharge	N_2O	87.9499	68.2697	30	50	58.3095	0.0850	0.0009	0.0016	0.0468	0.0668	0.0066
END												
Total		**43 391.1722**	**13 657.8174**				**52.8418**					**4.9702**
Total Uncertainties						**Uncertainty in total inventory %:**	**7.2692**				**Trend uncertainty %:**	**2.2294**

Annex 5-2. Summary of Direct Greenhouse Gas Uncertainties

Annex 5-2.1. Carbon Dioxide Uncertainties

IPCC category/Group	Gas	Base year emissions or removals	Year 2016 emissions or removals	Activity data uncertainty (1)	Emission factor / estimation parameter uncertainty (1)	Combined uncertainty	Contribution to variance by category in year 2016	Type A sensitivity	Type B sensitivity	Uncertainty in trend in national emissions introduced by emission factor / estimation parameter uncertainty (2)	Uncertainty in trend in national emissions introduced by activity data uncertainty (3)	Uncertainty introduced into the trend in total national emissions
		kt CO_2 equivalent	kt CO_2 equivalent	%	%	%		%	%	%	%	%
		input data	input data	input data Note A	input data Note A	$\sqrt{E^2+F^2}$	$\frac{(G \bullet D)^2}{(\sum D)^2}$	Note B	$\left\lvert\frac{D}{\sum C}\right\rvert$	I*F Note C	J*E*sqrt(2) Note D	K^2 + L^2
1.A.1. Energy industries	CO_2	21 244.3119	4 518.9699	5	5	7.0711	13.9811	0.0182	0.1285	0.0909	0.9086	0.8337
1.A.2. Manufacturing industries and construction	CO_2	2 204.8457	500.7010	5	5	7.0711	0.1716	0.0010	0.0142	0.0050	0.1007	0.0102
1.A.3. Transport	CO_2	4 344.7615	2 331.5969	5	5	7.0711	3.7219	0.0362	0.0663	0.1812	0.4688	0.2526
1.A.4. Other sectors	CO_2	7 372.2624	1 677.5744	5	5	7.0711	1.9268	0.0032	0.0477	0.0161	0.3373	0.1140
1.A.5. Other	CO_2	113.9722	2.1005	5	5	7.0711	0.0000	0.0007	0.0001	0.0036	0.0004	0.0000
1.B.2. Oil and natural gas and other emissions from energy production	CO_2	0.6377	1.6704	25	25	35.3553	0.0000	0.0000	0.0000	0.0011	0.0017	0.0000
2.A.1. Cement production	CO_2	971.6967	433.9022	2	3	3.6056	0.0335	0.0056	0.0123	0.0169	0.0349	0.0015
2.A.2. Lime production	CO_2	232.4996	21.5797	10	2	10.1980	0.0007	0.0010	0.0006	0.0020	0.0087	0.0001
2.A.3. Glass production	CO_2	25.2212	30.1307	15	10	18.0278	0.0040	0.0007	0.0009	0.0068	0.0182	0.0004
2.A.4. Other processes uses of carbonates	CO_2	76.8231	14.9649	20	5	20.6155	0.0013	0.0001	0.0004	0.0005	0.0120	0.0001
2.C.1. Iron and steel production	CO_2	28.5023	5.2203	5	10	11.1803	0.0000	0.0000	0.0001	0.0005	0.0010	0.0000
2.D.1. Lubricant use	CO_2	24.7987	4.9177	5	50	50.2494	0.0008	0.0000	0.0001	0.0016	0.0010	0.0000
2.D.2. Paraffin wax use	CO_2	0.1138	0.0449	20	100	101.9804	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
2.D.3. Solvent use	CO_2	204.1460	70.7300	20	35	40.3113	0.1113	0.0006	0.0020	0.0210	0.0569	0.0037
2.D.4. Other (urea-based catalysts)	CO_2	5.3005	2.9202	20	2	20.0998	0.0000	0.0000	0.0001	0.0001	0.0023	0.0000
2.G.4. Other product use	CO_2	3.1787	0.7041	5	50	50.2494	0.0000	0.0000	0.0000	0.0001	0.0001	0.0000
3.H. Urea application	CO_2	0.5820	12.2747	30	50	58.3095	0.0070	0.0003	0.0003	0.0172	0.0148	0.0005
4.A.1. Forest Land Remaining Forest Land	CO_2	-1 579.0396	-1 451.3266	15	5	15.8114	7.2104	0.0304	0.0413	0.1519	0.8754	0.7894
4.A.2. Land Converted to Forest Land	CO_2	-984.3932	-662.2202	15	5	15.8114	1.5012	0.0120	0.0188	0.0602	0.3994	0.1632
4.B.1. Cropland Remaining Cropland	CO_2	2 602.9804	1 775.4060	10	10	14.1421	8.6321	0.0325	0.0505	0.3247	0.7139	0.6151
4.B.2. Land Converted to Cropland	CO_2	-94.0174	-382.1704	10	10	14.1421	0.4000	0.0102	0.0109	0.1022	0.1537	0.0341
4.C.1. Grassland Remaining Grassland	CO_2	0.0000	0.0000	15	10	18.0278	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
4.C.2. Land Converted to Grassland	CO_2	-1 205.6938	-402.3693	15	10	18.0278	0.7205	0.0031	0.0114	0.0311	0.2427	0.0599
4.D.1. Wetlands Remaining Wetlands	CO_2	0.0000	0.0000	10	10	14.1421	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
4.D.2. Land Converted to Wetlands	CO_2	-555.3798	-82.7917	10	10	14.1421	0.0188	0.0015	0.0024	0.0148	0.0333	0.0013
4.E.1. Settlements Remaining Settlements	CO_2	0.0000	0.0000	10	10	14.1421	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
4.E.2. Land Converted to Settlements	CO_2	84.7480	19.3071	10	10	14.1421	0.0010	0.0000	0.0005	0.0004	0.0078	0.0001
4.F.1. Other Land Remaining Other Land	CO_2	0.0000	0.0000	10	10	14.1421	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
4.F.2. Land Converted to Other Land	CO_2	152.3638	85.6461	10	10	14.1421	0.0201	0.0014	0.0024	0.0138	0.0344	0.0014
4.H. HWP	CO_2	-122.1804	0.8816	30	10	31.6228	0.0000	0.0009	0.0000	0.0087	0.0011	0.0001
5.C. Incineration and open burning of waste	CO_2	17.1060	15.4600	40	25	47.1699	0.0073	0.0003	0.0004	0.0080	0.0249	0.0007
END												
Total		**35 170.1483**	**8 545.8253**				**38.4717**					**2.8819**
Total Uncertainties						**Uncertainty in total inventory %:**	**6.2026**				**Trend uncertainty %:**	**1.6976**

Annex 5-2.2. Methane Uncertainties

IPCC category/Group	Gas	Base year emissions or removals	Year 2016 emissions or removals	Activity data uncertainty (1)	Emission factor / estimation parameter uncertainty (1)	Combined uncertainty	Contribution to variance by category in year 2016	Type A sensitivity	Type B sensitivity	Uncertainty in trend in national emissions introduced by emission factor / estimation parameter uncertainty (2)	Uncertainty in trend in national emissions introduced by activity data uncertainty (3)	Uncertainty introduced into the trend in total national emissions
		kt CO_2 equivalent	kt CO_2 equivalent	%	%	%		%	%	%	%	%
		input data	input data	input data Note A	input data Note A	$\sqrt{E^2+F^2}$	$\frac{(G \bullet D)^2}{(\sum D)^2}$	Note B	$\left\lvert\frac{D}{\sum C}\right\rvert$	I*F Note C	J*E*sqrt(2) Note D	K^2 + L^2
1.A.1. Energy industries	CH_4	12.2564	2.2700	5	50	50.2494	0.0016	0.0009	0.0004	0.0451	0.0032	0.0020
1.A.2. Manufacturing industries and construction	CH_4	2.4619	0.4963	5	50	50.2494	0.0001	0.0002	0.0001	0.0087	0.0007	0.0001
1.A.3. Transport	CH_4	33.0652	12.0472	5	50	50.2494	0.0456	0.0013	0.0024	0.0633	0.0168	0.0043
1.A.4. Other sectors	CH_4	289.6015	116.7297	5	50	50.2494	4.2792	0.0089	0.0230	0.4438	0.1626	0.2234
1.A.5. Other	CH_4	0.2726	0.0061	5	50	50.2494	0.0000	0.0000	0.0000	0.0014	0.0000	0.0000
1.B.2. Oil and natural gas and other emissions from energy production	CH_4	640.6250	611.0903	25	25	35.3553	58.0581	0.0498	0.1204	1.2455	4.2570	19.6737
3.A. Enteric fermentation	CH_4	2 190.6944	649.2698	10	20	22.3607	26.2158	0.1127	0.1279	2.2549	1.8092	8.3576
3.B. Manure management	CH_4	495.0955	68.3414	10	30	31.6228	0.5809	0.0410	0.0135	1.2299	0.1904	1.5489
4.A.2.Land Converted to Forest Land. Non-CO_2 Emissions from Vegetation Fires.	CH_4	0.2072	0.3085	10	30	31.6228	0.0000	0.0000	0.0001	0.0011	0.0009	0.0000
4.B.1. Cropland Remaining Cropland. Non-CO_2 Emissions from Vegetation Fires	CH_4	2.4461	0.0483	10	30	31.6228	0.0000	0.0003	0.0000	0.0078	0.0001	0.0001
5.A. Solid waste disposal	CH_4	1 046.7277	1 115.1732	30	40	50.0000	386.6934	0.1043	0.2197	4.1715	9.3223	104.3075
5.C. Incineration and open burning of waste	CH_4	8.7818	7.9023	40	50	64.0312	0.0318	0.0006	0.0016	0.0295	0.0881	0.0086
5.D. Waste water treatment and discharge	CH_4	352.9650	251.8125	30	40	50.0000	19.7168	0.0108	0.0496	0.4301	2.1050	4.6162
END												
Total		**5 075.2004**	**2 835.4954**				**495.6233**					**138.7424**
Total Uncertainties						**Uncertainty in total inventory %:**	**22.2626**				**Trend uncertainty %:**	**11.7789**

Annex 5-2.3. Nitrous Oxide Uncertainties

IPCC category/Group	Gas	Base year emissions or removals	Year 2016 emissions or removals	Activity data uncertainty (1)	Emission factor / estimation parameter uncertainty (1)	Combined uncertainty	Contribution to variance by category in year 2016	Type A sensitivity	Type B sensitivity	Uncertainty in trend in national emissions introduced by emission factor / estimation parameter uncertainty (2)	Uncertainty in trend in national emissions introduced by activity data uncertainty (3)	Uncertainty introduced into the trend in total national emissions
		kt CO_2 equivalent	kt CO_2 equivalent	%	%	%		%	%	%	%	%
		input data	input data	input data Note A	input data Note A	$\sqrt{E^2+F^2}$	$\frac{(G \bullet D)^2}{(\sum D)^2}$	Note B	$\left\lvert\frac{D}{\sum C}\right\rvert$	I*F Note C	J*E*sqrt(2) Note D	K^2 + L^2
1.A.1. Energy industries	N_2O	51.6374	4.8207	5	50	50.2494	0.0133	0.0094	0.0015	0.4711	0.0108	0.2221
1.A.2. Manufacturing industries and construction	N_2O	5.1008	0.7988	5	50	50.2494	0.0004	0.0008	0.0003	0.0414	0.0018	0.0017
1.A.3. Transport	N_2O	101.6275	39.2820	5	50	50.2494	0.8837	0.0091	0.0125	0.4537	0.0883	0.2136
1.A.4. Other sectors	N_2O	27.8496	18.4881	5	50	50.2494	0.1958	0.0000	0.0059	0.0016	0.0416	0.0017
1.A.5. Other	N_2O	1.3253	0.0223	5	50	50.2494	0.0000	0.0003	0.0000	0.0137	0.0001	0.0002
1.B.2. Oil and natural gas and other emissions from energy production	N_2O	163.9000	88.5637	25	25	35.3553	2.2238	0.0066	0.0282	0.1655	0.9954	1.0181

IPCC category/Group	Gas	Base year emissions or removals	Year 2016 emissions or removals	Activity data uncertainty (1)	Emission factor / estimation parameter uncertainty (1)	Combined uncertainty	Contribution to variance by category in year 2016	Type A sensitivity	Type B sensitivity	Uncertainty in trend in national emissions introduced by emission factor / estimation parameter uncertainty (2)	Uncertainty in trend in national emissions introduced by activity data uncertainty (3)	Uncertainty introduced into the trend in total national emissions
		kt CO_2 equivalent	kt CO_2 equivalent	%	%	%		%	%	%	%	%
		input data	input data	input data Note A	input data Note A	$\sqrt{E^2+F^2}$	$\frac{(G \bullet D)^2}{(\sum D)^2}$	Note B	$\left\vert\frac{D}{\sum C}\right\vert$	I*F Note C	J*E*sqrt(2) Note D	K^2 + L^2
2.G.3. 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
3.B.a. Direct N_2O emissions from manure management	N_2O	871.9076	308.0594	30	100	104.4031	234.6182	0.0868	0.0979	8.6832	4.1547	92.6584
3.B.b. Indirect N_2O emissions from manure management	N_2O	244.7103	64.6604	30	150	152.9706	22.1901	0.0313	0.0206	4.7015	0.8720	22.8643
3.D.a.1. Synthetic N Fertilizers Application	N_2O	431.2911	203.2777	5	6	7.8102	0.5717	0.0269	0.0646	0.1611	0.4569	0.2347
3.D.a.2. Organic N Applied as Fertilizer	N_2O	259.7852	78.0910	30	6	30.5941	1.2946	0.0303	0.0248	0.1816	1.0532	1.1422
3.D.1.3. Urine and Dung N Deposited on Pasture	N_2O	53.8411	48.9589	30	50	58.3095	1.8485	0.0041	0.0156	0.2069	0.6603	0.4788
3.D.a.4. N in Crop Residue	N_2O	162.9914	120.0962	5	25	25.4951	2.1264	0.0036	0.0382	0.0898	0.2699	0.0809
3.D.a.5. N Mineralization	N_2O	169.2662	600.0808	5	25	25.4951	53.0883	0.1548	0.1908	3.8689	1.3488	16.7880
3.D.b.1. Atmospheric Deposition of N volatilized	N_2O	102.1793	42.5624	70	150	165.5295	11.2582	0.0081	0.0135	1.2221	1.3394	3.2876
.3D.b.2. N Leaching/Runoff from Managed Soils	N_2O	238.2299	232.7913	75	150	167.7051	345.6945	0.0234	0.0740	3.5153	7.8489	73.9627
4.A.2.Land Converted to Forest Land. Non-CO_2 Emissions from Vegetation Fires.	N_2O	0.1366	0.2034	10	30	31.6228	0.0000	0.0000	0.0001	0.0011	0.0009	0.0000
4.B.1. Cropland Remaining Cropland. Non-CO_2 Emissions from Vegetation Fires	N_2O	0.7559	0.0149	10	50	50.9902	0.0000	0.0002	0.0000	0.0078	0.0001	0.0001
4.B.2. Land Converted to Cropland. Non-CO_2 Emissions from converted lands	N_2O	9.6848	0.7691	10	30	31.6228	0.0001	0.0018	0.0002	0.0543	0.0035	0.0030
4.E.2. Land Converted to Settlements. Non-CO_2 Emissions	N_2O	159.7967	178.2795	10	30	31.6228	7.2089	0.0228	0.0567	0.6827	0.8015	1.1084
5.C. Incineration and open burning of waste	N_2O	1.8371	1.6560	40	100	107.7033	0.0072	0.0001	0.0005	0.0137	0.0298	0.0011
5.D. Waste water treatment and discharge	N_2O	87.9499	68.2697	30	50	58.3095	3.5942	0.0030	0.0217	0.1520	0.9207	0.8708
END												
Total		**3 145.8235**	**2 099.7464**				**686.8178**					**214.9383**
Total Uncertainties						**Uncertainty in total inventory %:**	**26.2072**				**Trend uncertainty %:**	**14.6608**

Annex 5-3. Overall Inventory Uncertainty

Annex 5-3.1. Overall Inventory Uncertainty for Sector 1 'Energy'

IPCC category/Group	Gas	Base year emissions or removals	Year 2016 emissions or removals	Activity data uncertainty (1)	Emission factor / estimation parameter uncertainty (1)	Combined uncertainty	Contribution to variance by category in year 2016	Type A sensitivity	Type B sensitivity	Uncertainty in trend in national emissions introduced by emission factor / estimation parameter uncertainty (2)	Uncertainty in trend in national emissions introduced by activity data uncertainty (3)	Uncertainty introduced into the trend in total national emissions
		kt CO_2 equivalent	kt CO_2 equivalent	%	%	%		%	%	%	%	%
		input data	input data	input data Note A	input data Note A	$\sqrt{E^2+F^2}$	$\frac{(G \bullet D)^2}{(\sum D)^2}$	Note B	$\left\vert\frac{D}{\sum C}\right\vert$	I*F Note C	J*E*sqrt(2) Note D	K^2 + L^2
1.A.1. Energy industries	CO_2	21244.3119	4518.9699	5	5	7.0711	10.3608	0.0337	0.1234	0.1686	0.8728	0.7902
1.A.1. Energy industries	CH_4	12.2564	2.2700	5	50	50.2494	0.0001	0.0000	0.0001	0.0014	0.0004	0.0000
1.A.1. Energy industries	N_2O	51.6374	4.8207	3	50	50.0899	0.0006	0.0003	0.0001	0.0125	0.0006	0.0002
1.A.2. Manufacturing industries and construction	CO_2	2204.8457	500.7010	5	5	7.0711	0.1272	0.0027	0.0137	0.0133	0.0967	0.0095

IPCC category/Group	Gas	Base year emissions or removals	Year 2016 emissions or removals	Activity data uncertainty (1)	Emission factor / estimation parameter uncertainty (1)	Combined uncertainty	Contribution to variance by category in year 2016	Type A sensitivity	Type B sensitivity	Uncertainty in trend in national emissions introduced by emission factor / estimation parameter uncertainty (2)	Uncertainty in trend in national emissions introduced by activity data uncertainty (3)	Uncertainty introduced into the trend in total national emissions
		kt CO_2 equivalent	kt CO_2 equivalent	%	%	%		%	%	%	%	%
		input data	input data	input data Note A	input data Note A	$\sqrt{E^2+F^2}$	$\frac{(G \bullet D)^2}{(\sum D)^2}$	Note B	$\left\lvert\frac{D}{\sum C}\right\rvert$	I*F Note C	J*E*sqrt(2) Note D	K^2 + L^2
1.A.2. Manufacturing industries and construction	CH_4	2.4619	0.4963	5	50	50.2494	0.0000	0.0000	0.0000	0.0002	0.0001	0.0000
1.A.2. Manufacturing industries and construction	N_2O	5.1008	0.7988	5	50	50.2494	0.0000	0.0000	0.0000	0.0008	0.0002	0.0000
1.A.3. Transport	CO_2	4344.7615	2331.5969	5	5	7.0711	2.7582	0.0315	0.0637	0.1573	0.4503	0.2276
1.A.3. Transport	CH_4	33.0652	12.0472	5	50	50.2494	0.0037	0.0001	0.0003	0.0042	0.0023	0.0000
1.A.3. Transport	N_2O	101.6275	39.2820	5	50	50.2494	0.0395	0.0003	0.0011	0.0160	0.0076	0.0003
1.A.4. Other sectors	CO_2	7372.2624	1677.5744	5	5	7.0711	1.4278	0.0088	0.0458	0.0438	0.3240	0.1069
1.A.4. Other sectors	CH_4	289.6015	116.7297	5	50	50.2494	0.3491	0.0010	0.0032	0.0522	0.0225	0.0032
1.A.4. Other sectors	N_2O	27.8496	18.4881	5	50	50.2494	0.0088	0.0003	0.0005	0.0149	0.0036	0.0002
1.A.5. Other	CO_2	113.9722	2.1005	5	5	7.0711	0.0000	0.0008	0.0001	0.0039	0.0004	0.0000
1.A.5. Other	CH_4	0.2726	0.0061	5	50	50.2494	0.0000	0.0000	0.0000	0.0001	0.0000	0.0000
1.A.5. Other	N_2O	1.3253	0.0223	5	50	50.2494	0.0000	0.0000	0.0000	0.0005	0.0000	0.0000
1.B.2. Oil and natural gas and other emissions from energy production	CO_2	0.6377	1.6704	25	25	35.3553	0.0000	0.0000	0.0000	0.0010	0.0016	0.0000
1.B.2. Oil and natural gas and other emissions from energy production	CH_4	640.6250	611.0903	25	25	35.3553	4.7366	0.0119	0.0167	0.2986	0.5901	0.4374
1.B.2. Oil and natural gas and other emissions from energy production	N_2O	163.9000	88.5637	25	25	35.3553	0.0995	0.0012	0.0024	0.0301	0.0855	0.0082
END												
Total		**36610.5147**	**9927.2284**				**19.9120**					**1.5838**
Total Uncertainties						**Uncertainty in total inventory %:**	**4.4623**				**Trend uncertainty %:**	**1.2585**

Annex 5-3.2. Overall Inventory Uncertainty for Sector 2 'Industrial Processes and Product Use'

IPCC category/Group	Gas	Base year emissions or removals	Year 2016 emissions or removals	Activity data uncertainty (1)	Emission factor / estimation parameter uncertainty (1)	Combined uncertainty	Contribution to variance by category in year 2016	Type A sensitivity	Type B sensitivity	Uncertainty in trend in national emissions introduced by emission factor / estimation parameter uncertainty (2)	Uncertainty in trend in national emissions introduced by activity data uncertainty (3)	Uncertainty introduced into the trend in total national emissions
		kt CO_2 equivalent	kt CO_2 equivalent	%	%	%		%	%	%	%	%
		input data	input data	input data Note A	input data Note A	$\sqrt{E^2+F^2}$	$\frac{(G \bullet D)^2}{(\sum D)^2}$	Note B	$\left\lvert\frac{D}{\sum C}\right\rvert$	I*F Note C	J*E*sqrt(2) Note D	K^2 + L^2
2.A.1. Cement production	CO_2	971.6967	433.9022	2	3	3.6056	4.2167	0.0233	0.2760	0.0700	0.7806	0.6142
2.A.2. Lime production	CO_2	232.4996	21.5797	10	2	10.1980	0.0834	0.0578	0.0137	0.1157	0.1941	0.0511
2.A3. Glass production	CO_2	25.2212	30.1307	15	10	18.0278	0.5083	0.0114	0.0192	0.1139	0.4065	0.1782
2.A.4. Other processes uses of carbonates	CO_2	76.8231	14.9649	20	5	20.6155	0.1640	0.0142	0.0095	0.0708	0.2692	0.0775
2.C.1. Iron and steel production	CO_2	28.5023	5.2203	5	10	11.1803	0.0059	0.0055	0.0033	0.0546	0.0235	0.0035
2.D.1. Lubricant use	CO_2	24.7987	4.9177	5	50	50.2494	0.1052	0.0045	0.0031	0.2257	0.0221	0.0514
2.D.2. Paraffin wax use	CO_2	0.1138	0.0449	20	100	101.9804	0.0000	0.0000	0.0000	0.0007	0.0008	0.0000
2.D.3. Solvent use	CO_2	204.1460	70.7300	20	35	40.3113	14.0057	0.0179	0.0450	0.6267	1.2724	2.0117
2.D.4. Other (urea-based catalysts)	CO_2	5.3005	2.9202	20	2	20.0998	0.0059	0.0002	0.0019	0.0004	0.0525	0.0028

IPCC category/Group	Gas	Base year emissions or removals	Year 2016 emissions or removals	Activity data uncertainty (1)	Emission factor / estimation parameter uncertainty (1)	Combined uncertainty	Contribution to variance by category in year 2016	Type A sensitivity	Type B sensitivity	Uncertainty in trend in national emissions introduced by emission factor / estimation parameter uncertainty (2)	Uncertainty in trend in national emissions introduced by activity data uncertainty (3)	Uncertainty introduced into the trend in total national emissions
		kt CO_2 equivalent	kt CO_2 equivalent	%	%	%		%	%	%	%	%
		input data	input data	input data Note A	input data Note A	$\sqrt{E^2+F^2}$	$\frac{(G \bullet D)^2}{(\sum D)^2}$	Note B	$\left\lvert\frac{D}{\sum C}\right\rvert$	I*F Note C	J*E*sqrt(2) Note D	K^2 + L^2
2.F.1. Refrigeration and air conditioning	HFCs		70.7568	20	50	53.8516	25.0138	0.0450	0.0450	2.2501	1.2729	6.6831
2.F.2. Foam blowing agents	HFCs		104.8218	30	30	42.4264	34.0737	0.0667	0.0667	2.0000	2.8285	12.0004
2.F.4. Aerosols	HFCs		0.0061	5	5	7.0711	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
2.G.1. Electrical equipment	SF_6		1.1252	5	20	20.6155	0.0009	0.0007	0.0007	0.0143	0.0051	0.0002
2.G.1. Electrical equipment	PFCs		0.0403	5	20	20.6155	0.0000	0.0000	0.0000	0.0005	0.0002	0.0000
2.G.3. 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
2.G.4. Other product use	CO_2	3.1787	0.7041	5	50	50.2494	0.0022	0.0005	0.0004	0.0266	0.0032	0.0007
END												
Total		**1572.3005**	**761.8649**				**78.1857**					**21.6748**
Total Uncertainties						**Uncertainty in total inventory %:**	**8.8423**				**Trend uncertainty %:**	**4.6556**

Annex 5-3.3. Overall Inventory Uncertainty for Sector 3 'Agriculture'

IPCC category/Group	Gas	Base year emissions or removals	Year 2016 emissions or removals	Activity data uncertainty (1)	Emission factor / estimation parameter uncertainty (1)	Combined uncertainty	Contribution to variance by category in year 2016	Type A sensitivity	Type B sensitivity	Uncertainty in trend in national emissions introduced by emission factor / estimation parameter uncertainty (2)	Uncertainty in trend in national emissions introduced by activity data uncertainty (3)	Uncertainty introduced into the trend in total national emissions
		kt CO_2 equivalent	kt CO_2 equivalent	%	%	%		%	%	%	%	%
		input data	input data	input data Note A	input data Note A	$\sqrt{E^2+F^2}$	$\frac{(G \bullet D)^2}{(\sum D)^2}$	Note B	$\left\lvert\frac{D}{\sum C}\right\rvert$	I*F Note C	J*E*sqrt(2) Note D	K^2 + L^2
3.A. Enteric fermentation	CH_4	2190.6944	649.2698	10	20	22.3607	35.7402	0.0705	0.1244	1.4107	1.7588	5.0835
3.B. Manure management	CH_4	495.0955	68.3414	10	30	31.6228	0.7920	0.0310	0.0131	0.9298	0.1851	0.8989
3.B.a. Direct N_2O emissions from manure management	N_2O	871.9076	308.0594	30	100	104.4031	175.4010	0.0187	0.0590	1.8650	2.5035	9.7460
3.B.b. Indirect N_2O emissions from manure management	N_2O	244.7103	64.6604	30	150	152.9706	16.5893	0.0094	0.0124	1.4122	0.5255	2.2704
3.D.a.1. Synthetic N Fertilizers Application	N_2O	431.2911	203.2777	5	6	7.8102	0.4274	0.0005	0.0389	0.0030	0.2753	0.0758
3.D.a.2. Organic N Applied as Fertilizer	N_2O	259.7852	78.0910	30	6	30.5941	0.9679	0.0082	0.0150	0.0491	0.6346	0.4052
3.D.1.3. Urine and Dung N Deposited on Pasture	N_2O	53.8411	48.9589	30	50	58.3095	1.3819	0.0046	0.0094	0.2290	0.3979	0.2108
3.D.a.4. N in Crop Residue	N_2O	162.9914	120.0962	5	25	25.4951	1.5897	0.0085	0.0230	0.2120	0.1627	0.0714
3.D.a.5. N Mineralization	N_2O	169.2662	600.0808	5	25	25.4951	39.6889	0.0998	0.1149	2.4958	0.8128	6.8895
3.D.b.1. Atmospheric Deposition of N volatilized	N_2O	102.1793	42.5624	70	150	165.5295	8.4167	0.0010	0.0082	0.1427	0.8071	0.6718
3.D.b.2. N Leaching/Runoff from Managed Soils	N_2O	238.2299	232.7913	75	150	167.7051	258.4418	0.0234	0.0446	3.5030	4.7296	34.6402
3.H. Urea application	CO_2	0.5820	12.2747	30	50	58.3095	0.0869	0.0023	0.0024	0.1150	0.0998	0.0232
END												
Total		**5220.5740**	**2428.4639**				**539.5237**					**60.9864**
Total Uncertainties						**Uncertainty in total inventory %:**	**23.2276**				**Trend uncertainty %:**	**7.8094**

Annex 5-3.4. Overall Inventory Uncertainty for Sector 4 'LULUCF'

IPCC category/Group	Gas	Base year emissions or removals	Year 2016 emissions or removals	Activity data uncertainty (1)	Emission factor / estimation parameter uncertainty (1)	Combined uncertainty	Contribution to variance by category in year 2016	Type A sensitivity	Type B sensitivity	Uncertainty in trend in national emissions introduced by emission factor / estimation parameter uncertainty (2)	Uncertainty in trend in national emissions introduced by activity data uncertainty (3)	Uncertainty introduced into the trend in total national emissions
		kt CO_2 equivalent	kt CO_2 equivalent	%	%	%		%	%	%	%	%
		input data	input data	input data Note A	input data Note A	$\sqrt{E^2+F^2}$	$\frac{(G \bullet D)^2}{(\sum D)^2}$	Note B	$\left\lvert\frac{D}{\sum C}\right\rvert$	I*F Note C	J*E*sqrt(2) Note D	K^2 + L^2
4.A.1. Forest Land Remaining Forest Land	CO_2	-1579.0396	-1451.3266	15	5	15.8114	622.1309	0.3242	0.9501	1.6209	20.1542	408.8201
4.A.2. Land Converted to Forest Land	CO_2	-984.3932	-662.2202	15	5	15.8114	129.5258	0.0451	0.4335	0.2255	9.1961	84.6190
4.A.2. Land Converted to Forest Land. Non-CO_2 Emissions from Vegetation Fires	CH_4	0.2072	0.3085	10	30	31.6228	0.0001	0.0001	0.0002	0.0036	0.0029	0.0000
4.A.2. Land Converted to Forest Land. Non-CO_2 Emissions from Vegetation Fires	N_2O	0.1366	0.2034	10	30	31.6228	0.0000	0.0001	0.0001	0.0024	0.0019	0.0000
4.B.1. Cropland Remaining Cropland	CO_2	2 602.9804	1 775.4060	10	10	14.1421	744.7952	0.1383	1.1622	1.3833	16.4364	272.0698
4.B.1. Cropland Remaining Cropland. Non-CO_2 Emissions from Vegetation Fires	CH_4	2.4461	0.0483	10	30	31.6228	0.0000	0.0009	0.0000	0.0280	0.0004	0.0008
4.B.1. Cropland Remaining Cropland. Non-CO_2 Emissions from Vegetation Fires	N_2O	0.7559	0.0149	10	50	50.9902	0.0000	0.0003	0.0000	0.0144	0.0001	0.0002
4.B.2. Land Converted to Cropland	CO_2	-94.0174	-382.1704	10	10	14.1421	34.5109	0.2130	0.2502	2.1298	3.5381	17.0541
4.B.2. Land Converted to Cropland. Non-CO_2 Emissions from converted lands	N_2O	9.6848	0.7691	10	30	31.6228	0.0007	0.0033	0.0005	0.0995	0.0071	0.0099
4.C.1. Grassland Remaining Grassland	CO_2	0.0000	0.0000	15	10	18.0278	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
4.C.2. Land Converted to Grassland	CO_2	-1205.6938	-402.3693	15	10	18.0278	62.1648	0.2103	0.2634	2.1030	5.5876	35.6438
4.D.1. Wetlands Remaining Wetlands	CO_2	0.0000	0.0000	10	10	14.1421	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
4.D.2. Land Converted to Wetlands	CO_2	-555.3798	-82.7917	10	10	14.1421	1.6196	0.1642	0.0542	1.6417	0.7665	3.2827
4.E.1. Settlements Remaining Settlements	CO_2	0.0000	0.0000	10	10	14.1421	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
4.E.2. Land Converted to Settlements	CO_2	84.7480	19.3071	10	10	14.1421	0.0881	0.0208	0.0126	0.2079	0.1787	0.0752
4.E.2. Land Converted to Settlements. Non-CO_2 Emissions	N_2O	159.7967	178.2795	10	30	31.6228	37.5504	0.0538	0.1167	1.6128	1.6505	5.3254
4.F.1. Other Land Remaining Other Land	CO_2	0.0000	0.0000	10	10	14.1421	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
4.F.2. Land Converted to Other Land	CO_2	152.3638	85.6461	10	10	14.1421	1.7332	0.0040	0.0561	0.0401	0.7929	0.6303
4.H. HWP	CO_2	-122.1804	0.8816	30	10	31.6228	0.0009	0.0487	0.0006	0.4871	0.0245	0.2379
END												
Total		**-1527.5846**	**-920.0136**				**1634.1207**					**827.7690**
Total Uncertainties						**Uncertainty in total inventory %:**	**40.4243**				**Trend uncertainty %:**	**28.7710**

Annex 5-3.5. Overall Inventory Uncertainty for Sector 5 'Waste Sector'

IPCC category/Group	Gas	Base year emissions	Year 2016 emissions	Activity data uncertainty (1)	Emission factor / estimation parameter uncertainty (1)	Combined uncertainty	Contribution to variance by category in year 2016	Type A sensitivity	Type B sensitivity	Uncertainty in trend in national emissions introduced by emission factor / estimation parameter uncertainty (2)	Uncertainty in trend in national emissions introduced by activity data uncertainty (3)	Uncertainty introduced into the trend in total national emissions
		kt CO_2 equivalent	kt CO_2 equivalent	%	%	%		%	%	%	%	%
		input data	input data	input data Note A	input data Note A	$\sqrt{E^2+F^2}$	$\frac{(G \bullet D)^2}{(\sum D)^2}$	Note B	$\left\lvert\frac{D}{\sum C}\right\rvert$	I*F Note C	J*E*sqrt(2) Note D	K^2 + L^2
5.A. Solid waste disposal	CH_4	1046.7277	1115.1732	30	40	50.0000	1457.9953	0.0698	0.7359	2.7919	31.2220	982.6077
5.C. Incineration and open burning of waste	CO_2	17.1060	15.4600	40	25	47.1699	0.2494	0.0007	0.0102	0.0169	0.5771	0.3334
5.C. Incineration and open burning of waste	CH_4	8.7818	7.9023	40	50	64.0312	0.1201	0.0004	0.0052	0.0185	0.2950	0.0874
5.C. Incineration and open burning of waste	N_2O	1.8371	1.6560	40	100	107.7033	0.0149	0.0001	0.0011	0.0075	0.0618	0.0039
5.D. Waste water treatment and discharge	CH_4	352.9650	251.8125	30	40	50.0000	74.3406	0.0581	0.1662	2.3259	7.0501	55.1138
5.D. Waste water treatment and discharge	N_2O	87.9499	68.2697	30	50	58.3095	7.4313	0.0109	0.0451	0.5435	1.9114	3.9488
END												
Total		**1515.3675**	**1460.2737**				**1540.1516**					**1042.0948**
Total Uncertainties						**Uncertainty in total inventory %:**	**39.2448**				**Trend uncertainty %:**	**32.2815**

Annex 6. Sectoral and Summary Reports on GHG Emissions in the Republic of Moldova within 1990-2016

Annex 6-1. Sectoral Report for Sector 1 'Energy' within 1990-2016

1990

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2	CH_4	N_2O	NO_X	CO	NMVOC	SO_2
	(kt)						
Total Energy	**35 280.7915**	**39.1313**	**1.1793**	**91.0406**	**271.4048**	**31.6819**	**155.7638**
A. Fuel combustion activities (sectoral approach)	**35 280.1538**	**13.5063**	**0.6293**	**91.0406**	**271.4048**	**31.1002**	**155.7638**
1. Energy industries	**21 244.3119**	**0.4903**	**0.1733**	**39.3776**	**7.1710**	**0.6271**	**102.3604**
a. Public electricity and heat production	21 244.3119	0.4903	0.1733	39.3776	7.1710	0.6271	102.3604
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	**2 204.8457**	**0.0985**	**0.0171**	**11.0992**	**3.7377**	**0.9764**	**2.8767**
a. Iron and steel	138.7639	0.0038	0.0005	0.1881	0.2105	0.0640	0.1441
b. Non-ferrous metals	NO	NO	NO	NO	NO	NO	NO
c. Chemicals	19.3408	0.0005	0.0001	0.0585	0.0121	0.0074	0.0039
d. Pulp, paper and print	NO	NO	NO	NO	NO	NO	NO
e. Food processing, beverages and tobacco	260.4791	0.0183	0.0030	1.3940	0.8997	0.1638	0.7589
f. Non-metallic minerals	1 449.1532	0.0569	0.0103	7.6737	1.9373	0.5549	1.4843
g. Transport equipment	NO	NO	NO	NO	NO	NO	NO
h. Machinery	88.8950	0.0035	0.0005	0.2103	0.1956	0.0451	0.1533
i. Mining and quarrying	11.7755	0.0007	0.0001	0.0719	0.0335	0.0056	0.0302
j. Wood and wood production	18.0676	0.0050	0.0007	0.1075	0.0977	0.0505	0.0096
k. Construction	194.9722	0.0079	0.0016	1.3386	0.1735	0.0665	0.1222
l. Textile and leather	23.3985	0.0020	0.0003	0.0566	0.1778	0.0184	0.1702
m. Other industries	NO	NO	NO	NO	NO	NO	NO
3. Transport	**4 344.7615**	**1.3226**	**0.3410**	**18.3508**	**71.4239**	**8.8402**	**5.1891**
a. Domestic aviation	6.0513	0.0000	0.0002	0.0080	2.4000	0.0380	0.0020
b. Road transportation	3 826.3625	1.2966	0.1845	11.0411	67.5634	8.1539	4.2980
c. Railways	403.4834	0.0226	0.1557	6.7072	1.3696	0.5952	0.7680
d. Domestic navigation	18.9133	0.0018	0.0005	0.4758	0.0444	0.0162	0.1200
e. Other transportation	89.9510	0.0016	0.0002	0.1187	0.0465	0.0369	0.0011
4. Other sectors	**7 372.2624**	**11.5841**	**0.0935**	**21.4533**	**188.2435**	**20.5339**	**44.9266**
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	0.3803	0.0130	13.8907	10.4922	1.5945	3.2431
ci. Stationary	160.5842	0.1930	0.0018	0.5222	0.6712	0.0894	0.5995
cii. Mobile	1 387.7627	0.1873	0.0112	13.3685	9.8210	1.5051	2.6436
5. Other	**113.9722**	**0.0109**	**0.0044**	**0.7597**	**0.8286**	**0.1226**	**0.4110**
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	0.1220
B. Fugitive emissions from fuels	**0.6377**	**25.6250**	**0.5500**	**0.0000**	**0.0000**	**0.5817**	**0.0000**
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	**0.6377**	**25.6250**	**0.5500**	**0.0000**	**0.0000**	**0.5817**	**0.0000**
a. Oil	IE	IE	IE	IE	IE	IE	IE
b. Natural gas	IE	IE				IE	IE
c. Venting and flaring	IE	IE	IE	IE	IE	IE	IE
d. Other	IE	IE	IE	IE	IE	IE	IE
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	**216.5837**	**0.0105**	**0.0070**	**0.8905**	**0.5270**	**0.2334**	**0.0687**
Aviation	216.5837	0.0105	0.0070	0.8905	0.5270	0.2334	0.0687
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						

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2	CH_4	N_2O	NO_X	CO	NMVOC	SO_2
	(kt)						
Total Energy	**31 560.0966**	**44.2135**	**1.0207**	**80.1554**	**255.1241**	**29.4152**	**141.0744**
A. Fuel combustion activities (sectoral approach)	**31 559.4826**	**13.7209**	**0.5386**	**80.1554**	**255.1241**	**28.8714**	**141.0744**
1. Energy industries	**18 873.0209**	**0.4220**	**0.1562**	**34.9804**	**6.3731**	**0.5490**	**90.5222**
a. Public electricity and heat production	18 873.0209	0.4220	0.1562	34.9804	6.3731	0.5490	90.5222
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	**1 485.7792**	**0.0631**	**0.0113**	**8.0111**	**1.9356**	**0.6185**	**1.3614**
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	214.1132	0.0152	0.0025	1.1286	0.7547	0.1359	0.6381
f. Non-metallic minerals	1 041.5663	0.0354	0.0066	5.6063	0.8206	0.3589	0.5012
g. Transport equipment	NO	NO	NO	NO	NO	NO	NO
h. Machinery	72.9611	0.0027	0.0004	0.2087	0.1536	0.0339	0.1247
i. Mining and quarrying	2.9014	0.0001	0.0000	0.0201	0.0026	0.0010	0.0018
j. Wood and wood production	13.7905	0.0041	0.0006	0.0833	0.0792	0.0410	0.0075
k. Construction	140.4466	0.0057	0.0011	0.9642	0.1249	0.0479	0.0881
l. Textile and leather	NO	NO	NO	NO	NO	NO	NO
m. Other industries	NO	NO	NO	NO	NO	NO	NO
3. Transport	**3 299.6478**	**0.9966**	**0.2721**	**15.9307**	**64.7274**	**8.0260**	**3.8891**
a. Domestic aviation	4.2358	0.0000	0.0001	0.0056	1.6800	0.0266	0.0014
b. Road transportation	2 875.2559	0.9759	0.1387	10.0849	61.8370	7.4595	3.2287
c. Railways	344.9573	0.0193	0.1331	5.7353	1.1711	0.5090	0.6566
d. Domestic navigation	0.2396	0.0000	0.0000	0.0060	0.0006	0.0002	0.0015
e. Other transportation	74.9592	0.0013	0.0001	0.0989	0.0387	0.0307	0.0009
4. Other sectors	**7 794.6662**	**12.2320**	**0.0956**	**20.5753**	**181.4709**	**19.5923**	**44.9417**
a. Commercial/institutional	1 097.2725	0.1910	0.0158	2.1402	8.9281	0.9622	7.8972
b. Residential	4 852.2218	10.5440	0.0615	4.9939	159.4198	16.8815	30.9500
c. Agriculture/forestry/fishing	1 845.1720	1.4970	0.0182	13.4412	13.1230	1.7487	6.0945
ci. Stationary	827.1599	1.3594	0.0100	2.4796	4.5593	0.5056	4.1553
cii. Mobile	1 018.0121	0.1376	0.0083	10.9615	8.5637	1.2430	1.9392
5. Other	**106.3685**	**0.0072**	**0.0034**	**0.6579**	**0.6170**	**0.0855**	**0.3599**
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	0.0950
B. Fugitive emissions from fuels	**0.6140**	**30.4926**	**0.4822**	**0.0000**	**0.0000**	**0.5438**	**0.0000**
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	**0.6140**	**30.4926**	**0.4822**	**0.0000**	**0.0000**	**0.5438**	**0.0000**
a. Oil	IE	IE	IE	IE	IE	IE	IE
b. Natural gas	IE	IE				IE	IE
c. Venting and flaring	IE	IE	IE	IE	IE	IE	IE
d. Other	IE	IE	IE	IE	IE	IE	IE
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	**232.8535**	**0.0113**	**0.0075**	**0.9574**	**0.5666**	**0.2510**	**0.0738**
Aviation	232.8535	0.0113	0.0075	0.9574	0.5666	0.2510	0.0738
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)						
Total Energy	**25 040.7269**	**35.8458**	**0.6834**	**59.6389**	**138.2917**	**16.3771**	**101.6319**
A. Fuel combustion activities (sectoral approach)	**25 040.2094**	**8.2415**	**0.3994**	**59.6389**	**138.2917**	**15.8840**	**101.6319**
1. Energy industries	**15 608.8471**	**0.3570**	**0.1218**	**28.6709**	**5.5397**	**0.4738**	**71.2475**
a. Public electricity and heat production	15 608.8471	0.3570	0.1218	28.6709	5.5397	0.4738	71.2475
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	**1 064.8093**	**0.0456**	**0.0080**	**5.5713**	**1.4481**	**0.4536**	**1.0216**

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2	CH_4	N_2O	NO_X	CO	NMVOC	SO_2
	(kt)						
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	167.7474	0.0120	0.0020	0.8633	0.6097	0.1080	0.5174
f. Non-metallic minerals	741.9497	0.0247	0.0046	3.8329	0.5822	0.2587	0.3470
g. Transport equipment	NO	NO	NO	NO	NO	NO	NO
h. Machinery	57.0273	0.0023	0.0004	0.2079	0.1168	0.0254	0.0962
i. Mining and quarrying	2.6506	0.0001	0.0000	0.0184	0.0024	0.0009	0.0017
j. Wood and wood production	9.5133	0.0031	0.0004	0.0590	0.0608	0.0315	0.0054
k. Construction	85.9209	0.0035	0.0007	0.5898	0.0763	0.0292	0.0539
l. Textile and leather	NO	NO	NO	NO	NO	NO	NO
m. Other industries	NO	NO	NO	NO	NO	NO	NO
3. Transport	**2 320.9288**	**0.6971**	**0.2057**	**10.5582**	**31.7322**	**4.0838**	**2.7653**
a. Domestic aviation	2.4204	0.0000	0.0001	0.0032	0.9600	0.0152	0.0008
b. Road transportation	1 975.6529	0.6801	0.0949	5.7123	29.7700	3.6227	2.2173
c. Railways	286.4312	0.0160	0.1106	4.7633	0.9727	0.4227	0.5452
d. Domestic navigation	0.2049	0.0000	0.0000	0.0052	0.0005	0.0002	0.0013
e. Other transportation	56.2194	0.0010	0.0001	0.0742	0.0291	0.0230	0.0007
4. Other sectors	**5 967.8768**	**7.1372**	**0.0616**	**14.3609**	**99.2287**	**10.8213**	**26.3830**
a. Commercial/institutional	800.5388	0.1385	0.0108	1.6132	5.9444	0.6645	5.2370
b. Residential	3 832.8956	5.6401	0.0369	3.7180	83.8178	8.9072	16.0934
c. Agriculture/forestry/fishing	1 334.4423	1.3586	0.0139	9.0297	9.4665	1.2496	5.0526
ci. Stationary	671.8393	1.2691	0.0085	1.8856	4.1702	0.4462	3.7905
cii. Mobile	662.6030	0.0895	0.0054	7.1441	5.2963	0.8034	1.2621
5. Other	**77.7474**	**0.0046**	**0.0023**	**0.4776**	**0.3429**	**0.0514**	**0.2146**
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	0.0624
B. Fugitive emissions from fuels	**0.5175**	**27.6043**	**0.2840**	**0.0000**	**0.0000**	**0.4931**	**0.0000**
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	**0.5175**	**27.6043**	**0.2840**	**0.0000**	**0.0000**	**0.4931**	**0.0000**
a. Oil	IE	IE	IE	IE	IE	IE	IE
b. Natural gas	IE	IE				IE	IE
c. Venting and flaring	IE	IE	IE	IE	IE	IE	IE
d. Other	IE	IE	IE	IE	IE	IE	IE
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	**96.2944**	**0.0047**	**0.0031**	**0.3959**	**0.2343**	**0.1038**	**0.0305**
Aviation	96.2944	0.0047	0.0031	0.3959	0.2343	0.1038	0.0305
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)						
Total Energy	**17 349.6063**	**27.4350**	**0.4615**	**47.5279**	**61.7648**	**8.3876**	**74.7382**
A. Fuel combustion activities (sectoral approach)	**17 349.1681**	**2.6323**	**0.3112**	**47.5279**	**61.7648**	**7.9439**	**74.7382**
1. Energy industries	**12 601.5386**	**0.2816**	**0.1057**	**23.5816**	**4.2083**	**0.3669**	**62.2741**
a. Public electricity and heat production	12 601.5386	0.2816	0.1057	23.5816	4.2083	0.3669	62.2741
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	**682.7002**	**0.0297**	**0.0051**	**3.3714**	**1.0112**	**0.3028**	**0.7220**
a. Iron and steel	0.9630	0.0001	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	122.2798	0.0089	0.0015	0.6030	0.4681	0.0805	0.3998
f. Non-metallic minerals	442.3330	0.0139	0.0025	2.0596	0.3438	0.1585	0.1928
g. Transport equipment	NO	NO	NO	NO	NO	NO	NO
h. Machinery	42.3376	0.0018	0.0003	0.2163	0.0811	0.0174	0.0686
i. Mining and quarrying	2.3997	0.0001	0.0000	0.0166	0.0021	0.0008	0.0015

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2	CH_4	N_2O	NO_X	CO	NMVOC	SO_2
	(kt)						
j. Wood and wood production	5.4462	0.0022	0.0003	0.0364	0.0425	0.0220	0.0034
k. Construction	33.0261	0.0013	0.0003	0.2252	0.0317	0.0112	0.0233
l. Textile and leather	0.5898	0.0001	0.0000	0.0010	0.0056	0.0005	0.0054
m. Other industries	33.3249	0.0013	0.0002	0.2117	0.0279	0.0109	0.0192
3. Transport	**1 699.5673**	**0.4721**	**0.1729**	**10.8208**	**24.8418**	**3.3466**	**2.1971**
a. Domestic aviation	0.6050	0.0000	0.0000	0.0008	0.2400	0.0038	0.0002
b. Road transportation	1 408.0668	0.4565	0.0679	5.9608	23.6056	2.9065	1.6773
c. Railways	272.0339	0.0152	0.1050	4.8286	0.9860	0.4285	0.5178
d. Domestic navigation	0.2364	0.0000	0.0000	0.0059	0.0006	0.0002	0.0015
e. Other transportation	18.6252	0.0003	0.0000	0.0246	0.0096	0.0076	0.0002
4. Other sectors	**2 271.9102**	**1.8431**	**0.0250**	**9.2951**	**31.0782**	**3.8422**	**9.1547**
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	702.7356	0.1735	0.0060	7.0634	3.5671	0.7724	1.4514
ci. Stationary	76.7498	0.0890	0.0009	0.2572	0.3046	0.0481	0.2594
cii. Mobile	625.9858	0.0845	0.0051	6.8062	3.2624	0.7244	1.1920
5. Other	**93.4518**	**0.0058**	**0.0024**	**0.4591**	**0.6253**	**0.0853**	**0.3903**
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	0.0534
B. Fugitive emissions from fuels	**0.4382**	**24.8026**	**0.1503**	**0.0000**	**0.0000**	**0.4437**	**0.0000**
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	**0.4382**	**24.8026**	**0.1503**	**0.0000**	**0.0000**	**0.4437**	**0.0000**
a. Oil	IE	IE	IE	IE	IE	IE	IE
b. Natural gas	IE	IE				IE	IE
c. Venting and flaring	IE	IE	IE	IE	IE	IE	IE
d. Other	IE	IE	IE	IE	IE	IE	IE
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	**62.1153**	**0.0030**	**0.0020**	**0.2554**	**0.1512**	**0.0669**	**0.0197**
Aviation	62.1153	0.0030	0.0020	0.2554	0.1512	0.0669	0.0197
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)						
Total Energy	**14 385.1477**	**26.9908**	**0.2932**	**36.0499**	**68.0468**	**8.8374**	**59.3963**
A. Fuel combustion activities (sectoral approach)	**14 384.7392**	**3.1194**	**0.2216**	**36.0499**	**68.0468**	**8.4105**	**59.3963**
1. Energy industries	**9 928.6683**	**0.1882**	**0.0871**	**18.7582**	**3.5339**	**0.2831**	**47.1205**
a. Public electricity and heat production	9 928.6683	0.1882	0.0871	18.7582	3.5339	0.2831	47.1205
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	**791.2803**	**0.0203**	**0.0027**	**1.6523**	**0.7840**	**0.3410**	**0.4040**
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	259.5575	0.0100	0.0014	0.7162	0.5456	0.1265	0.3407
f. Non-metallic minerals	410.0234	0.0061	0.0007	0.5314	0.1646	0.1606	0.0392
g. Transport equipment	NO	NO	NO	NO	NO	NO	NO
h. Machinery	35.2516	0.0004	0.0001	0.0644	0.0094	0.0043	0.0055
i. Mining and quarrying	6.1738	0.0002	0.0000	0.0253	0.0029	0.0019	0.0014
j. Wood and wood production	0.0000	0.0016	0.0002	0.0045	0.0250	0.0229	0.0003
k. Construction	79.7704	0.0020	0.0003	0.3105	0.0365	0.0249	0.0168
l. Textile and leather	NO	NO	NO	NO	NO	NO	NO
m. Other industries	NO	NO	NO	NO	NO	NO	NO
3. Transport	**1 485.6786**	**0.4245**	**0.1044**	**6.7086**	**22.3898**	**2.8852**	**1.7192**
a. Domestic aviation	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
b. Road transportation	1 289.4203	0.4168	0.0622	4.6536	21.9491	2.6775	1.5098
c. Railways	108.8368	0.0061	0.0420	1.9353	0.3952	0.1717	0.2072
d. Domestic navigation	0.1860	0.0000	0.0000	0.0047	0.0004	0.0002	0.0012

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2	CH_4	N_2O	NO_X	CO	NMVOC	SO_2
	(kt)						
e. Other transportation	87.2355	0.0016	0.0002	0.1151	0.0451	0.0358	0.0010
4. Other sectors	**2 090.7472**	**2.4795**	**0.0257**	**8.5983**	**40.7319**	**4.8148**	**9.8738**
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	0.1459	0.0055	6.6797	3.9179	0.7496	1.3001
ci. Stationary	32.3295	0.0637	0.0006	0.0911	0.1888	0.0360	0.1407
cii. Mobile	608.7849	0.0822	0.0049	6.5886	3.7290	0.7136	1.1594
5. Other	**88.3648**	**0.0069**	**0.0016**	**0.3325**	**0.6071**	**0.0863**	**0.2787**
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	0.0226
B. Fugitive emissions from fuels	**0.4085**	**23.8714**	**0.0716**	**0.0000**	**0.0000**	**0.4269**	**0.0000**
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	**0.4085**	**23.8714**	**0.0716**	**0.0000**	**0.0000**	**0.4269**	**0.0000**
a. Oil	IE	IE	IE	IE	IE	IE	IE
b. Natural gas	IE	IE				IE	IE
c. Venting and flaring	IE	IE	IE	IE	IE	IE	IE
d. Other	IE	IE	IE	IE	IE	IE	IE
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	**37.8367**	**0.0018**	**0.0012**	**0.1556**	**0.0921**	**0.0408**	**0.0120**
Aviation	37.8367	0.0018	0.0012	0.1556	0.0921	0.0408	0.0120
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)						
Total Energy	**11 372.9604**	**28.3994**	**0.2497**	**30.4649**	**58.2794**	**7.2884**	**33.9768**
A. Fuel combustion activities (sectoral approach)	**11 372.5410**	**1.9439**	**0.1782**	**30.4649**	**58.2794**	**6.8123**	**33.9768**
1. Energy industries	**7 142.1394**	**0.1364**	**0.0501**	**12.9349**	**3.1262**	**0.2355**	**25.5947**
a. Public electricity and heat production	7 142.1394	0.1364	0.0501	12.9349	3.1262	0.2355	25.5947
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	**439.7389**	**0.0139**	**0.0020**	**1.0932**	**0.6245**	**0.2000**	**0.4180**
a. Iron and steel	36.8261	0.0007	0.0001	0.0486	0.0190	0.0151	0.0004
b. Non-ferrous metals	NO	NO	NO	NO	NO	NO	NO
c. Chemicals	0.1344	0.0000	0.0000	0.0002	0.0001	0.0001	0.0000
d. Pulp, paper and print	3.6289	0.0001	0.0000	0.0048	0.0019	0.0015	0.0000
e. Food processing, beverages and tobacco	127.4838	0.0073	0.0012	0.4859	0.4248	0.0733	0.3665
f. Non-metallic minerals	162.0388	0.0033	0.0004	0.2510	0.1115	0.0672	0.0321
g. Transport equipment	NO	NO	NO	NO	NO	NO	NO
h. Machinery	33.0734	0.0006	0.0001	0.0557	0.0179	0.0134	0.0017
i. Mining and quarrying	2.1489	0.0001	0.0000	0.0149	0.0019	0.0007	0.0014
j. Wood and wood production	1.8816	0.0000	0.0000	0.0025	0.0010	0.0008	0.0000
k. Construction	33.2776	0.0011	0.0002	0.1780	0.0261	0.0119	0.0153
l. Textile and leather	19.8915	0.0004	0.0000	0.0262	0.0103	0.0082	0.0002
m. Other industries	19.3539	0.0003	0.0000	0.0255	0.0100	0.0079	0.0002
3. Transport	**1 498.3876**	**0.4335**	**0.1009**	**6.7826**	**23.3926**	**2.9874**	**1.7003**
a. Domestic aviation	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
b. Road transportation	1 318.5881	0.4266	0.0638	4.9391	22.9959	2.7995	1.5160
c. Railways	95.6942	0.0054	0.0369	1.7283	0.3529	0.1534	0.1821
d. Domestic navigation	0.1797	0.0000	0.0000	0.0045	0.0004	0.0002	0.0011
e. Other transportation	83.9256	0.0015	0.0001	0.1107	0.0434	0.0344	0.0010
4. Other sectors	**2 166.6313**	**1.3497**	**0.0230**	**9.1404**	**30.5063**	**3.2880**	**5.9766**
a. Commercial/institutional	395.4161	0.0766	0.0059	0.7759	3.3189	0.3623	2.9241
b. Residential	1 063.2228	1.1436	0.0112	1.0880	15.6999	1.9488	1.6609
c. Agriculture/forestry/fishing	707.9924	0.1295	0.0059	7.2766	11.4874	0.9768	1.3917
ci. Stationary	18.7639	0.0361	0.0003	0.0376	0.1054	0.0205	0.0771
cii. Mobile	689.2285	0.0933	0.0056	7.2389	11.3820	0.9563	1.3146
5. Other	**125.6438**	**0.0104**	**0.0022**	**0.5138**	**0.6299**	**0.1015**	**0.2872**
a. Stationary	104.4054	0.0050	0.0011	0.3366	0.3173	0.0599	0.2593

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2	CH_4	N_2O	NO_X	CO	NMVOC	SO_2
	(kt)						
b. Mobile	21.2384	0.0054	0.0011	0.1771	0.3125	0.0416	0.0279
B. Fugitive emissions from fuels	**0.4194**	**26.4555**	**0.0716**	**0.0000**	**0.0000**	**0.4761**	**0.0000**
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	**0.4194**	**26.4555**	**0.0716**	**0.0000**	**0.0000**	**0.4761**	**0.0000**
a. Oil	IE	IE	IE	IE	IE	IE	IE
b. Natural gas	IE	IE				IE	IE
c. Venting and flaring	IE	IE	IE	IE	IE	IE	IE
d. Other	IE	IE	IE	IE	IE	IE	IE
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	**41.9184**	**0.0059**	**0.0013**	**0.1572**	**0.1403**	**0.0813**	**0.0133**
Aviation	41.9184	0.0059	0.0013	0.1572	0.1403	0.0813	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						

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GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2	CH_4	N_2O	NO_X	CO	NMVOC	SO_2
	(kt)						
Total Energy	**11 259.1406**	**31.7252**	**0.2579**	**28.4374**	**71.5642**	**8.7276**	**33.8981**
A. Fuel combustion activities (sectoral approach)	**11 258.6680**	**2.9697**	**0.1750**	**28.4374**	**71.5642**	**8.2116**	**33.8981**
1. Energy industries	**7 074.2917**	**0.1347**	**0.0468**	**12.6955**	**3.2367**	**0.2406**	**23.4410**
a. Public electricity and heat production	7 074.2917	0.1347	0.0468	12.6955	3.2367	0.2406	23.4410
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	**369.3794**	**0.0136**	**0.0020**	**0.9809**	**0.6916**	**0.1772**	**0.5219**
a. Iron and steel	27.5382	0.0005	0.0000	0.0363	0.0142	0.0113	0.0003
b. Non-ferrous metals	NO	NO	NO	NO	NO	NO	NO
c. Chemicals	0.0977	0.0000	0.0000	0.0001	0.0001	0.0000	0.0000
d. Pulp, paper and print	1.9531	0.0000	0.0000	0.0026	0.0010	0.0008	0.0000
e. Food processing, beverages and tobacco	127.0939	0.0076	0.0012	0.4865	0.4522	0.0745	0.3949
f. Non-metallic minerals	126.9802	0.0033	0.0004	0.1968	0.1701	0.0573	0.1094
g. Transport equipment	NO	NO	NO	NO	NO	NO	NO
h. Machinery	17.4032	0.0003	0.0000	0.0230	0.0090	0.0071	0.0002
i. Mining and quarrying	2.1489	0.0001	0.0000	0.0149	0.0019	0.0007	0.0014
j. Wood and wood production	0.8789	0.0000	0.0000	0.0012	0.0005	0.0004	0.0000
k. Construction	30.5210	0.0011	0.0002	0.1738	0.0246	0.0107	0.0152
l. Textile and leather	19.5306	0.0003	0.0000	0.0258	0.0101	0.0080	0.0002
m. Other industries	15.2339	0.0003	0.0000	0.0201	0.0079	0.0062	0.0002
3. Transport	**1 451.6525**	**0.4184**	**0.0959**	**6.4252**	**22.2564**	**2.8534**	**1.5938**
a. Domestic aviation	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
b. Road transportation	1 240.1866	0.4111	0.0598	4.5981	21.8546	2.6568	1.4145
c. Railways	92.7872	0.0052	0.0358	1.6659	0.3402	0.1478	0.1766
d. Domestic navigation	0.1954	0.0000	0.0000	0.0049	0.0005	0.0002	0.0012
e. Other transportation	118.4832	0.0021	0.0002	0.1563	0.0612	0.0486	0.0014
4. Other sectors	**2 281.5067**	**2.3921**	**0.0280**	**7.8935**	**44.9136**	**4.8417**	**8.1114**
a. Commercial/institutional	362.4420	0.0905	0.0056	0.7011	2.9937	0.3484	2.5956
b. Residential	1 345.6189	2.1817	0.0175	1.4366	31.3591	3.6752	4.3875
c. Agriculture/forestry/fishing	573.4458	0.1199	0.0049	5.7559	10.5608	0.8180	1.1284
ci. Stationary	26.9754	0.0459	0.0005	0.0693	0.1310	0.0316	0.0857
cii. Mobile	546.4704	0.0741	0.0044	5.6865	10.4298	0.7864	1.0427
5. Other	**81.8376**	**0.0109**	**0.0023**	**0.4423**	**0.4659**	**0.0987**	**0.2300**
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	0.0336
B. Fugitive emissions from fuels	**0.4726**	**28.7555**	**0.0829**	**0.0000**	**0.0000**	**0.5160**	**0.0000**
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	**0.4726**	**28.7555**	**0.0829**	**0.0000**	**0.0000**	**0.5160**	**0.0000**
a. Oil	IE	IE	IE	IE	IE	IE	IE
b. Natural gas	IE	IE				IE	IE

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2	CH_4	N_2O	NO_X	CO	NMVOC	SO_2
	(kt)						
c. Venting and flaring	IE	IE	IE	IE	IE	IE	IE
d. Other	IE	IE	IE	IE	IE	IE	IE
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	**65.8650**	**0.0048**	**0.0021**	**0.2563**	**0.1684**	**0.0900**	**0.0209**
Aviation	65.8650	0.0048	0.0021	0.2563	0.1684	0.0900	0.0209
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						

