National Inventory Report

Greenhouse Gas Sources and Sinks in the Republic of Moldova 1990-2015

Submission to the United Nations Framework Convention on Climate Change

Chisinau, 2017

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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 First Biennial Update Report and the Fourth National Communication 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 July 2014 through December 2017.

The National Inventory Report reflects the efforts made by the National Inventory Team during 2016-2017, 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Europe and CIS countries)", that ended with the National Inventory Report of the Republic of Moldova: 1990-2002 (unpublished); based on the results obtained under the UNDP-GEF Project "Republic of Moldova: Enabling Activities for the Preparation of the First National Communication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); as well as 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).

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 1990-2015 time periods was made in August-September 2017 by relevant national experts, previously not involved in the national inventory compilation activities, representing public universities (Technical University of Moldova), research and development institutes (Institute of Power Engineering of the Academy of Sciences of Moldova and Forest Research and Management Institute).

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.

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LIST OF ACRONYMS, ABBREVIATIONS AND UNITS

ABS	Acrilonitril Butadien Stiren
AEZ	Agro-Ecological Zones
Al	Aluminium
Al_2O_3	Aluminium oxide
$Area_{(T)}$	Total annual area harvested of crop *T*
Area burnt $_{(T)}$	Annual area of crop *T* burnt (stubble fields burning)
a.s.	Active substance
ASH	Ash content of the manure in per cent
ASM	Academy of Science of Moldova
ATD	Atmospheric Deposition
ATULBD	Administrative-Territorial Units on the Left Bank of Dniester
AR4	IPCC 4^{th} Assessment Report (IPCC, 2007)
AR5	IPCC 5^{th} 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
^0C	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
CHP	Combined Heat and Power Plant
$CHClF_2$	HCFC-22
CH_2FCF_3	HFC-134a
CHF_3	HFC-23
CH_2F_3	HFC-32

C_2HF_5	HFC-125
CH_3CCl_2F	HCFC-141b
CH_3CClF_2	HCFC-142b
CF_3CH_3	HFC-143a
CH_3CHF_2	HFC-152a
CF_3CHFCF_3	HFC-227ea
$CF_3CH_2CF_3$	HFC-236fa
$CHF_2CH_2CF_3$	HFC-245fa
$CH_3CF_2CH_2CF_3$	HFC-365mfc
$CF_3CHFCHFCF_2CF_3$	HFC-43-10mee
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
CP	Conference of the Parties
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
dm	Dry matter
DOC	Degradable Organic Carbon
DOC_F	Dissimilated DOC fraction
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
EU	European Union
eq	Equivalent
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 urine and dung N deposited by grazing animals on pasture, range and paddock
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
g.e.c.	Grams coal equivalent
GDP	Gross Domestic Product
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
k	Methane generation rate constant
KCA	Key Category Analysis
kg	Kilogram
km	Kilometer
km^2	Square kilometer
kPa	Kilopascal
kt	Kiloton
kW	Kilowatt
kWh	Kilowatt-hour
l	Liter
L	Level
$L_{fellings}$	Annual carbon loss due to commercial fellings
L_0	Methane Generation Potential
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
NCs	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	Nnon 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
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.)
RCP	Representative Concentration Pathway
REG	Ratio of net energy available for growth in a diet to digestible energy consumed
RM	Republic of Moldova
J.S.C.	Joint Stock Company
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.*)
UNFCCC	United Nations Framework Convention on Climate Change
UN	United Nations
UNDP	United Nations Development Programme
UNEP	United Nations Environment Program
US EPA	United States Environmental Protection Agency
USA	United States of America
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. 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; within 2010-2013 – the Third National Communication (TNC), while from 2014 to 2017, the Fourth National Communication (4^{th}NC).

With reference to UNFCCC implementation instruments it should be noted that the COP 3 (Kyoto, 1997) adopted the Kyoto[1] 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 13^{th} 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.

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

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

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[2].

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 Decision). According to this decision, developing countries, non-Annex I Parties, consistent with their capabilities and the level of support provided for reporting, were expected to submit their first BUR to the Secretariat of the UNFCCC by December, 2014. The Report 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.

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

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[3]. 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[4].

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 August 9, 2017[5], only 80 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 (1^{st} of January 2021 – 31^{st} 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 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 1^{st} of

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

[4] 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

[5] < http://unfccc.int/kyoto_protocol/doha_amendment/items/7362.php>

October 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 is fully committed to the UNFCCC negotiation process towards adopting at COP 21 a Protocol, another legal instrument or an agreed outcome 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)[6].

At 25th of September 2015, the Republic of Moldova communicated its Intended Nationally Determined Contribution (INDC)[7] 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)[8].

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.

The National Inventory Team 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. The national GHG inventory consists of the National Inventory Report (NIR) and the inventory itself reported by using a series of standardized Common Sectoral and Summary Report Tables.

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 'Agricul-

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

ture', 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 (NOx, CO, NMVOC and SO_2) were estimated based on methodologies according to the Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories (IPCC, 1997), respectively 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 central public authorities; 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[9], developed by the US Environment Protection Agency (US EPA), revealed: without LULUCF – 16 key categories by level (L) and 16 key categories by trend (T): based on a Tier 2 approach – 14 key categories by level (L) and 12 key categories by trend (T); with LULUCF, based on the Tier 1 methodological approach – 20 key categories by level (L) and 16 key categories by trend (T), respective, based on a Tier 2 approach – 19 key categories by level (L) and 14 key categories by trend (T).

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 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 Moldova – for Sector 2 'Industrial Processes and Product Use'; independent consultants for plant production, animal breading and environment protection – 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 emissions.

Direct Greenhouse Gas Emission Trends

In comparison with the base year level (1990), by 2015, the Republic of Moldova has reduced its GHG emissions by circa 67.8 per cent (Table ES-1).

Table ES-1 reveals that the decrease in GHG emissions over the last 24 years is in full consistency with a decrease in some important economic and social indicators: the population decreased by 7.6 per cent within this time periods, the real value of GDP – by 29.3 per cent, the GHG intensity (CO_2eq/GDP) – by 54.5 per cent, electricity consumption – by 52.3 per cent, heat consumption – by 83.4 per cent, consumption of primary energy resources – by 78.8 per cent.

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

Table ES-1: Total GHG Emissions and Accompanying Variables in the Republic of Moldova within 1990-2015 periods

	1990	1995	2000	2005	2010	2011	2012	2013	2014	2015
Population, millions inhabitants	**4.362**	**4.348**	**4.282**	**4.148**	**4.082**	**4.074**	**4.069**	**4.065**	**4.058**	**4.030**
Compared to 1990, %		-0.3	-1.8	-4.9	-6.4	-6.6	-6.7	-6.8	-7.0	-7.6
Inter-annual fluctuation, %		-0.1	-0.3	-0.3	-0.2	-0.2	-0.1	-0.1	-0.2	-0.7
Total GHG emissions, Mt CO_2 eq.	**43.400**	**17.650**	**11.208**	**13.414**	**14.264**	**14.503**	**13.749**	**11.435**	**14.199**	**13.953**
Compared to 1990, %		-59.3	-74.2	-69.1	-67.1	-66.6	-68.3	-73.7	-67.3	-67.8
Inter-annual fluctuation, %		-16.8	-7.5	3.4	5.9	1.7	-5.2	-16.8	24.2	-1.7
GHG per capita, tons per capita	**9.950**	**4.059**	**2.618**	**3.234**	**3.495**	**3.560**	**3.379**	**2.813**	**3.499**	**3.462**
Compared to 1990, %		-59.2	-73.7	-67.5	-64.9	-64.2	-66.0	-71.7	-64.8	-65.2
Inter-annual fluctuation, %		-16.7	-7.3	3.8	6.1	1.9	-5.1	-16.7	24.4	-1.1
GDP, billion 2010 US $	**9.894**	**3.966**	**3.523**	**4.959**	**5.812**	**6.184**	**6.141**	**6.718**	**7.027**	**6.995**
Compared to 1990, %		-59.9	-64.4	-49.9	-41.3	-37.5	-37.9	-32.1	-29.0	-29.3
Inter-annual fluctuation, %		-1.4	2.1	7.5	7.1	6.4	-0.7	9.4	4.6	-0.5
GHG intensity, kg CO_2 eq. /2010 US $	**4.387**	**4.450**	**3.181**	**2.705**	**2.454**	**2.345**	**2.239**	**1.702**	**2.021**	**1.995**
Compared to 1990, %		1.4	-27.5	-38.3	-44.1	-46.5	-49.0	-61.2	-53.9	-54.5
Inter-annual fluctuation, %		-15.6	-9.5	-3.8	-1.2	-4.4	-4.5	-24.0	18.7	-1.3
Imported energy, million t.c.e.	**16.703**	**5.109**	**2.535**	**3.123**	**2.96**	**3.075**	**2.918**	**2.977**	**2.895**	**2.927**
Compared to 1990, %		-69.4	-84.8	-81.3	-82.3	-81.6	-82.5	-82.2	-82.7	-82.5
Inter-annual fluctuation, %		11.0	-18.0	4.2	5.0	3.9	-5.1	2.0	-2.8	1.1
Consumed energy, million t.c.e.	**14.269**	**5.085**	**2.647**	**3.257**	**3.157**	**3.201**	**3.068**	**3.091**	**3.095**	**3.024**
Compared to 1990, %		-64.4	-81.4	-77.2	-77.9	-77.6	-78.5	-78.3	-78.3	-78.8
Inter-annual fluctuation, %		9.7	-20.2	6.3	6.7	1.4	-4.2	0.7	0.1	-2.3
Produced electricity, billion kWh	**15.690**	**6.168**	**3.624**	**4.225**	**6.115**	**5.785**	**5.802**	**4.491**	**5.380**	**6.050**
Compared to 1990, %		-60.7	-76.9	-73.1	-61.0	-63.1	-63.0	-71.4	-65.7	-61.4
Inter-annual fluctuation, %		-25.8	-11.8	1.1	-1.3	-5.4	0.3	-22.6	19.8	12.5
Consumed electricity, billion kWh	**11.426**	**7.022**	**4.510**	**5.838**	**5.257**	**5.416**	**5.604**	**5.449**	**5.456**	**5.455**
Compared to 1990, %		-38.5	-60.5	-48.9	-54.0	-52.6	-51.0	-52.3	-52.3	-52.3
Inter-annual fluctuation, %		-3.9	-4.4	-3.1	-0.9	3.0	3.5	-2.8	0.1	0.0
Produced heat, million Gcal	**22.212**	**9.827**	**4.986**	**5.324**	**4.600**	**4.419**	**4.273**	**4.377**	**4.064**	**3.979**
Compared to 1990, %		-55.8	-77.6	-76.0	-79.3	-80.1	-80.8	-80.3	-81.7	-82.1
Inter-annual fluctuation, %		30.9	-26.0	8.2	5.4	-4.0	-3.3	2.4	-7.2	-2.1
Consumed heat, million Gcal	**20.983**	**8.796**	**4.501**	**4.765**	**3.988**	**3.952**	**3.785**	**3.861**	**3.579**	**3.473**
Compared to 1990, %		-58.1	-78.5	-77.3	-81.0	-81.2	-82.0	-81.6	-82.9	-83.4
Inter-annual fluctuation, %		32.1	-23.6	8.4	4.1	-0.9	-4.2	2.0	-7.3	-3.0

References: [1] Economic Research Service US Department of Agriculture (<http://www.ers.usda.gov/data-products/international-macroeconomic-data-set.aspx>); [2] Statistical Yearbooks of the RM (<http://www.statistica.md/pageview.php?l=ro&idc=263&id=2193>) and ATULBD (<http://www.mepmr.org/pechatnye-izdaniya/statisticheskij-ezhegodnik-pmr>); [3] Energy Balances of RM for 1990, 1993-2015 and Statistical Yearbooks of ATULBD.

The significant reduction of socio-economic indicators between 1990 and 2015 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 2015 the natural gas tariff increased 13 times; electricity tariff increased circa 7 times; gasoline, diesel and liquefied gases prices increased 2 times), in the condition when about 95% 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 Republic of Moldova, which led to a significant decrease of the energy intensity, declining since 2006 with an average annual negative growth of 11.0 per cent

At the same time, within 2000-2015 period, the real GDP increased by 98.6 per cent, from circa 3.5229 to 6.9951 billion 2010 US$, while the real GDP per capita increased by 134 per cent, from 842.8 to 1972.2 2010 US$. 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 2015 the real GDP reached only circa 71 per cent of the 1990 year level. It is worth mentioning that from 2000 to 2015, the electricity consumption increased in the Republic of Moldova by 21.0 per cent; the consumption of primary energy resources – by 14.2 per cent; while the GHG intensity (CO_2eq/GDP) decreased during the same period by 37.3 per cent, showing the first signs of the decoupling of economic growth from the growth in greenhouse gas emissions, by 24.5 per cent within 2000-2015 periods (see Figure ES-1).

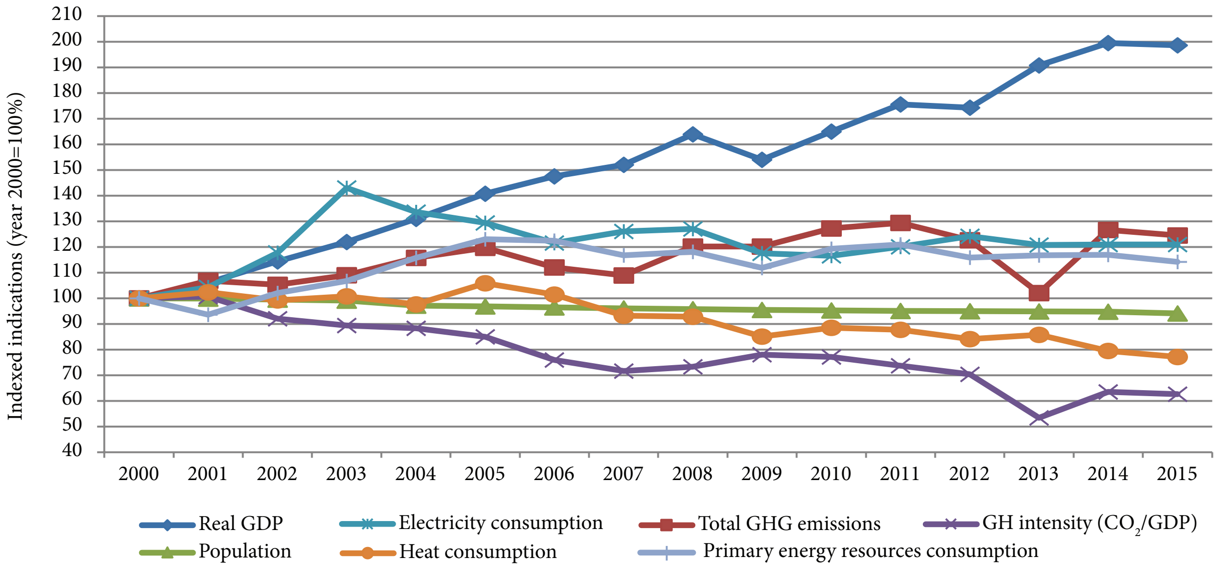


Figure ES-1: Trends in total GHG emissions and associated variables in the Republic of Moldova within 2000-2015 periods

Table ES-2 provides data on total and net GHG emissions in the Republic of Moldova in 2015.

The share of CO_2 emissions in the total direct GHG emissions was 66.9 per cent, CH_4 contributed with circa 20.5 per cent, N_2O emissions accounted for 11.3 per cent of the total, while the share of F-gases (HFCs, PFCs, SF_6) being totally insignificant, circa 1.3 per cent of the total (Figure R-2).

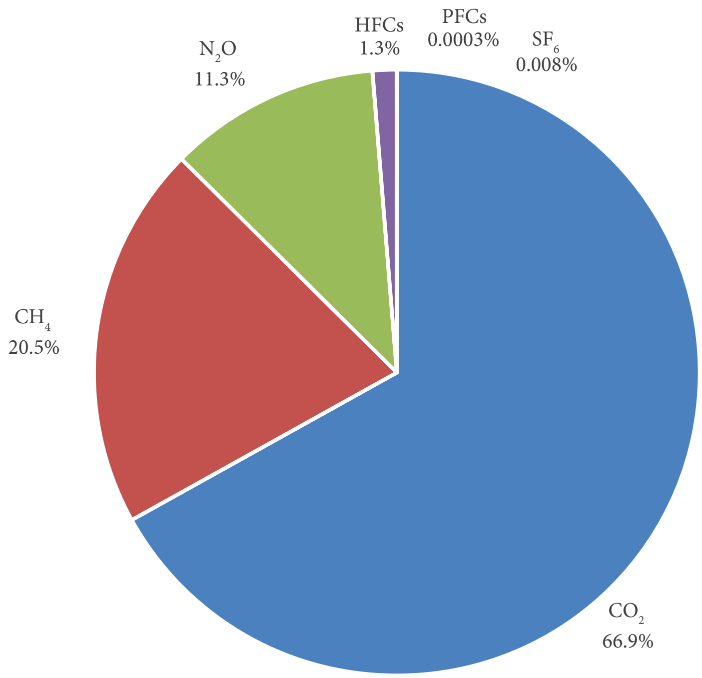


Figure ES-2: Republic of Moldova's GHG Emissions by Gas in 2015

Table ES-2: Republic of Moldova's Total Direct GHG Emissions in 2015

Categories of emissions and sinks	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)	**6 490.9952**	**2 863.4377**	**1 572.9806**	**179.4375**	**0.0403**	**1.0575**	**NO**	**NO**	**11 107.9488**
1. Energy	**8 759.0707**	**688.1863**	**57.6853**						**9 504.9423**
A. Fuel Combustion	8 757.4126	121.5847	57.6826						8 936.6798
1. Energy Industries	4 141.2201	1.7930	4.0598						4 147.0729
2. Manufacturing Industries and Construction	665.6173	1.0172	1.6577						668.2922
3. Transport	2 158.1164	9.8514	35.0077						2 202.9754
4. Other Sectors	1 790.2120	108.9172	16.9359						1 916.0651
5. Other	2.2468	0.0059	0.0215						2.2742
B. Fugitive Emissions from Fuels	1.6581	566.6016	0.0027						568.2625
1. Solid Fuels	NO	NO	NO						NO
2. Oil and Natural Gas	1.6581	566.6016	0.0027						568.2625
C. CO_2 Transport and Storage	NO								NO
2. Industrial Processes and Product Use	**614.5157**	**NO**	**NO**	**179.4375**	**0.0403**	**1.0575**	**NO**	**NO**	**795.0511**
A. Mineral Industry	509.6941								509.6941
B. Chemical Industry	NO	NO	NO						NO
C. Metal Industry	17.2258	NO	NO	NO	NO	NO	NO	NO	17.2258
D. Non-energy Products From Fuels and Solvent Use	86.8119	NO	NO						86.8119
E. Electronic Industry				NO	NO	NO	NO	NO	NO
F. Product Use as Substitutes for ODS				179.4375	NO	NO	NO	NO	179.4375
G. Other Product Manufacture and Use	0.7840	NO	NO	NO	0.0403	1.0575	NO	NO	1.8818
H. Other									
3. Agriculture	**5.8323**	**724.9634**	**1 383.8981**						**2 114.6937**
A. Enteric Fermentation		654.6016							654.6016
B. Manure Management		70.3618	352.0708						422.4326
C. Rice Cultivation		NO							NO
D. Agricultural Soils			1 031.8273						1 031.8273
E. Prescribed Burning of Savannas		NO	NO						NO
F. Field Burning of Agricultural Residues		IE	IE						IE
G. Liming	NO								NO
H. Urea Application	5.8323								5.8323
I. Other Carbon-containing Fertilizers	NO								NO,NE
J. Other	NO	NO	NO						NO
4. LULUCF	**-2 904.5678**	**0.7081**	**58.4603**						**-2 845.3994**
A. Forest Land	-2 027.2895	0.6633	0.4374						-2 026.1888
B. Cropland	-727.4181	0.0448	57.5206						-669.8527
C. Grassland	-306.2291	NE	NE						-306.2291
D. Wetlands	NO	NE	NE						NO, NE
E. Settlements	38.8867	NE	0.5023						39.3890
F. Other Land	60.8445	NE	NE						60.8445
G. Harvested Wood Products	56.6377								56.6377
H. Other	NO	NO	NO						NO
5. Waste	**16.1442**	**1 449.5799**	**72.9370**						**1 538.6611**
A. Solid Waste Disposal	NA, NO	1 087.1519							1 087.1519
B. Biological Treatment of Solid Waste		NO, NE	NO, NE						NO, NE
C. Incineration and Open Burning of Waste	16.1442	8.2516	2.2698						26.6656
D. Wastewater Treatment and Discharge		354.1764	70.6672						424.8436
E. Other	NO	NO	NO						NO
6. Other	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	NO
Memo Items									
International Bunkers	**218.4093**	**0.1451**	**2.0736**						**220.6280**
Aviation	218.4093	0.1451	2.0736						220.6280
Navigation	NO	NO	NO						NO
Multilateral Operations	**NO**	**NO**	**NO**						**NO**
CO_2 Emissions from Biomass	1 439.8048								1 439.8048
CO_2 Captured and Stored	NO								NO
Long-term Storage of C in waste disposal sites	NO								NO
Indirect N_2O			278.9598						278.9598
Indirect CO_2	80.0300								80.0300
Total CO_2 equivalent (without LULUCF)									**13 953.3482**
Total CO_2 equivalent (with LULUCF)									**11 107.9488**

Abbreviations: IE – Included Elsewhere; NE – Not Estimates; NO – Not Occurring

In 2015, in the Republic of Moldova, approximately 68.1 per cent of the total national direct GHG emissions originated from the Energy Sector. Other relevant direct GHG sources are represented by Sector 4 'Land Use, Land-Use Change and Forestry' (-20.4 per cent of the total), Sector 3 'Agriculture' (15.2 per cent of the total), Sector 5 'Waste' (11.0 per cent of the total) and Sector 2 'Industrial Processes and Product Use' (5.7 per cent of the total) (Figure ES-3).

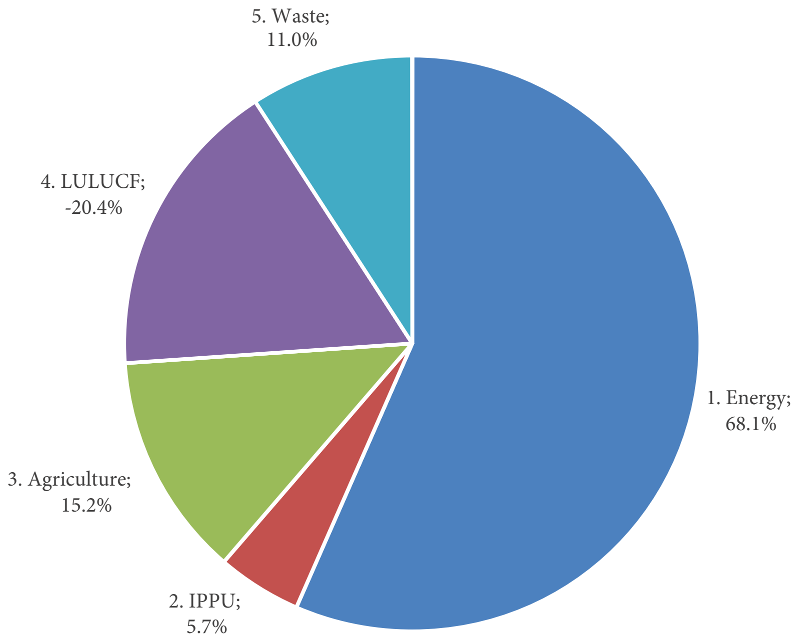


Figure ES-3: Sectoral Breakdown of the Republic of Moldova's Total GHG Emissions in 2015

Table ES-3 shows the evolution of total GHG emissions and removals in the Republic of Moldova for the time series from 1990 through 2015. As it can be noted, the total national direct GHG emissions (without LULUCF) decreased during the period under review by 67.8 per cent, from 43 400 kt CO_2 equivalent in 1990 to 13 953 kt CO_2 equivalent in 2015 (GHG emissions decreased by circa 1.7 per cent even compared to 2014).

To be noted that during the period under review, the GHG emissions from Energy Sector have decreased by 72.6 per cent (by 1.7 per cent compared to 2014), emissions from Industrial Processes and Product Use Sector decreased by circa 49.7 per cent (in 2015 a decrease by 1.2 per cent occurred compared to 2014 year level), emissions from Agriculture Sector decreased by 59.4 per cent (in 2015 a decrease by 15.0 per cent occurred compared to 2014 year level), net removals in LULUCF Sector decreased by 51.1 per cent (inn 2015 an increase by 6.9 per cent occurred compared to 2014 year level), respectively, emissions from Waste Sector decreased by 16.1 per cent (decreasing by 1.5 per cent in 2015, compared to 2014 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' (-143.6 per cent), 1A5 'Other' (-98.0 per cent), 4C 'Grassland' (-89.3 per cent), 1A1 'Energy Industries' (-78.6 per cent), 1A4 'Other Sectors' (-74.8 per cent), 3B 'Manure Management' (-73.8 per cent), 3A 'Enteric Fermentation' (-70.1 per cent) 1A2 'Manufacturing Industries and Construction' (-69.8 per cent), 2D 'Non-energy Products from Fuels and Solvent Use' (-62.8 per cent), 2A 'Mineral Industry' (-61.3 per cent), 4F 'Other Land' (-60.1 per cent), 4E 'Settlements' (-55.2 per cent), 5D 'Wastewater Treatment and Discharge' (-52.9 per cent) and 1A3 'Transport' (-50.8 per cent).

Between 2014 and 2015, total direct GHG emissions decreased by circa 1.7 per cent. At the same time, emissions from particular source categories increased, such as: 4E 'Settlements' (+106.4 per cent), 2C 'Metal Industry' (+24.8 per cent), 2F 'Product Uses as Substitutes for ODS' (+18.5 per cent), 1A2 'Manufacturing Industries and Construction' (+13.7 per cent), 1A3 'Transport' (+5.4 per cent) and 1A1 'Energy Industries' (+3.1 per cent). Also, removals from certain categories increased as well: 4B 'Cropland' (+28.6 per cent) and 4C 'Grassland' (+12.9 per cent).

Table ES-3: Republic of Moldova's Total Direct GHG Emissions within 1990-2015 periods

Categories of emissions and sinks	1990	1995	2000	2005	2010	2011	2012	2013	2014	2015
	CO_2 equivalent (kt)									
1. Energy	**34 630.7793**	**11 885.4927**	**6 787.8110**	**8 681.7347**	**9 828.7136**	**9 996.1204**	**9 654.5298**	**8 563.2692**	**9 344.7215**	**9 504.9423**
A. Fuel Combustion	33 817.9000	11 223.6852	6 186.8005	7 905.1774	9 247.6161	9 334.3990	9 002.3050	7 941.6657	8 747.7242	8 936.6798
1. Energy Industries	19 398.3484	6 904.3865	3 159.3286	3 233.2579	4 597.5705	4 187.9640	4 197.1458	3 316.4107	4 021.5062	4 147.0729
2. Manufacturing Industries and Construction	2 213.8153	465.0111	537.9965	604.8584	541.0995	601.4892	565.1582	601.6466	587.5527	668.2922
3. Transport	4 481.7645	1 522.9456	948.8464	1 767.9729	2 053.6866	2 164.2599	1 905.5612	2 015.0035	2 090.2898	2 202.9754
4. Other Sectors	7 608.4017	2 212.7842	1 514.3349	2 264.0705	2 031.0012	2 358.7490	2 326.6485	2 004.7593	2 046.0694	1 916.0651
5. Other	115.5701	118.5579	26.2941	35.0177	24.2583	21.9369	7.7913	3.8456	2.3060	2.2742
B. Fugitive Emissions from Fuels	812.8794	661.8075	601.0105	776.5573	581.0975	661.7214	652.2248	621.6035	596.9973	568.2625
1. Solid Fuels	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
2. Oil and Natural Gas	812.8794	661.8075	601.0105	776.5573	581.0975	661.7214	652.2248	621.6035	596.9973	568.2625
C. CO_2 Transport and Storage	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
2. Industrial Processes and Product Use	**1 581.0137**	**453.5222**	**319.0457**	**598.5509**	**604.9577**	**698.5117**	**716.3927**	**770.2877**	**804.9205**	**795.0511**
A. Mineral Industry	1 316.1041	345.1199	240.0428	444.8424	412.7424	491.5026	496.8003	551.5523	548.2551	509.6941
B. Chemical Industry	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	13.7976	17.2258
D. Non-energy Products From Fuels and Solvent Use	233.2089	76.4826	31.3591	68.4829	67.4640	72.7635	76.1943	71.3632	89.3660	86.8119
E. Electronic Industry	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
F. Product Use as Substitutes for ODS	NO	4.5879	10.4630	42.1522	113.4282	119.5378	128.8468	137.5611	151.3701	179.4375
G. Other Product Manufacture and Use	3.1983	1.0950	0.9118	1.1377	1.6246	1.8522	1.8540	2.1542	2.1317	1.8818
H. Other	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
3. Agriculture	**5 210.5504**	**3 590.5870**	**2 500.2063**	**2 576.5167**	**2 249.7258**	**2 204.0293**	**1 775.8023**	**2 249.0224**	**2 487.8723**	**2 114.6937**
A. Enteric Fermentation	2 190.6944	1 620.6669	1 085.6884	926.8686	712.6183	671.3756	634.3201	643.8453	681.6116	654.6016
B. Manure Management	1 611.4354	927.3910	549.3742	553.7250	498.5078	457.5476	421.4140	398.1773	435.7130	422.4326
C. Rice Cultivation	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
D. Agricultural Soils	1 407.8386	1 042.4684	864.7040	1 095.7492	1 036.8553	1 071.4308	714.4773	1 202.8159	1 360.3419	1 031.8273
E. Prescribed Burning of Savannas	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
G. Liming	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	5.8323
I. Other Carbon-containing Fertilizers	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
J. Other	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
4. LULUCF	**-5 819.6508**	**-6 482.0548**	**-6 057.0210**	**-4 764.3654**	**-3 230.1116**	**-2 644.0178**	**-2 945.1468**	**-2 547.0470**	**-2 661.0447**	**-2 845.3994**
A. Forest Land	-2 543.3691	-2 025.7634	-2 288.3278	-2 390.3424	-2 489.4639	-2 373.1372	-2 205.9924	-2 053.6776	-2 019.1901	-2 026.1888
B. Cropland	-518.8554	-1 854.5890	-1 214.0578	-415.3529	-333.8237	-333.2723	-406.7558	-390.9015	-520.7267	-669.8527
C. Grassland	-2 850.2941	-3 088.4744	-2 844.3351	-2 240.7618	-555.7508	-442.6724	-426.1414	-277.4696	-271.1606	-306.2291
D. Wetlands	-17.4403	NO, NE	NO, NE	NO, NE	NO, NE	NO, NE	NO, NE	NO, NE	NO, NE	NO, NE
E. Settlements	87.8830	110.8718	102.9755	55.6592	47.2742	63.2853	12.2684	12.2684	19.0884	39.3890
F. Other Land	152.4756	392.7422	170.1387	281.6495	131.6759	466.0972	87.3375	87.3375	70.4783	60.8445
G. Harvested Wood Products	-130.0504	-16.8419	16.5854	-55.2171	-30.0233	-24.3184	-5.8631	75.3959	60.4660	56.6377
H. Other	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
5. Waste	**1 977.7062**	**1 720.1979**	**1 600.6911**	**1 557.3015**	**1 580.1262**	**1 604.4245**	**1 601.8279**	**1 566.1229**	**1 561.9373**	**1 538.6611**
A. Solid Waste Disposal	1 046.7277	1 209.1845	1 169.5079	1 064.2940	1 137.8702	1 155.0902	1 143.6432	1 084.7888	1 083.0811	1 087.1519
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
C. Incineration and Open Burning of Waste	28.3035	28.3243	28.0229	27.3593	26.9649	27.0530	27.0156	26.9722	26.8791	26.6656
D. Wastewater Treatment and Discharge	902.6749	482.6890	403.1602	465.6482	415.2911	422.2813	431.1691	454.3619	451.9772	424.8436
E. Other	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
6. Other	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**
Memo Items										
International Bunkers	**220.5278**	**42.4672**	**66.9765**	**68.4023**	**83.5573**	**96.4069**	**108.7812**	**131.8213**	**156.0630**	**220.6280**
Aviation	220.5278	42.4672	66.9765	68.4023	83.5573	96.4069	108.7812	131.8213	156.0630	220.6280
Navigation	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Multilateral Operations	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
CO_2 Emissions from Biomass	**229.3072**	**230.0502**	**272.3720**	**307.3920**	**343.3412**	**386.2234**	**404.3122**	**431.4636**	**1 317.1650**	**1 439.8048**
CO_2 Captured and Stored	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
Indirect N_2O	**583.3295**	**357.6355**	**258.6705**	**305.8731**	**288.6536**	**288.6902**	**219.6508**	**307.2402**	**350.5447**	**278.9598**
Indirect CO_2	**207.3247**	**65.3743**	**26.4431**	**61.1468**	**60.4006**	**65.5327**	**70.0614**	**65.1517**	**83.0575**	**80.0300**
Total CO_2 equivalent (LULUCF)	**43 400.0496**	**17 649.7999**	**11 207.7541**	**13 414.1038**	**14 263.5234**	**14 503.0859**	**13 748.5526**	**11 434.8817**	**14 199.4516**	**13 953.3482**
Total CO_2 equivalent (with LULUCF)	**37 580.3987**	**11 167.7451**	**5 150.7331**	**8 649.7384**	**11 033.4118**	**11 859.0681**	**10 803.4058**	**8 887.8348**	**11 538.4069**	**11 107.9488**

Abbreviations: IE – Included Elsewhere; NE – Not Estimates; NO – Not Occurring

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 Republic of Moldova includes emissions of the following ozone and aerosol precursors: NOx, CO, NMVOC and SO_2.