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GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2	CH_4	N_2O	NO_X	CO	NMVOC	SO_2
	(kt)						
Total Energy	**10 212.0544**	**26.0293**	**0.2472**	**25.1996**	**65.0399**	**7.9743**	**18.6133**
A. Fuel combustion activities (sectoral approach)	**10 211.5893**	**2.3865**	**0.1492**	**25.1996**	**65.0399**	**7.5567**	**18.6133**
1. Energy industries	**5 583.3634**	**0.1102**	**0.0244**	**9.4662**	**3.1137**	**0.2218**	**10.5369**
a. Public electricity and heat production	5 583.3634	0.1102	0.0244	9.4662	3.1137	0.2218	10.5369
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	**588.3594**	**0.0200**	**0.0027**	**1.2171**	**0.7931**	**0.2990**	**0.4427**
a. Iron and steel	100.2195	0.0018	0.0002	0.1322	0.0518	0.0411	0.0012
b. Non-ferrous metals	NO	NO	NO	NO	NO	NO	NO
c. Chemicals	0.2839	0.0000	0.0000	0.0004	0.0001	0.0001	0.0000
d. Pulp, paper and print	5.1103	0.0001	0.0000	0.0067	0.0026	0.0021	0.0001
e. Food processing, beverages and tobacco	142.9982	0.0107	0.0016	0.4562	0.4743	0.1146	0.3394
f. Non-metallic minerals	173.0954	0.0039	0.0005	0.2562	0.1684	0.0748	0.0839
g. Transport equipment	NO	NO	NO	NO	NO	NO	NO
h. Machinery	40.9166	0.0007	0.0001	0.0540	0.0212	0.0168	0.0005
i. Mining and quarrying	2.1489	0.0001	0.0000	0.0149	0.0019	0.0007	0.0014
j. Wood and wood production	1.4195	0.0000	0.0000	0.0019	0.0007	0.0006	0.0000
k. Construction	39.5498	0.0012	0.0002	0.1857	0.0293	0.0144	0.0153
l. Textile and leather	45.1414	0.0008	0.0001	0.0595	0.0233	0.0185	0.0005
m. Other industries	37.4759	0.0007	0.0001	0.0494	0.0194	0.0154	0.0004
3. Transport	**1 469.7744**	**0.4631**	**0.0952**	**6.3542**	**25.1328**	**3.1478**	**1.6297**
a. Domestic aviation	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
b. Road transportation	1 340.3690	0.4577	0.0643	4.8762	24.8194	3.0025	1.4758
c. Railways	79.8262	0.0045	0.0308	1.4076	0.2874	0.1249	0.1519
d. Domestic navigation	0.2112	0.0000	0.0000	0.0053	0.0005	0.0002	0.0013
e. Other transportation	49.3680	0.0009	0.0001	0.0651	0.0255	0.0202	0.0006
4. Other sectors	**2 493.4333**	**1.7851**	**0.0250**	**7.8746**	**35.5006**	**3.8095**	**5.7662**
a. Commercial/institutional	307.2393	0.0668	0.0046	0.5690	2.5613	0.2901	2.2341
b. Residential	1 612.8537	1.5894	0.0152	1.6281	21.8380	2.6718	2.4605
c. Agriculture/forestry/fishing	573.3403	0.1289	0.0051	5.6775	11.1013	0.8475	1.0717
ci. Stationary	31.3633	0.0554	0.0007	0.0802	0.1313	0.0568	0.0372
cii. Mobile	541.9770	0.0735	0.0044	5.5974	10.9700	0.7907	1.0345
5. Other	**76.6587**	**0.0081**	**0.0020**	**0.2875**	**0.4997**	**0.0785**	**0.2379**
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	0.0365
B. Fugitive emissions from fuels	**0.4651**	**23.6428**	**0.0979**	**0.0000**	**0.0000**	**0.4176**	**0.0000**
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	**0.4651**	**23.6428**	**0.0979**	**0.0000**	**0.0000**	**0.4176**	**0.0000**
a. Oil	IE	IE	IE	IE	IE	IE	IE
b. Natural gas	IE	IE				IE	IE
c. Venting and flaring	IE	IE	IE	IE	IE	IE	IE
d. Other	IE	IE	IE	IE	IE	IE	IE
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	**75.6418**	**0.0054**	**0.0024**	**0.3033**	**0.1927**	**0.1018**	**0.0240**
Aviation	75.6418	0.0054	0.0024	0.3033	0.1927	0.1018	0.0240

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2	CH_4	N_2O	NO_X	CO	NMVOC	SO_2
	(kt)						
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						

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GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2	CH_4	N_2O	NO_X	CO	NMVOC	SO_2
	(kt)						
Total Energy	**8 789.7567**	**23.8383**	**0.2174**	**21.1263**	**49.2086**	**6.3618**	**13.9529**
A. Fuel combustion activities (sectoral approach)	**8 789.3294**	**1.7133**	**0.1232**	**21.1263**	**49.2086**	**5.9702**	**13.9529**
1. Energy industries	**4 806.4261**	**0.0957**	**0.0189**	**8.0624**	**2.7581**	**0.1958**	**7.9287**
a. Public electricity and heat production	4 806.4261	0.0957	0.0189	8.0624	2.7581	0.1958	7.9287
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	**566.7379**	**0.0197**	**0.0026**	**1.2172**	**0.7349**	**0.3099**	**0.3474**
a. Iron and steel	90.2098	0.0016	0.0002	0.1190	0.0466	0.0370	0.0011
b. Non-ferrous metals	NO	NO	NO	NO	NO	NO	NO
c. Chemicals	5.4839	0.0001	0.0000	0.0072	0.0028	0.0022	0.0001
d. Pulp, paper and print	4.1129	0.0001	0.0000	0.0054	0.0021	0.0017	0.0000
e. Food processing, beverages and tobacco	139.8186	0.0103	0.0015	0.5013	0.4460	0.1180	0.2993
f. Non-metallic minerals	161.3368	0.0041	0.0005	0.2436	0.1435	0.0846	0.0313
g. Transport equipment	NO	NO	NO	NO	NO	NO	NO
h. Machinery	27.6949	0.0005	0.0000	0.0365	0.0143	0.0114	0.0003
i. Mining and quarrying	4.3719	0.0002	0.0000	0.0303	0.0039	0.0015	0.0028
j. Wood and wood production	1.3710	0.0000	0.0000	0.0018	0.0007	0.0006	0.0000
k. Construction	31.9830	0.0010	0.0002	0.1397	0.0230	0.0118	0.0112
l. Textile and leather	62.2421	0.0011	0.0001	0.0821	0.0322	0.0255	0.0007
m. Other industries	38.1130	0.0007	0.0001	0.0503	0.0197	0.0156	0.0005
3. Transport	**1 273.6172**	**0.3957**	**0.0790**	**5.2998**	**21.3500**	**2.6683**	**1.4210**
a. Domestic aviation	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
b. Road transportation	1 166.5762	0.3915	0.0561	4.1667	21.1071	2.5539	1.3069
c. Railways	59.1674	0.0033	0.0228	1.0669	0.2179	0.0947	0.1126
d. Domestic navigation	0.1324	0.0000	0.0000	0.0033	0.0003	0.0001	0.0008
e. Other transportation	47.7411	0.0009	0.0001	0.0630	0.0247	0.0196	0.0006
4. Other sectors	**2 069.7199**	**1.1935**	**0.0205**	**6.1550**	**23.7795**	**2.6921**	**4.0184**
a. Commercial/institutional	305.5365	0.0669	0.0047	0.5770	2.6137	0.2925	2.2854
b. Residential	1 330.8387	1.0515	0.0123	1.3328	13.7286	1.8098	0.9303
c. Agriculture/forestry/fishing	433.3447	0.0750	0.0036	4.2452	7.4372	0.5899	0.8026
ci. Stationary	38.7431	0.0215	0.0003	0.1101	0.0766	0.0233	0.0497
cii. Mobile	394.6016	0.0535	0.0032	4.1351	7.3606	0.5666	0.7529
5. Other	**72.8283**	**0.0088**	**0.0021**	**0.3919**	**0.5862**	**0.1041**	**0.2375**
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	0.0341
B. Fugitive emissions from fuels	**0.4274**	**22.1250**	**0.0942**	**0.0000**	**0.0000**	**0.3916**	**0.0000**
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**	**22.1250**	**0.0942**	**0.0000**	**0.0000**	**0.3916**	**0.0000**
a. Oil	IE	IE	IE	IE	IE	IE	IE
b. Natural gas	IE	IE				IE	IE
c. Venting and flaring	IE	IE	IE	IE	IE	IE	IE
d. Other	IE	IE	IE	IE	IE	IE	IE
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	**72.4923**	**0.0041**	**0.0023**	**0.2935**	**0.1739**	**0.0883**	**0.0230**
Aviation	72.4923	0.0041	0.0023	0.2935	0.1739	0.0883	0.0230
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						

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2	CH_4	N_2O	NO_X	CO	NMVOC	SO_2
	(kt)						
Total Energy	**7 328.4925**	**23.9672**	**0.2036**	**16.1243**	**36.8298**	**4.9938**	**11.0284**
A. Fuel combustion activities (sectoral approach)	**7 328.0994**	**1.5627**	**0.0868**	**16.1243**	**36.8298**	**4.5931**	**11.0284**
1. Energy industries	**4 133.6361**	**0.0797**	**0.0160**	**6.9218**	**2.4138**	**0.1693**	**6.2916**
a. Public electricity and heat production	4 133.6361	0.0797	0.0160	6.9218	2.4138	0.1693	6.2916
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	**488.2612**	**0.0137**	**0.0017**	**0.8414**	**0.5356**	**0.2311**	**0.2632**
a. Iron and steel	93.3010	0.0017	0.0002	0.1231	0.0482	0.0383	0.0011
b. Non-ferrous metals	NO	NO	NO	NO	NO	NO	NO
c. Chemicals	4.8435	0.0001	0.0000	0.0064	0.0025	0.0020	0.0001
d. Pulp, paper and print	3.0591	0.0001	0.0000	0.0040	0.0016	0.0013	0.0000
e. Food processing, beverages and tobacco	94.8349	0.0062	0.0009	0.2607	0.3027	0.0692	0.2257
f. Non-metallic minerals	153.1475	0.0030	0.0003	0.2033	0.1047	0.0642	0.0279
g. Transport equipment	NO	NO	NO	NO	NO	NO	NO
h. Machinery	21.5067	0.0004	0.0000	0.0284	0.0111	0.0088	0.0003
i. Mining and quarrying	2.1489	0.0001	0.0000	0.0149	0.0019	0.0007	0.0014
j. Wood and wood production	1.0197	0.0000	0.0000	0.0013	0.0005	0.0004	0.0000
k. Construction	22.6285	0.0006	0.0001	0.0783	0.0149	0.0086	0.0057
l. Textile and leather	56.8473	0.0010	0.0001	0.0750	0.0294	0.0233	0.0007
m. Other industries	34.9242	0.0006	0.0001	0.0461	0.0181	0.0143	0.0004
3. Transport	**855.4540**	**0.2410**	**0.0492**	**3.5193**	**12.5713**	**1.5845**	**1.0059**
a. Domestic aviation	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
b. Road transportation	771.7337	0.2383	0.0372	2.9057	12.4336	1.5150	0.9452
c. Railways	30.8217	0.0017	0.0119	0.5385	0.1100	0.0478	0.0587
d. Domestic navigation	0.2207	0.0000	0.0000	0.0056	0.0005	0.0002	0.0014
e. Other transportation	52.6779	0.0009	0.0001	0.0695	0.0272	0.0216	0.0006
4. Other sectors	**1 801.5918**	**1.2218**	**0.0183**	**4.6961**	**20.9461**	**2.5442**	**3.2790**
a. Commercial/institutional	228.2272	0.0500	0.0033	0.4261	1.8053	0.2101	1.5675
b. Residential	1 275.5657	1.1320	0.0126	1.2873	15.0203	1.9521	1.1678
c. Agriculture/forestry/fishing	297.7989	0.0399	0.0024	2.9826	4.1206	0.3819	0.5437
ci. Stationary	18.5433	0.0021	0.0001	0.0488	0.0160	0.0064	0.0111
cii. Mobile	279.2556	0.0378	0.0023	2.9338	4.1046	0.3756	0.5326
5. Other	**49.1563**	**0.0065**	**0.0016**	**0.1458**	**0.3630**	**0.0640**	**0.1887**
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	0.0279
B. Fugitive emissions from fuels	**0.3931**	**22.4045**	**0.1168**	**0.0000**	**0.0000**	**0.4007**	**0.0000**
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	**0.3931**	**22.4045**	**0.1168**	**0.0000**	**0.0000**	**0.4007**	**0.0000**
a. Oil	IE	IE	IE	IE	IE	IE	IE
b. Natural gas	IE	IE				IE	IE
c. Venting and flaring	IE	IE	IE	IE	IE	IE	IE
d. Other	IE	IE	IE	IE	IE	IE	IE
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	**72.4890**	**0.0040**	**0.0023**	**0.2907**	**0.1724**	**0.0877**	**0.0230**
Aviation	72.4890	0.0040	0.0023	0.2907	0.1724	0.0877	0.0230
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)						
Total Energy	**6 584.0211**	**25.5715**	**0.2200**	**14.7597**	**34.8619**	**4.8848**	**9.3678**
A. Fuel combustion activities (sectoral approach)	**6 583.6452**	**1.5461**	**0.0881**	**14.7597**	**34.8619**	**4.4508**	**9.3678**
1. Energy industries	**3 607.4274**	**0.0676**	**0.0138**	**6.0316**	**2.1531**	**0.1489**	**4.9599**
a. Public electricity and heat production	3 607.4274	0.0676	0.0138	6.0316	2.1531	0.1489	4.9599
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	**531.0321**	**0.0125**	**0.0015**	**0.8916**	**0.4987**	**0.2297**	**0.2370**
a. Iron and steel	96.2465	0.0017	0.0002	0.1270	0.0498	0.0395	0.0011

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2	CH_4	N_2O	NO_X	CO	NMVOC	SO_2
	(kt)						
b. Non-ferrous metals	NO	NO	NO	NO	NO	NO	NO
c. Chemicals	5.1224	0.0001	0.0000	0.0068	0.0026	0.0021	0.0001
d. Pulp, paper and print	4.8528	0.0001	0.0000	0.0064	0.0025	0.0020	0.0001
e. Food processing, beverages and tobacco	86.6077	0.0041	0.0006	0.2435	0.2394	0.0468	0.1989
f. Non-metallic minerals	184.8565	0.0035	0.0004	0.2452	0.1211	0.0772	0.0283
g. Transport equipment	NO	NO	NO	NO	NO	NO	NO
h. Machinery	25.4169	0.0005	0.0000	0.0335	0.0131	0.0104	0.0003
i. Mining and quarrying	2.1489	0.0001	0.0000	0.0149	0.0019	0.0007	0.0014
j. Wood and wood production	1.6176	0.0000	0.0000	0.0021	0.0008	0.0007	0.0000
k. Construction	16.0539	0.0005	0.0001	0.0696	0.0115	0.0059	0.0056
l. Textile and leather	79.5315	0.0014	0.0001	0.1049	0.0411	0.0326	0.0009
m. Other industries	28.5774	0.0005	0.0001	0.0377	0.0148	0.0117	0.0003
3. Transport	**920.5951**	**0.2445**	**0.0546**	**3.8839**	**12.3795**	**1.5620**	**1.1803**
a. Domestic aviation	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
b. Road transportation	857.5798	0.2421	0.0417	3.2415	12.2413	1.4965	1.1160
c. Railways	33.2968	0.0019	0.0129	0.6009	0.1227	0.0533	0.0634
d. Domestic navigation	0.0977	0.0000	0.0000	0.0025	0.0002	0.0001	0.0006
e. Other transportation	29.6208	0.0005	0.0001	0.0391	0.0153	0.0121	0.0004
4. Other sectors	**1 488.2025**	**1.2169**	**0.0172**	**3.8215**	**19.5985**	**2.4681**	**2.8261**
a. Commercial/institutional	204.9794	0.0475	0.0027	0.3929	1.4360	0.1787	1.2316
b. Residential	1 046.8522	1.1380	0.0126	1.0817	15.2661	1.9971	1.1696
c. Agriculture/forestry/fishing	236.3708	0.0315	0.0019	2.3469	2.8965	0.2923	0.4249
ci. Stationary	20.7663	0.0024	0.0001	0.0580	0.0188	0.0070	0.0139
cii. Mobile	215.6045	0.0292	0.0017	2.2889	2.8777	0.2853	0.4110
5. Other	**36.3881**	**0.0046**	**0.0010**	**0.1311**	**0.2320**	**0.0421**	**0.1644**
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	0.0130
B. Fugitive emissions from fuels	**0.3759**	**24.0254**	**0.1318**	**0.0000**	**0.0000**	**0.4341**	**0.0000**
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	**0.3759**	**24.0254**	**0.1318**	**0.0000**	**0.0000**	**0.4341**	**0.0000**
a. Oil	IE	IE	IE	IE	IE	IE	IE
b. Natural gas	IE	IE				IE	IE
c. Venting and flaring	IE	IE	IE	IE	IE	IE	IE
d. Other	IE	IE	IE	IE	IE	IE	IE
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	**66.2279**	**0.0043**	**0.0021**	**0.2728**	**0.1738**	**0.0800**	**0.0210**
Aviation	66.2279	0.0043	0.0021	0.2728	0.1738	0.0800	0.0210
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)						
Total Energy	**7 180.7453**	**25.2431**	**0.2715**	**16.1444**	**33.7768**	**4.7942**	**8.8744**
A. Fuel combustion activities (sectoral approach)	**7 180.3360**	**1.4223**	**0.0944**	**16.1444**	**33.7768**	**4.3665**	**8.8744**
1. Energy industries	**4 101.5064**	**0.0787**	**0.0147**	**6.8092**	**2.5265**	**0.1735**	**4.6865**
a. Public electricity and heat production	4 101.5064	0.0787	0.0147	6.8092	2.5265	0.1735	4.6865
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	**611.5689**	**0.0152**	**0.0020**	**1.2488**	**0.5855**	**0.2629**	**0.2920**
a. Iron and steel	115.9720	0.0021	0.0002	0.1530	0.0599	0.0475	0.0014
b. Non-ferrous metals	NO	NO	NO	NO	NO	NO	NO
c. Chemicals	4.2469	0.0001	0.0000	0.0056	0.0022	0.0017	0.0001
d. Pulp, paper and print	7.8404	0.0001	0.0000	0.0103	0.0041	0.0032	0.0001
e. Food processing, beverages and tobacco	91.8737	0.0047	0.0007	0.2643	0.2945	0.0514	0.2533
f. Non-metallic minerals	201.6635	0.0046	0.0006	0.5046	0.1225	0.0819	0.0282
g. Transport equipment	NO	NO	NO	NO	NO	NO	NO
h. Machinery	29.4444	0.0005	0.0001	0.0388	0.0152	0.0121	0.0004
i. Mining and quarrying	2.1489	0.0001	0.0000	0.0149	0.0019	0.0007	0.0014
j. Wood and wood production	3.5935	0.0001	0.0000	0.0047	0.0019	0.0015	0.0000

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2	CH_4	N_2O	NO_X	CO	NMVOC	SO_2
	(kt)						
k. Construction	17.5793	0.0005	0.0001	0.0716	0.0123	0.0065	0.0056
l. Textile and leather	97.0245	0.0017	0.0002	0.1280	0.0502	0.0398	0.0012
m. Other industries	40.1818	0.0007	0.0001	0.0530	0.0208	0.0165	0.0005
3. Transport	**995.4935**	**0.2597**	**0.0601**	**4.1902**	**13.3146**	**1.6695**	**1.3035**
a. Domestic aviation	0.0972	0.0000	0.0000	0.0001	0.0385	0.0006	0.0000
b. Road transportation	944.6579	0.2574	0.0463	3.5031	13.1326	1.6039	1.2341
c. Railways	35.7682	0.0020	0.0138	0.6630	0.1354	0.0588	0.0681
d. Domestic navigation	0.1765	0.0000	0.0000	0.0044	0.0004	0.0002	0.0011
e. Other transportation	14.7936	0.0003	0.0000	0.0195	0.0076	0.0061	0.0002
4. Other sectors	**1 428.3712**	**1.0636**	**0.0164**	**3.7395**	**16.9934**	**2.2000**	**2.4655**
a. Commercial/institutional	236.0879	0.0681	0.0032	0.4570	1.5665	0.2132	1.3118
b. Residential	961.6192	0.9560	0.0113	0.9891	12.5810	1.6943	0.7359
c. Agriculture/forestry/fishing	230.6641	0.0396	0.0019	2.2934	2.8459	0.2925	0.4179
ci. Stationary	21.7542	0.0113	0.0003	0.0740	0.0390	0.0155	0.0197
cii. Mobile	208.9099	0.0283	0.0017	2.2194	2.8069	0.2771	0.3982
5. Other	**43.3961**	**0.0050**	**0.0012**	**0.1565**	**0.3569**	**0.0605**	**0.1268**
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	0.0221
B. Fugitive emissions from fuels	**0.4092**	**23.8208**	**0.1771**	**0.0000**	**0.0000**	**0.4278**	**0.0000**
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	**0.4092**	**23.8208**	**0.1771**	**0.0000**	**0.0000**	**0.4278**	**0.0000**
a. Oil	IE	IE	IE	IE	IE	IE	IE
b. Natural gas	IE	IE				IE	IE
c. Venting and flaring	IE	IE	IE	IE	IE	IE	IE
d. Other	IE	IE	IE	IE	IE	IE	IE
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	**61.8894**	**0.0039**	**0.0020**	**0.2403**	**0.1649**	**0.0728**	**0.0196**
Aviation	61.8894	0.0039	0.0020	0.2403	0.1649	0.0728	0.0196
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)						
Total Energy	**6 815.4249**	**27.6695**	**0.3037**	**16.7861**	**40.7569**	**5.8776**	**9.7897**
A. Fuel combustion activities (sectoral approach)	**6 815.0348**	**1.7870**	**0.1229**	**16.7861**	**40.7569**	**5.4078**	**9.7897**
1. Energy industries	**3 347.8492**	**0.0673**	**0.0132**	**5.6018**	**2.0379**	**0.1404**	**4.3168**
a. Public electricity and heat production	3 347.8492	0.0673	0.0132	5.6018	2.0379	0.1404	4.3168
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	**424.4928**	**0.0102**	**0.0012**	**0.7088**	**0.4221**	**0.1855**	**0.2119**
a. Iron and steel	26.9268	0.0005	0.0000	0.0355	0.0139	0.0110	0.0003
b. Non-ferrous metals	NO	NO	NO	NO	NO	NO	NO
c. Chemicals	1.6486	0.0000	0.0000	0.0022	0.0009	0.0007	0.0000
d. Pulp, paper and print	0.5495	0.0000	0.0000	0.0007	0.0003	0.0002	0.0000
e. Food processing, beverages and tobacco	66.4465	0.0036	0.0005	0.1670	0.2324	0.0397	0.1999
f. Non-metallic minerals	218.9973	0.0039	0.0004	0.2889	0.1132	0.0898	0.0026
g. Transport equipment	NO	NO	NO	NO	NO	NO	NO
h. Machinery	11.1041	0.0002	0.0000	0.0146	0.0057	0.0046	0.0001
i. Mining and quarrying	3.1522	0.0001	0.0000	0.0218	0.0028	0.0011	0.0020
j. Wood and wood production	1.7860	0.0000	0.0000	0.0024	0.0009	0.0007	0.0000
k. Construction	14.7500	0.0005	0.0001	0.0713	0.0110	0.0053	0.0060
l. Textile and leather	40.9397	0.0007	0.0001	0.0540	0.0212	0.0168	0.0005
m. Other industries	38.1921	0.0007	0.0001	0.0504	0.0197	0.0157	0.0005
3. Transport	**1 261.2777**	**0.3310**	**0.0875**	**5.8622**	**17.2703**	**2.2093**	**1.6207**
a. Domestic aviation	0.0841	0.0000	0.0000	0.0001	0.0333	0.0005	0.0000
b. Road transportation	1 147.4178	0.3258	0.0560	4.3392	16.9192	2.0649	1.4627
c. Railways	81.4606	0.0046	0.0314	1.4706	0.3003	0.1305	0.1551
d. Domestic navigation	0.4098	0.0000	0.0000	0.0103	0.0010	0.0004	0.0026
e. Other transportation	31.9056	0.0006	0.0001	0.0421	0.0165	0.0131	0.0004

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2	CH_4	N_2O	NO_X	CO	NMVOC	SO_2
	(kt)						
4. Other sectors	**1 741.9621**	**1.3702**	**0.0193**	**4.4721**	**20.7406**	**2.8043**	**3.4683**
a. Commercial/institutional	424.9314	0.0851	0.0039	0.6851	1.9650	0.3099	1.5930
b. Residential	1 061.7282	1.2509	0.0134	1.1031	16.9438	2.1952	1.4043
c. Agriculture/forestry/fishing	255.3025	0.0342	0.0020	2.6839	1.8318	0.2992	0.4710
ci. Stationary	10.9356	0.0012	0.0000	0.0267	0.0089	0.0039	0.0056
cii. Mobile	244.3669	0.0330	0.0020	2.6572	1.8229	0.2953	0.4654
5. Other	**39.4529**	**0.0083**	**0.0016**	**0.1411**	**0.2860**	**0.0683**	**0.1720**
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	0.0185
B. Fugitive emissions from fuels	**0.3901**	**25.8825**	**0.1808**	**0.0000**	**0.0000**	**0.4697**	**0.0000**
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	**0.3901**	**25.8825**	**0.1808**	**0.0000**	**0.0000**	**0.4697**	**0.0000**
a. Oil	IE	IE	IE	IE	IE	IE	IE
b. Natural gas	IE	IE				IE	IE
c. Venting and flaring	IE	IE	IE	IE	IE	IE	IE
d. Other	IE	IE	IE	IE	IE	IE	IE
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	**62.0647**	**0.0036**	**0.0020**	**0.2505**	**0.1652**	**0.0671**	**0.0197**
Aviation	62.0647	0.0036	0.0020	0.2505	0.1652	0.0671	0.0197
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)						
Total Energy	**7 469.8555**	**29.3361**	**0.3138**	**17.6796**	**50.0082**	**7.0341**	**11.3068**
A. Fuel combustion activities (sectoral approach)	**7 468.7964**	**2.2776**	**0.1255**	**17.6796**	**50.0082**	**6.4958**	**11.3068**
1. Energy industries	**3 431.0444**	**0.0681**	**0.0130**	**5.7150**	**2.1205**	**0.1452**	**3.9758**
a. Public electricity and heat production	3 430.9670	0.0681	0.0130	5.7149	2.1205	0.1452	3.9753
b. Petroleum refining	0.0774	0.0000	0.0000	0.0001	0.0000	0.0000	0.0005
c. Manufacture of solid fuels and other energy industries	NO	NO	NO	NO	NO	NO	NO
2. Manufacturing industries and construction	**452.5663**	**0.0105**	**0.0013**	**0.7738**	**0.4050**	**0.1942**	**0.1826**
a. Iron and steel	46.4947	0.0008	0.0001	0.0613	0.0240	0.0191	0.0006
b. Non-ferrous metals	NO	NO	NO	NO	NO	NO	NO
c. Chemicals	1.7825	0.0000	0.0000	0.0024	0.0009	0.0007	0.0000
d. Pulp, paper and print	2.2772	0.0000	0.0000	0.0030	0.0012	0.0009	0.0000
e. Food processing, beverages and tobacco	93.5138	0.0038	0.0006	0.2393	0.2153	0.0478	0.1715
f. Non-metallic minerals	216.6572	0.0039	0.0004	0.2981	0.1128	0.0886	0.0040
g. Transport equipment	NO	NO	NO	NO	NO	NO	NO
h. Machinery	13.5105	0.0002	0.0000	0.0178	0.0070	0.0055	0.0002
i. Mining and quarrying	2.1489	0.0001	0.0000	0.0149	0.0019	0.0007	0.0014
j. Wood and wood production	1.7825	0.0000	0.0000	0.0024	0.0009	0.0007	0.0000
k. Construction	12.3070	0.0004	0.0001	0.0528	0.0088	0.0046	0.0042
l. Textile and leather	26.1440	0.0005	0.0000	0.0345	0.0135	0.0107	0.0003
m. Other industries	35.9480	0.0006	0.0001	0.0474	0.0186	0.0147	0.0004
3. Transport	**1 477.1995**	**0.3896**	**0.0857**	**6.3214**	**20.8227**	**2.5969**	**1.9187**
a. Domestic aviation	0.6492	0.0000	0.0000	0.0009	0.2575	0.0041	0.0002
b. Road transportation	1 409.9136	0.3867	0.0689	5.4825	20.3894	2.5123	1.8335
c. Railways	43.2637	0.0024	0.0167	0.7983	0.1630	0.0708	0.0823
d. Domestic navigation	0.3720	0.0000	0.0000	0.0094	0.0009	0.0003	0.0024
e. Other transportation	23.0010	0.0004	0.0000	0.0303	0.0119	0.0094	0.0003
4. Other sectors	**2 079.5633**	**1.8052**	**0.0246**	**4.7268**	**26.3790**	**3.5070**	**5.1110**
a. Commercial/institutional	578.8570	0.2142	0.0072	0.9763	3.2412	0.5404	2.5344
b. Residential	1 263.0033	1.5506	0.0154	1.3104	21.3433	2.6821	2.1437
c. Agriculture/forestry/fishing	237.7030	0.0404	0.0020	2.4401	1.7945	0.2845	0.4329
ci. Stationary	12.0879	0.0099	0.0002	0.0246	0.0244	0.0134	0.0032
cii. Mobile	225.6151	0.0305	0.0018	2.4155	1.7701	0.2711	0.4297
5. Other	**28.4228**	**0.0043**	**0.0009**	**0.1427**	**0.2811**	**0.0524**	**0.1187**
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	0.0119

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2	CH_4	N_2O	NO_X	CO	NMVOC	SO_2
	(kt)						
B. Fugitive emissions from fuels	**1.0592**	**27.0585**	**0.1884**	**0.0000**	**0.0000**	**0.5383**	**0.0000**
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	**1.0592**	**27.0585**	**0.1884**	**0.0000**	**0.0000**	**0.5383**	**0.0000**
a. Oil	IE	IE	IE	IE	IE	IE	IE
b. Natural gas	IE	IE				IE	IE
c. Venting and flaring	IE	IE	IE	IE	IE	IE	IE
d. Other	IE	IE	IE	IE	IE	IE	IE
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	**70.1110**	**0.0035**	**0.0023**	**0.2887**	**0.1786**	**0.0705**	**0.0222**
Aviation	70.1110	0.0035	0.0023	0.2887	0.1786	0.0705	0.0222
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)						
Total Energy	**8 141.8766**	**31.3534**	**0.3326**	**18.8504**	**46.5982**	**7.0666**	**10.5973**
A. Fuel combustion activities (sectoral approach)	**8 140.7721**	**1.9835**	**0.1367**	**18.8504**	**46.5982**	**6.1973**	**10.5973**
1. Energy industries	**3 725.8039**	**0.0701**	**0.0130**	**5.8304**	**2.1781**	**0.1492**	**3.9179**
a. Public electricity and heat production	3 480.8353	0.0691	0.0128	5.7829	2.1730	0.1484	3.7525
b. Petroleum refining	244.9686	0.0010	0.0002	0.0476	0.0051	0.0008	0.1654
c. Manufacture of solid fuels and other energy industries	NO	NO	NO	NO	NO	NO	NO
2. Manufacturing industries and construction	**465.1130**	**0.0124**	**0.0016**	**0.8587**	**0.4651**	**0.2118**	**0.2180**
a. Iron and steel	45.5438	0.0008	0.0001	0.0602	0.0262	0.0188	0.0032
b. Non-ferrous metals	NO	NO	NO	NO	NO	NO	NO
c. Chemicals	2.4547	0.0000	0.0000	0.0036	0.0013	0.0010	0.0001
d. Pulp, paper and print	2.5283	0.0000	0.0000	0.0033	0.0013	0.0010	0.0000
e. Food processing, beverages and tobacco	77.5946	0.0046	0.0007	0.2408	0.2330	0.0507	0.1809
f. Non-metallic minerals	242.2819	0.0045	0.0005	0.3352	0.1386	0.0998	0.0171
g. Transport equipment	NO	NO	NO	NO	NO	NO	NO
h. Machinery	13.6086	0.0003	0.0000	0.0194	0.0106	0.0058	0.0039
i. Mining and quarrying	4.5153	0.0002	0.0000	0.0313	0.0040	0.0015	0.0029
j. Wood and wood production	1.9702	0.0003	0.0000	0.0062	0.0052	0.0029	0.0004
k. Construction	15.8084	0.0005	0.0001	0.0762	0.0133	0.0061	0.0072
l. Textile and leather	26.0104	0.0005	0.0001	0.0384	0.0137	0.0106	0.0008
m. Other industries	32.7968	0.0006	0.0001	0.0441	0.0179	0.0135	0.0014
3. Transport	**1 668.6104**	**0.4162**	**0.1001**	**7.2533**	**22.1923**	**2.8012**	**2.1963**
a. Domestic aviation	0.4091	0.0000	0.0000	0.0005	0.1622	0.0026	0.0001
b. Road transportation	1 571.6420	0.4122	0.0773	6.1201	21.7906	2.6877	2.0810
c. Railways	58.9867	0.0033	0.0228	1.0740	0.2193	0.0953	0.1123
d. Domestic navigation	0.3783	0.0000	0.0000	0.0095	0.0009	0.0003	0.0024
e. Other transportation	37.1943	0.0007	0.0001	0.0491	0.0192	0.0152	0.0004
4. Other sectors	**2 253.6075**	**1.4817**	**0.0210**	**4.6918**	**21.4752**	**2.9879**	**4.2007**
a. Commercial/institutional	819.0263	0.1771	0.0062	1.2593	2.8547	0.5581	2.1550
b. Residential	1 217.6063	1.2701	0.0130	1.2370	17.2748	2.1826	1.6542
c. Agriculture/forestry/fishing	216.9750	0.0345	0.0017	2.1955	1.3456	0.2472	0.3915
ci. Stationary	17.0198	0.0075	0.0001	0.0282	0.0245	0.0103	0.0107
cii. Mobile	199.9552	0.0270	0.0016	2.1673	1.3212	0.2370	0.3808
5. Other	**27.6373**	**0.0031**	**0.0010**	**0.2161**	**0.2875**	**0.0472**	**0.0644**
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	0.0272
B. Fugitive emissions from fuels	**1.1045**	**29.3699**	**0.1959**	**0.0000**	**0.0000**	**0.8693**	**0.0000**
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	**1.1045**	**29.3699**	**0.1959**	**0.0000**	**0.0000**	**0.8693**	**0.0000**
a. Oil	IE	IE	IE	IE	IE	IE	IE
b. Natural gas	IE	IE				IE	IE
c. Venting and flaring	IE	IE	IE	IE	IE	IE	IE

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2	CH_4	N_2O	NO_X	CO	NMVOC	SO_2
	(kt)						
d. Other	IE	IE	IE	IE	IE	IE	IE
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	**67.3304**	**0.0035**	**0.0022**	**0.2767**	**0.1815**	**0.0622**	**0.0213**
Aviation	67.3304	0.0035	0.0022	0.2767	0.1815	0.0622	0.0213
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)						
Total Energy	**8 318.1422**	**33.1010**	**0.3460**	**19.3776**	**48.2340**	**7.2002**	**10.2932**
A. Fuel combustion activities (sectoral approach)	**8 317.0204**	**2.0836**	**0.1464**	**19.3776**	**48.2340**	**6.4212**	**10.2932**
1. Energy industries	**3 755.2075**	**0.0719**	**0.0129**	**5.9812**	**2.2656**	**0.1548**	**3.6993**
a. Public electricity and heat production	3 582.9769	0.0708	0.0127	5.9316	2.2600	0.1540	3.5340
b. Petroleum refining	172.2306	0.0011	0.0002	0.0496	0.0057	0.0008	0.1653
c. Manufacture of solid fuels and other energy industries	NO	NO	NO	NO	NO	NO	NO
2. Manufacturing industries and construction	**598.3665**	**0.0140**	**0.0017**	**1.0377**	**0.5095**	**0.2596**	**0.2064**
a. Iron and steel	66.6061	0.0012	0.0001	0.0880	0.0388	0.0275	0.0053
b. Non-ferrous metals	NO	NO	NO	NO	NO	NO	NO
c. Chemicals	3.4177	0.0001	0.0000	0.0087	0.0020	0.0013	0.0005
d. Pulp, paper and print	3.1539	0.0001	0.0000	0.0042	0.0016	0.0013	0.0000
e. Food processing, beverages and tobacco	84.9575	0.0040	0.0006	0.2359	0.2116	0.0474	0.1659
f. Non-metallic minerals	312.2093	0.0058	0.0006	0.4311	0.1749	0.1284	0.0184
g. Transport equipment	NO	NO	NO	NO	NO	NO	NO
h. Machinery	18.8236	0.0004	0.0000	0.0263	0.0130	0.0081	0.0031
i. Mining and quarrying	4.8927	0.0002	0.0000	0.0326	0.0043	0.0017	0.0030
j. Wood and wood production	2.4488	0.0002	0.0000	0.0071	0.0049	0.0028	0.0005
k. Construction	17.5987	0.0006	0.0001	0.0856	0.0141	0.0065	0.0080
l. Textile and leather	38.8103	0.0007	0.0001	0.0562	0.0204	0.0158	0.0010
m. Other industries	45.4480	0.0008	0.0001	0.0621	0.0236	0.0186	0.0008
3. Transport	**1 723.5435**	**0.4294**	**0.1102**	**7.8009**	**22.8161**	**2.9145**	**2.2802**
a. Domestic aviation	0.1116	0.0000	0.0000	0.0001	0.0443	0.0007	0.0000
b. Road transportation	1 607.2628	0.4242	0.0790	6.2702	22.4515	2.7681	2.1242
c. Railways	80.6729	0.0045	0.0311	1.4761	0.3014	0.1310	0.1536
d. Domestic navigation	0.3215	0.0000	0.0000	0.0081	0.0008	0.0003	0.0020
e. Other transportation	35.1747	0.0006	0.0001	0.0464	0.0182	0.0144	0.0004
4. Other sectors	**2 213.9626**	**1.5658**	**0.0206**	**4.3277**	**22.5157**	**3.0624**	**4.0412**
a. Commercial/institutional	699.7094	0.1392	0.0050	1.0548	2.3477	0.4622	1.7722
b. Residential	1 329.2032	1.3936	0.0140	1.3491	19.0402	2.3830	1.9247
c. Agriculture/forestry/fishing	185.0500	0.0330	0.0016	1.9238	1.1278	0.2172	0.3443
ci. Stationary	7.8127	0.0091	0.0001	0.0155	0.0226	0.0100	0.0067
cii. Mobile	177.2373	0.0239	0.0014	1.9083	1.1052	0.2073	0.3376
5. Other	**25.9403**	**0.0024**	**0.0010**	**0.2301**	**0.1272**	**0.0300**	**0.0661**
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	0.0256
B. Fugitive emissions from fuels	**1.1219**	**31.0174**	**0.1997**	**0.0000**	**0.0000**	**0.7790**	**0.0000**
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	**1.1219**	**31.0174**	**0.1997**	**0.0000**	**0.0000**	**0.7790**	**0.0000**
a. Oil	IE	IE	IE	IE	IE	IE	IE
b. Natural gas	IE	IE				IE	IE
c. Venting and flaring	IE	IE	IE	IE	IE	IE	IE
d. Other	IE	IE	IE	IE	IE	IE	IE
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	**67.6488**	**0.0035**	**0.0022**	**0.2800**	**0.1836**	**0.0628**	**0.0214**
Aviation	67.6488	0.0035	0.0022	0.2800	0.1836	0.0628	0.0214
Navigation	NO	NO	NO	NO	NO	NO	NO

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2	CH_4	N_2O	NO_X	CO	NMVOC	SO_2
	(kt)						
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)						
Total Energy	**7 516.9276**	**29.6103**	**0.3403**	**18.3425**	**49.3605**	**7.3353**	**10.2098**
A. Fuel combustion activities (sectoral approach)	**7 515.7016**	**2.2799**	**0.1520**	**18.3425**	**49.3605**	**6.6559**	**10.2098**
1. Energy industries	**2 963.9244**	**0.0571**	**0.0110**	**4.7598**	**1.7605**	**0.1206**	**3.3790**
a. Public electricity and heat production	2 830.9518	0.0563	0.0109	4.7223	1.7564	0.1200	3.2498
b. Petroleum refining	132.9726	0.0008	0.0002	0.0376	0.0041	0.0006	0.1292
c. Manufacture of solid fuels and other energy industries	NO	NO	NO	NO	NO	NO	NO
2. Manufacturing industries and construction	**661.3778**	**0.0145**	**0.0017**	**1.1449**	**0.5118**	**0.2781**	**0.1884**
a. Iron and steel	75.6806	0.0014	0.0001	0.1000	0.0444	0.0313	0.0063
b. Non-ferrous metals	NO	NO	NO	NO	NO	NO	NO
c. Chemicals	4.7251	0.0001	0.0000	0.0112	0.0028	0.0019	0.0006
d. Pulp, paper and print	3.9843	0.0001	0.0000	0.0053	0.0021	0.0016	0.0000
e. Food processing, beverages and tobacco	97.8816	0.0036	0.0005	0.2407	0.1976	0.0478	0.1531
f. Non-metallic minerals	310.3942	0.0056	0.0006	0.4301	0.1627	0.1270	0.0069
g. Transport equipment	0.5049	0.0000	0.0000	0.0007	0.0003	0.0002	0.0000
h. Machinery	25.7363	0.0005	0.0001	0.0349	0.0169	0.0107	0.0040
i. Mining and quarrying	7.2570	0.0003	0.0001	0.0503	0.0065	0.0025	0.0046
j. Wood and wood production	2.4390	0.0001	0.0000	0.0067	0.0026	0.0016	0.0004
k. Construction	27.9213	0.0009	0.0002	0.1229	0.0216	0.0107	0.0108
l. Textile and leather	59.6107	0.0011	0.0001	0.0807	0.0309	0.0244	0.0009
m. Other industries	45.2427	0.0008	0.0001	0.0614	0.0235	0.0185	0.0007
3. Transport	**1 651.6254**	**0.3962**	**0.1150**	**7.8164**	**20.9913**	**2.7138**	**2.2777**
a. Domestic aviation	0.1952	0.0000	0.0000	0.0003	0.0774	0.0012	0.0001
b. Road transportation	1 543.9901	0.3904	0.0761	5.9286	20.5276	2.5435	2.0844
c. Railways	100.6052	0.0056	0.0388	1.8721	0.3823	0.1661	0.1915
d. Domestic navigation	0.2711	0.0000	0.0000	0.0068	0.0006	0.0002	0.0017
e. Other transportation	6.5637	0.0001	0.0000	0.0087	0.0034	0.0027	0.0001
4. Other sectors	**2 199.7343**	**1.8093**	**0.0229**	**4.2889**	**25.6932**	**3.4799**	**4.2136**
a. Commercial/institutional	642.6029	0.1448	0.0049	0.9749	2.2534	0.4455	1.6893
b. Residential	1 378.1302	1.6301	0.0164	1.4250	22.3494	2.8198	2.1869
c. Agriculture/forestry/fishing	179.0012	0.0344	0.0016	1.8890	1.0904	0.2146	0.3374
ci. Stationary	4.4540	0.0109	0.0001	0.0097	0.0240	0.0110	0.0049
cii. Mobile	174.5472	0.0236	0.0014	1.8794	1.0664	0.2036	0.3324
5. Other	**39.0397**	**0.0029**	**0.0013**	**0.3325**	**0.4037**	**0.0635**	**0.1512**
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	0.0314
B. Fugitive emissions from fuels	**1.2260**	**27.3303**	**0.1884**	**0.0000**	**0.0000**	**0.6793**	**0.0000**
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	**1.2260**	**27.3303**	**0.1884**	**0.0000**	**0.0000**	**0.6793**	**0.0000**
a. Oil	IE	IE	IE	IE	IE	IE	IE
b. Natural gas	IE	IE				IE	IE
c. Venting and flaring	IE	IE	IE	IE	IE	IE	IE
d. Other	IE	IE	IE	IE	IE	IE	IE
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	**75.9610**	**0.0040**	**0.0025**	**0.3208**	**0.2037**	**0.0722**	**0.0241**
Aviation	75.9610	0.0040	0.0025	0.3208	0.2037	0.0722	0.0241
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)						
Total Energy	**7 775.4299**	**30.8658**	**0.3533**	**18.6880**	**42.7530**	**6.7207**	**8.8827**
A. Fuel combustion activities (sectoral approach)	**7 774.1723**	**1.8120**	**0.1536**	**18.6880**	**42.7530**	**5.8497**	**8.8827**
1. Energy industries	**3 483.6780**	**0.0653**	**0.0116**	**5.3850**	**2.0508**	**0.1399**	**3.2259**
a. Public electricity and heat production	3 203.4923	0.0633	0.0112	5.2993	2.0406	0.1385	2.9490
b. Petroleum refining	280.1857	0.0020	0.0004	0.0857	0.0102	0.0014	0.2769
c. Manufacture of solid fuels and other energy industries	NO	NO	NO	NO	NO	NO	NO
2. Manufacturing industries and construction	**823.8199**	**0.0166**	**0.0019**	**1.3060**	**0.5264**	**0.3426**	**0.1156**
a. Iron and steel	204.6960	0.0037	0.0004	0.2702	0.1102	0.0841	0.0069
b. Non-ferrous metals	NO	NO	NO	NO	NO	NO	NO
c. Chemicals	4.8475	0.0001	0.0000	0.0068	0.0025	0.0020	0.0001
d. Pulp, paper and print	3.7197	0.0001	0.0000	0.0049	0.0019	0.0015	0.0000
e. Food processing, beverages and tobacco	91.7584	0.0027	0.0004	0.1846	0.1226	0.0423	0.0770
f. Non-metallic minerals	305.3793	0.0055	0.0006	0.4244	0.1610	0.1250	0.0078
g. Transport equipment	NO	NO	NO	NO	NO	NO	NO
h. Machinery	32.6105	0.0006	0.0001	0.0453	0.0214	0.0136	0.0051
i. Mining and quarrying	3.9654	0.0002	0.0000	0.0268	0.0035	0.0013	0.0024
j. Wood and wood production	1.7616	0.0002	0.0000	0.0065	0.0040	0.0022	0.0005
k. Construction	59.7865	0.0015	0.0002	0.1806	0.0377	0.0232	0.0120
l. Textile and leather	60.1762	0.0011	0.0001	0.0815	0.0330	0.0247	0.0027
m. Other industries	55.1188	0.0010	0.0001	0.0744	0.0286	0.0226	0.0008
3. Transport	**1 757.4108**	**0.4151**	**0.1206**	**8.2201**	**21.5888**	**2.7975**	**2.4651**
a. Domestic aviation	0.1244	0.0000	0.0000	0.0002	0.0494	0.0008	0.0000
b. Road transportation	1 652.9698	0.4093	0.0816	6.3329	21.1542	2.6288	2.2708
c. Railways	100.9750	0.0057	0.0390	1.8751	0.3829	0.1664	0.1922
d. Domestic navigation	0.3121	0.0000	0.0000	0.0079	0.0007	0.0003	0.0020
e. Other transportation	3.0294	0.0001	0.0000	0.0040	0.0016	0.0012	0.0000
4. Other sectors	**1 664.7540**	**1.3111**	**0.0178**	**3.3914**	**18.2795**	**2.5144**	**2.9324**
a. Commercial/institutional	361.7262	0.1193	0.0039	0.5930	1.7514	0.3098	1.3479
b. Residential	1 150.6322	1.1663	0.0126	1.1712	15.6708	2.0252	1.2959
c. Agriculture/forestry/fishing	152.3956	0.0256	0.0013	1.6273	0.8573	0.1795	0.2886
ci. Stationary	1.8161	0.0052	0.0001	0.0039	0.0113	0.0053	0.0019
cii. Mobile	150.5795	0.0203	0.0012	1.6235	0.8460	0.1741	0.2868
5. Other	**44.5097**	**0.0039**	**0.0017**	**0.3855**	**0.3075**	**0.0552**	**0.1437**
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	0.0475
B. Fugitive emissions from fuels	**1.2577**	**29.0539**	**0.1997**	**0.0000**	**0.0000**	**0.8710**	**0.0000**
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	**1.2577**	**29.0539**	**0.1997**	**0.0000**	**0.0000**	**0.8710**	**0.0000**
a. Oil	IE	IE	IE	IE	IE	IE	IE
b. Natural gas	IE	IE				IE	IE
c. Venting and flaring	IE	IE	IE	IE	IE	IE	IE
d. Other	IE	IE	IE	IE	IE	IE	IE
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	**79.8999**	**0.0028**	**0.0026**	**0.3447**	**0.1871**	**0.0698**	**0.0253**
Aviation	79.8999	0.0028	0.0026	0.3447	0.1871	0.0698	0.0253
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)						
Total Energy	**8 253.4802**	**30.7804**	**0.3664**	**19.3481**	**45.4277**	**7.3059**	**10.6366**
A. Fuel combustion activities (sectoral approach)	**8 252.2054**	**1.8818**	**0.1592**	**19.3481**	**45.4277**	**6.1576**	**10.6366**
1. Energy industries	**3 772.1690**	**0.0722**	**0.0124**	**5.5687**	**2.1292**	**0.1458**	**3.3292**
a. Public electricity and heat production	3 281.6019	0.0689	0.0117	5.4267	2.1125	0.1435	2.8653
b. Petroleum refining	490.5671	0.0033	0.0007	0.1420	0.0167	0.0023	0.4639
c. Manufacture of solid fuels and other energy industries	NO	NO	NO	NO	NO	NO	NO
2. Manufacturing industries and construction	**907.5951**	**0.0347**	**0.0047**	**1.5370**	**2.2890**	**0.4765**	**1.8642**
a. Iron and steel	213.8140	0.0039	0.0004	0.2891	0.1143	0.0877	0.0068

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2	CH_4	N_2O	NO_x	CO	NMVOC	SO_2
	(kt)						
b. Non-ferrous metals	NO	NO	NO	NO	NO	NO	NO
c. Chemicals	5.5894	0.0001	0.0000	0.0079	0.0029	0.0023	0.0001
d. Pulp, paper and print	4.2310	0.0001	0.0000	0.0056	0.0022	0.0017	0.0001
e. Food processing, beverages and tobacco	103.3459	0.0030	0.0004	0.2187	0.1320	0.0466	0.0821
f. Non-metallic minerals	338.0232	0.0223	0.0032	0.5527	1.8904	0.2359	1.7521
g. Transport equipment	NO	NO	NO	NO	NO	NO	NO
h. Machinery	31.7369	0.0006	0.0001	0.0484	0.0205	0.0132	0.0048
i. Mining and quarrying	4.5021	0.0002	0.0000	0.0309	0.0040	0.0015	0.0028
j. Wood and wood production	1.3987	0.0004	0.0001	0.0068	0.0084	0.0044	0.0006
k. Construction	71.3558	0.0017	0.0002	0.1914	0.0441	0.0283	0.0118
l. Textile and leather	58.9560	0.0011	0.0001	0.0825	0.0310	0.0241	0.0014
m. Other industries	74.6421	0.0014	0.0001	0.1030	0.0391	0.0306	0.0016
3. Transport	**1 848.2954**	**0.4358**	**0.1218**	**8.5432**	**22.4722**	**2.9125**	**2.6195**
a. Domestic aviation	0.1500	0.0000	0.0000	0.0002	0.0595	0.0009	0.0000
b. Road transportation	1 751.1533	0.4305	0.0861	6.7911	22.0550	2.7553	2.4410
c. Railways	92.6093	0.0052	0.0357	1.7379	0.3549	0.1542	0.1763
d. Domestic navigation	0.3436	0.0000	0.0000	0.0086	0.0008	0.0003	0.0022
e. Other transportation	4.0392	0.0001	0.0000	0.0053	0.0021	0.0017	0.0000
4. Other sectors	**1 675.4850**	**1.3355**	**0.0186**	**3.3674**	**18.1831**	**2.5680**	**2.6248**
a. Commercial/institutional	370.5198	0.1295	0.0040	0.6215	1.6814	0.3164	1.2641
b. Residential	1 155.1559	1.1820	0.0134	1.1849	15.7171	2.0802	1.0848
c. Agriculture/forestry/fishing	149.8094	0.0239	0.0012	1.5610	0.7845	0.1715	0.2759
ci. Stationary	6.1934	0.0046	0.0001	0.0097	0.0117	0.0059	0.0024
cii. Mobile	143.6160	0.0194	0.0012	1.5512	0.7728	0.1655	0.2735
5. Other	**48.6609**	**0.0037**	**0.0016**	**0.3318**	**0.3542**	**0.0549**	**0.1988**
a. Stationary	25.3950	0.0012	0.0004	0.0488	0.1932	0.0274	0.1583
b. Mobile	23.2659	0.0025	0.0012	0.2830	0.1610	0.0274	0.0405
B. Fugitive emissions from fuels	**1.2748**	**28.8986**	**0.2072**	**0.0000**	**0.0000**	**1.1483**	**0.0000**
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	**1.2748**	**28.8986**	**0.2072**	**0.0000**	**0.0000**	**1.1483**	**0.0000**
a. Oil	IE	IE	IE	IE	IE	IE	IE
b. Natural gas	IE	IE				IE	IE
c. Venting and flaring	IE	IE	IE	IE	IE	IE	IE
d. Other	IE	IE	IE	IE	IE	IE	IE
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	**89.2738**	**0.0017**	**0.0029**	**0.3939**	**0.1807**	**0.0752**	**0.0283**
Aviation	89.2738	0.0017	0.0029	0.3939	0.1807	0.0752	0.0283
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)						
Total Energy	**9 152.8755**	**25.9197**	**0.3719**	**19.7779**	**45.5750**	**7.1466**	**13.2555**
A. Fuel combustion activities (sectoral approach)	**9 151.6023**	**2.0024**	**0.1459**	**19.7779**	**45.5750**	**6.0141**	**13.2555**
1. Energy industries	**5 027.2977**	**0.0960**	**0.0194**	**7.6814**	**2.7418**	**0.1899**	**6.5062**
a. Public electricity and heat production	4 447.6480	0.0913	0.0185	7.4755	2.7180	0.1866	5.8250
b. Petroleum refining	579.6497	0.0047	0.0009	0.2059	0.0238	0.0033	0.6812
c. Manufacture of solid fuels and other energy industries	NO	NO	NO	NO	NO	NO	NO
2. Manufacturing industries and construction	**514.8733**	**0.0223**	**0.0031**	**0.8955**	**1.6077**	**0.2844**	**1.3799**
a. Iron and steel	74.6433	0.0014	0.0001	0.1015	0.0398	0.0306	0.0023
b. Non-ferrous metals	NO	NO	NO	NO	NO	NO	NO
c. Chemicals	3.7656	0.0001	0.0000	0.0050	0.0020	0.0015	0.0001
d. Pulp, paper and print	2.8326	0.0001	0.0000	0.0038	0.0015	0.0012	0.0001
e. Food processing, beverages and tobacco	57.6213	0.0015	0.0002	0.0969	0.0783	0.0260	0.0511
f. Non-metallic minerals	219.2269	0.0160	0.0023	0.3748	1.3959	0.1620	1.3108
g. Transport equipment	NO	NO	NO	NO	NO	NO	NO
h. Machinery	13.5626	0.0002	0.0000	0.0184	0.0072	0.0056	0.0004
i. Mining and quarrying	3.1522	0.0001	0.0000	0.0218	0.0028	0.0011	0.0020
j. Wood and wood production	0.2333	0.0000	0.0000	0.0003	0.0001	0.0001	0.0000

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2	CH_4	N_2O	NO_X	CO	NMVOC	SO_2
	(kt)						
k. Construction	24.1049	0.0008	0.0001	0.1156	0.0183	0.0089	0.0097
l. Textile and leather	38.7547	0.0007	0.0001	0.0526	0.0207	0.0159	0.0012
m. Other industries	76.9759	0.0014	0.0001	0.1047	0.0411	0.0316	0.0024
3. Transport	**1 771.7398**	**0.4415**	**0.1035**	**7.5996**	**22.2381**	**2.8305**	**2.4477**
a. Domestic aviation	0.0752	0.0000	0.0000	0.0001	0.0298	0.0005	0.0000
b. Road transportation	1 710.7571	0.4385	0.0840	6.6402	22.0106	2.7423	2.3496
c. Railways	50.5945	0.0028	0.0195	0.9392	0.1918	0.0833	0.0963
d. Domestic navigation	0.2711	0.0000	0.0000	0.0068	0.0006	0.0002	0.0017
e. Other transportation	10.0419	0.0002	0.0000	0.0132	0.0052	0.0041	0.0001
4. Other sectors	**1 824.3586**	**1.4415**	**0.0195**	**3.4941**	**18.8063**	**2.6817**	**2.8745**
a. Commercial/institutional	476.5167	0.2179	0.0053	0.7995	1.9152	0.4377	1.3016
b. Residential	1 208.6689	1.1980	0.0130	1.2286	16.0646	2.0783	1.3140
c. Agriculture/forestry/fishing	139.1730	0.0255	0.0012	1.4660	0.8264	0.1657	0.2588
ci. Stationary	4.6102	0.0074	0.0001	0.0087	0.0165	0.0083	0.0025
cii. Mobile	134.5628	0.0182	0.0011	1.4572	0.8099	0.1575	0.2563
5. Other	**13.3329**	**0.0012**	**0.0003**	**0.1073**	**0.1811**	**0.0277**	**0.0472**
a. Stationary	10.3169	0.0006	0.0002	0.0216	0.0570	0.0107	0.0426
b. Mobile	3.0161	0.0006	0.0002	0.0856	0.1241	0.0170	0.0046
B. Fugitive emissions from fuels	**1.2732**	**23.9173**	**0.2260**	**0.0000**	**0.0000**	**1.1325**	**0.0000**
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	**1.2732**	**23.9173**	**0.2260**	**0.0000**	**0.0000**	**1.1325**	**0.0000**
a. Oil	IE	IE	IE	IE	IE	IE	IE
b. Natural gas	IE	IE				IE	IE
c. Venting and flaring	IE	IE	IE	IE	IE	IE	IE
d. Other	IE	IE	IE	IE	IE	IE	IE
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	**82.6571**	**0.0018**	**0.0027**	**0.3672**	**0.1729**	**0.0709**	**0.0262**
Aviation	82.6571	0.0018	0.0027	0.3672	0.1729	0.0709	0.0262
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)						
Total Energy	**9 443.1854**	**25.3348**	**0.3974**	**21.3124**	**47.3547**	**7.0824**	**12.2631**
A. Fuel combustion activities (sectoral approach)	**9 441.9107**	**2.1419**	**0.1563**	**21.3124**	**47.3547**	**6.2054**	**12.2631**
1. Energy industries	**4 975.7812**	**0.0998**	**0.0186**	**7.7976**	**2.8882**	**0.1987**	**5.5945**
a. Public electricity and heat production	4 586.0896	0.0965	0.0180	7.6534	2.8714	0.1964	5.1211
b. Petroleum refining	389.6916	0.0033	0.0007	0.1442	0.0168	0.0023	0.4733
c. Manufacture of solid fuels and other energy industries	NO	NO	NO	NO	NO	NO	NO
2. Manufacturing industries and construction	**443.0025**	**0.0128**	**0.0017**	**0.8138**	**0.6084**	**0.2062**	**0.3865**
a. Iron and steel	40.7854	0.0008	0.0001	0.0549	0.0242	0.0169	0.0038
b. Non-ferrous metals	NO	NO	NO	NO	NO	NO	NO
c. Chemicals	3.9030	0.0001	0.0000	0.0052	0.0021	0.0016	0.0001
d. Pulp, paper and print	3.0051	0.0001	0.0000	0.0044	0.0016	0.0012	0.0001
e. Food processing, beverages and tobacco	75.0387	0.0023	0.0003	0.1626	0.1072	0.0348	0.0708
f. Non-metallic minerals	149.6905	0.0054	0.0007	0.2405	0.3605	0.0760	0.2928
g. Transport equipment	NO	NO	NO	NO	NO	NO	NO
h. Machinery	18.0146	0.0004	0.0001	0.0303	0.0128	0.0080	0.0029
i. Mining and quarrying	2.9592	0.0001	0.0000	0.0205	0.0026	0.0010	0.0019
j. Wood and wood production	0.8218	0.0006	0.0001	0.0043	0.0125	0.0066	0.0004
k. Construction	25.7770	0.0008	0.0001	0.1237	0.0196	0.0096	0.0103
l. Textile and leather	48.9094	0.0009	0.0001	0.0669	0.0260	0.0200	0.0014
m. Other industries	74.0979	0.0013	0.0001	0.1004	0.0393	0.0304	0.0020
3. Transport	**2 008.0937**	**0.4528**	**0.1165**	**8.8144**	**21.8270**	**2.8213**	**2.9534**
a. Domestic aviation	0.1158	0.0000	0.0000	0.0002	0.0459	0.0007	0.0000
b. Road transportation	1 954.2692	0.4499	0.0966	7.8629	21.5870	2.7359	2.8541
c. Railways	51.3468	0.0029	0.0198	0.9427	0.1925	0.0837	0.0977
d. Domestic navigation	0.2301	0.0000	0.0000	0.0058	0.0005	0.0002	0.0015
e. Other transportation	2.1318	0.0000	0.0000	0.0028	0.0011	0.0009	0.0000

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2	CH_4	N_2O	NO_X	CO	NMVOC	SO_2
	(kt)						
4. Other sectors	**1 985.0640**	**1.5742**	**0.0190**	**3.7572**	**21.7528**	**2.9332**	**3.2007**
a. Commercial/institutional	477.0165	0.1303	0.0035	0.7495	1.3666	0.3304	0.9312
b. Residential	1 352.3024	1.4132	0.0141	1.3726	19.3267	2.4123	1.9815
c. Agriculture/forestry/fishing	155.7451	0.0307	0.0013	1.6351	1.0595	0.1905	0.2880
ci. Stationary	5.8035	0.0105	0.0001	0.0106	0.0226	0.0118	0.0023
cii. Mobile	149.9416	0.0202	0.0012	1.6245	1.0368	0.1787	0.2857
5. Other	**29.9692**	**0.0023**	**0.0006**	**0.1294**	**0.2782**	**0.0459**	**0.1281**
a. Stationary	26.4674	0.0017	0.0004	0.0487	0.1652	0.0303	0.1228
b. Mobile	3.5018	0.0007	0.0002	0.0806	0.1130	0.0156	0.0053
B. Fugitive emissions from fuels	**1.2747**	**23.1928**	**0.2411**	**0.0000**	**0.0000**	**0.8770**	**0.0000**
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	**1.2747**	**23.1928**	**0.2411**	**0.0000**	**0.0000**	**0.8770**	**0.0000**
a. Oil	IE	IE	IE	IE	IE	IE	IE
b. Natural gas	IE	IE				IE	IE
c. Venting and flaring	IE	IE	IE	IE	IE	IE	IE
d. Other	IE	IE	IE	IE	IE	IE	IE
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	**82.6894**	**0.0027**	**0.0027**	**0.3600**	**0.1894**	**0.0734**	**0.0262**
Aviation	82.6894	0.0027	0.0027	0.3600	0.1894	0.0734	0.0262
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)						
Total Energy	**9 654.6698**	**28.7372**	**0.4209**	**21.5558**	**50.5851**	**7.7791**	**12.3977**
A. Fuel combustion activities (sectoral approach)	**9 653.3531**	**2.2724**	**0.1626**	**21.5558**	**50.5851**	**6.7617**	**12.3977**
1. Energy industries	**4 607.9596**	**0.0891**	**0.0159**	**7.0725**	**2.6695**	**0.1831**	**4.5393**
a. Public electricity and heat production	4 180.6692	0.0859	0.0152	6.9326	2.6531	0.1808	4.0804
b. Petroleum refining	427.2904	0.0032	0.0006	0.1399	0.0164	0.0022	0.4589
c. Manufacture of solid fuels and other energy industries	NO	NO	NO	NO	NO	NO	NO
2. Manufacturing industries and construction	**596.4123**	**0.0272**	**0.0038**	**1.0531**	**1.8817**	**0.3409**	**1.5948**
a. Iron and steel	53.4319	0.0010	0.0001	0.0725	0.0327	0.0221	0.0059
b. Non-ferrous metals	NO	NO	NO	NO	NO	NO	NO
c. Chemicals	5.9183	0.0001	0.0000	0.0157	0.0036	0.0023	0.0010
d. Pulp, paper and print	5.6164	0.0001	0.0000	0.0074	0.0029	0.0023	0.0001
e. Food processing, beverages and tobacco	78.9562	0.0024	0.0003	0.1466	0.1158	0.0375	0.0757
f. Non-metallic minerals	276.9052	0.0187	0.0027	0.4531	1.6009	0.1935	1.4927
g. Transport equipment	NO	NO	NO	NO	NO	NO	NO
h. Machinery	19.7765	0.0005	0.0001	0.0299	0.0147	0.0094	0.0026
i. Mining and quarrying	3.8484	0.0002	0.0000	0.0267	0.0034	0.0013	0.0024
j. Wood and wood production	1.3673	0.0011	0.0001	0.0096	0.0210	0.0110	0.0009
k. Construction	25.5539	0.0008	0.0001	0.1202	0.0193	0.0096	0.0099
l. Textile and leather	48.7186	0.0009	0.0001	0.0677	0.0270	0.0206	0.0015
m. Other industries	76.3196	0.0014	0.0001	0.1036	0.0405	0.0313	0.0020
3. Transport	**2 117.5188**	**0.4522**	**0.1212**	**9.1394**	**22.5108**	**2.8983**	**3.1362**
a. Domestic aviation	0.1195	0.0000	0.0000	0.0002	0.0474	0.0008	0.0000
b. Road transportation	2 069.9376	0.4495	0.1029	8.2594	22.2844	2.8198	3.0447
c. Railways	47.2252	0.0026	0.0182	0.8739	0.1784	0.0776	0.0899
d. Domestic navigation	0.2364	0.0000	0.0000	0.0059	0.0006	0.0002	0.0015
e. Other transportation	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
4. Other sectors	**2 310.0323**	**1.7027**	**0.0214**	**4.1347**	**23.1600**	**3.2929**	**3.0189**
a. Commercial/institutional	805.5903	0.1538	0.0040	1.1673	1.5325	0.4614	0.9375
b. Residential	1 352.2297	1.5224	0.0161	1.3927	20.6429	2.6529	1.7971
c. Agriculture/forestry/fishing	152.2124	0.0265	0.0013	1.5748	0.9846	0.1786	0.2843
ci. Stationary	5.8161	0.0067	0.0001	0.0099	0.0168	0.0071	0.0054
cii. Mobile	146.3963	0.0198	0.0012	1.5648	0.9678	0.1714	0.2789
5. Other	**21.4301**	**0.0013**	**0.0005**	**0.1561**	**0.3630**	**0.0465**	**0.1085**
a. Stationary	17.5679	0.0007	0.0003	0.0306	0.1252	0.0180	0.1024
b. Mobile	3.8622	0.0006	0.0002	0.1255	0.2378	0.0285	0.0061

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2	CH_4	N_2O	NO_X	CO	NMVOC	SO_2
	(kt)						
B. Fugitive emissions from fuels	**1.3167**	**26.4648**	**0.2583**	**0.0000**	**0.0000**	**1.0174**	**0.0000**
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	**1.3167**	**26.4648**	**0.2583**	**0.0000**	**0.0000**	**1.0174**	**0.0000**
a. Oil	IE	IE	IE	IE	IE	IE	IE
b. Natural gas	IE	IE				IE	IE
c. Venting and flaring	IE	IE	IE	IE	IE	IE	IE
d. Other	IE	IE	IE	IE	IE	IE	IE
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	**95.4144**	**0.0032**	**0.0031**	**0.3984**	**0.2213**	**0.0959**	**0.0303**
Aviation	95.4144	0.0032	0.0031	0.3984	0.2213	0.0959	0.0303
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)						
Total Energy	**9 195.8094**	**28.4588**	**0.4326**	**20.2207**	**48.4470**	**7.4794**	**10.8629**
A. Fuel combustion activities (sectoral approach)	**9 194.4989**	**2.4223**	**0.1490**	**20.2207**	**48.4470**	**6.5497**	**10.8629**
1. Energy industries	**4 596.6508**	**0.0848**	**0.0152**	**7.0895**	**2.6782**	**0.1832**	**4.4420**
a. Public electricity and heat production	4 198.2060	0.0807	0.0144	6.9412	2.6590	0.1807	3.9591
b. Petroleum refining	395.5328	0.0033	0.0007	0.1462	0.0169	0.0023	0.4827
c. Manufacture of solid fuels and other energy industries	2.9120	0.0008	0.0001	0.0021	0.0023	0.0002	0.0003
2. Manufacturing industries and construction	**456.6973**	**0.0120**	**0.0015**	**0.7894**	**0.4438**	**0.2107**	**0.1935**
a. Iron and steel	65.2565	0.0012	0.0001	0.0874	0.0343	0.0268	0.0014
b. Non-ferrous metals	NO	NO	NO	NO	NO	NO	NO
c. Chemicals	5.8879	0.0001	0.0000	0.0079	0.0031	0.0024	0.0001
d. Pulp, paper and print	3.5227	0.0001	0.0000	0.0047	0.0018	0.0014	0.0000
e. Food processing, beverages and tobacco	86.3833	0.0027	0.0004	0.1585	0.1349	0.0419	0.0902
f. Non-metallic minerals	113.9696	0.0028	0.0003	0.1667	0.1371	0.0507	0.0819
g. Transport equipment	NO	NO	NO	NO	NO	NO	NO
h. Machinery	19.0316	0.0004	0.0000	0.0268	0.0118	0.0079	0.0023
i. Mining and quarrying	2.8899	0.0001	0.0000	0.0200	0.0026	0.0010	0.0018
j. Wood and wood production	1.7396	0.0014	0.0002	0.0106	0.0268	0.0142	0.0010
k. Construction	30.1008	0.0009	0.0002	0.1339	0.0221	0.0113	0.0109
l. Textile and leather	47.1860	0.0009	0.0001	0.0646	0.0269	0.0200	0.0021
m. Other industries	80.7295	0.0015	0.0001	0.1085	0.0425	0.0331	0.0018
3. Transport	**1 859.5648**	**0.3906**	**0.1092**	**8.2552**	**18.9451**	**2.4721**	**2.8138**
a. Domestic aviation	0.2045	0.0000	0.0000	0.0003	0.0811	0.0013	0.0001
b. Road transportation	1 808.3518	0.3877	0.0896	7.3072	18.6713	2.3871	2.7155
c. Railways	50.7384	0.0028	0.0196	0.9409	0.1921	0.0835	0.0966
d. Domestic navigation	0.2701	0.0000	0.0000	0.0068	0.0006	0.0002	0.0017
e. Other transportation	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
4. Other sectors	**2 273.0863**	**1.9343**	**0.0229**	**4.0301**	**26.2302**	**3.6664**	**3.3897**
a. Commercial/institutional	777.8639	0.1756	0.0041	1.1073	1.4895	0.4722	0.8608
b. Residential	1 346.3584	1.7271	0.0175	1.4071	23.7411	3.0151	2.2553
c. Agriculture/forestry/fishing	148.8639	0.0315	0.0013	1.5158	0.9995	0.1791	0.2736
ci. Stationary	8.4213	0.0126	0.0002	0.0145	0.0290	0.0137	0.0060
cii. Mobile	140.4426	0.0190	0.0011	1.5013	0.9705	0.1655	0.2676
5. Other	**8.4998**	**0.0006**	**0.0002**	**0.0565**	**0.1496**	**0.0172**	**0.0238**
a. Stationary	5.1512	0.0001	0.0000	0.0086	0.0224	0.0034	0.0185
b. Mobile	3.3486	0.0005	0.0002	0.0479	0.1273	0.0138	0.0053
B. Fugitive emissions from fuels	**1.3104**	**26.0365**	**0.2836**	**0.0000**	**0.0000**	**0.9297**	**0.0000**
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	**1.3104**	**26.0365**	**0.2836**	**0.0000**	**0.0000**	**0.9297**	**0.0000**
a. Oil	IE	IE	IE	IE	IE	IE	IE
b. Natural gas	IE	IE				IE	IE
c. Venting and flaring	IE	IE	IE	IE	IE	IE	IE

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2	CH_4	N_2O	NO_x	CO	NMVOC	SO_2
	(kt)						
d. Other	IE	IE	IE	IE	IE	IE	IE
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	**107.6790**	**0.0031**	**0.0034**	**0.4332**	**0.2338**	**0.1073**	**0.0342**
Aviation	107.6790	0.0031	0.0034	0.4332	0.2338	0.1073	0.0342
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)						
Total Energy	**8 214.0054**	**27.2872**	**0.4347**	**19.0713**	**50.5789**	**7.5356**	**13.8040**
A. Fuel combustion activities (sectoral approach)	**8 212.3614**	**2.4890**	**0.1518**	**19.0713**	**50.5789**	**6.6563**	**13.8040**
1. Energy industries	**3 680.5879**	**0.0702**	**0.0149**	**5.7643**	**2.0314**	**0.1406**	**5.1228**
a. Public electricity and heat production	3 323.8598	0.0658	0.0141	5.6064	2.0112	0.1379	4.5982
b. Petroleum refining	353.2561	0.0034	0.0007	0.1554	0.0174	0.0025	0.5243
c. Manufacture of solid fuels and other energy industries	3.4720	0.0009	0.0001	0.0025	0.0028	0.0002	0.0003
2. Manufacturing industries and construction	**597.3290**	**0.0309**	**0.0044**	**1.0424**	**2.3184**	**0.3625**	**2.0459**
a. Iron and steel	31.9572	0.0006	0.0001	0.0432	0.0184	0.0132	0.0024
b. Non-ferrous metals	NO	NO	NO	NO	NO	NO	NO
c. Chemicals	7.4706	0.0004	0.0000	0.0181	0.0084	0.0050	0.0010
d. Pulp, paper and print	0.6391	0.0000	0.0000	0.0009	0.0003	0.0003	0.0000
e. Food processing, beverages and tobacco	88.8536	0.0028	0.0004	0.1605	0.1259	0.0442	0.0757
f. Non-metallic minerals	302.2747	0.0233	0.0034	0.4927	2.0645	0.2291	1.9523
g. Transport equipment	NO	NO	NO	NO	NO	NO	NO
h. Machinery	17.8294	0.0003	0.0000	0.0240	0.0093	0.0073	0.0003
i. Mining and quarrying	6.2985	0.0003	0.0001	0.0436	0.0056	0.0021	0.0040
j. Wood and wood production	4.6109	0.0005	0.0001	0.0073	0.0098	0.0058	0.0002
k. Construction	25.8274	0.0007	0.0001	0.1015	0.0179	0.0098	0.0078
l. Textile and leather	51.9160	0.0009	0.0001	0.0701	0.0271	0.0213	0.0010
m. Other industries	59.6516	0.0011	0.0001	0.0806	0.0312	0.0244	0.0011
3. Transport	**1 979.4512**	**0.3941**	**0.1089**	**8.4436**	**18.4275**	**2.4051**	**3.0379**
a. Domestic aviation	0.1945	0.0000	0.0000	0.0003	0.0772	0.0012	0.0001
b. Road transportation	1 933.9544	0.3920	0.0964	7.8155	18.2198	2.3448	2.9743
c. Railways	32.4079	0.0018	0.0125	0.6043	0.1234	0.0536	0.0617
d. Domestic navigation	0.2719	0.0000	0.0000	0.0068	0.0006	0.0002	0.0017
e. Other transportation	12.6225	0.0002	0.0000	0.0167	0.0065	0.0052	0.0002
4. Other sectors	**1 951.0935**	**1.9936**	**0.0235**	**3.7779**	**27.7566**	**3.7430**	**3.5798**
a. Commercial/institutional	472.1209	0.1304	0.0035	0.6980	1.3782	0.3338	0.9324
b. Residential	1 313.5563	1.8257	0.0186	1.3913	25.1288	3.2072	2.3343
c. Agriculture/forestry/fishing	165.4163	0.0375	0.0014	1.6886	1.2496	0.2020	0.3131
ci. Stationary	10.5355	0.0166	0.0002	0.0184	0.0420	0.0149	0.0181
cii. Mobile	154.8808	0.0209	0.0013	1.6702	1.2076	0.1871	0.2951
5. Other	**3.8998**	**0.0003**	**0.0001**	**0.0432**	**0.0450**	**0.0052**	**0.0176**
a. Stationary	1.7565	0.0000	0.0000	0.0037	0.0155	0.0015	0.0140
b. Mobile	2.1433	0.0003	0.0001	0.0395	0.0295	0.0036	0.0036
B. Fugitive emissions from fuels	**1.6441**	**24.7983**	**0.2829**	**0.0000**	**0.0000**	**0.8793**	**0.0000**
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	**1.6441**	**24.7983**	**0.2829**	**0.0000**	**0.0000**	**0.8793**	**0.0000**
a. Oil	IE	IE	IE	IE	IE	IE	IE
b. Natural gas	IE	IE				IE	IE
c. Venting and flaring	IE	IE	IE	IE	IE	IE	IE
d. Other	IE	IE	IE	IE	IE	IE	IE
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	**130.4626**	**0.0046**	**0.0042**	**0.5235**	**0.3098**	**0.1345**	**0.0414**
Aviation	130.4626	0.0046	0.0042	0.5235	0.3098	0.1345	0.0414
Navigation	NO	NO	NO	NO	NO	NO	NO

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2	CH_4	N_2O	NO_x	CO	NMVOC	SO_2
	(kt)						
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)						
Total Energy	**8 807.4746**	**28.4042**	**0.4675**	**20.1823**	**75.8060**	**11.5158**	**11.3285**
A. Fuel combustion activities (sectoral approach)	**8 805.8026**	**4.5913**	**0.1740**	**20.1823**	**75.8060**	**10.7386**	**11.3285**
1. Energy industries	**4 351.4775**	**0.0856**	**0.0160**	**6.8994**	**2.5652**	**0.1761**	**4.8179**
a. Public electricity and heat production	4 045.1883	0.0815	0.0153	6.7539	2.5467	0.1735	4.3256
b. Petroleum refining	302.4812	0.0031	0.0006	0.1427	0.0155	0.0023	0.4919
c. Manufacture of solid fuels and other energy industries	3.8080	0.0010	0.0001	0.0028	0.0031	0.0002	0.0004
2. Manufacturing industries and construction	**467.8569**	**0.0148**	**0.0019**	**0.8282**	**0.7873**	**0.2267**	**0.5538**
a. Iron and steel	68.1113	0.0012	0.0001	0.0917	0.0358	0.0279	0.0015
b. Non-ferrous metals	NO	NO	NO	NO	NO	NO	NO
c. Chemicals	6.6351	0.0001	0.0000	0.0089	0.0035	0.0027	0.0001
d. Pulp, paper and print	3.8107	0.0001	0.0000	0.0050	0.0020	0.0016	0.0001
e. Food processing, beverages and tobacco	97.0661	0.0034	0.0005	0.2048	0.1652	0.0484	0.1145
f. Non-metallic minerals	122.0367	0.0060	0.0008	0.1811	0.4748	0.0725	0.4221
g. Transport equipment	0.0693	0.0000	0.0000	0.0005	0.0001	0.0000	0.0000
h. Machinery	12.1813	0.0002	0.0000	0.0168	0.0064	0.0050	0.0003
i. Mining and quarrying	6.5901	0.0003	0.0001	0.0457	0.0059	0.0022	0.0042
j. Wood and wood production	2.3781	0.0005	0.0001	0.0046	0.0104	0.0058	0.0002
k. Construction	33.0954	0.0009	0.0001	0.1128	0.0224	0.0130	0.0082
l. Textile and leather	35.2510	0.0006	0.0001	0.0478	0.0185	0.0144	0.0008
m. Other industries	80.6318	0.0015	0.0001	0.1085	0.0424	0.0331	0.0018
3. Transport	**2 049.6794**	**0.3919**	**0.1026**	**7.9515**	**18.0907**	**2.3365**	**3.1778**
a. Domestic aviation	0.1180	0.0000	0.0000	0.0002	0.0468	0.0007	0.0000
b. Road transportation	2 030.0747	0.3915	0.1015	7.8575	18.0216	2.3231	3.1702
c. Railways	2.7049	0.0002	0.0010	0.0635	0.0130	0.0056	0.0051
d. Domestic navigation	0.3444	0.0000	0.0000	0.0087	0.0008	0.0003	0.0022
e. Other transportation	16.4373	0.0003	0.0000	0.0217	0.0085	0.0067	0.0002
4. Other sectors	**1 933.4972**	**4.0986**	**0.0533**	**4.4914**	**54.3206**	**7.9960**	**2.7674**
a. Commercial/institutional	485.0863	0.1894	0.0038	0.7192	1.2210	0.3839	0.6698
b. Residential	1 250.1951	3.8641	0.0477	1.6959	51.8144	7.3705	1.7147
c. Agriculture/forestry/fishing	198.2158	0.0451	0.0018	2.0762	1.2851	0.2417	0.3829
ci. Stationary	5.7310	0.0191	0.0002	0.0124	0.0444	0.0165	0.0162
cii. Mobile	192.4849	0.0260	0.0016	2.0638	1.2407	0.2252	0.3667
5. Other	**3.2915**	**0.0004**	**0.0001**	**0.0119**	**0.0423**	**0.0033**	**0.0118**
a. Stationary	1.0877	0.0000	0.0000	0.0024	0.0091	0.0009	0.0083
b. Mobile	2.2039	0.0003	0.0001	0.0095	0.0331	0.0025	0.0035
B. Fugitive emissions from fuels	**1.6721**	**23.8129**	**0.2935**	**0.0000**	**0.0000**	**0.7772**	**0.0000**
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	**1.6721**	**23.8129**	**0.2935**	**0.0000**	**0.0000**	**0.7772**	**0.0000**
a. Oil	IE	IE	IE	IE	IE	IE	IE
b. Natural gas	IE	IE				IE	IE
c. Venting and flaring	IE	IE	IE	IE	IE	IE	IE
d. Other	IE	IE	IE	IE	IE	IE	IE
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	**154.5245**	**0.0034**	**0.0050**	**0.6239**	**0.3279**	**0.1425**	**0.0490**
Aviation	154.5245	0.0034	0.0050	0.6239	0.3279	0.1425	0.0490
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)						
Total Energy	**9 231.5931**	**27.5534**	**0.4811**	**21.6188**	**81.5147**	**12.1824**	**12.3574**
A. Fuel combustion activities (sectoral approach)	**9 229.9350**	**4.8894**	**0.1917**	**21.6188**	**81.5147**	**11.4666**	**12.3574**
1. Energy industries	**4 737.5409**	**0.0928**	**0.0167**	**7.3734**	**2.7936**	**0.1911**	**4.6488**
a. Public electricity and heat production	4 338.1788	0.0877	0.0158	7.2331	2.7725	0.1884	4.1855
b. Petroleum refining	391.2981	0.0029	0.0006	0.1345	0.0146	0.0022	0.4625
c. Manufacture of solid fuels and other energy industries	8.0640	0.0022	0.0003	0.0058	0.0065	0.0005	0.0008
2. Manufacturing industries and construction	**532.9098**	**0.0261**	**0.0036**	**0.9164**	**1.8245**	**0.3207**	**1.5551**
a. Iron and steel	50.7320	0.0009	0.0001	0.0685	0.0267	0.0208	0.0011
b. Non-ferrous metals	NO	NO	NO	NO	NO	NO	NO
c. Chemicals	4.5650	0.0002	0.0000	0.0090	0.0048	0.0030	0.0004
d. Pulp, paper and print	4.1380	0.0001	0.0000	0.0055	0.0021	0.0017	0.0001
e. Food processing, beverages and tobacco	83.1728	0.0033	0.0004	0.1339	0.1182	0.0495	0.0540
f. Non-metallic minerals	239.6958	0.0180	0.0026	0.4030	1.5781	0.1806	1.4850
g. Transport equipment	0.0000	0.0000	0.0000	0.0001	0.0006	0.0003	0.0000
h. Machinery	9.6337	0.0002	0.0000	0.0139	0.0060	0.0040	0.0012
i. Mining and quarrying	4.5057	0.0002	0.0000	0.0313	0.0040	0.0015	0.0029
j. Wood and wood production	0.5618	0.0004	0.0001	0.0040	0.0079	0.0041	0.0004
k. Construction	22.7229	0.0006	0.0001	0.0897	0.0158	0.0086	0.0070
l. Textile and leather	27.6251	0.0005	0.0001	0.0382	0.0151	0.0116	0.0007
m. Other industries	85.5569	0.0016	0.0002	0.1193	0.0452	0.0350	0.0023
3. Transport	**2 158.9106**	**0.4126**	**0.1144**	**8.7542**	**18.6703**	**2.4258**	**3.3598**
a. Domestic aviation	0.3082	0.0000	0.0000	0.0004	0.1222	0.0019	0.0001
b. Road transportation	2 120.0212	0.4111	0.1060	8.3219	18.4565	2.3810	3.3167
c. Railways	21.6726	0.0012	0.0084	0.4038	0.0825	0.0358	0.0413
d. Domestic navigation	0.2469	0.0000	0.0000	0.0062	0.0006	0.0002	0.0016
e. Other transportation	16.6617	0.0003	0.0000	0.0220	0.0086	0.0068	0.0002
4. Other sectors	**1 797.6960**	**4.3577**	**0.0568**	**4.5637**	**58.1907**	**8.5260**	**2.7814**
a. Commercial/institutional	341.0371	0.1452	0.0032	0.5508	1.0628	0.2893	0.6518
b. Residential	1 237.8607	4.1660	0.0518	1.7360	55.8343	7.9791	1.7027
c. Agriculture/forestry/fishing	218.7982	0.0465	0.0019	2.2768	1.2936	0.2576	0.4268
ci. Stationary	7.9737	0.0180	0.0002	0.0147	0.0468	0.0134	0.0253
cii. Mobile	210.8245	0.0285	0.0017	2.2621	1.2468	0.2442	0.4015
5. Other	**2.8778**	**0.0003**	**0.0001**	**0.0112**	**0.0355**	**0.0030**	**0.0124**
a. Stationary	1.2342	0.0000	0.0000	0.0026	0.0108	0.0011	0.0098
b. Mobile	1.6436	0.0003	0.0001	0.0086	0.0247	0.0019	0.0026
B. Fugitive emissions from fuels	**1.6581**	**22.6640**	**0.2894**	**0.0000**	**0.0000**	**0.7158**	**0.0000**
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	**1.6581**	**22.6640**	**0.2894**	**0.0000**	**0.0000**	**0.7158**	**0.0000**
a. Oil	IE	IE	IE	IE	IE	IE	IE
b. Natural gas	IE	IE				IE	IE
c. Venting and flaring	IE	IE	IE	IE	IE	IE	IE
d. Other	IE	IE	IE	IE	IE	IE	IE
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	**218.4141**	**0.0058**	**0.0070**	**0.9076**	**0.4463**	**0.2200**	**0.0693**
Aviation	218.4141	0.0058	0.0070	0.9076	0.4463	0.2200	0.0693
Navigation	NO	NO	NO	NO	NO	NO	NO
Multilateral operations	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**
CO_2 emissions from biomass	**1 439.5226**						
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)						
Total Energy	**9 032.6132**	**29.7056**	**0.5100**	**22.2698**	**84.9869**	**12.8957**	**11.3492**
A. Fuel combustion activities (sectoral approach)	**9 030.9428**	**5.2620**	**0.2128**	**22.2698**	**84.9869**	**12.1865**	**11.3492**
1. Energy industries	**4 518.9699**	**0.0908**	**0.0162**	**7.1984**	**2.7454**	**0.1872**	**4.3305**
a. Public electricity and heat production	4 273.3730	0.0870	0.0155	7.1197	2.7295	0.1857	4.1247
b. Petroleum refining	238.9889	0.0020	0.0004	0.0739	0.0106	0.0011	0.2051
c. Manufacture of solid fuels and other energy industries	6.6080	0.0018	0.0002	0.0048	0.0053	0.0004	0.0006
2. Manufacturing industries and construction	**500.7010**	**0.0199**	**0.0027**	**0.8499**	**1.2769**	**0.2685**	**1.0313**
a. Iron and steel	42.4943	0.0008	0.0001	0.0573	0.0223	0.0174	0.0009

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2	CH_4	N_2O	NO_X	CO	NMVOC	SO_2
	(kt)						
b. Non-ferrous metals	NO	NO	NO	NO	NO	NO	NO
c. Chemicals	6.9246	0.0001	0.0000	0.0134	0.0039	0.0028	0.0006
d. Pulp, paper and print	3.4494	0.0001	0.0000	0.0046	0.0004	0.0003	0.0000
e. Food processing, beverages and tobacco	95.5096	0.0032	0.0004	0.1694	0.1235	0.0501	0.0625
f. Non-metallic minerals	180.9311	0.0120	0.0017	0.2964	1.0256	0.1262	0.9533
g. Transport equipment	NO	NO	NO	NO	NO	NO	NO
h. Machinery	11.6486	0.0002	0.0000	0.0170	0.0079	0.0049	0.0022
i. Mining and quarrying	2.4357	0.0001	0.0000	0.0169	0.0022	0.0008	0.0016
j. Wood and wood production	1.2517	0.0002	0.0000	0.0080	0.0039	0.0019	0.0007
k. Construction	24.9591	0.0007	0.0001	0.0891	0.0179	0.0101	0.0066
l. Textile and leather	34.4340	0.0007	0.0001	0.0477	0.0187	0.0144	0.0009
m. Other industries	96.6629	0.0017	0.0002	0.1302	0.0507	0.0396	0.0020
3. Transport	**2 331.5969**	**0.4819**	**0.1318**	**9.7662**	**19.1661**	**2.5173**	**3.6073**
a. Domestic aviation	0.2278	0.0000	0.0000	0.0003	0.0904	0.0014	0.0001
b. Road transportation	2 271.2546	0.4791	0.1142	8.8723	18.8904	2.4326	3.5191
c. Railways	45.4816	0.0025	0.0176	0.8691	0.1775	0.0771	0.0866
d. Domestic navigation	0.2152	0.0000	0.0000	0.0054	0.0005	0.0002	0.0014
e. Other transportation	14.4177	0.0003	0.0000	0.0190	0.0075	0.0059	0.0002
4. Other sectors	**1 677.5744**	**4.6692**	**0.0620**	**4.4456**	**61.7768**	**9.2109**	**2.3703**
a. Commercial/institutional	338.9734	0.1264	0.0029	0.5241	1.0320	0.2715	0.6526
b. Residential	1 127.9637	4.4919	0.0573	1.7033	59.9549	8.6941	1.3065
c. Agriculture/forestry/fishing	210.6373	0.0509	0.0019	2.2182	0.7899	0.2453	0.4113
ci. Stationary	7.8135	0.0235	0.0002	0.0164	0.0570	0.0190	0.0251
cii. Mobile	202.8239	0.0274	0.0016	2.2018	0.7329	0.2263	0.3862
5. Other	**2.1005**	**0.0002**	**0.0001**	**0.0097**	**0.0217**	**0.0026**	**0.0098**
a. Stationary	0.9015	0.0000	0.0000	0.0016	0.0089	0.0008	0.0080
b. Mobile	1.1989	0.0002	0.0001	0.0080	0.0128	0.0017	0.0018
B. Fugitive emissions from fuels	**1.6704**	**24.4436**	**0.2972**	**0.0000**	**0.0000**	**0.7092**	**0.0000**
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	**1.6704**	**24.4436**	**0.2972**	**0.0000**	**0.0000**	**0.7092**	**0.0000**
a. Oil	IE	IE	IE	IE	IE	IE	IE
b. Natural gas	IE	IE				IE	IE
c. Venting and flaring	IE	IE	IE	IE	IE	IE	IE
d. Other	IE	IE	IE	IE	IE	IE	IE
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	**313.0386**	**0.0063**	**0.0100**	**1.3124**	**0.6066**	**0.2929**	**0.0993**
Aviation	313.0386	0.0063	0.0100	1.3124	0.6066	0.2929	0.0993
Navigation	NO	NO	NO	NO	NO	NO	NO
Multilateral operations	NO	NO	NO	NO	NO	NO	NO
CO_2 emissions from biomass	**1 561.9690**						
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', 1990-2016

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)			
Total industrial processes	**1 572.2808**	**NO**	**0.0001**	**NO**	**NO**	**NO**	**NO**	**NO**	**3.6380**	**5.4100**	**106.6288**	**1.3289**
A. Mineral industry	**1 306.2407**								**3.4824**	**3.3540**	**0.0339**	**1.2645**
1. Cement production	971.6967								2.2355	2.6210	0.0324	0.6737
2. Lime production	232.4996								0.4288	0.6077		0.0990
3. Glass production	25.2212								0.6960		0.0015	0.4656
4. Other process uses of carbonates	76.8231								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

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)			
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				
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	**3.1787**	**NO**	**0.0001**	**NO**	**NO**	**NO**	**NO**	**NO**	**0.0197**	**0.6017**	**1.4449**	**NO**
1. Electrical equipment				NO	NO	NO	NO	NO				
2. SF_6 and PFCs from other product use					NO	NO	NO					
3. N_2O from product uses			0.0001									
4. Other	3.1787	NO	NO	NO	NO	NO	NO	NO	0.0197	0.6017	1.4449	NO
H. Other									**NO**	**NO**	**12.2544**	**NO**
1. Pulp and Paper Industry									NO	NO	NO	NO
2. Food and Beverages Industry									NO	NO	12.2544	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)			
Total industrial processes	**1 394.6352**	**NO**	**0.0001**	**NO**	**NO**	**NO**	**NO**	**NO**	**3.3511**	**4.8635**	**87.9714**	**1.2515**
A. Mineral industry	**1 173.7238**								**3.2148**	**3.0021**	**0.0315**	**1.1965**
1. Cement production	900.7877								2.0682	2.4249	0.0300	0.6233
2. Lime production	176.5179								0.3256	0.4614		0.0752
3. Glass production	25.0580								0.7083		0.0015	0.4738
4. Other process uses of carbonates	71.3602								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

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)			
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	**2.8632**	**NO**	**0.0001**	**NO**	**NO**	**NO**	**NO**	**NO**	**0.0199**	**0.6083**	**1.3014**	**NO**
1. Electrical equipment				NO	NO	NO	NO	NO				
2. SF_6 and PFCs from other product use					NO	NO	NO					
3. N_2O from product uses			0.0001									
4. Other	2.8632	NO	NO	NO	NO	NO	NO	NO	0.0199	0.6083	1.3014	NO
H. Other									**NO**	**NO**	**10.2883**	**NO**
1. Pulp and Paper Industry									NO	NO	NO	NO
2. Food and Beverages Industry									NO	NO	10.2883	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)			
Total industrial processes	**808.8996**	**NO**	**0.0001**	**NO**	**NO**	**NO**	**NO**	**NO**	**1.7876**	**3.3721**	**72.3206**	**0.6493**
A. Mineral industry	**628.3873**								**1.6607**	**1.6135**	**0.0165**	**0.5982**
1. Cement production	474.3138								1.0912	1.2794	0.0158	0.3289
2. Lime production	103.7620								0.1914	0.2712		0.0442
3. Glass production	11.9560								0.3169		0.0007	0.2120
4. Other process uses of carbonates	38.3555								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				

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)			
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	**2.2573**	**NO**	**0.0001**	**NO**	**NO**	**NO**	**NO**	**NO**	**0.0186**	**0.5686**	**1.0260**	**NO**
1. Electrical equipment				NO	NO	NO	NO	NO				
2. SF_6 and PFCs from other product use					NO	NO	NO					
3. N_2O from product uses			0.0001									
4. Other	2.2573	NO	NO	NO	NO	NO	NO	NO	0.0186	0.5686	1.0260	NO
H. Other									**NO**	**NO**	**8.2577**	**NO**
1. Pulp and Paper Industry									NO	NO	NO	NO
2. Food and Beverages Industry									NO	NO	8.2577	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)			
Total industrial processes	**724.8725**	**NO**	**0.0001**	**NO**	**NO**	**NO**	**NO**	**NO**	**1.6915**	**3.2093**	**60.6455**	**0.6314**
A. Mineral industry	**574.7172**								**1.5690**	**1.4535**	**0.0143**	**0.5827**
1. Cement production	405.7165								0.9338	1.0949	0.0135	0.2814
2. Lime production	100.6076								0.1856	0.2630		0.0428
3. Glass production	10.8638								0.3564		0.0007	0.2384
4. Other process uses of carbonates	57.5293								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	**1.8544**	**NO**	**0.0001**	**NO**	**NO**	**NO**	**NO**	**NO**	**0.0190**	**0.5819**	**0.8429**	**NO**
1. Electrical equipment				NO	NO	NO	NO	NO				
2. SF_6 and PFCs from other product use					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
	(kt)			CO_2 equivalent (kt)					(kt)			
3. N_2O from product uses			0.0001									
4. Other	1.8544	NO	NO	NO	NO	NO	NO	NO	0.0190	0.5819	0.8429	NO
H. Other									**NO**	**NO**	**9.6360**	**NO**
1. Pulp and Paper Industry									NO	NO	NO	NO
2. Food and Beverages Industry									NO	NO	9.6360	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)			
Total industrial processes	**548.7445**	**NO**	**0.0001**	**NO**	**NO**	**NO**	**NO**	**NO**	**1.3361**	**2.8203**	**41.6403**	**0.5025**
A. Mineral industry	**437.5899**								**1.2218**	**1.1320**	**0.0115**	**0.4572**
1. Cement production	328.4361								0.7552	0.8854	0.0110	0.2276
2. Lime production	76.1330								0.1404	0.1990		0.0324
3. Glass production	3.7901								0.2799		0.0006	0.1873
4. Other process uses of carbonates	29.2308								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	**1.3519**	**NO**	**0.0001**	**NO**	**NO**	**NO**	**NO**	**NO**	**0.0173**	**0.5290**	**0.6145**	**NO**
1. Electrical equipment				NO	NO	NO	NO	NO				
2. SF_6 and PFCs from other product use					NO	NO	NO					
3. N_2O from product uses			0.0001									
4. Other	1.3519	NO	NO	NO	NO	NO	NO	NO	0.0173	0.5290	0.6145	NO
H. Other									**NO**	**NO**	**8.1775**	**NO**
1. Pulp and Paper Industry									NO	NO	NO	NO
2. Food and Beverages Industry									NO	NO	8.1775	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)			
Total industrial processes	**446.5790**	**NO**	**0.0000**	**3.9514**	**NO**	**NO**	**NO**	**NO**	**1.1389**	**2.5418**	**40.2086**	**0.4519**
A. Mineral industry	**342.6866**								**1.0250**	**0.8818**	**0.0089**	**0.4060**
1. Cement production	248.5258								0.5705	0.6689	0.0083	0.1719
2. Lime production	69.3788								0.1280	0.1813		0.0295
3. Glass production	4.7151								0.2958		0.0006	0.1979
4. Other process uses of carbonates	20.0670								0.0307	0.0315		0.0066
B. Chemical industry	**NO**	**NO**	**NO**						**NO**	**NO**	**0.0051**	**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	0.0051	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	**76.5608**	**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	64.2796	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				**3.9514**	**NO**	**NO**	**NO**	**NO**				
1. Refrigeration and air conditioning				3.6751	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	**1.0947**	**NO**	**0.0000**	**NO**	**NO**	**NO**	**NO**	**NO**	**0.0153**	**0.4695**	**0.4976**	**NO**
1. Electrical equipment				NO	NO	NO	NO	NO				
2. SF_6 and PFCs from other product use					NO	NO	NO					
3. N_2O from product uses			0.0000									
4. Other	1.0947	NO	NO	NO	NO	NO	NO	NO	0.0153	0.4695	0.4976	NO
H. Other									**NO**	**NO**	**10.4463**	**NO**
1. Pulp and Paper Industry									NO	NO	NO	NO
2. Food and Beverages Industry									NO	NO	10.4463	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)			
Total industrial processes	**405.4054**	**NO**	**0.0000**	**4.2815**	**NO**	**NO**	**NO**	**NO**	**0.9923**	**2.6269**	**36.9171**	**0.3822**
A. Mineral industry	**306.5696**								**0.8724**	**0.7810**	**0.0069**	**0.3361**
1. Cement production	193.1220								0.4434	0.5198	0.0064	0.1336
2. Lime production	89.0847								0.1643	0.2328		0.0379
3. Glass production	6.9080								0.2371		0.0005	0.1586
4. Other process uses of carbonates	17.4550								0.0276	0.0283		0.0059
B. Chemical industry	**NO**	**NO**	**NO**						**NO**	**NO**	**0.0046**	**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	

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)			
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	0.0046	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	**71.0711**	**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	59.4607	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				**4.2815**	**NO**	**NO**	**NO**	**NO**				
1. Refrigeration and air conditioning				3.5951	NO	NO	NO	NO				
2. Foam blowing agents				0.6864	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	**1.0386**	**NO**	**0.0000**	**NO**	**NO**	**NO**	**NO**	**NO**	**0.0210**	**0.6414**	**0.4721**	**NO**
1. Electrical equipment				NO	NO	NO	NO	NO				
2. SF_6 and PFCs from other product use					NO	NO	NO					
3. N_2O from product uses			0.0000									
4. Other	1.0386	NO	NO	NO	NO	NO	NO	NO	0.0210	0.6414	0.4721	NO
H. Other									**NO**	**NO**	**9.3728**	**NO**
1. Pulp and Paper Industry									NO	NO	NO	NO
2. Food and Beverages Industry									NO	NO	9.3728	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)			
Total industrial processes	**446.3084**	**NO**	**0.0000**	**5.1070**	**NO**	**NO**	**NO**	**NO**	**1.2016**	**2.9865**	**22.9531**	**0.4641**
A. Mineral industry	**370.9362**								**1.0716**	**0.9575**	**0.0096**	**0.4134**
1. Cement production	270.1273								0.6207	0.7278	0.0090	0.1871
2. Lime production	75.7247								0.1397	0.1979		0.0322
3. Glass production	4.6608								0.2802		0.0006	0.1875
4. Other process uses of carbonates	20.4234								0.0309	0.0318		0.0067
B. Chemical industry	**NO**	**NO**	**NO**						**NO**	**NO**	**0.0037**	**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	0.0037	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

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)			
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	**42.0527**	**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	31.0928	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				**5.1070**	**NO**	**NO**	**NO**	**NO**				
1. Refrigeration and air conditioning				3.8776	NO	NO	NO	NO				
2. Foam blowing agents				1.2294	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	**0.9389**	**NO**	**0.0000**	**NO**	**NO**	**NO**	**NO**	**NO**	**0.0205**	**0.6281**	**0.4268**	**NO**
1. Electrical equipment				NO	NO	NO	NO	NO				
2. SF_6 and PFCs from other product use					NO	NO	NO					
3. N_2O from product uses			0.0000									
4. Other	0.9389	NO	NO	NO	NO	NO	NO	NO	0.0205	0.6281	0.4268	NO
H. Other									**NO**	**NO**	**8.3398**	**NO**
1. Pulp and Paper Industry									NO	NO	NO	NO
2. Food and Beverages Industry									NO	NO	8.3398	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)			
Total industrial processes	**371.0737**	**NO**	**0.0000**	**6.0624**	**NO**	**NO**	**NO**	**NO**	**1.0549**	**2.5139**	**20.5122**	**0.4279**
A. Mineral industry	**304.0902**								**0.9420**	**0.7779**	**0.0078**	**0.3832**
1. Cement production	215.0572								0.4937	0.5788	0.0072	0.1488
2. Lime production	64.8141								0.1195	0.1694		0.0276
3. Glass production	4.9882								0.2999		0.0006	0.2006
4. Other process uses of carbonates	19.2306								0.0289	0.0297		0.0062
B. Chemical industry	**NO**	**NO**	**NO**						**NO**	**NO**	**0.0042**	**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	0.0042	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	**37.5993**	**NO**	**NO**						**0.0033**	**0.0185**	**13.2679**	**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	29.1801	NO	NO						0.0033	0.0185	13.2679	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				

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)			
4. Heat transfer fluid				NO	NO	NO	NO	NO				
5. Other				NO	NO	NO	NO	NO				
F. Product uses as substitutes for ODS				**6.0624**	**NO**	**NO**	**NO**	**NO**				
1. Refrigeration and air conditioning				4.1996	NO	NO	NO	NO				
2. Foam blowing agents				1.8628	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	**0.7020**	**NO**	**0.0000**	**NO**	**NO**	**NO**	**NO**	**NO**	**0.0162**	**0.4967**	**0.3191**	**NO**
1. Electrical equipment				NO	NO	NO	NO	NO				
2. SF_6 and PFCs from other product use					NO	NO	NO					
3. N_2O from product uses			0.0000									
4. Other	0.7020	NO	NO	NO	NO	NO	NO	NO	0.0162	0.4967	0.3191	NO
H. Other									**NO**	**NO**	**6.8761**	**NO**
1. Pulp and Paper Industry									NO	NO	NO	NO
2. Food and Beverages Industry									NO	NO	6.8761	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)			
Total industrial processes	**334.1373**	**NO**	**0.0000**	**6.8017**	**NO**	**NO**	**NO**	**NO**	**0.9405**	**2.6378**	**16.1821**	**0.3736**
A. Mineral industry	**270.1228**								**0.8158**	**0.6939**	**0.0075**	**0.3247**
1. Cement production	210.8122								0.4844	0.5680	0.0070	0.1460
2. Lime production	36.6099								0.0675	0.0957		0.0156
3. Glass production	3.4167								0.2344		0.0005	0.1568
4. Other process uses of carbonates	19.2840								0.0294	0.0302		0.0063
B. Chemical industry	**NO**	**NO**	**NO**						**NO**	**NO**	**0.0035**	**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	0.0035	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	**31.6142**	**NO**	**NO**						**0.0024**	**0.0133**	**11.6405**	**0.0012**
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	25.5994	NO	NO						0.0024	0.0133	11.6405	0.0012
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				**6.8017**	**NO**	**NO**	**NO**	**NO**				
1. Refrigeration and air conditioning				4.1971	NO	NO	NO	NO				
2. Foam blowing agents				2.6045	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	**0.6062**	**NO**	**0.0000**	**NO**	**NO**	**NO**	**NO**	**NO**	**0.0189**	**0.5773**	**0.2755**	**NO**
1. Electrical equipment				NO	NO	NO	NO	NO				
2. SF_6 and PFCs from other product use					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
	(kt)			CO_2 equivalent (kt)			(kt)					
3. N_2O from product uses			0.0000									
4. Other	0.6062	NO	NO	NO	NO	NO	NO	NO	0.0189	0.5773	0.2755	NO
H. Other									**NO**	**NO**	**4.2144**	**NO**
1. Pulp and Paper Industry									NO	NO	NO	NO
2. Food and Beverages Industry									NO	NO	4.2144	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)					
Total industrial processes	**305.7865**	**NO**	**0.0000**	**8.3038**	**NO**	**NO**	**NO**	**NO**	**1.0642**	**2.7415**	**15.8877**	**0.4903**
A. Mineral industry	**237.9796**								**0.9242**	**0.5746**	**0.0067**	**0.4349**
1. Cement production	172.7600								0.3975	0.4660	0.0058	0.1198
2. Lime production	30.7649								0.0567	0.0804		0.0131
3. Glass production	15.4704								0.4426		0.0009	0.2961
4. Other process uses of carbonates	18.9843								0.0274	0.0282		0.0059
B. Chemical industry	**NO**	**NO**	**NO**						**NO**	**NO**	**0.0065**	**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	0.0065	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	**30.6392**	**NO**	**NO**						**0.0019**	**0.0108**	**11.6590**	**0.0010**
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	25.6400	NO	NO						0.0019	0.0108	11.6590	0.0010
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				**8.3038**	**NO**	**NO**	**NO**	**NO**				
1. Refrigeration and air conditioning				4.1151	NO	NO	NO	NO				
2. Foam blowing agents				4.1887	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	**0.8987**	**NO**	**0.0000**	**NO**	**NO**	**NO**	**NO**	**NO**	**0.0200**	**0.6124**	**0.4085**	**NO**
1. Electrical equipment				NO	NO	NO	NO	NO				
2. SF_6 and PFCs from other product use					NO	NO	NO					
3. N_2O from product uses			0.0000									
4. Other	0.8987	NO	NO	NO	NO	NO	NO	NO	0.0200	0.6124	0.4085	NO
H. Other									**NO**	**NO**	**3.7608**	**NO**
1. Pulp and Paper Industry									NO	NO	NO	NO
2. Food and Beverages Industry									NO	NO	3.7608	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)			
Total industrial processes	**308.5598**	**NO**	**0.0000**	**10.4771**	**NO**	**NO**	**NO**	**NO**	**1.0250**	**2.8520**	**17.4938**	**0.4631**
A. Mineral industry	**235.2359**								**0.8765**	**0.5715**	**0.0066**	**0.4038**
1. Cement production	173.8847								0.3995	0.4684	0.0058	0.1204
2. Lime production	28.5383								0.0526	0.0746		0.0122
3. Glass production	14.0377								0.3966		0.0008	0.2653
4. Other process uses of carbonates	18.7753								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	**33.9235**	**NO**	**NO**						**0.0024**	**0.0135**	**12.8867**	**0.0012**
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	28.3468	NO	NO						0.0024	0.0135	12.8867	0.0012
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				**10.4771**	**NO**	**NO**	**NO**	**NO**				
1. Refrigeration and air conditioning				4.5048	NO	NO	NO	NO				
2. Foam blowing agents				5.9723	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	**0.7730**	**NO**	**0.0000**	**NO**	**NO**	**NO**	**NO**	**NO**	**0.0203**	**0.6229**	**0.3514**	**NO**
1. Electrical equipment				NO	NO	NO	NO	NO				
2. SF_6 and PFCs from other product use					NO	NO	NO					
3. N_2O from product uses			0.0000									
4. Other	0.7730	NO	NO	NO	NO	NO	NO	NO	0.0203	0.6229	0.3514	NO
H. Other									**NO**	**NO**	**4.1911**	**NO**
1. Pulp and Paper Industry									NO	NO	NO	NO
2. Food and Beverages Industry									NO	NO	4.1911	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)			
Total industrial processes	**357.7976**	**NO**	**0.0000**	**14.5015**	**NO**	**NO**	**NO**	**NO**	**1.1676**	**2.0313**	**19.0331**	**0.5249**
A. Mineral industry	**300.3739**								**1.0852**	**0.7298**	**0.0083**	**0.4931**
1. Cement production	219.1917								0.5048	0.5919	0.0073	0.1521
2. Lime production	39.4860								0.0728	0.1032		0.0168
3. Glass production	18.7603								0.4737		0.0010	0.3169
4. Other process uses of carbonates	22.9359								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

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)			
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	**36.1900**	**NO**	**NO**						**0.0021**	**0.0118**	**13.8294**	**0.0010**
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	30.4210	NO	NO						0.0021	0.0118	13.8294	0.0010
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				**14.5015**	**NO**	**NO**	**NO**	**NO**				
1. Refrigeration and air conditioning				5.0760	NO	NO	NO	NO				
2. Foam blowing agents				9.4256	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	**0.7307**	**NO**	**0.0000**	**NO**	**NO**	**NO**	**NO**	**NO**	**0.0136**	**0.4172**	**0.3321**	**NO**
1. Electrical equipment				NO	NO	NO	NO	NO				
2. SF_6 and PFCs from other product use					NO	NO	NO					
3. N_2O from product uses			0.0000									
4. Other	0.7307	NO	NO	NO	NO	NO	NO	NO	0.0136	0.4172	0.3321	NO
H. Other									**NO**	**NO**	**4.8266**	**NO**
1. Pulp and Paper Industry									NO	NO	NO	NO
2. Food and Beverages Industry									NO	NO	4.8266	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)			
Total industrial processes	**385.6075**	**NO**	**0.0000**	**20.8415**	**NO**	**NO**	**0.0000**	**NO**	**1.2054**	**2.7466**	**20.1643**	**0.5309**
A. Mineral industry	**308.3700**								**1.0721**	**0.7534**	**0.0091**	**0.4765**
1. Cement production	245.6276								0.5618	0.6586	0.0081	0.1693
2. Lime production	22.0253								0.0406	0.0576		0.0094
3. Glass production	17.2567								0.4335		0.0009	0.2900
4. Other process uses of carbonates	23.4604								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

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)			
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	**40.9211**	**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	32.7176	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				**20.8415**	**NO**	**NO**	**NO**	**NO**				
1. Refrigeration and air conditioning				5.7491	NO	NO	NO	NO				
2. Foam blowing agents				15.0924	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	**0.8881**	**NO**	**0.0000**	**NO**	**NO**	**NO**	**0.0000**	**NO**	**0.0154**	**0.4712**	**0.4037**	**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	0.8881	NO	NO	NO	NO	NO	NO	NO	0.0154	0.4712	0.4037	NO
H. Other									**NO**	**NO**	**4.8202**	**NO**
1. Pulp and Paper Industry									NO	NO	NO	NO
2. Food and Beverages Industry									NO	NO	4.8202	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)			
Total industrial processes	**456.2031**	**NO**	**0.0001**	**29.1966**	**NO**	**NO**	**0.0000**	**NO**	**1.3536**	**3.1045**	**31.9898**	**0.5887**
A. Mineral industry	**350.6290**								**1.1984**	**0.8689**	**0.0104**	**0.5238**
1. Cement production	282.5765								0.6524	0.7649	0.0095	0.1966
2. Lime production	22.8789								0.0422	0.0598		0.0097
3. Glass production	17.8332								0.4608		0.0010	0.3082
4. Other process uses of carbonates	27.3405								0.0431	0.0443		0.0093
B. Chemical industry	**NO**	**NO**	**NO**						**NO**	**NO**	**0.0118**	**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	0.0118	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	**64.1000**	**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	55.7018	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				

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)			
5. Other				NO	NO	NO	NO	NO				
F. Product uses as substitutes for ODS				**29.1966**	**NO**	**NO**	**NO**	**NO**				
1. Refrigeration and air conditioning				8.0196	NO	NO	NO	NO				
2. Foam blowing agents				21.1768	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	**0.9656**	**NO**	**0.0001**	**NO**	**NO**	**NO**	**0.0000**	**NO**	**0.0152**	**0.4661**	**0.4389**	**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	0.9656	NO	NO	NO	NO	NO	NO	NO	0.0152	0.4661	0.4389	NO
H. Other									**NO**	**NO**	**6.1437**	**NO**
1. Pulp and Paper Industry									NO	NO	NO	NO
2. Food and Beverages Industry									NO	NO	6.1437	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)			
Total industrial processes	**551.0519**	**NO**	**0.0001**	**40.7988**	**NO**	**NO**	**0.0000**	**NO**	**1.6255**	**3.3507**	**34.3106**	**0.6942**
A. Mineral industry	**440.2134**								**1.4680**	**1.1141**	**0.0133**	**0.6274**
1. Cement production	365.0817								0.8422	0.9874	0.0122	0.2538
2. Lime production	31.5025								0.0581	0.0823		0.0134
3. Glass production	20.5674								0.5246		0.0011	0.3509
4. Other process uses of carbonates	23.0617								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	**67.8400**	**NO**	**NO**						**0.0077**	**0.0431**	**27.0205**	**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	59.5365	NO	NO						0.0077	0.0431	27.0205	0.0038
4. Other	1.8195	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				**40.7988**	**NO**	**NO**	**NO**	**NO**				
1. Refrigeration and air conditioning				9.5679	NO	NO	NO	NO				
2. Foam blowing agents				31.2305	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	**1.0626**	**NO**	**0.0001**	**NO**	**NO**	**NO**	**0.0000**	**NO**	**0.0134**	**0.4096**	**0.4830**	**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									

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)			
4. Other	1.0626	NO	NO	NO	NO	NO	NO	NO	0.0134	0.4096	0.4830	NO
H. Other									**NO**	**NO**	**6.7243**	**NO**
1. Pulp and Paper Industry									NO	NO	NO	NO
2. Food and Beverages Industry									NO	NO	6.7243	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)			
Total industrial processes	**648.0792**	**NO**	**0.0001**	**53.5982**	**0.0231**	**NO**	**0.0000**	**NO**	**1.7731**	**2.9245**	**39.1714**	**0.7229**
A. Mineral industry	**538.2308**								**1.6619**	**1.3730**	**0.0164**	**0.6761**
1. Cement production	457.0753								1.0555	1.2376	0.0153	0.3181
2. Lime production	35.1917								0.0649	0.0920		0.0150
3. Glass production	21.5950								0.4992		0.0010	0.3339
4. Other process uses of carbonates	24.3688								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	**81.8718**	**NO**	**NO**						**0.0124**	**0.0697**	**33.1366**	**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	72.9830	NO	NO						0.0124	0.0697	33.1366	0.0062
4. Other	1.8432	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				**53.5982**	**NO**	**NO**	**NO**	**NO**				
1. Refrigeration and air conditioning				10.9815	NO	NO	NO	NO				
2. Foam blowing agents				42.6149	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	**0.9584**	**NO**	**0.0001**	**NO**	**0.0231**	**NO**	**0.0000**	**NO**	**0.0109**	**0.3326**	**0.4356**	**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	0.9584	NO	NO	NO	NO	NO	NO	NO	0.0109	0.3326	0.4356	NO
H. Other									**NO**	**NO**	**5.5342**	**NO**
1. Pulp and Paper Industry									NO	NO	NO	NO
2. Food and Beverages Industry									NO	NO	5.5342	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)					
Total industrial processes	**893.3513**	**NO**	**NO**	**67.7992**	**0.0231**	**NO**	**0.0000**	**NO**	**2.3147**	**4.0508**	**39.5494**	**0.8784**
A. Mineral industry	**768.8438**								**2.1654**	**2.0062**	**0.0244**	**0.8139**
1. Cement production	702.6656								1.6161	1.8948	0.0234	0.4870
2. Lime production	24.9579								0.0460	0.0652		0.0106
3. Glass production	18.7981								0.4583		0.0010	0.3066
4. Other process uses of carbonates	22.4222								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	**84.9474**	**NO**	**NO**						**0.0130**	**0.0732**	**35.0576**	**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	77.1889	NO	NO						0.0130	0.0732	35.0576	0.0065
4. Other	1.9311	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				**67.7992**	**NO**	**NO**	**NO**	**NO**				
1. Refrigeration and air conditioning				13.1757	NO	NO	NO	NO				
2. Foam blowing agents				54.6209	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	**0.9474**	**NO**	**NO**	**NO**	**0.0231**	**NO**	**0.0000**	**NO**	**0.0107**	**0.3289**	**0.4306**	**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	0.9474	NO	NO	NO	NO	NO	NO	NO	0.0107	0.3289	0.4306	NO
H. Other									**NO**	**NO**	**3.9720**	**NO**
1. Pulp and Paper Industry									NO	NO	NO	NO
2. Food and Beverages Industry									NO	NO	3.9720	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)					
Total industrial processes	**972.6989**	**NO**	**NO**	**82.0655**	**0.0288**	**NO**	**0.0000**	**NO**	**2.5157**	**4.1128**	**32.4087**	**0.9256**
A. Mineral industry	**869.1962**								**2.3845**	**2.2999**	**0.0277**	**0.8688**
1. Cement production	789.9160								1.8448	2.1630	0.0268	0.5560
2. Lime production	35.5041								0.0655	0.0928		0.0151
3. Glass production	21.5408								0.4312		0.0009	0.2884
4. Other process uses of carbonates	22.2352								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

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)			
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	**67.1050**	**NO**	**NO**						**0.0075**	**0.0427**	**26.7467**	**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	58.9055	NO	NO						0.0075	0.0427	26.7467	0.0037
4. Other	2.0219	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				**82.0655**	**NO**	**NO**	**NO**	**NO**				
1. Refrigeration and air conditioning				16.3707	NO	NO	NO	NO				
2. Foam blowing agents				65.6924	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	**0.9859**	**NO**	**NO**	**NO**	**0.0288**	**NO**	**0.0000**	**NO**	**0.0086**	**0.2638**	**0.4481**	**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	0.9859	NO	NO	NO	NO	NO	NO	NO	0.0086	0.2638	0.4481	NO
H. Other									**NO**	**NO**	**5.1274**	**NO**
1. Pulp and Paper Industry									NO	NO	NO	NO
2. Food and Beverages Industry									NO	NO	5.1274	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)			
Total industrial processes	**463.8910**	**NO**	**NO**	**91.3620**	**0.0288**	**NO**	**0.0000**	**NO**	**1.2491**	**2.0725**	**27.0536**	**0.5008**
A. Mineral industry	**387.9410**								**1.1775**	**0.9929**	**0.0122**	**0.4724**
1. Cement production	340.5679								0.7959	0.9331	0.0115	0.2398
2. Lime production	10.5446								0.0194	0.0276		0.0045
3. Glass production	16.3507								0.3308		0.0007	0.2213
4. Other process uses of carbonates	20.4778								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

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)			
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	**58.1883**	**NO**	**NO**						**0.0056**	**0.0316**	**23.2322**	**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	51.1739	NO	NO						0.0056	0.0316	23.2322	0.0028
4. Other	1.8487	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				**91.3620**	**NO**	**NO**	**NO**	**NO**				
1. Refrigeration and air conditioning				18.5147	NO	NO	NO	NO				
2. Foam blowing agents				72.8440	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	**0.6998**	**NO**	**NO**	**NO**	**0.0288**	**NO**	**0.0000**	**NO**	**0.0105**	**0.3225**	**0.3181**	**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	0.6998	NO	NO	NO	NO	NO	NO	NO	0.0105	0.3225	0.3181	NO
H. Other									**NO**	**NO**	**3.4583**	**NO**
1. Pulp and Paper Industry									NO	NO	NO	NO
2. Food and Beverages Industry									NO	NO	3.4583	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)			
Total industrial processes	**488.7178**	**NO**	**NO**	**102.8657**	**0.0403**	**NO**	**0.0000**	**NO**	**1.3351**	**1.9059**	**31.7424**	**0.5465**
A. Mineral industry	**411.0616**								**1.2832**	**1.0406**	**0.0126**	**0.5285**
1. Cement production	349.8333								0.8135	0.9538	0.0118	0.2452
2. Lime production	21.6512								0.0399	0.0566		0.0092
3. Glass production	19.5231								0.4003		0.0008	0.2678
4. Other process uses of carbonates	20.0540								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	**67.0530**	**NO**	**NO**						**0.0069**	**0.0392**	**26.8426**	**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	59.1169	NO	NO						0.0069	0.0392	26.8426	0.0034
4. Other	2.2918	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				

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)			
F. Product uses as substitutes for ODS				**102.8657**	**NO**	**NO**	**NO**	**NO**				
1. Refrigeration and air conditioning				23.1089	NO	NO	NO	NO				
2. Foam blowing agents				79.7528	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	**0.9046**	**NO**	**NO**	**NO**	**0.0403**	**NO**	**0.0000**	**NO**	**0.0135**	**0.4140**	**0.4112**	**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	0.9046	NO	NO	NO	NO	NO	NO	NO	0.0135	0.4140	0.4112	NO
H. Other									**NO**	**NO**	**4.4489**	**NO**
1. Pulp and Paper Industry									NO	NO	NO	NO
2. Food and Beverages Industry									NO	NO	4.4489	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)			
Total industrial processes	**578.6725**	**NO**	**NO**	**116.5249**	**0.0403**	**NO**	**0.0000**	**NO**	**1.6415**	**2.3161**	**34.2293**	**0.6794**
A. Mineral industry	**492.3783**								**1.5766**	**1.2592**	**0.0155**	**0.6562**
1. Cement production	427.2624								0.9986	1.1709	0.0145	0.3010
2. Lime production	22.0613								0.0407	0.0577		0.0094
3. Glass production	25.0779								0.5074		0.0011	0.3394
4. Other process uses of carbonates	17.9768								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	**72.3407**	**NO**	**NO**						**0.0078**	**0.0443**	**29.0886**	**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	64.0577	NO	NO						0.0078	0.0443	29.0886	0.0039
4. Other	2.4321	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				**116.5249**	**NO**	**NO**	**NO**	**NO**				
1. Refrigeration and air conditioning				31.5903	NO	NO	NO	NO				
2. Foam blowing agents				84.9304	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	**1.0979**	**NO**	**NO**	**NO**	**0.0403**	**NO**	**0.0000**	**NO**	**0.0152**	**0.4661**	**0.4389**	**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	1.0979	NO	NO	NO	NO	NO	NO	NO	0.0152	0.4661	0.4389	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
	(kt)			CO_2 equivalent (kt)					(kt)			
H. Other									**NO**	**NO**	**4.6537**	**NO**
1. Pulp and Paper Industry									NO	NO	NO	NO
2. Food and Beverages Industry									NO	NO	4.6537	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)			
Total industrial processes	**588.1935**	**NO**	**NO**	**124.2123**	**0.0403**	**NO**	**0.0000**	**NO**	**1.5651**	**2.1892**	**36.1774**	**0.6221**
A. Mineral industry	**498.5638**								**1.5049**	**1.2916**	**0.0158**	**0.5987**
1. Cement production	442.1615								1.0335	1.2118	0.0150	0.3115
2. Lime production	20.6563								0.0381	0.0540		0.0088
3. Glass production	20.7542								0.4081		0.0009	0.2730
4. Other process uses of carbonates	14.9917								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	**75.8897**	**NO**	**NO**						**0.0088**	**0.0500**	**31.1720**	**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	68.6412	NO	NO						0.0088	0.0500	31.1720	0.0044
4. Other	2.1716	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				**124.2123**	**NO**	**NO**	**NO**	**NO**				
1. Refrigeration and air conditioning				34.2235	NO	NO	NO	NO				
2. Foam blowing agents				89.9845	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	**1.0427**	**NO**	**NO**	**NO**	**0.0403**	**NO**	**0.0000**	**NO**	**0.0101**	**0.3078**	**0.4739**	**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	1.0427	NO	NO	NO	NO	NO	NO	NO	0.0101	0.3078	0.4739	NO
H. Other									**NO**	**NO**	**4.4834**	**NO**
1. Pulp and Paper Industry									NO	NO	NO	NO
2. Food and Beverages Industry									NO	NO	4.4834	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)			
Total industrial processes	**631.0394**	**NO**	**NO**	**130.5506**	**0.0403**	**NO**	**0.0000**	**NO**	**1.7356**	**2.0193**	**35.5686**	**0.7023**
A. Mineral industry	**551.2987**								**1.6944**	**1.4147**	**0.0172**	**0.6865**
1. Cement production	476.9104								1.1139	1.3060	0.0162	0.3357