Between 1990 and 2015, total nitrogen oxides emissions decreased by circa 68.5 per cent: from 137.19 kt in 1990 to 43.22 kt in 2015, total carbon monoxide emissions decreased by circa 61.5 per cent: from 439.06 kt in 1990, to 169.01 kt in 2015, non-methane volatile organic compounds emissions decreased by circa 61.6 per cent: from 183.02 kt in 1990 to 70.31 kt in 2015, while sulphur dioxide emissions decreased by circa 92.6 per cent: from 294.25 kt in 1990 to 21.89 kt in 2015 (Figure ES-4).

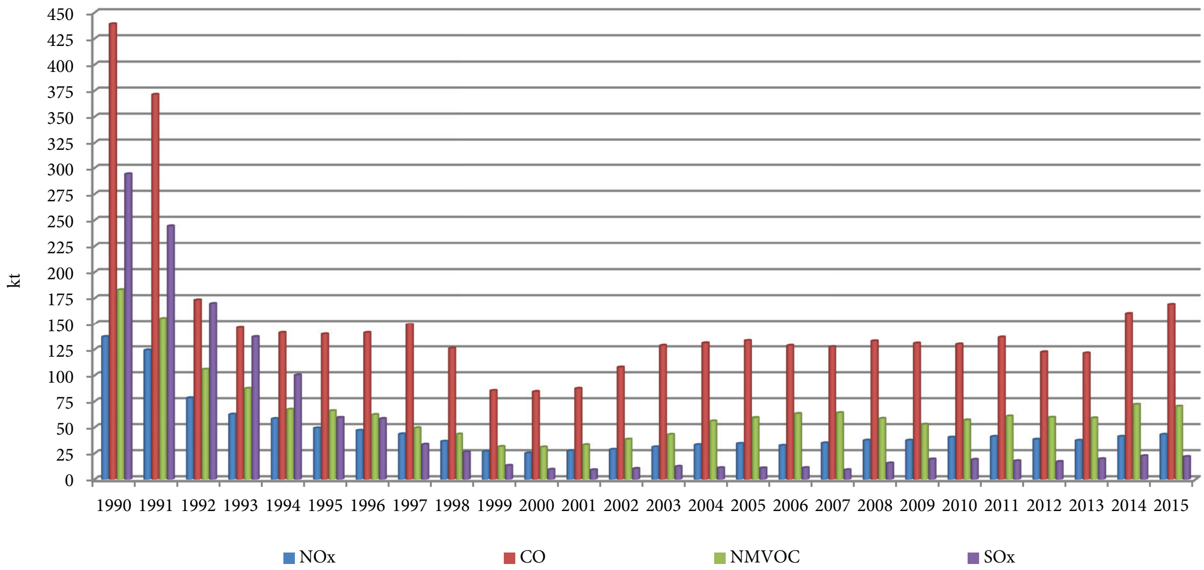


Figure ES-4: National Indirect GHG Emissions in the RM within 1990-2015 periods

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 0.26-0.55m according to RCP2.6, respectively by 0.45-0.82m 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 1.01°C (Figure 1-1), while the average annual precipitation values, respectively, by 54.74 mm (Figure 1-2).

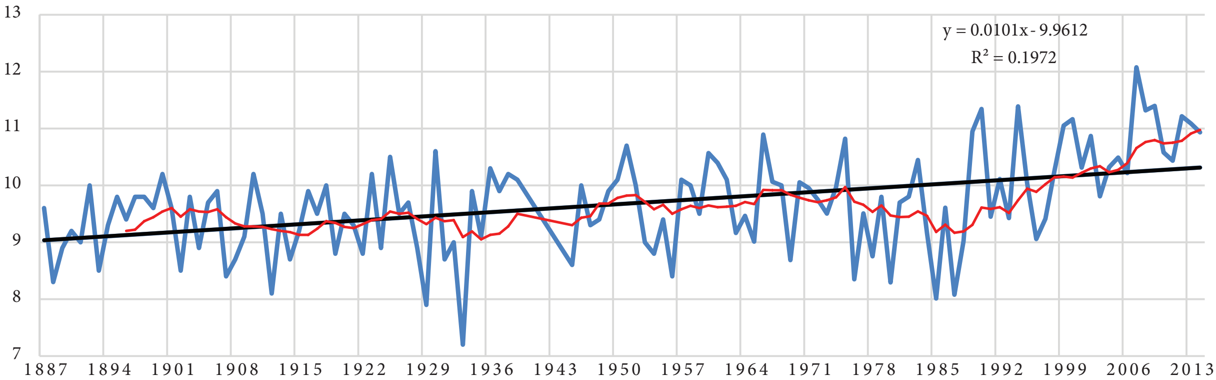


Figure 1-1: Trends of annual average air temperature change (°C) for 1887-2014: blue (actual course trend), black solid line (linear trend secular course) and red line (10 year moving average trend) at the meteorological station Chisinau, Central part of the Republic of Moldova

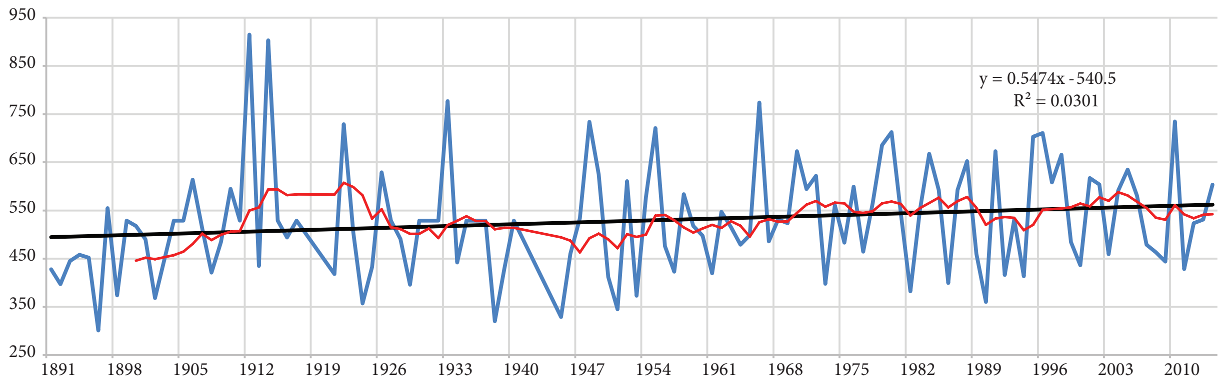


Figure 1-2: Trends of annual average precipitation (mm) for 1891-2014: blue (actual course trend), black solid line (linear trend secular course) and red line (10 year moving average trend) at the meteorological station Chisinau, Central part of the Republic of Moldova

The early 1980s are generally regarded as a kind of "breaking point" in the long-term air temperature curve, from which the human influence on the atmosphere is expressed most distinctly (IPCC, 2007); this fact was confirmed statistically both by foreign (Gil-Alana, 2008) and national studies (Corobov et al, 2013; Țăranu, 2014). The annual course of mean air temperature in the RM, with a maximum in July-August and a minimum in January, and total precipitation, maximum in July and minimum in March, is shown in Figure 1-3.

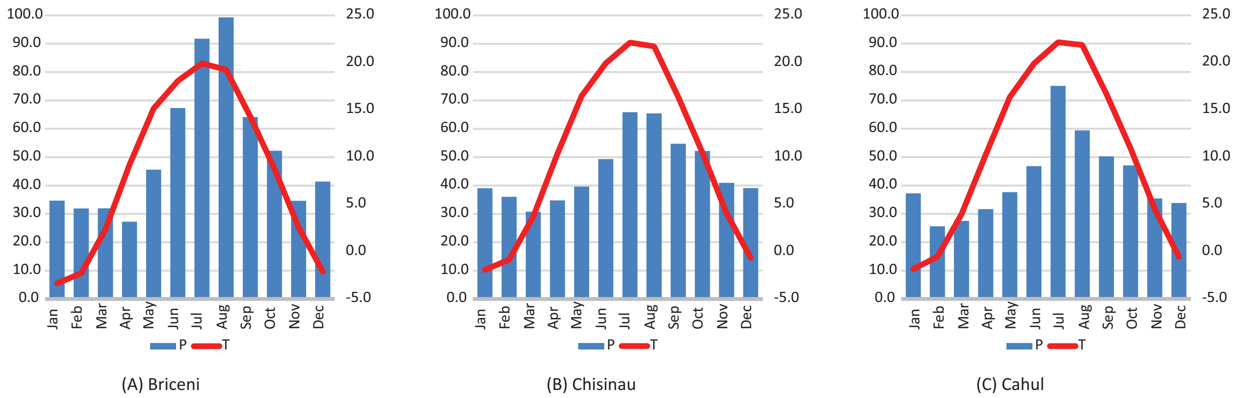


Figure 1-3: Diagrams of total monthly precipitation (columns) with superimposed curves of mean monthly temperatures in different areas

Their average numerical values in the seasonal aspect are listed in Table 1-1. The temperature rise in a southern direction is clearly seen (from an average annual value of 8.5°C in the North to 10.3°C in the South, followed by a decrease in the amount of annual precipitation, respectively, from 622 mm to 508 mm. However, as it follows from the above definition of climate, it is described not only by the mean values, but also by their variability, which is usually characterized by standard deviations (σ) from the medium. The ratio of σ to the mean value (x), expressed as a percentage, or the so-called coefficient of variation (CV) provides an easily interpretable magnitude of the climate variability variable.

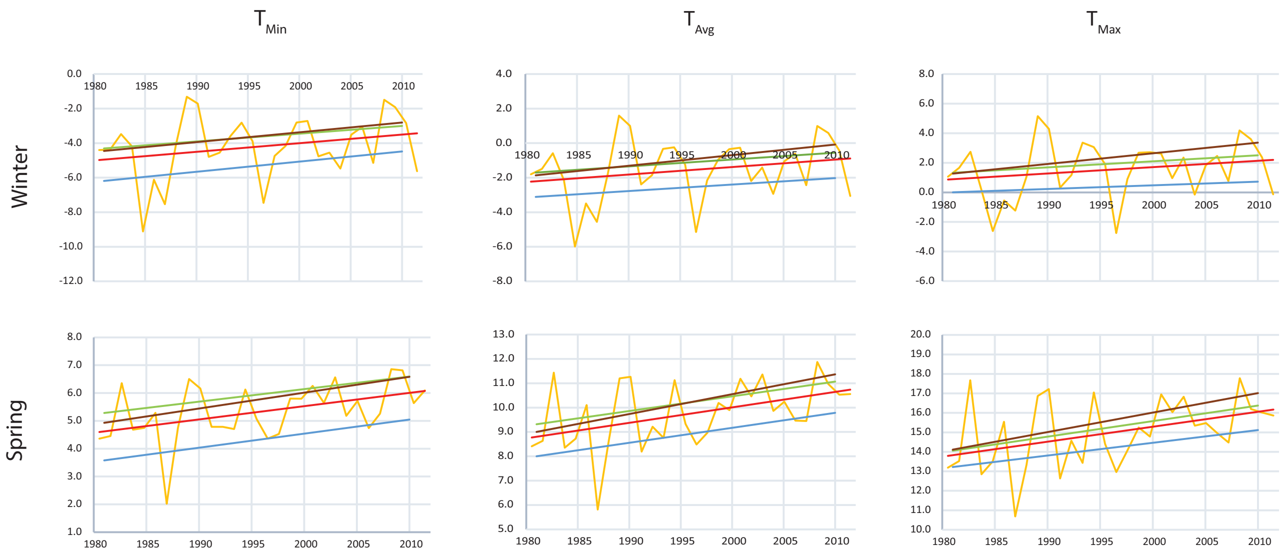
$$CV = \frac{\sigma}{x} \times 100\%$$

The temperature is the most variable in the winter, reaching 50% or more for the mean, maximum and minimum temperatures. The least variable are the mean, maximum and minimum summer temperatures, when the CV ranges from 4.7 to 7.4%. With regard to annual temperatures, they range from 7.9% (Briceni) - 8.2% (Cahul) for maximum temperatures to up to 13.1% (Cahul) - 20% (Briceni) for minimum temperatures. Variability of precipitation is considerably higher and it is > 30% for all seasons, with the exception of the annual precipitation (Table 1-1).

Table 1-1: Mean air temperatures and total precipitation over the period 1981-2010 and their inter-annual variability

Season	Observations at the meteorological stations					
	Briceni		Chisinau		Cahul	
	X	CV,%	X	CV,%	X	CV,%
Maximal air temperature, °C						
Winter	0.4	>50	1.9	>50	2.3	>50
Spring	14.2	11.6	15.2	11.4	15.6	12.1
Summer	24.8	4.7	26.7	5.4	27.0	5.5
Autumn	13.2	9.4	14.7	8.0	15.4	8.5
Annual	13.1	7.9	14.6	7.9	15.1	8.2
Mean air temperature, °C						
Winter	-2.6	>50	-1.1	>50	-1.0	>50
Spring	8.9	14.7	10.2	13.1	10.2	13.7
Summer	19.1	5.7	21.3	5.5	21.3	5.6
Autumn	8.5	11.0	10.3	10.4	10.7	10.6
Annual	8.5	12.4	10.2	9.6	10.3	9.8
Minimal air temperature, °C						
Winter	-5.3	39.0	-3.7	48.4	-3.6	44.3
Spring	4.3	23.6	5.9	17.1	5.8	17.5
Summer	14.0	7.4	16.5	6.0	16.3	5.6
Autumn	4.8	23.8	6.7	16.2	6.9	15.4
Annual	4.5	20.0	6.4	13.6	6.3	13.1
Precipitation, mm						
Winter	99.6	42.0	105.8	48.4	90.4	40.8
Spring	140.2	35.5	123.7	43.8	116.1	49.8
Summer	255.3	30.8	186.1	41.0	184.8	51.9
Autumn	128.3	48.7	132.2	55.3	116.3	44.2
Annual	622.4	23.0	547.7	19.8	507.6	23.4

Trends in air temperature and precipitation calculated by linear regression analysis are shown in Figures 1-4 and 1-5, and more details are provided in Table 1-2.



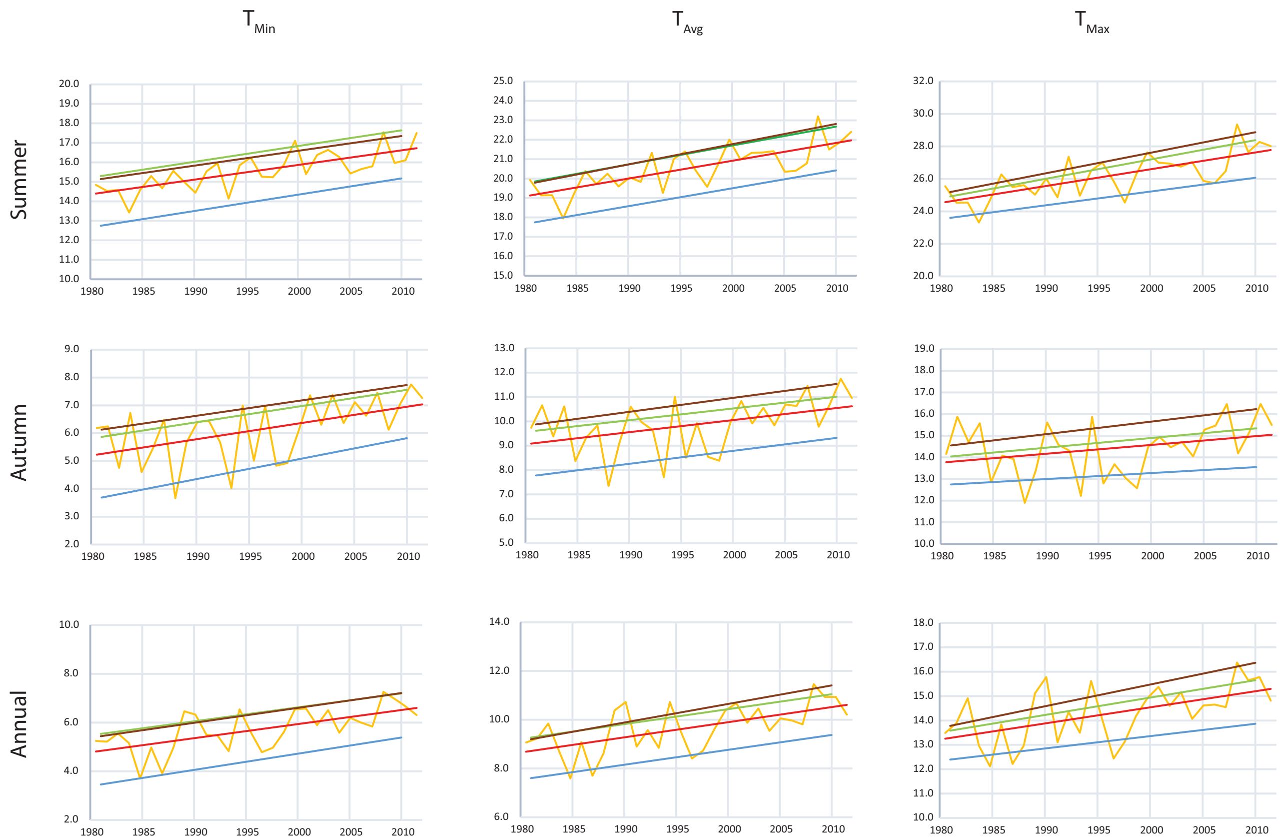


Figure 1-4: Trends in air temperature for 1981-2010: Briceni - blue, Chisinau - green, Cahul - brown, the red linear trend - the average for the RM; the yellow curve shows the inter-annual temperature variability for the Republic of Moldova

The positive trend rate on all graphs shows a temperature rise with different intensity in all seasons and on all territory of the RM. The statistical significance of the trend is shown by their *p*-values. Trends, where $p<0.10$, underlined in the table by shading should be considered as valid with 90% confidence level. In many cases, the statistical significance is significantly higher ($p<0.05$, and even <0.001).

The air temperature rises on the territory of the RM over the years 1981-2010 bears no doubt and it is most clearly seen during the warm season, especially in summer, when the mean temperature rises by 0.9-1.0°C, and T_{max} - by 0.9-1.3°C per decade with a very high degree of certainty. Climate is getting warmer to a lesser degree during the winter months, by 0.4-0.6°C per decade and this growth is statistically significant ($p \geq 0.10$) only for Cahul.

For the southern regions, the greatest temperature rise is registered due to T_{max}, while for the northern and central regions - due to T_{min}. In the transitional seasons, the greatest statistically significant increase in temperature is observed for T_{max} in the spring of 0.7°C (Briceni) to 1.0°C (Cahul) over the decade, and the lowest over autumn of 0.3°C (Briceni) to 0.6°C (Cahul) per decade. However, T_{min} shows a reverse pattern with autumn growth of 0.6°C (Cahul) to 0.7°C (Briceni) as compared to 0.5°C (Briceni) and 0.6°C (Cahul) per decade in spring.

In annual terms, also the largest increase T_{max} 0.9°C per decade is observed in Cahul against 0.5°C in Briceni, while the largest increase in T_{min} is observed, on the contrary, in Briceni 0.7°C per decade as opposed to 0.6°C in Cahul (Table 1-2, Figure 1-5).

Table 1-2: Indicators of linear trends of temperature and precipitation

Season	Observation site								
	Briceni			Chisinau			Cahul		
	r_0	r_1	*p*	r_0	r_1	*p*	r_0	r_1	*p*
Maximal air temperature, °C									
Winter	-0.02	0.025	0.5652	+1.28	0.041	0.3235	+1.20	0.072	0.0641
Spring	+13.15	0.066	0.0569	+13.98	0.080	0.0266	+14.01	0.100	0.0095
Summer	+23.51	0.086	0.0001	+24.80	0.120	0.0000	+25.07	0.127	0.0000
Autumn	+12.72	0.029	0.2982	+13.99	0.045	0.0716	+14.49	0.058	0.0348
Annual	+12.34	0.051	0.0169	+13.51	0.071	0.0020	+13.69	0.089	0.0002

Season	Observation site								
	Briceni			Chisinau			Cahul		
	r_0	r_1	p	r_0	r_1	p	r_0	r_1	p
Mean air temperature, °C									
Winter	-3.15	0.038	0.3689	-1.74	0.040	0.3000	-1.92	0.061	0.0725
Spring	+7.94	0.062	0.0223	+9.25	0.060	0.0287	+8.92	0.081	0.0037
Summer	+17.65	0.092	0.0000	+19.76	0.097	0.0000	+19.69	0.104	0.0000
Autumn	+7.73	0.053	0.0149	+7.96	0.042	0.0708	+9.82	0.057	0.0139
Annual	+7.54	0.061	0.0008	+9.21	0.061	0.0014	+9.13	0.076	0.0000
Minimal air temperature, °C									
Winter	-6.25	0.059	0.1854	-4.35	0.045	0.2376	-4.51	0.057	0.0955
Spring	+3.52	0.051	0.0159	+5.24	0.045	0.0328	+4.87	0.057	0.0050
Summer	+12.67	0.084	0.0000	+15.22	0.081	0.0000	+15.07	0.076	0.0000
Autumn	+3.61	0.073	0.0083	+5.81	0.058	0.0083	+6.07	0.055	0.0111
Annual	+3.39	0.067	0.0000	+5.48	0.057	0.0007	+5.38	0.061	0.0000
Precipitation, mm									
Winter	96.215	0.156	0.8621	86.464	1.248	0.2548	94.854	-0.288	0.7181
Spring	142.52	-0.150	0.8890	120.76	0.187	0.8733	130.09	-0.903	0.4693
Summer	208.41	3.022	0.0678	207.85	-1.406	0.3919	194.98	-0.656	0.7519
Autumn	105.96	1.440	0.2813	112.19	1.291	0.4118	101.90	0.930	0.4006
Annual	553.10	4.470	0.1409	527.27	1.321	0.5725	521.83	-0.916	0.7219

Legend: r_0 – free term; $r_{1\text{ - regression coefficient}}$ (trend coefficient); p - statistical significance of the trend.

Unlike temperature, statistically significant changes in precipitation are not observed, except for a statistically significant increase in summer precipitation of 30 mm per decade for Briceni. The upward trend in mean annual rainfall is observed in the North (44.7 mm) and the Centre (13.2 mm) per decade, while for the South the trend is towards a reduced growth of autumn precipitation of 9.2 mm per decade. Moreover, a trend towards decrease of precipitation is observed in the South during all seasons, except autumn, while in the Center decrease is seen only in summer.

Figure 1-5: Trends in precipitation over period 1981-2010: Briceni - blue, Chisinau - green, Cahul - brown, red linear trend - the average for the RM; the yellow curve shows the inter-annual fluctuations in precipitation for the RM

The Republic of Moldova has experienced also 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 1990-2014 timespan, 10 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 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 +4.2oC 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% in North to 13.4% in South. Controversially, according to RCP 2.6 scenario moderate increase in precipitation from 3.1% in North to 5.1% in South by 2100 is projected. Winters were 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% (RCP 2.6) to 11.8% (RCP 8.5) in winter over Northern and the lowest one from 3.0% (RCP 2.6) to 7.4% (RCP 8.5) 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% (RCP 4.5) to 25.1% (RCP 8.5) is projected in Centre and the lowest one from 7.4% (RCP 4.5) to 18.1% (RCP 8.5) 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 2015, the concentration of CO_2 increased by circa 42.6 per cent, concentration of CH_4 – by 154.0 per cent, while N_2O concentration – by circa 21.5 per cent[10] (Table 1-3). To a great extent these trends can be attributed to human activities — in particular, to fossil fuels combustion and continuous deforestation of forest lands.

By the end of 2015, globally, the amount of annual emissions of carbon dioxide represented circa 36.2 Gigatons (Gt)[11], 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.

Table 1-3: 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 2015)	GWP (100-yr time horizon) (IPCC, 2013)	Tropospheric lifetime (years)	Increased radiative forcing[12] (W/m²)
Concentration in parts per million (ppm)					
Carbon dioxide (CO_2)	280	399.5	1	~ 100-300	1.94
Concentration in parts per billion (ppb)					
Methane (CH_4)	722	1834	28	12.4	0.50
Nitrous oxide (N_2O)	270	328	265	121	0.20
Tropospheric ozone (O_3)	237	337	n.a.	hours-days	0.40
Concentration in parts per trillion (ppt)					
CFC-11 (CCl_3F)	zero	232	4660	45	0.060
CFC-12 (CCl_2F_2)	zero	516	10200	100	0.166
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 ($CBrCIF_2$)	zero	3.6	1750	16	0.0010
Halon 1301 ($CBrCIF_3$)	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

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 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[13]).

It has been stated that circa 40 per cent of the atmospheric N_2O is of anthropogenic origin[14], 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

[10] <http://cdiac.ornl.gov/pns/current_ghg.html>
[11] <http://edgar.jrc.ec.europa.eu/news_docs/jrc-2014-trends-in-global-co2-emissions-2014-report-93171.pdf>
[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 (m2).
[13] <https://www.globalmethane.org/documents/analysis_fs_en.pdf>
[14] <https://www.wmo.int/pages/mediacentre/press_releases/pr_1002_en.html>.

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[15].

PFCs (perfluorocarbones), HFCs (hydrofluorocarbones) 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 aluminium 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 takes into account 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 relate 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 1-4).

Table 1-4: GWP for a Period of 100 Years and Direct GHG Atmospheric Lifetimes[16]

GHG	Chemical formula	Lifetime	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	$C_2H_2F_4$ (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
Perfluorocarbons (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.

15 <http://edgar.jrc.ec.europa.eu/part_N$_2$O.php#1overview>, <http://edgar.jrc.ec.europa.eu/ingos/JRC-INGOS-report.pdf>
16 <http://www.epa.gov/climatechange/Downloads/ghgemissions/US-GHG-Inventory-2014-Annex-6-Additional-Information.pdf>

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, within 2010-2013 period – the Third National Communication (TNC), while from 2014 to 2017, the Fourth National Communication (4^{th}NC).

With reference to UNFCCC implementation instruments it should be noted that the COP 3 (Kyoto, 1997) adopted the Kyoto Protocol[17], 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 13^{th} 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.

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

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

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 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[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 years. The inventory section of the BUR should consist of a National Inventory Report (NIR) as a summary or as an update of the information contained in Decision 17/CP.8, Annex, Chapter III (National Greenhouse Gas Inventories). The inventory section is expected to present in a detailed and transparent manner the procedures of national inventory for anthropogenic GHG emissions by sources or removals of carbon dioxide through sequestration, including information on 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 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

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

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 September 21, 2017[21], only 83 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.

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 1st of October 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 a Protocol, another legal instrument or an agreed outcome 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)[22].

At 25th of September 2015, the Republic of Moldova 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 INDC, 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

[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] <http://unfccc.int/kyoto_protocol/doha_amendment/items/7362.php>
[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>.

emission reduction targets set out in the Republic of Moldova's INDC 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 Contribution to Global Warming

The Republic of Moldova historic contribution to global warming is low. In 2015, the country contributed with circa 13.95 Mt CO_2 equivalent (without LULUCF) and 11.11 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 (3.5 t CO_2 equivalent per capita compared to 6.4 t CO_2 equivalent per capita, respectively 2.8 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 67.8 per cent, which is much more than in most industrialized countries and economies in transition included in Annex I to Convention (Figure 1-6).