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. Lime production	30.1662								0.0556	0.0788		0.0128
3. Glass production	26.9857								0.4958		0.0010	0.3317
4. Other process uses of carbonates	17.2364								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	**70.9399**	**NO**	**NO**						**0.0088**	**0.0501**	**28.8972**	**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	63.6359	NO	NO						0.0088	0.0501	28.8972	0.0044
4. Other	2.3829	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				**130.5506**	**NO**	**NO**	**NO**	**NO**				
1. Refrigeration and air conditioning				37.1211	NO	NO	NO	NO				
2. Foam blowing agents				93.4254	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	**1.1438**	**NO**	**NO**	**NO**	**0.0403**	**NO**	**0.0000**	**NO**	**0.0075**	**0.2296**	**0.5199**	**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	1.1438	NO	NO	NO	NO	NO	NO	NO	0.0075	0.2296	0.5199	NO
H. Other									**NO**	**NO**	**6.1085**	**NO**
1. Pulp and Paper Industry									NO	NO	NO	NO
2. Food and Beverages Industry									NO	NO	6.1085	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)			
Total industrial processes	**651.6580**	**NO**	**NO**	**142.0853**	**0.0403**	**NO**	**0.0000**	**NO**	**1.7352**	**2.2144**	**43.9371**	**0.7035**
A. Mineral industry	**547.8150**								**1.6724**	**1.4004**	**0.0167**	**0.6764**
1. Cement production	464.6082								1.0820	1.2686	0.0157	0.3261
2. Lime production	39.1904								0.0723	0.1024		0.0167
3. Glass production	27.1317								0.4895		0.0010	0.3275
4. Other process uses of carbonates	16.8848								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

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)			
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	**88.9627**	**NO**	**NO**						**0.0128**	**0.0723**	**37.0850**	**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	81.6487	NO	NO						0.0128	0.0723	37.0850	0.0064
4. Other	2.5008	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				**142.0853**	**NO**	**NO**	**NO**	**NO**				
1. Refrigeration and air conditioning				45.1294	NO	NO	NO	NO				
2. Foam blowing agents				96.9516	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	**1.0338**	**NO**	**NO**	**NO**	**0.0403**	**NO**	**0.0000**	**NO**	**0.0050**	**0.1535**	**0.4699**	**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	1.0338	NO	NO	NO	NO	NO	NO	NO	0.0050	0.1535	0.4699	NO
H. Other									**NO**	**NO**	**6.3301**	**NO**
1. Pulp and Paper Industry									NO	NO	NO	NO
2. Food and Beverages Industry									NO	NO	6.3301	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)			
Total industrial processes	**615.2290**	**NO**	**NO**	**167.8122**	**0.0403**	**NO**	**0.0000**	**NO**	**1.6893**	**2.1941**	**40.9424**	**0.7059**
A. Mineral industry	**510.8250**								**1.6204**	**1.2924**	**0.0160**	**0.6756**
1. Cement production	443.2441								1.0311	1.2089	0.0150	0.3107
2. Lime production	21.7547								0.0401	0.0569		0.0093
3. Glass production	30.3969								0.5232		0.0011	0.3500
4. Other process uses of carbonates	15.4294								0.0260	0.0267		0.0056
B. Chemical industry	**NO**	**NO**	**NO**						**NO**	**NO**	**0.0118**	**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	0.0118	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	**86.3698**	**NO**	**NO**						**0.0089**	**0.0503**	**35.8010**	**0.0044**
1. Lubricant use	4.8165	NO	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
	(kt)			CO_2 equivalent (kt)					(kt)			
2. Paraffin wax use	0.0600	NO	NO						NO	NO	NO	NO
3. Solvent use	78.8011	NO	NO						0.0089	0.0503	35.8010	0.0044
4. Other	2.6922	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				**167.8122**	**NO**	**NO**	**NO**	**NO**				
1. Refrigeration and air conditioning				66.2081	NO	NO	NO	NO				
2. Foam blowing agents				101.5988	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	**0.7549**	**NO**	**NO**	**NO**	**0.0403**	**NO**	**0.0000**	**NO**	**0.0038**	**0.1174**	**0.3432**	**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	0.7549	NO	NO	NO	NO	NO	NO	NO	0.0038	0.1174	0.3432	NO
H. Other									**NO**	**NO**	**4.7483**	**NO**
1. Pulp and Paper Industry									NO	NO	NO	NO
2. Food and Beverages Industry									NO	NO	4.7483	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)			
Total industrial processes	**585.1146**	**NO**	**NO**	**175.5848**	**0.0403**	**NO**	**0.0000**	**NO**	**1.6158**	**1.6323**	**37.8661**	**0.6760**
A. Mineral industry	**500.5774**								**1.5895**	**1.2591**	**0.0157**	**0.6655**
1. Cement production	433.9022								1.0040	1.1771	0.0146	0.3026
2. Lime production	21.5797								0.0398	0.0564		0.0092
3. Glass production	30.1307								0.5208		0.0011	0.3484
4. Other process uses of carbonates	14.9649								0.0249	0.0256		0.0054
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	**78.6128**	**NO**	**NO**						**0.0055**	**0.0313**	**32.3532**	**0.0028**
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	70.7300	NO	NO						0.0055	0.0313	32.3532	0.0028
4. Other	2.9202	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				**175.5848**	**NO**	**NO**	**NO**	**NO**				
1. Refrigeration and air conditioning				70.7568	NO	NO	NO	NO				
2. Foam blowing agents				104.8218	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
	(kt)			CO_2 equivalent (kt)					(kt)			
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	**0.7041**	**NO**	**NO**	**NO**	**0.0403**	**NO**	**0.0000**	**NO**	**0.0040**	**0.1216**	**0.3200**	**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	0.7041	NO	NO	NO	NO	NO	NO	NO	0.0040	0.1216	0.3200	NO
H. Other									**NO**	**NO**	**5.1565**	**NO**
1. Pulp and Paper Industry									NO	NO	NO	NO
2. Food and Beverages Industry									NO	NO	5.1565	NO
3. Other									NO	NO	NO	NO

Annex 6-3. Sectoral Report for Sector 3 'Agriculture', 1990-2016

1990

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2	CH_4	N_2O	NO_x	CO	NMVOC
	(kt)					
3. Total agriculture	**0.5820**	**107.4316**	**8.5040**	**NO**	**NO**	**NE, NO**
I. Livestock		**107.4316**	**3.7470**			**NE**
A. Enteric fermentation		**87.6278**				
1. Cattle		74.9935				
Dairy cattle		41.4105				
Non-dairy cattle		33.5830				
2. Sheep		8.5887				
3. Swine		2.7751				
4. Other livestock		1.2705				
Goats		0.2361				
Horses		0.8505				
Mules and asses		0.0169				
Other (rabbits)		0.1670				
B. Manure management		**19.8038**	**3.7470**			**NE**
1. Cattle		9.2140	1.3936			NE
Dairy cattle		5.3324	0.5914			NE
Non-dairy cattle		3.8816	0.8022			NE
2. Sheep		0.2365	0.4399			NE
3. Swine		9.4938	0.5406			NE
4. Other livestock		0.8595	0.5517			NE
Goats		0.0048	0.0162			NE
Horses		0.0737	0.0655			NE
Mules and asses		0.0013	0.0008			NE
Poultry		0.7571	0.4135			NE
Other (rabbits)		0.0226	0.0557			NE
5. Indirect N_2O emissions			0.8212			
C. Rice cultivation		**NO**				**NO**
D. Agricultural soils			**4.7570**			
a. Direct N_2O emissions from managed soils			3.6147			
1. Inorganic N fertilizers			1.4473			
2. Organic N fertilizers			0.8718			
a. Animal manure applied to soils			0.8718			
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			0.5470			
5. Mineralization/immobilization associated with loss/gain of soil organic matter			0.5680			
6. Cultivation of organic soils (i.e. histosols)			NO			
7. Other			NO			
b. Indirect N_2O Emissions from managed soils			1.1423			
1. Atmospheric deposition			0.3429			
2. Nitrogen leaching and run-off			0.7994			
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**	**97.8292**	**8.1094**	**NO**	**NO**	**NE, NO**
I. Livestock		**97.8292**	**3.4991**			**NE**
A. Enteric fermentation		**81.2260**				
1. Cattle		68.6275				
Dairy cattle		38.7594				
Non-dairy cattle		29.8681				
2. Sheep		8.6126				
3. Swine		2.6295				
4. Other livestock		1.3564				
Goats		0.3186				
Horses		0.8719				
Mules and asses		0.0179				
Other (rabbits)		0.1479				
B. Manure management		**16.6032**	**3.4991**			**NE**
1. Cattle		7.4678	1.2622			NE
Dairy cattle		4.5405	0.5548			NE
Non-dairy cattle		2.9272	0.7074			NE
2. Sheep		0.2355	0.4474			NE
3. Swine		8.0652	0.5391			NE
4. Other livestock		0.8348	0.5209			NE
Goats		0.0064	0.0222			NE
Horses		0.0756	0.0576			NE
Mules and asses		0.0014	0.0009			NE
Poultry		0.7314	0.3913			NE
Other (rabbits)		0.0201	0.0489			NE
5. Indirect N_2O emissions			0.7295			
C. Rice cultivation		**NO**				**NO**
D. Agricultural soils			**4.6102**			
a. Direct N_2O emissions from managed soils			3.5204			
1. Inorganic N fertilizers			1.2996			
2. Organic N fertilizers			0.7923			
a. Animal manure applied to soils			0.7923			
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			0.6157			
5. Mineralization/immobilization associated with loss/gain of soil organic matter			0.5734			
6. Cultivation of organic soils (i.e. histosols)			NO			
7. Other			NO			
b. Indirect N_2O Emissions from managed soils			1.0898			
1. Atmospheric deposition			0.3182			
2. Nitrogen leaching and run-off			0.7717			
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**	**94.7068**	**6.8184**	**NO**	**NO**	**NE, NO**
I. Livestock		**94.7068**	**3.1392**			**NE**
A. Enteric fermentation		**79.7785**				
1. Cattle		67.3319				
Dairy cattle		39.1042				
Non-dairy cattle		28.2278				
2. Sheep		8.6947				
3. Swine		2.2311				
4. Other livestock		1.5207				
Goats		0.3987				
Horses		0.9248				
Mules and asses		0.0211				
Other (rabbits)		0.1761				
B. Manure management		**14.9283**	**3.1392**			**NE**
1. Cattle		7.3474	1.1797			NE
Dairy cattle		4.5809	0.5518			NE
Non-dairy cattle		2.7665	0.6279			NE
2. Sheep		0.2459	0.4586			NE

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2	CH_4	N_2O	NO_x	CO	NMVOC
	(kt)					
3. Swine		6.6885	0.4236			NE
4. Other livestock		0.6465	0.4394			NE
Goats		0.0082	0.0276			NE
Horses		0.0802	0.0646			NE
Mules and asses		0.0016	0.0010			NE
Poultry		0.5327	0.2883			NE
Other (rabbits)		0.0239	0.0578			NE
5. Indirect N_2O emissions			0.6380			
C. Rice cultivation		**NO**				**NO**
D. Agricultural soils			**3.6792**			
a. Direct N_2O emissions from managed soils			2.7989			
1. Inorganic N fertilizers			0.9711			
2. Organic N fertilizers			0.7172			
a. Animal manure applied to soils			0.7172			
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			0.4134			
5. Mineralization/immobilization associated with loss/gain of soil organic matter			0.4720			
6. Cultivation of organic soils (i.e. histosols)			NO			
7. Other			NO			
b. Indirect N_2O Emissions from managed soils			0.8804			
1. Atmospheric deposition			0.2691			
2. Nitrogen leaching and run-off			0.6112			
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**	**86.0110**	**6.9774**	**NO**	**NO**	**NE, NO**
I. Livestock		**86.0110**	**2.7360**			**NE**
A. Enteric fermentation		**75.0132**				
1. Cattle		62.7512				
Dairy cattle		37.6503				
Non-dairy cattle		25.1009				
2. Sheep		9.0097				
3. Swine		1.6235				
4. Other livestock		1.6288				
Goats		0.4713				
Horses		0.9802				
Mules and asses		0.0225				
Other (rabbits)		0.1548				
B. Manure management		**10.9978**	**2.7360**			**NE**
1. Cattle		5.5019	1.0636			NE
Dairy cattle		3.4585	0.5343			NE
Non-dairy cattle		2.0434	0.5293			NE
2. Sheep		0.2589	0.4697			NE
3. Swine		4.7183	0.3163			NE
4. Other livestock		0.5188	0.3685			NE
Goats		0.0097	0.0320			NE
Horses		0.0849	0.0671			NE
Mules and asses		0.0017	0.0011			NE
Poultry		0.4014	0.2179			NE
Other (rabbits)		0.0210	0.0505			NE
5. Indirect N_2O emissions			0.5178			
C. Rice cultivation		**NO**				**NO**
D. Agricultural soils			**4.2414**			
a. Direct N_2O emissions from managed soils			3.3192			
1. Inorganic N fertilizers			0.4145			
2. Organic N fertilizers			0.6123			
a. Animal manure applied to soils			0.6123			
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			0.4958			
5. Mineralization/immobilization associated with loss/gain of soil organic matter			1.5097			

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2	CH_4	N_2O	NO_x	CO	NMVOC
	(kt)					
6. Cultivation of organic soils (i.e. histosols)			NO			
7. Other			NO			
b. Indirect N_2O Emissions from managed soils			0.9223			
1. Atmospheric deposition			0.1997			
2. Nitrogen leaching and run-off			0.7226			
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**	**83.6261**	**5.5546**	**NO**	**NO**	**NE, NO**
I. Livestock		**83.6261**	**2.6585**			**NE**
A. Enteric fermentation		**73.0168**				
1. Cattle		60.4337				
Dairy cattle		37.3768				
Non-dairy cattle		23.0570				
2. Sheep		9.2321				
3. Swine		1.5702				
4. Other livestock		1.7807				
Goats		0.5643				
Horses		1.0473				
Mules and asses		0.0292				
Other (rabbits)		0.1399				
B. Manure management		**10.6093**	**2.6585**			**NE**
1. Cattle		5.4501	0.9913			NE
Dairy cattle		3.5237	0.5334			NE
Non-dairy cattle		1.9264	0.4579			NE
2. Sheep		0.2679	0.4965			NE
3. Swine		4.3463	0.2928			NE
4. Other livestock		0.5449	0.3800			NE
Goats		0.0120	0.0403			NE
Horses		0.0908	0.0755			NE
Mules and asses		0.0022	0.0014			NE
Poultry		0.4210	0.2168			NE
Other (rabbits)		0.0190	0.0460			NE
5. Indirect N_2O emissions			0.4978			
C. Rice cultivation		NO				NO
D. Agricultural soils			**2.8961**			
a. Direct N_2O emissions from managed soils			2.2385			
1. Inorganic N fertilizers			0.2217			
2. Organic N fertilizers			0.5947			
a. Animal manure applied to soils			0.5947			
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			0.2354			
5. Mineralization/immobilization associated with loss/gain of soil organic matter			0.9061			
6. Cultivation of organic soils (i.e. histosols)			NO			
7. Other			NO			
b. Indirect N_2O Emissions from managed soils			0.6576			
1. Atmospheric deposition			0.1768			
2. Nitrogen leaching and run-off			0.4807			
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**	**73.0803**	**5.9592**	**NO**	**NO**	**NE, NO**
I. Livestock		**73.0803**	**2.4596**			**NE**
A. Enteric fermentation		**64.8293**				
1. Cattle		52.9539				

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2	CH_4	N_2O	NO_x	CO	NMVOC
	(kt)					
Dairy cattle		34.6078				
Non-dairy cattle		18.3461				
2. Sheep		8.4987				
3. Swine		1.5246				
4. Other livestock		1.8522				
Goats		0.5878				
Horses		1.1086				
Mules and asses		0.0323				
Other (rabbits)		0.1235				
B. Manure management		**8.2510**	**2.4596**			**NE**
1. Cattle		3.6724	0.8857			NE
Dairy cattle		2.5546	0.5019			NE
Non-dairy cattle		1.1178	0.3838			NE
2. Sheep		0.2520	0.4179			NE
3. Swine		3.7683	0.3320			NE
4. Other livestock		0.5583	0.3690			NE
Goats		0.0125	0.0371			NE
Horses		0.0961	0.0778			NE
Mules and asses		0.0025	0.0015			NE
Poultry		0.4305	0.2118			NE
Other (rabbits)		0.0167	0.0408			NE
5. Indirect N_2O emissions			0.4550			
C. Rice cultivation		**NO**				**NO**
D. Agricultural soils			**3.4996**			
a. Direct N_2O emissions from managed soils			2.7465			
1. Inorganic N fertilizers			0.1652			
2. Organic N fertilizers			0.5410			
a. Animal manure applied to soils			0.5410			
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			1.4004			
6. Cultivation of organic soils (i.e. histosols)			NO			
7. Other			NO			
b. Indirect N_2O Emissions from managed soils			0.7531			
1. Atmospheric deposition			0.1614			
2. Nitrogen leaching and run-off			0.5917			
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**	**67.1421**	**5.7247**	**NO**	**NO**	**NE, NO**
I. Livestock		**67.1421**	**2.5974**			**NE**
A. Enteric fermentation		**59.6463**				
1. Cattle		48.1637				
Dairy cattle		32.1108				
Non-dairy cattle		16.0529				
2. Sheep		8.1628				
3. Swine		1.4251				
4. Other livestock		1.8947				
Goats		0.6116				
Horses		1.1403				
Mules and asses		0.0308				
Other (rabbits)		0.1120				
B. Manure management		**7.4958**	**2.5974**			**NE**
1. Cattle		3.3483	0.7978			NE
Dairy cattle		2.3702	0.4686			NE
Non-dairy cattle		0.9781	0.3292			NE
2. Sheep		0.2415	0.4015			NE
3. Swine		3.3886	0.3544			NE
4. Other livestock		0.5174	0.5693			NE
Goats		0.0132	0.0390			NE
Horses		0.0988	0.0776			NE
Mules and asses		0.0023	0.0014			NE

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2	CH_4	N_2O	NO_x	CO	NMVOC
	(kt)					
Poultry		0.3879	0.1968			NE
Other (rabbits)		0.0152	0.2544			NE
5. Indirect N_2O emissions			0.4744			
C. Rice cultivation		NO				NO
D. Agricultural soils			**3.1273**			
a. Direct N_2O emissions from managed soils			2.4361			
1. Inorganic N fertilizers			0.2077			
2. Organic N fertilizers			0.5597			
a. Animal manure applied to soils			0.5597			
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			1.2072			
6. Cultivation of organic soils (i.e. histosols)			NO			
7. Other			NO			
b. Indirect N_2O Emissions from managed soils			0.6912			
1. Atmospheric deposition			0.1668			
2. Nitrogen leaching and run-off			0.5244			
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**	**57.4896**	**5.8619**	**NO**	**NO**	**NE, NO**
I. Livestock		**57.4896**	**2.0035**			**NE**
A. Enteric fermentation		**51.4030**				
1. Cattle		41.1875				
Dairy cattle		29.1741				
Non-dairy cattle		12.0134				
2. Sheep		7.1139				
3. Swine		1.1963				
4. Other livestock		1.9053				
Goats		0.5940				
Horses		1.1773				
Mules and asses		0.0297				
Other (rabbits)		0.1043				
B. Manure management		**6.0866**	**2.0035**			**NE**
1. Cattle		2.8115	0.7066			NE
Dairy cattle		2.0983	0.4578			NE
Non-dairy cattle		0.7132	0.2488			NE
2. Sheep		0.2159	0.3242			NE
3. Swine		2.5398	0.2661			NE
4. Other livestock		0.5194	0.3365			NE
Goats		0.0129	0.0339			NE
Horses		0.1020	0.0743			NE
Mules and asses		0.0023	0.0013			NE
Poultry		0.3881	0.1924			NE
Other (rabbits)		0.0141	0.0346			NE
5. Indirect N_2O emissions			0.3702			
C. Rice cultivation		NO				NO
D. Agricultural soils			**3.8583**			
a. Direct N_2O emissions from managed soils			3.0562			
1. Inorganic N fertilizers			0.1795			
2. Organic N fertilizers			0.4405			
a. Animal manure applied to soils			0.4405			
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			0.3291			
5. Mineralization/immobilization associated with loss/gain of soil organic matter			1.8617			
6. Cultivation of organic soils (i.e. histosols)			NO			
7. Other			NO			
b. Indirect N_2O Emissions from managed soils			0.8021			
1. Atmospheric deposition			0.1360			
2. Nitrogen leaching and run-off			0.6661			

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2	CH_4	N_2O	NO_x	CO	NMVOC
	(kt)					
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	55.0092	5.2920	NO	NO	NE, NO
I. Livestock		55.0092	1.9398			NE
A. Enteric fermentation		49.9008				
1. Cattle		40.0305				
Dairy cattle		28.7829				
Non-dairy cattle		11.2475				
2. Sheep		6.5068				
3. Swine		1.3921				
4. Other livestock		1.9714				
Goats		0.5967				
Horses		1.2330				
Mules and asses		0.0320				
Other (rabbits)		0.1097				
B. Manure management		5.1085	1.9398			NE
1. Cattle		2.0923	0.6743			NE
Dairy cattle		1.6125	0.4433			NE
Non-dairy cattle		0.4798	0.2309			NE
2. Sheep		0.1988	0.2911			NE
3. Swine		2.2708	0.2802			NE
4. Other livestock		0.5466	0.3523			NE
Goats		0.0131	0.0336			NE
Horses		0.1069	0.0755			NE
Mules and asses		0.0024	0.0014			NE
Poultry		0.4093	0.2058			NE
Other (rabbits)		0.0149	0.0361			NE
5. Indirect N_2O emissions			0.3419			
C. Rice cultivation		NO				NO
D. Agricultural soils			3.3522			
a. Direct N_2O emissions from managed soils			2.6483			
1. Inorganic N fertilizers			0.1600			
2. Organic N fertilizers			0.4169			
a. Animal manure applied to soils			0.4169			
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			1.5189			
6. Cultivation of organic soils (i.e. histosols)			NO			
7. Other			NO			
b. Indirect N_2O Emissions from managed soils			0.7039			
1. Atmospheric deposition			0.1321			
2. Nitrogen leaching and run-off			0.5718			
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	50.6594	4.7978	NO	NO	NE, NO
I. Livestock		50.6594	1.7608			NE
A. Enteric fermentation		46.1673				
1. Cattle		37.0494				
Dairy cattle		27.7978				
Non-dairy cattle		9.2516				
2. Sheep		5.9250				
3. Swine		1.1270				
4. Other livestock		2.0659				

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2	CH_4	N_2O	NO_x	CO	NMVOC
	(kt)					
Goats		0.6277				
Horses		1.2964				
Mules and asses		0.0341				
Other (rabbits)		0.1077				
B. Manure management		**4.4921**	**1.7608**			**NE**
1. Cattle		1.9520	0.6113			NE
Dairy cattle		1.5573	0.4244			NE
Non-dairy cattle		0.3947	0.1869			NE
2. Sheep		0.1803	0.2640			NE
3. Swine		1.7854	0.2112			NE
4. Other livestock		0.5744	0.3678			NE
Goats		0.0139	0.0356			NE
Horses		0.1124	0.0752			NE
Mules and asses		0.0026	0.0014			NE
Poultry		0.4310	0.2206			NE
Other (rabbits)		0.0146	0.0350			NE
5. Indirect N_2O emissions			0.3065			
C. Rice cultivation		**NO**				**NO**
D. Agricultural soils			**3.0370**			
a. Direct N_2O emissions from managed soils			2.4030			
1. Inorganic N fertilizers			0.0929			
2. Organic N fertilizers			0.3796			
a. Animal manure applied to soils			0.3796			
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			1.4048			
6. Cultivation of organic soils (i.e. histosols)			NO			
7. Other			NO			
b. Indirect N_2O Emissions from managed soils			0.6340			
1. Atmospheric deposition			0.1157			
2. Nitrogen leaching and run-off			0.5184			
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**	**46.8269**	**4.3951**	**NO**	**NO**	**NE, NO**
I. Livestock		**46.8269**	**1.5712**			**NE**
A. Enteric fermentation		**43.4256**				
1. Cattle		35.2640				
Dairy cattle		27.1900				
Non-dairy cattle		8.0740				
2. Sheep		5.2531				
3. Swine		0.7390				
4. Other livestock		2.1695				
Goats		0.6673				
Horses		1.3687				
Mules and asses		0.0384				
Other (rabbits)		0.0951				
B. Manure management		**3.4013**	**1.5712**			**NE**
1. Cattle		1.6521	0.5625			NE
Dairy cattle		1.3106	0.4135			NE
Non-dairy cattle		0.3416	0.1490			NE
2. Sheep		0.1608	0.2360			NE
3. Swine		1.0111	0.1423			NE
4. Other livestock		0.5772	0.3672			NE
Goats		0.0150	0.0387			NE
Horses		0.1186	0.0803			NE
Mules and asses		0.0029	0.0016			NE
Poultry		0.4278	0.2157			NE
Other (rabbits)		0.0129	0.0308			NE
5. Indirect N_2O emissions			0.2631			
C. Rice cultivation		**NO**				**NO**
D. Agricultural soils			**2.8239**			

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2	CH_4	N_2O	NO_x	CO	NMVOC
	(kt)					
a. Direct N_2O emissions from managed soils			2.2307			
1. Inorganic N fertilizers			0.1609			
2. Organic N fertilizers			0.3377			
a. Animal manure applied to soils			0.3377			
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			1.3374			
6. Cultivation of organic soils (i.e. histosols)			NO			
7. Other			NO			
b. Indirect N_2O Emissions from managed soils			0.5932			
1. Atmospheric deposition			0.1131			
2. Nitrogen leaching and run-off			0.4800			
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**	**47.6636**	**4.9809**	NO	NO	NE, NO
I. Livestock		**47.6636**	**1.5998**			NE
A. Enteric fermentation		**44.2270**				
1. Cattle		35.8303				
Dairy cattle		27.6639				
Non-dairy cattle		8.1664				
2. Sheep		5.3399				
3. Swine		0.7362				
4. Other livestock		2.3206				
Goats		0.6969				
Horses		1.4680				
Mules and asses		0.0427				
Other (rabbits)		0.1129				
B. Manure management		**3.4366**	**1.5998**			NE
1. Cattle		1.6789	0.5710			NE
Dairy cattle		1.3334	0.4142			NE
Non-dairy cattle		0.3455	0.1569			NE
2. Sheep		0.1618	0.2246			NE
3. Swine		0.9724	0.1358			NE
4. Other livestock		0.6235	0.4004			NE
Goats		0.0156	0.0376			NE
Horses		0.1272	0.0856			NE
Mules and asses		0.0032	0.0017			NE
Poultry		0.4621	0.2381			NE
Other (rabbits)		0.0153	0.0373			NE
5. Indirect N_2O emissions			0.2680			
C. Rice cultivation		NO				NO
D. Agricultural soils			**3.3811**			
a. Direct N_2O emissions from managed soils			2.6816			
1. Inorganic N fertilizers			0.1994			
2. Organic N fertilizers			0.3445			
a. Animal manure applied to soils			0.3445			
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			1.6191			
6. Cultivation of organic soils (i.e. histosols)			NO			
7. Other			NO			
b. Indirect N_2O Emissions from managed soils			0.6996			
1. Atmospheric deposition			0.1186			
2. Nitrogen leaching and run-off			0.5810			
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**	**48.7415**	**5.1218**	NO	NO	NE, NO
I. Livestock		**48.7415**	**1.6116**			NE
A. Enteric fermentation		**45.1436**				
1. Cattle		36.5787				
Dairy cattle		28.4383				
Non-dairy cattle		8.1404				
2. Sheep		5.3074				
3. Swine		0.8252				
4. Other livestock		2.4322				
Goats		0.7925				
Horses		1.4875				
Mules and asses		0.0397				
Other (rabbits)		0.1125				
B. Manure management		**3.5979**	**1.6116**			NE
1. Cattle		1.7151	0.5723			NE
Dairy cattle		1.3707	0.4206			NE
Non-dairy cattle		0.3444	0.1517			NE
2. Sheep		0.1603	0.2168			NE
3. Swine		1.0728	0.1459			NE
4. Other livestock		0.6498	0.4056			NE
Goats		0.0175	0.0411			NE
Horses		0.1289	0.0849			NE
Mules and asses		0.0030	0.0016			NE
Poultry		0.4851	0.2410			NE
Other (rabbits)		0.0153	0.0370			NE
5. Indirect N_2O emissions			0.2710			
C. Rice cultivation		NO				NO
D. Agricultural soils			**3.5102**			
a. Direct N_2O emissions from managed soils			2.7789			
1. Inorganic N fertilizers			0.2823			
2. Organic N fertilizers			0.3474			
a. Animal manure applied to soils			0.3474			
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			1.6159			
6. Cultivation of organic soils (i.e. histosols)			NO			
7. Other			NO			
b. Indirect N_2O Emissions from managed soils			0.7313			
1. Atmospheric deposition			0.1288			
2. Nitrogen leaching and run-off			0.6025			
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**	**44.5900**	**4.3116**	NO	NO	NE, NO
I. Livestock		**44.5900**	**1.5302**			NE
A. Enteric fermentation		**41.2430**				
1. Cattle		33.0553				
Dairy cattle		25.9741				
Non-dairy cattle		7.0812				
2. Sheep		5.0960				
3. Swine		0.7146				
4. Other livestock		2.3771				
Goats		0.7476				
Horses		1.4656				
Mules and asses		0.0428				
Other (rabbits)		0.1212				
B. Manure management		**3.3469**	**1.5302**			NE
1. Cattle		1.5515	0.5128			NE
Dairy cattle		1.2520	0.3812			NE
Non-dairy cattle		0.2996	0.1316			NE
2. Sheep		0.1575	0.2130			NE

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2	CH_4	N_2O	NO_x	CO	NMVOC
	(kt)					
3. Swine		0.9748	0.1307			NE
4. Other livestock		0.6631	0.4166			NE
Goats		0.0168	0.0394			NE
Horses		0.1270	0.0847			NE
Mules and asses		0.0033	0.0017			NE
Poultry		0.4996	0.2517			NE
Other (rabbits)		0.0164	0.0390			NE
5. Indirect N_2O emissions			0.2572			
C. Rice cultivation		NO				NO
D. Agricultural soils			**2.7814**			
a. Direct N_2O emissions from managed soils			2.1912			
1. Inorganic N fertilizers			0.2298			
2. Organic N fertilizers			0.3291			
a. Animal manure applied to soils			0.3291			
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			1.2640			
6. Cultivation of organic soils (i.e. histosols)			NO			
7. Other			NO			
b. Indirect N_2O Emissions from managed soils			0.5902			
1. Atmospheric deposition			0.1180			
2. Nitrogen leaching and run-off			0.4722			
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**	**41.7419**	**5.1970**	NO	NO	NE, NO
I. Livestock		**41.7419**	**1.4804**			NE
A. Enteric fermentation		**38.4891**				
1. Cattle		30.3317				
Dairy cattle		24.1309				
Non-dairy cattle		6.2007				
2. Sheep		5.2302				
3. Swine		0.6335				
4. Other livestock		2.2937				
Goats		0.7481				
Horses		1.3646				
Mules and asses		0.0400				
Other (rabbits)		0.1410				
B. Manure management		**3.2528**	**1.4804**			NE
1. Cattle		1.5011	0.4526			NE
Dairy cattle		1.2057	0.3410			NE
Non-dairy cattle		0.2954	0.1116			NE
2. Sheep		0.1582	0.2145			NE
3. Swine		0.8799	0.1177			NE
4. Other livestock		0.7135	0.4451			NE
Goats		0.0165	0.0389			NE
Horses		0.1183	0.0775			NE
Mules and asses		0.0030	0.0016			NE
Poultry		0.5566	0.2809			NE
Other (rabbits)		0.0191	0.0463			NE
5. Indirect N_2O emissions			0.2505			
C. Rice cultivation		NO				NO
D. Agricultural soils			**3.7166**			
a. Direct N_2O emissions from managed soils			2.9548			
1. Inorganic N fertilizers			0.2524			
2. Organic N fertilizers			0.3167			
a. Animal manure applied to soils			0.3167			
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			1.8458			

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2	CH_4	N_2O	NO_x	CO	NMVOC
	(kt)					
6. Cultivation of organic soils (i.e. histosols)			NO			
7. Other			NO			
b. Indirect N_2O Emissions from managed soils			0.7617			
1. Atmospheric deposition			0.1164			
2. Nitrogen leaching and run-off			0.6453			
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**	**40.5020**	**5.2539**	**NO**	**NO**	**NE, NO**
I. Livestock		**40.5020**	**1.5820**			**NE**
A. Enteric fermentation		**37.0587**				
1. Cattle		28.7238				
Dairy cattle		22.8364				
Non-dairy cattle		5.8874				
2. Sheep		5.3632				
3. Swine		0.7395				
4. Other livestock		2.2322				
Goats		0.7342				
Horses		1.2961				
Mules and asses		0.0374				
Other (rabbits)		0.1645				
B. Manure management		**3.4433**	**1.5820**			**NE**
1. Cattle		1.4215	0.4207			NE
Dairy cattle		1.1411	0.3152			NE
Non-dairy cattle		0.2805	0.1055			NE
2. Sheep		0.1571	0.2125			NE
3. Swine		1.0087	0.1349			NE
4. Other livestock		0.8559	0.5422			NE
Goats		0.0166	0.0388			NE
Horses		0.1123	0.0759			NE
Mules and asses		0.0028	0.0015			NE
Poultry		0.7019	0.3718			NE
Other (rabbits)		0.0223	0.0541			NE
5. Indirect N_2O emissions			0.2717			
C. Rice cultivation		**NO**				**NO**
D. Agricultural soils			**3.6718**			
a. Direct N_2O emissions from managed soils			2.9156			
1. Inorganic N fertilizers			0.2530			
2. Organic N fertilizers			0.3334			
a. Animal manure applied to soils			0.3334			
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			1.7900			
6. Cultivation of organic soils (i.e. histosols)			NO			
7. Other			NO			
b. Indirect N_2O Emissions from managed soils			0.7562			
1. Atmospheric deposition			0.1196			
2. Nitrogen leaching and run-off			0.6366			
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**	**39.3812**	**4.9723**	NO	NO	NE, NO
I. Livestock		**39.3812**	**1.6257**			NE
A. Enteric fermentation		**35.8683**				
1. Cattle		27.4654				
Dairy cattle		21.6435				
Non-dairy cattle		5.8220				
2. Sheep		5.3596				
3. Swine		0.8524				
4. Other livestock		2.1909				
Goats		0.7153				
Horses		1.2468				
Mules and asses		0.0364				
Other (rabbits)		0.1923				
B. Manure management		**3.5129**	**1.6257**			NE
1. Cattle		1.3230	0.4040			NE
Dairy cattle		1.0530	0.2991			NE
Non-dairy cattle		0.2700	0.1049			NE
2. Sheep		0.1601	0.2224			NE
3. Swine		1.1714	0.1580			NE
4. Other livestock		0.8584	0.5607			NE
Goats		0.0156	0.0378			NE
Horses		0.1081	0.0791			NE
Mules and asses		0.0028	0.0015			NE
Poultry		0.7059	0.3787			NE
Other (rabbits)		0.0261	0.0636			NE
5. Indirect N_2O emissions			0.2806			
C. Rice cultivation		NO				NO
D. Agricultural soils			**3.3466**			
a. Direct N_2O emissions from managed soils			2.6514			
1. Inorganic N fertilizers			0.2170			
2. Organic N fertilizers			0.3413			
a. Animal manure applied to soils			0.3413			
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			1.5655			
6. Cultivation of organic soils (i.e. histosols)			NO			
7. Other			NO			
b. Indirect N_2O Emissions from managed soils			0.6952			
1. Atmospheric deposition			0.1175			
2. Nitrogen leaching and run-off			0.5777			
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**	**31.4975**	**2.9835**	NO	NO	NE, NO
I. Livestock		**31.4975**	**1.2423**			NE
A. Enteric fermentation		**28.9954**				
1. Cattle		21.7190				
Dairy cattle		17.7675				
Non-dairy cattle		3.9515				
2. Sheep		4.8749				
3. Swine		0.4812				
4. Other livestock		1.9204				
Goats		0.6441				
Horses		1.0897				
Mules and asses		0.0312				
Other (rabbits)		0.1554				
B. Manure management		**2.5021**	**1.2423**			NE
1. Cattle		1.0477	0.3131			NE
Dairy cattle		0.8644	0.2431			NE
Non-dairy cattle		0.1833	0.0700			NE
2. Sheep		0.1444	0.1952			NE
3. Swine		0.6434	0.0892			NE
4. Other livestock		0.6665	0.4341			NE

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2	CH_4	N_2O	NO_x	CO	NMVOC
	(kt)					
Goats		0.0138	0.0325			NE
Horses		0.0944	0.0640			NE
Mules and asses		0.0024	0.0013			NE
Poultry		0.5348	0.2866			NE
Other (rabbits)		0.0211	0.0498			NE
5. Indirect N_2O emissions			0.2106			
C. Rice cultivation		NO				NO
D. Agricultural soils			**1.7412**			
a. Direct N_2O emissions from managed soils			1.3481			
1. Inorganic N fertilizers			0.2959			
2. Organic N fertilizers			0.2631			
a. Animal manure applied to soils			0.2631			
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			0.5331			
6. Cultivation of organic soils (i.e. histosols)			NO			
7. Other			NO			
b. Indirect N_2O Emissions from managed soils			0.3932			
1. Atmospheric deposition			0.1044			
2. Nitrogen leaching and run-off			0.2888			
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**	**30.0951**	**5.0005**	**NO**	**NO**	**NE, NO**
I. Livestock		**30.0951**	**1.2244**			**NE**
A. Enteric fermentation		**27.6273**				
1. Cattle		20.3809				
Dairy cattle		16.9295				
Non-dairy cattle		3.4514				
2. Sheep		4.9102				
3. Swine		0.4544				
4. Other livestock		1.8818				
Goats		0.6705				
Horses		1.0329				
Mules and asses		0.0319				
Other (rabbits)		0.1466				
B. Manure management		**2.4678**	**1.2244**			**NE**
1. Cattle		0.9571	0.2877			NE
Dairy cattle		0.8014	0.2230			NE
Non-dairy cattle		0.1558	0.0647			NE
2. Sheep		0.1459	0.1925			NE
3. Swine		0.6661	0.0886			NE
4. Other livestock		0.6988	0.4465			NE
Goats		0.0145	0.0333			NE
Horses		0.0895	0.0607			NE
Mules and asses		0.0024	0.0013			NE
Poultry		0.5724	0.3028			NE
Other (rabbits)		0.0199	0.0483			NE
5. Indirect N_2O emissions			0.2092			
C. Rice cultivation		NO				NO
D. Agricultural soils			**3.7762**			
a. Direct N_2O emissions from managed soils			3.0053			
1. Inorganic N fertilizers			0.3446			
2. Organic N fertilizers			0.2581			
a. Animal manure applied to soils			0.2581			
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			1.8951			
6. Cultivation of organic soils (i.e. histosols)			NO			
7. Other			NO			

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2	CH_4	N_2O	NO_x	CO	NMVOC
	(kt)					
b. Indirect N_2O Emissions from managed soils			0.7708			
1. Atmospheric deposition			0.1088			
2. Nitrogen leaching and run-off			0.6620			
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**	**31.5113**	**5.7499**	NO	NO	NE, NO
I. Livestock		**31.5113**	**2.8112**			NE
A. Enteric fermentation		**28.7000**				
1. Cattle		20.7338				
Dairy cattle		17.1419				
Non-dairy cattle		3.5919				
2. Sheep		5.4028				
3. Swine		0.6054				
4. Other livestock		1.9580				
Goats		0.7575				
Horses		1.0092				
Mules and asses		0.0294				
Other (rabbits)		0.1619				
B. Manure management		**2.8113**	**2.8112**			NE
1. Cattle		0.9735	0.9734			NE
Dairy cattle		0.8114	0.8114			NE
Non-dairy cattle		0.1621	0.1619			NE
2. Sheep		0.1538	0.1538			NE
3. Swine		0.8616	0.8616			NE
4. Other livestock		0.8224	0.8224			NE
Goats		0.0156	0.0156			NE
Horses		0.0875	0.0875			NE
Mules and asses		0.0022	0.0022			NE
Poultry		0.6951	0.6951			NE
Other (rabbits)		0.0220	0.0220			NE
5. Indirect N_2O emissions			0.2360			
C. Rice cultivation		NO				NO
D. Agricultural soils			**2.9387**			
a. Direct N_2O emissions from managed soils			2.3226			
1. Inorganic N fertilizers			0.2670			
2. Organic N fertilizers			0.2879			
a. Animal manure applied to soils			0.2879			
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			1.3319			
6. Cultivation of organic soils (i.e. histosols)			NO			
7. Other			NO			
b. Indirect N_2O Emissions from managed soils			0.6161			
1. Atmospheric deposition			0.1088			
2. Nitrogen leaching and run-off			0.5074			
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**	**31.5783**	**4.9121**	NO	NO	NE, NO
I. Livestock		**31.5783**	**1.4304**			NE
A. Enteric fermentation		**28.5028**				
1. Cattle		20.4583				
Dairy cattle		16.7968				
Non-dairy cattle		3.6615				

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2	CH_4	N_2O	NO_x	CO	NMVOC
	(kt)					
2. Sheep		5.3083				
3. Swine		0.7675				
4. Other livestock		1.9687				
Goats		0.8131				
Horses		0.9646				
Mules and asses		0.0275				
Other (rabbits)		0.1635				
B. Manure management		**3.0755**	**1.4304**			**NE**
1. Cattle		0.9603	0.2900			NE
Dairy cattle		0.7951	0.2207			NE
Non-dairy cattle		0.1652	0.0694			NE
2. Sheep		0.1507	0.2093			NE
3. Swine		1.1196	0.1470			NE
4. Other livestock		0.8449	0.5336			NE
Goats		0.0166	0.0404			NE
Horses		0.0836	0.0564			NE
Mules and asses		0.0021	0.0011			NE
Poultry		0.7205	0.3813			NE
Other (rabbits)		0.0222	0.0545			NE
5. Indirect N_2O emissions			0.2504			
C. Rice cultivation		**NO**				**NO**
D. Agricultural soils			**3.4817**			
a. Direct N_2O emissions from managed soils			2.7600			
1. Inorganic N fertilizers			0.3234			
2. Organic N fertilizers			0.2967			
a. Animal manure applied to soils			0.2967			
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			1.6157			
6. Cultivation of organic soils (i.e. histosols)			NO			
7. Other			NO			
b. Indirect N_2O Emissions from managed soils			0.7218			
1. Atmospheric deposition			0.1161			
2. Nitrogen leaching and run-off			0.6057			
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**	**29.7453**	**4.9014**	**NO**	**NO**	**NE, NO**
I. Livestock		**29.7453**	**1.3045**			**NE**
A. Enteric fermentation		**26.8403**				
1. Cattle		19.4806				
Dairy cattle		15.8625				
Non-dairy cattle		3.6181				
2. Sheep		4.7236				
3. Swine		0.7076				
4. Other livestock		1.9285				
Goats		0.8238				
Horses		0.9160				
Mules and asses		0.0251				
Other (rabbits)		0.1636				
B. Manure management		**2.9050**	**1.3045**			**NE**
1. Cattle		0.9142	0.2810			NE
Dairy cattle		0.7509	0.2077			NE
Non-dairy cattle		0.1633	0.0733			NE
2. Sheep		0.1357	0.1885			NE
3. Swine		1.1353	0.1397			NE
4. Other livestock		0.7198	0.4677			NE
Goats		0.0172	0.0418			NE
Horses		0.0794	0.0532			NE
Mules and asses		0.0019	0.0010			NE
Poultry		0.5992	0.3176			NE
Other (rabbits)		0.0222	0.0541			NE

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2	CH_4	N_2O	NO_x	CO	NMVOC
	(kt)					
5. Indirect N_2O emissions			0.2275			
C. Rice cultivation		NO				NO
D. Agricultural soils			**3.5970**			
a. Direct N_2O emissions from managed soils			2.8530			
1. Inorganic N fertilizers			0.3928			
2. Organic N fertilizers			0.2719			
a. Animal manure applied to soils			0.2719			
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			1.6786			
6. Cultivation of organic soils (i.e. histosols)			NO			
7. Other			NO			
b. Indirect N_2O Emissions from managed soils			0.7440			
1. Atmospheric deposition			0.1162			
2. Nitrogen leaching and run-off			0.6278			
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**	**28.0764**	**3.5322**	NO	NO	NE, NO
I. Livestock		**28.0764**	**1.1973**			NE
A. Enteric fermentation		**25.3134**				
1. Cattle		18.2691				
Dairy cattle		14.7992				
Non-dairy cattle		3.4700				
2. Sheep		4.5098				
3. Swine		0.6576				
4. Other livestock		1.8768				
Goats		0.8406				
Horses		0.8546				
Mules and asses		0.0242				
Other (rabbits)		0.1575				
B. Manure management		**2.7630**	**1.1973**			NE
1. Cattle		0.8571	0.2653			NE
Dairy cattle		0.7005	0.1959			NE
Non-dairy cattle		0.1566	0.0694			NE
2. Sheep		0.1328	0.1898			NE
3. Swine		1.1759	0.1313			NE
4. Other livestock		0.5971	0.4032			NE
Goats		0.0179	0.0451			NE
Horses		0.0741	0.0515			NE
Mules and asses		0.0018	0.0010			NE
Poultry		0.4820	0.2549			NE
Other (rabbits)		0.0214	0.0506			NE
5. Indirect N_2O emissions			0.2079			
C. Rice cultivation		NO				NO
D. Agricultural soils			**2.3349**			
a. Direct N_2O emissions from managed soils			1.8142			
1. Inorganic N fertilizers			0.5355			
2. Organic N fertilizers			0.2512			
a. Animal manure applied to soils			0.2512			
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			0.1641			
4. Crop residues			0.0997			
5. Mineralization/immobilization associated with loss/gain of soil organic matter			0.7638			
6. Cultivation of organic soils (i.e. histosols)			NO			
7. Other			NO			
b. Indirect N_2O Emissions from managed soils			0.5207			
1. Atmospheric deposition			0.1252			
2. Nitrogen leaching and run-off			0.3954			
E. Prescribed burning of savannas		NO	NO			
F. Field burning of agricultural residues		IE	IE			

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2	CH_4	N_2O	NO_x	CO	NMVOC
	(kt)					
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**	**28.4486**	**5.1582**	**NO**	**NO**	**NE, NO**
I. Livestock		**28.4486**	**1.1203**			**NE**
A. Enteric fermentation		**25.7324**				
1. Cattle		18.0684				
Dairy cattle		14.5984				
Non-dairy cattle		3.4700				
2. Sheep		5.0433				
3. Swine		0.6672				
4. Other livestock		1.9534				
Goats		0.9298				
Horses		0.8275				
Mules and asses		0.0214				
Other (rabbits)		0.1748				
B. Manure management		**2.7162**	**1.1203**			**NE**
1. Cattle		0.8476	0.2605			NE
Dairy cattle		0.6910	0.1914			NE
Non-dairy cattle		0.1566	0.0691			NE
2. Sheep		0.1363	0.2041			NE
3. Swine		1.2548	0.1233			NE
4. Other livestock		0.4775	0.3410			NE
Goats		0.0188	0.0500			NE
Horses		0.0717	0.0505			NE
Mules and asses		0.0016	0.0009			NE
Poultry		0.3617	0.1838			NE
Other (rabbits)		0.0237	0.0558			NE
5. Indirect N_2O emissions			0.1913			
C. Rice cultivation		**NO**				**NO**
D. Agricultural soils			**4.0379**			
a. Direct N_2O emissions from managed soils			3.1956			
1. Inorganic N fertilizers			0.6617			
2. Organic N fertilizers			0.2385			
a. Animal manure applied to soils			0.2385			
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			0.1578			
4. Crop residues			0.3639			
5. Mineralization/immobilization associated with loss/gain of soil organic matter			1.7737			
6. Cultivation of organic soils (i.e. histosols)			NO			
7. Other			NO			
b. Indirect N_2O Emissions from managed soils			0.8423			
1. Atmospheric deposition			0.1350			
2. Nitrogen leaching and run-off			0.7073			
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**	**30.1395**	**5.8007**	**NO**	**NO**	**NE, NO**
I. Livestock		**30.1395**	**1.2336**			**NE**
A. Enteric fermentation		**27.2385**				
1. Cattle		19.0417				
Dairy cattle		15.3275				
Non-dairy cattle		3.7142				
2. Sheep		5.4777				
3. Swine		0.7571				
4. Other livestock		1.9621				
Goats		0.9779				
Horses		0.7699				

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2	CH_4	N_2O	NO_x	CO	NMVOC
	(kt)					
Mules and asses		0.0220				
Other (rabbits)		0.1924				
B. Manure management		**2.9011**	**1.2336**			**NE**
1. Cattle		0.8932	0.2763			NE
Dairy cattle		0.7256	0.1971			NE
Non-dairy cattle		0.1676	0.0791			NE
2. Sheep		0.1394	0.2339			NE
3. Swine		1.3764	0.1464			NE
4. Other livestock		0.4921	0.3656			NE
Goats		0.0199	0.0606			NE
Horses		0.0667	0.0461			NE
Mules and asses		0.0017	0.0009			NE
Poultry		0.3777	0.1947			NE
Other (rabbits)		0.0261	0.0633			NE
5. Indirect N_2O emissions			0.2114			
C. Rice cultivation		**NO**				**NO**
D. Agricultural soils			**4.5671**			
a. Direct N_2O emissions from managed soils			3.5988			
1. Inorganic N fertilizers			0.9603			
2. Organic N fertilizers			0.2597			
a. Animal manure applied to soils			0.2597			
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			0.1703			
4. Crop residues			0.4079			
5. Mineralization/immobilization associated with loss/gain of soil organic matter			1.8006			
6. Cultivation of organic soils (i.e. histosols)			NO			
7. Other			NO			
b. Indirect N_2O Emissions from managed soils			0.9683			
1. Atmospheric deposition			0.1710			
2. Nitrogen leaching and run-off			0.7973			
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**	**28.9696**	**4.5493**	**NO**	**NO**	**NE, NO**
I. Livestock		**28.9696**	**1.1950**			**NE**
A. Enteric fermentation		**26.1360**				
1. Cattle		18.3827				
Dairy cattle		14.9508				
Non-dairy cattle		3.4318				
2. Sheep		5.1021				
3. Swine		0.7267				
4. Other livestock		1.9246				
Goats		0.9756				
Horses		0.7227				
Mules and asses		0.0196				
Other (rabbits)		0.2066				
B. Manure management		**2.8336**	**1.1950**			**NE**
1. Cattle		0.8626	0.2735			NE
Dairy cattle		0.7077	0.1973			NE
Non-dairy cattle		0.1549	0.0762			NE
2. Sheep		0.1372	0.2204			NE
3. Swine		1.3412	0.1343			NE
4. Other livestock		0.4926	0.3628			NE
Goats		0.0206	0.0595			NE
Horses		0.0626	0.0431			NE
Mules and asses		0.0015	0.0008			NE
Poultry		0.3798	0.1916			NE
Other (rabbits)		0.0280	0.0677			NE
5. Indirect N_2O emissions			0.2041			
C. Rice cultivation		**NO**				**NO**
D. Agricultural soils			**3.3543**			
a. Direct N_2O emissions from managed soils			2.6392			
1. Inorganic N fertilizers			0.6078			

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2	CH_4	N_2O	NO_x	CO	NMVOC
	(kt)					
2. Organic N fertilizers			0.2525			
a. Animal manure applied to soils			0.2525			
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			0.1660			
4. Crop residues			0.1442			
5. Mineralization/immobilization associated with loss/gain of soil organic matter			1.4687			
6. Cultivation of organic soils (i.e. histosols)			NO			
7. Other			NO			
b. Indirect N_2O Emissions from managed soils			0.7151			
1. Atmospheric deposition			0.1336			
2. Nitrogen leaching and run-off			0.5815			
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**	**28.7044**	**5.6999**	**NO**	**NO**	**NE, NO**
I. Livestock		**28.7044**	**1.2507**			**NE**
A. Enteric fermentation		**25.9708**				
1. Cattle		18.0084				
Dairy cattle		14.2955				
Non-dairy cattle		3.7129				
2. Sheep		5.2761				
3. Swine		0.7046				
4. Other livestock		1.9818				
Goats		1.0618				
Horses		0.6728				
Mules and asses		0.0308				
Other (rabbits)		0.2163				
B. Manure management		**2.7337**	**1.2507**			**NE**
1. Cattle		0.8443	0.2640			NE
Dairy cattle		0.6767	0.1877			NE
Non-dairy cattle		0.1676	0.0763			NE
2. Sheep		0.1358	0.2231			NE
3. Swine		1.2437	0.1726			NE
4. Other livestock		0.5098	0.3742			NE
Goats		0.0217	0.0643			NE
Horses		0.0583	0.0401			NE
Mules and asses		0.0023	0.0012			NE
Poultry		0.3981	0.1971			NE
Other (rabbits)		0.0293	0.0715			NE
5. Indirect N_2O emissions			0.2170			
C. Rice cultivation		**NO**				**NO**
D. Agricultural soils			**4.4492**			
a. Direct N_2O emissions from managed soils			3.5252			
1. Inorganic N fertilizers			0.6821			
2. Organic N fertilizers			0.2621			
a. Animal manure applied to soils			0.2621			
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			0.1643			
4. Crop residues			0.4030			
5. Mineralization/immobilization associated with loss/gain of soil organic matter			2.0137			
6. Cultivation of organic soils (i.e. histosols)			NO			
7. Other			NO			
b. Indirect N_2O Emissions from managed soils			0.9240			
1. Atmospheric deposition			0.1428			
2. Nitrogen leaching and run-off			0.7812			
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**

Annex 6-4. Sectoral Reports for Sector 4 'LULUCF', 1990-2016

1990

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	Net CO_2 emissions / removals	CH_4	N_2O	NO_x	CO	NMVOC
	(kt)					
4. Total LULUCF	**-1 700.6120**	**0.1061**	**0.5717**	**0.0959**	**3.5227**	**NE**
A. Forest land	**-2 563.4328**	**0.0083**	**0.0005**	**0.0053**	**0.1887**	**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	NE
B. Cropland	**2 508.9630**	**0.0978**	**0.0350**	**0.0906**	**3.3340**	**NE**
1. Cropland remaining cropland	2 602.9804	0.0978	0.0025	0.0906	3.3340	NE
2. Land converted to cropland	-94.0174	NE	0.0325	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**	**NE**	**0.5362**	**NE**	**NE**	**NE**
1. Settlements remaining settlements	NO	NE	NE	NE	NE	NE
2. Land converted to settlements	84.7480	NE	0.5362	NE	NE	NE
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	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**

1991

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	Net CO_2 emissions / removals	CH_4	N_2O	NO_x	CO	NMVOC
	(kt)					
4. Total LULUCF	**-2 776.1620**	**0.0960**	**0.6171**	**0.0885**	**3.2552**	**NE**
A. Forest land	**-2 343.3131**	**0.0014**	**0.0001**	**0.0009**	**0.0316**	**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	NE
B. Cropland	**1 380.4637**	**0.0946**	**0.0335**	**0.0876**	**3.2236**	**NE**
1. Cropland remaining cropland	1 489.8617	0.0946	0.0025	0.0876	3.2236	NE
2. Land converted to cropland	-109.3980	NE	0.0310	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**	**NE**	**0.5835**	**NE**	**NE**	**NE**
1. Settlements remaining settlements	NO	NE	NE	NE	NE	NE
2. Land converted to settlements	88.7139	NE	0.5835	NE	NE	NE
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	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**

1992

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	Net CO_2 emissions / removals	CH_4	N_2O	NO_x	CO	NMVOC
	(kt)					
4. Total LULUCF	**-2 178.3822**	**0.0879**	**0.6868**	**0.0809**	**2.9777**	**NE**
A. Forest land	**-2 184.2404**	**0.0015**	**0.0001**	**0.0010**	**0.0346**	**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	NE
B. Cropland	**1 318.7877**	**0.0864**	**0.0321**	**0.0800**	**2.9431**	**NE**
1. Cropland remaining cropland	1 571.4108	0.0864	0.0022	0.0800	2.9431	NE
2. Land converted to cropland	-252.6231	NE	0.0299	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

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	Net CO_2 emissions / removals	CH_4	N_2O	NO_x	CO	NMVOC
	(kt)					
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**	**NE**	**0.6545**	**NE**	**NE**	**NE**
1. Settlements remaining settlements	NO	NE	NE	NE	NE	NE
2. Land converted to settlements	386.6196	NE	0.6545	NE	NE	NE
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	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**

1993

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	Net CO_2 emissions / removals	CH_4	N_2O	NO_x	CO	NMVOC
	(kt)					
4. Total LULUCF	**-2 226.5422**	**0.1179**	**0.7469**	**0.1091**	**4.0151**	**NE**
A. Forest land	**-2 193.5115**	**0.0001**	**0.0000**	**0.0001**	**0.0024**	**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	NE
B. Cropland	**1 581.1497**	**0.1178**	**0.0328**	**0.1090**	**4.0127**	**NE**
1. Cropland remaining cropland	1 707.8393	0.1178	0.0031	0.1090	4.0127	NE
2. Land converted to cropland	-126.6896	NE	0.0297	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**	**NE**	**0.7141**	**NE**	**NE**	**NE**
1. Settlements remaining settlements	NO	NE	NE	NE	NE	NE
2. Land converted to settlements	114.6181	NE	0.7141	NE	NE	NE
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	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**

1994

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	Net CO_2 emissions / removals	CH_4	N_2O	NO_x	CO	NMVOC
	(kt)					
4. Total LULUCF	**-2 139.1679**	**0.0662**	**0.7938**	**0.0606**	**2.2302**	**NE**
A. Forest land	**-2 108.0022**	**0.0023**	**0.0001**	**0.0015**	**0.0526**	**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	NE
B. Cropland	**1 378.5094**	**0.0639**	**0.0265**	**0.0592**	**2.1776**	**NE**
1. Cropland remaining cropland	1 479.6972	0.0639	0.0017	0.0592	2.1776	NE
2. Land converted to cropland	-101.1878	NE	0.0249	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**	**NE**	**0.7671**	**NE**	**NE**	**NE**
1. Settlements remaining settlements	NO	NE	NE	NE	NE	NE
2. Land converted to settlements	130.4883	NE	0.7671	NE	NE	NE
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	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**

1995

GREENHOUSE GAS SOURCE AND SINK C ATEGORIES	Net CO_2 emissions / removals	CH_4	N_2O	NO_x	CO	NMVOC
	(kt)					
4. Total LULUCF	**-2 122.7016**	**0.0896**	**0.8440**	**0.0829**	**3.0510**	**NE**
A. Forest land	**-2 045.0670**	**0.0001**	**0.0000**	**0.0001**	**0.0030**	**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	NE
B. Cropland	**1 478.8872**	**0.0895**	**0.0270**	**0.0828**	**3.0480**	**NE**
1. Cropland remaining cropland	1 652.6167	0.0895	0.0023	0.0828	3.0480	NE
2. Land converted to cropland	-173.7295	NE	0.0247	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**	**NE**	**0.8170**	**NE**	**NE**	**NE**
1. Settlements remaining settlements	NO	NE	NE	NE	NE	NE
2. Land converted to settlements	106.9167	NE	0.8170	NE	NE	NE
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	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**

1996

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	Net CO_2 emissions / removals	CH_4	N_2O	NO_x	CO	NMVOC
	(kt)					
4. Total LULUCF	**-2 546.9382**	**0.0616**	**0.8801**	**0.0569**	**2.0916**	**NE**
A. Forest land	**-2 190.4337**	**0.0008**	**0.0000**	**0.0005**	**0.0176**	**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	NE
B. Cropland	**1 312.1146**	**0.0609**	**0.0194**	**0.0564**	**2.0740**	**NE**
1. Cropland remaining cropland	1 489.3644	0.0609	0.0016	0.0564	2.0740	NE
2. Land converted to cropland	-177.2498	NE	0.0178	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**	**NE**	**0.8606**	**NE**	**NE**	**NE**
1. Settlements remaining settlements	NO	NE	NE	NE	NE	NE
2. Land converted to settlements	101.5910	NE	0.8606	NE	NE	NE
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	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**

1997

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	Net CO_2 emissions / removals	CH_4	N_2O	NO_x	CO	NMVOC
	(kt)					
4. Total LULUCF	**-2 148.3338**	**0.1075**	**0.9134**	**0.0995**	**3.6610**	**NE**
A. Forest land	**-2 232.2854**	**0.0002**	**0.0000**	**0.0001**	**0.0053**	**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	NE
B. Cropland	**1 628.0567**	**0.1073**	**0.0116**	**0.0993**	**3.6556**	**NE**
1. Cropland remaining cropland	1 802.8445	0.1073	0.0028	0.0993	3.6556	NE
2. Land converted to cropland	-174.7878	NE	0.0088	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

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	Net CO_2 emissions / removals	CH_4	N_2O	NO_x	CO	NMVOC
	(kt)					
2. Land converted to wetlands	-413.0332	NE	NE	NE	NE	NE
E. Settlements	**100.7954**	**NE**	**0.9017**	**NE**	**NE**	**NE**
1. Settlements remaining settlements	NO	NE	NE	NE	NE	NE
2. Land converted to settlements	100.7954	NE	0.9017	NE	NE	NE
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	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**

1998

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	Net CO_2 emissions / removals	CH_4	N_2O	NO_x	CO	NMVOC
	(kt)					
4. Total LULUCF	**-2 177.5062**	**0.0989**	**0.9542**	**0.0909**	**3.3430**	**NE**
A. Forest land	**-2 288.4857**	**0.0023**	**0.0001**	**0.0015**	**0.0530**	**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	0.0530	NE
B. Cropland	**1 657.1571**	**0.0966**	**0.0110**	**0.0894**	**3.2900**	**NE**
1. Cropland remaining cropland	1 838.5706	0.0966	0.0025	0.0894	3.2900	NE
2. Land converted to cropland	-181.4135	NE	0.0085	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**	**NE**	**0.9431**	**NE**	**NE**	**NE**
1. Settlements remaining settlements	NO	NE	NE	NE	NE	NE
2. Land converted to settlements	99.0440	NE	0.9431	NE	NE	NE
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	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**

1999

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	Net CO_2 emissions / removals	CH_4	N_2O	NO_x	CO	NMVOC
	(kt)					
4. Total LULUCF	**-1 893.5700**	**0.0956**	**0.9861**	**0.0880**	**3.2363**	**NE**
A. Forest land	**-2 336.8468**	**0.0017**	**0.0001**	**0.0011**	**0.0396**	**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	NE
B. Cropland	**1 677.6681**	**0.0938**	**0.0109**	**0.0869**	**3.1967**	**NE**
1. Cropland remaining cropland	1 814.6174	0.0938	0.0024	0.0869	3.1967	NE
2. Land converted to cropland	-136.9493	NE	0.0085	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**	**NE**	**0.9751**	**NE**	**NE**	**NE**
1. Settlements remaining settlements	NO	NE	NE	NE	NE	NE
2. Land converted to settlements	111.8259	NE	0.9751	NE	NE	NE
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	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**