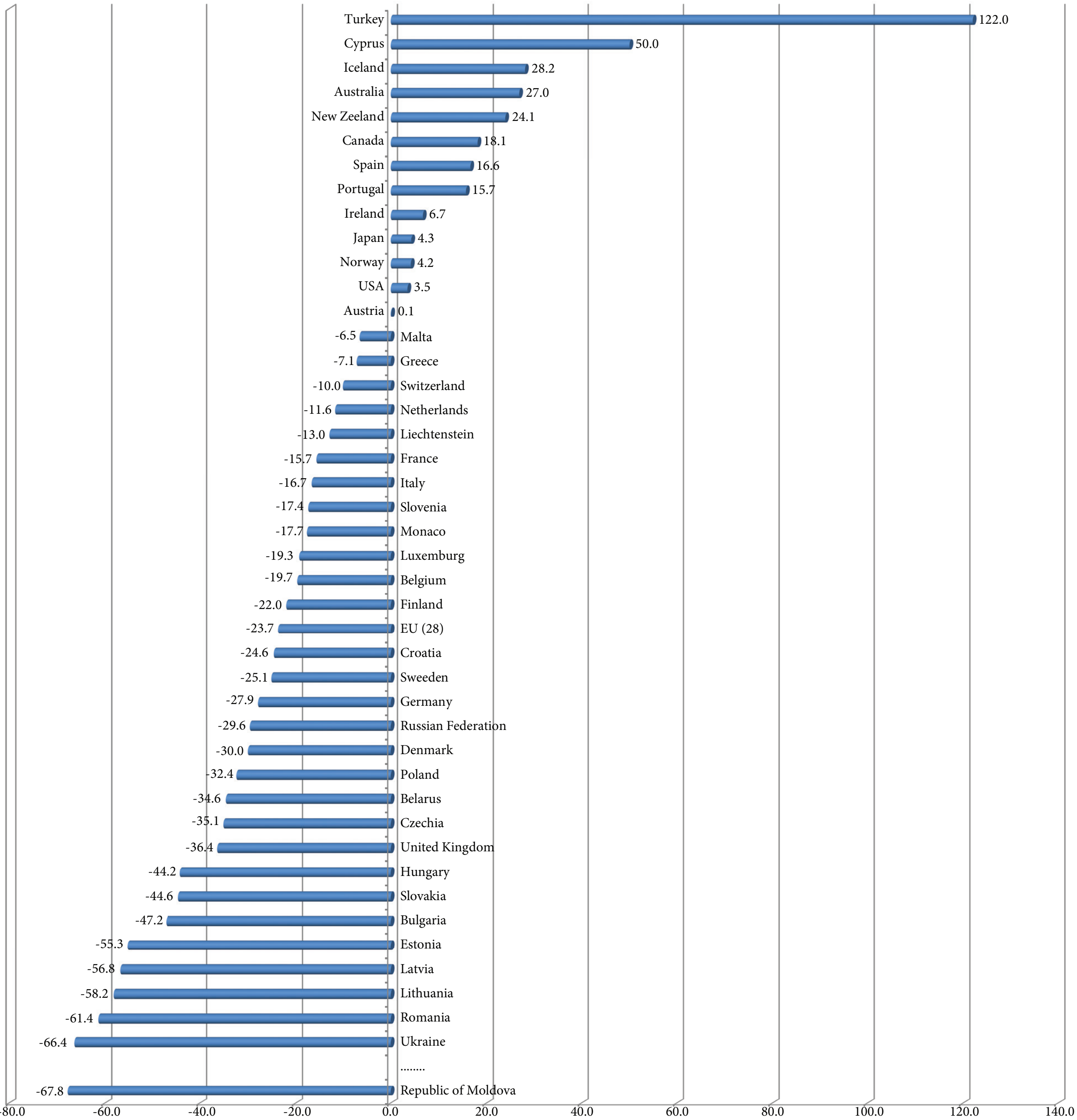


Figure 1-6: Total GHG Emissions from the Republic of Moldova (without LULUCF) and Annex I Parties to the Convention in 2015[25] (% compared to 1990)

[24] <http://lex.justice.md/index.php?action=view&view=doc&lang=1&id=369528>
[25] <http://unfccc.int/resource/docs/2017/sbi/eng/18.pdf>

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 UNFCCC). 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 activities;
    - development and implementation of measures aimed to adapt to climate change;
    - assessment of the climate change impact on environment 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, etc.

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, Paragraph 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).

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 1-7 reveals the responsibilities and arrangements for the National Inventory System (NIS) of the RM.

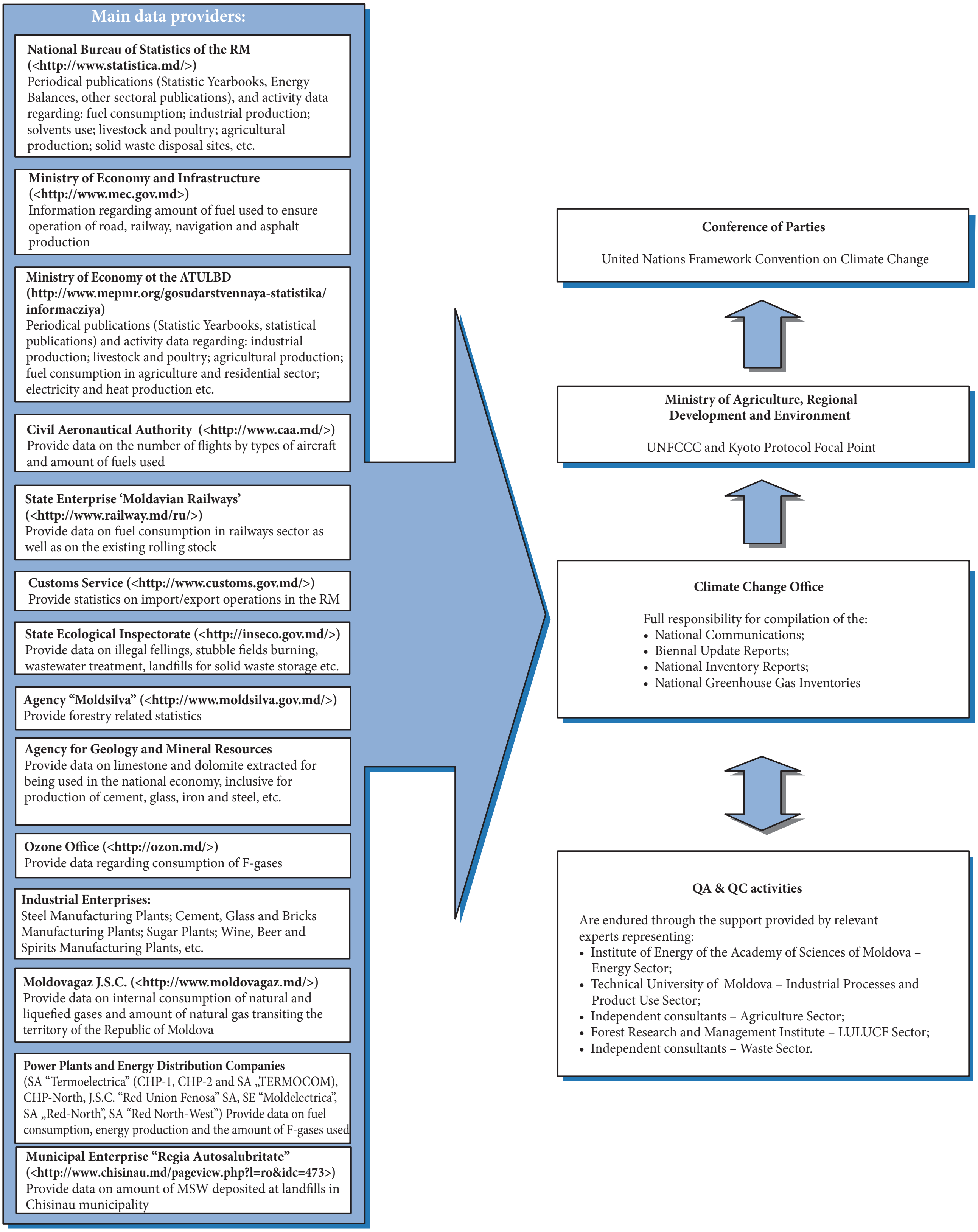


Figure 1-7: Institutional arrangements under the National Inventory System of the Republic Moldova

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;

- 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.

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[26] 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 by the Statistical Yearbooks of the ATULBD[27] and the State Statistical Service beside the Ministry of Economy of the ATULBD[28].

Additional statistical data (unpublished data) may be provided at request, in conformity with provisions of the Law No. 412 as of 09.12.2004 on "Official Statistics", Article 9 (2), item a) and b), according to which "*the official statistics authorities must disseminate statistical data to users in the amount, manner and terms specified in the statistical works programme*", as well as to "*to ensure access of all users to non-confidential statistic on equal conditions in terms of amount and terms of dissemination*".

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, other relevant activity data is collected from various partner institutions:

- from Ministry of Economy and Infrastructure (has recently taken over the responsibilities of the former Ministry of Transport and Road Infrastructure, respectively, the Ministry of Information Technology and Communications): information on the amount of fuel used to ensure operation of road, railway, naval transport; on the amount of asphalt produced and used in the country; information on transport units registered, their type, ages of fleet and/or production year;
- from State Enterprise "Moldavian Railways": information of fuel used for rail transport, as well as on the rolling stock used by the enterprise;
- from 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;
- from the Ministry of Defense: information on the amount of fuels used for military transportation;
- from the Ministry of Health, Labor and Social Protection: information on the use of medicines which contains aerosols (specifically on HFCs), as well as on use of N_2O for anesthesia purposes;
- from Agency "Moldsilva": information on forestry related statistics;
- from Land Relations and Cadaster Agency: information on land use by categories type;
- from Customs Service: statistics on import/export operations in the Republic of Moldova;
- from State Ecological Inspectorate: information on illegal felling and stubble fields burning;
- from Agency for Geology and Mineral Resources: information on limestone and dolomite extraction and use;

[26] National Bureau of Statistics of the Republic of Moldova, on-line database: <http://statbank.statistica.md/pxweb/Database/RO/databasetree.asp>
[27] CCO of the MARDE has copies of the Statistical Yearbooks of ATULBD for the years of 2000-2016, covering the statistical data for the 1990 year and 1995-2015 periods.
[28] Ministry of Economy of the ATULBD: <http://www.mepmr.org/gosudarstvennaya-statistika/informacziya>

- from 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;
- from "IPROCOM" Institute: information on the characteristics of landfills for solid waste storage on the territory of the RM;
- from Municipal Enterprise "Regia Autosalubritate": information on landfill storage of solid household waste generated in Chisinau municipality;
- from "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, as well as on technical losses;
- from Power Plants ("TERMOELECTRICA" S.A. in Chisinau [CHP-1 S.A., CHP-2 S.A. and "TERMOCOM" S.A.], CHP-North S.A. in Balti: information on the amount of fuel used for electricity and heat production;
- from 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;
- from a range of industrial enterprises representing mainly the manufacture of non-metallic mineral products ("Lafarge Cement (Moldova)" J.S.C., "Macon" J.S.C., Glass Factory No. 1 in Chisinau, "Glass-Container" Company in Chisinau, etc.) – information on industrial output, amount of mineral resources used, amount of fuel 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 MARDE 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 (Annex 6). The National Inventory preparation process is outlined in Figure 1-8.

The Coordinator of the National GHG Inventory 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 Coordinator of the National GHG Inventory, 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 Coordinator of the National GHG Inventory 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 produced 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 Coordinator of the National GHG Inventory 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 Coordinator of the National GHG Inventory 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.

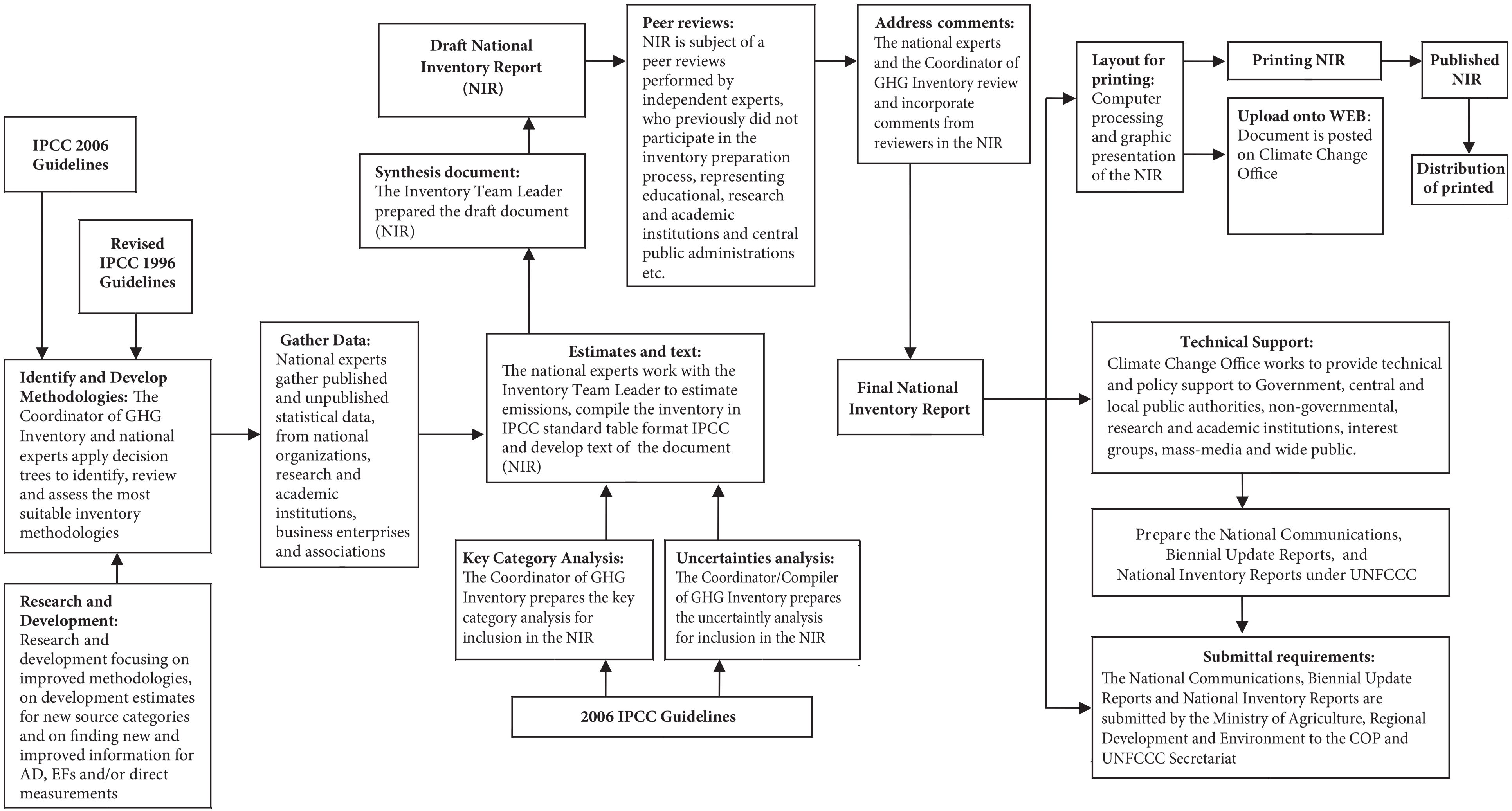


Figure 1-8: Inventory Process in the Republic of Moldova

The NIR is produced in compliance with the general structure of the National Inventory Reports (NRI), as was established in the Decision 24/CP.19. In addition to NIR, the common reporting tables are filled-in (see Annex 6).

The Coordinator of the National GHG Inventory has the task to monitor the process of producing the 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 Coordinator of the National GHG Inventory.

The first QA/QC Plan was produced in 2006 within the UNDP-GEF Regional Project "Capacity Building for Improving the Quality of the National GHG Inventories (Central Europe and CIS 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 COP, 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 1-5).

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 Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories (IPCC, 1997), respectively 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 national 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.

Table 1-5: Summary of Methods and Emission Factors Used for Inventory Preparation Process in the Republic of Moldova

Categories by sources and sinks	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.

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 (International Statistic Yearbook of Iron and Steel, 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; Civil Aeronautical Authority of the Republic of Moldova; Customs Service; SEI, SHS, Agency for Geology and Mineral Resources, Ozone Office) and central administrative authorities (National Bureau of Statistics, Agency for Land Relations and Cadaster, Agency "Moldsilva"), 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.), legislation acts (*National Complex Program of Enhancing Soil Fertility in 2001-2020*, approved by the Government Decree No. 591 as of 20.06.2000; C*omplex Program for Reclamation of Degraded Lands and Enhancing Soils Fertility. Part I Reclamation of degraded lands*, approved by the Government Decree No. 636 as of 26.05.2003 and C*omplex Program for Reclamation of Degraded Lands and Enhancing Soils Fertility, Part II Enhancing Soils Fertility*, approved by the Government Decree No. 841 as of 26.07.2004 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 1-6, respectively Annex 1, presents the key categories for the Republic of Moldova's National GHG Inventory, 1990-2015, without LULUCF – based on the Tier 1 methodological approach, 16 key categories by level (L) and 16 key categories by trend (T); based on a Tier 2 approach – 14 key categories by level (L) and 12 key categories by trend (T); with LULUCF – based on the Tier 1 methodological approach – 20 key categories by level (L) and 16 key categories by trend (T); based on a Tier 2 approach – 19 key categories by level (L) and 14 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.

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.

Table 1-6: Summary Overview of the Republic of Moldova's Key Categories for 1990-2015, 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	
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				
2F2	Product Uses as Substitutes for ODS – Foam Blowing	HFC	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	
3B1-4	Direct N_2O Emissions from Manure Management	N_2O	X		X		X		X	
3B5	Indirect N_2O Emissions from Manure Management	N_2O			X	X			X	
3Da	Direct N_2O Emissions from Managed Soils	N_2O	X	X	X	X	X	X	X	X
3Db	Indirect N_2O Emissions from Managed Soils	N_2O	X	X	X	X	X	X	X	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	X
4C2	Land Converted to Grassland	CO_2					X	X	X	X
4G	Harvested Wood Products	CO_2						X		X
5A	Solid Waste Disposal	CH_4	X	X	X	X	X	X	X	X
5D	Wastewater Treatment and Discharge	CH_4	X	X	X	X	X	X	X	X

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

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)[29].

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 (see Figure 1-9) and standard verification and quality control forms and checklists (Annex 4), by using Tier 1 (general procedures) and Tier 2 (source-specific procedures), that serve to standardize the process of implementing quality

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

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.

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.

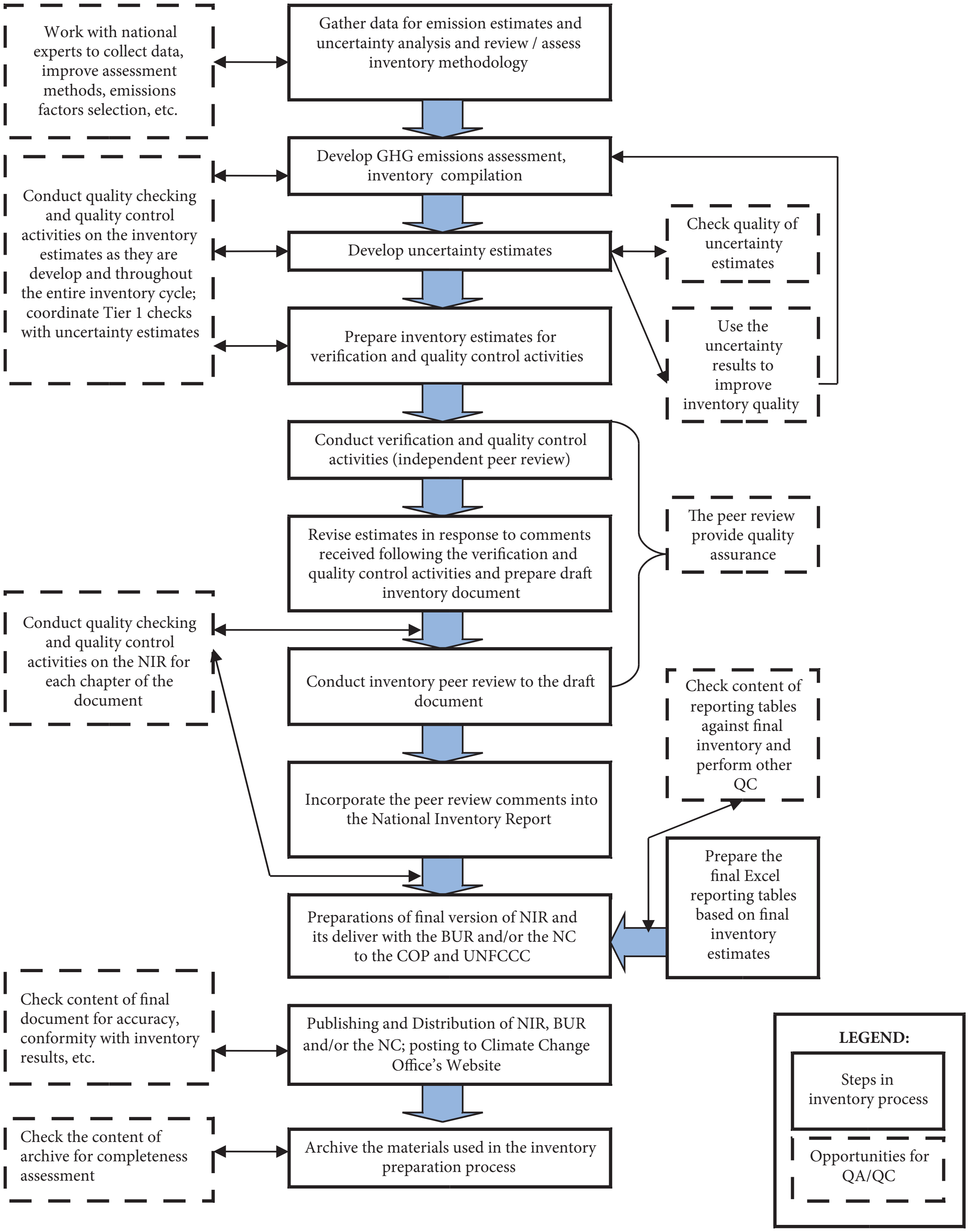


Figure 1-9: The Role of QA/QC Activities in the Inventory Preparing Process.

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 Republic of Moldova'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 Republic of Moldova'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 example, 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 waste 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 (HFC, PFC, SF_6 and NF_3) 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 (±8.45 per cent level uncertainty and, respectively ±2.37 per cent trend uncertainty) are shown in Table 1-7, as well as in the Annex 5.

Table 1-7: Estimated Overall National Inventory Quantitative Uncertainty

	CO_2	CH_4	N_2O	Total
Level Uncertainty	±8.06	±21.86	±29.31	±8.45
Trend Uncertainty	±1.97	±10.44	±10.74	±2.37

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.

2. GREENHOUSE GAS EMISSION TRENDS

2.1. Summary of Direct GHG Emission Trends

Between 1990 and 2015, the total direct greenhouse gas emissions dynamic expressed in CO_2 equivalent, revealed a decreasing trend in the Republic of Moldova, reducing by circa 67.8 per cent: from 43.40 Mt CO_2 equivalent in 1990 to 13.95 Mt CO_2 equivalent in 2015 (Figure 2-1).

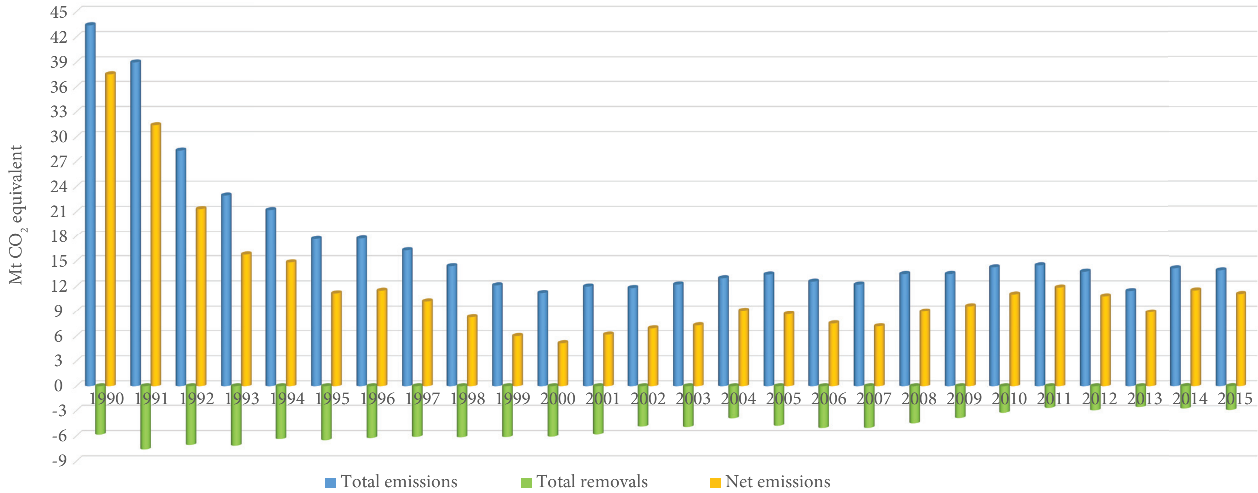


Figure 2-1: Greenhouse Gas Emission and Removals Trends in the Republic of Moldova within 1990-2015 time series

The most significant direct GHG emissions reductions have been registered under the following source categories: 4G "Harvested Wood Products" (-143.6 per cent), 1A5 "Other" (-98.0 per cent), 4C "Grassland" (-89.3 per cent), 1A1 "Energy Industry" (-78.6 per cent), 1A4 "Other Sectors" (-74.8 per cent), 3B "Manure Management" (-73.8 per cent), 3A "Enteric Fermentation" (-70.1 per cent) 1A2 "Manufacturing Industries and Construction" (-69.8 per cent), 2D "Non-energy Products from Fuels and Solvent Use" (-62.8 per cent), 2A "Mineral Industry" (-61.3 per cent), 4F "Other Land" (-60.1 per cent), 4E "Settlements" (-55.2 per cent), 5D "Wastewater Treatment and Discharge" (-52.9 per cent) and 1A3 "Transport" (-50.8 per cent).

Between 2014 and 2015, total direct GHG emissions decreased in the Republic of Moldova by circa 1.7 per cent. At the same time, emissions from certain source categories increased, in particular from: 4E "Settlements" (+106.4 per cent), 2C "Metal Industry" (+24.8 per cent), 2F "Product Uses as Substitutes for ODS" (+18.5 per cent), 1A2 "Manufacturing Industries and Construction" (+13.7 per cent), 1A3 "Transport" (+5.4 per cent) and 1A1 "Energy Industry" (+3.1 per cent). Also, removals from certain categories increased as well: 4B "Cropland" (+28.6 per cent) and 4C "Grassland" (+12.9 per cent).

2.2. Emission Trends by Gas

Within 1990 to 2015 periods, the total CO_2 emissions (without LULUCF) decreased by circa 73.1 per cent (from 34.8952 Mt in 1990 to 9.3956 Mt in 2015). CH_4 and N_2O emissions decreased by circa 49.8 per cent (from 5.7036 Mt CO_2 equivalent in 1990 to 2.8627 Mt CO_2 equivalent in 2015), respectively by 45.9 per cent (from 2.8013 Mt CO_2 equivalent in 1990 to 1.5145 Mt CO_2 equivalent in 2015) (Table 2-1).

Table 2-1: Direct GHG Emissions in the Republic of Moldova within 1990-2015, Mt CO_2 equivalent

	1990	1991	1992	1993	1994	1995	1996	1997	1998
CO_2 (without LULUCF)	34.8952	31.0359	21.3191	16.0959	14.9803	11.5887	11.7678	10.7194	9.1852
CO_2 (with LULUCF)	29.0128	23.3966	14.2115	8.8982	8.5721	5.0373	5.4717	4.5634	2.9740
CH_4 (without LULUCF)	5.7036	5.2873	4.8574	4.5944	4.4237	4.1673	4.0936	3.7181	3.5328
CH_4 (with LULUCF)	5.7063	5.2897	4.8596	4.5974	4.4254	4.1695	4.0952	3.7208	3.5352
N_2O (without LULUCF)	2.8013	2.6646	2.2085	2.2483	1.7987	1.8892	1.8457	1.8593	1.6807
N_2O (with LULUCF)	2.8614	2.7241	2.2625	2.3064	1.8597	1.9563	1.9140	1.9239	1.7480
HFCs	NO	NO	NO	NO	NO	0.0046	0.0052	0.0060	0.0075
PFCs	NO	NO	NO	NO	NO	NO	NO	NO	NO
SF_6	NO	NO	NO	NO	NO	NO	NO	NO	NO
Total (without LULUCF)	43.4000	38.9878	28.3850	22.9386	21.2027	17.6498	17.7123	16.3028	14.4061
Total (with LULUCF)	37.5804	31.4104	21.3336	15.8020	14.8571	11.1677	11.4861	10.2141	8.2647

	1999	2000	2001	2002	2003	2004	2005	2006	2007
CO_2 (without LULUCF)	7.2033	6.4504	7.0595	6.7827	7.4863	8.0163	8.3850	7.7398	8.1264
CO_2 (with LULUCF)	1.0176	0.3199	1.1837	1.8325	2.4732	4.0463	3.5447	2.6378	3.0328
CH_4 (without LULUCF)	3.3915	3.3209	3.3225	3.3681	3.2940	3.2622	3.3030	3.1688	2.9971
CH_4 (with LULUCF)	3.3939	3.3219	3.3237	3.3684	3.2940	3.2624	3.3032	3.1691	2.9988
N_2O (without LULUCF)	1.5195	1.4260	1.5813	1.6343	1.4182	1.6621	1.6839	1.5989	1.0149
N_2O (with LULUCF)	1.5906	1.4985	1.6631	1.7173	1.5039	1.7472	1.7596	1.6651	1.0826
HFCs	0.0086	0.0105	0.0129	0.0169	0.0237	0.0311	0.0422	0.0547	0.0698
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)	12.1228	11.2078	11.9762	11.8020	12.2221	12.9717	13.4141	12.5625	12.2087
Total (with LULUCF)	6.0108	5.1507	6.1833	6.9351	7.2948	9.0870	8.6497	7.5270	7.1845
	2008	2009	2010	2011	2012	2013	2014	2015	%
CO_2 (without LULUCF)	8.7930	9.0898	9.6570	9.8288	9.5065	8.4882	9.2609	9.3956	-73.1
CO_2 (with LULUCF)	4.2377	5.1696	6.3596	7.1157	6.4892	5.8716	6.5376	6.4910	-77.6
CH_4 (without LULUCF)	2.9837	2.8913	2.9134	2.9767	2.9285	2.8710	2.9367	2.8627	-49.8
CH_4 (with LULUCF)	2.9844	2.8917	2.9136	2.9769	2.9298	2.8719	2.9368	2.8634	-49.8
N_2O (without LULUCF)	1.6066	1.3994	1.5789	1.5772	1.1839	1.6509	1.8494	1.5145	-45.9
N_2O (with LULUCF)	1.6735	1.4671	1.6461	1.6461	1.2548	1.7196	1.9115	1.5730	-45.0
HFCs	0.0847	0.0932	0.1134	0.1195	0.1288	0.1376	0.1514	0.1794	NA
PFCs	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	NA
SF_6	0.0005	0.0006	0.0007	0.0007	0.0008	0.0010	0.0011	0.0011	NA
Total (without LULUCF)	13.4685	13.4743	14.2635	14.5031	13.7486	11.4349	14.1995	13.9533	-67.8
Total (with LULUCF)	8.9809	9.6222	11.0334	11.8591	10.8034	8.8878	11.5384	11.1079	-70.4

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

Halocarbons emissions (HFCs, PFCs) and sulphur hexafluoride (SF_6) emissions have been recorded beginning with 1995, considered as a starting year for monitoring F-gases (HFCs, PFCs and SF_6) (no NF_3 emissions 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 2015.

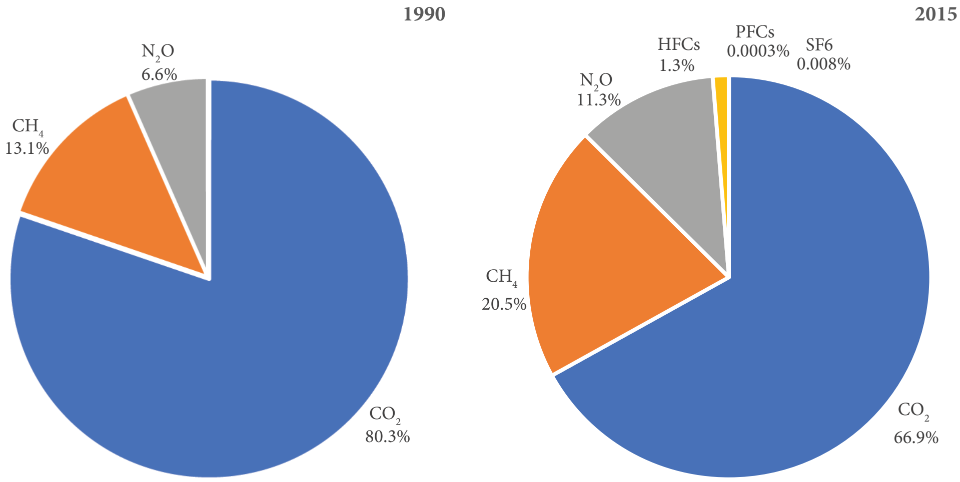


Figure 2-2: Direct GHGs share in the structure of total GHG emissions in the Republic of Moldova in 1990 and 2015 years

In 2015, the source categories having the biggest share in the total dioxide of carbon emissions in the Republic of Moldova were: 1A1 "Energy Industries" (4.1412 Mt or 44.1 per cent of the total), 1A3 "Transport" (2.1581 Mt or 23.0 per cent of the total), 4A "Forest Land" (-2.0273 Mt or -21.6 per cent of the total), 1A4 "Other Sectors" (1.7902 Mt or 19.1 per cent of the total), 4B "Cropland" (-0.7274 Mt or -7.7 per cent of the total), 1A2 "Manufacturing Industries and Constructions" (0.6656 Mt or 7.1 per cent of the total), 2A "Mineral Industry" (0.5097 Mt or 5.4 per cent of the total) and 4C "Grassland" (-0.3062 Mt or -3.3 per cent of the total) (Figure 2-3).

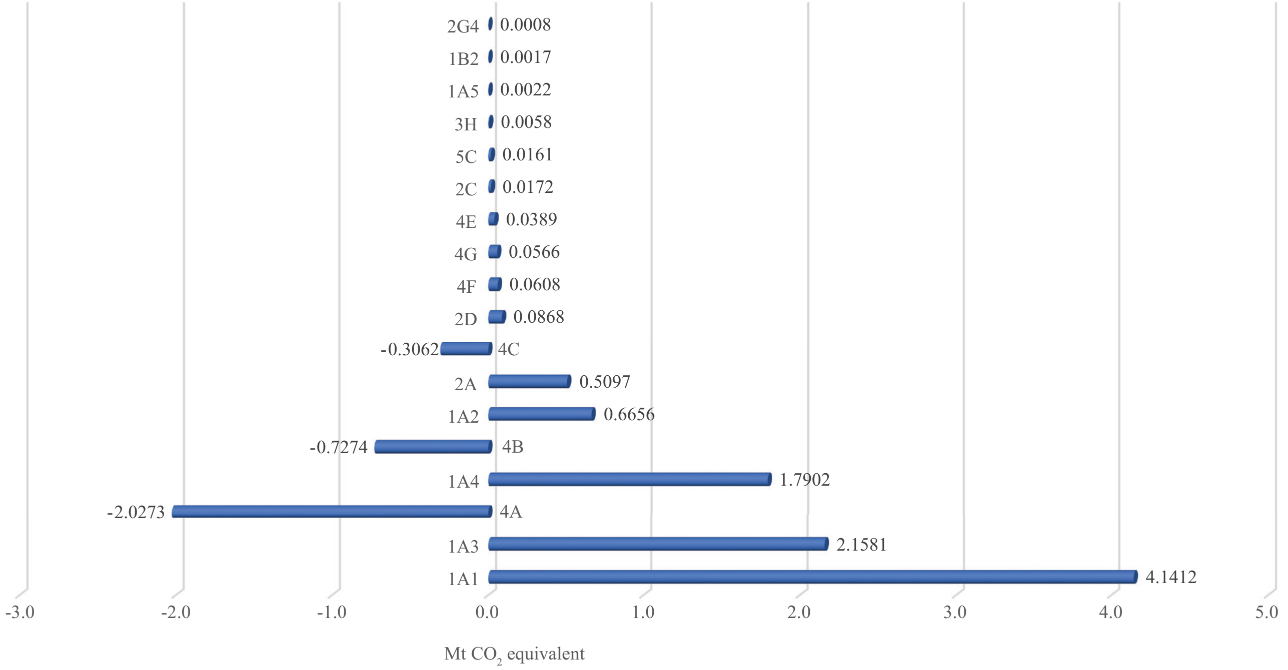


Figure 2-3: Source Categories of CO_2 in the Republic of Moldova in 2015

In 2015, the source categories having the biggest share in the total methane emissions in the Republic of Moldova were: 5A "Solid Waste Disposal" (1.0872 Mt CO_2 equivalent or 38.0 per cent of the total), 3A "Enteric Fermentation" (0.6546 Mt CO_2 equivalent or 22.9 per cent of the total), 1B2 "Fugitive Emissions from Oil and Natural Gas" (0.5666 Mt CO_2 equivalent or 19.8 per cent of the total), 5D "Wastewater Treatment and Discharge" (0.3542 Mt CO_2 equivalent or 12.4 per cent of the total), 1A4 "Other Sectors" (0.1089 Mt CO_2 equivalent or 3.8 per cent of the total) and 3B "Manure Management" (0.0704 Mt CO_2 equivalent or 2.5 per cent of the total) (Figure 2-4).

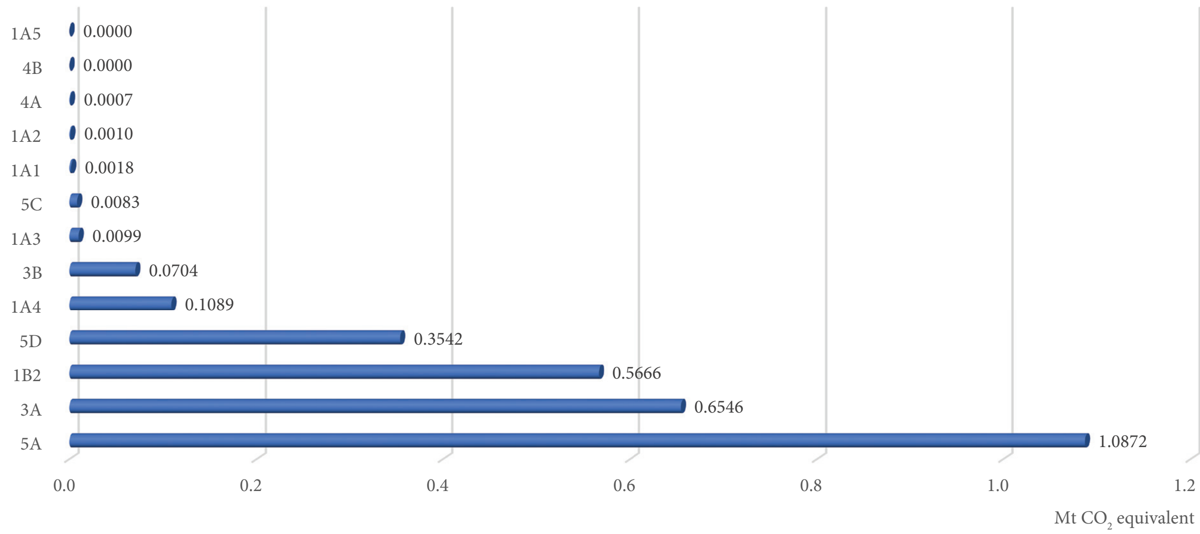


Figure 2-4: Source Categories of CH_4 in the Republic of Moldova in 2015

In 2015, the source categories having the biggest share in the total nitrous oxide emissions in the Republic of Moldova were: 3D "Agricultural Soils" (1.0318 Mt CO_2 equivalent or 68.1 per cent of the total), 3B "Manure Management" (0.3521 Mt CO_2 equivalent or 23.2 per cent of the total), 5D "Wastewater Treatment and Discharge" (0.0707 Mt CO_2 equivalent or 4.7 per cent of the total), 4B "Cropland" (0.0575 Mt CO_2 equivalent or 3.8 per cent), 1A3 "Transport" (0.0350 Mt CO_2 equivalent or 2.3 per cent of the total) and 1A4 "Other Sectors" (0.0169 Mt CO_2 equivalent or 1.1 per cent of the total) (Figure 2-5).

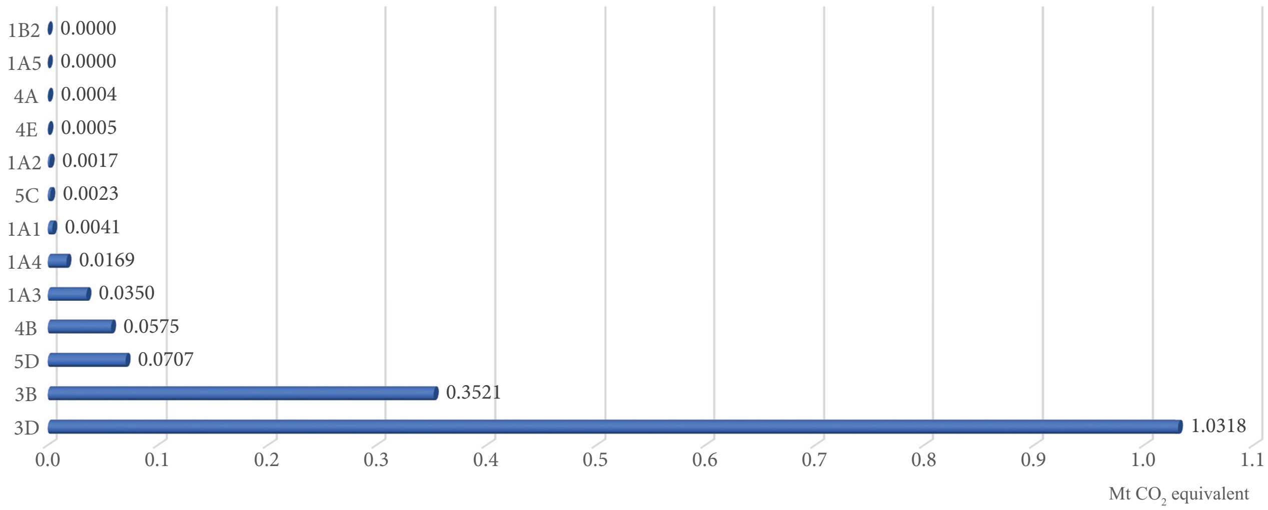


Figure 2-5: Source Categories of N_2O in the Republic of Moldova in 2015

2.3. Emission Trends by Sources

Emissions estimates were grouped into five large categories: (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 1990-2015 time series, total GHG emissions in the Republic of Moldova tended to decrease, thus emissions under Energy Sector decreased by circa 72.6 per cent, Industrial Processes and Product Use – by circa 49.7 per cent, Agriculture – by 59.4 per cent, LULUCF – by 51.1 per cent, while from Waste Sector – by 22.2 per cent (Table 2-2).

Table 2-2: Direct Greenhouse Gas Emissions in the Republic of Moldova by Sector within 1990-2015, Mt CO_2 equivalent

	1990	1991	1992	1993	1994	1995	1996	1997	1998
1. Energy	34.6308	30.7803	21.3699	16.1330	15.1511	11.8855	12.1887	10.9476	9.4270
2. Industrial Processes and Product Use	1.5810	1.4026	0.8144	0.7331	0.5529	0.4535	0.4129	0.4550	0.3809
3. Agriculture	5.2106	4.8569	4.3977	4.2227	3.7517	3.5906	3.4009	3.1810	2.9467
4. LULUCF	-5.8197	-7.5773	-7.0514	-7.1366	-6.3455	-6.4821	-6.2262	-6.0886	-6.1414
5. Waste	1.9777	1.9479	1.8030	1.8497	1.7471	1.7202	1.7098	1.7191	1.6514
	1999	2000	2001	2002	2003	2004	2005	2006	2007
1. Energy	7.4725	6.7878	7.3880	7.1323	7.8500	8.3637	8.6817	7.8533	8.0245
2. Industrial Processes and Product Use	0.3452	0.3190	0.3243	0.3770	0.4119	0.4897	0.5986	0.7092	0.9713
3. Agriculture	2.6892	2.5002	2.6728	2.7425	2.4246	2.5921	2.5765	2.4631	1.6847
4. LULUCF	-6.1121	-6.0570	-5.7928	-4.8670	-4.9273	-3.8846	-4.7644	-5.0355	-5.0242
5. Waste	1.6159	1.6007	1.5911	1.5503	1.5356	1.5262	1.5573	1.5369	1.5282
	2008	2009	2010	2011	2012	2013	2014	2015	%
1. Energy	8.6140	9.3023	9.8287	9.9961	9.6545	8.5633	9.3447	9.5049	-72.6
2. Industrial Processes and Product Use	1.0639	0.5601	0.6050	0.6985	0.7164	0.7703	0.8049	0.7951	-49.7
3. Agriculture	2.2384	2.0703	2.2497	2.2040	1.7758	2.2490	2.4879	2.1147	-59.4
4. LULUCF	-4.4876	-3.8521	-3.2301	-2.6440	-2.9451	-2.5470	-2.6610	-2.8454	-51.1
5. Waste	1.5522	1.5417	1.5801	1.6044	1.6018	1.5661	1.5619	1.5387	-22.2

Energy Sector is the most important source of total national direct GHG emissions, its share varying over the time series from 1990 through 2015 from 79.8 per cent and 68.1 per cent. Other relevant sources are represented by Agriculture, Waste and IPPU Sectors (Figure 2-6). During the entire period under review, the LULUCF Sector 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 significantly: in 1990 – the removals represented only circa 13.4 per cent of the total national GHG emissions, while in 2015 it represented already circa 20.4 per cent of the total.

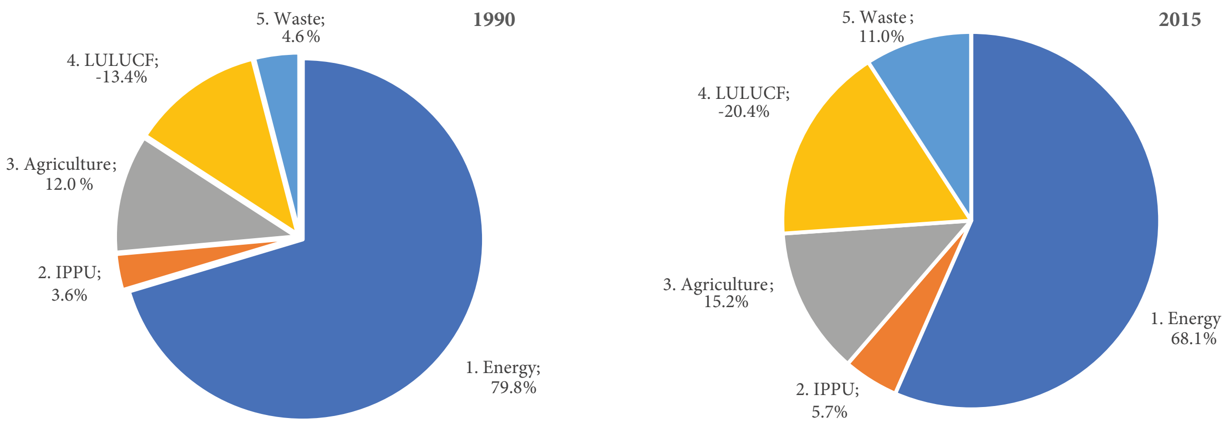


Figure 2-6: Sectoral Breakdown of the Republic of Moldova's total GHG Emissions in 1990 and 2015

2.3.1. Energy Sector

Energy-related activities are by far the largest source of GHG emissions in the Republic of Moldova. The Energy Sector includes emissions of all GHGs from fuel combustion (stationary and mobile combustion) for the primary purpose of delivering energy (94 per cent of total emissions per sector in 2015), 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 (6 per cent of total emissions per sector in 2015) (Figure 2-7, Table 2-3).

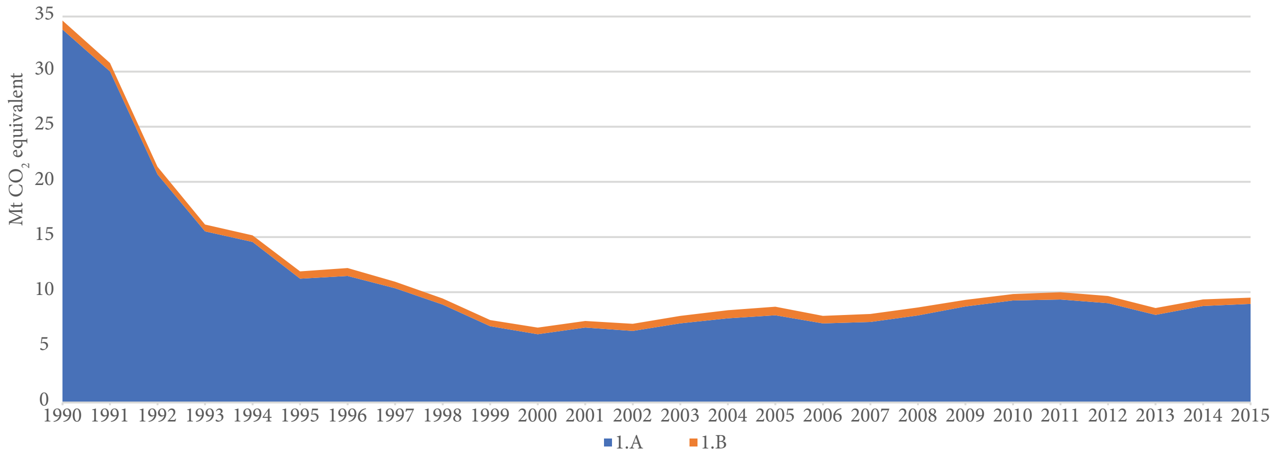


Figure 2-7: GHG Emissions from Energy Sector in the Republic of Moldova within 1990-2015 periods

Overall, these emissions accounted, in 2015 circa 68.1 per of total Republic of Moldova's direct GHG emissions. Between 1990 and 2015, total GHG emissions from Energy Sector decreased by circa 72.6 per cent: from 34.6308 Mt CO_2 equivalent in 1990 to 9.5049 Mt CO_2 equivalent in 2015.

Table 2-3: GHG Emissions from Energy Sector within 1990-2015 periods, Mt CO_2 equivalent

	1990	1995	2000	2005	2010	2011	2012	2013	2014	2015
1. Energy	**34.6308**	**11.8855**	**6.7878**	**8.6817**	**9.8287**	**9.9961**	**9.6545**	**8.5633**	**9.3447**	**9.5049**
1A. Fuel Combustion	**33.8179**	**11.2237**	**6.1868**	**7.9052**	**9.2476**	**9.3344**	**9.0023**	**7.9417**	**8.7477**	**8.9367**
1A.1. Energy Industries	19.3983	6.9044	3.1593	3.2333	4.5976	4.1880	4.1971	3.3164	4.0215	4.1471
1A.2. Manufacturing Industries and Construction	2.2138	0.4650	0.5380	0.6049	0.5411	0.6015	0.5652	0.6016	0.5876	0.6683
1A.3. Transport	4.4818	1.5229	0.9488	1.7680	2.0537	2.1643	1.9056	2.0150	2.0903	2.2030
1A.4. Other Sectors	7.6084	2.2128	1.5143	2.2641	2.0310	2.3587	2.3266	2.0048	2.0461	1.9161
1A.5. Other	0.1156	0.1186	0.0263	0.0350	0.0243	0.0219	0.0078	0.0038	0.0023	0.0023
1B. Fugitive Emissions from Fuels	**0.8129**	**0.6618**	**0.6010**	**0.7766**	**0.5811**	**0.6617**	**0.6522**	**0.6216**	**0.5970**	**0.5683**
1B.1. Solid Fuels	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
1B.2. Oil and Natural Gas	0.8129	0.6618	0.6010	0.7766	0.5811	0.6617	0.6522	0.6216	0.5970	0.5683
1C. CO_2 Transport and Storage	**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 Energy Sector, accounting for circa 43.6 per cent of the total per sector in 2015 (56.0 per cent in 1990). Other relevant categories are represented by 1A3 "Transport" accounting for circa

23.2 per cent of the total per sector (12.9 per cent in 1990), 1A4 “Other Sectors”, accounting for circa 20.2 per cent of the total (22.0 per cent in 1990) and 1A2 “Manufacturing Industries and Construction” accounting for circa 7.0 per cent of the total (6.4 per cent in 1990) (Figure 2-8).

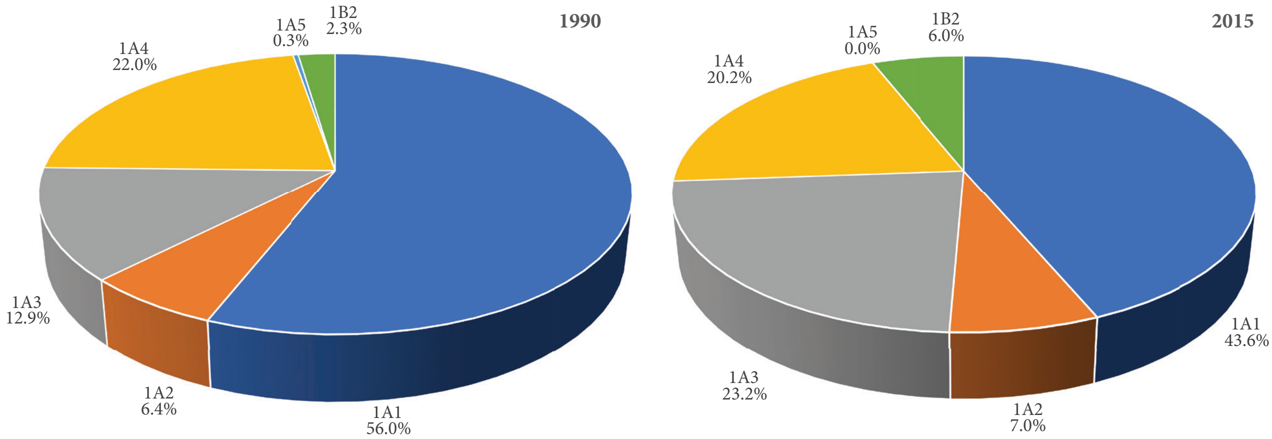


Figure 2-8: Energy Sector Greenhouse Gas Sources in the Republic of Moldova in 1990 and 2015

2.3.2. Industrial Processes and Product Use Sector

The IPPU Sector represents an important GHG emission source in the Republic of Moldova that includes emissions generated by non-energy industrial activities. In 2015, this sector accounted for circa 5.7 per cent of the total national GHG emissions (3.6 per cent in 1990). During 1990-2015 time periods, total sectoral GHG emissions decreased by circa 49.7 per cent: from 1.5810 Mt CO_2 equivalent in 1990 to 0.7951 Mt CO_2 equivalent in 2015 (Figure 2-9).

Between 2008 and 2009, the respective emissions decreased by 47.4 per cent as a consequence of the global and regional 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 halocarbons. Between 2014 and 2015, total GHG emissions from this sector decreased by 1.2 per cent (Table 2-4).

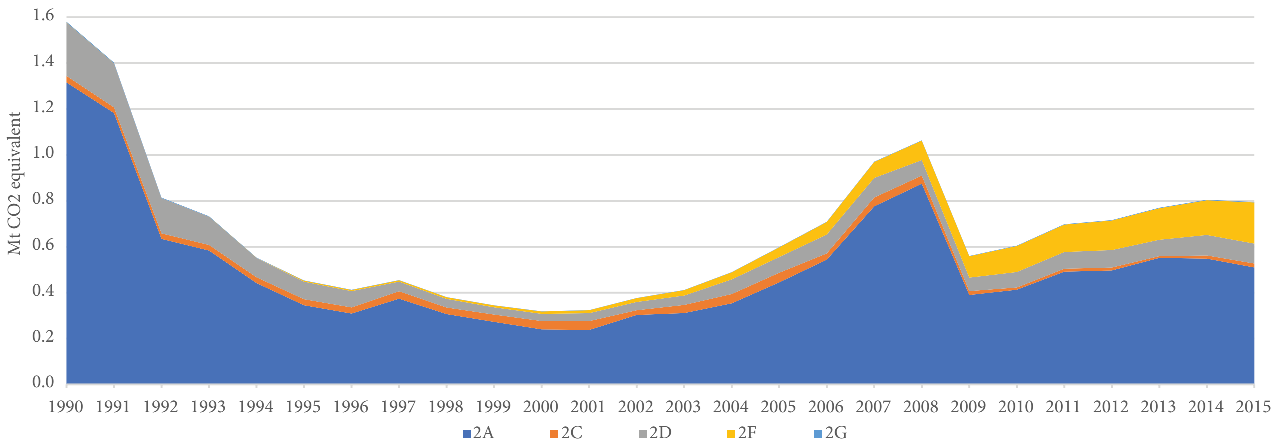


Figure 2-9: Total GHG Emissions from IPPU in the Republic of Moldova within 1990-2015 periods

Table 2-4: Direct GHG Emissions from IPPU within 1990-2015, Mt CO_2 equivalent

	1990	1995	2000	2005	2010	2011	2012	2013	2014	2015
2. Industrial Processes and Product Use	**1.5810**	**0.4535**	**0.3190**	**0.5986**	**0.6050**	**0.6985**	**0.7164**	**0.7703**	**0.8049**	**0.7951**
A. Mineral Industry	1.3161	0.3451	0.2400	0.4448	0.4127	0.4915	0.4968	0.5516	0.5483	0.5097
B. Chemical Industry	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	0.0172
D. Non-energy Products from Fuels and Solvent Use	0.2332	0.0765	0.0314	0.0685	0.0675	0.0728	0.0762	0.0714	0.0894	0.0868
E. Electronic Industry	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
F. Product Uses as Substitutes for ODS	NO	NO	NO	NO	0.1134	0.1195	0.1288	0.1376	0.1514	0.1794
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
H. Other	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 55.8 per cent of the total sectoral emissions in 2015 (61.5 per cent in 1990). Other relevant sources in 2015 were represented by 2F2 “Foam Blowing Agents” with a share of 12.8 per cent of the total, 2D3 “Solvent Use” - 10.0 per cent of the total (12.9 per cent in 1990), 2F1 “Refrigeration and Air Conditioning” - circa 9.7 per cent of the total, 2A3 “Glass Production” - 3.5 per cent of the total (1.6 per cent in 1990), 2A2 “Lime Production” - 2.7 per cent of the total (14.7 per cent in 1990), 2C1 “Iron and Steel Production” - 2.2 per cent of the total (1.8 per cent in 1990) and 2A4 “Other Process Uses of Carbonates” - 2.1 per cent of the total (5.5 per cent in 1990) (Figure 2-10).

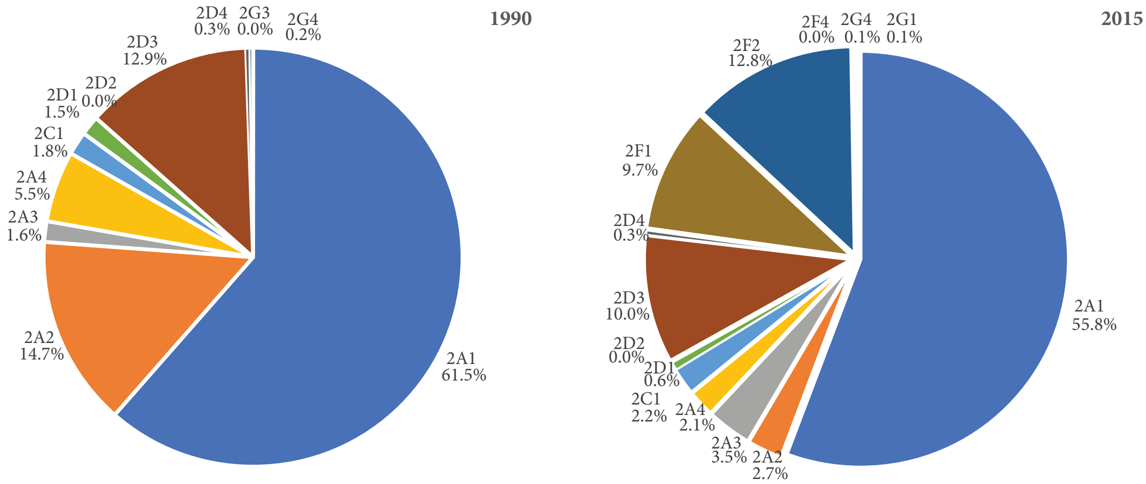


Figure 2-10: Breakdown of IPPU’s GHG Emissions by Category in the RM in 1990 and 2015

2.3.3. Agriculture Sector

The Agriculture Sector 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 LULUCF Sector, under the category 4B “Cropland”.