2000

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	Net CO_2 emissions / removals	CH_4	N_2O	NO_x	CO	NMVOC
	(kt)					
4. Total LULUCF	**-2 177.9243**	**0.0365**	**0.9944**	**0.0338**	**1.2427**	**NE**
A. Forest land	**-2 307.4384**	**0.0001**	**0.0000**	**0.0000**	**0.0014**	**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	NE
B. Cropland	**1 465.3794**	**0.0364**	**0.0091**	**0.0337**	**1.2413**	**NE**
1. Cropland remaining cropland	1 618.8065	0.0364	0.0009	0.0337	1.2413	NE
2. Land converted to cropland	-153.4270	NE	0.0081	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**	**NE**	**0.9853**	**NE**	**NE**	**NE**
1. Settlements remaining settlements	NO	NE	NE	NE	NE	NE
2. Land converted to settlements	100.1768	NE	0.9853	NE	NE	NE
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	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**

2001

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	Net CO_2 emissions / removals	CH_4	N_2O	NO_x	CO	NMVOC
	(kt)					
4. Total LULUCF	**-1 813.9954**	**0.0508**	**0.9951**	**0.0459**	**1.6868**	**NE**
A. Forest land	**-2 273.7027**	**0.0039**	**0.0002**	**0.0025**	**0.0896**	**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	NE
B. Cropland	**1 811.2281**	**0.0469**	**0.0079**	**0.0434**	**1.5972**	**NE**
1. Cropland remaining cropland	1 999.8174	0.0469	0.0012	0.0434	1.5972	NE
2. Land converted to cropland	-188.5893	NE	0.0067	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**	**NE**	**0.9870**	**NE**	**NE**	**NE**
1. Settlements remaining settlements	NO	NE	NE	NE	NE	NE
2. Land converted to settlements	67.0898	NE	0.9870	NE	NE	NE
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	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**

2002

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	Net CO_2 emissions / removals	CH_4	N_2O	NO_x	CO	NMVOC
	(kt)					
4. Total LULUCF	**-1 900.5120**	**0.0106**	**0.9965**	**0.0092**	**0.3385**	**NE**
A. Forest land	**-2 267.6159**	**0.0021**	**0.0001**	**0.0013**	**0.0481**	**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	NE
B. Cropland	**1 407.6151**	**0.0085**	**0.0066**	**0.0079**	**0.2904**	**NE**
1. Cropland remaining cropland	1 568.8050	0.0085	0.0002	0.0079	0.2904	NE
2. Land converted to cropland	-161.1900	NE	0.0063	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

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	Net CO_2 emissions / removals	CH_4	N_2O	NO_x	CO	NMVOC
	(kt)					
2. Land converted to wetlands	-272.0188	NE	NE	NE	NE	NE
E. Settlements	**67.0898**	**NE**	**0.9898**	**NE**	**NE**	**NE**
1. Settlements remaining settlements	NO	NE	NE	NE	NE	NE
2. Land converted to settlements	67.0898	NE	0.9898	NE	NE	NE
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	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**

2003

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	Net CO_2 emissions / removals	CH_4	N_2O	NO_x	CO	NMVOC
	(kt)					
4. Total LULUCF	**-1 827.6049**	**0.0024**	**0.9877**	**0.0016**	**0.0573**	**NE**
A. Forest land	**-2 270.1176**	**0.0023**	**0.0001**	**0.0015**	**0.0526**	**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	NE
B. Cropland	**1 489.1023**	**0.0001**	**0.0056**	**0.0001**	**0.0046**	**NE**
1. Cropland remaining cropland	1 645.1586	0.0001	0.0000	0.0001	0.0046	NE
2. Land converted to cropland	-156.0563	NE	0.0056	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**	**NE**	**0.9820**	**NE**	**NE**	**NE**
1. Settlements remaining settlements	NO	NE	NE	NE	NE	NE
2. Land converted to settlements	67.8615	NE	0.9820	NE	NE	NE
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	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**

2004

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	Net CO_2 emissions / removals	CH_4	N_2O	NO_x	CO	NMVOC
	(kt)					
4. Total LULUCF	**-1 992.6605**	**0.0080**	**0.9736**	**0.0057**	**0.2051**	**NE**
A. Forest land	**-2 334.7768**	**0.0061**	**0.0003**	**0.0039**	**0.1383**	**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	NE
B. Cropland	**1 454.1892**	**0.0020**	**0.0046**	**0.0018**	**0.0668**	**NE**
1. Cropland remaining cropland	1 589.7492	0.0020	0.0001	0.0018	0.0668	NE
2. Land converted to cropland	-135.5600	NE	0.0046	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**	**NE**	**0.9686**	**NE**	**NE**	**NE**
1. Settlements remaining settlements	NO	NE	NE	NE	NE	NE
2. Land converted to settlements	53.6737	NE	0.9686	NE	NE	NE
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	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**

2005

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	Net CO_2 emissions / removals	CH_4	N_2O	NO_x	CO	NMVOC
	(kt)					
4. Total LULUCF	**-1 697.7069**	**0.0099**	**0.9615**	**0.0090**	**0.3317**	**NE**
A. Forest land	**-2 409.5185**	**0.0006**	**0.0000**	**0.0004**	**0.0132**	**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	NE
B. Cropland	**1 528.2806**	**0.0093**	**0.0056**	**0.0087**	**0.3185**	**NE**
1. Cropland remaining cropland	1 630.9279	0.0093	0.0002	0.0087	0.3185	NE
2. Land converted to cropland	-102.6473	NE	0.0054	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**	**NE**	**0.9559**	**NE**	**NE**	**NE**
1. Settlements remaining settlements	NO	NE	NE	NE	NE	NE
2. Land converted to settlements	53.6737	NE	0.9559	NE	NE	NE
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	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**

2006

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	Net CO_2 emissions / removals	CH_4	N_2O	NO_x	CO	NMVOC
	(kt)					
4. Total LULUCF	**-1 813.6146**	**0.0100**	**0.9483**	**0.0075**	**0.2706**	**NE**
A. Forest land	**-2 366.5168**	**0.0063**	**0.0003**	**0.0040**	**0.1427**	**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	NE
B. Cropland	**1 565.8949**	**0.0038**	**0.0048**	**0.0035**	**0.1279**	**NE**
1. Cropland remaining cropland	1 666.3069	0.0038	0.0001	0.0035	0.1279	NE
2. Land converted to cropland	-100.4120	NE	0.0047	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**	**NE**	**0.9432**	**NE**	**NE**	**NE**
1. Settlements remaining settlements	NO	NE	NE	NE	NE	NE
2. Land converted to settlements	53.6737	NE	0.9432	NE	NE	NE
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	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**

2007

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	Net CO_2 emissions / removals	CH_4	N_2O	NO_x	CO	NMVOC
	(kt)					
4. Total LULUCF	**-2 006.6996**	**0.0607**	**0.9330**	**0.0405**	**1.4512**	**NE**
A. Forest land	**-2 460.3855**	**0.0546**	**0.0030**	**0.0349**	**1.2433**	**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	1.2433	NE
B. Cropland	**1 528.1376**	**0.0061**	**0.0049**	**0.0056**	**0.2079**	**NE**
1. Cropland remaining cropland	1 621.1746	0.0061	0.0002	0.0056	0.2079	NE
2. Land converted to cropland	-93.0370	NE	0.0048	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

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	Net CO_2 emissions / removals	CH_4	N_2O	NO_x	CO	NMVOC
	(kt)					
2. Land converted to wetlands	-131.0044	NE	NE	NE	NE	NE
E. Settlements	**49.2742**	**NE**	**0.9250**	**NE**	**NE**	**NE**
1. Settlements remaining settlements	NO	NE	NE	NE	NE	NE
2. Land converted to settlements	49.2742	NE	0.9250	NE	NE	NE
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	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**

2008

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	Net CO_2 emissions / removals	CH_4	N_2O	NO_x	CO	NMVOC
	(kt)					
4. Total LULUCF	**-1 693.2806**	**0.0308**	**0.9128**	**0.0274**	**1.0067**	**NE**
A. Forest land	**-2 462.7874**	**0.0038**	**0.0002**	**0.0024**	**0.0864**	**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	NE
B. Cropland	**1 499.7873**	**0.0270**	**0.0052**	**0.0250**	**0.9203**	**NE**
1. Cropland remaining cropland	1 603.3550	0.0270	0.0007	0.0250	0.9203	NE
2. Land converted to cropland	-103.5677	NE	0.0045	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**	**NE**	**0.9074**	**NE**	**NE**	**NE**
1. Settlements remaining settlements	NO	NE	NE	NE	NE	NE
2. Land converted to settlements	49.2742	NE	0.9074	NE	NE	NE
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	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**

2009

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	Net CO_2 emissions / removals	CH_4	N_2O	NO_x	CO	NMVOC
	(kt)					
4. Total LULUCF	**-1 298.8485**	**0.0126**	**0.8904**	**0.0090**	**0.3239**	**NE**
A. Forest land	**-2 526.0659**	**0.0093**	**0.0005**	**0.0059**	**0.2109**	**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	0.2109	NE
B. Cropland	**1 652.4751**	**0.0033**	**0.0046**	**0.0031**	**0.1130**	**NE**
1. Cropland remaining cropland	1 744.0569	0.0033	0.0001	0.0031	0.1130	NE
2. Land converted to cropland	-91.5818	NE	0.0045	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**	**NE**	**0.8853**	**NE**	**NE**	**NE**
1. Settlements remaining settlements	NO	NE	NE	NE	NE	NE
2. Land converted to settlements	45.5694	NE	0.8853	NE	NE	NE
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	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**

2010

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	Net CO_2 emissions / removals	CH_4	N_2O	NO_x	CO	NMVOC
	(kt)					
4. Total LULUCF	**-1 220.3031**	**0.0056**	**0.8665**	**0.0042**	**0.1529**	**NE**
A. Forest land	**-2 484.1627**	**0.0032**	**0.0002**	**0.0021**	**0.0737**	**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	NE
B. Cropland	**1 537.9925**	**0.0023**	**0.0028**	**0.0022**	**0.0792**	**NE**
1. Cropland remaining cropland	1 618.9873	0.0023	0.0001	0.0022	0.0792	NE
2. Land converted to cropland	-80.9948	NE	0.0027	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**	**NE**	**0.8636**	**NE**	**NE**	**NE**
1. Settlements remaining settlements	NO	NE	NE	NE	NE	NE
2. Land converted to settlements	45.5694	NE	0.8636	NE	NE	NE
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	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**

2011

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	Net CO_2 emissions / removals	CH_4	N_2O	NO_x	CO	NMVOC
	(kt)					
4. Total LULUCF	**-1 160.1391**	**0.0064**	**0.8455**	**0.0047**	**0.1680**	**NE**
A. Forest land	**-2 390.5712**	**0.0043**	**0.0002**	**0.0028**	**0.0987**	**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	NE
B. Cropland	**1 492.5261**	**0.0020**	**0.0026**	**0.0019**	**0.0693**	**NE**
1. Cropland remaining cropland	1 610.5807	0.0020	0.0001	0.0019	0.0693	NE
2. Land converted to cropland	-118.0546	NE	0.0026	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**	**NE**	**0.8426**	**NE**	**NE**	**NE**
1. Settlements remaining settlements	NO	NE	NE	NE	NE	NE
2. Land converted to settlements	62.0438	NE	0.8426	NE	NE	NE
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	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**

2012

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	Net CO_2 emissions / removals	CH_4	N_2O	NO_x	CO	NMVOC
	(kt)					
4. Total LULUCF	**-1 174.1542**	**0.0467**	**0.7833**	**0.0299**	**1.0665**	**NE**
A. Forest land	**-2 294.8221**	**0.0464**	**0.0026**	**0.0296**	**1.0565**	**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	1.0565	NE
B. Cropland	**1 496.0113**	**0.0003**	**0.0026**	**0.0003**	**0.0100**	**NE**
1. Cropland remaining cropland	1 593.5785	0.0003	0.0000	0.0003	0.0100	NE
2. Land converted to cropland	-97.5672	NE	0.0026	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

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	Net CO_2 emissions / removals	CH_4	N_2O	NO_x	CO	NMVOC
	(kt)					
2. Land converted to wetlands	-15.4700	NE	NE	NE	NE	NE
E. Settlements	**11.8882**	**NE**	**0.7781**	**NE**	**NE**	**NE**
1. Settlements remaining settlements	NO	NE	NE	NE	NE	NE
2. Land converted to settlements	11.8882	NE	0.7781	NE	NE	NE
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	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**

2013

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	Net CO_2 emissions / removals	CH_4	N_2O	NO_x	CO	NMVOC
	(kt)					
4. Total LULUCF	**-1 020.8558**	**0.0349**	**0.7290**	**0.0230**	**0.8237**	**NE**
A. Forest land	**-2 141.8702**	**0.0322**	**0.0018**	**0.0206**	**0.7339**	**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	NE
B. Cropland	**1 408.2056**	**0.0026**	**0.0026**	**0.0024**	**0.0898**	**NE**
1. Cropland remaining cropland	1 689.4814	0.0026	0.0001	0.0024	0.0898	NE
2. Land converted to cropland	-281.2757	NE	0.0026	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**	**NE**	**0.7246**	**NE**	**NE**	**NE**
1. Settlements remaining settlements	NO	NE	NE	NE	NE	NE
2. Land converted to settlements	13.7512	NE	0.7246	NE	NE	NE
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	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**

2014

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	Net CO_2 emissions / removals	CH_4	N_2O	NO_x	CO	NMVOC
	(kt)					
4. Total LULUCF	**-656.2221**	**0.0047**	**0.6794**	**0.0036**	**0.1293**	**NE**
A. Forest land	**-2 134.7390**	**0.0027**	**0.0001**	**0.0017**	**0.0603**	**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	NE
B. Cropland	**1 445.7270**	**0.0020**	**0.0026**	**0.0019**	**0.0690**	**NE**
1. Cropland remaining cropland	1 696.1650	0.0020	0.0001	0.0019	0.0690	NE
2. Land converted to cropland	-250.4380	NE	0.0026	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**	**NE**	**0.6766**	**NE**	**NE**	**NE**
1. Settlements remaining settlements	NO	NE	NE	NE	NE	NE
2. Land converted to settlements	18.9848	NE	0.6766	NE	NE	NE
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	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**

2015

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	Net CO_2 emissions / removals	CH_4	N_2O	NO_x	CO	NMVOC
	(kt)					
4. Total LULUCF	**-1 093.0947**	**0.0261**	**0.6385**	**0.0171**	**0.6123**	**NE**
A. Forest land	**-2 159.4439**	**0.0246**	**0.0014**	**0.0157**	**0.5597**	**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	0.5597	NE
B. Cropland	**1 392.3816**	**0.0015**	**0.0026**	**0.0014**	**0.0526**	**NE**
1. Cropland remaining cropland	1 700.3970	0.0015	0.0000	0.0014	0.0526	NE
2. Land converted to cropland	-308.0154	NE	0.0026	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**	**NE**	**0.6345**	**NE**	**NE**	**NE**
1. Settlements remaining settlements	NO	NE	NE	NE	NE	NE
2. Land converted to settlements	39.1617	NE	0.6345	NE	NE	NE
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	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**

2016

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	Net CO_2 emissions / removals	CH_4	N_2O	NO_x	CO	NMVOC
	(kt)					
4. Total LULUCF	**-1 099.6373**	**0.0143**	**0.6016**	**0.0097**	**0.3468**	**NE**
A. Forest land	**-2 113.5468**	**0.0123**	**0.0007**	**0.0079**	**0.2809**	**NE**
1. Forest land remaining forest land	-1 451.3266	NE	NE	NE	NE	NE
2. Land converted to forest land	-662.2202	0.0123	0.0007	0.0079	0.2809	NE
B. Cropland	**1 393.2356**	**0.0019**	**0.0026**	**0.0018**	**0.0658**	**NE**
1. Cropland remaining cropland	1 775.4060	0.0019	0.0001	0.0018	0.0658	NE
2. Land converted to cropland	-382.1704	NE	0.0026	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**	**NE**	**0.5983**	**NE**	**NE**	**NE**
1. Settlements remaining settlements	NO	NE	NE	NE	NE	NE
2. Land converted to settlements	19.3071	NE	0.5983	NE	NE	NE
F. Other land	**85.6461**	**NE**	**NE**	**NE**	**NE**	**NE**
1. Other land remaining other land						
2. Land converted to other land	85.6461	NE	NE	NE	NE	NE
G. Harvested wood products	**0.8816**					
H. Other	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**

Annex 6-5. Sectoral Report for Sector 5 'Waste' 1990-2016

1990

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2	CH_4	N_2O	NO_x	CO	NMVOC	SO_2
	(kt)						
Total waste	**17.1060**	**56.3390**	**0.3013**	**0.1717**	**3.0071**	**3.0982**	**0.0060**
A. Solid waste disposal	**NA, NO**	**41.8691**		**NA, NO**	**NA, NO**	**2.9908**	
1. Managed waste disposal sites	NA, NO	NO		NA, NO	NA	NO	
2. Unmanaged waste disposal sites	NA, NO	41.8691		NA, NO	NA	2.9908	
3. Uncategorized waste disposal sites	NO	NO		NO	NO	NO	
B. Biological treatment of solid waste		**NO, NE**	**NO, NE**	**NO, NE**	**NO, NE**	**NO, NE**	
1. Composting		NO	NO	NO	NO	NO	
2. Anaerobic digestion at biogas facilities		NE	NE	NE	NE	NE	
C. Incineration and open burning of waste	**17.1060**	**0.3513**	**0.0062**	**0.1717**	**3.0071**	**0.0664**	**0.0060**
1. Waste incineration	NO	NO	NO	NO	NO	NO	NO
2. Open burning of waste	17.1060	0.3513	0.0062	0.1717	3.0071	0.0664	0.0060
D. Wastewater treatment and discharge		**14.1186**	**0.2951**	**NA, IE**	**NA, IE**	**0.0410**	
1. Domestic wastewater		9.3618	0.2951	NA	NA	0.0410	
2. Industrial wastewater		4.7568	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)						
Total waste	**17.1256**	**57.9597**	**0.2786**	**0.1719**	**3.0098**	**2.9196**	**0.0060**
A. Solid waste disposal	**NA, NO**	**43.9447**		**NA, NO**	**NA, NO**	**2.8159**	
1. Managed waste disposal sites	NA, NO	NO		NA, NO	NA	NO	
2. Unmanaged waste disposal sites	NA, NO	43.9447		NA, NO	NA	2.8159	
3. Uncategorized waste disposal sites	NO	NO		NO	NO	NO	
B. Biological treatment of solid waste		**NO, NE**	**NO, NE**	**NO, NE**	**NO, NE**	**NO, NE**	
1. Composting		NO	NO	NO	NO	NO	
2. Anaerobic digestion at biogas facilities		NE	NE	NE	NE	NE	
C. Incineration and open burning of waste	**17.1256**	**0.3516**	**0.0062**	**0.1719**	**3.0098**	**0.0664**	**0.0060**
1. Waste incineration	NO	NO	NO	NO	NO	NO	NO
2. Open burning of waste	17.1256	0.3516	0.0062	0.1719	3.0098	0.0664	0.0060
D. Wastewater treatment and discharge		**13.6633**	**0.2724**	**NA, IE**	**NA, IE**	**0.0373**	
1. Domestic wastewater		9.4087	0.2724	NA	NA	0.0373	
2. Industrial wastewater		4.2546	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)						
Total waste	**17.1291**	**58.3125**	**0.2558**	**0.1719**	**3.0096**	**2.8134**	**0.0060**
A. Solid waste disposal	**NA, NE**	**45.6782**		**NA, NO**	**NA, NO**	**2.7135**	
1. Managed waste disposal sites	NA, NO	7.4456		NA, NO	NA	0.4423	
2. Unmanaged waste disposal sites	NA, NO	38.2327		NA, NO	NA	2.2712	
3. Uncategorized waste disposal sites	NO	NO		NO	NO	NO	
B. Biological treatment of solid waste		**NO, NE**	**NO, NE**	**NO, NE**	**NO, NE**	**NO, NE**	
1. Composting		NO	NO	NO	NO	NO	
2. Anaerobic digestion at biogas facilities		NE	NE	NE	NE	NE	
C. Incineration and open burning of waste	**17.1291**	**0.3517**	**0.0062**	**0.1719**	**3.0096**	**0.0664**	**0.0060**
1. Waste incineration	NO	NO	NO	NO	NO	NO	NO
2. Open burning of waste	17.1291	0.3517	0.0062	0.1719	3.0096	0.0664	0.0060
D. Wastewater treatment and discharge		**12.2826**	**0.2496**	**NA, IE**	**NA, IE**	**0.0335**	
1. Domestic wastewater		9.5186	0.2496	NA	NA	0.0335	
2. Industrial wastewater		2.7640	IE	IE	IE	IE	
3. Other		NA	NA	NA	NA	NA	

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2	CH_4	N_2O	NO_x	CO	NMVOC	SO_2
	(kt)						
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)						
Total waste	**17.1013**	**60.9808**	**0.2403**	**0.1716**	**3.0038**	**1.7665**	**0.0060**
A. Solid waste disposal	**NA, NO**	**48.1887**		**NA, NO**	**NA, NO**	**1.6703**	
1. Managed waste disposal sites	NA, NO	13.1073		NA, NO	NA	0.4543	
2. Unmanaged waste disposal sites	NA, NO	35.0814		NA, NO	NA	1.2160	
3. Uncategorized waste disposal sites	NO	NO		NO	NO	NO	
B. Biological treatment of solid waste		**NO, NE**	**NO, NE**	**NO, NE**	**NO, NE**	**NO, NE**	
1. Composting		NO	NO	NO	NO	NO	
2. Anaerobic digestion at biogas facilities		NE	NE	NE	NE	NE	
C. Incineration and open burning of waste	**17.1013**	**0.3511**	**0.0062**	**0.1716**	**3.0038**	**0.0663**	**0.0060**
1. Waste incineration	NO	NO	NO	NO	NO	NO	NO
2. Open burning of waste	17.1013	0.3511	0.0062	0.1716	3.0038	0.0663	0.0060
D. Wastewater treatment and discharge		**12.4409**	**0.2341**	**NA, IE**	**NA, IE**	**0.0299**	
1. Domestic wastewater		9.5882	0.2341	NA	NA	0.0299	
2. Industrial wastewater		2.8528	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)						
Total waste	**17.1330**	**60.3807**	**0.2334**	**0.1719**	**3.0085**	**1.6024**	**0.0060**
A. Solid waste disposal	**NA, NO**	**48.3920**		**NA, NO**	**NA, NO**	**1.5088**	
1. Managed waste disposal sites	NA, NO	13.8401		NA, NO	NA	0.4315	
2. Unmanaged waste disposal sites	NA, NO	34.5519		NA, NO	NA	1.0773	
3. Uncategorized waste disposal sites	NO	NO		NO	NO	NO	
B. Biological treatment of solid waste		**NO, NE**	**NO, NE**	**NO, NE**	**NO, NE**	**NO, NE**	
1. Composting		NO	NO	NO	NO	NO	
2. Anaerobic digestion at biogas facilities		NE	NE	NE	NE	NE	
C. Incineration and open burning of waste	**17.1330**	**0.3517**	**0.0062**	**0.1719**	**3.0085**	**0.0664**	**0.0060**
1. Waste incineration	NO	NO	NO	NO	NO	NO	NO
2. Open burning of waste	17.1330	0.3517	0.0062	0.1719	3.0085	0.0664	0.0060
D. Wastewater treatment and discharge		**11.6369**	**0.2272**	**NA, IE**	**NA, IE**	**0.0272**	
1. Domestic wastewater		9.6883	0.2272	NA	NA	0.0272	
2. Industrial wastewater		1.9486	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)						
Total waste	**17.1216**	**60.2883**	**0.2362**	**0.1717**	**3.0055**	**1.4718**	**0.0060**
A. Solid waste disposal	**NA, NO**	**48.3670**		**NA, NO**	**NA, NO**	**1.3847**	
1. Managed waste disposal sites	NA, NO	15.0421		NA, NO	NA	0.4306	
2. Unmanaged waste disposal sites	NA, NO	33.3249		NA, NO	NA	0.9541	
3. Uncategorized waste disposal sites	NO	NO		NO	NO	NO	
B. Biological treatment of solid waste		**NO, NE**	**NO, NE**	**NO, NE**	**NO, NE**	**NO, NE**	
1. Composting		NO	NO	NO	NO	NO	
2. Anaerobic digestion at biogas facilities		NE	NE	NE	NE	NE	
C. Incineration and open burning of waste	**17.1216**	**0.3514**	**0.0062**	**0.1717**	**3.0055**	**0.0664**	**0.0060**

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2	CH_4	N_2O	NO_x	CO	NMVOC	SO_2
	(kt)						
1. Waste incineration	NO	NO	NO	NO	NO	NO	NO
2. Open burning of waste	17.1216	0.3514	0.0062	0.1717	3.0055	0.0664	0.0060
D. Wastewater treatment and discharge		**11.5698**	**0.2301**	**NA, IE**	**NA, IE**	**0.0207**	
1. Domestic wastewater		9.7971	0.2301	NA	NA	0.0207	
2. Industrial wastewater		1.7727	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)						
Total waste	**17.1083**	**60.5003**	**0.2328**	**0.1716**	**3.0022**	**1.4379**	**0.0060**
A. Solid waste disposal	**NA, NO**	**48.6713**		**NA, NO**	**NA, NO**	**1.3509**	
1. Managed waste disposal sites	NA, NO	14.6014		NA, NO	NA	0.4053	
2. Unmanaged waste disposal sites	NA, NO	34.0699		NA, NO	NA	0.9456	
3. Uncategorized waste disposal sites	NO	NO		NO	NO	NO	
B. Biological treatment of solid waste		**NO, NE**	**NO, NE**	**NO, NE**	**NO, NE**	**NO, NE**	
1. Composting		NO	NO	NO	NO	NO	
2. Anaerobic digestion at biogas facilities		NE	NE	NE	NE	NE	
C. Incineration and open burning of waste	**17.1083**	**0.3511**	**0.0062**	**0.1716**	**3.0022**	**0.0663**	**0.0060**
1. Waste incineration	NO	NO	NO	NO	NO	NO	NO
2. Open burning of waste	17.1083	0.3511	0.0062	0.1716	3.0022	0.0663	0.0060
D. Wastewater treatment and discharge		**11.4778**	**0.2266**	**NA, IE**	**NA, IE**	**0.0208**	
1. Domestic wastewater		9.8913	0.2266	NA	NA	0.0208	
2. Industrial wastewater		1.5865	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)						
Total waste	**17.0610**	**60.3063**	**0.2369**	**0.1711**	**2.9928**	**1.3447**	**0.0060**
A. Solid waste disposal	**NA, NO**	**48.1521**		**NA, NO**	**NA, NO**	**1.2600**	
1. Managed waste disposal sites	NA, NO	15.7939		NA, NO	NA	0.4133	
2. Unmanaged waste disposal sites	NA, NO	32.3582		NA, NO	NA	0.8467	
3. Uncategorized waste disposal sites	NO	NO		NO	NO	NO	
B. Biological treatment of solid waste		**NO, NE**	**NO, NE**	**NO, NE**	**NO, NE**	**NO, NE**	
1. Composting		NO	NO	NO	NO	NO	
2. Anaerobic digestion at biogas facilities		NE	NE	NE	NE	NE	
C. Incineration and open burning of waste	**17.0610**	**0.3501**	**0.0061**	**0.1711**	**2.9928**	**0.0661**	**0.0060**
1. Waste incineration	NO	NO	NO	NO	NO	NO	NO
2. Open burning of waste	17.0610	0.3501	0.0061	0.1711	2.9928	0.0661	0.0060
D. Wastewater treatment and discharge		**11.8041**	**0.2307**	**NA, IE**	**NA, IE**	**0.0186**	
1. Domestic wastewater		9.9157	0.2307	NA	NA	0.0186	
2. Industrial wastewater		1.8884	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)						
Total waste	**17.0846**	**59.3055**	**0.2404**	**0.1713**	**2.9958**	**1.3384**	**0.0061**
A. Solid waste disposal	**NA, NO**	**47.5742**		**NA, NO**	**NA, NO**	**1.2568**	
1. Managed waste disposal sites	NA, NO	15.4616		NA, NO	NA	0.4085	

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2	CH_4	N_2O	NO_x	CO	NMVOC	SO_2
	(kt)						
2. Unmanaged waste disposal sites	NA, NO	32.1126		NA, NO	NA	0.8483	
3. Uncategorized waste disposal sites	NO	NO		NO	NO	NO	
B. Biological treatment of solid waste		**NO, NE**	**NO, NE**	**NO, NE**	**NO, NE**	**NO, NE**	
1. Composting		NO	NO	NO	NO	NO	
2. Anaerobic digestion at biogas facilities		NE	NE	NE	NE	NE	
C. Incineration and open burning of waste	**17.0846**	**0.3506**	**0.0062**	**0.1713**	**2.9958**	**0.0662**	**0.0061**
1. Waste incineration	NO	NO	NO	NO	NO	NO	NO
2. Open burning of waste	17.0846	0.3506	0.0062	0.1713	2.9958	0.0662	0.0061
D. Wastewater treatment and discharge		**11.3807**	**0.2342**	**NA, IE**	**NA, IE**	**0.0155**	
1. Domestic wastewater		9.9595	0.2342	NA	NA	0.0155	
2. Industrial wastewater		1.4213	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)						
Total waste	**17.0578**	**59.1454**	**0.2353**	**0.1710**	**2.9899**	**1.2123**	**0.0060**
A. Solid waste disposal	**NA, NO**	**47.8091**		**NA, NO**	**NA, NO**	**1.1343**	
1. Managed waste disposal sites	NA, NO	15.7292		NA, NO	NA	0.3732	
2. Unmanaged waste disposal sites	NA, NO	32.0799		NA, NO	NA	0.7611	
3. Uncategorized waste disposal sites	NO	NO		NO	NO	NO	
B. Biological treatment of solid waste		**NO, NE**	**NO, NE**	**NO, NE**	**NO, NE**	**NO, NE**	
1. Composting		NO	NO	NO	NO	NO	
2. Anaerobic digestion at biogas facilities		NE	NE	NE	NE	NE	
C. Incineration and open burning of waste	**17.0578**	**0.3500**	**0.0061**	**0.1710**	**2.9899**	**0.0661**	**0.0060**
1. Waste incineration	NO	NO	NO	NO	NO	NO	NO
2. Open burning of waste	17.0578	0.3500	0.0061	0.1710	2.9899	0.0661	0.0060
D. Wastewater treatment and discharge		**10.9864**	**0.2292**	**NA, IE**	**NA, IE**	**0.0119**	
1. Domestic wastewater		9.9796	0.2292	NA	NA	0.0119	
2. Industrial wastewater		1.0068	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)						
Total waste	**17.0226**	**58.1191**	**0.2408**	**0.1706**	**2.9825**	**1.2088**	**0.0060**
A. Solid waste disposal	**NA, NO**	**46.7813**		**NA, NO**	**NA, NO**	**1.1318**	
1. Managed waste disposal sites	NA, NO	14.8765		NA, NO	NA	0.3599	
2. Unmanaged waste disposal sites	NA, NO	31.9049		NA, NO	NA	0.7719	
3. Uncategorized waste disposal sites	NO	NO		NO	NO	NO	
B. Biological treatment of solid waste		**NO, NE**	**NO, NE**	**NO, NE**	**NO, NE**	**NO, NE**	
1. Composting		NO	NO	NO	NO	NO	
2. Anaerobic digestion at biogas facilities		NE	NE	NE	NE	NE	
C. Incineration and open burning of waste	**17.0226**	**0.3492**	**0.0061**	**0.1706**	**2.9825**	**0.0659**	**0.0060**
1. Waste incineration	NO	NO	NO	NO	NO	NO	NO
2. Open burning of waste	17.0226	0.3492	0.0061	0.1706	2.9825	0.0659	0.0060
D. Wastewater treatment and discharge		**10.9886**	**0.2346**	**NA, IE**	**NA, IE**	**0.0111**	
1. Domestic wastewater		9.9711	0.2346	NA	NA	0.0111	
2. Industrial wastewater		1.0175	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)						
Total waste	**17.0025**	**57.0030**	**0.2434**	**0.1703**	**2.9776**	**1.0956**	**0.0060**
A. Solid waste disposal	**NA, NO**	**45.4990**		**NA, NO**	**NA, NO**	**1.0191**	
1. Managed waste disposal sites	NA, NO	14.5142		NA, NO	NA	0.3251	
2. Unmanaged waste disposal sites	NA, NO	30.9848		NA, NO	NA	0.6940	
3. Uncategorized waste disposal sites	NO	NO		NO	NO	NO	
B. Biological treatment of solid waste		**NO, NE**	**NO, NE**	**NO, NE**	**NO, NE**	**NO, NE**	
1. Composting		NO	NO	NO	NO	NO	
2. Anaerobic digestion at biogas facilities		NE	NE	NE	NE	NE	
C. Incineration and open burning of waste	**17.0025**	**0.3487**	**0.0061**	**0.1703**	**2.9776**	**0.0658**	**0.0060**
1. Waste incineration	NO	NO	NO	NO	NO	NO	NO
2. Open burning of waste	17.0025	0.3487	0.0061	0.1703	2.9776	0.0658	0.0060
D. Wastewater treatment and discharge		**11.1552**	**0.2373**	**NA, IE**	**NA, IE**	**0.0106**	
1. Domestic wastewater		9.8779	0.2373	NA	NA	0.0106	
2. Industrial wastewater		1.2773	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)						
Total waste	**16.9466**	**55.6389**	**0.2495**	**0.1697**	**2.9664**	**1.1541**	**0.0060**
A. Solid waste disposal	**NA, NO**	**44.3224**		**NA, NO**	**NA, NO**	**1.0781**	
1. Managed waste disposal sites	NA, NO	14.1832		NA, NO	NA	0.3450	
2. Unmanaged waste disposal sites	NA, NO	30.1392		NA, NO	NA	0.7331	
3. Uncategorized waste disposal sites	NO	NO		NO	NO	NO	
B. Biological treatment of solid waste		**NO, NE**	**NO, NE**	**NO, NE**	**NO, NE**	**NO, NE**	
1. Composting		NO	NO	NO	NO	NO	
2. Anaerobic digestion at biogas facilities		NE	NE	NE	NE	NE	
C. Incineration and open burning of waste	**16.9466**	**0.3475**	**0.0061**	**0.1697**	**2.9664**	**0.0656**	**0.0060**
1. Waste incineration	NO	NO	NO	NO	NO	NO	NO
2. Open burning of waste	16.9466	0.3475	0.0061	0.1697	2.9664	0.0656	0.0060
D. Wastewater treatment and discharge		**10.9689**	**0.2434**	**NA, IE**	**NA, IE**	**0.0104**	
1. Domestic wastewater		9.8249	0.2434	NA	NA	0.0104	
2. Industrial wastewater		1.1441	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)						
Total waste	**16.8812**	**54.3324**	**0.2412**	**0.1690**	**2.9534**	**1.3071**	**0.0060**
A. Solid waste disposal	**NA, NO**	**42.8093**		**NA, NO**	**NA, NO**	**1.2315**	
1. Managed waste disposal sites	NA, NO	13.0997		NA, NO	NA	0.3769	
2. Unmanaged waste disposal sites	NA, NO	29.7097		NA, NO	NA	0.8547	
3. Uncategorized waste disposal sites	NO	NO		NO	NO	NO	
B. Biological treatment of solid waste		**NO, NE**	**NO, NE**	**NO, NE**	**NO, NE**	**NO, NE**	
1. Composting		NO	NO	NO	NO	NO	
2. Anaerobic digestion at biogas facilities		NE	NE	NE	NE	NE	
C. Incineration and open burning of waste	**16.8812**	**0.3461**	**0.0061**	**0.1690**	**2.9534**	**0.0653**	**0.0060**
1. Waste incineration	NO	NO	NO	NO	NO	NO	NO
2. Open burning of waste	16.8812	0.3461	0.0061	0.1690	2.9534	0.0653	0.0060
D. Wastewater treatment and discharge		**11.1769**	**0.2351**	**NA, IE**	**NA, IE**	**0.0103**	
1. Domestic wastewater		9.7559	0.2351	NA	NA	0.0103	
2. Industrial wastewater		1.4210	IE	IE	IE	IE	
3. Other		NA	NA	NA	NA	NA	
E. Other	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**
Memo item:							

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2	CH_4	N_2O	NO_x	CO	NMVOC	SO_2
	(kt)						
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)						
Total waste	**16.8147**	**53.7943**	**0.2513**	**0.1683**	**2.9402**	**1.3947**	**0.0060**
A. Solid waste disposal	**NA, NO**	**42.2061**		**NA, NO**	**NA, NO**	**1.3194**	
1. Managed waste disposal sites	NA, NO	12.4086		NA, NO	NA	0.3879	
2. Unmanaged waste disposal sites	NA, NO	29.7975		NA, NO	NA	0.9315	
3. Uncategorized waste disposal sites	NO	NO		NO	NO	NO	
B. Biological treatment of solid waste		**NO, NE**	**NO, NE**	**NO, NE**	**NO, NE**	**NO, NE**	
1. Composting		NO	NO	NO	NO	NO	
2. Anaerobic digestion at biogas facilities		NE	NE	NE	NE	NE	
C. Incineration and open burning of waste	**16.8147**	**0.3447**	**0.0061**	**0.1683**	**2.9402**	**0.0650**	**0.0060**
1. Waste incineration	NO	NO	NO	NO	NO	NO	NO
2. Open burning of waste	16.8147	0.3447	0.0061	0.1683	2.9402	0.0650	0.0060
D. Wastewater treatment and discharge		**11.2435**	**0.2453**	**NA, IE**	**NA, IE**	**0.0103**	
1. Domestic wastewater		9.7365	0.2453	NA	NA	0.0103	
2. Industrial wastewater		1.5070	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)						
Total waste	**15.8340**	**53.5909**	**0.2455**	**0.1584**	**2.7653**	**1.5487**	**0.0057**
A. Solid waste disposal	**NA, NO**	**42.5723**		**NA, NO**	**NA, NO**	**1.4772**	
1. Managed waste disposal sites	NA, NO	12.0480		NA, NO	NA	0.4180	
2. Unmanaged waste disposal sites	NA, NO	30.5244		NA, NO	NA	1.0591	
3. Uncategorized waste disposal sites	NO	NO		NO	NO	NO	
B. Biological treatment of solid waste		**NO, NE**	**NO, NE**	**NO, NE**	**NO, NE**	**NO, NE**	
1. Composting		NO	NO	NO	NO	NO	
2. Anaerobic digestion at biogas facilities		NE	NE	NE	NE	NE	
C. Incineration and open burning of waste	**15.8340**	**0.3245**	**0.0057**	**0.1584**	**2.7653**	**0.0612**	**0.0057**
1. Waste incineration	NO	NO	NO	NO	NO	NO	NO
2. Open burning of waste	15.8340	0.3245	0.0057	0.1584	2.7653	0.0612	0.0057
D. Wastewater treatment and discharge		**10.6940**	**0.2398**	**NA, IE**	**NA, IE**	**0.0103**	
1. Domestic wastewater		8.9790	0.2398	NA	NA	0.0103	
2. Industrial wastewater		1.7150	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)						
Total waste	**15.8420**	**53.2662**	**0.2420**	**0.1584**	**2.7651**	**1.6772**	**0.0057**
A. Solid waste disposal	**NA, NO**	**42.4737**		**NA, NO**	**NA, NO**	**1.6057**	
1. Managed waste disposal sites	NA, NO	11.5529		NA, NO	NA	0.4368	
2. Unmanaged waste disposal sites	NA, NO	30.9209		NA, NO	NA	1.1690	
3. Uncategorized waste disposal sites	NO	NO		NO	NO	NO	
B. Biological treatment of solid waste		**NO, NE**	**NO, NE**	**NO, NE**	**NO, NE**	**NO, NE**	
1. Composting		NO	NO	NO	NO	NO	
2. Anaerobic digestion at biogas facilities		NE	NE	NE	NE	NE	
C. Incineration and open burning of waste	**15.8420**	**0.3246**	**0.0057**	**0.1584**	**2.7651**	**0.0612**	**0.0057**
1. Waste incineration	NO	NO	NO	NO	NO	NO	NO
2. Open burning of waste	15.8420	0.3246	0.0057	0.1584	2.7651	0.0612	0.0057

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2	CH_4	N_2O	NO_x	CO	NMVOC	SO_2
	(kt)						
D. Wastewater treatment and discharge		**10.4679**	**0.2363**	**NA, IE**	**NA, IE**	**0.0103**	
1. Domestic wastewater		8.9341	0.2363	NA	NA	0.0103	
2. Industrial wastewater		1.5338	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)						
Total waste	**15.9412**	**53.3414**	**0.2345**	**0.1594**	**2.7809**	**2.1003**	**0.0057**
A. Solid waste disposal	**NA, NO**	**42.5929**		**NA, NO**	**NA, NO**	**2.0285**	
1. Managed waste disposal sites	NA, NO	13.1186		NA, NO	NA	0.6248	
2. Unmanaged waste disposal sites	NA, NO	29.4743		NA, NO	NA	1.4038	
3. Uncategorized waste disposal sites	NO	NO		NO	NO	NO	
B. Biological treatment of solid waste		**NO, NE**	**NO, NE**	**NO, NE**	**NO, NE**	**NO, NE**	
1. Composting		NO	NO	NO	NO	NO	
2. Anaerobic digestion at biogas facilities		NE	NE	NE	NE	NE	
C. Incineration and open burning of waste	**15.9412**	**0.3266**	**0.0057**	**0.1594**	**2.7809**	**0.0616**	**0.0057**
1. Waste incineration	NO	NO	NO	NO	NO	NO	NO
2. Open burning of waste	15.9412	0.3266	0.0057	0.1594	2.7809	0.0616	0.0057
D. Wastewater treatment and discharge		**10.4219**	**0.2288**	**NA, IE**	**NA, IE**	**0.0102**	
1. Domestic wastewater		8.9871	0.2288	NA	NA	0.0102	
2. Industrial wastewater		1.4349	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)						
Total waste	**15.8898**	**54.0976**	**0.2354**	**0.1588**	**2.7699**	**2.3951**	**0.0057**
A. Solid waste disposal	**NA, NO**	**43.3679**		**NA, NO**	**NA, NO**	**2.3236**	
1. Managed waste disposal sites	NA, NO	14.6583		NA, NO	NA	0.7854	
2. Unmanaged waste disposal sites	NA, NO	28.7095		NA, NO	NA	1.5382	
3. Uncategorized waste disposal sites	NO	NO		NO	NO	NO	
B. Biological treatment of solid waste		**NO, NE**	**NO, NE**	**NO, NE**	**NO, NE**	**NO, NE**	
1. Composting		NO	NO	NO	NO	NO	
2. Anaerobic digestion at biogas facilities		NE	NE	NE	NE	NE	
C. Incineration and open burning of waste	**15.8898**	**0.3254**	**0.0057**	**0.1588**	**2.7699**	**0.0613**	**0.0057**
1. Waste incineration	NO	NO	NO	NO	NO	NO	NO
2. Open burning of waste	15.8898	0.3254	0.0057	0.1588	2.7699	0.0613	0.0057
D. Wastewater treatment and discharge		**10.4043**	**0.2297**	**NA, IE**	**NA, IE**	**0.0102**	
1. Domestic wastewater		8.9331	0.2297	NA	NA	0.0102	
2. Industrial wastewater		1.4712	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)						
Total waste	**15.8568**	**54.8247**	**0.2221**	**0.1584**	**2.7622**	**2.1790**	**0.0057**
A. Solid waste disposal	**NA, NO**	**44.6020**		**NA, NO**	**NA, NO**	**2.1076**	
1. Managed waste disposal sites	NA, NO	15.9675		NA, NO	NA	0.7545	
2. Unmanaged waste disposal sites	NA, NO	28.6345		NA, NO	NA	1.3531	
3. Uncategorized waste disposal sites	NO	NO		NO	NO	NO	

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2	CH_4	N_2O	NO_x	CO	NMVOC	SO_2
	(kt)						
B. Biological treatment of solid waste		**NO, NE**	**NO, NE**	**NO, NE**	**NO, NE**	**NO, NE**	
1. Composting		NO	NO	NO	NO	NO	
2. Anaerobic digestion at biogas facilities		NE	NE	NE	NE	NE	
C. Incineration and open burning of waste	**15.8568**	**0.3247**	**0.0057**	**0.1584**	**2.7622**	**0.0612**	**0.0057**
1. Waste incineration	NO	NO	NO	NO	NO	NO	NO
2. Open burning of waste	15.8568	0.3247	0.0057	0.1584	2.7622	0.0612	0.0057
D. Wastewater treatment and discharge		**9.8980**	**0.2164**	**NA, IE**	**NA, IE**	**0.0102**	
1. Domestic wastewater		8.8986	0.2164	NA	NA	0.0102	
2. Industrial wastewater		0.9994	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)						
Total waste	**15.8271**	**55.9225**	**0.2329**	**0.1581**	**2.7549**	**2.0077**	**0.0057**
A. Solid waste disposal	**NA, NO**	**45.5140**		**NA, NO**	**NA, NO**	**1.9364**	
1. Managed waste disposal sites	NA, NO	17.7504		NA, NO	NA	0.7552	
2. Unmanaged waste disposal sites	NA, NO	27.7635		NA, NO	NA	1.1812	
3. Uncategorized waste disposal sites	NO	NO		NO	NO	NO	
B. Biological treatment of solid waste		**NO, NE**	**NO, NE**	**NO, NE**	**NO, NE**	**NO, NE**	
1. Composting		NO	NO	NO	NO	NO	
2. Anaerobic digestion at biogas facilities		NE	NE	NE	NE	NE	
C. Incineration and open burning of waste	**15.8271**	**0.3240**	**0.0057**	**0.1581**	**2.7549**	**0.0610**	**0.0057**
1. Waste incineration	NO	NO	NO	NO	NO	NO	NO
2. Open burning of waste	15.8271	0.3240	0.0057	0.1581	2.7549	0.0610	0.0057
D. Wastewater treatment and discharge		**10.0845**	**0.2272**	**NA, IE**	**NA, IE**	**0.0102**	
1. Domestic wastewater		8.8733	0.2272	NA	NA	0.0102	
2. Industrial wastewater		1.2112	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)						
Total waste	**15.8962**	**56.6537**	**0.2304**	**0.1582**	**2.7486**	**2.0361**	**0.0058**
A. Solid waste disposal	**NA, NO**	**46.2032**		**NA, NO**	**NA, NO**	**1.9649**	
1. Managed waste disposal sites	NA, NO	18.5275		NA, NO	NA	0.7879	
2. Unmanaged waste disposal sites	NA, NO	27.6757		NA, NO	NA	1.1770	
3. Uncategorized waste disposal sites	NO	NO		NO	NO	NO	
B. Biological treatment of solid waste		**NO, NE**	**NO, NE**	**NO, NE**	**NO, NE**	**NO, NE**	
1. Composting		NO	NO	NO	NO	NO	
2. Anaerobic digestion at biogas facilities		NE	NE	NE	NE	NE	
C. Incineration and open burning of waste	**15.8962**	**0.3248**	**0.0057**	**0.1582**	**2.7486**	**0.0611**	**0.0058**
1. Waste incineration	NO	NO	NO	NO	NO	NO	NO
2. Open burning of waste	15.8962	0.3248	0.0057	0.1582	2.7486	0.0611	0.0058
D. Wastewater treatment and discharge		**10.1257**	**0.2247**	**NA, IE**	**NA, IE**	**0.0102**	
1. Domestic wastewater		8.8387	0.2247	NA	NA	0.0102	
2. Industrial wastewater		1.2870	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)						
Total waste	**15.8744**	**56.2859**	**0.2285**	**0.1580**	**2.7443**	**2.0122**	**0.0058**
A. Solid waste disposal	**NA, NO**	**45.7446**		**NA, NO**	**NA, NO**	**1.9411**	
1. Managed waste disposal sites	NA, NO	18.2979		NA, NO	NA	0.7764	
2. Unmanaged waste disposal sites	NA, NO	27.4468		NA, NO	NA	1.1646	
3. Uncategorized waste disposal sites	NO	NO		NO	NO	NO	
B. Biological treatment of solid waste		**NO, NE**	**NO, NE**	**NO, NE**	**NO, NE**	**NO, NE**	
1. Composting		NO	NO	NO	NO	NO	
2. Anaerobic digestion at biogas facilities		NE	NE	NE	NE	NE	
C. Incineration and open burning of waste	**15.8744**	**0.3243**	**0.0057**	**0.1580**	**2.7443**	**0.0610**	**0.0058**
1. Waste incineration	NO	NO	NO	NO	NO	NO	NO
2. Open burning of waste	15.8744	0.3243	0.0057	0.1580	2.7443	0.0610	0.0058
D. Wastewater treatment and discharge		**10.2170**	**0.2228**	**NA, IE**	**NA, IE**	**0.0101**	
1. Domestic wastewater		8.8564	0.2228	NA	NA	0.0101	
2. Industrial wastewater		1.3605	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)						
Total waste	**15.8530**	**54.1182**	**0.2307**	**0.1578**	**2.7406**	**2.1773**	**0.0058**
A. Solid waste disposal	**NA, NO**	**43.3907**		**NA, NO**	**NA, NO**	**2.1063**	
1. Managed waste disposal sites	NA, NO	16.4017		NA, NO	NA	0.7962	
2. Unmanaged waste disposal sites	NA, NO	26.9890		NA, NO	NA	1.3101	
3. Uncategorized waste disposal sites	NO	NO		NO	NO	NO	
B. Biological treatment of solid waste		**NO, NE**	**NO, NE**	**NO, NE**	**NO, NE**	**NO, NE**	
1. Composting		NO	NO	NO	NO	NO	
2. Anaerobic digestion at biogas facilities		NE	NE	NE	NE	NE	
C. Incineration and open burning of waste	**15.8530**	**0.3239**	**0.0057**	**0.1578**	**2.7406**	**0.0609**	**0.0058**
1. Waste incineration	NO	NO	NO	NO	NO	NO	NO
2. Open burning of waste	15.8530	0.3239	0.0057	0.1578	2.7406	0.0609	0.0058
D. Wastewater treatment and discharge		**10.4036**	**0.2250**	**NA, IE**	**NA, IE**	**0.0101**	
1. Domestic wastewater		8.8209	0.2250	NA	NA	0.0101	
2. Industrial wastewater		1.5827	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)						
Total waste	**15.8047**	**54.0294**	**0.2333**	**0.1574**	**2.7351**	**2.3033**	**0.0058**
A. Solid waste disposal	**NA, NO**	**43.3232**		**NA, NO**	**NA, NO**	**2.2326**	
1. Managed waste disposal sites	NA, NO	15.7263		NA, NO	NA	0.8104	
2. Unmanaged waste disposal sites	NA, NO	27.5969		NA, NO	NA	1.4222	
3. Uncategorized waste disposal sites	NO	NO		NO	NO	NO	
B. Biological treatment of solid waste		**NO, NE**	**NO, NE**	**NO, NE**	**NO, NE**	**NO, NE**	
1. Composting		NO	NO	NO	NO	NO	
2. Anaerobic digestion at biogas facilities		NE	NE	NE	NE	NE	
C. Incineration and open burning of waste	**15.8047**	**0.3230**	**0.0057**	**0.1574**	**2.7351**	**0.0607**	**0.0058**
1. Waste incineration	NO	NO	NO	NO	NO	NO	NO
2. Open burning of waste	15.8047	0.3230	0.0057	0.1574	2.7351	0.0607	0.0058
D. Wastewater treatment and discharge		**10.3832**	**0.2276**	**NA, IE**	**NA, IE**	**0.0100**	
1. Domestic wastewater		8.8055	0.2276	NA	NA	0.0100	
2. Industrial wastewater		1.5776	IE	IE	IE	IE	
3. Other		NA	NA	NA	NA	NA	
E. Other	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2	CH_4	N_2O	NO_x	CO	NMVOC	SO_2
	(kt)						
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)						
Total waste	**15.6434**	**53.8343**	**0.2342**	**0.1559**	**2.7094**	**2.3056**	**0.0057**
A. Solid waste disposal	**NA, NO**	**43.4869**		**NA, NO**	**NA, NO**	**2.2355**	
1. Managed waste disposal sites	NA, NO	17.0034		NA, NO	NA	0.8741	
2. Unmanaged waste disposal sites	NA, NO	26.4835		NA, NO	NA	1.3614	
3. Uncategorized waste disposal sites	NO	NO		NO	NO	NO	
B. Biological treatment of solid waste		**NO, NE**	**NO, NE**	**NO, NE**	**NO, NE**	**NO, NE**	
1. Composting		NO	NO	NO	NO	NO	
2. Anaerobic digestion at biogas facilities		NE	NE	NE	NE	NE	
C. Incineration and open burning of waste	**15.6434**	**0.3198**	**0.0056**	**0.1559**	**2.7094**	**0.0602**	**0.0057**
1. Waste incineration	NO	NO	NO	NO	NO	NO	NO
2. Open burning of waste	15.6434	0.3198	0.0056	0.1559	2.7094	0.0602	0.0057
D. Wastewater treatment and discharge		**10.0277**	**0.2286**	**NA, IE**	**NA, IE**	**0.0100**	
1. Domestic wastewater		8.7070	0.2286	NA	NA	0.0100	
2. Industrial wastewater		1.3207	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)						
Total waste	**15.4600**	**54.9955**	**0.2347**	**0.1541**	**2.6797**	**2.0983**	**0.0056**
A. Solid waste disposal	**NA, NO**	**44.6069**		**NA, NO**	**NA, NO**	**2.0288**	
1. Managed waste disposal sites	NA, NO	17.6134		NA, NO	NA	0.8011	
2. Unmanaged waste disposal sites	NA, NO	26.9935		NA, NO	NA	1.2277	
3. Uncategorized waste disposal sites	NO	NO		NO	NO	NO	
B. Biological treatment of solid waste		**NO, NE**	**NO, NE**	**NO, NE**	**NO, NE**	**NO, NE**	
1. Composting		NO	NO	NO	NO	NO	
2. Anaerobic digestion at biogas facilities		NE	NE	NE	NE	NE	
C. Incineration and open burning of waste	**15.4600**	**0.3161**	**0.0056**	**0.1541**	**2.6797**	**0.0595**	**0.0056**
1. Waste incineration	NO	NO	NO	NO	NO	NO	NO
2. Open burning of waste	15.4600	0.3161	0.0056	0.1541	2.6797	0.0595	0.0056
D. Wastewater treatment and discharge		**10.0725**	**0.2291**	**NA, IE**	**NA, IE**	**0.0100**	
1. Domestic wastewater		8.6269	0.2291	NA	NA	0.0100	
2. Industrial wastewater		1.4456	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 1990-2016

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	**35170.1483**	**203.0080**	**10.5565**	**NO**	**NO**	**NO**	**NO**	**NO**	**94.9462**	**283.3446**	**141.4089**	**157.0987**
1. Energy	**35280.7915**	**39.1313**	**1.1793**						**91.0406**	**271.4048**	**31.6819**	**155.7638**
A. Fuel combustion Reference approach	35068.3279											
Sectoral approach	35280.1538	13.5063	0.6293						91.0406	271.4048	31.1002	155.7638
1. Energy industries	21244.3119	0.4903	0.1733						39.3776	7.1710	0.6271	102.3604
2. Manufacturing industries and construction	2204.8457	0.0985	0.0171						11.0992	3.7377	0.9764	2.8767
3. Transport	4344.7615	1.3226	0.3410						18.3508	71.4239	8.8402	5.1891
4. Other sectors	7372.2624	11.5841	0.0935						21.4533	188.2435	20.5339	44.9266
5. Other	113.9722	0.0109	0.0044						0.7597	0.8286	0.1226	0.4110
B. Fugitive emissions from fuels	0.6377	25.6250	0.5500						0.0000	0.0000	0.5817	0.0000
1. Solid fuels	NO	NO	NO						NO	NO	NO	NO
2. Oil and natural gas and other emissions from energy production	0.6377	25.6250	0.5500						0.0000	0.0000	0.5817	0.0000
C. CO_2 Transport and storage	NO											
2. Industrial processes and product use	**1572.2808**	**NO**	**0.0001**	**NO**	**NO**	**NO**	**NO**	**NO**	**3.6380**	**5.4100**	**106.6288**	**1.3289**
A. Mineral industry	1306.2407								3.4824	3.3540	0.0339	1.2645
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	3.1787	NO	0.0001	NO	NO	NO	NO	NO	0.0197	0.6017	1.4449	NO
H. Other									NO	NO	12.2544	NO
3. Agriculture	**0.5820**	**107.4316**	**8.5040**						**NO**	**NO**	**NE, NO**	
A. Enteric fermentation		87.6278										
B. Manure management		19.8038	3.7470								NO	
C. Rice cultivation		NO										
D. Agricultural soils			4.7570									
E. Prescribed burning of savannas		NO	NO						NO	NO	NO	
F. Field burning of agricultural residues		IE	IE						IE	IE	NO, NE	
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	**-1700.6120**	**0.1061**	**0.5717**						**0.0959**	**3.5227**	**NE**	
A. Forest land	-2563.4328	0.0083	0.0005						0.0053	0.1887	NE	
B. Cropland	2508.9630	0.0978	0.0350						0.0906	3.3340	NE	
C. Grassland	-1205.6938	NE	NE						NE	NE	NE	
D. Wetlands	-555.3798	NE	NE						NE	NE	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)			
E. Settlements	84.7480	NE	0.5362						NE	NE	NE	
F. Other land	152.3638	NE	NE						NE	NE	NE	
G. Harvested wood products	-122.1804											
H. Other	NO	NO	NO						NO	NO	NO	
5. Waste	**17.1060**	**56.3390**	**0.3013**						**0.1717**	**3.0071**	**3.0982**	**0.0060**
A. Solid waste disposal	NA, NO	41.8691							NA, NO	NA, NO	2.9908	
B. Biological treatment of solid waste		NO, NE	NO, NE						NO, NE	NO, NE	NO, NE	
C. Incineration and open burning of waste	17.1060	0.3513	0.0062						0.1717	3.0071	0.0664	0.0060
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	**216.5837**	**0.0105**	**0.0070**						**0.8905**	**0.5270**	**0.2334**	**0.0687**
Aviation	216.5837	0.0105	0.0070						0.8905	0.5270	0.2334	0.0687
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	NO											
Indirect N_2O			**1.9635**									
Indirect CO_2	**207.3247**											

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	**30196.2180**	**200.0984**	**10.0258**	**NO**	**NO**	**NO**	**NO**	**NO**	**83.7669**	**266.2526**	**120.3062**	**142.3319**
1. Energy	**31560.0966**	**44.2135**	**1.0207**						**80.1554**	**255.1241**	**29.4152**	**141.0744**
A. Fuel combustion Reference approach	31331.7444											
Sectoral approach	31559.4826	13.7209	0.5386						80.1554	255.1241	28.8714	141.0744
1. Energy industries	18873.0209	0.4220	0.1562						34.9804	6.3731	0.5490	90.5222
2. Manufacturing industries and construction	1485.7792	0.0631	0.0113						8.0111	1.9356	0.6185	1.3614
3. Transport	3299.6478	0.9966	0.2721						15.9307	64.7274	8.0260	3.8891
4. Other sectors	7794.6662	12.2320	0.0956						20.5753	181.4709	19.5923	44.9417
5. Other	106.3685	0.0072	0.0034						0.6579	0.6170	0.0855	0.3599
B. Fugitive emissions from fuels	0.6140	30.4926	0.4822						0.0000	0.0000	0.5438	0.0000
1. Solid fuels	NO	NO	NO						NO	NO	NO	NO
2. Oil and natural gas and other emissions from energy production	0.6140	30.4926	0.4822						0.0000	0.0000	0.5438	0.0000
C. CO_2 Transport and storage	NO											
2. Industrial processes and product use	**1394.6352**	**NO**	**0.0001**	**NO**	**NO**	**NO**	**NO**	**NO**	**3.3511**	**4.8635**	**87.9714**	**1.2515**
A. Mineral industry	1173.7238								3.2148	3.0021	0.0315	1.1965
B. Chemical industry	NO	NO	NO						NO	NO	0.0544	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)			
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	2.8632	NO	0.0001	NO	NO	NO	NO	NO	0.0199	0.6083	1.3014	NO
H. Other									NO	NO	10.2883	NO
3. Agriculture	**0.5226**	**97.8292**	**8.1094**						**NO**	**NO**	**NE, NO**	
A. Enteric fermentation		81.2260										
B. Manure management		16.6032	3.4991									
C. Rice cultivation		NO										
D. Agricultural soils			4.6102									
E. Prescribed burning of savannas		NO	NO						NO	NO	NO	
F. Field burning of agricultural residues		IE	IE						IE	IE	NO, NE	
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	**-2776.1620**	**0.0960**	**0.6171**						**0.0885**	**3.2552**	**NE**	
A. Forest land	-2343.3131	0.0014	0.0001						0.0009	0.0316	NE	
B. Cropland	1380.4637	0.0946	0.0335						0.0876	3.2236	NE	
C. Grassland	-1414.3167	NE	NE						NE	NE	NE	
D. Wetlands	-526.4627	NE	NE						NE	NE	NE	
E. Settlements	88.7139	NE	0.5835						NE	NE	NE	
F. Other land	152.3638	NE	NE						NE	NE	NE	
G. Harvested wood products	-113.6108											
H. Other	NO	NO	NO						NO	NO	NO	
5. Waste	**17.1256**	**57.9597**	**0.2786**						**0.1719**	**3.0098**	**2.9196**	**0.0060**
A. Solid waste disposal	NA, NO	43.9447							NA, NO	NA, NO	2.8159	
B. Biological treatment of solid waste		NO, NE	NO, NE						NO, NE	NO, NE	NO, NE	
C. Incineration and open burning of waste	17.1256	0.3516	0.0062						0.1719	3.0098	0.0664	0.0060
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	**232.8535**	**0.0113**	**0.0075**						**0.9574**	**0.5666**	**0.2510**	**0.0738**
Aviation	232.8535	0.0113	0.0075						0.9574	0.5666	0.2510	0.0738
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	NO											
Indirect N_2O			**1.8193**									
Indirect CO_2	**170.6429**											