In 2015, Agriculture Sector accounted for circa 15.2 per cent of the total national direct GHG emissions (12.0 per cent in 1990). Between 1990 and 2015 total GHG emissions originated from this sector decreased by circa 59.4 per cent: from 5.2106 Mt CO_2 equivalent in 1990 to 2.1147 Mt CO_2 equivalent in 2015 (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 Agriculture Sector within 1990-2015, Mt CO_2 equivalent

	1990	1995	2000	2005	2010	2011	2012	2013	2014	2015
3. Agriculture	**5.2106**	**3.5906**	**2.5002**	**2.5765**	**2.2497**	**2.2040**	**1.7758**	**2.2490**	**2.4879**	**2.1147**
A. Enteric fermentation	2.1907	1.6207	1.0857	0.9269	0.7126	0.6714	0.6343	0.6438	0.6816	0.6546
B. Manure management	1.6114	0.9274	0.5494	0.5537	0.4985	0.4575	0.4214	0.3982	0.4357	0.4224
C. Rice cultivation	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
D. Agricultural soils	1.4078	1.0425	0.8647	1.0957	1.0369	1.0714	0.7145	1.2028	1.3603	1.0318
E. Prescribed burning of savannas	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
G. Liming	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	0.0058
I. Other carbon-containing fertilizers	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
J. Other	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO

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

Between 2014 and 2015, direct GHG emissions from Agriculture Sector decreased by circa 15.0 per cent (Figure 2-11), in particular as a result of the decreasing use of synthetic nitrogen fertilizers and the decrease of livestock population.

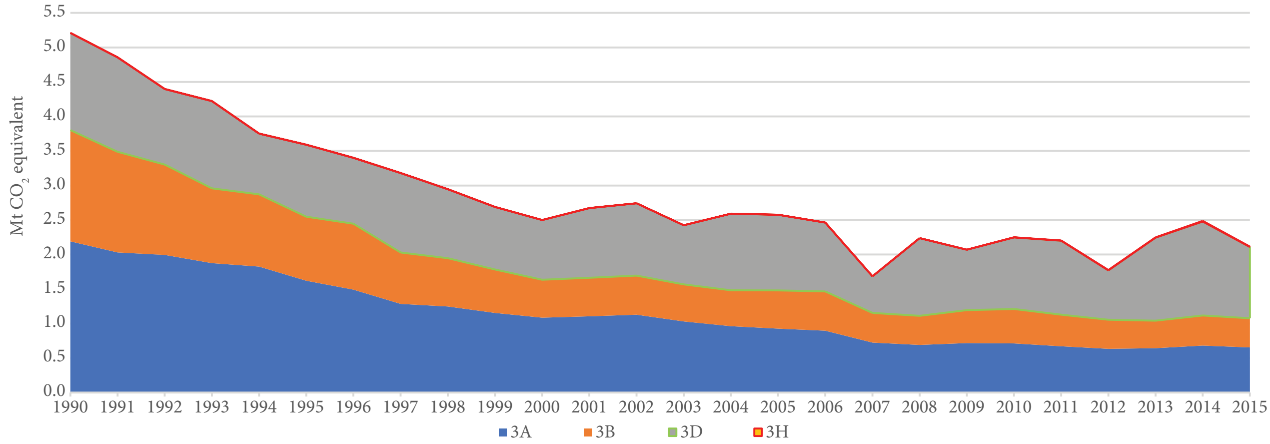


Figure 2-11: Total Direct GHG Emissions from Agriculture Sector in the Republic of Moldova within 1990-2015 periods

In 2015, the largest source of emission was 3D "Agricultural Soils", accounting for circa 48.8 per cent of the total per sector (27.0 per cent in 1990). Other relevant sources are represented by 3A "Enteric Fermentation" accounting for 31.0 per cent of the total (42.0 per cent in 1990) and 3B "Manure Management" accounting for circa 20.0 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).

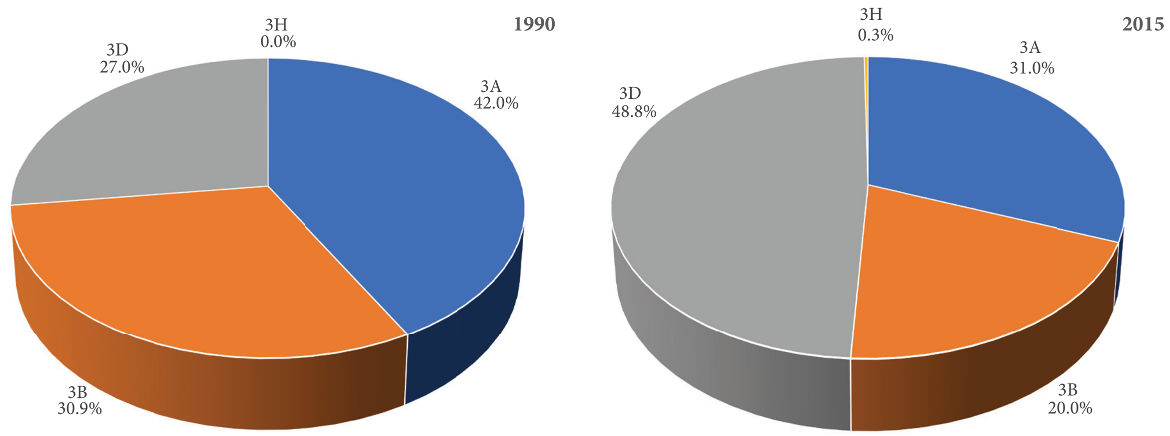


Figure 2-12: Breakdown of Agriculture GHG Emissions by Category in the RM in 1990 and 2015

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

Between 1990 and 2015, the LULUCF Sector represented a sink of net carbon removals. Within the respective period, net CO_2 removals registered a decreasing trend, reducing by circa 51.1 per cent, from -5.8197 Mt CO_2 equivalent recorded in 1990 to -2.8454 Mt CO_2 equivalent in 2015 (Table 2-6, Figure 2-13).

Table 2-6: Emissions and Removals in LULUCF Sector within 1990-2015 periods, Mt CO_2 equivalent

	1990	1995	2000	2005	2010	2011	2012	2013	2014	2015
4. LULUCF	**-5.8197**	**-6.4821**	**-6.0570**	**-4.7644**	**-3.2301**	**-2.6440**	**-2.9451**	**-2.5470**	**-2.6610**	**-2.8454**
A. Forest Land	-2.5434	-2.0258	-2.2883	-2.3903	-2.4895	-2.3731	-2.2060	-2.0537	-2.0192	-2.0262
B. Cropland	-0.5189	-1.8546	-1.2141	-0.4154	-0.3338	-0.3333	-0.4068	-0.3909	-0.5207	-0.6699
C. Grassland	-2.8503	-3.0885	-2.8443	-2.2408	-0.5558	-0.4427	-0.4261	-0.2775	-0.2712	-0.3062
D. Wetlands	-0.0174	NO, NE	NO, NE	NO, NE	NO, NE	NO, NE	NO, NE	NO, NE	NO, NE	NO, NE
E. Settlements	0.0879	0.1109	0.1030	0.0557	0.0473	0.0633	0.0123	0.0123	0.0191	0.0394
F. Other Land	0.1525	0.3927	0.1701	0.2816	0.1317	0.4661	0.0873	0.0873	0.0705	0.0608
G. Harvested Wood Products	-0.1301	-0.0168	0.0166	-0.0552	-0.0300	-0.0243	-0.0059	0.0754	0.0605	0.0566
H. Other	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[30], 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 fellings, increased conversion of forest land into cropland etc.

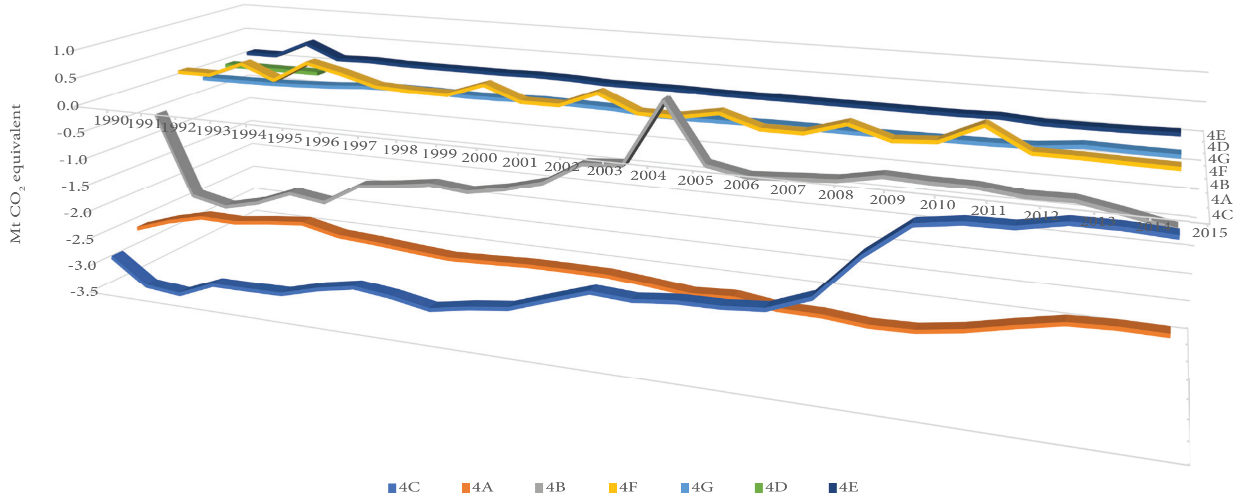


Figure 2-13: Direct GHG Emissions/Removals in LULUCF Sector by Source/Sink Categories

In the Republic of Moldova, in 2015, the largest source of carbon removals under LULUCF Sector was 4A „Forest Land" (forests, protective forests etc.) accounting for 64.1 per cent (40.4 per cent in 1990), followed by 4B „Cropland" (lands covered with wood vegetation – multiannual plantations as well as the agricultural soils), accounting for 21.2 per cent (8.2 per cent in 1990), respectively from category 4C „Grassland" accounting for circa 9.7 per cent of the total (45.2 per cent in 1990) (Figure 2-14).

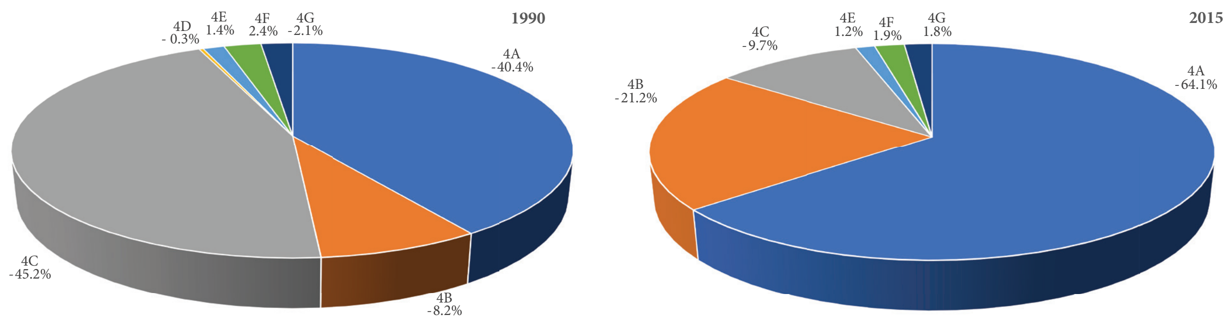


Figure 2-14: Breakdown of GHG Emissions and Removals by Source and Sink Categories in LULUCF Sector in 1990 and 2015

2.3.5. Waste Sector

Waste Sector is an important source of GHG emissions in the Republic of Moldova: 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 2015, Waste Sector accounted for circa 11.0 per cent of the total national direct GHG emissions (4.6 per cent in 1990). Within 1990-2015 time series, total GHG emissions from this sector decreased by

[30] 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.

circa 22.2 per cent: from 1.9777 Mt CO_2 equivalent in 1990 to 1.5387 Mt CO_2 equivalent in 2015 (Table 2-7). Between 2014 and 2015, direct GHG emissions from this sector decreased by circa 1.5 per cent.

Table 2-7: GHG Emissions from Waste Sector within 1990-2015 periods, Mt CO_2 equivalent

Source Categories	1990	1995	2000	2005	2010	2011	2012	2013	2014	2015
5. Waste	**1.9777**	**1.7202**	**1.6007**	**1.5573**	**1.5801**	**1.6044**	**1.6018**	**1.5661**	**1.5619**	**1.5387**
A. Solid Waste Disposal	1.0467	1.2092	1.1695	1.0643	1.1379	1.1551	1.1436	1.0848	1.0831	1.0872
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
C. Incineration and Open Burning of Waste	0.0283	0.0283	0.0280	0.0274	0.0270	0.0271	0.0270	0.0270	0.0269	0.0267
D. Wastewater Treatment and Discharge	0.9027	0.4827	0.4032	0.4656	0.4153	0.4223	0.4312	0.4544	0.4520	0.4248
E. Other	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO

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

Reduction of total GHG emissions from the Waste Sector, 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 2005, there has been a slight growing trend of direct GHG emissions from the "Waste Sector" (Figure 2-15).

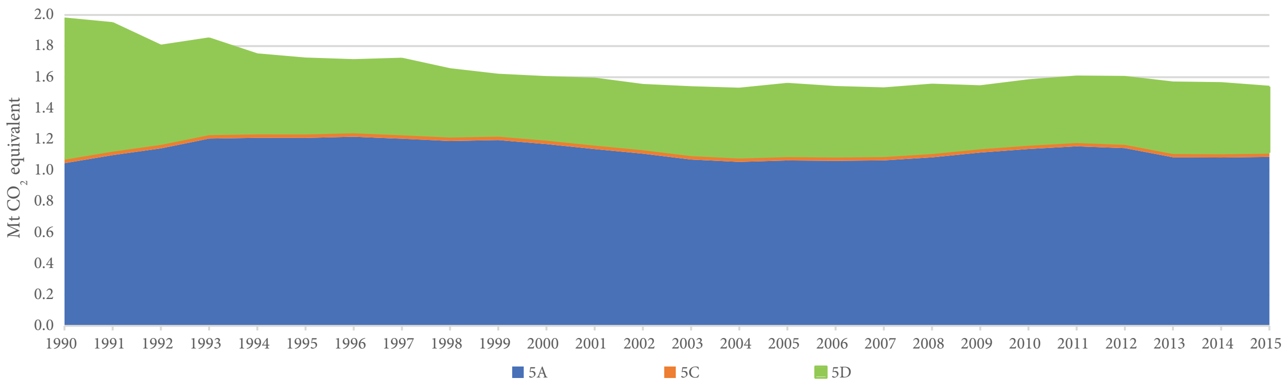


Figure 2-15: Total Waste Sector GHG Emissions Trends in the RM within 1990-2015 periods

In 2015, the largest source of GHG emissions within the Waste Sector was 5A "Solid Waste Disposal", accounting for circa 70.7 per cent of the total sectoral emissions (52.9 per cent in 1990), followed by 5D "Wastewater Treatment and Discharge", accounting for circa 27.6 per cent of the total (45.6 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 (1.4 per cent in 1990) (Figure 2-16).

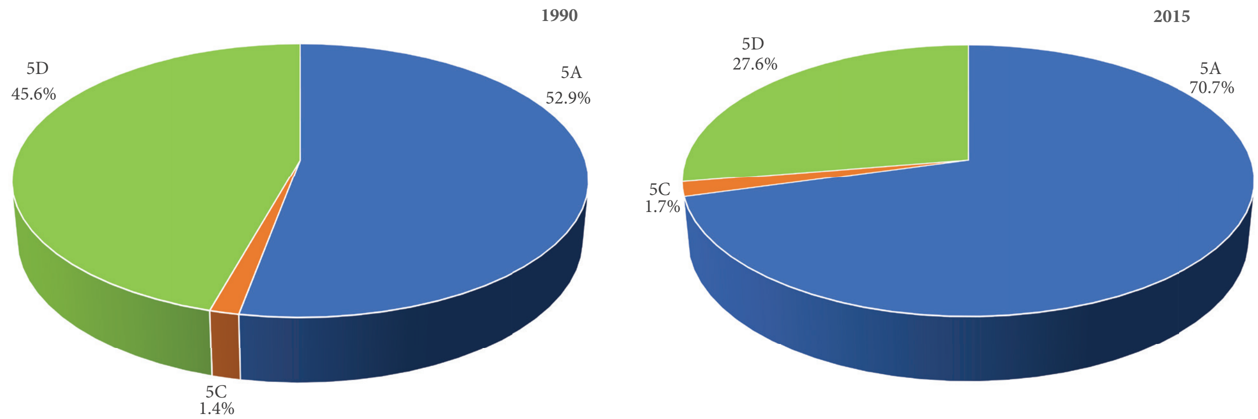


Figure 2-16: Breakdown of Waste GHG Emissions by Category in the RM in 1990 and 2015

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 2015, total nitrogen oxides emissions decreased by circa 68.5 per cent: from 137.1930 kt in 1990 to 43.2178 kt in 2015; total carbon monoxide emissions decreased by circa 61.5 per cent: from 439.0588 kt in 1990 to 169.0056 kt in 2015, non-methane volatile organic compounds emissions decreased by circa 61.6 per cent: from 183.0223 kt in 1990 to 70.3063 kt in 2015, while sulphur dioxide emissions decreased by circa 92.6 per cent: from 294.2491 kt in 1990 to 21.8899 kt in 2015 (Table 2-8).

Table 2-8: Ozone and Aerosol Precursors (NO_x, CO and NMVOC) and SO_2 Emission Trends in the RM within 1990-2015 periods, kt

	1990	1991	1992	1993	1994	1995	1996	1997	1998
NO_x	137.1930	124.3404	78.2802	62.5812	58.3531	49.3980	47.1068	43.6544	36.5540
CO	439.0588	371.4113	173.3580	146.0255	141.2352	139.9312	141.2185	149.7084	126.2339
NMVOC	183.0223	155.2900	105.8855	87.4951	67.2505	66.0356	62.3036	49.5601	43.5191
SO_2	294.2491	244.2434	169.7527	137.1709	100.3805	59.5089	58.3896	33.5716	26.3976
	1999	2000	2001	2002	2003	2004	2005	2006	2007
NO_x	26.7366	25.2064	27.4804	28.7878	31.1685	33.2657	34.5095	32.6202	35.0212
CO	85.4601	84.3441	87.4949	107.8300	128.7661	131.1277	133.5524	128.7570	127.6376
NMVOC	31.4470	31.0555	33.2102	38.5332	43.1876	56.0942	59.3127	63.1443	64.1206
SO_2	13.4319	9.5508	9.1867	10.3037	12.3242	11.1911	10.9459	11.2334	9.2497
	2008	2009	2010	2011	2012	2013	2014	2015	%
NO_x	37.5402	37.5455	40.5531	41.2474	38.4362	37.4587	41.2859	43.2178	-68.5
CO	133.1239	130.8874	130.1470	136.8043	122.5016	121.5024	160.1651	169.0056	-61.5
NMVOC	58.5079	52.8153	57.0391	60.7789	59.7134	58.9806	72.1587	70.3063	-61.6
SO_2	15.7014	19.4449	19.0192	17.8646	16.9376	19.8122	22.5976	21.8899	-92.6

In 2015, the source categories having the biggest share in the total nitrogen oxides emissions in the Republic of Moldova were: 1A3 "Transport" (21.9992 kt or 50.9 per cent of the total), 1A1 "Energy Industries" (11.2794 kt or 26.1 per cent of the total), 1A4 "Other Sectors" (6.2097 kt or 14.4 per cent of the total), 1A2 "Manufacturing Industries and Constructions" (1.9040 kt or 4.4 per cent of the total) and 2A "Mineral Industry" (1.5815 kt or 3.7 per cent of the total) (Figure 2-17).

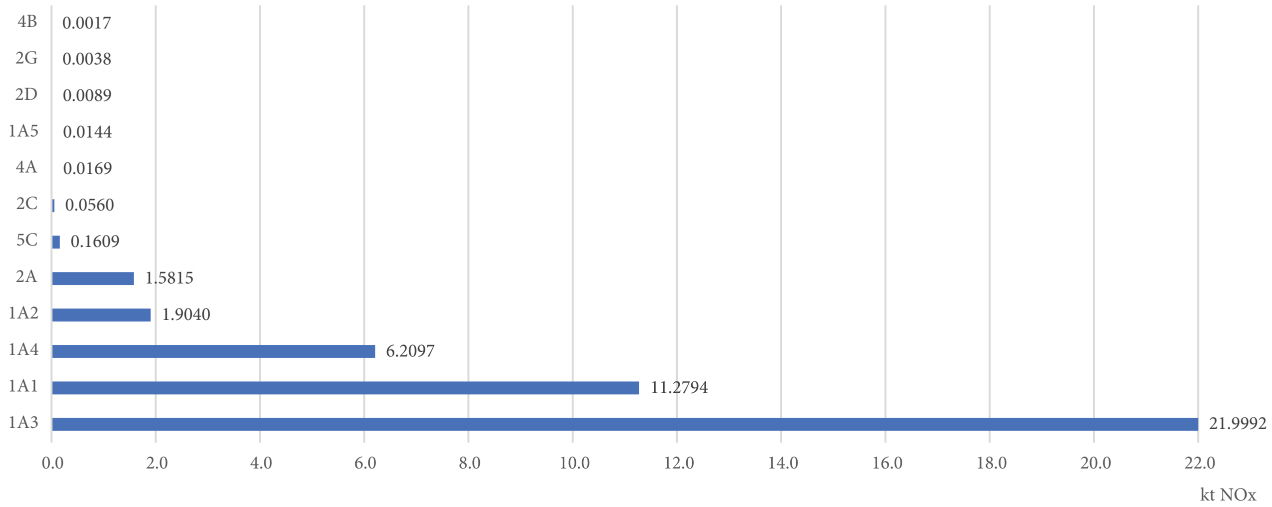


Figure 2-17: Source Categories of NO_x in the Republic of Moldova in 2015

In 2015, the source categories having the biggest share in the total carbon monoxide emissions in the Republic of Moldova were: 1A3 "Transport" (90.0932 kt or 53.1 per cent of the total), 1A4 "Other Sectors" (70.2315 kt or 41.4 per cent of the total), 5C "Incineration and Open Burning of Waste" (2.7979 kt or 1.6 per cent of the total), 1A2 "Manufacturing Industries and Constructions" (2.2239 kt or 1.3 per cent of the total), 1A1 "Energy Industries" (1.4073 kt or 0.8 per cent of the total), 2A "Mineral Industry" (1.2964 kt or 0.8 per cent of the total), 2C "Metal Industry" (0.7325 kt or 0.4 per cent of the total) and 4A "Forest Land" (forest fires) (0.6041 kt or 0.4 per cent of the total) (Figure 2-18).

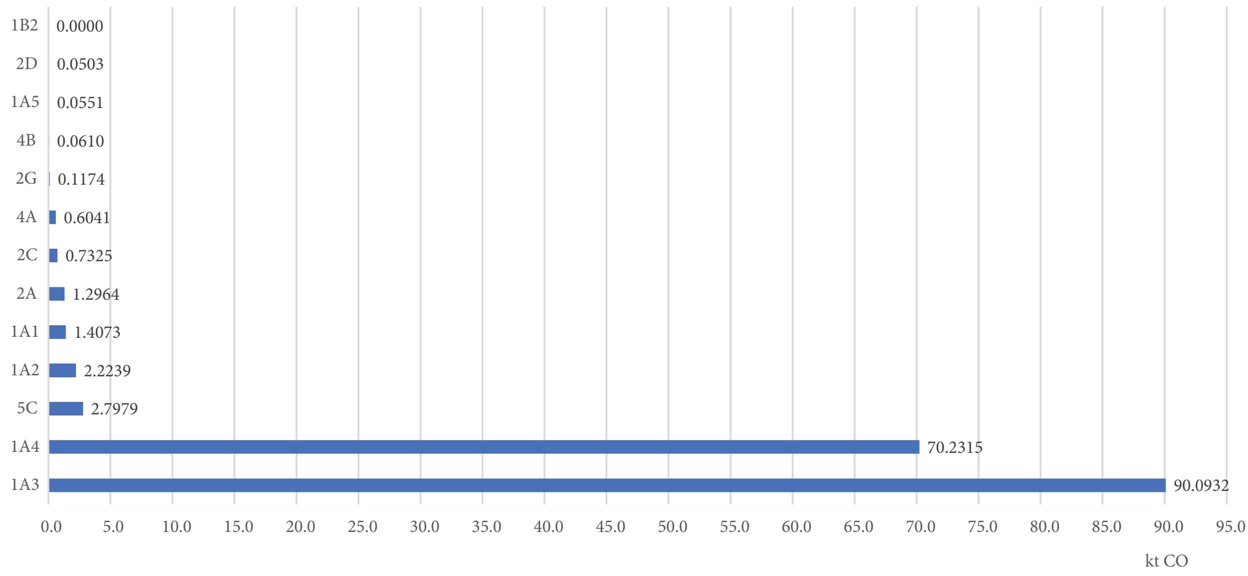


Figure 2-18: Source Categories of CO in the Republic of Moldova in 2015

In 2015, 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" (36.0209 kt or 51.2 per cent of the total), 1A3 "Transport" (17.1297 kt or 24.4 per cent of the total), 1A4 "Other Sectors" (8.5288 kt or 12.1 per cent of the total), 2H "Other" (food and alcoholic beverages) (4.7339 kt or 6.7 per cent of the total), 5A "Solid Waste Disposal" (2.2355 kt or 3.2 per cent of the total), 1B2 "Fugitive Emissions from Fuels" (0.7158 kt or 1.0 per cent of the total) 2G "Other Product Manufacture and Use" (0.3564 kt or 0.5 per cent of the total) and 1A1 "Energy Industries" (0.3526 kt or 0.5 per cent of the total) (Figure 2-19).

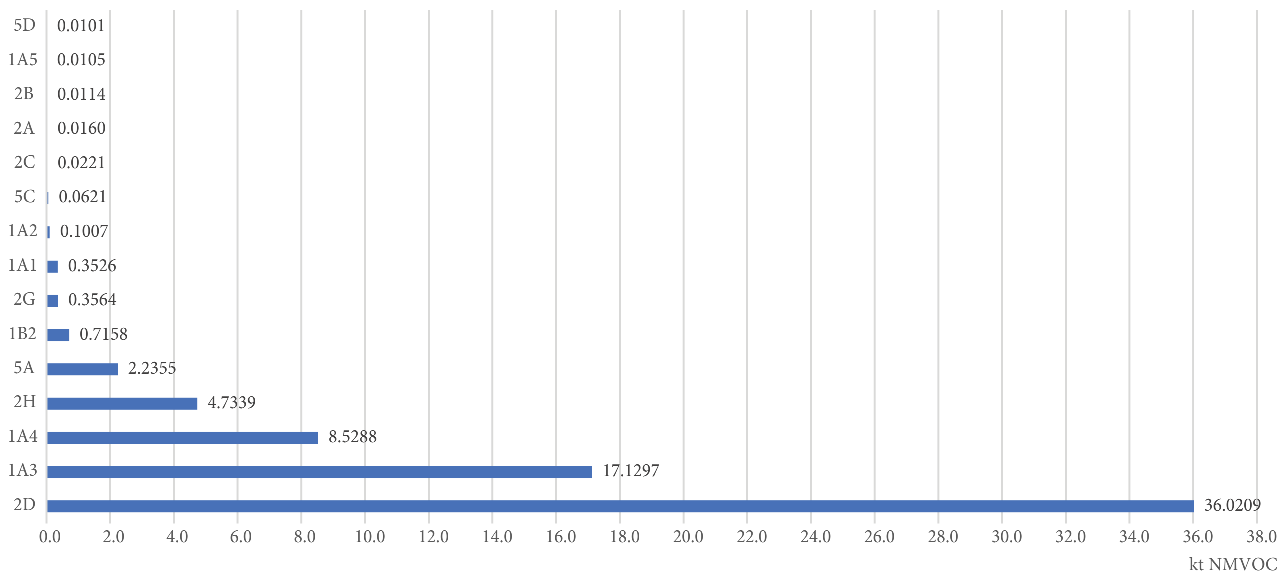


Figure 2-19: Source Categories of NMVOC in the Republic of Moldova in 2015

In 2015, the source categories having the biggest share in the total sulphur dioxide emissions in the Republic of Moldova were: 1A4 "Other Sectors" (9.3297 kt or 42.6 per cent of the total), 1A1 "Energy Industries" (5.9151 kt or 27.0 per cent of the total), 1A3 "Transport" (3.3575 kt or 15.3 per cent of the total), 1A2 "Manufacturing Industries and Constructions" (2.5810 kt or 11.8 per cent of the total) and 2A "Mineral Industry" (0.6478 kt or 3.0 per cent of the total) (Figure 2-20).

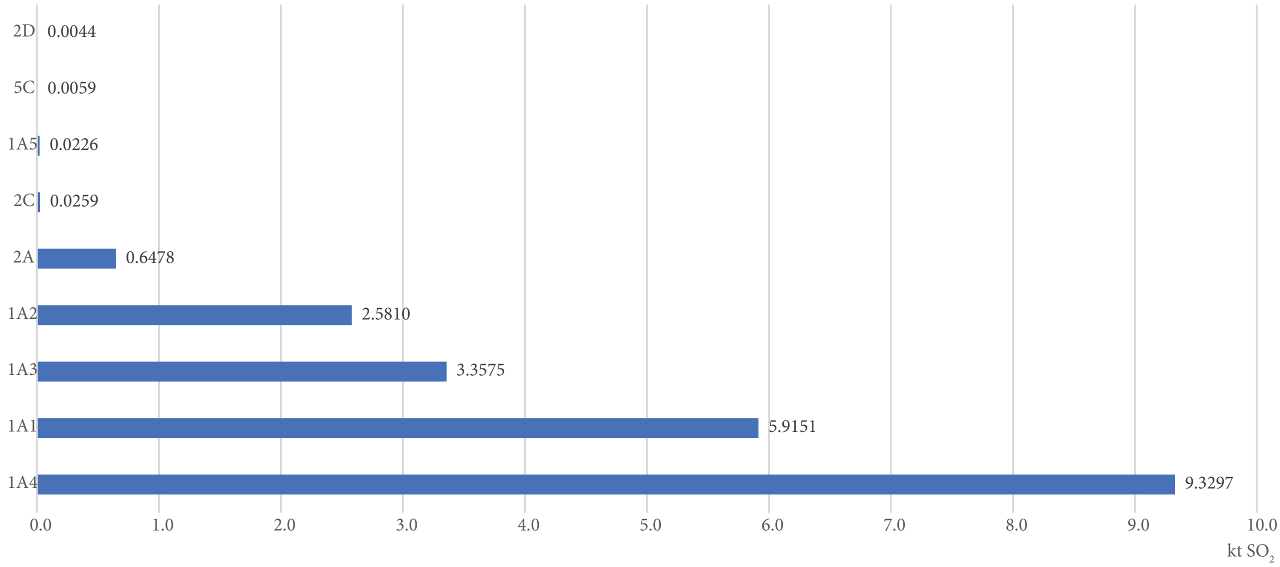


Figure 2-20: Source Categories of SO_2 in the Republic of Moldova in 2015

3. ENERGY SECTOR

3.1. Overview

Energy Sector includes GHG emissions resulting from electricity and heat production activities, and fuel combustion for energy generation purposes. Methodological guidance used includes the Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories (IPCC, 1997) (in particular, for estimating non-CO_2 emissions) and 2006 IPCC Guidelines for National Greenhouse Gas Inventories (IPCC, 2006) (in particular, for estimating direct GHG emissions).