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	**23688.7639**	**188.9530**	**8.4444**	**NO**	**NO**	**NO**	**NO**	**NO**	**61.6793**	**147.6510**	**91.5110**	**102.2872**
1. Energy	**25040.7269**	**35.8458**	**0.6834**						**59.6389**	**138.2917**	**16.3771**	**101.6319**
A. Fuel combustion Reference approach	24946.0303											
Sectoral approach	25040.2094	8.2415	0.3994						59.6389	138.2917	15.8840	101.6319
1. Energy industries	15608.8471	0.3570	0.1218						28.6709	5.5397	0.4738	71.2475
2. Manufacturing industries and construction	1064.8093	0.0456	0.0080						5.5713	1.4481	0.4536	1.0216
3. Transport	2320.9288	0.6971	0.2057						10.5582	31.7322	4.0838	2.7653
4. Other sectors	5967.8768	7.1372	0.0616						14.3609	99.2287	10.8213	26.3830
5. Other	77.7474	0.0046	0.0023						0.4776	0.3429	0.0514	0.2146
B. Fugitive emissions from fuels	0.5175	27.6043	0.2840						0.0000	0.0000	0.4931	0.0000
1. Solid fuels	NO	NO	NO						NO	NO	NO	NO
2. Oil and natural gas and other emissions from energy production	0.5175	27.6043	0.2840						0.0000	0.0000	0.4931	0.0000
C. CO_2 Transport and storage	NO											
2. Industrial processes and product use	**808.8996**	**NO**	**0.0001**	**NO**	**NO**	**NO**	**NO**	**NO**	**1.7876**	**3.3721**	**72.3206**	**0.6493**
A. Mineral industry	628.3873								1.6607	1.6135	0.0165	0.5982
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	2.2573	NO	0.0001	NO	NO	NO	NO	NO	0.0186	0.5686	1.0260	NO
H. Other									NO	NO	8.2577	NO
3. Agriculture	**0.3905**	**94.7068**	**6.8184**						**NO**	**NO**	**NE, NO**	
A. Enteric fermentation		79.7785										
B. Manure management		14.9283	3.1392								NO	
C. Rice cultivation		NO										
D. Agricultural soils			3.6792									
E. Prescribed burning of savannas		NO	NO						NO	NO	NO	
F. Field burning of agricultural residues		IE	IE						IE	IE	NO, NE	
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	**-2178.3822**	**0.0879**	**0.6868**						**0.0809**	**2.9777**	**NE**	
A. Forest land	-2184.2404	0.0015	0.0001						0.0010	0.0346	NE	
B. Cropland	1318.7877	0.0864	0.0321						0.0800	2.9431	NE	
C. Grassland	-1428.4835	NE	NE						NE	NE	NE	
D. Wetlands	-595.5455	NE	NE						NE	NE	NE	
E. Settlements	386.6196	NE	0.6545						NE	NE	NE	
F. Other land	418.7786	NE	NE						NE	NE	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)			
G. Harvested wood products	-94.2986											
H. Other	NO	NO	NO						NO	NO	NO	
5. Waste	**17.1291**	**58.3125**	**0.2558**						**0.1719**	**3.0096**	**2.8134**	**0.0060**
A. Solid waste disposal	NA, NE	45.6782							NA, NO	NA, NO	2.7135	
B. Biological treatment of solid waste		NO, NE	NO, NE						NO, NE	NO, NE	NO, NE	
C. Incineration and open burning of waste	17.1291	0.3517	0.0062						0.1719	3.0096	0.0664	0.0060
D. Wastewater treatment and discharge		12.2826	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	**96.2944**	**0.0047**	**0.0031**						**0.3959**	**0.2343**	**0.1038**	**0.0305**
Aviation	96.2944	0.0047	0.0031						0.3959	0.2343	0.1038	0.0305
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	NO											
Indirect N_2O			**1.5183**									
Indirect CO_2	**140.7804**											

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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	**15865.1656**	**174.5446**	**8.4261**	**NO**	**NO**	**NO**	**NO**	**NO**	**49.5001**	**71.9930**	**70.7995**	**75.3756**
1. Energy	**17349.6063**	**27.4350**	**0.4615**						**47.5279**	**61.7648**	**8.3876**	**74.7382**
A. Fuel combustion Reference approach	17288.4173											
Sectoral approach	17349.1681	2.6323	0.3112						47.5279	61.7648	7.9439	74.7382
1. Energy industries	12601.5386	0.2816	0.1057						23.5816	4.2083	0.3669	62.2741
2. Manufacturing industries and construction	682.7002	0.0297	0.0051						3.3714	1.0112	0.3028	0.7220
3. Transport	1699.5673	0.4721	0.1729						10.8208	24.8418	3.3466	2.1971
4. Other sectors	2271.9102	1.8431	0.0250						9.2951	31.0782	3.8422	9.1547
5. Other	93.4518	0.0058	0.0024						0.4591	0.6253	0.0853	0.3903
B. Fugitive emissions from fuels	0.4382	24.8026	0.1503						0.0000	0.0000	0.4437	0.0000
1. Solid fuels	NO	NO	NO						NO	NO	NO	NO
2. Oil and natural gas and other emissions from energy production	0.4382	24.8026	0.1503						0.0000	0.0000	0.4437	0.0000
C. CO_2 Transport and storage	NO											
2. Industrial processes and product use	**724.8725**	**NO**	**0.0001**	**NO**	**NO**	**NO**	**NO**	**NO**	**1.6915**	**3.2093**	**60.6455**	**0.6314**
A. Mineral industry	574.7172								1.5690	1.4535	0.0143	0.5827
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

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)			
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	1.8544	NO	0.0001	NO	NO	NO	NO	NO	0.0190	0.5819	0.8429	NO
H. Other									NO	NO	9.6360	NO
3. Agriculture	**0.1276**	**86.0110**	**6.9774**						**NO**	**NO**	**NE, NO**	
A. Enteric fermentation		75.0132										
B. Manure management		10.9978	2.7360								NO	
C. Rice cultivation		NO										
D. Agricultural soils			4.2414									
E. Prescribed burning of savannas		NO	NO						NO	NO	NO	
F. Field burning of agricultural residues		IE	IE						IE	IE	NO, NE	
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	**-2226.5422**	**0.1179**	**0.7469**						**0.1091**	**4.0151**	**NE**	
A. Forest land	-2193.5115	0.0001	0.0000						0.0001	0.0024	NE	
B. Cropland	1581.1497	0.1178	0.0328						0.1090	4.0127	NE	
C. Grassland	-1303.5202	NE	NE						NE	NE	NE	
D. Wetlands	-525.8447	NE	NE						NE	NE	NE	
E. Settlements	114.6181	NE	0.7141						NE	NE	NE	
F. Other land	164.0168	NE	NE						NE	NE	NE	
G. Harvested wood products	-63.4504											
H. Other	NO	NO	NO						NO	NO	NO	
5. Waste	**17.1013**	**60.9808**	**0.2403**						**0.1716**	**3.0038**	**1.7665**	**0.0060**
A. Solid waste disposal	NA, NO	48.1887							NA, NO	NA, NO	1.6703	
B. Biological treatment of solid waste		NO, NE	NO, NE						NO, NE	NO, NE	NO, NE	
C. Incineration and open burning of waste	17.1013	0.3511	0.0062						0.1716	3.0038	0.0663	0.0060
D. Wastewater treatment and discharge		12.4409	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	**62.1153**	**0.0030**	**0.0020**						**0.2554**	**0.1512**	**0.0669**	**0.0197**
Aviation	62.1153	0.0030	0.0020						0.2554	0.1512	0.0669	0.0197
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	NO											
Indirect N_2O			**1.4401**									
Indirect CO_2	**112.0762**											

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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	**12811.9109**	**171.0638**	**6.8750**	**NO**	**NO**	**NO**	**NO**	**NO**	**37.6185**	**76.1058**	**52.0801**	**59.9048**
1. Energy	**14385.1477**	**26.9908**	**0.2932**						**36.0499**	**68.0468**	**8.8374**	**59.3963**
A. Fuel combustion Reference approach	14347.7336											
Sectoral approach	14384.7392	3.1194	0.2216						36.0499	68.0468	8.4105	59.3963
1. Energy industries	9928.6683	0.1882	0.0871						18.7582	3.5339	0.2831	47.1205
2. Manufacturing industries and construction	791.2803	0.0203	0.0027						1.6523	0.7840	0.3410	0.4040
3. Transport	1485.6786	0.4245	0.1044						6.7086	22.3898	2.8852	1.7192
4. Other sectors	2090.7472	2.4795	0.0257						8.5983	40.7319	4.8148	9.8738
5. Other	88.3648	0.0069	0.0016						0.3325	0.6071	0.0863	0.2787
B. Fugitive emissions from fuels	0.4085	23.8714	0.0716						0.0000	0.0000	0.4269	0.0000
1. Solid fuels	NO	NO	NO						NO	NO	NO	NO
2. Oil and natural gas and other emissions from energy production	0.4085	23.8714	0.0716						0.0000	0.0000	0.4269	0.0000
C. CO_2 Transport and storage	NO											
2. Industrial processes and product use	**548.7445**	**NO**	**0.0001**	**NO**	**NO**	**NO**	**NO**	**NO**	**1.3361**	**2.8203**	**41.6403**	**0.5025**
A. Mineral industry	437.5899								1.2218	1.1320	0.0115	0.4572
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	1.3519	NO	0.0001	NO	NO	NO	NO	NO	0.0173	0.5290	0.6145	NO
H. Other									NO	NO	8.1775	NO
3. Agriculture	**0.0537**	**83.6261**	**5.5546**						**NO**	**NO**	**NE, NO**	
A. Enteric fermentation		73.0168										
B. Manure management		10.6093	2.6585								NO	
C. Rice cultivation		NO										
D. Agricultural soils			2.8961									
E. Prescribed burning of savannas		NO	NO						NO	NO	NO	
F. Field burning of agricultural residues		IE	IE						IE	IE	NO, NE	
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	**-2139.1679**	**0.0662**	**0.7938**						**0.0606**	**2.2302**	**NE**	
A. Forest land	-2108.0022	0.0023	0.0001						0.0015	0.0526	NE	
B. Cropland	1378.5094	0.0639	0.0265						0.0592	2.1776	NE	
C. Grassland	-1577.3332	NE	NE						NE	NE	NE	
D. Wetlands	-497.6418	NE	NE						NE	NE	NE	
E. Settlements	130.4883	NE	0.7671						NE	NE	NE	
F. Other land	549.4579	NE	NE						NE	NE	NE	
G. Harvested wood products	-14.6464											

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)			
H. Other	NO	NO	NO						NO	NO	NO	
5. Waste	**17.1330**	**60.3807**	**0.2334**						**0.1719**	**3.0085**	**1.6024**	**0.0060**
A. Solid waste disposal	NA, NO	48.3920							NA, NO	NA, NO	1.5088	
B. Biological treatment of solid waste		NO, NE	NO, NE						NO, NE	NO, NE	NO, NE	
C. Incineration and open burning of waste	17.1330	0.3517	0.0062						0.1719	3.0085	0.0664	0.0060
D. Wastewater treatment and discharge		11.6369	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	**37.8367**	**0.0018**	**0.0012**						**0.1556**	**0.0921**	**0.0408**	**0.0120**
Aviation	37.8367	0.0018	0.0012						0.1556	0.0921	0.0408	0.0120
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	NO											
Indirect N_2O			**1.1554**									
Indirect CO_2	**73.5058**											

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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	**9714.0200**	**161.8576**	**7.2892**	**3.9514**	**NO**	**NO**	**NO**	**NO**	**31.8584**	**66.8777**	**48.9688**	**34.4348**
1. Energy	**11372.9604**	**28.3994**	**0.2497**						**30.4649**	**58.2794**	**7.2884**	**33.9768**
A. Fuel combustion Reference approach	11331.5265											
Sectoral approach	11372.5410	1.9439	0.1782						30.4649	58.2794	6.8123	33.9768
1. Energy industries	7142.1394	0.1364	0.0501						12.9349	3.1262	0.2355	25.5947
2. Manufacturing industries and construction	439.7389	0.0139	0.0020						1.0932	0.6245	0.2000	0.4180
3. Transport	1498.3876	0.4335	0.1009						6.7826	23.3926	2.9874	1.7003
4. Other sectors	2166.6313	1.3497	0.0230						9.1404	30.5063	3.2880	5.9766
5. Other	125.6438	0.0104	0.0022						0.5138	0.6299	0.1015	0.2872
B. Fugitive emissions from fuels	0.4194	26.4555	0.0716						0.0000	0.0000	0.4761	0.0000
1. Solid fuels	NO	NO	NO						NO	NO	NO	NO
2. Oil and natural gas and other emissions from energy production	0.4194	26.4555	0.0716						0.0000	0.0000	0.4761	0.0000
C. CO_2 Transport and storage	NO											
2. Industrial processes and product use	**446.5790**	**NO**	**0.0000**	**3.9514**	**NO**	**NO**	**NO**	**NO**	**1.1389**	**2.5418**	**40.2086**	**0.4519**
A. Mineral industry	342.6866								1.0250	0.8818	0.0089	0.4060
B. Chemical industry	NO	NO	NO						NO	NO	0.0051	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	76.5608	NO	NO						0.0132	0.0740	29.2180	0.0065

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)			
E. Electronic industry				NO	NO	NO	NO	NO				
F. Product uses as substitutes for ODS				3.9514	NO	NO	NO	NO				
G. Other product manufacture and use	1.0947	NO	0.0000	NO	NO	NO	NO	NO	0.0153	0.4695	0.4976	NO
H. Other									NO	NO	10.4463	NO
3. Agriculture	**0.0607**	**73.0803**	**5.9592**						**NO**	**NO**	**NE, NO**	
A. Enteric fermentation		64.8293										
B. Manure management		8.2510	2.4596								NO	
C. Rice cultivation		NO										
D. Agricultural soils			3.4996									
E. Prescribed burning of savannas		NO	NO						NO	NO	NO	
F. Field burning of agricultural residues		IE	IE						IE	IE	NO, NE	
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	**-2122.7016**	**0.0896**	**0.8440**						**0.0829**	**3.0510**	**NE**	
A. Forest land	-2045.0670	0.0001	0.0000						0.0001	0.0030	NE	
B. Cropland	1478.8872	0.0895	0.0270						0.0828	3.0480	NE	
C. Grassland	-1601.1004	NE	NE						NE	NE	NE	
D. Wetlands	-469.4389	NE	NE						NE	NE	NE	
E. Settlements	106.9167	NE	0.8170						NE	NE	NE	
F. Other land	401.1281	NE	NE						NE	NE	NE	
G. Harvested wood products	5.9727											
H. Other	NO	NO	NO						NO	NO	NO	
5. Waste	**17.1216**	**60.2883**	**0.2362**						**0.1717**	**3.0055**	**1.4718**	**0.0060**
A. Solid waste disposal	NA, NO	48.3670							NA, NO	NA, NO	1.3847	
B. Biological treatment of solid waste		NO, NE	NO, NE						NO, NE	NO, NE	NO, NE	
C. Incineration and open burning of waste	17.1216	0.3514	0.0062						0.1717	3.0055	0.0664	0.0060
D. Wastewater treatment and discharge		11.5698	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	**41.9184**	**0.0059**	**0.0013**						**0.1572**	**0.1403**	**0.0813**	**0.0133**
Aviation	41.9184	0.0059	0.0013						0.1572	0.1403	0.0813	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	NO											
Indirect N_2O			**1.2081**									
Indirect CO_2	**65.3743**											

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	**9134.8072**	**159.4293**	**7.0954**	**4.2815**	**NO**	**NO**	**NO**	**NO**	**29.6580**	**79.2850**	**47.0827**	**34.2863**
1. Energy	**11259.1406**	**31.7252**	**0.2579**						**28.4374**	**71.5642**	**8.7276**	**33.8981**
A. Fuel combustion Reference approach	11194.2167											
Sectoral approach	11258.6680	2.9697	0.1750						28.4374	71.5642	8.2116	33.8981
1. Energy industries	7074.2917	0.1347	0.0468						12.6955	3.2367	0.2406	23.4410
2. Manufacturing industries and construction	369.3794	0.0136	0.0020						0.9809	0.6916	0.1772	0.5219
3. Transport	1451.6525	0.4184	0.0959						6.4252	22.2564	2.8534	1.5938
4. Other sectors	2281.5067	2.3921	0.0280						7.8935	44.9136	4.8417	8.1114
5. Other	81.8376	0.0109	0.0023						0.4423	0.4659	0.0987	0.2300
B. Fugitive emissions from fuels	0.4726	28.7555	0.0829						0.0000	0.0000	0.5160	0.0000
1. Solid fuels	NO	NO	NO						NO	NO	NO	NO
2. Oil and natural gas and other emissions from energy production	0.4726	28.7555	0.0829						0.0000	0.0000	0.5160	0.0000
C. CO_2 Transport and storage	NO											
2. Industrial processes and product use	**405.4054**	**NO**	**0.0000**	**4.2815**	**NO**	**NO**	**NO**	**NO**	**0.9923**	**2.6269**	**36.9171**	**0.3822**
A. Mineral industry	306.5696								0.8724	0.7810	0.0069	0.3361
B. Chemical industry	NO	NO	NO						NO	NO	0.0046	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	71.0711	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				4.2815	NO	NO	NO	NO				
G. Other product manufacture and use	1.0386	NO	0.0000	NO	NO	NO	NO	NO	0.0210	0.6414	0.4721	NO
H. Other									NO	NO	9.3728	NO
3. Agriculture	**0.0911**	**67.1421**	**5.7247**						**NO**	**NO**	**NE, NO**	
A. Enteric fermentation		59.6463										
B. Manure management		7.4958	2.5974								NO	
C. Rice cultivation		NO										
D. Agricultural soils			3.1273									
E. Prescribed burning of savannas		NO	NO						NO	NO	NO	
F. Field burning of agricultural residues		IE	IE						IE	IE	NO, NE	
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	**-2546.9382**	**0.0616**	**0.8801**						**0.0569**	**2.0916**	**NE**	
A. Forest land	-2190.4337	0.0008	0.0000						0.0005	0.0176	NE	
B. Cropland	1312.1146	0.0609	0.0194						0.0564	2.0740	NE	
C. Grassland	-1548.0826	NE	NE						NE	NE	NE	
D. Wetlands	-441.2360	NE	NE						NE	NE	NE	
E. Settlements	101.5910	NE	0.8606						NE	NE	NE	
F. Other land	217.3293	NE	NE						NE	NE	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)			
G. Harvested wood products	1.7792											
H. Other	NO	NO	NO						NO	NO	NO	
5. Waste	**17.1083**	**60.5003**	**0.2328**						**0.1716**	**3.0022**	**1.4379**	**0.0060**
A. Solid waste disposal	NA, NO	48.6713							NA, NO	NA, NO	1.3509	
B. Biological treatment of solid waste		NO, NE	NO, NE						NO, NE	NO, NE	NO, NE	
C. Incineration and open burning of waste	17.1083	0.3511	0.0062						0.1716	3.0022	0.0663	0.0060
D. Wastewater treatment and discharge		11.4778	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	**65.8650**	**0.0048**	**0.0021**						**0.2563**	**0.1684**	**0.0900**	**0.0209**
Aviation	65.8650	0.0048	0.0021						0.2563	0.1684	0.0900	0.0209
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	NO											
Indirect N_2O			**1.1656**									
Indirect CO_2	**60.4993**											

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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	**8528.1893**	**143.9327**	**7.2593**	**5.1070**	**NO**	**NO**	**NO**	**NO**	**26.6717**	**74.6802**	**32.2721**	**19.0834**
1. Energy	**10212.0544**	**26.0293**	**0.2472**						**25.1996**	**65.0399**	**7.9743**	**18.6133**
A. Fuel combustion Reference approach	10137.5783											
Sectoral approach	10211.5893	2.3865	0.1492						25.1996	65.0399	7.5567	18.6133
1. Energy industries	5583.3634	0.1102	0.0244						9.4662	3.1137	0.2218	10.5369
2. Manufacturing industries and construction	588.3594	0.0200	0.0027						1.2171	0.7931	0.2990	0.4427
3. Transport	1469.7744	0.4631	0.0952						6.3542	25.1328	3.1478	1.6297
4. Other sectors	2493.4333	1.7851	0.0250						7.8746	35.5006	3.8095	5.7662
5. Other	76.6587	0.0081	0.0020						0.2875	0.4997	0.0785	0.2379
B. Fugitive emissions from fuels	0.4651	23.6428	0.0979						0.0000	0.0000	0.4176	0.0000
1. Solid fuels	NO	NO	NO						NO	NO	NO	NO
2. Oil and natural gas and other emissions from energy production	0.4651	23.6428	0.0979						0.0000	0.0000	0.4176	0.0000
C. CO_2 Transport and storage	NO											
2. Industrial processes and product use	**446.3084**	**NO**	**0.0000**	**5.1070**	**NO**	**NO**	**NO**	**NO**	**1.2016**	**2.9865**	**22.9531**	**0.4641**
A. Mineral industry	370.9362								1.0716	0.9575	0.0096	0.4134
B. Chemical industry	NO	NO	NO						NO	NO	0.0037	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	42.0527	NO	NO						0.0040	0.0227	14.1331	0.0020

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)			
E. Electronic industry				NO	NO	NO	NO	NO				
F. Product uses as substitutes for ODS				5.1070	NO	NO	NO	NO				
G. Other product manufacture and use	0.9389	NO	0.0000	NO	NO	NO	NO	NO	0.0205	0.6281	0.4268	NO
H. Other									NO	NO	8.3398	NO
3. Agriculture	**1.0992**	**57.4896**	**5.8619**						**NO**	**NO**	**NE, NO**	
A. Enteric fermentation		51.4030										
B. Manure management		6.0866	2.0035								NO	
C. Rice cultivation		NO										
D. Agricultural soils			3.8583									
E. Prescribed burning of savannas		NO	NO						NO	NO	NO	
F. Field burning of agricultural residues		IE	IE						IE	IE	NO, NE	
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	**-2148.3338**	**0.1075**	**0.9134**						**0.0995**	**3.6610**	**NE**	
A. Forest land	-2232.2854	0.0002	0.0000						0.0001	0.0053	NE	
B. Cropland	1628.0567	0.1073	0.0116						0.0993	3.6556	NE	
C. Grassland	-1400.8607	NE	NE						NE	NE	NE	
D. Wetlands	-413.0332	NE	NE						NE	NE	NE	
E. Settlements	100.7954	NE	0.9017						NE	NE	NE	
F. Other land	188.2363	NE	NE						NE	NE	NE	
G. Harvested wood products	-19.2429											
H. Other	NO	NO	NO						NO	NO	NO	
5. Waste	**17.0610**	**60.3063**	**0.2369**						**0.1711**	**2.9928**	**1.3447**	**0.0060**
A. Solid waste disposal	NA, NO	48.1521							NA, NO	NA, NO	1.2600	
B. Biological treatment of solid waste		NO, NE	NO, NE						NO, NE	NO, NE	NO, NE	
C. Incineration and open burning of waste	17.0610	0.3501	0.0061						0.1711	2.9928	0.0661	0.0060
D. Wastewater treatment and discharge		11.8041	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	**75.6418**	**0.0054**	**0.0024**						**0.3033**	**0.1927**	**0.1018**	**0.0240**
Aviation	75.6418	0.0054	0.0024						0.3033	0.1927	0.1018	0.0240
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	NO											
Indirect N_2O			**1.1723**									
Indirect CO_2	**32.0316**											

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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	**7000.6810**	**138.2519**	**6.7040**	**6.0624**	**NO**	**NO**	**NO**	**NO**	**22.4434**	**58.0613**	**28.2124**	**14.3869**
1. Energy	**8789.7567**	**23.8383**	**0.2174**						**21.1263**	**49.2086**	**6.3618**	**13.9529**
A. Fuel combustion Reference approach	8718.4021											
Sectoral approach	8789.3294	1.7133	0.1232						21.1263	49.2086	5.9702	13.9529
1. Energy industries	4806.4261	0.0957	0.0189						8.0624	2.7581	0.1958	7.9287
2. Manufacturing industries and construction	566.7379	0.0197	0.0026						1.2172	0.7349	0.3099	0.3474
3. Transport	1273.6172	0.3957	0.0790						5.2998	21.3500	2.6683	1.4210
4. Other sectors	2069.7199	1.1935	0.0205						6.1550	23.7795	2.6921	4.0184
5. Other	72.8283	0.0088	0.0021						0.3919	0.5862	0.1041	0.2375
B. Fugitive emissions from fuels	0.4274	22.1250	0.0942						0.0000	0.0000	0.3916	0.0000
1. Solid fuels	NO	NO	NO						NO	NO	NO	NO
2. Oil and natural gas and other emissions from energy production	0.4274	22.1250	0.0942						0.0000	0.0000	0.3916	0.0000
C. CO_2 Transport and storage	NO											
2. Industrial processes and product use	**371.0737**	**NO**	**0.0000**	**6.0624**	**NO**	**NO**	**NO**	**NO**	**1.0549**	**2.5139**	**20.5122**	**0.4279**
A. Mineral industry	304.0902								0.9420	0.7779	0.0078	0.3832
B. Chemical industry	NO	NO	NO						NO	NO	0.0042	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	37.5993	NO	NO						0.0033	0.0185	13.2679	0.0016
E. Electronic industry				NO	NO	NO	NO	NO				
F. Product uses as substitutes for ODS				6.0624	NO	NO	NO	NO				
G. Other product manufacture and use	0.7020	NO	0.0000	NO	NO	NO	NO	NO	0.0162	0.4967	0.3191	NO
H. Other									NO	NO	6.8761	NO
3. Agriculture	**0.2721**	**55.0092**	**5.2920**						**NO**	**NO**	**NE, NO**	
A. Enteric fermentation		49.9008										
B. Manure management		5.1085	1.9398								NO	
C. Rice cultivation		NO										
D. Agricultural soils			3.3522									
E. Prescribed burning of savannas		NO	NO						NO	NO	NO	
F. Field burning of agricultural residues		IE	IE						IE	IE	NO, NE	
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	**-2177.5062**	**0.0989**	**0.9542**						**0.0909**	**3.3430**	**NE**	
A. Forest land	-2288.4857	0.0023	0.0001						0.0015	0.0530	NE	
B. Cropland	1657.1571	0.0966	0.0110						0.0894	3.2900	NE	
C. Grassland	-1436.2698	NE	NE						NE	NE	NE	
D. Wetlands	-384.8303	NE	NE						NE	NE	NE	
E. Settlements	99.0440	NE	0.9431						NE	NE	NE	
F. Other land	185.0077	NE	NE						NE	NE	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)			
G. Harvested wood products	-9.1293											
H. Other	NO	NO	NO						NO	NO	NO	
5. Waste	**17.0846**	**59.3055**	**0.2404**						**0.1713**	**2.9958**	**1.3384**	**0.0061**
A. Solid waste disposal	NA, NO	47.5742							NA, NO	NA, NO	1.2568	
B. Biological treatment of solid waste		NO, NE	NO, NE						NO, NE	NO, NE	NO, NE	
C. Incineration and open burning of waste	17.0846	0.3506	0.0062						0.1713	2.9958	0.0662	0.0061
D. Wastewater treatment and discharge		11.3807	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	**72.4923**	**0.0041**	**0.0023**						**0.2935**	**0.1739**	**0.0883**	**0.0230**
Aviation	72.4923	0.0041	0.0023						0.2935	0.1739	0.0883	0.0230
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	NO											
Indirect N_2O			**1.0458**									
Indirect CO_2	**29.8821**											

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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	**5786.1209**	**133.8675**	**6.2228**	**6.8017**	**NO**	**NO**	**NO**	**NO**	**17.3237**	**45.6938**	**22.3883**	**11.4081**
1. Energy	**7328.4925**	**23.9672**	**0.2036**						**16.1243**	**36.8298**	**4.9938**	**11.0284**
A. Fuel combustion Reference approach	7257.1721											
Sectoral approach	7328.0994	1.5627	0.0868						16.1243	36.8298	4.5931	11.0284
1. Energy industries	4133.6361	0.0797	0.0160						6.9218	2.4138	0.1693	6.2916
2. Manufacturing industries and construction	488.2612	0.0137	0.0017						0.8414	0.5356	0.2311	0.2632
3. Transport	855.4540	0.2410	0.0492						3.5193	12.5713	1.5845	1.0059
4. Other sectors	1801.5918	1.2218	0.0183						4.6961	20.9461	2.5442	3.2790
5. Other	49.1563	0.0065	0.0016						0.1458	0.3630	0.0640	0.1887
B. Fugitive emissions from fuels	0.3931	22.4045	0.1168						0.0000	0.0000	0.4007	0.0000
1. Solid fuels	NO	NO	NO						NO	NO	NO	NO
2. Oil and natural gas and other emissions from energy production	0.3931	22.4045	0.1168						0.0000	0.0000	0.4007	0.0000
C. CO_2 Transport and storage	NO											
2. Industrial processes and product use	**334.1373**	**NO**	**0.0000**	**6.8017**	**NO**	**NO**	**NO**	**NO**	**0.9405**	**2.6378**	**16.1821**	**0.3736**
A. Mineral industry	270.1228								0.8158	0.6939	0.0075	0.3247
B. Chemical industry	NO	NO	NO						NO	NO	0.0035	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	31.6142	NO	NO						0.0024	0.0133	11.6405	0.0012
E. Electronic industry				NO	NO	NO	NO	NO				
F. Product uses as substitutes for ODS				6.8017	NO	NO	NO	NO				
G. Other product manufacture and use	0.6062	NO	0.0000	NO	NO	NO	NO	NO	0.0189	0.5773	0.2755	NO
H. Other									NO	NO	4.2144	NO
3. Agriculture	**0.0034**	**50.6594**	**4.7978**						**NO**	**NO**	**NE, NO**	
A. Enteric fermentation		46.1673										
B. Manure management		4.4921	1.7608								NO	
C. Rice cultivation		NO										
D. Agricultural soils			3.0370									
E. Prescribed burning of savannas		NO	NO						NO	NO	NO	
F. Field burning of agricultural residues		IE	IE						IE	IE	NO, NE	
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	**-1893.5700**	**0.0956**	**0.9861**						**0.0880**	**3.2363**	**NE**	
A. Forest land	-2336.8468	0.0017	0.0001						0.0011	0.0396	NE	
B. Cropland	1677.6681	0.0938	0.0109						0.0869	3.1967	NE	
C. Grassland	-1433.2865	NE	NE						NE	NE	NE	
D. Wetlands	-356.6274	NE	NE						NE	NE	NE	
E. Settlements	111.8259	NE	0.9751						NE	NE	NE	
F. Other land	425.1554	NE	NE						NE	NE	NE	
G. Harvested wood products	18.5414											
H. Other	NO	NO	NO						NO	NO	NO	
5. Waste	**17.0578**	**59.1454**	**0.2353**						**0.1710**	**2.9899**	**1.2123**	**0.0060**
A. Solid waste disposal	NA, NO	47.8091							NA, NO	NA, NO	1.1343	
B. Biological treatment of solid waste		NO, NE	NO, NE						NO, NE	NO, NE	NO, NE	
C. Incineration and open burning of waste	17.0578	0.3500	0.0061						0.1710	2.9899	0.0661	0.0060
D. Wastewater treatment and discharge		10.9864	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	**72.4890**	**0.0040**	**0.0023**						**0.2907**	**0.1724**	**0.0877**	**0.0230**
Aviation	72.4890	0.0040	0.0023						0.2907	0.1724	0.0877	0.0230
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	NO											
Indirect N_2O			**0.9405**									
Indirect CO_2	**26.2056**											

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	**4729.3456**	**130.5540**	**5.8503**	**8.3038**	**NO**	**NO**	**NO**	**NO**	**16.0283**	**41.8286**	**21.9813**	**9.8641**
1. Energy	**6584.0211**	**25.5715**	**0.2200**						**14.7597**	**34.8619**	**4.8848**	**9.3678**
A. Fuel combustion Reference approach	6518.8855											
Sectoral approach	6583.6452	1.5461	0.0881						14.7597	34.8619	4.4508	9.3678
1. Energy industries	3607.4274	0.0676	0.0138						6.0316	2.1531	0.1489	4.9599
2. Manufacturing industries and construction	531.0321	0.0125	0.0015						0.8916	0.4987	0.2297	0.2370
3. Transport	920.5951	0.2445	0.0546						3.8839	12.3795	1.5620	1.1803
4. Other sectors	1488.2025	1.2169	0.0172						3.8215	19.5985	2.4681	2.8261
5. Other	36.3881	0.0046	0.0010						0.1311	0.2320	0.0421	0.1644
B. Fugitive emissions from fuels	0.3759	24.0254	0.1318						0.0000	0.0000	0.4341	0.0000
1. Solid fuels	NO	NO	NO						NO	NO	NO	NO
2. Oil and natural gas and other emissions from energy production	0.3759	24.0254	0.1318						0.0000	0.0000	0.4341	0.0000
C. CO_2 Transport and storage	NO											
2. Industrial processes and product use	**305.7865**	**NO**	**0.0000**	**8.3038**	**NO**	**NO**	**NO**	**NO**	**1.0642**	**2.7415**	**15.8877**	**0.4903**
A. Mineral industry	237.9796								0.9242	0.5746	0.0067	0.4349
B. Chemical industry	NO	NO	NO						NO	NO	0.0065	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	30.6392	NO	NO						0.0019	0.0108	11.6590	0.0010
E. Electronic industry				NO	NO	NO	NO	NO				
F. Product uses as substitutes for ODS				8.3038	NO	NO	NO	NO				
G. Other product manufacture and use	0.8987	NO	0.0000	NO	NO	NO	NO	NO	0.0200	0.6124	0.4085	NO
H. Other									NO	NO	3.7608	NO
3. Agriculture	**0.4397**	**46.8269**	**4.3951**						**NO**	**NO**	**NE, NO**	
A. Enteric fermentation		43.4256										
B. Manure management		3.4013	1.5712								NO	
C. Rice cultivation		NO										
D. Agricultural soils			2.8239									
E. Prescribed burning of savannas		NO	NO						NO	NO	NO	
F. Field burning of agricultural residues		IE	IE						IE	IE	NO, NE	
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	**-2177.9243**	**0.0365**	**0.9944**						**0.0338**	**1.2427**	**NE**	
A. Forest land	-2307.4384	0.0001	0.0000						0.0000	0.0014	NE	
B. Cropland	1465.3794	0.0364	0.0091						0.0337	1.2413	NE	
C. Grassland	-1291.9495	NE	NE						NE	NE	NE	
D. Wetlands	-328.4245	NE	NE						NE	NE	NE	
E. Settlements	100.1768	NE	0.9853						NE	NE	NE	
F. Other land	178.5246	NE	NE						NE	NE	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)			
G. Harvested wood products	5.8073											
H. Other	NO	NO	NO						NO	NO	NO	
5. Waste	**17.0226**	**58.1191**	**0.2408**						**0.1706**	**2.9825**	**1.2088**	**0.0060**
A. Solid waste disposal	NA, NO	46.7813							NA, NO	NA, NO	1.1318	
B. Biological treatment of solid waste		NO, NE	NO, NE						NO, NE	NO, NE	NO, NE	
C. Incineration and open burning of waste	17.0226	0.3492	0.0061						0.1706	2.9825	0.0659	0.0060
D. Wastewater treatment and discharge		10.9886	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	**66.2279**	**0.0043**	**0.0021**						**0.2728**	**0.1738**	**0.0800**	**0.0210**
Aviation	66.2279	0.0043	0.0021						0.2728	0.1738	0.0800	0.0210
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	NO											
Indirect N_2O			**0.8563**									
Indirect CO_2	**26.5388**											

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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	**5692.4617**	**129.9605**	**6.4910**	**10.4771**	**NO**	**NO**	**NO**	**NO**	**17.3856**	**41.2933**	**23.3836**	**9.3435**
1. Energy	**7180.7453**	**25.2431**	**0.2715**						**16.1444**	**33.7768**	**4.7942**	**8.8744**
A. Fuel combustion — Reference approach	7119.8320											
Sectoral approach	7180.3360	1.4223	0.0944						16.1444	33.7768	4.3665	8.8744
1. Energy industries	4101.5064	0.0787	0.0147						6.8092	2.5265	0.1735	4.6865
2. Manufacturing industries and construction	611.5689	0.0152	0.0020						1.2488	0.5855	0.2629	0.2920
3. Transport	995.4935	0.2597	0.0601						4.1902	13.3146	1.6695	1.3035
4. Other sectors	1428.3712	1.0636	0.0164						3.7395	16.9934	2.2000	2.4655
5. Other	43.3961	0.0050	0.0012						0.1565	0.3569	0.0605	0.1268
B. Fugitive emissions from fuels	0.4092	23.8208	0.1771						0.0000	0.0000	0.4278	0.0000
1. Solid fuels	NO	NO	NO						NO	NO	NO	NO
2. Oil and natural gas and other emissions from energy production	0.4092	23.8208	0.1771						0.0000	0.0000	0.4278	0.0000
C. CO_2 Transport and storage	NO											
2. Industrial processes and product use	**308.5598**	**NO**	**0.0000**	**10.4771**	**NO**	**NO**	**NO**	**NO**	**1.0250**	**2.8520**	**17.4938**	**0.4631**
A. Mineral industry	235.2359								0.8765	0.5715	0.0066	0.4038
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	33.9235	NO	NO						0.0024	0.0135	12.8867	0.0012

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)			
E. Electronic industry				NO	NO	NO	NO	NO				
F. Product uses as substitutes for ODS				10.4771	NO	NO	NO	NO				
G. Other product manufacture and use	0.7730	NO	0.0000	NO	NO	NO	NO	NO	0.0203	0.6229	0.3514	NO
H. Other									NO	NO	4.1911	NO
3. Agriculture	**0.1496**	**47.6636**	**4.9809**						**NO**	**NO**	**NE, NO**	
A. Enteric fermentation		44.2270										
B. Manure management		3.4366	1.5998								NO	
C. Rice cultivation		NO										
D. Agricultural soils			3.3811									
E. Prescribed burning of savannas		NO	NO						NO	NO	NO	
F. Field burning of agricultural residues		IE	IE						IE	IE	NO, NE	
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	**-1813.9954**	**0.0508**	**0.9951**						**0.0459**	**1.6868**	**NE**	
A. Forest land	-2273.7027	0.0039	0.0002						0.0025	0.0896	NE	
B. Cropland	1811.2281	0.0469	0.0079						0.0434	1.5972	NE	
C. Grassland	-1290.6541	NE	NE						NE	NE	NE	
D. Wetlands	-300.2217	NE	NE						NE	NE	NE	
E. Settlements	67.0898	NE	0.9870						NE	NE	NE	
F. Other land	178.5246	NE	NE						NE	NE	NE	
G. Harvested wood products	-6.2594											
H. Other	NO	NO	NO						NO	NO	NO	
5. Waste	**17.0025**	**57.0030**	**0.2434**						**0.1703**	**2.9776**	**1.0956**	**0.0060**
A. Solid waste disposal	NA, NO	45.4990							NA, NO	NA, NO	1.0191	
B. Biological treatment of solid waste		NO, NE	NO, NE						NO, NE	NO, NE	NO, NE	
C. Incineration and open burning of waste	17.0025	0.3487	0.0061						0.1703	2.9776	0.0658	0.0060
D. Wastewater treatment and discharge		11.1552	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	**61.8894**	**0.0039**	**0.0020**						**0.2403**	**0.1649**	**0.0728**	**0.0196**
Aviation	61.8894	0.0039	0.0020						0.2403	0.1649	0.0728	0.0196
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	NO											
Indirect N_2O			**0.9676**									
Indirect CO_2	**29.1198**											

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	**5289.7042**	**132.0605**	**6.6715**	**14.5015**	**NO**	**NO**	**NO**	**NO**	**18.1326**	**46.0931**	**26.0647**	**10.3207**
1. Energy	**6815.4249**	**27.6695**	**0.3037**						**16.7861**	**40.7569**	**5.8776**	**9.7897**
A. Fuel combustion Reference approach	6754.3765											
Sectoral approach	6815.0348	1.7870	0.1229						16.7861	40.7569	5.4078	9.7897
1. Energy industries	3347.8492	0.0673	0.0132						5.6018	2.0379	0.1404	4.3168
2. Manufacturing industries and construction	424.4928	0.0102	0.0012						0.7088	0.4221	0.1855	0.2119
3. Transport	1261.2777	0.3310	0.0875						5.8622	17.2703	2.2093	1.6207
4. Other sectors	1741.9621	1.3702	0.0193						4.4721	20.7406	2.8043	3.4683
5. Other	39.4529	0.0083	0.0016						0.1411	0.2860	0.0683	0.1720
B. Fugitive emissions from fuels	0.3901	25.8825	0.1808						0.0000	0.0000	0.4697	0.0000
1. Solid fuels	NO	NO	NO						NO	NO	NO	NO
2. Oil and natural gas and other emissions from energy production	0.3901	25.8825	0.1808						0.0000	0.0000	0.4697	0.0000
C. CO_2 Transport and storage	NO											
2. Industrial processes and product use	**357.7976**	**NO**	**0.0000**	**14.5015**	**NO**	**NO**	**NO**	**NO**	**1.1676**	**2.0313**	**19.0331**	**0.5249**
A. Mineral industry	300.3739								1.0852	0.7298	0.0083	0.4931
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	36.1900	NO	NO						0.0021	0.0118	13.8294	0.0010
E. Electronic industry				NO	NO	NO	NO	NO				
F. Product uses as substitutes for ODS				14.5015	NO	NO	NO	NO				
G. Other product manufacture and use	0.7307	NO	0.0000	NO	NO	NO	NO	NO	0.0136	0.4172	0.3321	NO
H. Other									NO	NO	4.8266	NO
3. Agriculture	**0.0470**	**48.7415**	**5.1218**						**NO**	**NO**	**NE, NO**	
A. Enteric fermentation		45.1436										
B. Manure management		3.5979	1.6116								NO	
C. Rice cultivation		NO										
D. Agricultural soils			3.5102									
E. Prescribed burning of savannas		NO	NO						NO	NO	NO	
F. Field burning of agricultural residues		IE	IE						IE	IE	NO, NE	
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	**-1900.5120**	**0.0106**	**0.9965**						**0.0092**	**0.3385**	**NE**	
A. Forest land	-2267.6159	0.0021	0.0001						0.0013	0.0481	NE	
B. Cropland	1407.6151	0.0085	0.0066						0.0079	0.2904	NE	
C. Grassland	-1235.1380	NE	NE						NE	NE	NE	
D. Wetlands	-272.0188	NE	NE						NE	NE	NE	
E. Settlements	67.0898	NE	0.9898						NE	NE	NE	
F. Other land	456.2431	NE	NE						NE	NE	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)			
G. Harvested wood products	-56.6873											
H. Other	NO	NO	NO						NO	NO	NO	
5. Waste	**16.9466**	**55.6389**	**0.2495**						**0.1697**	**2.9664**	**1.1541**	**0.0060**
A. Solid waste disposal	NA, NO	44.3224							NA, NO	NA, NO	1.0781	
B. Biological treatment of solid waste		NO, NE	NO, NE						NO, NE	NO, NE	NO, NE	
C. Incineration and open burning of waste	16.9466	0.3475	0.0061						0.1697	2.9664	0.0656	0.0060
D. Wastewater treatment and discharge		10.9689	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	**62.0647**	**0.0036**	**0.0020**						**0.2505**	**0.1652**	**0.0671**	**0.0197**
Aviation	62.0647	0.0036	0.0020						0.2505	0.1652	0.0671	0.0197
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	NO											
Indirect N_2O			**1.0023**									
Indirect CO_2	**31.1517**											

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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	**6044.9776**	**128.2609**	**5.8544**	**20.8415**	**NO**	**NO**	**0.0000**	**NO**	**19.0556**	**55.7655**	**28.5055**	**11.8437**
1. Energy	**7469.8555**	**29.3361**	**0.3138**						**17.6796**	**50.0082**	**7.0341**	**11.3068**
A. Fuel combustion — Reference approach	7400.3518											
Sectoral approach	7468.7964	2.2776	0.1255						17.6796	50.0082	6.4958	11.3068
1. Energy industries	3431.0444	0.0681	0.0130						5.7150	2.1205	0.1452	3.9758
2. Manufacturing industries and construction	452.5663	0.0105	0.0013						0.7738	0.4050	0.1942	0.1826
3. Transport	1477.1995	0.3896	0.0857						6.3214	20.8227	2.5969	1.9187
4. Other sectors	2079.5633	1.8052	0.0246						4.7268	26.3790	3.5070	5.1110
5. Other	28.4228	0.0043	0.0009						0.1427	0.2811	0.0524	0.1187
B. Fugitive emissions from fuels	1.0592	27.0585	0.1884						0.0000	0.0000	0.5383	0.0000
1. Solid fuels	NO	NO	NO						NO	NO	NO	NO
2. Oil and natural gas and other emissions from energy production	1.0592	27.0585	0.1884						0.0000	0.0000	0.5383	0.0000
C. CO_2 Transport and storage	NO											
2. Industrial processes and product use	**385.6075**	**NO**	**0.0000**	**20.8415**	**NO**	**NO**	**0.0000**	**NO**	**1.2054**	**2.7466**	**20.1643**	**0.5309**
A. Mineral industry	308.3700								1.0721	0.7534	0.0091	0.4765
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

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)			
D. Non-energy products from fuels and solvent use	40.9211	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				20.8415	NO	NO	NO	NO				
G. Other product manufacture and use	0.8881	NO	0.0000	NO	NO	NO	0.0000	NO	0.0154	0.4712	0.4037	NO
H. Other									NO	NO	4.8202	NO
3. Agriculture	**0.2381**	**44.5900**	**4.3116**						**NO**	**NO**	**NE, NO**	
A. Enteric fermentation		41.2430										
B. Manure management		3.3469	1.5302								NO	
C. Rice cultivation		NO										
D. Agricultural soils			2.7814									
E. Prescribed burning of savannas		NO	NO						NO	NO	NO	
F. Field burning of agricultural residues		IE	IE						IE	IE	NO, NE	
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	**-1827.6049**	**0.0024**	**0.9877**						**0.0016**	**0.0573**	**NE**	
A. Forest land	-2270.1176	0.0023	0.0001						0.0015	0.0526	NE	
B. Cropland	1489.1023	0.0001	0.0056						0.0001	0.0046	NE	
C. Grassland	-1007.1842	NE	NE						NE	NE	NE	
D. Wetlands	-243.8159	NE	NE						NE	NE	NE	
E. Settlements	67.8615	NE	0.9820						NE	NE	NE	
F. Other land	201.6619	NE	NE						NE	NE	NE	
G. Harvested wood products	-65.1129											
H. Other	NO	NO	NO						NO	NO	NO	
5. Waste	**16.8812**	**54.3324**	**0.2412**						**0.1690**	**2.9534**	**1.3071**	**0.0060**
A. Solid waste disposal	NA, NO	42.8093							NA, NO	NA, NO	1.2315	
B. Biological treatment of solid waste		NO, NE	NO, NE						NO, NE	NO, NE	NO, NE	
C. Incineration and open burning of waste	16.8812	0.3461	0.0061						0.1690	2.9534	0.0653	0.0060
D. Wastewater treatment and discharge		11.1769	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	**70.1110**	**0.0035**	**0.0023**						**0.2887**	**0.1786**	**0.0705**	**0.0222**
Aviation	70.1110	0.0035	0.0023						0.2887	0.1786	0.0705	0.0222
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	NO											
Indirect N_2O			**0.8474**									
Indirect CO_2	**33.6057**											

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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	**6622.6008**	**126.8977**	**6.7546**	**29.1966**	**NO**	**NO**	**0.0000**	**NO**	**20.3780**	**52.8480**	**40.4511**	**11.1920**
1. Energy	**8141.8766**	**31.3534**	**0.3326**						**18.8504**	**46.5982**	**7.0666**	**10.5973**
A. Fuel combustion Reference approach	8319.9634											
Sectoral approach	8140.7721	1.9835	0.1367						18.8504	46.5982	6.1973	10.5973
1. Energy industries	3725.8039	0.0701	0.0130						5.8304	2.1781	0.1492	3.9179
2. Manufacturing industries and construction	465.1130	0.0124	0.0016						0.8587	0.4651	0.2118	0.2180
3. Transport	1668.6104	0.4162	0.1001						7.2533	22.1923	2.8012	2.1963
4. Other sectors	2253.6075	1.4817	0.0210						4.6918	21.4752	2.9879	4.2007
5. Other	27.6373	0.0031	0.0010						4.6918	21.4752	2.9879	4.2007
B. Fugitive emissions from fuels	1.1045	29.3699	0.1959						0.0000	0.0000	0.8693	0.0000
1. Solid fuels	NO	NO	NO						NO	NO	NO	NO
2. Oil and natural gas and other emissions from energy production	1.1045	29.3699	0.1959						0.0000	0.0000	0.8693	0.0000
C. CO_2 Transport and storage	NO											
2. Industrial processes and product use	**456.2031**	**NO**	**0.0001**	**29.1966**	**NO**	**NO**	**0.0000**	**NO**	**1.3536**	**3.1045**	**31.9898**	**0.5887**
A. Mineral industry	350.6290								1.1984	0.8689	0.0104	0.5238
B. Chemical industry	NO	NO	NO						NO	NO	0.0118	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	64.1000	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				29.1966	NO	NO	NO	NO				
G. Other product manufacture and use	0.9656	NO	0.0001	NO	NO	NO	0.0000	NO	0.0152	0.4661	0.4389	NO
H. Other									NO	NO	6.1437	NO
3. Agriculture	**0.3669**	**41.7419**	**5.1970**						**NO**	**NO**	**NE, NO**	
A. Enteric fermentation		38.4891										
B. Manure management		3.2528	1.4804								NO	
C. Rice cultivation		NO										
D. Agricultural soils			3.7166									
E. Prescribed burning of savannas		NO	NO						NO	NO	NO	
F. Field burning of agricultural residues		IE	IE						IE	IE	NO, NE	
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	**-1992.6605**	**0.0080**	**0.9736**						**0.0057**	**0.2051**	**NE**	
A. Forest land	-2334.7768	0.0061	0.0003						0.0039	0.1383	NE	
B. Cropland	1454.1892	0.0020	0.0046						0.0018	0.0668	NE	
C. Grassland	-1120.4767	NE	NE						NE	NE	NE	
D. Wetlands	-215.6130	NE	NE						NE	NE	NE	
E. Settlements	53.6737	NE	0.9686						NE	NE	NE	
F. Other land	223.8177	NE	NE						NE	NE	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)			
G. Harvested wood products	-53.4745											
H. Other	NO	NO	NO						NO	NO	NO	
5. Waste	**16.8147**	**53.7943**	**0.2513**						**0.1683**	**2.9402**	**1.3947**	**0.0060**
A. Solid waste disposal	NA, NO	42.2061							NA, NO	NA, NO	1.3194	
B. Biological treatment of solid waste		NO, NE	NO, NE						NO, NE	NO, NE	NO, NE	
C. Incineration and open burning of waste	16.8147	0.3447	0.0061						0.1683	2.9402	0.0650	0.0060
D. Wastewater treatment and discharge		11.2435	0.2453						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	**67.3304**	**0.0035**	**0.0022**						**0.2767**	**0.1815**	**0.0622**	**0.0213**
Aviation	67.3304	0.0035	0.0022						0.2767	0.1815	0.0622	0.0213
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	NO											
Indirect N_2O			**1.0122**									
Indirect CO_2	**56.6674**											

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	**7187.4952**	**127.2037**	**6.8069**	**40.7988**	**NO**	**NO**	**0.0000**	**NO**	**21.1705**	**54.6818**	**43.0595**	**10.9930**
1. Energy	**8318.1422**	**33.1010**	**0.3460**						**19.3776**	**48.2340**	**7.2002**	**10.2932**
A. Fuel combustion Reference approach	8423.1477											
Sectoral approach	8317.0204	2.0836	0.1464						19.3776	48.2340	6.4212	10.2932
1. Energy industries	3755.2075	0.0719	0.0129						5.9812	2.2656	0.1548	3.6993
2. Manufacturing industries and construction	598.3665	0.0140	0.0017						1.0377	0.5095	0.2596	0.2064
3. Transport	1723.5435	0.4294	0.1102						7.8009	22.8161	2.9145	2.2802
4. Other sectors	2213.9626	1.5658	0.0206						4.3277	22.5157	3.0624	4.0412
5. Other	25.9403	0.0024	0.0010						0.2301	0.1272	0.0300	0.0661
B. Fugitive emissions from fuels	1.1219	31.0174	0.1997						0.0000	0.0000	0.7790	0.0000
1. Solid fuels	NO	NO	NO						NO	NO	NO	NO
2. Oil and natural gas and other emissions from energy production	1.1219	31.0174	0.1997						0.0000	0.0000	0.7790	0.0000
C. CO_2 Transport and storage	NO											
2. Industrial processes and product use	**551.0519**	**NO**	**0.0001**	**40.7988**	**NO**	**NO**	**0.0000**	**NO**	**1.6255**	**3.3507**	**34.3106**	**0.6942**
A. Mineral industry	440.2134								1.4680	1.1141	0.0133	0.6274
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

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)			
D. Non-energy products from fuels and solvent use	67.8400	NO	NO						0.0077	0.0431	27.0205	0.0038
E. Electronic industry				NO	NO	NO	NO	NO				
F. Product uses as substitutes for ODS				40.7988	NO	NO	NO	NO				
G. Other product manufacture and use	1.0626	NO	0.0001	NO	NO	NO	0.0000	NO	0.0134	0.4096	0.4830	NO
H. Other									NO	NO	6.7243	NO
3. Agriculture	**0.1739**	**40.5020**	**5.2539**						**NO**	**NO**	**NE, NO**	
A. Enteric fermentation		37.0587										
B. Manure management		3.4433	1.5820								NO	
C. Rice cultivation		NO										
D. Agricultural soils			3.6718									
E. Prescribed burning of savannas		NO	NO						NO	NO	NO	
F. Field burning of agricultural residues		IE	IE						IE	IE	NO, NE	
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	**-1697.7069**	**0.0099**	**0.9615**						**0.0090**	**0.3317**	**NE**	
A. Forest land	-2409.5185	0.0006	0.0000						0.0004	0.0132	NE	
B. Cropland	1528.2806	0.0093	0.0056						0.0087	0.3185	NE	
C. Grassland	-1058.1239	NE	NE						NE	NE	NE	
D. Wetlands	-187.4101	NE	NE						NE	NE	NE	
E. Settlements	53.6737	NE	0.9559						NE	NE	NE	
F. Other land	416.5012	NE	NE						NE	NE	NE	
G. Harvested wood products	-41.1098											
H. Other	NO	NO	NO						NO	NO	NO	
5. Waste	**15.8340**	**53.5909**	**0.2455**						**0.1584**	**2.7653**	**1.5487**	**0.0057**
A. Solid waste disposal	NA, NO	42.5723							NA, NO	NA, NO	1.4772	
B. Biological treatment of solid waste		NO, NE	NO, NE						NO, NE	NO, NE	NO, NE	
C. Incineration and open burning of waste	15.8340	0.3245	0.0057						0.1584	2.7653	0.0612	0.0057
D. Wastewater treatment and discharge		10.6940	0.2398						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	**67.6488**	**0.0035**	**0.0022**						**0.2800**	**0.1836**	**0.0628**	**0.0214**
Aviation	67.6488	0.0035	0.0022						0.2800	0.1836	0.0628	0.0214
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	NO											
Indirect N_2O			**1.0280**									
Indirect CO_2	**60.5990**											

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	**6367.3802**	**122.2676**	**6.5030**	**53.5982**	**0.0231**	**NO**	**0.0000**	**NO**	**20.2815**	**55.3207**	**48.1839**	**10.9383**
1. Energy	**7516.9276**	**29.6103**	**0.3403**						**18.3425**	**49.3605**	**7.3353**	**10.2098**
A. Fuel combustion Reference approach	7574.4333											
Sectoral approach	7515.7016	2.2799	0.1520						18.3425	49.3605	6.6559	10.2098
1. Energy industries	2963.9244	0.0571	0.0110						4.7598	1.7605	0.1206	3.3790
2. Manufacturing industries and construction	661.3778	0.0145	0.0017						1.1449	0.5118	0.2781	0.1884
3. Transport	1651.6254	0.3962	0.1150						7.8164	20.9913	2.7138	2.2777
4. Other sectors	2199.7343	1.8093	0.0229						4.2889	25.6932	3.4799	4.2136
5. Other	39.0397	0.0029	0.0013						0.3325	0.4037	0.0635	0.1512
B. Fugitive emissions from fuels	1.2260	27.3303	0.1884						0.0000	0.0000	0.6793	0.0000
1. Solid fuels	NO	NO	NO						NO	NO	NO	NO
2. Oil and natural gas and other emissions from energy production	1.2260	27.3303	0.1884						0.0000	0.0000	0.6793	0.0000
C. CO_2 Transport and storage	NO											
2. Industrial processes and product use	**648.0792**	**NO**	**0.0001**	**53.5982**	**0.0231**	**NO**	**0.0000**	**NO**	**1.7731**	**2.9245**	**39.1714**	**0.7229**
A. Mineral industry	538.2308								1.6619	1.3730	0.0164	0.6761
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	81.8718	NO	NO						0.0124	0.0697	33.1366	0.0062
E. Electronic industry				NO	NO	NO	NO	NO				
F. Product uses as substitutes for ODS				53.5982	NO	NO	NO	NO				
G. Other product manufacture and use	0.9584	NO	0.0001	NO	0.0231	NO	0.0000	NO	0.0109	0.3326	0.4356	NO
H. Other									NO	NO	5.5342	NO
3. Agriculture	**0.1460**	**39.3812**	**4.9723**						**NO**	**NO**	**NE, NO**	
A. Enteric fermentation		35.8683										
B. Manure management		3.5129	1.6257								NO	
C. Rice cultivation		NO										
D. Agricultural soils			3.3466									
E. Prescribed burning of savannas		NO	NO						NO	NO	NO	
F. Field burning of agricultural residues		IE	IE						IE	IE	NO, NE	
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	**-1813.6146**	**0.0100**	**0.9483**						**0.0075**	**0.2706**	**NE**	
A. Forest land	-2366.5168	0.0063	0.0003						0.0040	0.1427	NE	
B. Cropland	1565.8949	0.0038	0.0048						0.0035	0.1279	NE	
C. Grassland	-1056.3692	NE	NE						NE	NE	NE	
D. Wetlands	-159.2073	NE	NE						NE	NE	NE	
E. Settlements	53.6737	NE	0.9432						NE	NE	NE	
F. Other land	189.4964	NE	NE						NE	NE	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)			
G. Harvested wood products	-40.5864											
H. Other	NO	NO	NO						NO	NO	NO	
5. Waste	**15.8420**	**53.2662**	**0.2420**						**0.1584**	**2.7651**	**1.6772**	**0.0057**
A. Solid waste disposal	NA, NO	42.4737							NA, NO	NA, NO	1.6057	
B. Biological treatment of solid waste		NO, NE	NO, NE						NO, NE	NO, NE	NO, NE	
C. Incineration and open burning of waste	15.8420	0.3246	0.0057						0.1584	2.7651	0.0612	0.0057
D. Wastewater treatment and discharge		10.4679	0.2363						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	**75.9610**	**0.0040**	**0.0025**						**0.3208**	**0.2037**	**0.0722**	**0.0241**
Aviation	75.9610	0.0040	0.0025						0.3208	0.2037	0.0722	0.0241
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	NO											
Indirect N_2O			**0.9757**									
Indirect CO_2	**73.9415**											

2007

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	**6678.2859**	**115.7654**	**4.5042**	**67.7992**	**0.0231**	**NO**	**0.0000**	**NO**	**21.2027**	**51.0359**	**48.3704**	**9.7668**
1. Energy	**7775.4299**	**30.8658**	**0.3533**						**18.6880**	**42.7530**	**6.7207**	**8.8827**
A. Fuel combustion Reference approach	7976.2424											
Sectoral approach	7774.1723	1.8120	0.1536						18.6880	42.7530	5.8497	8.8827
1. Energy industries	3483.6780	0.0653	0.0116						5.3850	2.0508	0.1399	3.2259
2. Manufacturing industries and construction	823.8199	0.0166	0.0019						1.3060	0.5264	0.3426	0.1156
3. Transport	1757.4108	0.4151	0.1206						8.2201	21.5888	2.7975	2.4651
4. Other sectors	1664.7540	1.3111	0.0178						3.3914	18.2795	2.5144	2.9324
5. Other	44.5097	0.0039	0.0017						0.3855	0.3075	0.0552	0.1437
B. Fugitive emissions from fuels	1.2577	29.0539	0.1997						0.0000	0.0000	0.8710	0.0000
1. Solid fuels	NO	NO	NO						NO	NO	NO	NO
2. Oil and natural gas and other emissions from energy production	1.2577	29.0539	0.1997						0.0000	0.0000	0.8710	0.0000
C. CO_2 Transport and storage	NO											
2. Industrial processes and product use	**893.3513**	**NO**	**NO**	**67.7992**	**0.0231**	**NO**	**0.0000**	**NO**	**2.3147**	**4.0508**	**39.5494**	**0.8784**
A. Mineral industry	768.8438								2.1654	2.0062	0.0244	0.8139
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

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)			
D. Non-energy products from fuels and solvent use	84.9474	NO	NO						0.0130	0.0732	35.0576	0.0065
E. Electronic industry				NO	NO	NO	NO	NO				
F. Product uses as substitutes for ODS				67.7992	NO	NO	NO	NO				
G. Other product manufacture and use	0.9474	NO	NO	NO	0.0231	NO	0.0000	NO	0.0107	0.3289	0.4306	NO
H. Other									NO	NO	3.9720	NO
3. Agriculture	**0.2631**	**31.4975**	**2.9835**						**NO**	**NO**	**NE, NO**	
A. Enteric fermentation		28.9954										
B. Manure management		2.5021	1.2423								NO	
C. Rice cultivation		NO										
D. Agricultural soils			1.7412									
E. Prescribed burning of savannas		NO	NO						NO	NO	NO	
F. Field burning of agricultural residues		IE	IE						IE	IE	NO, NE	
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	**-2006.6996**	**0.0607**	**0.9330**						**0.0405**	**1.4512**	**NE**	
A. Forest land	-2460.3855	0.0546	0.0030						0.0349	1.2433	NE	
B. Cropland	1528.1376	0.0061	0.0049						0.0056	0.2079	NE	
C. Grassland	-1031.2350	NE	NE						NE	NE	NE	
D. Wetlands	-131.0044	NE	NE						NE	NE	NE	
E. Settlements	49.2742	NE	0.9250						NE	NE	NE	
F. Other land	83.1072	NE	NE						NE	NE	NE	
G. Harvested wood products	-44.5936											
H. Other	NO	NO	NO						NO	NO	NO	
5. Waste	**15.9412**	**53.3414**	**0.2345**						**0.1594**	**2.7809**	**2.1003**	**0.0057**
A. Solid waste disposal	NA, NO	42.5929							NA, NO	NA, NO	2.0285	
B. Biological treatment of solid waste		NO, NE	NO, NE						NO, NE	NO, NE	NO, NE	
C. Incineration and open burning of waste	15.9412	0.3266	0.0057						0.1594	2.7809	0.0616	0.0057
D. Wastewater treatment and discharge		10.4219	0.2288						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	**79.8999**	**0.0028**	**0.0026**						**0.3447**	**0.1871**	**0.0698**	**0.0253**
Aviation	79.8999	0.0028	0.0026						0.3447	0.1871	0.0698	0.0253
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	NO											
Indirect N_2O			**0.6037**									
Indirect CO_2	**78.1363**											

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	**7549.6388**	**115.0039**	**6.5151**	**82.0655**	**0.0288**	**NO**	**0.0000**	**NO**	**22.0500**	**53.3172**	**42.1097**	**11.5680**
1. Energy	**8253.4802**	**30.7804**	**0.3664**						**19.3481**	**45.4277**	**7.3059**	**10.6366**
A. Fuel combustion Reference approach	8655.4441											
Sectoral approach	8252.2054	1.8818	0.1592						19.3481	45.4277	6.1576	10.6366
1. Energy industries	3772.1690	0.0722	0.0124						5.5687	2.1292	0.1458	3.3292
2. Manufacturing industries and construction	907.5951	0.0347	0.0047						1.5370	2.2890	0.4765	1.8642
3. Transport	1848.2954	0.4358	0.1218						8.5432	22.4722	2.9125	2.6195
4. Other sectors	1675.4850	1.3355	0.0186						3.3674	18.1831	2.5680	2.6248
5. Other	48.6609	0.0037	0.0016						0.3318	0.3542	0.0549	0.1988
B. Fugitive emissions from fuels	1.2748	28.8986	0.2072						0.0000	0.0000	1.1483	0.0000
1. Solid fuels	NO	NO	NO						NO	NO	NO	NO
2. Oil and natural gas and other emissions from energy production	1.2748	28.8986	0.2072						0.0000	0.0000	1.1483	0.0000
C. CO_2 Transport and storage	NO											
2. Industrial processes and product use	**972.6989**	**NO**	**NO**	**82.0655**	**0.0288**	**NO**	**0.0000**	**NO**	**2.5157**	**4.1128**	**32.4087**	**0.9256**
A. Mineral industry	869.1962								2.3845	2.2999	0.0277	0.8688
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	67.1050	NO	NO						0.0075	0.0427	26.7467	0.0037
E. Electronic industry				NO	NO	NO	NO	NO				
F. Product uses as substitutes for ODS				82.0655	NO	NO	NO	NO				
G. Other product manufacture and use	0.9859	NO	NO	NO	0.0288	NO	0.0000	NO	0.0086	0.2638	0.4481	NO
H. Other									NO	NO	5.1274	NO
3. Agriculture	**0.8505**	**30.0951**	**5.0005**						**NO**	**NO**	**NE, NO**	
A. Enteric fermentation		27.6273										
B. Manure management		2.4678	1.2244								NO	
C. Rice cultivation		NO										
D. Agricultural soils			3.7762									
E. Prescribed burning of savannas		NO	NO						NO	NO	NO	
F. Field burning of agricultural residues		IE	IE						IE	IE	NO, NE	
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	**-1693.2806**	**0.0308**	**0.9128**						**0.0274**	**1.0067**	**NE**	
A. Forest land	-2462.7874	0.0038	0.0002						0.0024	0.0864	NE	
B. Cropland	1499.7873	0.0270	0.0052						0.0250	0.9203	NE	
C. Grassland	-932.1498	NE	NE						NE	NE	NE	
D. Wetlands	-102.8015	NE	NE						NE	NE	NE	
E. Settlements	49.2742	NE	0.9074						NE	NE	NE	
F. Other land	291.0044	NE	NE						NE	NE	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)			
G. Harvested wood products	-35.6078											
H. Other	NO	NO	NO						NO	NO	NO	
5. Waste	**15.8898**	**54.0976**	**0.2354**						**0.1588**	**2.7699**	**2.3951**	**0.0057**
A. Solid waste disposal	NA, NO	43.3679							NA, NO	NA, NO	2.3236	
B. Biological treatment of solid waste		NO, NE	NO, NE						NO, NE	NO, NE	NO, NE	
C. Incineration and open burning of waste	15.8898	0.3254	0.0057						0.1588	2.7699	0.0613	0.0057
D. Wastewater treatment and discharge		10.4043	0.2297						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	**89.2738**	**0.0017**	**0.0029**						**0.3939**	**0.1807**	**0.0752**	**0.0283**
Aviation	89.2738	0.0017	0.0029						0.3939	0.1807	0.0752	0.0283
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	NO											
Indirect N_2O			**0.9800**									
Indirect CO_2	**59.8913**											

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	**8334.3612**	**112.2682**	**7.2343**	**91.3620**	**0.0288**	**NO**	**0.0000**	**NO**	**21.1944**	**50.7336**	**36.3792**	**13.7619**
1. Energy	**9152.8755**	**25.9197**	**0.3719**						**19.7779**	**45.5750**	**7.1466**	**13.2555**
A. Fuel combustion Reference approach	9650.4082											
Sectoral approach	9151.6023	2.0024	0.1459						19.7779	45.5750	6.0141	13.2555
1. Energy industries	5027.2977	0.0960	0.0194						7.6814	2.7418	0.1899	6.5062
2. Manufacturing industries and construction	514.8733	0.0223	0.0031						0.8955	1.6077	0.2844	1.3799
3. Transport	1771.7398	0.4415	0.1035						7.5996	22.2381	2.8305	2.4477
4. Other sectors	1824.3586	1.4415	0.0195						3.4941	18.8063	2.6817	2.8745
5. Other	13.3329	0.0012	0.0003						0.1073	0.1811	0.0277	0.0472
B. Fugitive emissions from fuels	1.2732	23.9173	0.2260						0.0000	0.0000	1.1325	0.0000
1. Solid fuels	NO	NO	NO						NO	NO	NO	NO
2. Oil and natural gas and other emissions from energy production	1.2732	23.9173	0.2260						0.0000	0.0000	1.1325	0.0000
C. CO_2 Transport and storage	NO											
2. Industrial processes and product use	**463.8910**	**NO**	**NO**	**91.3620**	**0.0288**	**NO**	**0.0000**	**NO**	**1.2491**	**2.0725**	**27.0536**	**0.5008**
A. Mineral industry	387.9410								1.1775	0.9929	0.0122	0.4724
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

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)			
D. Non-energy products from fuels and solvent use	58.1883	NO	NO						0.0056	0.0316	23.2322	0.0028
E. Electronic industry				NO	NO	NO	NO	NO				
F. Product uses as substitutes for ODS				91.3620	NO	NO	NO	NO				
G. Other product manufacture and use	0.6998	NO	NO	NO	0.0288	NO	0.0000	NO	0.0105	0.3225	0.3181	NO
H. Other									NO	NO	3.4583	NO
3. Agriculture	**0.5864**	**31.5113**	**5.7499**						**NO**	**NO**	**NE, NO**	
A. Enteric fermentation		28.7000										
B. Manure management		2.8113	2.8112								NO	
C. Rice cultivation		NO										
D. Agricultural soils			2.9387									
E. Prescribed burning of savannas		NO	NO						NO	NO	NO	
F. Field burning of agricultural residues		IE	IE						IE	IE	NO, NE	
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	**-1298.8485**	**0.0126**	**0.8904**						**0.0090**	**0.3239**	**NE**	
A. Forest land	-2526.0659	0.0093	0.0005						0.0059	0.2109	NE	
B. Cropland	1652.4751	0.0033	0.0046						0.0031	0.1130	NE	
C. Grassland	-447.6932	NE	NE						NE	NE	NE	
D. Wetlands	-74.5986	NE	NE						NE	NE	NE	
E. Settlements	45.5694	NE	0.8853						NE	NE	NE	
F. Other land	79.9357	NE	NE						NE	NE	NE	
G. Harvested wood products	-28.4708											
H. Other	NO	NO	NO						NO	NO	NO	
5. Waste	**15.8568**	**54.8247**	**0.2221**						**0.1584**	**2.7622**	**2.1790**	**0.0057**
A. Solid waste disposal	NA, NO	44.6020							NA, NO	NA, NO	2.1076	
B. Biological treatment of solid waste		NO, NE	NO, NE						NO, NE	NO, NE	NO, NE	
C. Incineration and open burning of waste	15.8568	0.3247	0.0057						0.1584	2.7622	0.0612	0.0057
D. Wastewater treatment and discharge		9.8980	0.2164						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	**82.6571**	**0.0018**	**0.0027**						**0.3672**	**0.1729**	**0.0709**	**0.0262**
Aviation	82.6571	0.0018	0.0027						0.3672	0.1729	0.0709	0.0262
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	NO											
Indirect N_2O			**0.8522**									
Indirect CO_2	**51.8736**											

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	**8729.1714**	**112.8412**	**6.4089**	**102.8657**	**0.0403**	**NO**	**0.0000**	**NO**	**22.8098**	**52.1684**	**40.8325**	**12.8153**
1. Energy	**9443.1854**	**25.3348**	**0.3974**						**21.3124**	**47.3547**	**7.0824**	**12.2631**
A. Fuel combustion Reference approach	9750.7612											
Sectoral approach	9441.9107	2.1419	0.1563						21.3124	47.3547	6.2054	12.2631
1. Energy industries	4975.7812	0.0998	0.0186						7.7976	2.8882	0.1987	5.5945
2. Manufacturing industries and construction	443.0025	0.0128	0.0017						0.8138	0.6084	0.2062	0.3865
3. Transport	2008.0937	0.4528	0.1165						8.8144	21.8270	2.8213	2.9534
4. Other sectors	1985.0640	1.5742	0.0190						3.7572	21.7528	2.9332	3.2007
5. Other	29.9692	0.0023	0.0006						0.1294	0.2782	0.0459	0.1281
B. Fugitive emissions from fuels	1.2747	23.1928	0.2411						0.0000	0.0000	0.8770	0.0000
1. Solid fuels	NO	NO	NO						NO	NO	NO	NO
2. Oil and natural gas and other emissions from energy production	1.2747	23.1928	0.2411						0.0000	0.0000	0.8770	0.0000
C. CO_2 Transport and storage	NO											
2. Industrial processes and product use	**488.7178**	**NO**	**NO**	**102.8657**	**0.0403**	**NO**	**0.0000**	**NO**	**1.3351**	**1.9059**	**31.7424**	**0.5465**
A. Mineral industry	411.0616								1.2832	1.0406	0.0126	0.5285
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	67.0530	NO	NO						0.0069	0.0392	26.8426	0.0034
E. Electronic industry				NO	NO	NO	NO	NO				
F. Product uses as substitutes for ODS				102.8657	NO	NO	NO	NO				
G. Other product manufacture and use	0.9046	NO	NO	NO	0.0403	NO	0.0000	NO	0.0135	0.4140	0.4112	NO
H. Other									NO	NO	4.4489	NO
3. Agriculture	**1.7443**	**31.5783**	**4.9121**						**NO**	**NO**	**NE, NO**	
A. Enteric fermentation		28.5028										
B. Manure management		3.0755	1.4304								NO	
C. Rice cultivation		NO										
D. Agricultural soils			3.4817									
E. Prescribed burning of savannas		NO	NO						NO	NO	NO	
F. Field burning of agricultural residues		IE	IE						IE	IE	NO, NE	
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	**-1220.3031**	**0.0056**	**0.8665**						**0.0042**	**0.1529**	**NE**	
A. Forest land	-2484.1627	0.0032	0.0002						0.0021	0.0737	NE	
B. Cropland	1537.9925	0.0023	0.0028						0.0022	0.0792	NE	
C. Grassland	-691.9874	NE	NE						NE	NE	NE	
D. Wetlands	-46.3958	NE	NE						NE	NE	NE	
E. Settlements	45.5694	NE	0.8636						NE	NE	NE	
F. Other land	441.4824	NE	NE						NE	NE	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)			
G. Harvested wood products	-22.8014											
H. Other	NO	NO	NO						NO	NO	NO	
5. Waste	**15.8271**	**55.9225**	**0.2329**						**0.1581**	**2.7549**	**2.0077**	**0.0057**
A. Solid waste disposal	NA, NO	45.5140							NA, NO	NA, NO	1.9364	
B. Biological treatment of solid waste		NO, NE	NO, NE						NO, NE	NO, NE	NO, NE	
C. Incineration and open burning of waste	15.8271	0.3240	0.0057						0.1581	2.7549	0.0610	0.0057
D. Wastewater treatment and discharge		10.0845	0.2272						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	**82.6894**	**0.0027**	**0.0027**						**0.3600**	**0.1894**	**0.0734**	**0.0262**
Aviation	82.6894	0.0027	0.0027						0.3600	0.1894	0.0734	0.0262
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	NO											
Indirect N_2O			**0.9721**									
Indirect CO_2	**60.0215**											

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	**9092.7746**	**115.1425**	**6.3983**	**116.5249**	**0.0403**	**NO**	**0.0000**	**NO**	**23.3601**	**55.8177**	**44.0445**	**13.0829**
1. Energy	**9654.6698**	**28.7372**	**0.4209**						**21.5558**	**50.5851**	**7.7791**	**12.3977**
A. Fuel combustion Reference approach	9987.3155											
Sectoral approach	9653.3531	2.2724	0.1626						21.5558	50.5851	6.7617	12.3977
1. Energy industries	4607.9596	0.0891	0.0159						7.0725	2.6695	0.1831	4.5393
2. Manufacturing industries and construction	596.4123	0.0272	0.0038						1.0531	1.8817	0.3409	1.5948
3. Transport	2117.5188	0.4522	0.1212						9.1394	22.5108	2.8983	3.1362
4. Other sectors	2310.0323	1.7027	0.0214						4.1347	23.1600	3.2929	3.0189
5. Other	21.4301	0.0013	0.0005						0.1561	0.3630	0.0465	0.1085
B. Fugitive emissions from fuels	1.3167	26.4648	0.2583						0.0000	0.0000	1.0174	0.0000
1. Solid fuels	NO	NO	NO						NO	NO	NO	NO
2. Oil and natural gas and other emissions from energy production	1.3167	26.4648	0.2583						0.0000	0.0000	1.0174	0.0000
C. CO_2 Transport and storage	NO											
2. Industrial processes and product use	**578.6725**	**NO**	**NO**	**116.5249**	**0.0403**	**NO**	**0.0000**	**NO**	**1.6415**	**2.3161**	**34.2293**	**0.6794**
A. Mineral industry	492.3783								1.5766	1.2592	0.0155	0.6562
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

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)					
D. Non-energy products from fuels and solvent use	72.3407	NO	NO						0.0078	0.0443	29.0886	0.0039
E. Electronic industry				NO	NO	NO	NO	NO				
F. Product uses as substitutes for ODS				116.5249	NO	NO	NO	NO				
G. Other product manufacture and use	1.0979	NO	NO	NO	0.0403	NO	0.0000	NO	0.0152	0.4661	0.4389	NO
H. Other									NO	NO	4.6537	NO
3. Agriculture	**3.6752**	**29.7453**	**4.9014**						**NO**	**NO**	**NE, NO**	
A. Enteric fermentation		26.8403										
B. Manure management		2.9050	1.3045								NO	
C. Rice cultivation		NO										
D. Agricultural soils			3.5970									
E. Prescribed burning of savannas		NO	NO						NO	NO	NO	
F. Field burning of agricultural residues		IE	IE						IE	IE	NO, NE	
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	**-1160.1391**	**0.0064**	**0.8455**						**0.0047**	**0.1680**	**NE**	
A. Forest land	-2390.5712	0.0043	0.0002						0.0028	0.0987	NE	
B. Cropland	1492.5261	0.0020	0.0026						0.0019	0.0693	NE	
C. Grassland	-638.1726	NE	NE						NE	NE	NE	
D. Wetlands	-75.3129	NE	NE						NE	NE	NE	
E. Settlements	62.0438	NE	0.8426						NE	NE	NE	
F. Other land	393.7285	NE	NE						NE	NE	NE	
G. Harvested wood products	-4.3808											
H. Other	NO	NO	NO						NO	NO	NO	
5. Waste	**15.8962**	**56.6537**	**0.2304**						**0.1582**	**2.7486**	**2.0361**	**0.0058**
A. Solid waste disposal	NA, NO	46.2032							NA, NO	NA, NO	1.9649	
B. Biological treatment of solid waste		NO, NE	NO, NE						NO, NE	NO, NE	NO, NE	
C. Incineration and open burning of waste	15.8962	0.3248	0.0057						0.1582	2.7486	0.0611	0.0058
D. Wastewater treatment and discharge		10.1257	0.2247						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	95.4144	0.0032	0.0031						0.3984	0.2213	0.0959	0.0303
Aviation	95.4144	0.0032	0.0031						0.3984	0.2213	0.0959	0.0303
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	NO											
Indirect N_2O			**0.9716**									
Indirect CO_2	**65.1556**											

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	**8631.3138**	**112.8679**	**4.9766**	**124.2123**	**0.0403**	**NO**	**0.0000**	**NO**	**21.9737**	**54.4470**	**45.6689**	**11.4909**
1. Energy	**9195.8094**	**28.4588**	**0.4326**						**20.2207**	**48.4470**	**7.4794**	**10.8629**
A. Fuel combustion Reference approach	9487.6044											
Sectoral approach	9194.4989	2.4223	0.1490						20.2207	48.4470	6.5497	10.8629
1. Energy industries	4596.6508	0.0848	0.0152						7.0895	2.6782	0.1832	4.4420
2. Manufacturing industries and construction	456.6973	0.0120	0.0015						0.7894	0.4438	0.2107	0.1935
3. Transport	1859.5648	0.3906	0.1092						8.2552	18.9451	2.4721	2.8138
4. Other sectors	2273.0863	1.9343	0.0229						4.0301	26.2302	3.6664	3.3897
5. Other	8.4998	0.0006	0.0002						0.0565	0.1496	0.0172	0.0238
B. Fugitive emissions from fuels	1.3104	26.0365	0.2836						0.0000	0.0000	0.9297	0.0000
1. Solid fuels	NO	NO	NO						NO	NO	NO	NO
2. Oil and natural gas and other emissions from energy production	1.3104	26.0365	0.2836						0.0000	0.0000	0.9297	0.0000
C. CO_2 Transport and storage	NO											
2. Industrial processes and product use	**588.1935**	**NO**	**NO**	**124.2123**	**0.0403**	**NO**	**0.0000**	**NO**	**1.5651**	**2.1892**	**36.1774**	**0.6221**
A. Mineral industry	498.5638								1.5049	1.2916	0.0158	0.5987
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	75.8897	NO	NO						0.0088	0.0500	31.1720	0.0044
E. Electronic industry				NO	NO	NO	NO	NO				
F. Product uses as substitutes for ODS				124.2123	NO	NO	NO	NO				
G. Other product manufacture and use	1.0427	NO	NO	NO	0.0403	NO	0.0000	NO	0.0101	0.3078	0.4739	NO
H. Other									NO	NO	4.4834	NO
3. Agriculture	**5.5908**	**28.0764**	**3.5322**						**NO**	**NO**	**NE, NO**	
A. Enteric fermentation		25.3134										
B. Manure management		2.7630	1.1973								NO	
C. Rice cultivation		NO										
D. Agricultural soils			2.3349									
E. Prescribed burning of savannas		NO	NO						NO	NO	NO	
F. Field burning of agricultural residues		IE	IE						IE	IE	NO, NE	
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	**-1174.1542**	**0.0467**	**0.7833**						**0.0299**	**1.0665**	**NE**	
A. Forest land	-2294.8221	0.0464	0.0026						0.0296	1.0565	NE	
B. Cropland	1496.0113	0.0003	0.0026						0.0003	0.0100	NE	
C. Grassland	-562.7510	NE	NE						NE	NE	NE	
D. Wetlands	-15.4700	NE	NE						NE	NE	NE	
E. Settlements	11.8882	NE	0.7781						NE	NE	NE	
F. Other land	114.1449	NE	NE						NE	NE	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)			
G. Harvested wood products	76.8444											
H. Other	NO	NO	NO						NO	NO	NO	
5. Waste	**15.8744**	**56.2859**	**0.2285**						**0.1580**	**2.7443**	**2.0122**	**0.0058**
A. Solid waste disposal	NA, NO	45.7446							NA, NO	NA, NO	1.9411	
B. Biological treatment of solid waste		NO, NE	NO, NE						NO, NE	NO, NE	NO, NE	
C. Incineration and open burning of waste	15.8744	0.3243	0.0057						0.1580	2.7443	0.0610	0.0058
D. Wastewater treatment and discharge		10.2170	0.2228						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	**107.6790**	**0.0031**	**0.0034**						**0.4332**	**0.2338**	**0.1073**	**0.0342**
Aviation	107.6790	0.0031	0.0034						0.4332	0.2338	0.1073	0.0342
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	NO											
Indirect N_2O			**0.7285**									
Indirect CO_2	**69.6839**											

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	**7844.2261**	**109.8890**	**6.5526**	**130.5506**	**0.0403**	**NO**	**0.0000**	**NO**	**20.9878**	**56.1626**	**45.2815**	**14.5122**
1. Energy	**8214.0054**	**27.2872**	**0.4347**						**19.0713**	**50.5789**	**7.5356**	**13.8040**
A. Fuel combustion — Reference approach	8441.4833											
Sectoral approach	8212.3614	2.4890	0.1518						19.0713	50.5789	6.6563	13.8040
1. Energy industries	3680.5879	0.0702	0.0149						5.7643	2.0314	0.1406	5.1228
2. Manufacturing industries and construction	597.3290	0.0309	0.0044						1.0424	2.3184	0.3625	2.0459
3. Transport	1979.4512	0.3941	0.1089						8.4436	18.4275	2.4051	3.0379
4. Other sectors	1951.0935	1.9936	0.0235						3.7779	27.7566	3.7430	3.5798
5. Other	3.8998	0.0003	0.0001						0.0432	0.0450	0.0052	0.0176
B. Fugitive emissions from fuels	1.6441	24.7983	0.2829						0.0000	0.0000	0.8793	0.0000
1. Solid fuels	NO	NO	NO						NO	NO	NO	NO
2. Oil and natural gas and other emissions from energy production	1.6441	24.7983	0.2829						0.0000	0.0000	0.8793	0.0000
C. CO_2 Transport and storage	NO											
2. Industrial processes and product use	**631.0394**	**NO**	**NO**	**130.5506**	**0.0403**	**NO**	**0.0000**	**NO**	**1.7356**	**2.0193**	**35.5686**	**0.7023**
A. Mineral industry	551.2987								1.6944	1.4147	0.0172	0.6865
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

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)			
D. Non-energy products from fuels and solvent use	70.9399	NO	NO						0.0088	0.0501	28.8972	0.0044
E. Electronic industry				NO	NO	NO	NO	NO				
F. Product uses as substitutes for ODS				130.5506	NO	NO	NO	NO				
G. Other product manufacture and use	1.1438	NO	NO	NO	0.0403	NO	0.0000	NO	0.0075	0.2296	0.5199	NO
H. Other									NO	NO	6.1085	NO
3. Agriculture	**4.1840**	**28.4486**	**5.1582**						**NO**	**NO**	**NE, NO**	
A. Enteric fermentation		25.7324										
B. Manure management		2.7162	1.1203								NO	
C. Rice cultivation		NO										
D. Agricultural soils			4.0379									
E. Prescribed burning of savannas		NO	NO						NO	NO	NO	
F. Field burning of agricultural residues		IE	IE						IE	IE	NO, NE	
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	**-1020.8558**	**0.0349**	**0.7290**						**0.0230**	**0.8237**	**NE**	
A. Forest land	-2141.8702	0.0322	0.0018						0.0206	0.7339	NE	
B. Cropland	1408.2056	0.0026	0.0026						0.0024	0.0898	NE	
C. Grassland	-360.1740	NE	NE						NE	NE	NE	
D. Wetlands	-106.0998	NE	NE						NE	NE	NE	
E. Settlements	13.7512	NE	0.7246						NE	NE	NE	
F. Other land	103.4500	NE	NE						NE	NE	NE	
G. Harvested wood products	61.8814											
H. Other	NO	NO	NO						NO	NO	NO	
5. Waste	**15.8530**	**54.1182**	**0.2307**						**0.1578**	**2.7406**	**2.1773**	**0.0058**
A. Solid waste disposal	NA, NO	43.3907							NA, NO	NA, NO	2.1063	
B. Biological treatment of solid waste		NO, NE	NO, NE						NO, NE	NO, NE	NO, NE	
C. Incineration and open burning of waste	15.8530	0.3239	0.0057						0.1578	2.7406	0.0609	0.0058
D. Wastewater treatment and discharge		10.4036	0.2250						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	**130.4626**	**0.0046**	**0.0042**						**0.5235**	**0.3098**	**0.1345**	**0.0414**
Aviation	130.4626	0.0046	0.0042						0.5235	0.3098	0.1345	0.0414
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	NO											
Indirect N_2O			**1.0337**									
Indirect CO_2	**64.7797**											

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	**8828.9210**	**112.5777**	**7.1810**	**142.0853**	**0.0403**	**NO**	**0.0000**	**NO**	**22.0784**	**80.8849**	**57.7562**	**12.0378**
1. Energy	**8807.4746**	**28.4042**	**0.4675**						**20.1823**	**75.8060**	**11.5158**	**11.3285**
A. Fuel combustion Reference approach	8960.9436											
Sectoral approach	8805.8026	4.5913	0.1740						20.1823	75.8060	10.7386	11.3285
1. Energy industries	4351.4775	0.0856	0.0160						6.8994	2.5652	0.1761	4.8179
2. Manufacturing industries and construction	467.8569	0.0148	0.0019						0.8282	0.7873	0.2267	0.5538
3. Transport	2049.6794	0.3919	0.1026						7.9515	18.0907	2.3365	3.1778
4. Other sectors	1933.4972	4.0986	0.0533						4.4914	54.3206	7.9960	2.7674
5. Other	3.2915	0.0004	0.0001						0.0119	0.0423	0.0033	0.0118
B. Fugitive emissions from fuels	1.6721	23.8129	0.2935						0.0000	0.0000	0.7772	0.0000
1. Solid fuels	NO	NO	NO						NO	NO	NO	NO
2. Oil and natural gas and other emissions from energy production	1.6721	23.8129	0.2935						0.0000	0.0000	0.7772	0.0000
C. CO_2 Transport and storage	NO											
2. Industrial processes and product use	**651.6580**	**NO**	**NO**	**142.0853**	**0.0403**	**NO**	**0.0000**	**NO**	**1.7352**	**2.2144**	**43.9371**	**0.7035**
A. Mineral industry	547.8150								1.6724	1.4004	0.0167	0.6764
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	88.9627	NO	NO						0.0128	0.0723	37.0850	0.0064
E. Electronic industry				NO	NO	NO	NO	NO				
F. Product uses as substitutes for ODS				142.0853	NO	NO	NO	NO				
G. Other product manufacture and use	1.0338	NO	NO	NO	0.0403	NO	0.0000	NO	0.0050	0.1535	0.4699	NO
H. Other									NO	NO	6.3301	NO
3. Agriculture	**10.2058**	**30.1395**	**5.8007**						**NO**	**NO**	**NE, NO**	
A. Enteric fermentation		27.2385										
B. Manure management		2.9011	1.2336								NO	
C. Rice cultivation		NO										
D. Agricultural soils			4.5671									
E. Prescribed burning of savannas		NO	NO						NO	NO	NO	
F. Field burning of agricultural residues		IE	IE						IE	IE	NO, NE	
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	**-656.2221**	**0.0047**	**0.6794**						**0.0036**	**0.1293**	**NE**	
A. Forest land	-2134.7390	0.0027	0.0001						0.0017	0.0603	NE	
B. Cropland	1445.7270	0.0020	0.0026						0.0019	0.0690	NE	
C. Grassland	-341.1085	NE	NE						NE	NE	NE	
D. Wetlands	-139.7535	NE	NE						NE	NE	NE	
E. Settlements	18.9848	NE	0.6766						NE	NE	NE	
F. Other land	436.6463	NE	NE						NE	NE	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)			
G. Harvested wood products	58.0208											
H. Other	NO	NO	NO						NO	NO	NO	
5. Waste	**15.8047**	**54.0294**	**0.2333**						**0.1574**	**2.7351**	**2.3033**	**0.0058**
A. Solid waste disposal	NA, NO	43.3232							NA, NO	NA, NO	2.2326	
B. Biological treatment of solid waste		NO, NE	NO, NE						NO, NE	NO, NE	NO, NE	
C. Incineration and open burning of waste	15.8047	0.3230	0.0057						0.1574	2.7351	0.0607	0.0058
D. Wastewater treatment and discharge		10.3832	0.2276						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	**154.5245**	**0.0034**	**0.0050**						**0.6239**	**0.3279**	**0.1425**	**0.0490**
Aviation	154.5245	0.0034	0.0050						0.6239	0.3279	0.1425	0.0490
Navigation	NO	NO	NO						NO	NO	NO	NO
Multilateral operations	**NO**	**NO**	**NO**						**NO**	**NO**	**NO**	**NO**
CO_2 emissions from biomass	1314.4896											
CO_2 captured	NO											
Long-term storage of C in waste disposal sites	NO											
Indirect N_2O			**1.1797**									
Indirect CO_2	**82.6825**											

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	**8780.6110**	**110.3835**	**5.9031**	**167.8122**	**0.0403**	**NO**	**0.0000**	**NO**	**23.4811**	**87.0305**	**55.4304**	**13.0690**
1. Energy	**9231.5931**	**27.5534**	**0.4811**						**21.6188**	**81.5147**	**12.1824**	**12.3574**
A. Fuel combustion Reference approach	9415.5922											
Sectoral approach	9229.9350	4.8894	0.1917						21.6188	81.5147	11.4666	12.3574
1. Energy industries	4737.5409	0.0928	0.0167						7.3734	2.7936	0.1911	4.6488
2. Manufacturing industries and construction	532.9098	0.0261	0.0036						0.9164	1.8245	0.3207	1.5551
3. Transport	2158.9106	0.4126	0.1144						8.7542	18.6703	2.4258	3.3598
4. Other sectors	1797.6960	4.3577	0.0568						4.5637	58.1907	8.5260	2.7814
5. Other	2.8778	0.0003	0.0001						0.0112	0.0355	0.0030	0.0124
B. Fugitive emissions from fuels	1.6581	22.6640	0.2894						0.0000	0.0000	0.7158	0.0000
1. Solid fuels	NO	NO	NO						NO	NO	NO	NO
2. Oil and natural gas and other emissions from energy production	1.6581	22.6640	0.2894						0.0000	0.0000	0.7158	0.0000
C. CO_2 Transport and storage	NO											
2. Industrial processes and product use	**615.2290**	**NO**	**NO**	**167.8122**	**0.0403**	**NO**	**0.0000**	**NO**	**1.6893**	**2.1941**	**40.9424**	**0.7059**
A. Mineral industry	510.8250								1.6204	1.2924	0.0160	0.6756
B. Chemical industry	NO	NO	NO						NO	NO	0.0118	NO
C. Metal industry	17.2792	NO	NO	NO	NO	NO	NO	NO	0.0561	0.7340	0.0221	0.0259

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)			
D. Non-energy products from fuels and solvent use	86.3698	NO	NO						0.0089	0.0503	35.8010	0.0044
E. Electronic industry				NO	NO	NO	NO	NO				
F. Product uses as substitutes for ODS				167.8122	NO	NO	NO	NO				
G. Other product manufacture and use	0.7549	NO	NO	NO	0.0403	NO	0.0000	NO	0.0038	0.1174	0.3432	NO
H. Other									NO	NO	4.7483	NO
3. Agriculture	**11.2402**	**28.9696**	**4.5493**						**NO**	**NO**	**NE, NO**	
A. Enteric fermentation		26.1360										
B. Manure management		2.8336	1.1950								NO	
C. Rice cultivation		NO										
D. Agricultural soils			3.3543									
E. Prescribed burning of savannas		NO	NO						NO	NO	NO	
F. Field burning of agricultural residues		IE	IE						IE	IE	NO, NE	
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	**-1093.0947**	**0.0261**	**0.6385**						**0.0171**	**0.6123**	**NE**	
A. Forest land	-2159.4439	0.0246	0.0014						0.0157	0.5597	NE	
B. Cropland	1392.3816	0.0015	0.0026						0.0014	0.0526	NE	
C. Grassland	-418.4569	NE	NE						NE	NE	NE	
D. Wetlands	-82.7917	NE	NE						NE	NE	NE	
E. Settlements	39.1617	NE	0.6345						NE	NE	NE	
F. Other land	86.8192	NE	NE						NE	NE	NE	
G. Harvested wood products	49.2353											
H. Other	NO	NO	NO						NO	NO	NO	
5. Waste	**15.6434**	**53.8343**	**0.2342**						**0.1559**	**2.7094**	**2.3056**	**0.0057**
A. Solid waste disposal	NA, NO	43.4869							NA, NO	NA, NO	2.2355	
B. Biological treatment of solid waste		NO, NE	NO, NE						NO, NE	NO, NE	NO, NE	
C. Incineration and open burning of waste	15.6434	0.3198	0.0056						0.1559	2.7094	0.0602	0.0057
D. Wastewater treatment and discharge		10.0277	0.2286						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	**218.4141**	**0.0058**	**0.0070**						**0.9076**	**0.4463**	**0.2200**	**0.0693**
Aviation	218.4141	0.0058	0.0070						0.9076	0.4463	0.2200	0.0693
Navigation	NO	NO	NO						NO	NO	NO	NO
Multilateral operations	**NO**	**NO**	**NO**						**NO**	**NO**	**NO**	**NO**
CO_2 emissions from biomass	1439.5226											
CO_2 captured	NO											
Long-term storage of C in waste disposal sites	NO											
Indirect N_2O			**0.9192**									
Indirect CO_2	**79.5560**											

2016

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	**8545.8253**	**113.4198**	**7.0461**	**175.5848**	**0.0403**	**NO**	**0.0000**	**NO**	**24.0494**	**89.6457**	**52.8600**	**12.0308**
1. Energy	**9032.6132**	**29.7056**	**0.5100**						**22.2698**	**84.9869**	**12.8957**	**11.3492**
A. Fuel combustion Reference approach	8970.2547											
Sectoral approach	9030.9428	5.2620	0.2128						22.2698	84.9869	12.1865	11.3492
1. Energy industries	4518.9699	0.0908	0.0162						7.1984	2.7454	0.1872	4.3305
2. Manufacturing industries and construction	500.7010	0.0199	0.0027						0.8499	1.2769	0.2685	1.0313
3. Transport	2331.5969	0.4819	0.1318						9.7662	19.1661	2.5173	3.6073
4. Other sectors	1677.5744	4.6692	0.0620						4.4456	61.7768	9.2109	2.3703
5. Other	2.1005	0.0002	0.0001						0.0097	0.0217	0.0026	0.0098
B. Fugitive emissions from fuels	1.6704	24.4436	0.2972						0.0000	0.0000	0.7092	0.0000
1. Solid fuels	NO	NO	NO						NO	NO	NO	NO
2. Oil and natural gas and other emissions from energy production	1.6704	24.4436	0.2972						0.0000	0.0000	0.7092	0.0000
C. CO_2 Transport and storage	NO											
2. Industrial processes and product use	**585.1146**	**NO**	**NO**	**175.5848**	**0.0403**	**NO**	**0.0000**	**NO**	**1.6158**	**1.6323**	**37.8661**	**0.6760**
A. Mineral industry	500.5774								1.5895	1.2591	0.0157	0.6655
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	78.6128	NO	NO						0.0055	0.0313	32.3532	0.0028
E. Electronic industry				NO	NO	NO	NO	NO				
F. Product uses as substitutes for ODS				175.5848	NO	NO	NO	NO				
G. Other product manufacture and use	0.7041	NO	NO	NO	0.0403	NO	0.0000	NO	0.0040	0.1216	0.3200	NO
H. Other									NO	NO	5.1565	NO
3. Agriculture	**12.2747**	**28.7044**	**5.6999**						**NO**	**NO**	**NE, NO**	
A. Enteric fermentation		25.9708										
B. Manure management		2.7337	1.2507								NO	
C. Rice cultivation		NO										
D. Agricultural soils			4.4492									
E. Prescribed burning of savannas		NO	NO						NO	NO	NO	
F. Field burning of agricultural residues		IE	IE						IE	IE	NO, NE	
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	**-1099.6373**	**0.0143**	**0.6016**						**0.0097**	**0.3468**	**NE**	
A. Forest land	-2113.5468	0.0123	0.0007						0.0079	0.2809	NE	
B. Cropland	1393.2356	0.0019	0.0026						0.0018	0.0658	NE	
C. Grassland	-402.3693	NE	NE						NE	NE	NE	
D. Wetlands	-82.7917	NE	NE						NE	NE	NE	
E. Settlements	19.3071	NE	0.5983						NE	NE	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)			
F. Other land	85.6461	NE	NE						NE	NE	NE	
G. Harvested wood products	0.8816											
H. Other	NO	NO	NO						NO	NO	NO	
5. Waste	**15.4600**	**54.9955**	**0.2347**						**0.1541**	**2.6797**	**2.0983**	**0.0056**
A. Solid waste disposal	NA, NO	44.6069							NA, NO	NA, NO	2.0288	
B. Biological treatment of solid waste		NO, NE	NO, NE						NO, NE	NO, NE	NO, NE	
C. Incineration and open burning of waste	15.4600	0.3161	0.0056						0.1541	2.6797	0.0595	0.0056
D. Wastewater treatment and discharge		10.0725	0.2291						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	**313.0386**	**0.0063**	**0.0100**						1.3124	0.6066	0.2929	0.0993
Aviation	313.0386	0.0063	0.0100						1.3124	0.6066	0.2929	0.0993
Navigation	NO	NO	NO						NO	NO	NO	NO
Multilateral operations	**NO**	**NO**	**NO**						**NO**	**NO**	**NO**	**NO**
CO_2 emissions from biomass	1561.9690											
CO_2 captured	NO											
Long-term storage of C in waste disposal sites	NE											
Indirect N_2O			**1.1410**									
Indirect CO_2	**71.4341**											

Annex 6-7. Summary Reports for GHG Emissions in CO_2 equivalent in the Republic of Moldova within 1990-2016

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)	**35 170.1483**	**5 075.2004**	**3 145.8235**	NO	NO	NO	NO	NO	**43 391.1722**
1. Energy	**35 280.7915**	**978.2826**	**351.4407**						**36 610.5147**
A. Fuel Combustion (Sectoral approach)	35 280.1538	337.6576	187.5407						35 805.3520
1. Energy Industries	21 244.3119	12.2564	51.6374						21 308.2056
2. Manufacturing Industries and Construction	2 204.8457	2.4619	5.1008						2 212.4085
3. Transport	4 344.7615	33.0652	101.6275						4 479.4542
4. Other Sectors	7 372.2624	289.6015	27.8496						7 689.7135
5. Other	113.9722	0.2726	1.3253						115.5701
B. Fugitive Emissions from Fuels	0.6377	640.6250	163.9000						805.1627
1. Solid Fuels	NO	NO	NO						NO
2. Oil and Natural Gas	0.6377	640.6250	163.9000						805.1627
C. CO_2 Transport and Storage	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)								
2. Industrial Processes and Product Use	**1 572.2808**	**NO**	**0.0197**	**NO**	**NO**	**NO**	**NO**	**NO**	**1 572.3005**
A. Mineral Industry	1 306.2407								1 306.2407
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	3.1787	NO	0.0197	NO	NO	NO	NO	NO	3.1983
H. Other									
3. Agriculture	**0.5820**	**2 685.7899**	**2 534.2021**						**5 220.5740**
A. Enteric Fermentation		2 190.6944							2 190.6944
B. Manure Management		495.0955	1 116.6179						1 611.7134
C. Rice Cultivation		NO							NO
D. Agricultural Soils			1 417.5842						1 417.5842
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
J. Other	NO	NO	NO						NO
4. LULUCF	**-1 700.6120**	**2.6534**	**170.3740**						**-1 527.5846**
A. Forest Land	-2 563.4328	0.2072	0.1366						-2 563.0889
B. Cropland	2 508.9630	2.4461	10.4407						2 521.8498
C. Grassland	-1 205.6938	NE	NE						-1 205.6938
D. Wetlands	-555.3798	NE	NE						-555.3798
E. Settlements	84.7480	NE	159.7967						244.5446
F. Other Land	152.3638	NE	NE						152.3638
G. Harvested Wood Products	-122.1804								-122.1804
H. Other	NO	NO	NO						NO
5. Waste	**17.1060**	**1 408.4745**	**89.7870**						**1 515.3675**
A. Solid Waste Disposal	NA, NO	1 046.7277							1 046.7277
B. Biological Treatment of Solid Waste		NO, NE	NO, NE						NO, NE
C. Incineration and Open Burning of Waste	17.1060	8.7818	1.8371						27.7249
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	**216.5837**	**0.2618**	**2.0881**						**218.9336**

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)								
Aviation	216.5837	0.2618	2.0881						218.9336
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	NO								NO
Indirect N_2O			585.1195						585.1195
Indirect CO_2	207.3247								207.3247
Total (without LULUCF)									**44 918.7567**
Total (with LULUCF)									**43 391.1722**

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)	**30 196.2180**	**5 002.4612**	**2 987.6761**	**NO**	**NO**	**NO**	**NO**	**NO**	**38 186.3553**
1. Energy	**31 560.0966**	**1 105.3381**	**304.1812**						**32 969.6160**
A. Fuel Combustion (Sectoral approach)	31 559.4826	343.0236	160.4881						32 062.9943
1. Energy Industries	18 873.0209	10.5503	46.5335						18 930.1047
2. Manufacturing Industries and Construction	1 485.7792	1.5787	3.3622						1 490.7200
3. Transport	3 299.6478	24.9141	81.0777						3 405.6396
4. Other Sectors	7 794.6662	305.7997	28.4916						8 128.9575
5. Other	106.3685	0.1809	1.0231						107.5724
B. Fugitive Emissions from Fuels	0.6140	762.3145	143.6932						906.6216
1. Solid Fuels	NO	NO	NO						NO
2. Oil and Natural Gas	0.6140	762.3145	143.6932						906.6216
C. CO_2 Transport and Storage	NO								NO
2. Industrial Processes and Product Use	**1 394.6352**	**NO**	**0.0164**	**NO**	**NO**	**NO**	**NO**	**NO**	**1 394.6516**
A. Mineral Industry	1 173.7238								1 173.7238
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
G. Other Product Manufacture and Use	2.8632	NO	0.0164	NO	NO	NO	NO	NO	2.8795
H. Other									
3. Agriculture	**0.5226**	**2 445.7301**	**2 416.5879**						**4 862.8405**
A. Enteric Fermentation		2 030.6501							2 030.6501

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. Manure Management		415.0799	1 042.7426						1 457.8226
C. Rice Cultivation		NO							NO
D. Agricultural Soils			1 373.8453						1 373.8453
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
J. Other	NO	NO	NO						NO
4. LULUCF	**-2 776.1620**	**2.3998**	**183.8820**						**-2 589.8802**
A. Forest Land	-2 343.3131	0.0347	0.0229						-2 343.2556
B. Cropland	1 380.4637	2.3651	9.9806						1 392.8094
C. Grassland	-1 414.3167	NE	NE						-1 414.3167
D. Wetlands	-526.4627	NE	NE						-526.4627
E. Settlements	88.7139	NE	173.8786						262.5924
F. Other Land	152.3638	NE	NE						152.3638
G. Harvested Wood Products	-113.6108								-113.6108
H. Other	NO	NO	NO						NO
5. Waste	**17.1256**	**1 448.9932**	**83.0085**						**1 549.1274**
A. Solid Waste Disposal	NA, NO	1 098.6185							1 098.6185
B. Biological Treatment of Solid Waste		NO, NE	NO, NE						NO, NE
C. Incineration and Open Burning of Waste	17.1256	8.7912	1.8391						27.7559
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	**232.8535**	**0.2815**	**2.2450**						**235.3800**
Aviation	232.8535	0.2815	2.2450						235.3800
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	NO								NO
Indirect N_2O			542.1572						542.1572
Indirect CO_2	170.6429								170.6429
Total (without LULUCF)									**40 776.2355**
Total (with LULUCF)									**38 186.3553**

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)	**23 688.7639**	**4 723.8238**	**2 516.4325**	**NO**	**NO**	**NO**	**NO**	**NO**	**30 929.0202**
1. Energy	**25 040.7269**	**896.1442**	**203.6611**						**26 140.5321**
A. Fuel Combustion (Sectoral approach)	25 040.2094	206.0371	119.0168						25 365.2633
1. Energy Industries	15 608.8471	8.9238	36.2950						15 654.0659
2. Manufacturing Industries and Construction	1 064.8093	1.1404	2.3983						1 068.3480
3. Transport	2 320.9288	17.4287	61.2910						2 399.6485
4. Other Sectors	5 967.8768	178.4291	18.3613						6 164.6672
5. Other	77.7474	0.1152	0.6712						78.5337
B. Fugitive Emissions from Fuels	0.5175	690.1071	84.6442						775.2688
1. Solid Fuels	NO	NO	NO						NO
2. Oil and Natural Gas	0.5175	690.1071	84.6442						775.2688
C. CO_2 Transport and Storage	NO								NO
2. Industrial Processes and Product Use	**808.8996**	**NO**	**0.0149**	**NO**	**NO**	**NO**	**NO**	**NO**	**808.9145**
A. Mineral Industry	628.3873								628.3873
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	2.2573	NO	0.0149	NO	NO	NO	NO	NO	2.2722
H. Other									
3. Agriculture	**0.3905**	**2 367.6699**	**2 031.8910**						**4 399.9514**
A. Enteric Fermentation		1 994.4621							1 994.4621
B. Manure Management		373.2078	935.4783						1 308.6861
C. Rice Cultivation		NO							NO
D. Agricultural Soils			1 096.4127						1 096.4127
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
J. Other	NO	NO	NO						NO
4. LULUCF	**-2 178.3822**	**2.1973**	**204.6518**						**-1 971.5330**
A. Forest Land	-2 184.2404	0.0380	0.0250						-2 184.1774
B. Cropland	1 318.7877	2.1593	9.5721						1 330.5192
C. Grassland	-1 428.4835	NE	NE						-1 428.4835
D. Wetlands	-595.5455	NE	NE						-595.5455
E. Settlements	386.6196	NE	195.0547						581.6742
F. Other Land	418.7786	NE	NE						418.7786

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. Harvested Wood Products	-94.2986								-94.2986
H. Other	NO	NO	NO						NO
5. Waste	**17.1291**	**1 457.8123**	**76.2137**						**1 551.1552**
A. Solid Waste Disposal	NA, NE	1 141.9561							1 141.9561
B. Biological Treatment of Solid Waste		NO, NE	NO, NE						NO, NE
C. Incineration and Open Burning of Waste	17.1291	8.7923	1.8394						27.7607
D. Wastewater Treatment and Discharge		307.0640	74.3744						381.4383
E. Other	NO	NO	NO						NO
6. Other	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	NO
Memo Items									
International Bunkers	**96.2944**	**0.1164**	**0.9284**						**97.3393**
Aviation	96.2944	0.1164	0.9284						97.3393
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	NO								NO
Indirect N_2O			452.4587						452.4587
Indirect CO_2	140.7804								140.7804
Total (without LULUCF)									**32 900.5532**
Total (with LULUCF)									**30 929.0202**

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)	**15 865.1656**	**4 363.6154**	**2 510.9771**	**NO**	**NO**	**NO**	**NO**	**NO**	**22 739.7581**
1. Energy	**17 349.6063**	**685.8740**	**137.5203**						**18 173.0006**
A. Fuel Combustion (Sectoral approach)	17 349.1681	65.8080	92.7285						17 507.7046
1. Energy Industries	12 601.5386	7.0406	31.4960						12 640.0753
2. Manufacturing Industries and Construction	682.7002	0.7424	1.5263						684.9689
3. Transport	1 699.5673	11.8028	51.5306						1 762.9007
4. Other Sectors	2 271.9102	46.0765	7.4465						2 325.4332
5. Other	93.4518	0.1456	0.7291						94.3265
B. Fugitive Emissions from Fuels	0.4382	620.0660	44.7918						665.2960
1. Solid Fuels	NO	NO	NO						NO
2. Oil and Natural Gas	0.4382	620.0660	44.7918						665.2960
C. CO_2 Transport and Storage	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)								
2. Industrial Processes and Product Use	**724.8725**	**NO**	**0.0179**	**NO**	**NO**	**NO**	**NO**	**NO**	**724.8904**
A. Mineral Industry	574.7172								574.7172
B. Chemical Industry	NO	NO	NO						NO
C. Metal Industry	24.4250	NO	NO	NO	NO	NO	NO	NO	24.4250
D. Non-Eergy 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	1.8544	NO	0.0179	NO	NO	NO	NO	NO	1.8723
H. Other									
3. Agriculture	**0.1276**	**2 150.2757**	**2 079.2669**						**4 229.6703**
A. Enteric Fermentation		1 875.3295							1 875.3295
B. Manure Management		274.9462	815.3185						1 090.2647
C. Rice Cultivation		NO							NO
D. Agricultural Soils			1 263.9484						1 263.9484
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	**-2 226.5422**	**2.9467**	**222.5703**						**-2 001.0251**
A. Forest Land	-2 193.5115	0.0026	0.0017						-2 193.5072
B. Cropland	1 581.1497	2.9441	9.7649						1 593.8588
C. Grassland	-1 303.5202	NE	NE						-1 303.5202
D. Wetlands	-525.8447	NE	NE						-525.8447
E. Settlements	114.6181	NE	212.8037						327.4218
F. Other Land	164.0168	NE	NE						164.0168
G. Harvested Wood Products	-63.4504								-63.4504
H. Other	NO	NO	NO						NO
5. Waste	**17.1013**	**1 524.5190**	**71.6016**						**1 613.2220**
A. Solid Waste Disposal	NA, NO	1 204.7183							1 204.7183
B. Biological Treatment of Solid Waste		NO, NE	NO, NE						NO, NE
C. Incineration and Open Burning of Waste	17.1013	8.7772	1.8363						27.7148
D. Wastewater Treatment and Discharge		311.0235	69.7653						380.7889
E. Other	NO	NO	NO						NO
6. Other	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	NO
Memo Items									
International Bunkers	**62.1153**	**0.0751**	**0.5989**						**62.7892**

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)								
Aviation	62.1153	0.0751	0.5989						62.7892
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	NO								NO
Indirect N_2O			429.1426						429.1426
Indirect CO_2	112.0762								112.0762
Total (without LULUCF)									**24 740.7832**
Total (with LULUCF)									**22 739.7581**

1994

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 (k)								
Total (net emissions)	**12 811.9109**	**4 276.5942**	**2 048.7407**	**NO**	**NO**	**NO**	**NO**	**NO**	**19 137.2457**
1. Energy	**14 385.1477**	**674.7702**	**87.3618**						**15 147.2796**
A. Fuel Combustion (Sectoral approach)	14 384.7392	77.9845	66.0324						14 528.7561
1. Energy Industries	9 928.6683	4.7059	25.9702						9 959.3444
2. Manufacturing Industries and Construction	791.2803	0.5077	0.7967						792.5847
3. Transport	1 485.6786	10.6126	31.1152						1 527.4063
4. Other Sectors	2 090.7472	61.9867	7.6673						2 160.4012
5. Other	88.3648	0.1716	0.4830						89.0194
B. Fugitive Emissions from Fuels	0.4085	596.7856	21.3295						618.5236
1. Solid Fuels	NO	NO	NO						NO
2. Oil and Natural Gas	0.4085	596.7856	21.3295						618.5236
C. CO_2 Transport and Storage	NO								NO
2. Industrial Processes and Product Use	**548.7445**	**NO**	**0.0149**	**NO**	**NO**	**NO**	**NO**	**NO**	**548.7594**
A. Mineral Industry	437.5899								437.5899
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	1.3519	NO	0.0149	NO	NO	NO	NO	NO	1.3668
H. Other									
3. Agriculture	**0.0537**	**2 090.6519**	**1 655.2645**						**3 745.9701**
A. Enteric Fermentation		1 825.4206							1 825.4206

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 (k)								
B. Manure Management		265.2313	792.2223						1 057.4535
C. Rice Cultivation		NO							NO
D. Agricultural Soils			863.0423						863.0423
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	**-2 139.1679**	**1.6555**	**236.5414**						**-1 900.9711**
A. Forest Land	-2 108.0022	0.0578	0.0381						-2 107.9063
B. Cropland	1 378.5094	1.5977	7.9073						1 388.0144
C. Grassland	-1 577.3332	NE	NE						-1 577.3332
D. Wetlands	-497.6418	NE	NE						-497.6418
E. Settlements	130.4883	NE	228.5960						359.0843
F. Other Land	549.4579	NE	NE						549.4579
G. Harvested Wood Products	-14.6464								-14.6464
H. Other	NO	NO	NO						NO
5. Waste	**17.1330**	**1 509.5166**	**69.5580**						**1 596.2076**
A. Solid Waste Disposal	NA, NO	1 209.8012							1 209.8012
B. Biological Treatment of Solid Waste		NO, NE	NO, NE						NO, NE
C. Incineration and Open Burning of Waste	17.1330	8.7926	1.8396						27.7652
D. Wastewater Treatment and Discharge		290.9228	67.7185						358.6413
E. Other	NO	NO	NO						NO
6. Other	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	NO
Memo Items									
International Bunkers	**37.8367**	**0.0457**	**0.3648**						**38.2473**
Aviation	37.8367	0.0457	0.3648						38.2473
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	NO								NO
Indirect N_2O			344.3073						344.3073
Indirect CO_2	73.5058								73.5058
Total (without LULUCF)									**21 038.2168**
Total (with LULUCF)									**19 137.2457**

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)	**9 714.0200**	**4 046.4403**	**2 172.1813**	**3.9514**	**NO**	**NO**	**NO**	**NO**	**15 936.5931**
1. Energy	**11 372.9604**	**709.9851**	**74.4222**						**12 157.3676**
A. Fuel Combustion (Sectoral approach)	11 372.5410	48.5969	53.0927						11 474.2307
1. Energy Industries	7 142.1394	3.4107	14.9369						7 160.4871
2. Manufacturing Industries and Construction	439.7389	0.3481	0.5902						440.6772
3. Transport	1 498.3876	10.8380	30.0557						1 539.2813
4. Other Sectors	2 166.6313	33.7413	6.8630						2 207.2356
5. Other	125.6438	0.2589	0.6468						126.5495
B. Fugitive Emissions from Fuels	0.4194	661.3881	21.3295						683.1369
1. Solid Fuels	NO	NO	NO						NO
2. Oil and Natural Gas	0.4194	661.3881	21.3295						683.1369
C. CO_2 Transport and Storage	NO								NO
2. Industrial Processes and Product Use	**446.5790**	**NO**	**0.0003**	**3.9514**	**NO**	**NO**	**NO**	**NO**	**450.5308**
A. Mineral Industry	342.6866								342.6866
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	76.5608	NO	NO						76.5608
E. Electronic Industry				NO	NO	NO	NO	NO	NO
F. Product Use as Substitutes for ODS				3.9514	NO	NO	NO	NO	3.9514
G. Other Product Manufacture and Use	1.0947	NO	0.0003	NO	NO	NO	NO	NO	1.0950
H. Other									
3. Agriculture	**0.0607**	**1 827.0086**	**1 775.8460**						**3 602.9153**
A. Enteric Fermentation		1 620.7325							1 620.7325
B. Manure Management		206.2761	732.9723						939.2484
C. Rice Cultivation		NO							NO
D. Agricultural Soils			1 042.8737						1 042.8737
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	**-2 122.7016**	**2.2396**	**251.5155**						**-1 868.9465**
A. Forest Land	-2 045.0670	0.0033	0.0022						-2 045.0615
B. Cropland	1 478.8872	2.2363	8.0566						1 489.1801
C. Grassland	-1 601.1004	NE	NE						-1 601.1004
D. Wetlands	-469.4389	NE	NE						-469.4389
E. Settlements	106.9167	NE	243.4567						350.3734
F. Other Land	401.1281	NE	NE						401.1281

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. Harvested Wood Products	5.9727								5.9727
H. Other	NO	NO	NO						NO
5. Waste	**17.1216**	**1 507.2070**	**70.3974**						**1 594.7260**
A. Solid Waste Disposal	NA, NO	1 209.1757							1 209.1757
B. Biological Treatment of Solid Waste		NO, NE	NO, NE						NO, NE
C. Incineration and Open Burning of Waste	17.1216	8.7859	1.8382						27.7458
D. Wastewater Treatment and Discharge		289.2454	68.5592						357.8046
E. Other	NO	NO	NO						NO
6. Other	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	NO
Memo Items									
International Bunkers	**41.9184**	**0.1487**	**0.4001**						**42.4672**
Aviation	41.9184	0.1487	0.4001						42.4672
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	NO								NO
Indirect N_2O			360.0057						360.0057
Indirect CO_2	65.3743								65.3743
Total (without LULUCF)									**17 805.5396**
Total (with LULUCF)									**15 936.5931**

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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)	**9 134.8072**	**3 985.7328**	**2 114.4288**	**4.2815**	**NO**	**NO**	**NO**	**NO**	**15 239.2504**
1. Energy	**11 259.1406**	**793.1311**	**76.8402**						**12 129.1119**
A. Fuel Combustion (Sectoral approach)	11 258.6680	74.2436	52.1430						11 385.0545
1. Energy Industries	7 074.2917	3.3675	13.9569						7 091.6162
2. Manufacturing Industries and Construction	369.3794	0.3389	0.5917						370.3100
3. Transport	1 451.6525	10.4609	28.5671						1 490.6804
4. Other Sectors	2 281.5067	59.8034	8.3344						2 349.6445
5. Other	81.8376	0.2730	0.6929						82.8034
B. Fugitive Emissions from Fuels	0.4726	718.8875	24.6973						744.0574
1. Solid Fuels	NO	NO	NO						NO
2. Oil and Natural Gas	0.4726	718.8875	24.6973						744.0574
C. CO_2 Transport and Storage	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)								
2. Industrial Processes and Product Use	**405.4054**	**NO**	**0.0006**	**4.2815**	**NO**	**NO**	**NO**	**NO**	**409.6875**
A. Mineral Industry	306.5696								306.5696
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	71.0711	NO	NO						71.0711
E. Electronic Industry				NO	NO	NO	NO	NO	NO
F. Product Use as Substitutes for ODS				4.2815	NO	NO	NO	NO	4.2815
G. Other Product Manufacture and Use	1.0386	NO	0.0006	NO	NO	NO	NO	NO	1.0392
H. Other									
3. Agriculture	**0.0911**	**1 678.5535**	**1 705.9690**						**3 384.6136**
A. Enteric Fermentation		1 491.1578							1 491.1578
B. Manure Management		187.3957	774.0215						961.4172
C. Rice Cultivation		NO							NO
D. Agricultural Soils			931.9476						931.9476
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
J. Other	NO	NO	NO						NO
4. LULUCF	**-2 546.9382**	**1.5410**	**262.2576**						**-2 283.1395**
A. Forest Land	-2 190.4337	0.0193	0.0127						-2 190.4016
B. Cropland	1 312.1146	1.5217	5.7712						1 319.4075
C. Grassland	-1 548.0826	NE	NE						-1 548.0826
D. Wetlands	-441.2360	NE	NE						-441.2360
E. Settlements	101.5910	NE	256.4737						358.0647
F. Other Land	217.3293	NE	NE						217.3293
G. Harvested Wood Products	1.7792								1.7792
H. Other	NO	NO	NO						NO
5. Waste	**17.1083**	**1 512.5072**	**69.3613**						**1 598.9768**
A. Solid Waste Disposal	NA, NO	1 216.7829							1 216.7829
B. Biological Treatment of Solid Waste		NO, NE	NO, NE						NO, NE
C. Incineration and Open Burning of Waste	17.1083	8.7782	1.8367						27.7232
D. Wastewater Treatment and Discharge		286.9461	67.5246						354.4707
E. Other	NO	NO	NO						NO
6. Other	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	NO
Memo Items									
International Bunkers	**65.8650**	**0.1196**	**0.6300**						**66.6146**

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)								
Aviation	65.8650	0.1196	0.6300						66.6146
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	NO								NO
Indirect N_2O			347.3515						347.3515
Indirect CO_2	60.4993								60.4993
Total (without LULUCF)									**17 522.3899**
Total (with LULUCF)									**15 239.2504**

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)	**8 528.1893**	**3 598.3175**	**2 163.2702**	**5.1070**	**NO**	**NO**	**NO**	**NO**	**14 294.8840**
1. Energy	**10 212.0544**	**650.7319**	**73.6559**						**10 936.4422**
A. Fuel Combustion (Sectoral approach)	10 211.5893	59.6627	44.4682						10 315.7202
1. Energy Industries	5 583.3634	2.7548	7.2685						5 593.3867
2. Manufacturing Industries and Construction	588.3594	0.5009	0.7940						589.6544
3. Transport	1 469.7744	11.5768	28.3666						1 509.7178
4. Other Sectors	2 493.4333	44.6285	7.4438						2 545.5057
5. Other	76.6587	0.2017	0.5953						77.4557
B. Fugitive Emissions from Fuels	0.4651	591.0693	29.1877						620.7220
1. Solid Fuels	NO	NO	NO						NO
2. Oil and Natural Gas	0.4651	591.0693	29.1877						620.7220
C. CO_2 Transport and Storage	NO								NO
2. Industrial Processes and Product Use	**446.3084**	**NO**	**0.0009**	**5.1070**	**NO**	**NO**	**NO**	**NO**	**451.4163**
A. Mineral Industry	370.9362								370.9362
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	42.0527	NO	NO						42.0527
E. Electronic Industry				NO	NO	NO	NO	NO	NO
F. Product Use as Substitutes for ODS				5.1070	NO	NO	NO	NO	5.1070
G. Other Product Manufacture and Use	0.9389	NO	0.0009	NO	NO	NO	NO	NO	0.9398
H. Other									
3. Agriculture	**1.0992**	**1 437.2403**	**1 746.8398**						**3 185.1794**
A. Enteric Fermentation		1 285.0760							1 285.0760

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. Manure Management		152.1643	597.0533						749.2176
C. Rice Cultivation		NO							NO
D. Agricultural Soils			1 149.7865						1 149.7865
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
J. Other	NO	NO	NO						NO
4. LULUCF	**-2 148.3338**	**2.6880**	**272.1818**						**-1 873.4640**
A. Forest Land	-2 232.2854	0.0059	0.0039						-2 232.2757
B. Cropland	1 628.0567	2.6821	3.4635						1 634.2023
C. Grassland	-1 400.8607	NE	NE						-1 400.8607
D. Wetlands	-413.0332	NE	NE						-413.0332
E. Settlements	100.7954	NE	268.7144						369.5098
F. Other Land	188.2363	NE	NE						188.2363
G. Harvested Wood Products	-19.2429								-19.2429
H. Other	NO	NO	NO						NO
5. Waste	**17.0610**	**1 507.6573**	**70.5918**						**1 595.3101**
A. Solid Waste Disposal	NA, NO	1 203.8019							1 203.8019
B. Biological Treatment of Solid Waste		NO, NE	NO, NE						NO, NE
C. Incineration and Open Burning of Waste	17.0610	8.7529	1.8315						27.6455
D. Wastewater Treatment and Discharge		295.1025	68.7603						363.8628
E. Other	NO	NO	NO						NO
6. Other	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	NO
Memo Items									
International Bunkers	**75.6418**	**0.1341**	**0.7235**						**76.4994**
Aviation	75.6418	0.1341	0.7235						76.4994
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	NO								NO
Indirect N_2O			349.3554						349.3554
Indirect CO_2	32.0316								32.0316
Total (without LULUCF)									**16 168.3480**
Total (with LULUCF)									**14 294.8840**

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)	**7 000.6810**	**3 456.2975**	**1 997.7927**	**6.0624**	**NO**	**NO**	**NO**	**NO**	**12 460.8336**
1. Energy	**8 789.7567**	**595.9576**	**64.7736**						**9 450.4879**
A. Fuel Combustion (Sectoral approach)	8 789.3294	42.8333	36.7086						8 868.8713
1. Energy Industries	4 806.4261	2.3913	5.6464						4 814.4638
2. Manufacturing Industries and Construction	566.7379	0.4921	0.7802						568.0101
3. Transport	1 273.6172	9.8924	23.5421						1 307.0517
4. Other Sectors	2 069.7199	29.8364	6.1110						2 105.6673
5. Other	72.8283	0.2211	0.6289						73.6783
B. Fugitive Emissions from Fuels	0.4274	553.1242	28.0651						581.6167
1. Solid Fuels	NO	NO	NO						NO
2. Oil and Natural Gas	0.4274	553.1242	28.0651						581.6167
C. CO_2 Transport and Storage	NO								NO
2. Industrial Processes and Product Use	**371.0737**	**NO**	**0.0015**	**6.0624**	**NO**	**NO**	**NO**	**NO**	**377.1376**
A. Mineral Industry	304.0902								304.0902
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	37.5993	NO	NO						37.5993
E. Electronic Industry				NO	NO	NO	NO	NO	NO
F. Product Use as Substitutes for ODS				6.0624	NO	NO	NO	NO	6.0624
G. Other Product Manufacture and Use	0.7020	NO	0.0015	NO	NO	NO	NO	NO	0.7035
H. Other									
3. Agriculture	**0.2721**	**1 375.2311**	**1 577.0224**						**2 952.5257**
A. Enteric Fermentation		1 247.5198							1 247.5198
B. Manure Management		127.7113	578.0598						705.7711
C. Rice Cultivation		NO							NO
D. Agricultural Soils			998.9626						998.9626
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
J. Other	NO	NO	NO						NO
4. LULUCF	**-2 177.5062**	**2.4720**	**284.3568**						**-1 890.6774**
A. Forest Land	-2 288.4857	0.0581	0.0383						-2 288.3892
B. Cropland	1 657.1571	2.4139	3.2690						1 662.8400
C. Grassland	-1 436.2698	NE	NE						-1 436.2698
D. Wetlands	-384.8303	NE	NE						-384.8303
E. Settlements	99.0440	NE	281.0494						380.0933
F. Other Land	185.0077	NE	NE						185.0077