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

1. Energy Sector

    1A. "Fuel Combustion Activities"

        1A1 "Energy Industries" (1A1a "Public electricity and heat production", 1A1b "Petroleum refining", 1A1c "Manufacture of solid fuels and other energy industries");

        1A2 "Manufacturing Industries and Construction";

        1A3 "Transport" (1A3a "Domestic aviation", 1A3b "Road transportation", 1A3c "Railways", 1A3d "Domestic navigation", 1A3e "Other transportation");

        1A4 "Other Sectors" (1A4a "Commercial/institutional", 1A4b "Residential", 1A4c "Agriculture/forestry/fishing", including: 1A4ci "Stationary combustion" and 1A4cii "Mobile combustion");

        1A5 "Other" (1A5a "Stationary" și 1A5b "Mobile").

    1B "Fugitive Emissions from Fuels"

        1B2 "Oil and Natural Gas and Other Emissions from Energy Production".

"Memo items"

    "International Bunkers: Aviation";

    "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 Energy Sector 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 2015, the total GHG emissions from the Energy Sector tended to lower values, decreasing by 72.6 per cent (Figure 3-1, Table 3-1).

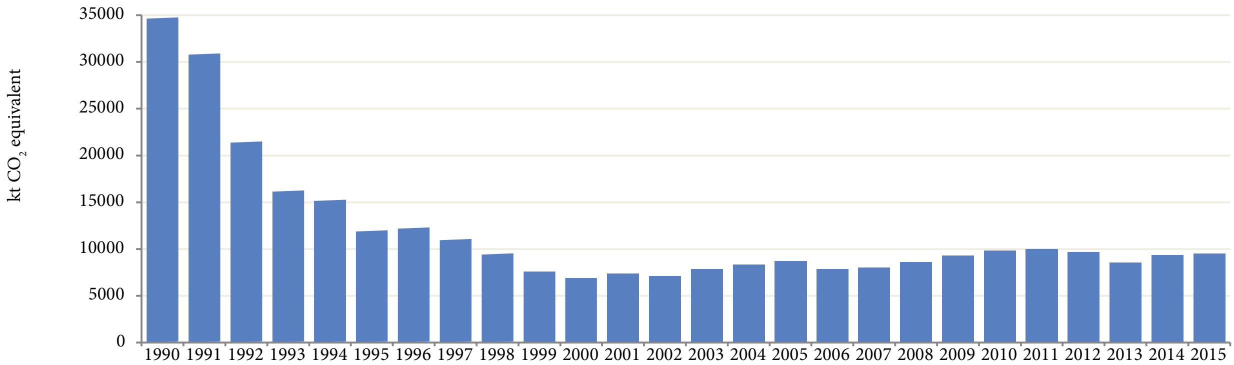


Figure 3-1: Total Direct GHG Emissions from Energy Sector in the Republic of Moldova within 1990-2015 periods

Table 3-1: Total Direct GHG Emissions from Energy Sector in the Republic of Moldova within 1990-2015 periods

	1990	1991	1992	1993	1994	1995	1996	1997	1998
Energy Sector, kt CO_2 equivalent	34 630.78	30 780.32	21 369.95	16 133.02	15 151.06	11 885.49	12 188.69	10 947.65	9 426.98
in %, compared to 1990	100.0	88.9	61.7	46.6	43.8	34.3	35.2	31.6	27.2
	1999	2000	2001	2002	2003	2004	2005	2006	2007
Energy Sector, kt CO_2 equivalent	7 472.51	6 787.81	7 388.05	7 132.32	7 850.00	8 363.71	8 681.73	7 853.28	8 024.51
in %, compared to 1990	21.6	19.6	21.3	20.6	22.7	24.2	25.1	22.7	23.2
	2008	2009	2010	2011	2012	2013	2014	2015	%
Energy Sector, kt CO_2 equivalent	8 613.96	9 302.29	9 828.71	9 996.12	9 654.53	8 563.27	9 344.72	9 504.94	-72.6
in %, compared to 1990	24.9	26.9	28.4	28.9	27.9	24.7	27.0	27.4	

Compared to the reference year (1990), by 2015 direct GHG emissions decreased significantly: CO_2 by 73.7 per cent, CH_4 by 40.0 per cent, N_2O by 69.1 per cent.

Table 3-2: Direct GHG Emissions from Energy Sector in the Republic of Moldova within 1990-2015 periods

	Direct GHG Emissions, kt CO_2 equivalent				% of the total				in %, compared to 1990			
	CO_2	CH_4	N_2O	Total	CO_2	CH_4	N_2O	Total	CO_2	CH_4	N_2O	Total
1990	33 296.50	1 147.85	186.43	34 630.78	96.1	3.3	0.5	100.0	0.0	0.0	0.0	0.0
1991	29 615.67	994.54	170.12	30 780.32	96.2	3.2	0.6	100.0	-11.1	-13.4	-8.7	-11.1
1992	20 487.24	780.76	101.95	21 369.95	95.9	3.7	0.5	100.0	-38.5	-32.0	-45.3	-38.3
1993	15 345.54	684.55	102.93	16 133.02	95.1	4.2	0.6	100.0	-53.9	-40.4	-44.8	-53.4
1994	14 410.20	674.64	66.22	15 151.06	95.1	4.5	0.4	100.0	-56.7	-41.2	-64.5	-56.2
1995	11 122.61	709.77	53.12	11 885.49	93.6	6.0	0.4	100.0	-66.6	-38.2	-71.5	-65.7
1996	11 342.92	792.99	52.78	12 188.69	93.1	6.5	0.4	100.0	-65.9	-30.9	-71.7	-64.8
1997	10 252.20	650.57	44.88	10 947.65	93.6	5.9	0.4	100.0	-69.2	-43.3	-75.9	-68.4
1998	8 794.43	595.65	36.89	9 426.98	93.3	6.3	0.4	100.0	-73.6	-48.1	-80.2	-72.8
1999	6 849.65	598.80	24.06	7 472.51	91.7	8.0	0.3	100.0	-79.4	-47.8	-87.1	-78.4
2000	6 124.41	638.87	24.54	6 787.81	90.2	9.4	0.4	100.0	-81.6	-44.3	-86.8	-80.4
2001	6 731.00	630.66	26.38	7 388.05	91.1	8.5	0.4	100.0	-79.8	-45.1	-85.8	-78.7
2002	6 405.66	691.42	35.24	7 132.32	89.8	9.7	0.5	100.0	-80.8	-39.8	-81.1	-79.4
2003	7 080.94	733.04	36.02	7 850.00	90.2	9.3	0.5	100.0	-78.7	-36.1	-80.7	-77.3
2004	7 540.71	783.54	39.47	8 363.71	90.2	9.4	0.5	100.0	-77.4	-31.7	-78.8	-75.8
2005	7 811.95	827.23	42.56	8 681.73	90.0	9.5	0.5	100.0	-76.5	-27.9	-77.2	-74.9
2006	7 069.02	739.99	44.28	7 853.28	90.0	9.4	0.6	100.0	-78.8	-35.5	-76.3	-77.3
2007	7 208.64	771.31	44.56	8 024.51	89.8	9.6	0.6	100.0	-78.4	-32.8	-76.1	-76.8
2008	7 797.11	769.11	47.74	8 613.96	90.5	8.9	0.6	100.0	-76.6	-33.0	-74.4	-75.1
2009	8 606.64	647.58	48.07	9 302.29	92.5	7.0	0.5	100.0	-74.2	-43.6	-74.2	-73.1
2010	9 148.11	633.10	47.49	9 828.70	93.1	6.4	0.5	100.0	-72.5	-44.8	-74.5	-71.6
2011	9 230.55	716.79	48.77	9 996.11	92.3	7.2	0.5	100.0	-72.3	-37.6	-73.8	-71.1
2012	8 897.82	711.21	45.50	9 654.52	92.2	7.4	0.5	100.0	-73.3	-38.0	-75.6	-72.1
2013	7 835.98	681.55	45.73	8 563.26	91.5	8.0	0.5	100.0	-76.5	-40.6	-75.5	-75.3
2014	8 581.94	709.86	52.90	9 344.71	91.8	7.6	0.6	100.0	-74.2	-38.2	-71.6	-73.0
2015	8 759.07	688.19	57.68	9 504.94	92.2	7.2	0.6	100.0	-73.7	-40.0	-69.1	-72.6

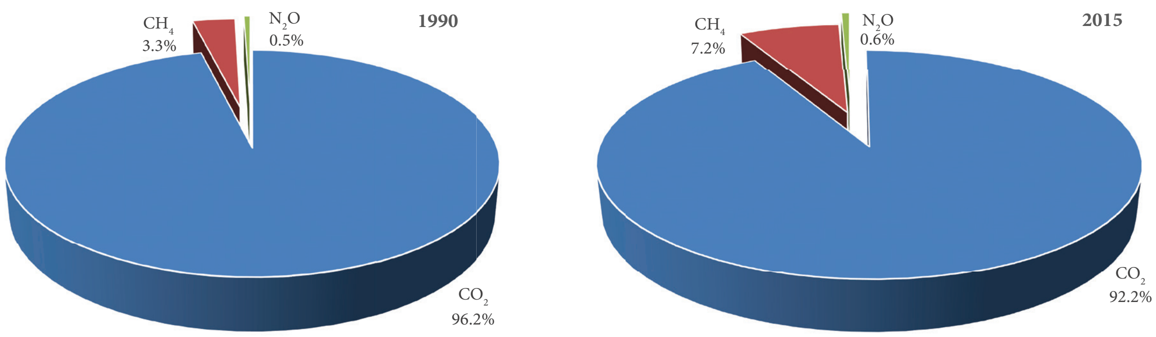


Figure 3-2: The Share of Direct GHG Emissions from Energy Sector in the Total Direct GHG Emissions in 1990 and 2015, in % from the total

Compared to the reference year (1990), by 2015 GHG emissions decreased significantly: CO_2 emissions – 26.3 per cent of the 1990 level, CH_4 – 60.0 per cent, N_2O – 30.9 per cent, NO_x – 31.0 per cent, CO – 38.1 per cent, NMVOC – 36.6 per cent, and SO_x – 7.2 per cent of the 1990 level (Table 3-3).

Table 3-3: Results of GHG Emissions Inventory from Energy Sector in the RM within 1990-2015

	GHG Emissions kt							in %, compared to 1990						
	CO_2	CH_4	N_2O	NO_x	CO	NMVOC	SO_x	CO_2	CH_4	N_2O	NO_x	CO	NMVOC	SO_x
1990	33 296.50	45.91	0.63	133.36	430.6	73.3	292.9	100.0	100.0	100.0	100.0	100.0	100.0	100.0
1991	29 615.67	39.78	0.57	120.80	363.5	64.4	243.0	88.9	86.6	91.3	90.6	84.4	87.9	83.0
1992	20 487.24	31.23	0.34	76.31	167.0	30.8	169.1	61.5	68.0	54.7	57.2	38.8	42.0	57.7
1993	15 345.54	27.38	0.35	60.70	139.8	25.1	136.5	46.1	59.6	55.2	45.5	32.5	34.2	46.6
1994	14 410.20	26.99	0.22	56.84	135.4	24.0	99.9	43.3	58.8	35.5	42.6	31.4	32.8	34.1
1995	11 122.61	28.39	0.18	48.08	134.4	24.4	59.0	33.4	61.8	28.5	36.1	31.2	33.2	20.2
1996	11 342.92	31.72	0.18	45.94	135.6	23.9	58.0	34.1	69.1	28.3	34.4	31.5	32.7	19.8
1997	10 252.20	26.02	0.15	42.28	143.7	25.7	33.1	30.8	56.7	24.1	31.7	33.4	35.0	11.3
1998	8 794.43	23.83	0.12	35.32	120.7	21.7	26.0	26.4	51.9	19.8	26.5	28.0	29.6	8.9
1999	6 849.65	23.95	0.08	25.62	79.8	14.1	13.1	20.6	52.2	12.9	19.2	18.5	19.2	4.5
2000	6 124.41	25.55	0.08	23.97	78.6	14.0	9.1	18.4	55.7	13.2	18.0	18.3	19.1	3.1
2001	6 731.00	25.23	0.09	26.28	81.7	14.7	8.7	20.2	54.9	14.2	19.7	19.0	20.0	3.0
2002	6 405.66	27.66	0.12	27.45	102.8	18.4	9.8	19.2	60.2	18.9	20.6	23.9	25.1	3.3
2003	7 080.94	29.32	0.12	29.79	123.1	21.7	11.8	21.3	63.9	19.3	22.3	28.6	29.7	4.0
2004	7 540.71	31.34	0.13	31.74	125.1	22.8	10.6	22.6	68.3	21.2	23.8	29.1	31.1	3.6
2005	7 811.95	33.09	0.14	32.71	127.3	23.2	10.2	23.5	72.1	22.8	24.5	29.6	31.6	3.5
2006	7 069.02	29.60	0.15	30.67	122.9	22.0	10.5	21.2	64.5	23.7	23.0	28.5	30.1	3.6
2007	7 208.64	30.85	0.15	32.52	120.7	22.3	8.4	21.6	67.2	23.9	24.4	28.0	30.4	2.9
2008	7 797.11	30.76	0.16	34.85	126.1	23.5	14.8	23.4	67.0	25.6	26.1	29.3	32.1	5.0
2009	8 606.64	25.90	0.16	36.13	126.0	23.4	18.9	25.8	56.4	25.8	27.1	29.3	31.9	6.5
2010	9 148.11	25.32	0.16	39.05	125.4	23.1	18.5	27.5	55.2	25.5	29.3	29.1	31.5	6.3
2011	9 230.55	28.67	0.16	39.48	131.7	24.3	17.2	27.7	62.4	26.2	29.6	30.6	33.1	5.9
2012	8 897.82	28.45	0.15	36.76	117.5	21.3	16.3	26.7	62.0	24.4	27.6	27.3	29.1	5.6
2013	7 835.98	27.26	0.15	35.58	116.7	21.0	19.1	23.5	59.4	24.5	26.7	27.1	28.7	6.5
2014	8 581.94	28.39	0.18	39.40	155.1	25.7	21.9	25.8	61.8	28.4	29.5	36.0	35.1	7.5
2015	8 759.07	27.53	0.19	41.41	164.0	26.8	21.2	26.3	60.0	30.9	31.0	38.1	36.6	7.2

Within 1990-2015, practically all source categories under the Energy Sector revealed in the Republic of Moldova a GHG emission decreasing trend (Table 3-4, Figure 3-3):

- 1A1 “Energy Industries” – by 78.6 per cent;
- 1A2 “Manufacturing Industries and Construction” – by 69.8 per cent;
- 1A3 “Transport” – by 50.8 per cent;
- 1A4 “Other Sectors” – by 74.8 per cent;
- 1A5 “Other” – by 98.0 per cent;
- 1B2 “Fugitive Emissions from Oil and Natural Gas” – by 30.1 per cent;

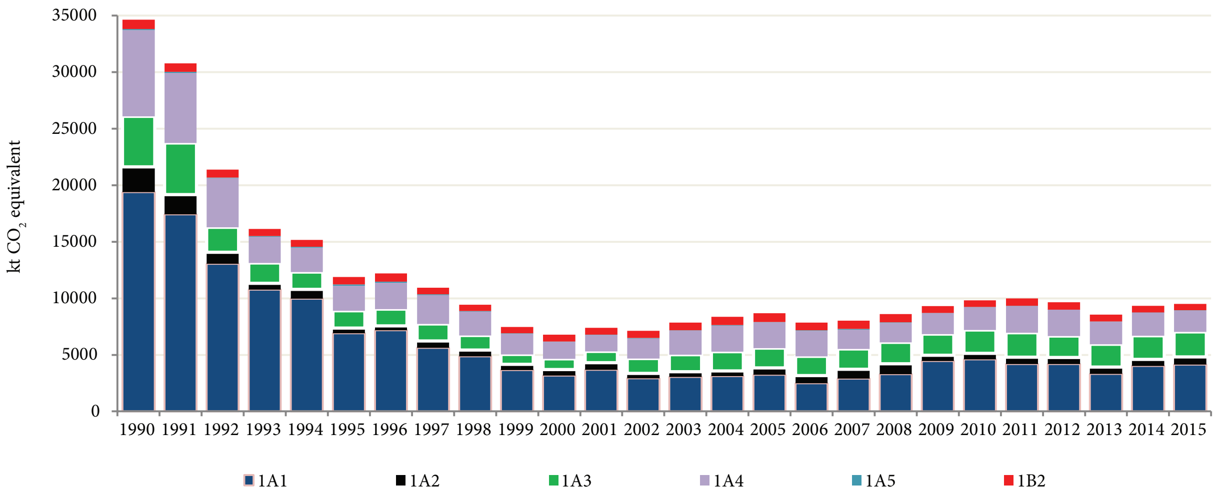


Figure 3-3: Breakdown of the Republic of Moldova’s Energy Sector Direct GHG Emissions by Category within 1990-2015 periods

Table 3-4: Breakdown of the Republic of Moldova's Energy Sector Direct GHG Emissions by Category within 1990-2015 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	Total
1990	19 398.35	2 213.82	4 481.76	7 608.40	115.57	812.88	34 630.78	56.0	6.4	12.9	22.0	0.3	2.3	100.0
1991	17 416.57	1 757.46	4 567.61	6 194.23	81.53	762.93	30 780.32	56.6	5.7	14.8	20.1	0.3	2.5	100.0
1992	13 050.86	1 016.91	2 214.09	4 334.51	62.95	690.62	21 369.95	61.1	4.8	10.4	20.3	0.3	3.2	100.0
1993	10 770.81	565.09	1 777.15	2 306.80	92.66	620.50	16 133.02	66.8	3.5	11.0	14.3	0.6	3.8	100.0
1994	9 965.96	830.39	1 527.45	2 156.00	74.07	597.19	15 151.06	65.8	5.5	10.1	14.2	0.5	3.9	100.0
1995	6 904.39	465.01	1 522.95	2 212.78	118.56	661.81	11 885.49	58.1	3.9	12.8	18.6	1.0	5.6	100.0
1996	7 172.93	378.57	1 490.93	2 342.97	83.93	719.36	12 188.69	58.8	3.1	12.2	19.2	0.7	5.9	100.0
1997	5 625.56	599.10	1 509.97	2 548.07	73.41	591.53	10 947.65	51.4	5.5	13.8	23.3	0.7	5.4	100.0
1998	4 856.77	560.06	1 307.30	2 092.82	56.48	553.55	9 426.98	51.5	5.9	13.9	22.2	0.6	5.9	100.0
1999	3 664.88	492.34	875.29	1 834.54	44.96	560.51	7 472.51	49.0	6.6	11.7	24.6	0.6	7.5	100.0
2000	3 159.33	538.00	948.85	1 514.33	26.29	601.01	6 787.81	46.5	7.9	14.0	22.3	0.4	8.9	100.0
2001	3 681.93	619.74	1 013.85	1 448.17	28.42	595.93	7 388.05	49.8	8.4	13.7	19.6	0.4	8.1	100.0
2002	2 936.80	432.42	1 296.40	1 783.46	35.80	647.45	7 132.32	41.2	6.1	18.2	25.0	0.5	9.1	100.0
2003	3 040.38	457.27	1 512.73	2 134.96	27.14	677.52	7 850.00	38.7	5.8	19.3	27.2	0.3	8.6	100.0
2004	3 110.79	471.87	1 709.27	2 302.30	34.13	735.35	8 363.71	37.2	5.6	20.4	27.5	0.4	8.8	100.0
2005	3 233.26	604.86	1 767.97	2 264.07	35.02	776.56	8 681.73	37.2	7.0	20.4	26.1	0.4	8.9	100.0
2006	2 495.92	669.43	1 696.44	2 255.59	51.41	684.49	7 853.28	31.8	8.5	21.6	28.7	0.7	8.7	100.0
2007	2 893.82	832.17	1 804.19	1 704.84	61.87	727.61	8 024.51	36.1	10.4	22.5	21.2	0.8	9.1	100.0
2008	3 297.57	916.78	1 896.07	1 716.31	63.49	723.74	8 613.96	38.3	10.6	22.0	19.9	0.7	8.4	100.0
2009	4 460.51	509.15	1 853.83	1 866.57	13.03	599.21	9 302.29	48.0	5.5	19.9	20.1	0.1	6.4	100.0
2010	4 597.57	541.10	2 053.69	2 031.00	24.26	581.10	9 828.71	46.8	5.5	20.9	20.7	0.2	5.9	100.0
2011	4 187.96	601.49	2 164.26	2 358.75	21.94	661.72	9 996.12	41.9	6.0	21.7	23.6	0.2	6.6	100.0
2012	4 197.15	565.16	1 905.56	2 326.65	7.79	652.22	9 654.53	43.5	5.9	19.7	24.1	0.1	6.8	100.0
2013	3 316.41	601.65	2 015.00	2 004.76	3.85	621.60	8 563.27	38.7	7.0	23.5	23.4	0.0	7.3	100.0
2014	4 021.51	587.55	2 090.29	2 046.07	2.31	597.00	9 344.72	43.0	6.3	22.4	21.9	0.0	6.4	100.0
2015	4 147.07	668.29	2 202.98	1 916.07	2.27	568.26	9 504.94	43.6	7.0	23.2	20.2	0.0	6.0	100.0

Within the Energy Sector, 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 66.8 per cent (1993) to a minimum of 31.8 per cent (2006). Other major emissions sources within the Energy Sector are represented by 1A4 'Other Sectors', with a share varying from a maximum of 28.7 per cent (2006) to a minimum of 14.2 per cent (1994); 1A3 'Transport', with a share varying from a maximum of 23.5 per cent (2013) to a minimum of 10.1 per cent (1994); 1A2 'Manufacturing Industries and Construction', varying from a maximum of 10.6 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 9.1 per cent (2007) to a minimum of 2.3 per cent (1990) (Table 3-4, Figure 3-4).

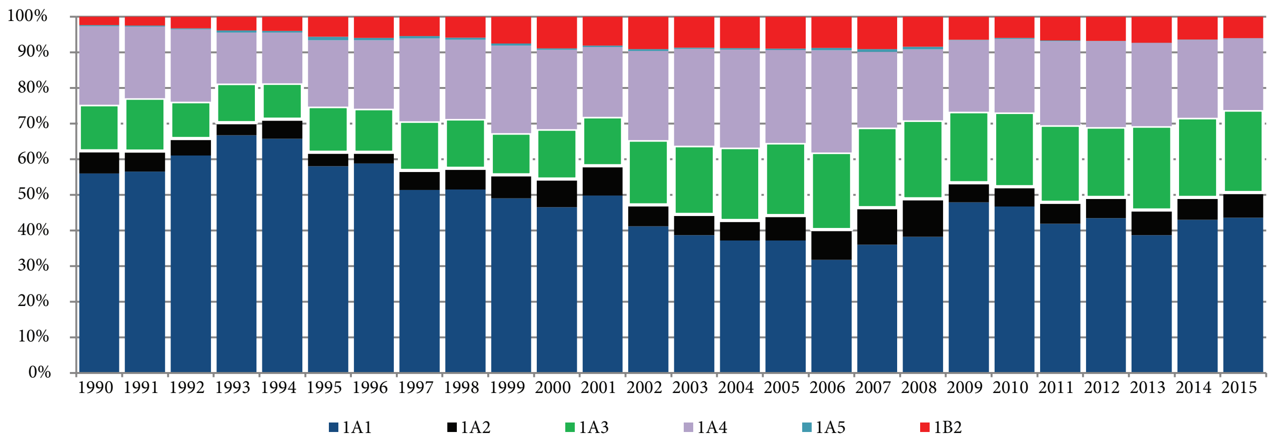


Figure 3-4: The Share of Different Source Categories in the Structure of Total Direct GHG Emissions from Energy Sector within 1990-2015 periods, % from the total

Compared to 1990, by 2015 the share of certain categories increased in the structure of total sectoral direct GHG emissions: 1A3 "Transport" (from 12.9 per cent to 23.2 per cent), 1A2 "Manufacturing Industries and Construction" (from 6.4 per cent to 7.0 per cent), respectively 1B2 "Fugitive Emissions from Oil and Natural Gas" (from 2.3 per cent to 6.0 per cent) (Figure 3-5).

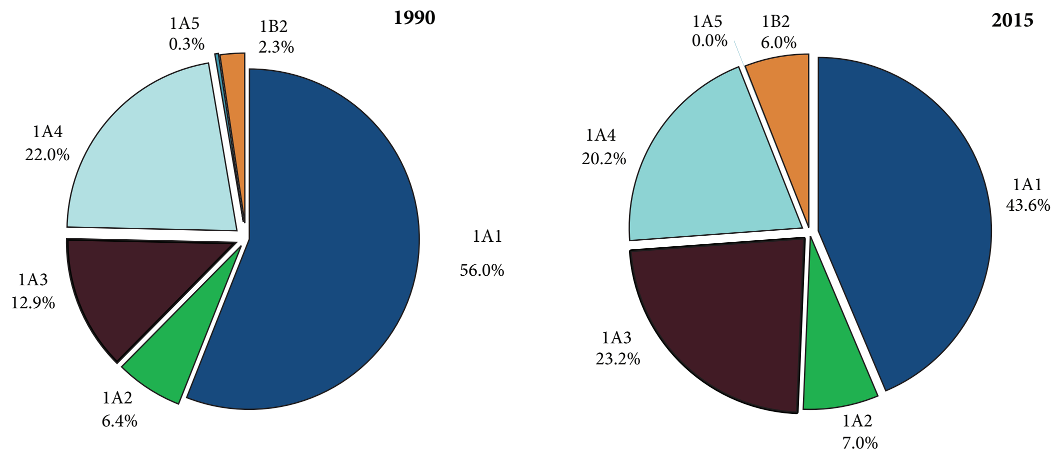


Figure 3-5: The Share of Different Source Categories in the Structure of Total Direct GHG Emissions from Energy Sector in 1990 and 2015, % from the total

To be noted that the share of GHG emissions originated from the sub-sector 'Stationary Fuel Combustion', from sources like 1A1, 1A2, 1A4 and 1A5 significantly varied during the reference period, from a maximum of 85.9 per cent in 1992 to a minimum of 72.5 per cent in 2013. Respectively, the share of GHG emissions originated from sub-sector 'Mobile Fuel Combustion', from sources like 1A3, 1A4 and 1A5, varied from a minimum of 14.1 per cent of the total in 1994 up to a maximum of 27.4 per cent in 2013 (Table 3-5, Figure 3-6).

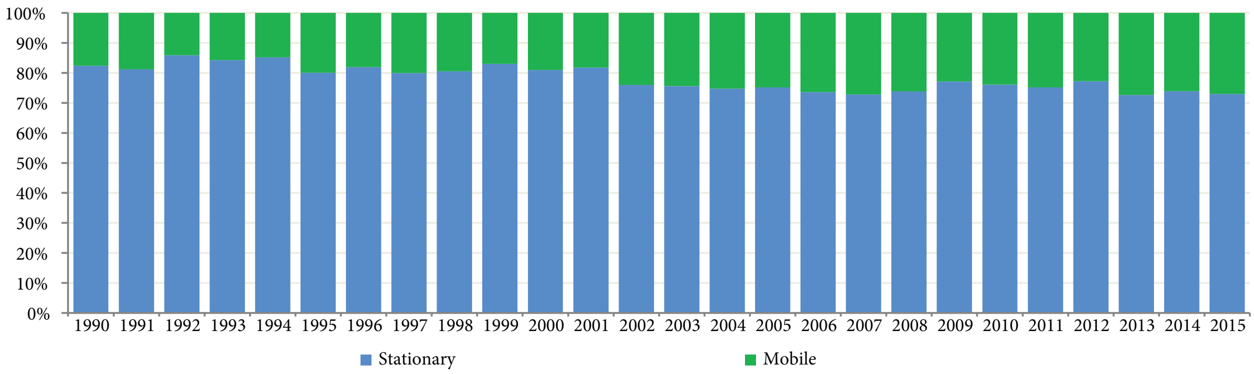


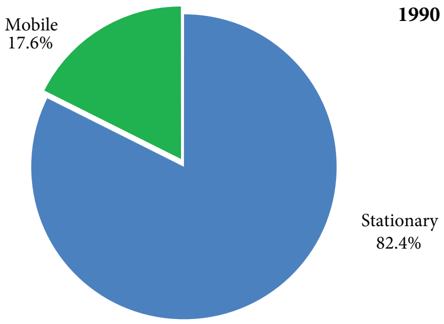
Figure 3-6: Share of Direct GHG Emissions from "Stationary Fuel Combustion" and "Mobile Fuel Combustion" within the Energy Sector within 1990-2015, % from the total within sub-sector 1A

Table 3-5: GHG Emissions from "Stationary Fuel Combustion" and "Mobile Fuel Combustion" within the Energy Sector in the Republic of Moldova within 1990-2015 periods

	Direct GHG Emissions kt CO_2 equivalent			in % from the total		in % compared to 1990	
	Stationary	Mobile	Total	Stationary	Mobile	Stationary	Mobile
1990	27 867.21	5 950.90	33 818.11	82.4	17.6	100.0	100.0
1991	24 370.24	5 647.37	30 017.61	81.2	18.8	87.5	94.9
1992	17 763.00	2 916.32	20 679.32	85.9	14.1	63.7	49.0
1993	13 073.44	2 439.21	15 512.65	84.3	15.7	46.9	41.0
1994	12 395.01	2 159.15	14 554.16	85.2	14.8	44.5	36.3
1995	8 986.15	2 237.60	11 223.75	80.1	19.9	32.2	37.6
1996	9 401.73	2 067.60	11 469.33	82.0	18.0	33.7	34.7
1997	8 277.17	2 078.94	10 356.12	79.9	20.1	29.7	34.9
1998	7 146.14	1 727.29	8 873.43	80.5	19.5	25.6	29.0
1999	5 737.40	1 174.60	6 912.00	83.0	17.0	20.6	19.7
2000	5 011.09	1 175.71	6 186.80	81.0	19.0	18.0	19.8
2001	5 553.23	1 238.88	6 792.12	81.8	18.2	19.9	20.8
2002	4 928.30	1 556.56	6 484.87	76.0	24.0	17.7	26.2
2003	5 424.65	1 747.82	7 172.47	75.6	24.4	19.5	29.4
2004	5 701.43	1 926.93	7 628.36	74.7	25.3	20.5	32.4
2005	5 944.44	1 960.73	7 905.18	75.2	24.8	21.3	32.9
2006	5 278.93	1 889.87	7 168.80	73.6	26.4	18.9	31.8
2007	5 314.07	1 982.83	7 296.90	72.8	27.2	19.1	33.3
2008	5 826.02	2 064.20	7 890.22	73.8	26.2	20.9	34.7
2009	6 710.84	1 992.25	8 703.08	77.1	22.9	24.1	33.5
2010	7 039.55	2 208.07	9 247.62	76.1	23.9	25.3	37.1

	Direct GHG Emissions kt CO_2 equivalent			in % from the total		in % compared to 1990	
	Stationary	Mobile	Total	Stationary	Mobile	Stationary	Mobile
2011	7 018.96	2 315.44	9 334.40	75.2	24.8	25.2	38.9
2012	6 952.08	2 050.23	9 002.30	77.2	22.8	24.9	34.5
2013	5 768.70	2 172.96	7 941.67	72.6	27.4	20.7	36.5
2014	6 462.49	2 285.23	8 747.72	73.9	26.1	23.2	38.4
2015	6 520.54	2 416.14	8 936.68	73.0	27.0	23.4	40.6

Compared to 1990, by 2015 the share of "Mobile Fuel Combustion" increased in the structure of total sectoral emissions (from 17.6 per cent in 1990 to 27.0 per cent in 2015), while the share of "Stationary Fuel Combustion" decreased (from 82.4 per cent in 1990 to 73.0 per cent in 2015) (Figure 3-7).



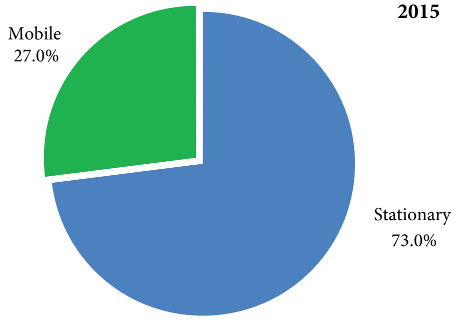


Figure 3-7: Share of Direct GHG Emissions from "Stationary" and "Mobile" Sources within the Energy Sector in the RM, % from the total within sub-sector 1A, in 1990 and 2015

The share of fugitive emissions - sub-sector 1B 'Fugitive Emissions', in particular from the category 1B2 'Fugitive Emissions from Oil and Natural Gas', in the structure of the total GHG emissions originated from the Energy Sector, tended to grow from a minimum of 2.3 per cent in 1990 to maximum of 9.1 per cent in 2007. At the same time, the share of GHG emissions originated from the sub-sector 1A 'Fuel Combustion Activities' varied from a minimum of 90.9 per cent in 2007 up to 97.7 per cent in 1990 (Table 3-6, Figure 3-8).

Table 3-6: Direct GHG Emissions from 1A 'Fuel Combustion Activities' and 1B 'Fugitive Emissions from Fuels' sub-sectors within 1990-2015 periods

	Direct GHG Emissions kt CO_2 equivalent			in % from the total		in % compared to 1990		
	1A Fuel Combustion	1B Fugitive Emissions	1 Energy, total	1A Fuel Combustion	1B Fugitive Emissions	1A Fuel Combustion	1B Fugitive Emissions	1 Energy, total
1990	33 817.90	812.88	34 630.78	97.7	2.3	100.0	100.0	100.0
1991	30 017.39	762.93	30 780.32	97.5	2.5	88.8	93.9	88.9
1992	20 679.32	690.62	21 369.95	96.8	3.2	61.1	85.0	61.7
1993	15 512.51	620.50	16 133.02	96.2	3.8	45.9	76.3	46.6
1994	14 553.87	597.19	15 151.06	96.1	3.9	43.0	73.5	43.8
1995	11 223.69	661.81	11 885.49	94.4	5.6	33.2	81.4	34.3
1996	11 469.33	719.36	12 188.69	94.1	5.9	33.9	88.5	35.2
1997	10 356.12	591.53	10 947.65	94.6	5.4	30.6	72.8	31.6
1998	8 873.43	553.55	9 426.98	94.1	5.9	26.2	68.1	27.2
1999	6 912.00	560.51	7 472.51	92.5	7.5	20.4	69.0	21.6
2000	6 186.80	601.01	6 787.81	91.1	8.9	18.3	73.9	19.6
2001	6 792.12	595.93	7 388.05	91.9	8.1	20.1	73.3	21.3
2002	6 484.87	647.45	7 132.32	90.9	9.1	19.2	79.6	20.6
2003	7 172.47	677.52	7 850.00	91.4	8.6	21.2	83.3	22.7
2004	7 628.36	735.35	8 363.71	91.2	8.8	22.6	90.5	24.2
2005	7 905.18	776.56	8 681.73	91.1	8.9	23.4	95.5	25.1
2006	7 168.80	684.49	7 853.28	91.3	8.7	21.2	84.2	22.7
2007	7 296.90	727.61	8 024.51	90.9	9.1	21.6	89.5	23.2
2008	7 890.22	723.74	8 613.96	91.6	8.4	23.3	89.0	24.9
2009	8 703.08	599.21	9 302.29	93.6	6.4	25.7	73.7	26.9
2010	9 247.62	581.10	9 828.71	94.1	5.9	27.3	71.5	28.4
2011	9 334.40	661.72	9 996.12	93.4	6.6	27.6	81.4	28.9
2012	9 002.30	652.22	9 654.53	93.2	6.8	26.6	80.2	27.9
2013	7 941.67	621.60	8 563.27	92.7	7.3	23.5	76.5	24.7
2014	8 747.72	597.00	9 344.72	93.6	6.4	25.9	73.4	27.0
2015	8 936.68	568.26	9 504.94	94.0	6.0	26.4	69.9	27.4

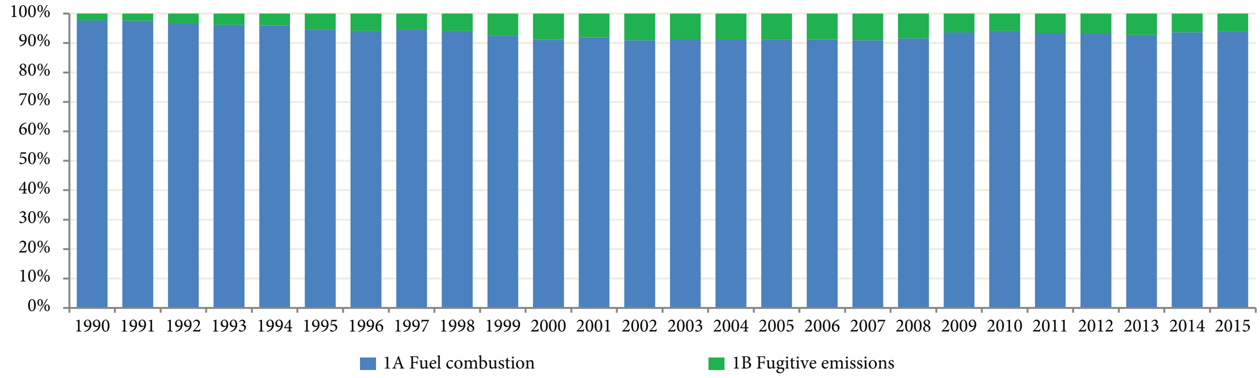


Figura 3-8: Direct GHG Emissions from 1A 'Fuel Combustion Activities' and 1B 'Fugitive Emissions from Fuels' sub-sectors within 1990-2015 periods, % from the total

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 (Annex 1-2). Table 3-7 provides information on identified key categories (by level and trend assessment) within the Energy Sector of the Republic of Moldova.

Table 3-7: Key Categories Identified within the Energy Sector

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	N
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 Other Transportation	No
1.A.3e	CH_4	CH_4 Emissions from Other Transportation	No
1.A.3e	N_2O	N_2O Emissions from Other Transportation	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 Energy Sector there were estimated GHG emissions originated from 5 source categories under sub-sector 1A (1A1, 1A2, 1A3, 1A4 and 1A5), 1 source category under subsector 1B (1B2) and 2 source categories under Memo Items (International Bunkers: Aviation, and CO_2 Emissions from Biomass). GHG emissions originated from the Energy Sector were estimated following a Tier 1 methodological approach, for all source categories, except 'International Bunkers: Aviation', for which was applied a Tier 2 methodology (Table 3-8).

Table 3-8: Summary of Methods Used to Estimate GHG Emissions from Energy Sector

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, Other Transportation)	T1	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 Bunkers: 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.

The basic equations used to estimate GHG emissions under the Energy Sector are described below (SO_2 emissions estimation methodologies are described as well in the Annex 3-1.1):

$$CO_2\,Emissions = \Sigma\,(Fuel\ Consumption_{\ j} \bullet Conversion\ Factor\ (TJ/unit) \bullet Carbon\ Emission\ Factor_{\ j}\ (t\ C/TJ) - Carbon\ Stored \bullet Oxidation\ Fraction_{\ j} \bullet 44/12)$$ and

$$Non\text{-}CO_2\,Emissions = \Sigma\,(Fuel\ Consumption_{\ j} \bullet Emission\ Factor_{\ j})$$

Where: j – type of fuel.

The main source of reference for activity data used for estimating GHG emissions under the Energy Sector is the National Bureau of Statistics (NBS), through its annual publication – Energy Balances of the Republic of Moldova for 1990, 1993-2015 years (the Energy Balances for 2015 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 3-1.2).

In order to estimate emissions from all source categories within this sector, a large amount of detailed information on fuel consumption is needed. The main source of information are the Energy Balances of the RM, provided annually by the National Bureau of Statistics. 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. 412 as of 09.12.2004 on official statistics, as well as Law No. 982 as of 11.05.2000 on access to information (for S.E. "Centre for State Information Resources „Register", an additional contract was signed between the parts regarding services providing). The list of organisations that provide primary data for the Energy Sector 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. S.E "Centre for State Information Resources "Register", Department for Project Management and Servicies;
5. Ministry of Defense, Ecology and Environment Protection Service;
6. Ministry of Economy and Infrastructure of the Republicii Moldova;
7. "Moldavian Railways" State Owned Enterprises;
8. Civil Aeronautical Authority;
9. Customs Service;
10. "Moldovagaz" J.S.C;
11. State Ecological Inspectorate of the RM (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 2015 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 form, 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 3-9).

Table 3-9: Emission Factors and Other Relevant Parameters Used to Estimate GHG Emissions from the Energy Sector of the Republic of Moldova

Fuel Type	Net Calorific Value (country specific value), 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
Donetsk	25.70	25.70			26.8		0.98	1
Kuznetsk	25.44	25.44			26.8		0.98	1
Ukraine	6.31 - 11.68	11.68			27.6		0.98	1
Kansk-Acinsk	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 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 conformity with recommendations in the 2006 IPCC Guidelines, the value of oxidation fraction was assumed being 1.0 for all types of fuel (in the previous inventory cycles, the respective value was 0.99 for liquid fuels, 0.98 – for solid fuels and 0.995 – for gaseous fuels).

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 3-10).

Table 3-10: 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 (de la 0.215 pina la 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

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)
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-spiret petroleum	t	1.474	43.25
Paraffins	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/

3.1.4. Uncertainties Assessment and Time-Series Consistency

The uncertainty analysis of the GHG emissions from the Energy Sector (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 3.70 per cent (without “Memo Items”) and 11.26 per cent (with “Memo Items”). The uncertainties introduced in trend in sectoral emissions were estimated at circa ±1.23 per cent (without “Memo Items”) and 3.55 per cent (with “Memo Items”). In view of ensuring time-series consistency of the results, the same approach was used for the entire period under review accordin to the recommendations of the GPG.

3.1.5. Quality Assurance and Quality Control

The main procedures associated with the quality assurance and quality control process in the Energy Sector include the following:

- according to the description of each source category, representetive 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 streadsheets 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 left bank of Dniester River - 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 calculation and reporting tables used by Annex I countries;

- 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 left bank of Dniester River 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 Analyzis 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 (<http://clima.md/doc.php?l=en&idc=82&id=3852>), including:
  - the estimation of GHG emissions from fossil fuel combustion within the Energy Sector uses AD in energy units (TJ) and not in natural units (kt or million m^3);
  - 1A1a category was disaggregated in 3 sub-categories (1A1ai Electricity Production; 1A1aii Combined Electricity and Heat Production; 1A1aiii Heat Production);
  - for 1A3 and 1A4 categories, GHG emissions were estimated for one additional sub-category;
  - the database for the Energy Sector was changed according to the model of the CRF tables used by Annex I countries, making it much easier to use;
  - for each source category where problems were identified, an additional verification of the AD sources was carried out, respectively the AD rows were updated;
  - for some source categories (for example 1A3c), the Energy Balances 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.

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:

- there were used AD expressed in energy units (TJ) and not in natural units (kt or thousand m^3) from the Energy Balances of the Republic of Moldova;
- with reference to 1A1a category, the emissions have been calculated for 3 sub-categories: 1A1ai Electricity Production; 1A1aii Combined Electricity and Heat Production; 1A1aiii Heat Production; while for the 1A5 category, the emissions were estimated for 2 sub-categories: 1A5a Stationary and 1A5b Mobile;
- for 1A3 and 1A4 categories, GHG emissions were estimated for one additional sub-category;
- for each source category, the AD used were updated, while for the categories included for the first time, AD were identified based on existing sources of reference;
- a new list of fuels were identified and accounted for the first time (including for 1990); previously, the consumption of these fuels were considered insignificant and were not considered;
- for 1A2, 1A3b and 1A3c categories, AD on diesel and gasoline consumption on the left bank of Dniester River were considered for the first time;
- the distribution formula of diesel consumption for agriculture sector was revised: for national roads and off-road, the following distribution was applied: for 1990 – 30 per cent and 70 per

cent, for 1991 – 20 per cent and 80 per cent, for 1992 – 15 per cent and 85 per cent; while for 1993-2015 time series it was kept the respective formula: 10 per cent and 90 per cent;

- to convert direct GHG emissions to CO_2 equivalent, in the current inventory cycle, the 100-year Global Warming Potential (GWP_{100}) values available in the Fourth IPCC Assessment Report (AR4), were used in the detriment of GWP_{100} values in the Second IPCC Assessment Report (SAR).

Overall, the performed recalculations showed slight differences compared to the results obtained in the previous inventory cycle.

In comparison with the results included into the BUR1 of the RM under the UNFCCC, these recalculations resulted in a small increase of direct GHG emissions within 1990-2013 periods (with the exception of 1992 and 1993), varying from a minimum of 0.3 per cent in 1990, up to a maximum of 3.6 per cent in 2007 (Table 3-11).

Tabelul 3-11: Recalculated GHG Emissions under the Energy Sector for 1990-2013 periods, included into the BUR1 and NC4 of the RM under the UNFCCC, kt CO_2 equivalent

	1990	1991	1992	1993	1994	1995	1996	1997	1998
BUR1	34 521.3158	30 221.7163	21 378.9094	16 472.0623	15 018.4635	11 722.2406	11 947.2474	10 788.3762	9 272.5132
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
Difference, %	0.3	1.8	0.0	-2.1	0.9	1.4	2.0	1.5	1.7
	1999	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**
BUR1	7 373.2500	6 672.7679	7 268.7844	6 951.9177	7 725.3056	8 184.1495	8 468.4040	7 633.3822	7 745.5404
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
Difference, %	1.3	1.7	1.6	2.6	1.6	2.2	2.5	2.9	3.6
	2008	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**%**
BUR1	8 351.4173	9 070.9351	9 647.3410	9 825.4771	9 469.0343	8 404.6226			
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	-72.6
Difference, %	3.1	2.6	1.9	1.7	2.0	1.9			

Abbreviations: NC4 – Fourth National Communication; BUR1 – First Biennial Update Report.

3.1.7. Assessment of Completeness

Under the current inventory cycle within the Energy Sector there were estimated GHG emissions originated from 8 source categories (Table 3-12). As no coal mining exists in the country, no GHG emissions from the category 1B1 'Fugitive Emissions from Coal Mining and Handling' were registered.

Table 3-12: Assessment of Completeness under the Energy Sector

IPCC Category	Source Category	CO_2	CH_4	N_2O
1.A.1	Energy Industries	X	X	X
1.A.2	Manufacturing Industries and Construction	X	X	X
1.A.3	Transport (Domestic Aviation, Road Transportation, Railways, Domestic Navigation, Other Transportation)	X	X	X
1.A.4	Other Sectors (Commercial/Institutional, Residential, Agriculture/Forestry/Fishing)	X	X	X
1.A.5	Other (Stationary/Mobile)	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 and Other Emissions from Energy Production	X	X	X
Memo items	International Bunkers: 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 Energy Sector are described in more detail in sub-chapters 3.2-3.9 of this report.

3.2. Energy Industries (Category 1A1)

In the Republic of Moldova electricity generation capacity include: Moldovan Thermal Power Plant (MTPP) in Dnestrovsk (on the left bank of the Dniester River) with an installed capacity of 2520 MW, built between 1964-1982; CHP-2 Chisinau, with an installed capacity of 240 MW and 1200 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.

Of relatively high total nominal capacity (2996.5 MW) it can be used only about 346 MW in cogeneration regime in Chisinau and Balti and in the hydro base, respectively, it is used only about half of the MTPP capacity (in particular, due to difficult trading conditions). Most (stabilized at around 76-79% during 2007-2010) of the electricity consumption of the country is covered by MTPP and less, by the imports from Ukraine. In recent years, renewable energy sources of small power are being developed. Their total capacity in 2015 represented 5 MW of electric power and 32 MW of thermal capacity. In the Energy Balances for 2015 year, AD on fuel consumption for separate sources of electricity and heat production are available.

The power transmission system operator 'Moldelectrica' SOE manages the internal transport network on the right bank of the Dniester River, including 5977.5 km transmission lines of 400, 330, 110kV, and 25,877.4 km radial lines of 35 and 6-10 kV.

3.2.1. Source Category Description

The emission sources monitored in the Republic of Moldova under the category 1A1 'Energy Industries' are as following: 1A1ai 'Public Electricity Generation'; 1A1aii 'Public Combined Heat and Power Generation'; and 1A1aiii 'Public Heat Plants'.

The Energy Balances of the RM for 2015 included for the first time data on GHG emissions from subcategory 1A1ai for the right bank of the Dniester River (Table 3-13).

Table 3-13: AD on Fuel Consumption for Public Electricity Generation on the Right Bank of Dniester River within 2010-2015 periods, TJ

Fuels	2010	2011	2012	2013	2014	2015
Residual Fuel Oil	21	19	10	10	9	
Natural Gas	21	10	7	30	40	1
Diesel						6
Biogas				10	18	14
Total	**42**	**29**	**17**	**50**	**67**	**21**

Source: Energy Balances of the RM for 2015.

On the left bank of the Dniester is located the largest source of electricity generation of the Republic of Moldova – Moldovan Thermal Power Plant (MTPP) in Dnestrovsk. The MTPP 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 1990-2015 at MTPP decreased by circa 66 per cent (Table 3-14).

Table 3-14: Electricity Generation at MTPP within 1990-2015, 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**	**%**
Electricity Generation	2 631	4 863	4 619	4 255	4 375	3 044	3 893	4 610	-66.0

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

The MTPP can operate on coal, resudual fuel oil and natural gas. Currently, the main fuel type is represented by natural gas with a volume that increased from circa 1,030 million m^3 (1994) up to 1,348 million m^3 (2015). Between 1994 and 2015, consumption of other two types of fuel (resudual fuel oil and coal) varied from a minimum of 6.0 kt and 228.0 kt, respectively from 115.4 kt to 1,675.6 kt.

To be noted that official statistical data on residual fuel oil and coal consumption within the MTTP are available only for 1994-1998 and 2008-2015. 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 – 33.86 TJ/mil.m^3 (Table 3-15).

Table 3-15: Fuel Consumption for Public Electricity Generation at the MTPP from Dnestrovsk within 1994-2015 periods

	Bitumionous Coal, kt	Residual Fuel Oil, kt	Natural Gas, mill. m³	Bitumionous Coal, TJ	Residual Fuel Oil, TJ	Natural Gas, TJ
1994	1 675.6	228.0	1 030.0	42 627.3	9 165.6	34 875.8
1995	880.9	26.1	1 098.4	22 410.1	1 049.2	37 191.8
1996	826.4	23.6	1 231.8	21 023.6	948.7	41 708.7
1997	281.9	6.0	1 113.3	7 171.5	241.2	37 696.3
1998	187.4	26.9	856.6	4 767.9	1 082.1	29 004.5
1999			841.3			28 486.0
2000			768.4			26 018.0
2001			937.4			31 740.0
2002			719.3			24 355.0
2003			756.2			25 605.0
2004			838.7			28 398.0
2005			805.4			27 271.0
2006			429.4			14 539.0
2007			719.0			24 345.0
2008	115.4	7.6	766.2	2 937.0	306.0	25 944.0
2009	230.9	19.8	1 267.2	5 874.0	795.0	42 907.0
2010	201.1	19.5	1 339.4	5 116.0	785.0	45 352.0
2011	160.6	16.2	1 220.0	4 087.0	652.0	41 309.0
2012	160.0	13.9	1 255.8	4 070.0	558.0	42 521.0
2013	180.8	12.3	754.3	4 600.0	493.0	25 541.0
2014	178.3	14.0	1 162.6	4 536.0	564.0	39 366.0
2015	176.0	15.0	1 348.0	4 479.0	602.0	45 643.0

Source: for natural gas –„Moldovagaz"; for residual fuel oil and coal – Statistical Yearbooks of the ATULBD; * for 1990-1993time series fuel consumption waspresented aggregated for the entire coutry and is included in subcategory 1A1aii.

1A1aii Public Combined Heat and Power Generation

At the moment, on the right bank of the Dniester there are three Combined Heat and Power Plants (CHP): 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 right bank of Dniester River decreased from approximately 1.697 billion kWh in 1990 to about 864 billion kWh in 2015 (Table 3-16).

Table 3-16: Electricity Generation, Import and Consumption on the Right Bank of Dniester River**,** within 2003-2015 periods, million kWh

	2003	2004	2005	2006	2007	2008	2009
Generation	975	952	1127	1080	1051	985	970
Import	1757.3	1835.6	1600.2	2881.1	2931.4	2961.0	2941.0
Consumption	3570.0	3454.7	3686.2	3871.2	4029.7	4065.0	3979.0
	2010	**2011**	**2012**	**2013**	**2014**	**2015**	**%**
Generation	972	933	890	849	889	864	-16.9
Import	2662	3142	3279	3244	3341	3360	91.2
Consumption	4106	4161	4211	4236	4305	4305	20.6

Source: S.O.E. "Moldelectrica". Statistical Yearbooks of the RM for 2003-2015.

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 combined heat and power plants in the Republic of Moldova (CHP-1 and CHP-2 in Chisinau, respectively CHP-North in Balti) is presented in Table 3-17.

Table 3-17: Fuel Consumption, Electricity and Heat Generation from the Combined Heat and Power Plants in the Republic of Moldova within 1990-2015 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 m³	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	2249.2	2618.7	2178.1	1023.7	1308.5	1035.1	1006.3	882.1	1045.9
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 m³	486.1	419.0	337.1	318.4	315.2	270.7	323.2	386.5	313.5
	Electricity, millions kWh	1150.0	951.4	923.4	883.4	751.2	670.9	838.8	896.2	723.3
	Heat, thousands Gcal	2544.7	2775.8	2577.6	2021.6	1631.6	1518.2	1515.0	1524.6	1296.0

		1990	1991	1992	1993	1994	1995	1996	1997	1998
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 m³	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	1360.0	1450.0	1144.0	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 m³	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 m³	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	1286.5	947.0	1068.4	1069.2	1018.6	885.7	1198.1	1204.2	1159.3
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 m³	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	%
CHP-1	Residual Fuel Oil, kt	0.0	1.2	0.0	0.0	0.0	0.0	0.0	0.0	-100.0
	Natural Gas, millions m³	78.3	70.0	51.2	40.3	33.8	33.1	35.9	25.6	-90.5
	Electricity, millions kWh	140.3	135.6	94.9	70.2	56.7	59.5	67.4	47.2	-77.2
	Heat, thousands Gcal	319.6	271.9	245.4	203.5	184.6	170.9	167.8	195.3	-91.3
CHP-2	Residual Fuel Oil, kt	0.0	9.6	0.0	0.0	0.0	1.0	2.0	3.0	-96.1
	Natural Gas, millions m³	294.8	284.6	304.2	295.3	288.9	267.2	268.7	274.7	-43.5
	Electricity, millions kWh	755.3	754.6	782.4	765.2	742.9	649.8	702.3	731.6	-36.4
	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	-56.9
CHP-North	Residual Fuel Oil, kt	0.0	0.8	0.0	0.0	0.0	0.0	0.0	0.0	-100.0
	Natural Gas, millions m³	37.8	38.0	41.5	39.1	38.9	33.5	34.4	36.0	129.4
	Electricity, millions kWh	67.4	66.5	70.0	69.9	66.3	60.2	61.5	320.4	164.8
	Heat, thousands Gcal	199.1	205.8	227.5	225.9	227.7	253.9	259.9	275.5	-79.7

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.

More detailed information on fuel consumption from the combined heat and power plants in the Republic of Moldova is presented in Table 3-18.

Table 3-18: Fuel Consumption from the Combined Heat and Power Plants in the Republic of Moldova within 1990-2015 periods, TJ

	1990	1991	1992	1993	1994	1995	1996	1997	1998
Anthracite				129					
Bituminous Coal	64 134	61 539	47 522	36 344					
Diesel	43	2 127	1 276	12		29	29	29	29
Residual Fuel Oil	39 758	68 943	50 190	25 984	1 086	1 144	1 350	1 144	851
Natural Gas	51 704	107 810	80 858	33 536	4 606	3 961	6 015	7 570	5 164
	1999	2000	2001	2002	2003	2004	2005	2006	2007
Diesel	59	29	29			11	21	17	12
Residual Fuel Oil	352	147	235	88	88	61	116	35	14
Natural Gas	5 868	6 631	10 034	8 655	7 914	8 351	9 503	9 279	9 097
	2008	2009	2010	2011	2012	2013	2014	2015	%
Diesel	16	18	20	19	10	10	9		
Residual Fuel Oil	40	309	105	94	58	57	64		
Natural Gas	8 140	7 526	7 358	6 951	6 699	6 326	6 249	11 686	-77.4
Biogas						29	79		

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 1993-2015, AD in energy units were taken directly from the Energy Balances of the RM.

As in the Energy Balances of the RM for 1990, AD are available only in natural units, respectively in tonnes of coal equivalent (t.c.e.), these were converted in energy units (TJ) by applying the conversion factors. Between 1991 and 1992, the Energy Balances were not published and all activity data used were taken from different sources.

1A1aiii Public Heat Plant

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 3-19).

Table 3-19: Natural Gas Consumption for Heat Production on the Left Bank of Dniester River within 1994-2015 periods

	1994	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
Natural Gas, millions m^3	268.0	49.7	148.1	224.7	187.2	262.4	250.4	143.2	175.3	151.8	166.7
Natural Gas, TJ	9073	1683	5015	7609	6339	8885	8479	4849	5936	5140	5644
	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	%
Natural Gas, millions m^3	181.7	166.7	189	181.1	210.5	208.8	203.1	204.1	188.1	191	-28.7
Natural Gas, TJ	6152	5644	6400	6132	7128	7070	6877	6911	6369	6467	-28.7

These were considered as the difference between total fuel consumption in the energy sector of the ATULBD and fuel consumption at the MTTP. AD are available in million m^3, being converted in TJ by applying the conversion factor of 33.86 TJ/mill.m^3.

AD on fuel consumption (including in energy units) for heat generation on the right bank of Dniester River are available in the Energy Balances of the RM within a separate rubric named "Heat Production". Table 3-20 presents aggregated AD on fuel consumption for heat production in the Republic of Moldova.

Table 3-20: Fuel Consumption for Heat Production in the Republic of Moldova within 1990-2015 periods, TJ

	1990	1993	1994	1995	1996	1997	1998	1999
Anthracite	0	373	176	117	29	29	29	0
Brown Coal	35	202	59	29	29	29	29	0
Other types of Bituminous Coal	3 384	1 429	675	441	499	411	323	176
Diesel	298	244	293	323	205	147	59	29
Kerosene for Oven	431	100	59	0	29	29	59	59
Residual Fuel Oil	45 426	21 841	12 176	11 208	10 034	7 130	5 663	3 609
Natural Gas	57 968	26 427	32 780	23 853	26 065	29 925	32 900	24 941
Liquefied Petroleum Gases	46	35	0	0	0	0	0	0
Fuel Wood	9	6	0	0	0	0	0	0
Wood Waste	0	50	147	88	0	59	29	29
Agricultural Residues	59	0	0	0	88	0	0	0
	2000	2001	2002	2003	2004	2005	2006	2007
Anthracite	0	0	59	59	59	81	44	39
Other types of Bituminous Coal	117	88	29	58	78	42	56	26
Diesel	59	29	59	88	75	73	42	21
Kerosene for Oven	59	29	29	29	15	0	0	0
Residual Fuel Oil	1 584	1 350	1 115	733	637	523	439	268
Natural Gas	20 826	21 301	17 348	19 125	17 299	19 563	19 706	17 531
Liquefied Petroleum Gases	0	29	0	0	5	9	8	4
Fuel Wood	0	0	0	0	3	3	2	0
Wood Waste	59	147	0	29	16	16	1	1
Agricultural Residues	0	0	235	205	226	226	214	239
	2008	2009	2010	2011	2012	2013	2014	2015
Antracit	71	113	91	61	67	264	52	0
Other types of Bituminous Coal	28	9	5	8	7	64	28	0
Diesel	22	31	28	19	18	33	20	0
Kerosene for Oven	0	3	0	0	0	0	0	0
Residual Fuel Oil	372	679	745	544	460	528	408	0
Other Oil Products	0	0	0	0	17	1	0	0
Natural Gas	18 436	16 283	17 990	17 429	16 946	17 273	16 697	8 107
Liquefied Petroleum Gases	3	7	1	1	0	0	0	0
Fuel Wood	1	1	2	1	1	37	29	0
Wood Waste	1	2	2	1	3	3	5	0
Agricultural Residues	373	435	514	399	226	229	321	0
Biogas	0	0	0	0	0	7	99	0

Note: in the 1991-1992 years, the Energy Balances were not published, AD on fuel consumption for heat generation were collected from different department sources; as a result of the impossibility to distribute AD on subcategories (1A1aii and 1A1aiii), the fuel consumption recorded was included within subcategory 1A1aii.