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. Harvested Wood Products	-9.1293								-9.1293
H. Other	NO	NO	NO						NO
5. Waste	**17.0846**	**1 482.6368**	**71.6384**						**1 571.3598**
A. Solid Waste Disposal	NA, NO	1 189.3544							1 189.3544
B. Biological Treatment of Solid Waste		NO, NE	NO, NE						NO, NE
C. Incineration and Open Burning of Waste	17.0846	8.7641	1.8339						27.6826
D. Wastewater Treatment and Discharge		284.5183	69.8045						354.3228
E. Other	NO	NO	NO						NO
6. Other	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	NO
Memo Items									
International Bunkers	**72.4923**	**0.1025**	**0.6940**						**73.2888**
Aviation	72.4923	0.1025	0.6940						73.2888
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	NO								NO
Indirect N_2O			311.6572						311.6572
Indirect CO_2	29.8821								29.8821
Total (without LULUCF)									**14 351.5111**
Total (with LULUCF)									**12 460.8336**

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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)	**5 786.1209**	**3 346.6886**	**1 854.4088**	**6.8017**	**NO**	**NO**	**NO**	**NO**	**10 994.0200**
1. Energy	**7 328.4925**	**599.1797**	**60.6770**						**7 988.3492**
A. Fuel Combustion (Sectoral approach)	7 328.0994	39.0672	25.8763						7 393.0429
1. Energy Industries	4 133.6361	1.9915	4.7780						4 140.4056
2. Manufacturing Industries and Construction	488.2612	0.3428	0.5083						489.1123
3. Transport	855.4540	6.0249	14.6629						876.1417
4. Other Sectors	1 801.5918	30.5458	5.4448						1 837.5824
5. Other	49.1563	0.1623	0.4823						49.8010
B. Fugitive Emissions from Fuels	0.3931	560.1125	34.8007						595.3063
1. Solid Fuels	NO	NO	NO						NO
2. Oil and Natural Gas	0.3931	560.1125	34.8007						595.3063
C. CO_2 Transport and Storage	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)								
2. Industrial Processes and Product Use	**334.1373**	**NO**	**0.0128**	**6.8017**	**NO**	**NO**	**NO**	**NO**	**340.9518**
A. Mineral Industry	270.1228								270.1228
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	31.6142	NO	NO						31.6142
E. Electronic Industry				NO	NO	NO	NO	NO	NO
F. Product Use as Substitutes for ODS				6.8017	NO	NO	NO	NO	6.8017
G. Other Product Manufacture and Use	0.6062	NO	0.0128	NO	NO	NO	NO	NO	0.6190
H. Other									
3. Agriculture	**0.0034**	**1 266.4842**	**1 429.7300**						**2 696.2176**
A. Enteric Fermentation		1 154.1817							1 154.1817
B. Manure Management		112.3024	524.7140						637.0164
C. Rice Cultivation		NO							NO
D. Agricultural Soils			905.0161						905.0161
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
J. Other	NO	NO	NO						NO
4. LULUCF	**-1 893.5700**	**2.3889**	**293.8604**						**-1 597.3208**
A. Forest Land	-2 336.8468	0.0435	0.0287						-2 336.7747
B. Cropland	1 677.6681	2.3454	3.2479						1 683.2614
C. Grassland	-1 433.2865	NE	NE						-1 433.2865
D. Wetlands	-356.6274	NE	NE						-356.6274
E. Settlements	111.8259	NE	290.5838						402.4097
F. Other Land	425.1554	NE	NE						425.1554
G. Harvested Wood Products	18.5414								18.5414
H. Other	NO	NO	NO						NO
5. Waste	**17.0578**	**1 478.6359**	**70.1287**						**1 565.8223**
A. Solid Waste Disposal	NA, NO	1 195.2267							1 195.2267
B. Biological Treatment of Solid Waste		NO, NE	NO, NE						NO, NE
C. Incineration and Open Burning of Waste	17.0578	8.7492	1.8309						27.6378
D. Wastewater Treatment and Discharge		274.6600	68.2978						342.9578
E. Other	NO	NO	NO						NO
6. Other	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	NO
Memo Items									
International Bunkers	**72.4890**	**0.0994**	**0.6934**						**73.2819**

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)								
Aviation	72.4890	0.0994	0.6934						73.2819
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	NO								NO
Indirect N_2O			280.2693						280.2693
Indirect CO_2	26.2056								26.2056
Total (without LULUCF)									**12 591.3408**
Total (with LULUCF)									**10 994.0200**

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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)	**4 729.3456**	**3 263.8504**	**1 743.3757**	**8.3038**	**NO**	**NO**	**NO**	**NO**	**9 744.8755**
1. Energy	**6 584.0211**	**639.2872**	**65.5517**						**7 288.8600**
A. Fuel Combustion (Sectoral approach)	6 583.6452	38.6526	26.2606						6 648.5584
1. Energy Industries	3 607.4274	1.6900	4.1255						3 613.2428
2. Manufacturing Industries and Construction	531.0321	0.3118	0.4494						531.7932
3. Transport	920.5951	6.1129	16.2647						942.9727
4. Other Sectors	1 488.2025	30.4236	5.1191						1 523.7452
5. Other	36.3881	0.1145	0.3018						36.8044
B. Fugitive Emissions from Fuels	0.3759	600.6346	39.2911						640.3016
1. Solid Fuels	NO	NO	NO						NO
2. Oil and Natural Gas	0.3759	600.6346	39.2911						640.3016
C. CO_2 Transport and Storage	NO								NO
2. Industrial Processes and Product Use	**305.7865**	**NO**	**0.0131**	**8.3038**	**NO**	**NO**	**NO**	**NO**	**314.1033**
A. Mineral Industry	237.9796								237.9796
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	30.6392	NO	NO						30.6392
E. Electronic Industry				NO	NO	NO	NO	NO	NO
F. Product Use as Substitutes for ODS				8.3038	NO	NO	NO	NO	8.3038
G. Other Product Manufacture and Use	0.8987	NO	0.0131	NO	NO	NO	NO	NO	0.9118
H. Other									
3. Agriculture	**0.4397**	**1 170.6727**	**1 309.7359**						**2 480.8483**
A. Enteric Fermentation		1 085.6403							1 085.6403

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. Manure Management		85.0324	468.2084						553.2408
C. Rice Cultivation		NO							NO
D. Agricultural Soils			841.5274						841.5274
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
J. Other	NO	NO	NO						NO
4. LULUCF	**-2 177.9243**	**0.9123**	**296.3244**						**-1 880.6877**
A. Forest Land	-2 307.4384	0.0016	0.0010						-2 307.4358
B. Cropland	1 465.3794	0.9107	2.7057						1 468.9958
C. Grassland	-1 291.9495	NE	NE						-1 291.9495
D. Wetlands	-328.4245	NE	NE						-328.4245
E. Settlements	100.1768	NE	293.6176						393.7945
F. Other Land	178.5246	NE	NE						178.5246
G. Harvested Wood Products	5.8073								5.8073
H. Other	NO	NO	NO						NO
5. Waste	**17.0226**	**1 452.9783**	**71.7506**						**1 541.7515**
A. Solid Waste Disposal	NA, NO	1 169.5330							1 169.5330
B. Biological Treatment of Solid Waste		NO, NE	NO, NE						NO, NE
C. Incineration and Open Burning of Waste	17.0226	8.7300	1.8270						27.5796
D. Wastewater Treatment and Discharge		274.7153	69.9236						344.6389
E. Other	NO	NO	NO						NO
6. Other	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	NO
Memo Items									
International Bunkers	**66.2279**	**0.1086**	**0.6399**						**66.9765**
Aviation	66.2279	0.1086	0.6399						66.9765
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	NO								NO
Indirect N_2O			255.1670						255.1670
Indirect CO_2	26.5388								26.5388
Total (without LULUCF)									**11 625.5631**
Total (with LULUCF)									**9 744.8755**

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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)	**5 692.4617**	**3 249.0115**	**1 934.3068**	**10.4771**	**NO**	**NO**	**NO**	**NO**	**10 886.2572**
1. Energy	**7 180.7453**	**631.0773**	**80.8998**						**7 892.7224**
A. Fuel Combustion (Sectoral approach)	7 180.3360	35.5568	28.1375						7 244.0303
1. Energy Industries	4 101.5064	1.9679	4.3744						4 107.8487
2. Manufacturing Industries and Construction	611.5689	0.3806	0.5883						612.5378
3. Transport	995.4935	6.4923	17.9170						1 019.9028
4. Other Sectors	1 428.3712	26.5909	4.8978						1 459.8599
5. Other	43.3961	0.1253	0.3599						43.8813
B. Fugitive Emissions from Fuels	0.4092	595.5205	52.7623						648.6921
1. Solid Fuels	NO	NO	NO						NO
2. Oil and Natural Gas	0.4092	595.5205	52.7623						648.6921
C. CO_2 Transport and Storage	NO								NO
2. Industrial Processes and Product Use	**308.5598**	**NO**	**0.0131**	**10.4771**	**NO**	**NO**	**NO**	**NO**	**319.0500**
A. Mineral Industry	235.2359								235.2359
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	33.9235	NO	NO						33.9235
E. Electronic Industry				NO	NO	NO	NO	NO	NO
F. Product Use as Substitutes for ODS				10.4771	NO	NO	NO	NO	10.4771
G. Other Product Manufacture and Use	0.7730	NO	0.0131	NO	NO	NO	NO	NO	0.7861
H. Other									
3. Agriculture	**0.1496**	**1 191.5902**	**1 484.3183**						**2 676.0581**
A. Enteric Fermentation		1 105.6742							1 105.6742
B. Manure Management		85.9160	476.7359						562.6519
C. Rice Cultivation		NO							NO
D. Agricultural Soils			1 007.5824						1 007.5824
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
J. Other	NO	NO	NO						NO
4. LULUCF	**-1 813.9954**	**1.2702**	**296.5454**						**-1 516.1797**
A. Forest Land	-2 273.7027	0.0984	0.0649						-2 273.5395
B. Cropland	1 811.2281	1.1719	2.3489						1 814.7489
C. Grassland	-1 290.6541	NE	NE						-1 290.6541
D. Wetlands	-300.2217	NE	NE						-300.2217
E. Settlements	67.0898	NE	294.1316						361.2214
F. Other Land	178.5246	NE	NE						178.5246

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. Harvested Wood Products	-6.2594								-6.2594
H. Other	NO	NO	NO						NO
5. Waste	**17.0025**	**1 425.0738**	**72.5302**						**1 514.6064**
A. Solid Waste Disposal	NA, NO	1 137.4743							1 137.4743
B. Biological Treatment of Solid Waste		NO, NE	NO, NE						NO, NE
C. Incineration and Open Burning of Waste	17.0025	8.7185	1.8247						27.5456
D. Wastewater Treatment and Discharge		278.8810	70.7055						349.5865
E. Other	NO	NO	NO						NO
6. Other	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	NO
Memo Items									
International Bunkers	**61.8894**	**0.0978**	**0.5990**						**62.5861**
Aviation	61.8894	0.0978	0.5990						62.5861
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	NO								NO
Indirect N_2O			288.3473						288.3473
Indirect CO_2	29.1198								29.1198
Total (without LULUCF)									**12 402.4369**
Total (with LULUCF)									**10 886.2572**

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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)	**5 289.7042**	**3 301.5130**	**1 988.1076**	**14.5015**	**NO**	**NO**	**NO**	**NO**	**10 593.8263**
1. Energy	**6 815.4249**	**691.7368**	**90.5025**						**7 597.6642**
A. Fuel Combustion (Sectoral approach)	6 815.0348	44.6746	36.6176						6 896.3270
1. Energy Industries	3 347.8492	1.6823	3.9483						3 353.4798
2. Manufacturing Industries and Construction	424.4928	0.2557	0.3705						425.1190
3. Transport	1 261.2777	8.2741	26.0713						1 295.6232
4. Other Sectors	1 741.9621	34.2549	5.7577						1 781.9747
5. Other	39.4529	0.2076	0.4698						40.1303
B. Fugitive Emissions from Fuels	0.3901	647.0622	53.8849						701.3372
1. Solid Fuels	NO	NO	NO						NO
2. Oil and Natural Gas	0.3901	647.0622	53.8849						701.3372
C. CO_2 Transport and Storage	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)								
2. Industrial Processes and Product Use	**357.7976**	**NO**	**0.0131**	**14.5015**	**NO**	**NO**	**NO**	**NO**	**372.3123**
A. Mineral Industry	300.3739								300.3739
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	36.1900	NO	NO						36.1900
E. Electronic Industry				NO	NO	NO	NO	NO	NO
F. Product Use as Substitutes for ODS				14.5015	NO	NO	NO	NO	14.5015
G. Other Product Manufacture and Use	0.7307	NO	0.0131	NO	NO	NO	NO	NO	0.7438
H. Other									
3. Agriculture	**0.0470**	**1 218.5383**	**1 526.2868**						**2 744.8721**
A. Enteric Fermentation		1 128.5903							1 128.5903
B. Manure Management		89.9480	480.2456						570.1936
C. Rice Cultivation		NO							NO
D. Agricultural Soils			1 046.0412						1 046.0412
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
J. Other	NO	NO	NO						NO
4. LULUCF	**-1 900.5120**	**0.2659**	**296.9504**						**-1 603.2957**
A. Forest Land	-2 267.6159	0.0528	0.0348						-2 267.5283
B. Cropland	1 407.6151	0.2131	1.9531						1 409.7812
C. Grassland	-1 235.1380	NE	NE						-1 235.1380
D. Wetlands	-272.0188	NE	NE						-272.0188
E. Settlements	67.0898	NE	294.9625						362.0523
F. Other Land	456.2431	NE	NE						456.2431
G. Harvested Wood Products	-56.6873								-56.6873
H. Other	NO	NO	NO						NO
5. Waste	**16.9466**	**1 390.9720**	**74.3548**						**1 482.2734**
A. Solid Waste Disposal	NA, NO	1 108.0606							1 108.0606
B. Biological Treatment of Solid Waste		NO, NE	NO, NE						NO, NE
C. Incineration and Open Burning of Waste	16.9466	8.6885	1.8185						27.4536
D. Wastewater Treatment and Discharge		274.2228	72.5363						346.7591
E. Other	NO	NO	NO						NO
6. Other	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	NO
Memo Items									
International Bunkers	**62.0647**	**0.0909**	**0.6047**						**62.7602**

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)								
Aviation	62.0647	0.0909	0.6047						62.7602
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	NO								NO
Indirect N_2O			298.6851						298.6851
Indirect CO_2	31.1517								31.1517
Total (without LULUCF)									**12 197.1220**
Total (with LULUCF)									**10 593.8263**

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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)	**6 044.9776**	**3 206.5230**	**1 744.6055**	**20.8415**	**NO**	**0.0071**	**NO**	**NO**	**11 016.9547**
1. Energy	**7 469.8555**	**733.4034**	**93.5203**						**8 296.7792**
A. Fuel Combustion (Sectoral approach)	7 468.7964	56.9407	37.3888						7 563.1258
1. Energy Industries	3 431.0444	1.7037	3.8761						3 436.6241
2. Manufacturing Industries and Construction	452.5663	0.2618	0.3778						453.2059
3. Transport	1 477.1995	9.7390	25.5334						1 512.4719
4. Other Sectors	2 079.5633	45.1299	7.3230						2 132.0162
5. Other	28.4228	0.1063	0.2785						28.8076
B. Fugitive Emissions from Fuels	1.0592	676.4627	56.1315						733.6534
1. Solid Fuels	NO	NO	NO						NO
2. Oil and Natural Gas	1.0592	676.4627	56.1315						733.6534
C. CO_2 Transport and Storage	NO								NO
2. Industrial Processes and Product Use	**385.6075**	**NO**	**0.0131**	**20.8415**	**NO**	**0.0071**	**NO**	**NO**	**406.4693**
A. Mineral Industry	308.3700								308.3700
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	40.9211	NO	NO						40.9211
E. Electronic Industry				NO	NO	NO	NO	NO	NO
F. Product Use as Substitutes for ODS				20.8415	NO	NO	NO	NO	20.8415
G. Other Product Manufacture and Use	0.8881	NO	0.0131	NO	NO	0.0071	NO	NO	0.9083
H. Other									
3. Agriculture	**0.2381**	**1 114.7492**	**1 284.8654**						**2 399.8528**
A. Enteric Fermentation		1 031.0757							1 031.0757

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. Manure Management		83.6736	456.0074						539.6810
C. Rice Cultivation		NO							NO
D. Agricultural Soils			828.8580						828.8580
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
J. Other	NO	NO	NO						NO
4. LULUCF	**-1 827.6049**	**0.0612**	**294.3382**						**-1 533.2054**
A. Forest Land	-2 270.1176	0.0578	0.0381						-2 270.0217
B. Cropland	1 489.1023	0.0034	1.6702						1 490.7759
C. Grassland	-1 007.1842	NE	NE						-1 007.1842
D. Wetlands	-243.8159	NE	NE						-243.8159
E. Settlements	67.8615	NE	292.6299						360.4914
F. Other Land	201.6619	NE	NE						201.6619
G. Harvested Wood Products	-65.1129								-65.1129
H. Other	NO	NO	NO						NO
5. Waste	**16.8812**	**1 358.3092**	**71.8685**						**1 447.0589**
A. Solid Waste Disposal	NA, NO	1 070.2330							1 070.2330
B. Biological Treatment of Solid Waste		NO, NE	NO, NE						NO, NE
C. Incineration and Open Burning of Waste	16.8812	8.6536	1.8113						27.3461
D. Wastewater Treatment and Discharge		279.4227	70.0571						349.4798
E. Other	NO	NO	NO						NO
6. Other	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	NO
Memo Items									
International Bunkers	**70.1110**	**0.0875**	**0.6823**						**70.8808**
Aviation	70.1110	0.0875	0.6823						70.8808
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	NO								NO
Indirect N_2O			252.5139						252.5139
Indirect CO_2	33.6057								33.6057
Total (without LULUCF)									**12 550.1602**
Total (with LULUCF)									**11 016.9547**

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)	**6 622.6008**	**3 172.4422**	**2 012.8567**	**29.1966**	**NO**	**0.0071**	**NO**	**NO**	**11 837.1033**
1. Energy	**8 141.8766**	**783.8355**	**99.1270**						**9 024.8391**
A. Fuel Combustion (Sectoral approach)	8 140.7721	49.5885	40.7503						8 231.1109
1. Energy Industries	3 725.8039	1.7531	3.8860						3 731.4430
2. Manufacturing Industries and Construction	465.1130	0.3091	0.4638						465.8858
3. Transport	1 668.6104	10.4049	29.8435						1 708.8588
4. Other Sectors	2 253.6075	37.0431	6.2518						2 296.9025
5. Other	27.6373	0.0782	0.3052						28.0207
B. Fugitive Emissions from Fuels	1.1045	734.2470	58.3767						793.7282
1. Solid Fuels	NO	NO	NO						NO
2. Oil and Natural Gas	1.1045	734.2470	58.3767						793.7282
C. CO_2 Transport and Storage	NO								NO
2. Industrial Processes and Product Use	**456.2031**	**NO**	**0.0149**	**29.1966**	**NO**	**0.0071**	**NO**	**NO**	**485.4217**
A. Mineral Industry	350.6290								350.6290
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	64.1000	NO	NO						64.1000
E. Electronic Industry				NO	NO	NO	NO	NO	NO
F. Product Use as Substitutes for ODS				29.1966	NO	NO	NO	NO	29.1966
G. Other Product Manufacture and Use	0.9656	NO	0.0149	NO	NO	0.0071	NO	NO	0.9876
H. Other									
3. Agriculture	**0.3669**	**1 043.5482**	**1 548.6947**						**2 592.6098**
A. Enteric Fermentation		962.2286							962.2286
B. Manure Management		81.3197	441.1540						522.4737
C. Rice Cultivation		NO							NO
D. Agricultural Soils			1 107.5406						1 107.5406
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
J. Other	NO	NO	NO						NO
4. LULUCF	**-1 992.6605**	**0.2009**	**290.1214**						**-1 702.3382**
A. Forest Land	-2 334.7768	0.1518	0.1001						-2 334.5248
B. Cropland	1 454.1892	0.0490	1.3797						1 455.6179
C. Grassland	-1 120.4767	NE	NE						-1 120.4767
D. Wetlands	-215.6130	NE	NE						-215.6130
E. Settlements	53.6737	NE	288.6416						342.3153
F. Other Land	223.8177	NE	NE						223.8177

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. Harvested Wood Products	-53.4745								-53.4745
H. Other	NO	NO	NO						NO
5. Waste	**16.8147**	**1 344.8576**	**74.8987**						**1 436.5710**
A. Solid Waste Disposal	NA, NO	1 055.1514							1 055.1514
B. Biological Treatment of Solid Waste		NO, NE	NO, NE						NO, NE
C. Incineration and Open Burning of Waste	16.8147	8.6180	1.8040						27.2367
D. Wastewater Treatment and Discharge		281.0883	73.0947						354.1830
E. Other	NO	NO	NO						NO
6. Other	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	NO
Memo Items									
International Bunkers	**67.3304**	**0.0866**	**0.6628**						**68.0797**
Aviation	67.3304	0.0866	0.6628						68.0797
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	NO								NO
Indirect N_2O			301.6447						301.6447
Indirect CO_2	56.6674								56.6674
Total (without LULUCF)									**13 539.4415**
Total (with LULUCF)									**11 837.1033**

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)	**7 187.4952**	**3 180.0931**	**2 028.4701**	**40.7988**	**NO**	**0.0572**	**NO**	**NO**	**12 436.9142**
1. Energy	**8 318.1422**	**827.5240**	**103.1143**						**9 248.7805**
A. Fuel Combustion (Sectoral approach)	8 317.0204	52.0895	43.6149						8 412.7248
1. Energy Industries	3 755.2075	1.7986	3.8537						3 760.8597
2. Manufacturing Industries and Construction	598.3665	0.3504	0.5056						599.2226
3. Transport	1 723.5435	10.7353	32.8398						1 767.1186
4. Other Sectors	2 213.9626	39.1457	6.1323						2 259.2406
5. Other	25.9403	0.0595	0.2836						26.2833
B. Fugitive Emissions from Fuels	1.1219	775.4346	59.4993						836.0558
1. Solid Fuels	NO	NO	NO						NO
2. Oil and Natural Gas	1.1219	775.4346	59.4993						836.0558
C. CO_2 Transport and Storage	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)								
2. Industrial Processes and Product Use	**551.0519**	**NO**	**0.0182**	**40.7988**	**NO**	**0.0572**	**NO**	**NO**	**591.9260**
A. Mineral Industry	440.2134								440.2134
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	67.8400	NO	NO						67.8400
E. Electronic Industry				NO	NO	NO	NO	NO	NO
F. Product Use as Substitutes for ODS				40.7988	NO	NO	NO	NO	40.7988
G. Other Product Manufacture and Use	1.0626	NO	0.0182	NO	NO	0.0572	NO	NO	1.1379
H. Other									
3. Agriculture	**0.1739**	**1 012.5495**	**1 565.6484**						**2 578.3718**
A. Enteric Fermentation		926.4666							926.4666
B. Manure Management		86.0829	471.4376						557.5205
C. Rice Cultivation		NO							NO
D. Agricultural Soils			1 094.2109						1 094.2109
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
J. Other	NO	NO	NO						NO
4. LULUCF	**-1 697.7069**	**0.2482**	**286.5410**						**-1 410.9177**
A. Forest Land	-2 409.5185	0.0145	0.0096						-2 409.4945
B. Cropland	1 528.2806	0.2337	1.6813						1 530.1956
C. Grassland	-1 058.1239	NE	NE						-1 058.1239
D. Wetlands	-187.4101	NE	NE						-187.4101
E. Settlements	53.6737	NE	284.8502						338.5239
F. Other Land	416.5012	NE	NE						416.5012
G. Harvested Wood Products	-41.1098								-41.1098
H. Other	NO	NO	NO						NO
5. Waste	**15.8340**	**1 339.7714**	**73.1482**						**1 428.7535**
A. Solid Waste Disposal	NA, NO	1 064.3081							1 064.3081
B. Biological Treatment of Solid Waste		NO, NE	NO, NE						NO, NE
C. Incineration and Open Burning of Waste	15.8340	8.1123	1.6984						25.6447
D. Wastewater Treatment and Discharge		267.3509	71.4498						338.8006
E. Other	NO	NO	NO						NO
6. Other	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	NO
Memo Items									
International Bunkers	**67.6488**	**0.0874**	**0.6661**						**68.4023**

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)								
Aviation	67.6488	0.0874	0.6661						68.4023
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	NO								NO
Indirect N_2O			306.3316						306.3316
Indirect CO_2	60.5990								60.5990
Total (without LULUCF)									**13 847.8319**
Total (with LULUCF)									**12 436.9142**

2006

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)	**6 367.3802**	**3 056.6912**	**1 937.8821**	**53.5982**	**0.0231**	**0.3307**	**NO**	**NO**	**11 415.9054**
1. Energy	**7 516.9276**	**740.2563**	**101.4160**						**8 358.5998**
A. Fuel Combustion (Sectoral approach)	7 515.7016	56.9975	45.2842						7 617.9832
1. Energy Industries	2 963.9244	1.4269	3.2877						2 968.6389
2. Manufacturing Industries and Construction	661.3778	0.3620	0.5159						662.2557
3. Transport	1 651.6254	9.9044	34.2680						1 695.7978
4. Other Sectors	2 199.7343	45.2321	6.8324						2 251.7988
5. Other	39.0397	0.0722	0.3801						39.4920
B. Fugitive Emissions from Fuels	1.2260	683.2587	56.1319						740.6166
1. Solid Fuels	NO	NO	NO						NO
2. Oil and Natural Gas	1.2260	683.2587	56.1319						740.6166
C. CO_2 Transport and Storage	NO								NO
2. Industrial Processes and Product Use	**648.0792**	**NO**	**0.0176**	**53.5982**	**0.0231**	**0.3307**	**NO**	**NO**	**702.0487**
A. Mineral Industry	538.2308								538.2308
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	81.8718	NO	NO						81.8718
E. Electronic Industry				NO	NO	NO	NO	NO	NO
F. Product Use as Substitutes for ODS				53.5982	NO	NO	NO	NO	53.5982
G. Other Product Manufacture and Use	0.9584	NO	0.0176	NO	0.0231	0.3307	NO	NO	1.3298
H. Other									
3. Agriculture	**0.1460**	**984.5297**	**1 481.7433**						**2 466.4190**
A. Enteric Fermentation		896.7070							896.7070

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. Manure Management		87.8226	484.4637						572.2863
C. Rice Cultivation		NO							NO
D. Agricultural Soils			997.2796						997.2796
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
J. Other	NO	NO	NO						NO
4. LULUCF	**-1 813.6146**	**0.2505**	**282.6021**						**-1 530.7620**
A. Forest Land	-2 366.5168	0.1567	0.1033						-2 366.2568
B. Cropland	1 565.8949	0.0938	1.4400						1 567.4287
C. Grassland	-1 056.3692	NE	NE						-1 056.3692
D. Wetlands	-159.2073	NE	NE						-159.2073
E. Settlements	53.6737	NE	281.0588						334.7325
F. Other Land	189.4964	NE	NE						189.4964
G. Harvested Wood Products	-40.5864								-40.5864
H. Other	NO	NO	NO						NO
5. Waste	**15.8420**	**1 331.6548**	**72.1031**						**1 419.5998**
A. Solid Waste Disposal	NA, NO	1 061.8430							1 061.8430
B. Biological Treatment of Solid Waste		NO, NE	NO, NE						NO, NE
C. Incineration and Open Burning of Waste	15.8420	8.1149	1.6991						25.6560
D. Wastewater Treatment and Discharge		261.6968	70.4040						332.1009
E. Other	NO	NO	NO						NO
6. Other	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	NO
Memo Items									
International Bunkers	**75.9610**	**0.0989**	**0.7468**						**76.8068**
Aviation	75.9610	0.0989	0.7468						76.8068
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,NE
Long-term Storage of C in Waste Disposal Sites	NO								NO,NE
Indirect N_2O			290.7715						290.7715
Indirect CO_2	73.9415								73.9415
Total (without LULUCF)									**12 946.6674**
Total (with LULUCF)									**11 415.9054**

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)	**6 678.2859**	**2 894.1352**	**1 342.2660**	**67.7992**	**0.0231**	**0.4306**	**NO**	**NO**	**10 982.9399**
1. Energy	**7 775.4299**	**771.6460**	**105.2782**						**8 652.3541**
A. Fuel Combustion (Sectoral approach)	7 774.1723	45.2996	45.7785						7 865.2504
1. Energy Industries	3 483.6780	1.6316	3.4621						3 488.7717
2. Manufacturing Industries and Construction	823.8199	0.4157	0.5586						824.7942
3. Transport	1 757.4108	10.3768	35.9299						1 803.7175
4. Other Sectors	1 664.7540	32.7780	5.3147						1 702.8467
5. Other	44.5097	0.0975	0.5132						45.1203
B. Fugitive Emissions from Fuels	1.2577	726.3463	59.4997						787.1037
1. Solid Fuels	NO	NO	NO						NO
2. Oil and Natural Gas	1.2577	726.3463	59.4997						787.1037
C. CO_2 Transport and Storage	NO								NO
2. Industrial Processes and Product Use	**893.3513**	**NO**	**NO**	**67.7992**	**0.0231**	**0.4306**	**NO**	**NO**	**961.6041**
A. Mineral Industry	768.8438								768.8438
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	84.9474	NO	NO						84.9474
E. Electronic Industry				NO	NO	NO	NO	NO	NO
F. Product Use as Substitutes for ODS				67.7992	NO	NO	NO	NO	67.7992
G. Other Product Manufacture and Use	0.9474	NO	NO	NO	0.0231	0.4306	NO	NO	1.4010
H. Other									
3. Agriculture	**0.2631**	**787.4367**	**889.0798**						**1 676.7796**
A. Enteric Fermentation		724.8851							724.8851
B. Manure Management		62.5516	370.1945						432.7461
C. Rice Cultivation		NO							NO
D. Agricultural Soils			518.8853						518.8853
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
J. Other	NO	NO	NO						NO
4. LULUCF	**-2 006.6996**	**1.5179**	**278.0203**						**-1 727.1614**
A. Forest Land	-2 460.3855	1.3653	0.9003						-2 458.1199
B. Cropland	1 528.1376	0.1525	1.4676						1 529.7577
C. Grassland	-1 031.2350	NE	NE						-1 031.2350
D. Wetlands	-131.0044	NE	NE						-131.0044
E. Settlements	49.2742	NE	275.6524						324.9266
F. Other Land	83.1072	NE	NE						83.1072

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. Harvested Wood Products	-44.5936								-44.5936
H. Other	NO	NO	NO						NO
5. Waste	**15.9412**	**1 333.5346**	**69.8876**						**1 419.3635**
A. Solid Waste Disposal	NA, NO	1 064.8219							1 064.8219
B. Biological Treatment of Solid Waste		NO, NE	NO, NE						NO, NE
C. Incineration and Open Burning of Waste	15.9412	8.1643	1.7095						25.8151
D. Wastewater Treatment and Discharge		260.5483	68.1781						328.7264
E. Other	NO	NO	NO						NO
6. Other	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	NO
Memo Items									
International Bunkers	**79.8999**	**0.0690**	**0.7782**						**80.7471**
Aviation	79.8999	0.0690	0.7782						80.7471
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	NO								NO
Indirect N_2O			179.9097						179.9097
Indirect CO_2	78.1363								78.1363
Total (without LULUCF)									**12 710.1014**
Total (with LULUCF)									**10 982.9399**

2008

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)	**7 549.6388**	**2 875.0981**	**1 941.5085**	**82.0655**	**0.0288**	**0.5186**	NO	NO	**12 448.8584**
1. Energy	**8 253.4802**	**769.5097**	**109.1741**						**9 132.1640**
A. Fuel Combustion (Sectoral approach)	8 252.2054	47.0446	47.4292						8 346.6792
1. Energy Industries	3 772.1690	1.8041	3.6942						3 777.6673
2. Manufacturing Industries and Construction	907.5951	0.8664	1.3937						909.8553
3. Transport	1 848.2954	10.8957	36.3092						1 895.5003
4. Other Sectors	1 675.4850	33.3867	5.5509						1 714.4226
5. Other	48.6609	0.0916	0.4812						49.2337
B. Fugitive Emissions from Fuels	1.2748	722.4651	61.7449						785.4848
1. Solid Fuels	NO	NO	NO						NO
2. Oil and Natural Gas	1.2748	722.4651	61.7449						785.4848
C. CO_2 Transport and Storage	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)								
2. Industrial Processes and Product Use	**972.6989**	**NO**	**NO**	**82.0655**	**0.0288**	**0.5186**	**NO**	**NO**	**1 055.3117**
A. Mineral Industry	869.1962								869.1962
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	67.1050	NO	NO						67.1050
E. Electronic Industry				NO	NO	NO	NO	NO	NO
F. Product Use as Substitutes for ODS				82.0655	NO	NO	NO	NO	82.0655
G. Other Product Manufacture and Use	0.9859	NO	NO	NO	0.0288	0.5186	NO	NO	1.5333
H. Other									
3. Agriculture	**0.8505**	**752.3781**	**1 490.1625**						**2 243.3912**
A. Enteric Fermentation		690.6823							690.6823
B. Manure Management		61.6958	364.8654						426.5613
C. Rice Cultivation		NO							NO
D. Agricultural Soils			1 125.2971						1 125.2971
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
J. Other	NO	NO	NO						NO
4. LULUCF	**-1 693.2806**	**0.7701**	**272.0280**						**-1 420.4825**
A. Forest Land	-2 462.7874	0.0949	0.0626						-2 462.6299
B. Cropland	1 499.7873	0.6752	1.5568						1 502.0193
C. Grassland	-932.1498	NE	NE						-932.1498
D. Wetlands	-102.8015	NE	NE						-102.8015
E. Settlements	49.2742	NE	270.4086						319.6829
F. Other Land	291.0044	NE	NE						291.0044
G. Harvested Wood Products	-35.6078								-35.6078
H. Other	NO	NO	NO						NO
5. Waste	**15.8898**	**1 352.4402**	**70.1439**						**1 438.4739**
A. Solid Waste Disposal	NA, NO	1 084.1973							1 084.1973
B. Biological Treatment of Solid Waste		NO, NE	NO, NE						NO, NE
C. Incineration and Open Burning of Waste	15.8898	8.1362	1.7038						25.7298
D. Wastewater Treatment and Discharge		260.1067	68.4401						328.5468
E. Other	NO	NO	NO						NO
6. Other	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	NO
Memo Items									
International Bunkers	**89.2738**	**0.0421**	**0.8591**						**90.1750**

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)								
Aviation	89.2738	0.0421	0.8591						90.1750
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	NO								NO
Indirect N_2O			292.0310						292.0310
Indirect CO_2	59.8913								59.8913
Total (without LULUCF)									**13 869.3408**
Total (with LULUCF)									**12 448.8584**

2009

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)	**8 334.3612**	**2 806.7058**	**2 155.8181**	**91.3620**	**0.0288**	**0.5615**	**NO**	**NO**	**13 388.8375**
1. Energy	**9 152.8755**	**647.9916**	**110.8307**						**9 911.6978**
A. Fuel Combustion (Sectoral approach)	9 151.6023	50.0596	43.4728						9 245.1347
1. Energy Industries	5 027.2977	2.3988	5.7949						5 035.4915
2. Manufacturing Industries and Construction	514.8733	0.5576	0.9209						516.3518
3. Transport	1 771.7398	11.0374	30.8574						1 813.6345
4. Other Sectors	1 824.3586	36.0363	5.8093						1 866.2043
5. Other	13.3329	0.0294	0.0903						13.4527
B. Fugitive Emissions from Fuels	1.2732	597.9320	67.3579						666.5631
1. Solid Fuels	NO	NO	NO						NO
2. Oil and Natural Gas	1.2732	597.9320	67.3579						666.5631
C. CO_2 Transport and Storage	NO								NO
2. Industrial Processes and Product Use	**463.8910**	**NO**	**NO**	**91.3620**	**0.0288**	**0.5615**	**NO**	**NO**	**555.8433**
A. Mineral Industry	387.9410								387.9410
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	58.1883	NO	NO						58.1883
E. Electronic Industry				NO	NO	NO	NO	NO	NO
F. Product Use as Substitutes for ODS				91.3620	NO	NO	NO	NO	91.3620
G. Other Product Manufacture and Use	0.6998	NO	NO	NO	0.0288	0.5615	NO	NO	1.2901
H. Other									
3. Agriculture	**0.5864**	**787.7830**	**1 713.4632**						**2 501.8325**
A. Enteric Fermentation		717.4997							717.4997

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. Manure Management		70.2833	837.7304						908.0137
C. Rice Cultivation		NO							NO
D. Agricultural Soils			875.7328						875.7328
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
J. Other	NO	NO	NO						NO
4. LULUCF	**-1 298.8485**	**0.3145**	**265.3313**						**-1 033.2027**
A. Forest Land	-2 526.0659	0.2316	0.1527						-2 525.6817
B. Cropland	1 652.4751	0.0829	1.3737						1 653.9318
C. Grassland	-447.6932	NE	NE						-447.6932
D. Wetlands	-74.5986	NE	NE						-74.5986
E. Settlements	45.5694	NE	263.8049						309.3743
F. Other Land	79.9357	NE	NE						79.9357
G. Harvested Wood Products	-28.4708								-28.4708
H. Other	NO	NO	NO						NO
5. Waste	**15.8568**	**1 370.6168**	**66.1929**						**1 452.6665**
A. Solid Waste Disposal	NA, NO	1 115.0489							1 115.0489
B. Biological Treatment of Solid Waste		NO, NE	NO, NE						NO, NE
C. Incineration and Open Burning of Waste	15.8568	8.1175	1.7000						25.6744
D. Wastewater Treatment and Discharge		247.4503	64.4928						311.9432
E. Other	NO	NO	NO						NO
6. Other	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	NO
Memo Items									
International Bunkers	**82.6571**	**0.0455**	**0.7970**						**83.4996**
Aviation	82.6571	0.0455	0.7970						83.4996
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	NO								NO
Indirect N_2O			253.9413						253.9413
Indirect CO_2	51.8736								51.8736
Total (without LULUCF)									**14 422.0402**
Total (with LULUCF)									**13 388.8375**

2010

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)	**8 729.1714**	**2 821.0293**	**1 909.8668**	**102.8657**	**0.0403**	**0.6819**	**NO**	**NO**	**13 563.6553**
1. Energy	**9 443.1854**	**633.3696**	**118.4299**						**10 194.9848**
A. Fuel Combustion (Sectoral approach)	9 441.9107	53.5485	46.5815						9 542.0407
1. Energy Industries	4 975.7812	2.4944	5.5531						4 983.8288
2. Manufacturing Industries and Construction	443.0025	0.3208	0.4950						443.8184
3. Transport	2 008.0937	11.3198	34.7045						2 054.1180
4. Other Sectors	1 985.0640	39.3549	5.6517						2 030.0705
5. Other	29.9692	0.0586	0.1772						30.2051
B. Fugitive Emissions from Fuels	1.2747	579.8211	71.8483						652.9441
1. Solid Fuels	NO	NO	NO						NO
2. Oil and Natural Gas	1.2747	579.8211	71.8483						652.9441
C. CO_2 Transport and Storage	NO								NO
2. Industrial Processes and Product Use	**488.7178**	**NO**	**NO**	**102.8657**	**0.0403**	**0.6819**	**NO**	**NO**	**592.3056**
A. Mineral Industry	411.0616								411.0616
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	67.0530	NO	NO						67.0530
E. Electronic Industry				NO	NO	NO	NO	NO	NO
F. Product Use as Substitutes for ODS				102.8657	NO	NO	NO	NO	102.8657
G. Other Product Manufacture and Use	0.9046	NO	NO	NO	0.0403	0.6819	NO	NO	1.6268
H. Other									
3. Agriculture	**1.7443**	**789.4582**	**1 463.8125**						**2 255.0151**
A. Enteric Fermentation		712.5704							712.5704
B. Manure Management		76.8879	426.2558						503.1437
C. Rice Cultivation		NO							NO
D. Agricultural Soils			1 037.5567						1 037.5567
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
J. Other	NO	NO	NO						NO
4. LULUCF	**-1 220.3031**	**0.1390**	**258.2142**						**-961.9499**
A. Forest Land	-2 484.1627	0.0809	0.0534						-2 484.0285
B. Cropland	1 537.9925	0.0581	0.8227						1 538.8733
C. Grassland	-691.9874	NE	NE						-691.9874
D. Wetlands	-46.3958	NE	NE						-46.3958
E. Settlements	45.5694	NE	257.3381						302.9075
F. Other Land	441.4824	NE	NE						441.4824

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. Harvested Wood Products	-22.8014								-22.8014
H. Other	NO	NO	NO						NO
5. Waste	**15.8271**	**1 398.0624**	**69.4101**						**1 483.2997**
A. Solid Waste Disposal	NA, NO	1 137.8491							1 137.8491
B. Biological Treatment of Solid Waste		NO, NE	NO, NE						NO, NE
C. Incineration and Open Burning of Waste	15.8271	8.1003	1.6966						25.6241
D. Wastewater Treatment and Discharge		252.1130	67.7135						319.8265
E. Other	NO	NO	NO						NO
6. Other	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	NO
Memo Items									
International Bunkers	**82.6894**	**0.0663**	**0.8016**						**83.5573**
Aviation	82.6894	0.0663	0.8016						83.5573
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	NO								NO
Indirect N_2O			289.6907						289.6907
Indirect CO_2	60.0215								60.0215
Total (without LULUCF)									**14 525.6052**
Total (with LULUCF)									**13 563.6553**

2011

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)	**9 092.7746**	**2 878.5637**	**1 906.6931**	**116.5249**	**0.0403**	**0.7174**	**NO**	**NO**	**13 995.3141**
1. Energy	**9 654.6698**	**718.4304**	**125.4362**						**10 498.5364**
A. Fuel Combustion (Sectoral approach)	9 653.3531	56.8099	48.4623						9 758.6253
1. Energy Industries	4 607.9596	2.2274	4.7247						4 614.9116
2. Manufacturing Industries and Construction	596.4123	0.6794	1.1236						598.2152
3. Transport	2 117.5188	11.3044	36.1094						2 164.9327
4. Other Sectors	2 310.0323	42.5665	6.3696						2 358.9684
5. Other	21.4301	0.0322	0.1350						21.5974
B. Fugitive Emissions from Fuels	1.3167	661.6205	76.9739						739.9111
1. Solid Fuels	NO	NO	NO						NO
2. Oil and Natural Gas	1.3167	661.6205	76.9739						739.9111
C. CO_2 Transport and Storage	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)								
2. Industrial Processes and Product Use	**578.6725**	**NO**	**NO**	**116.5249**	**0.0403**	**0.7174**	**NO**	**NO**	**695.9553**
A. Mineral Industry	492.3783								492.3783
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	72.3407	NO	NO						72.3407
E. Electronic Industry				NO	NO	NO	NO	NO	NO
F. Product Use as Substitutes for ODS				116.5249	NO	NO	NO	NO	116.5249
G. Other Product Manufacture and Use	1.0979	NO	NO	NO	0.0403	0.7174	NO	NO	1.8557
H. Other									
3. Agriculture	**3.6752**	**743.6316**	**1 460.6271**						**2 207.9339**
A. Enteric Fermentation		671.0063							671.0063
B. Manure Management		72.6254	388.7320						461.3574
C. Rice Cultivation		NO							NO
D. Agricultural Soils			1 071.8950						1 071.8950
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
J. Other	NO	NO	NO						NO
4. LULUCF	**-1 160.1391**	**0.1592**	**251.9572**						**-908.0226**
A. Forest Land	-2 390.5712	0.1084	0.0715						-2 390.3914
B. Cropland	1 492.5261	0.0509	0.7848						1 493.3618
C. Grassland	-638.1726	NE	NE						-638.1726
D. Wetlands	-75.3129	NE	NE						-75.3129
E. Settlements	62.0438	NE	251.1010						313.1448
F. Other Land	393.7285	NE	NE						393.7285
G. Harvested Wood Products	-4.3808								-4.3808
H. Other	NO	NO	NO						NO
5. Waste	**15.8962**	**1 416.3424**	**68.6726**						**1 500.9112**
A. Solid Waste Disposal	NA, NO	1 155.0806							1 155.0806
B. Biological Treatment of Solid Waste		NO, NE	NO, NE						NO, NE
C. Incineration and Open Burning of Waste	15.8962	8.1190	1.7019						25.7171
D. Wastewater Treatment and Discharge		253.1427	66.9707						320.1134
E. Other	NO	NO	NO						NO
6. Other	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	NO
Memo Items									
International Bunkers	**95.4144**	**0.0810**	**0.9115**						**96.4069**

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)								
Aviation	95.4144	0.0810	0.9115						96.4069
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	NO								NO
Indirect N_2O			289.5234						289.5234
Indirect CO_2	65.1556								65.1556
Total (without LULUCF)									**14 903.3367**
Total (with LULUCF)									**13 995.3141**

2012

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)	**8 631.3138**	**2 821.6965**	**1 483.0139**	**124.2123**	**0.0403**	**0.7757**	**NO**	**NO**	**13 061.0526**
1. Energy	**9 195.8094**	**711.4709**	**128.9107**						**10 036.1910**
A. Fuel Combustion (Sectoral approach)	9 194.4989	60.5585	44.4088						9 299.4662
1. Energy Industries	4 596.6508	2.1209	4.5338						4 603.3054
2. Manufacturing Industries and Construction	456.6973	0.3010	0.4404						457.4388
3. Transport	1 859.5648	9.7647	32.5427						1 901.8722
4. Other Sectors	2 273.0863	48.3566	6.8284						2 328.2713
5. Other	8.4998	0.0153	0.0635						8.5786
B. Fugitive Emissions from Fuels	1.3104	650.9125	84.5018						736.7247
1. Solid Fuels	NO	NO	NO						NO
2. Oil and Natural Gas	1.3104	650.9125	84.5018						736.7247
C. CO_2 Transport and Storage	NO								NO
2. Industrial Processes and Product Use	**588.1935**	**NO**	**NO**	**124.2123**	**0.0403**	**0.7757**	**NO**	**NO**	**713.2218**
A. Mineral Industry	498.5638								498.5638
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	75.8897	NO	NO						75.8897
E. Electronic Industry				NO	NO	NO	NO	NO	NO
F. Product Use as Substitutes for ODS				124.2123	NO	NO	NO	NO	124.2123
G. Other Product Manufacture and Use	1.0427	NO	NO	NO	0.0403	0.7757	NO	NO	1.8588
H. Other									
3. Agriculture	**5.5908**	**701.9100**	**1 052.5989**						**1 760.0998**
A. Enteric Fermentation		632.8347							632.8347

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. Manure Management		69.0754	356.8055						425.8809
C. Rice Cultivation		NO							NO
D. Agricultural Soils			695.7934						695.7934
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
J. Other	NO	NO	NO						NO
4. LULUCF	**-1 174.1542**	**1.1675**	**233.4235**						**-939.5632**
A. Forest Land	-2 294.8221	1.1602	0.7650						-2 292.8969
B. Cropland	1 496.0113	0.0073	0.7713						1 496.7899
C. Grassland	-562.7510	NE	NE						-562.7510
D. Wetlands	-15.4700	NE	NE						-15.4700
E. Settlements	11.8882	NE	231.8871						243.7754
F. Other Land	114.1449	NE	NE						114.1449
G. Harvested Wood Products	76.8444								76.8444
H. Other	NO	NO	NO						NO
5. Waste	**15.8744**	**1 407.1480**	**68.0807**						**1 491.1032**
A. Solid Waste Disposal	NA, NO	1 143.6162							1 143.6162
B. Biological Treatment of Solid Waste		NO, NE	NO, NE						NO, NE
C. Incineration and Open Burning of Waste	15.8744	8.1074	1.6996						25.6814
D. Wastewater Treatment and Discharge		255.4244	66.3812						321.8055
E. Other	NO	NO	NO						NO
6. Other	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	NO
Memo Items									
International Bunkers	**107.6790**	**0.0765**	**1.0257**						**108.7812**
Aviation	107.6790	0.0765	1.0257						108.7812
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	NO								NO
Indirect N_2O			217.0970						217.0970
Indirect CO_2	69.6839								69.6839
Total (without LULUCF)									**14 000.6158**
Total (with LULUCF)									**13 061.0526**

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)	**7 844.2261**	**2 747.2240**	**1 952.6791**	**130.5506**	**0.0403**	**0.9770**	**NO**	**NO**	**12 675.6971**
1. Energy	**8 214.0054**	**682.1804**	**129.5360**						**9 025.7218**
A. Fuel Combustion (Sectoral approach)	8 212.3614	62.2238	45.2327						8 319.8178
1. Energy Industries	3 680.5879	1.7543	4.4402						3 686.7824
2. Manufacturing Industries and Construction	597.3290	0.7717	1.2985						599.3992
3. Transport	1 979.4512	9.8515	32.4624						2 021.7651
4. Other Sectors	1 951.0935	49.8388	6.9912						2 007.9234
5. Other	3.8998	0.0075	0.0405						3.9478
B. Fugitive Emissions from Fuels	1.6441	619.9566	84.3033						705.9040
1. Solid Fuels	NO	NO	NO						NO
2. Oil and Natural Gas	1.6441	619.9566	84.3033						705.9040
C. CO_2 Transport and Storage	NO								NO
2. Industrial Processes and Product Use	**631.0394**	**NO**	**NO**	**130.5506**	**0.0403**	**0.9770**	**NO**	**NO**	**762.6073**
A. Mineral Industry	551.2987								551.2987
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	70.9399	NO	NO						70.9399
E. Electronic Industry				NO	NO	NO	NO	NO	NO
F. Product Use as Substitutes for ODS				130.5506	NO	NO	NO	NO	130.5506
G. Other Product Manufacture and Use	1.1438	NO	NO	NO	0.0403	0.9770	NO	NO	2.1611
H. Other									
3. Agriculture	**4.1840**	**711.2160**	**1 537.1504**						**2 252.5504**
A. Enteric Fermentation		643.3105							643.3105
B. Manure Management		67.9055	333.8503						401.7558
C. Rice Cultivation		NO							NO
D. Agricultural Soils			1 203.3001						1 203.3001
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
J. Other	NO	NO	NO						NO
4. LULUCF	**-1 020.8558**	**0.8718**	**217.2511**						**-802.7329**
A. Forest Land	-2 141.8702	0.8060	0.5315						-2 140.5328
B. Cropland	1 408.2056	0.0659	0.7894						1 409.0609
C. Grassland	-360.1740	NE	NE						-360.1740
D. Wetlands	-106.0998	NE	NE						-106.0998
E. Settlements	13.7512	NE	215.9302						229.6814
F. Other Land	103.4500	NE	NE						103.4500

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. Harvested Wood Products	61.8814								61.8814
H. Other	NO	NO	NO						NO
5. Waste	**15.8530**	**1 352.9558**	**68.7417**						**1 437.5505**
A. Solid Waste Disposal	NA, NO	1 084.7685							1 084.7685
B. Biological Treatment of Solid Waste		NO, NE	NO, NE						NO, NE
C. Incineration and Open Burning of Waste	15.8530	8.0965	1.6973						25.6468
D. Wastewater Treatment and Discharge		260.0907	67.0444						327.1351
E. Other	NO	NO	NO						NO
6. Other	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	NO
Memo Items									
International Bunkers	**130.4626**	**0.1157**	**1.2430**						**131.8213**
Aviation	130.4626	0.1157	1.2430						131.8213
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	NO								NO
Indirect N_2O			308.0323						308.0323
Indirect CO_2	64.7797								64.7797
Total (without LULUCF)									**13 478.4300**
Total (with LULUCF)									**12 675.6971**

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)	**8 828.9210**	**2 814.4432**	**2 139.9245**	**142.0853**	**0.0403**	**1.0667**	**NO**	**NO**	**13 926.4810**
1. Energy	**8 807.4746**	**710.1038**	**139.3208**						**9 656.8992**
A. Fuel Combustion (Sectoral approach)	8 805.8026	114.7815	51.8550						8 972.4391
1. Energy Industries	4 351.4775	2.1402	4.7802						4 358.3979
2. Manufacturing Industries and Construction	467.8569	0.3698	0.5763						468.8030
3. Transport	2 049.6794	9.7987	30.5750						2 090.0531
4. Other Sectors	1 933.4972	102.4640	15.8856						2 051.8469
5. Other	3.2915	0.0088	0.0379						3.3383
B. Fugitive Emissions from Fuels	1.6721	595.3223	87.4658						684.4601
1. Solid Fuels	NO	NO	NO						NO
2. Oil and Natural Gas	1.6721	595.3223	87.4658						684.4601
C. CO_2 Transport and Storage	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)								
2. Industrial Processes and Product Use	**651.6580**	**NO**	**NO**	**142.0853**	**0.0403**	**1.0667**	**NO**	**NO**	**794.8503**
A. Mineral Industry	547.8150								547.8150
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	88.9627	NO	NO						88.9627
E. Electronic Industry				NO	NO	NO	NO	NO	NO
F. Product Use as Substitutes for ODS				142.0853	NO	NO	NO	NO	142.0853
G. Other Product Manufacture and Use	1.0338	NO	NO	NO	0.0403	1.0667	NO	NO	2.1409
H. Other									
3. Agriculture	**10.2058**	**753.4887**	**1 728.6204**						**2 492.3149**
A. Enteric Fermentation		680.9618							680.9618
B. Manure Management		72.5269	367.6124						440.1394
C. Rice Cultivation		NO							NO
D. Agricultural Soils			1 361.0079						1 361.0079
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
J. Other	NO	NO	NO						NO
4. LULUCF	**-656.2221**	**0.1169**	**202.4681**						**-453.6371**
A. Forest Land	-2 134.7390	0.0663	0.0437						-2 134.6291
B. Cropland	1 445.7270	0.0506	0.7847						1 446.5623
C. Grassland	-341.1085	NE	NE						-341.1085
D. Wetlands	-139.7535	NE	NE						-139.7535
E. Settlements	18.9848	NE	201.6397						220.6246
F. Other Land	436.6463	NE	NE						436.6463
G. Harvested Wood Products	58.0208								58.0208
H. Other	NO	NO	NO						NO
5. Waste	**15.8047**	**1 350.7338**	**69.5152**						**1 436.0537**
A. Solid Waste Disposal	NA, NO	1 083.0800							1 083.0800
B. Biological Treatment of Solid Waste		NO, NE	NO, NE						NO, NE
C. Incineration and Open Burning of Waste	15.8047	8.0744	1.6924						25.5716
D. Wastewater Treatment and Discharge		259.5794	67.8228						327.4022
E. Other	NO	NO	NO						NO
6. Other	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	NO
Memo Items									
International Bunkers	**154.5245**	**0.0859**	**1.4810**						**156.0913**

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)								
Aviation	154.5245	0.0859	1.4810						156.0913
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	NO								NO
Indirect N_2O			351.5434						351.5434
Indirect CO_2	82.6825								82.6825
Total (without LULUCF)									**14 380.1181**
Total (with LULUCF)									**13 926.4810**

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)	**8 780.6110**	**2 759.5868**	**1 759.1113**	**167.8122**	**0.0403**	**1.1195**	**NO**	**NO**	**13 468.2811**
1. Energy	**9 231.5931**	**688.8354**	**143.3583**						**10 063.7869**
A. Fuel Combustion (Sectoral approach)	9 229.9350	122.2343	57.1164						9 409.2857
1. Energy Industries	4 737.5409	2.3193	4.9653						4 744.8255
2. Manufacturing Industries and Construction	532.9098	0.6513	1.0762						534.6373
3. Transport	2 158.9106	10.3156	34.1035						2 203.3296
4. Other Sectors	1 797.6960	108.9414	16.9411						1 923.5784
5. Other	2.8778	0.0067	0.0302						2.9147
B. Fugitive Emissions from Fuels	1.6581	566.6011	86.2420						654.5012
1. Solid Fuels	NO	NO	NO						NO
2. Oil and Natural Gas	1.6581	566.6011	86.2420						654.5012
C. CO_2 Transport and Storage	NO								NO
2. Industrial Processes and Product Use	**615.2290**	**NO**	**NO**	**167.8122**	**0.0403**	**1.1195**	**NO**	**NO**	**784.2010**
A. Mineral Industry	510.8250								510.8250
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	86.3698	NO	NO						86.3698
E. Electronic Industry				NO	NO	NO	NO	NO	NO
F. Product Use as Substitutes for ODS				167.8122	NO	NO	NO	NO	167.8122
G. Other Product Manufacture and Use	0.7549	NO	NO	NO	0.0403	1.1195	NO	NO	1.9148
H. Other									
3. Agriculture	**11.2402**	**724.2403**	**1 355.6975**						**2 091.1781**
A. Enteric Fermentation		653.4004							653.4004

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. Manure Management		70.8399	356.1224						426.9623
C. Rice Cultivation		NO							NO
D. Agricultural Soils			999.5751						999.5751
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	**-1 093.0947**	**0.6532**	**190.2644**						**-902.1771**
A. Forest Land	-2 159.4439	0.6146	0.4053						-2 158.4241
B. Cropland	1 392.3816	0.0386	0.7810						1 393.2012
C. Grassland	-418.4569	NE	NE						-418.4569
D. Wetlands	-82.7917	NE	NE						-82.7917
E. Settlements	39.1617	NE	189.0781						228.2398
F. Other Land	86.8192	NE	NE						86.8192
G. Harvested Wood Products	49.2353								49.2353
H. Other	NO	NO	NO						NO
5. Waste	**15.6434**	**1 345.8578**	**69.7911**						**1 431.2923**
A. Solid Waste Disposal	NA, NO	1 087.1715							1 087.1715
B. Biological Treatment of Solid Waste		NO, NE	NO, NE						NO, NE
C. Incineration and Open Burning of Waste	15.6434	7.9940	1.6754						25.3128
D. Wastewater Treatment and Discharge		250.6923	68.1157						318.8081
E. Other	NO	NO	NO						NO
6. Other	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	NO
Memo Items									
International Bunkers	**218.4141**	**0.1458**	**2.0772**						**220.6372**
Aviation	218.4141	0.1458	2.0772						220.6372
Navigation	NO	NO	NO						NO
Multilateral Operations	**NO**	**NO**	**NO**						**NO**
CO_2 Emissions from Biomass	1 439.5226								1 439.5226
CO_2 Captured and Stored	NO								NO
Long-term Storage of C in Waste Disposal Sites	NO								NO
Indirect N_2O			273.9260						273.9260
Indirect CO_2	79.5560								79.5560
Total (without LULUCF)									**14 370.4582**
Total (with LULUCF)									**13 468.2811**

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)	**8 545.8253**	**2 835.4954**	**2 099.7464**	**175.5848**	**0.0403**	**1.1252**	**NO**	**NO**	**13 657.8174**
1. Energy	**9 032.6132**	**742.6395**	**151.9757**						**9 927.2284**
A. Fuel Combustion (Sectoral approach)	9 030.9428	131.5493	63.4119						9 225.9040
1. Energy Industries	4 518.9699	2.2700	4.8207						4 526.0607
2. Manufacturing Industries and Construction	500.7010	0.4963	0.7988						501.9962
3. Transport	2 331.5969	12.0472	39.2820						2 382.9261
4. Other Sectors	1 677.5744	116.7297	18.4881						1 812.7922
5. Other	2.1005	0.0061	0.0223						2.1288
B. Fugitive Emissions from Fuels	1.6704	611.0903	88.5637						701.3244
1. Solid Fuels	NO	NO	NO						NO
2. Oil and Natural Gas	1.6704	611.0903	88.5637						701.3244
C. CO_2 Transport and Storage	NO								NO
2. Industrial Processes and Product Use	**585.1146**	**NO**	**NO**	**175.5848**	**0.0403**	**1.1252**	**NO**	**NO**	**761.8649**
A. Mineral Industry	500.5774								500.5774
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	78.6128	NO	NO						78.6128
E. Electronic Industry				NO	NO	NO	NO	NO	NO
F. Product Use as Substitutes for ODS				175.5848	NO	NO	NO	NO	175.5848
G. Other Product Manufacture and Use	0.7041	NO	NO	NO	0.0403	1.1252	NO	NO	1.8696
H. Other									
3. Agriculture	**12.2747**	**717.6111**	**1 698.5781**						**2 428.4639**
A. Enteric Fermentation		649.2698							649.2698
B. Manure Management		68.3414	372.7198						441.0611
C. Rice Cultivation		NO							NO
D. Agricultural Soils			1 325.8583						1 325.8583
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	**-1 099.6373**	**0.3568**	**179.2669**						**-920.0136**
A. Forest Land	-2 113.5468	0.3085	0.2034						-2 113.0348
B. Cropland	1 393.2356	0.0483	0.7840						1 394.0679
C. Grassland	-402.3693	NE	NE						-402.3693
D. Wetlands	-82.7917	NE	NE						-82.7917
E. Settlements	19.3071	NE	178.2795						197.5866
F. Other Land	85.6461	NE	NE						85.6461

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. Harvested Wood Products	0.8816								0.8816
H. Other	NO	NO	NO						NO
5. Waste	**15.4600**	**1 374.8879**	**69.9257**						**1 460.2737**
A. Solid Waste Disposal	NA, NO	1 115.1732							1 115.1732
B. Biological Treatment of Solid Waste		NO, NE	NO, NE						NO, NE
C. Incineration and Open Burning of Waste	15.4600	7.9023	1.6560						25.0183
D. Wastewater Treatment and Discharge		251.8125	68.2697						320.0822
E. Other	NO	NO	NO						NO
6. Other	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**
Memo Items									
International Bunkers	**313.0386**	**0.1576**	**2.9905**						**316.1867**
Aviation	313.0386	0.1576	2.9905						316.1867
Navigation	NO	NO	NO						NO
Multilateral Operations	**NO**	**NO**	**NO**						**NO**
CO_2 Emissions from Biomass	1 561.9690								1 561.9690
CO_2 Captured and Stored	NO								NO
Long-term Storage of C in Waste Disposal Sites	NE								NO
Indirect N_2O			340.0142						340.0142
Indirect CO_2	71.4341								71.4341
Total (without LULUCF)									**14 577.8310**
Total (with LULUCF)									**13 657.8174**