1A1 "Energy Industries"

Fuel consumption in all subcategories included under 1A1 "Energy" and the share of each subcategory are presented in Table 3-21. With reference to this table, it should be noted that for 1990, it was possible to disaggregate fuel consumption only between 1A1aii and 1A1aiii. For 1991 and 1992, aggregate fuel consumption was assigned to 1A1aii, while for 1993 there are no data on fuel consumption for 1A1ai.

Table 3-21: Fuel Consumption (TJ) within 1A1 "Energy Industries" and the Share of Subcategories (% from the total), in the Republic of Moldova, within 1990-2015 periods

	Fuel Consumption by subcategories, TJ				% from the total		
	1A1ai	1A1aii	1A1aiii	1A1	1A1ai	1A1aii	1A1aiii
1990		155 639	109 564	265 203		58.7	41.3
1991		240 420		240 420		100.0	
1992		179 855		179 855		100.0	
1993		96 005	50 707	146 712		65.4	34.6
1994	86 669	5 692	46 365	138 725	62.5	4.1	33.4
1995	60 651	5 134	36 059	101 844	59.6	5.0	35.4
1996	63 681	7 394	36 978	108 053	58.9	6.8	34.2
1997	45 109	8 743	37 759	91 611	49.2	9.5	41.2
1998	34 855	6 044	39 091	79 990	43.6	7.6	48.9
1999	28 486	6 279	28 843	63 608	44.8	9.9	45.3
2000	26 018	6 807	22 704	55 529	46.9	12.3	40.9
2001	31 740	10 298	22 973	65 011	48.8	15.8	35.3
2002	24 355	8 743	18 874	51 972	46.9	16.8	36.3
2003	25 605	8 002	20 326	53 933	47.5	14.8	37.7
2004	28 398	8 423	18 413	55 234	51.4	15.2	33.3
2005	27 271	9 640	20 536	57 447	47.5	16.8	35.7
2006	14 539	9 331	20 512	44 383	32.8	21.0	46.2
2007	24 345	9 123	18 129	51 598	47.2	17.7	35.1
2008	29 186	8 196	19 307	56 689	51.5	14.5	34.1
2009	49 576	7 853	17 563	74 992	66.1	10.5	23.4
2010	51 295	7 483	19 378	78 155	65.6	9.6	24.8
2011	46 077	7 064	18 463	71 604	64.3	9.9	25.8
2012	47 167	6 767	17 745	71 679	65.8	9.4	24.8
2013	30 683	6 422	18 439	55 544	55.2	11.6	33.2
2014	44 533	6 401	17 659	68 593	64.9	9.3	25.7
2015	50 744	11 686	8 107	70 538	71.9	16.6	11.5

The evolution of fuel consumption within the 1A1 category "Energy Industries" over 1990-2015, disaggregated by fuel type is presented in Table 3-22. During the respective period, the share of solid fuels (coal) decreased from 25.5 per cent to 6.3 per cent; the share of liquid fuels (petroleum products) dropped from 33.1 per cent to circa 0.9 per cent; the share of gaseous fuels (natural gas) increased from 41.4 per cent to 92.8 per cent, while the share of biofuels varied between 0.1 and 0.7 per cent of the total (biofuel consumption recorded a significant growth, in particular between 2000 and 2014, from circa 59 TJ to 551 TJ). In total, in 2015 fuel consumption within this category represented only 26.6 per cent of the reference year level (1990).

Table 3-22: Fuel Consumption within 1A1 "Energy Industries" Category, breakdown by fuel type, within 1990-2015 periods

	Fuel Consumption, TJ					Share, % from the total				in % compared to 1990				
	Coal	Petroleum products	Natural gas	Biofuels	Total	Coal	Petroleum products	Natural gas	Biofuels	Coal	Petroleum products	Natural gas	Biofuels	Total
1990	67 553	87 910	109 673	67	265 203	25.5	33.1	41.4	0.0	100.0	100.0	100.0	100.0	100.0
1991	61 539	71 070	107 810		240 420	25.6	29.6	44.8	0.0	91.1	80.8	98.3		90.7
1992	47 522	51 466	80 858		179 846	26.4	28.6	45.0	0.0	70.3	58.5	73.7		67.8
1993	38 477	48 216	59 963	56	146 712	26.2	32.9	40.9	0.0	57.0	54.8	54.7	82.8	55.3
1994	43 537	22 780	72 262	147	138 725	31.4	16.4	52.1	0.1	64.4	25.9	65.9	217.2	52.3
1995	22 997	13 753	65 006	88	101 844	22.6	13.5	63.8	0.1	34.0	15.6	59.3	130.0	38.4
1996	21 581	12 596	73 789	88	108 053	20.0	11.7	68.3	0.1	31.9	14.3	67.3	130.0	40.7
1997	7 641	8 720	75 191	59	91 611	8.3	9.5	82.1	0.1	11.3	9.9	68.6	87.2	34.5
1998	5 149	7 743	67 069	29	79 990	6.4	9.7	83.8	0.0	7.6	8.8	61.2	42.9	30.2
1999	176	4 108	59 295	29	63 608	0.3	6.5	93.2	0.0	0.3	4.7	54.1	42.9	24.0
2000	117	1 878	53 475	59	55 529	0.2	3.4	96.3	0.1	0.2	2.1	48.8	87.2	20.9
2001	88	1 701	63 075	147	65 011	0.1	2.6	97.0	0.2	0.1	1.9	57.5	217.2	24.5
2002	88	1 291	50 358	235	51 972	0.2	2.5	96.9	0.5	0.1	1.5	45.9	347.3	19.6
2003	117	938	52 644	234	53 933	0.2	1.7	97.6	0.4	0.2	1.1	48.0	345.8	20.3

	Fuel Consumption, TJ					Share, % from the total				in % compared to 1990				
	Coal	Petroleum products	Natural gas	Biofuels	Total	Coal	Petroleum products	Natural gas	Biofuels	Coal	Petroleum products	Natural gas	Biofuels	Total
2004	137	804	54 048	245	55 234	0.2	1.5	97.9	0.4	0.2	0.9	49.3	362.0	20.8
2005	123	742	56 337	245	57 447	0.2	1.3	98.1	0.4	0.2	0.8	51.4	362.0	21.7
2006	100	541	43 525	217	44 383	0.2	1.2	98.1	0.5	0.1	0.6	39.7	320.7	16.7
2007	65	319	50 974	240	51 598	0.1	0.6	98.8	0.5	0.1	0.4	46.5	354.6	19.5
2008	3 036	759	52 519	375	56 689	5.4	1.3	92.6	0.7	4.5	0.9	47.9	554.1	21.4
2009	5 996	1 842	66 716	438	74 992	8.0	2.5	89.0	0.6	8.9	2.1	60.8	647.2	28.3
2010	5 212	1 705	70 721	518	78 155	6.7	2.2	90.5	0.7	7.7	1.9	64.5	765.4	29.5
2011	4 156	1 348	65 699	401	71 604	5.8	1.9	91.8	0.6	6.2	1.5	59.9	592.6	27.0
2012	4 144	1 131	66 173	230	71 679	5.8	1.6	92.3	0.3	6.1	1.3	60.3	339.9	27.0
2013	4 928	1 132	49 169	315	55 544	8.9	2.0	88.5	0.6	7.3	1.3	44.8	465.5	20.9
2014	4 616	1 074	62 352	551	68 593	6.7	1.6	90.9	0.8	6.8	1.2	56.9	814.2	25.9
2015	4 479	608	65 438	14	70 538	6.3	0.9	92.8	0.0	6.6	0.7	59.7	20.7	26.6

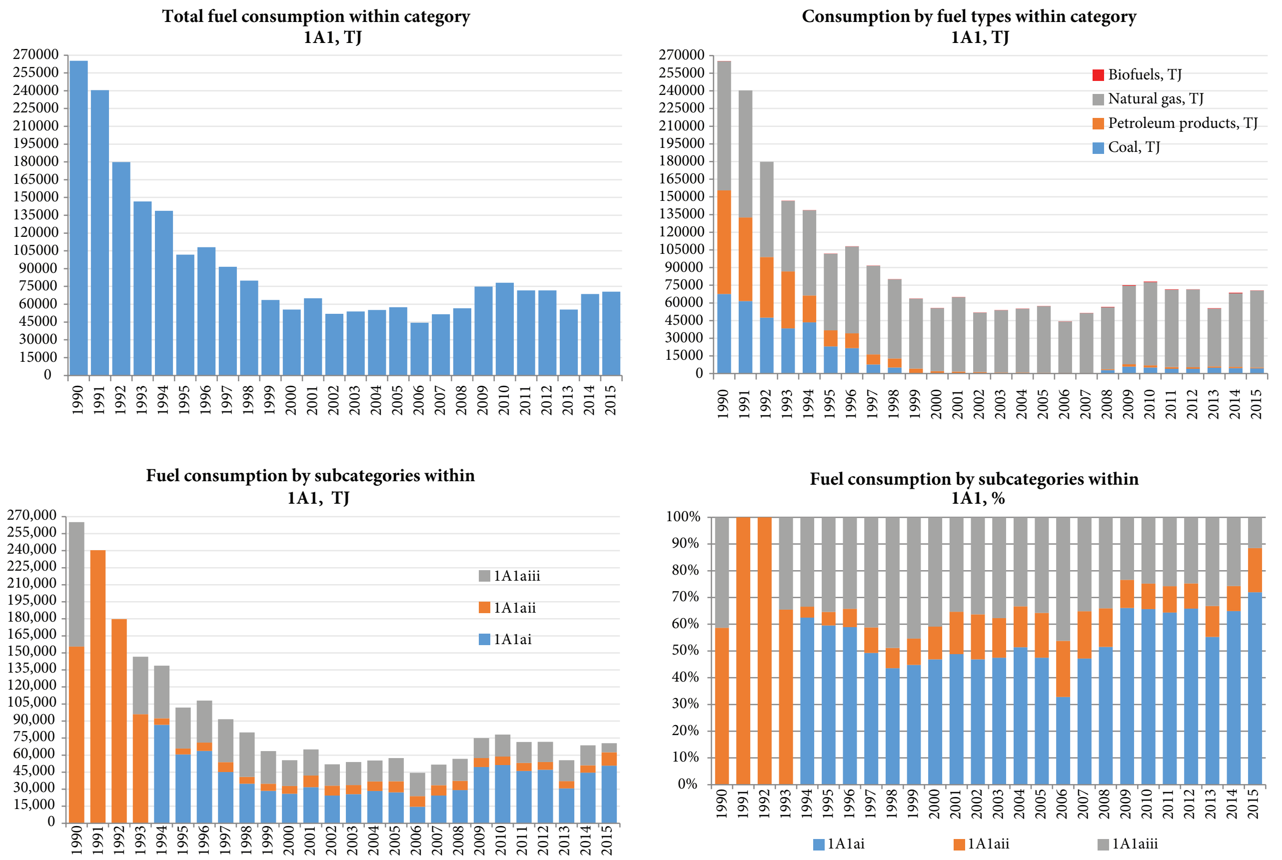


Figure 3-9: Fuel Consumption within 1A1 “Energy Industries” between 1990-2015, by subcategories and fuel type

Trend of GHG Emission within the Source Category 1A1 “Energy Industries”

During 1990-2015, GHG emission within the source category 1A1 „Energy Industries” presented a decreasing trend (Table 3-23).

Table 3-23: GHG Emissions from 1A1 ‘Energy Industries’ in the Republic of Moldova within 1990-2015 periods

	1990	1991	1992	1993	1994	1995	1996	1997	1998
1A1, kt CO_2 equivalent	19 398.56	17 416.79	13 051.05	10 770.94	9 966.24	6 904.45	7 172.96	5 625.41	4 856.62
%, compared to1990	100	89.8	67.3	55.5	51.4	35.6	37.0	29.0	25.0
	1999	2000	2001	2002	2003	2004	2005	2006	2007
1A1, kt CO_2 equivalent	3 664.88	3 159.33	3 681.93	2 936.80	3 040.38	3 110.79	3 233.26	2 495.92	2 893.82
%, compared to1990	18.9	16.3	19.0	15.1	15.7	16.0	16.7	12.9	14.9
	2008	2009	2010	2011	2012	2013	2014	2015	%
1A1, kt CO_2 equivalent	3 297.57	4 460.51	4 597.56	4 187.95	4 197.14	3 316.40	4 021.49	4 147.07	-78.6
%, compared to1990	17.0	23.0	23.7	21.6	21.6	17.1	20.7	21.4	

Compared to the base year - 1990, in 2015 the level of GHG emissions from the source category 1A1 'Energy Industries' represented: CO_2 emissions – only circa 21.4 per cent, CH_4 – 16.2 per cent, N_2O – 8.2 per cent, NO_x – 20.8 per cent, CO – 28.7 per cent, NMVOC – 26.6 per cent, respectively SO_2 – 2.9 per cent (Table 3-24).

Table 3-24: GHG Emissions from 1A1 'Energy Industries' in the Republic of Moldova within 1990-2015 periods

Years	GHG							GHG Emissions 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
	kt							%						
1990	19 338.02	0.4429	0.1653	54.31	4.93	1.33	203.25	100.0	100.0	100.0	100.0	100.0	100.0	100.0
1991	17 363.58	0.3826	0.1457	48.85	4.45	1.20	172.14	89.8	86.4	88.2	89.9	90.3	90.4	84.7
1992	13 010.94	0.2828	0.1102	36.68	3.34	0.90	128.33	67.3	63.8	66.7	67.5	67.7	67.7	63.1
1993	10 737.02	0.2447	0.0928	30.19	2.75	0.74	114.69	55.5	55.2	56.2	55.6	55.7	55.4	56.4
1994	9 935.38	0.1885	0.0868	28.47	2.80	0.70	82.38	51.4	42.6	52.5	52.4	56.9	52.7	40.5
1995	6 886.31	0.1319	0.0496	19.41	2.05	0.51	45.86	35.6	29.8	30.0	35.7	41.7	38.6	22.6
1996	7 155.34	0.1358	0.0477	20.07	2.18	0.54	42.66	37.0	30.7	28.8	37.0	44.3	40.9	21.0
1997	5 615.51	0.1108	0.0244	15.32	1.85	0.46	21.34	29.0	25.0	14.8	28.2	37.4	34.7	10.5
1998	4 848.64	0.0963	0.0192	13.16	1.59	0.40	17.16	25.1	21.7	11.6	24.2	32.2	30.2	8.4
1999	3 660.44	0.0727	0.0088	9.77	1.28	0.32	6.14	18.9	16.4	5.3	18.0	26.0	24.0	3.0
2000	3 155.75	0.0610	0.0069	8.44	1.16	0.28	2.75	16.3	13.8	4.2	15.5	23.5	21.1	1.4
2001	3 677.72	0.0726	0.0080	9.84	1.44	0.33	2.53	19.0	16.4	4.9	18.1	29.1	25.0	1.2
2002	2 933.21	0.0614	0.0069	7.86	1.26	0.27	1.97	15.2	13.9	4.2	14.5	25.6	20.3	1.0
2003	3 036.74	0.0626	0.0069	8.14	1.30	0.28	1.44	15.7	14.1	4.2	15.0	26.4	21.1	0.7
2004	3 107.08	0.0639	0.0071	8.33	1.34	0.29	1.28	16.1	14.4	4.3	15.3	27.2	21.6	0.6
2005	3 229.45	0.0660	0.0072	8.66	1.39	0.30	1.17	16.7	14.9	4.4	15.9	28.1	22.4	0.6
2006	2 492.93	0.0517	0.0057	6.69	1.10	0.23	0.89	12.9	11.7	3.4	12.3	22.3	17.4	0.4
2007	2 890.45	0.0592	0.0063	7.75	1.27	0.27	0.56	14.9	13.4	3.8	14.3	25.7	20.2	0.3
2008	3 292.34	0.0691	0.0118	8.98	1.50	0.30	4.58	17.0	15.6	7.1	16.5	30.4	22.6	2.3
2009	4 452.70	0.0914	0.0185	12.22	1.92	0.39	9.50	23.0	20.6	11.2	22.5	38.9	29.7	4.7
2010	4 589.79	0.0965	0.0180	12.56	2.06	0.41	8.43	23.7	21.8	10.9	23.1	41.8	31.1	4.1
2011	4 181.28	0.0859	0.0152	11.41	1.82	0.38	6.70	21.6	19.4	9.2	21.0	36.9	28.3	3.3
2012	4 190.83	0.0806	0.0144	11.42	1.65	0.37	6.32	21.7	18.2	8.7	21.0	33.5	27.7	3.1
2013	3 310.57	0.0656	0.0141	9.10	1.40	0.29	7.22	17.1	14.8	8.5	16.8	28.5	21.9	3.6
2014	4 014.93	0.0810	0.0153	11.00	1.89	0.37	6.87	20.8	18.3	9.2	20.3	38.3	27.6	3.4
2015	4 141.22	0.0717	0.0136	11.28	1.41	0.35	5.92	21.4	16.2	8.2	20.8	28.5	26.5	2.9

Total direct GHG emissions from 1A1 "Energy Industries" decreased from circa 19 398 kt CO_2 equivalent in 1990, to circa 4 147 kt CO_2 equivalent in 2015 (Table 3-25). The largest share in the structure of total direct GHG emissions is represented by CO_2 (circa 99.69 per cent in 1990, respectively circa 99.86 per cent in 2015).

Table 3-25: Direct GHG Emissions from 1A1 'Energy Industries' in the Republic of Moldova within 1990-2015 periods and the Share of Each Gas in the Total Structure at Category Level

Years	Direct GHG Emissions, kt CO_2 equivalent				Share from the total, %			Compared to 1990, %		
	CO_2	CH_4	N_2O	Total	CO_2	CH_4	N_2O	CO_2	CH_4	N_2O
1990	19 338.02	11.07	49.26	19 398.3	99.69	0.06	0.25	100.0	100.0	100.0
1991	17 363.58	9.56	43.43	17 416.6	99.70	0.05	0.25	89.8	86.4	88.2
1992	13 010.94	7.07	32.85	13 050.9	99.69	0.05	0.25	67.3	63.8	66.7
1993	10 737.02	6.12	27.67	10 770.8	99.69	0.06	0.26	55.5	55.2	56.2
1994	9 935.38	4.71	25.86	9 966.0	99.69	0.05	0.26	51.4	42.6	52.5
1995	6 886.31	3.30	14.78	6 904.4	99.74	0.05	0.21	35.6	29.8	30.0
1996	7 155.34	3.39	14.20	7 172.9	99.75	0.05	0.20	37.0	30.7	28.8
1997	5 615.51	2.77	7.29	5 625.6	99.82	0.05	0.13	29.0	25.0	14.8
1998	4 848.64	2.41	5.72	4 856.8	99.83	0.05	0.12	25.1	21.7	11.6
1999	3 660.44	1.82	2.61	3 664.9	99.88	0.05	0.07	18.9	16.4	5.3
2000	3 155.75	1.52	2.05	3 159.3	99.89	0.05	0.06	16.3	13.8	4.2
2001	3 677.72	1.82	2.39	3 681.9	99.89	0.05	0.07	19.0	16.4	4.9
2002	2 933.21	1.53	2.05	2 936.8	99.88	0.05	0.07	15.2	13.9	4.2
2003	3 036.74	1.56	2.07	3 040.4	99.88	0.05	0.07	15.7	14.1	4.2
2004	3 107.08	1.60	2.11	3 110.8	99.88	0.05	0.07	16.1	14.4	4.3
2005	3 229.45	1.65	2.16	3 233.3	99.88	0.05	0.07	16.7	14.9	4.4
2006	2 492.93	1.29	1.70	2 495.9	99.88	0.05	0.07	12.9	11.7	3.4
2007	2 890.45	1.48	1.89	2 893.8	99.88	0.05	0.07	14.9	13.4	3.8
2008	3 292.34	1.73	3.50	3 297.6	99.84	0.05	0.11	17.0	15.6	7.1
2009	4 452.70	2.28	5.52	4 460.5	99.83	0.05	0.12	23.0	20.6	11.2
2010	4 589.79	2.41	5.37	4 597.6	99.83	0.05	0.12	23.7	21.8	10.9
2011	4 181.28	2.15	4.54	4 188.0	99.84	0.05	0.11	21.6	19.4	9.2

Years	Direct GHG Emissions, kt CO_2 equivalent				Share from the total, %			Compared to 1990, %		
	CO_2	CH_4	N_2O	Total	CO_2	CH_4	N_2O	CO_2	CH_4	N_2O
2012	4 190.83	2.01	4.30	4 197.1	99.85	0.05	0.10	21.7	18.2	8.7
2013	3 310.57	1.64	4.20	3 316.4	99.82	0.05	0.13	17.1	14.8	8.5
2014	4 014.93	2.03	4.55	4 021.5	99.84	0.05	0.11	20.8	18.3	9.2
2015	4 141.22	1.79	4.06	4 147.1	99.86	0.04	0.10	21.4	16.2	8.2

Table 3-26 and Figure 3-10 present direct GHG emissions from 1A1 "Energy Industries", breakdown by subcategories.

Table 3-26: Breakdown of Direct GHG Emissions from 1A1 "Energy Industries", by Subcategories, within 1990-2015 periods

Years	Direct GHG Emissions, kt CO_2 equivalent				Share from the total, %		
	1Aai	1Aaii	1Aaiii	1A1	1Aai	1Aaii	1Aaiii
1990		12 091.30	7 307.00	19 398.30		62.3	37.7
1991		17 416.60		17 416.60		100.0	
1992		13 050.90		13 050.90		100.0	
1993		7 369.90	3 400.90	10 770.80		68.4	31.6
1994	6 722.80	343.00	2 900.10	9 966.00	67.5	3.4	29.1
1995	4 300.50	313.40	2 290.40	6 904.40	62.3	4.5	33.2
1996	4 414.60	444.80	2 313.60	7 172.90	61.5	6.2	32.3
1997	2 817.40	516.10	2 292.10	5 625.60	50.1	9.2	40.7
1998	2 166.10	358.20	2 332.50	4 856.80	44.6	7.4	48.0
1999	1 599.60	361.20	1 704.00	3 664.90	43.6	9.9	46.5
2000	1 461.00	385.90	1 312.40	3 159.30	46.2	12.2	41.5
2001	1 782.40	583.90	1 315.70	3 681.90	48.4	15.9	35.7
2002	1 367.70	492.90	1 076.30	2 936.80	46.6	16.8	36.6
2003	1 437.80	451.20	1 151.30	3 040.40	47.3	14.8	37.9
2004	1 594.70	474.50	1 041.60	3 110.80	51.3	15.3	33.5
2005	1 531.40	544.20	1 157.70	3 233.30	47.4	16.8	35.8
2006	816.50	525.00	1 154.40	2 495.90	32.7	21.0	46.3
2007	1 367.10	512.80	1 013.90	2 893.80	47.2	17.7	35.0
2008	1 759.80	461.40	1 076.40	3 297.60	53.4	14.0	32.6
2009	3 029.60	448.00	982.90	4 460.50	67.9	10.0	22.0
2010	3 094.10	422.80	1 080.70	4 597.60	67.3	9.2	23.5
2011	2 758.90	399.00	1 030.00	4 188.00	65.9	9.5	24.6
2012	2 818.10	381.40	997.60	4 197.10	67.1	9.1	23.8
2013	1 909.80	360.40	1 046.20	3 316.40	57.6	10.9	31.5
2014	2 685.70	356.60	979.30	4 021.50	66.8	8.9	24.4
2015	3 035.60	656.20	455.30	4 147.10	73.2	15.8	11.0

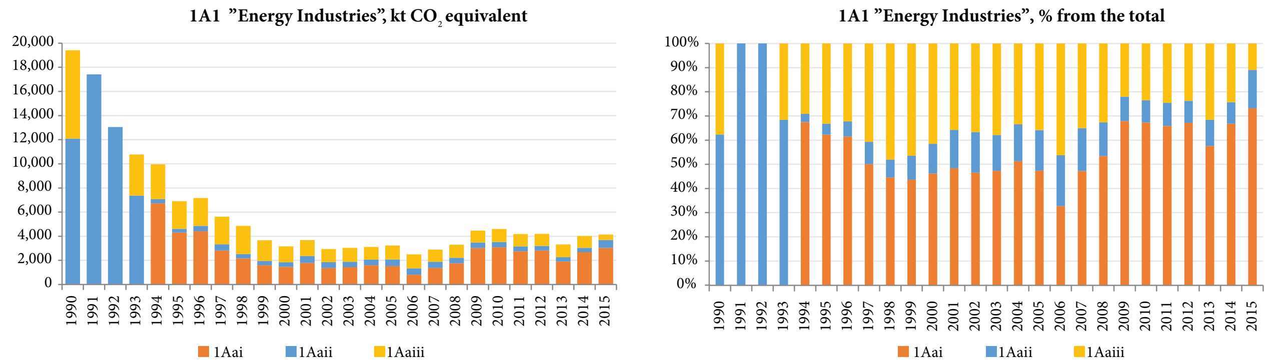


Figure 3-10: Direct GHG Emissions from 1A1 'Energy Industries' in the Republic of Moldova within 1990-2015 periods, kt CO_2 equivalent and Breakdown of Direct GHG Emissions from 1A1 "Energy Industries", by Subcategories, in % from the total

3.2.2. Methodological Issues, Emission Factors and Data Sources

GHG emissions originated from 1A1 'Energy Industries' was estimated following a Tier 1 methodology (Table 3-27), using default emission factors. To assure the natural conversion from natural units to energy units, country specific NCVs were used (see Table 3-9). The carbon oxidation fraction values used were those recommended by 2006 IPCC Guidelines.

Table 3-27: Methods and Coefficients used for Estimating Direct GHG Emissions Originated from 1A1 'Energy Industries' Source Category

Category	CO_2				CH_4		N_2O	
	Method	Net Calorific Value, TJ/kt	Carbon Oxidation Fraction	FE, tC/TJ	Method	FE, kg/TJ	Method	FE, kg/TJ
1A1a Electricity and Heat Generation	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 Revised 1996 IPCC Guidelines (IPCC, 1997) were used for estimating non-CO_2[31] emissions (Table 3-28).

Table 3-28: Emission Factors Used for Estimating GHG Emissions Originated from 1A1 'Energy Industries', kg/TJ

	CO_2	CH_4	N_2O	NO_x	CO	NMVOC
Anthracite	98 300	1	1.5	300	20	5
Brown Coal (lignite)	101 000	1	1.5	300	20	5
Other types of bituminous coal	94 600	1	1.5	300	20	5
Diesel	74 100	3	0.6	200	15	5
Kerosene for oven	71 900	3	0.6	200	15	5
Residual Fuel Oil	77 400	3	0.6	200	15	5
Other Petroleum Products	73 300	3	0.6	200	15	5
Natural Gas	56 100	1	0.1	150	20	5
Liquefied Petroleum Gases	63 100	1	0.1	200	15	5
Fuel Wood	112 000	30	4	100	1 000	50
Wood Waste	112 000	30	4	100	1 000	50
Agricultural Residues	100 000	30	4	100	1 000	50
Charcoal	112 000	200	4	100	1 000	50
Pelllets and Briquettes from Vegetable Waste	100 000	30	4	100	1 000	50
Biogas	54 600	1	0.1	100	1 000	50

Source: for NO_x, CO and NMVOC: *Revised 1996 IPCC Guidelines*, Vol. 3, Tab. 1-9, 1-10 and 1-11, pages 1.37-1.42; for CH_4, N_2O – *2006 IPCC Guidelines,*, Vol. 2, Cap. 2, Tab. 2.2, pages 2.16-2.17.

The AD related to fuel consumption for electricity and heat generation (Table 3-29) for the Right Bank of Dniester River were collected from the Energy Balances of the RM for 1990, 1993-2013 and other relevant sources of information including the Ministry of Economy, Customs Service and relevant energy enterprises (SOE "Moldelectrica", "Moldovagaz" J.S.C., CHP-1 J.S.C., CHP-2 J.S.C. and CHP-North J.S.C.). For the Left Bank of Dniester River activity data were provided by "Moldovagaz" J.S.C. and MTTP in Dnestrovsk, as well as information available in the Statistical Yearbooks of ATULBD.

Table 3-29: Fuel Consumption for Electricity and Heat Generation in the Republic of Moldova within 1990-2015 periods, TJ

	1990	1991	1992	1993	1994*	1995	1996	1997	1998
Anthracite	0	0	0	502	176	117	29	29	29
Brown Coal (lignite)	35	0	0	202	59	29	29	29	29
Bituminous Coal	67 518	61 539	47 522	37 773	43 302	22 851	21 523	7 583	5 091
Diesel Oil	2 637	2 127	1 276	256	293	352	234	176	88
Kerosene for oven	43	0	0	100	59	0	29	29	59
Residual Fuel Oil	85 184	68 943	50 190	47 825	22 428	13 401	12 333	8 515	7 596
Natural Gas	109 673	107 810	80 858	59 963	72 262	65 006	73 789	75 191	67 069
Liquefied Petroleum Gases	46	0	0	35	0	0	0	0	0
Fuel Wood	9	0	0	6	0	0	0	0	0
Wood Waste	59	0	0	50	147	88	0	59	29
Agricultural Residues	0	0	0	0	0	0	88	0	0
	1999	2000	2001	2002	2003	2004	2005	2006	2007
Anthracite	0	0	0	59	59	59	81	44	39
Bituminous Coal	176	176	176	176	176	176	176	176	176
Diesel Oil	88	88	88	88	88	88	88	88	88
Kerosene for oven	59	59	59	59	59	59	59	59	59
Residual Fuel Oil	3 961	3 961	3 961	3 961	3 961	3 961	3 961	3 961	3 961
Natural Gas	59 295	59 295	59 295	59 295	59 295	59 295	59 295	59 295	59 295
Wood Waste	29	29	29	29	29	29	29	29	29
	2008	2009	2010	2011	2012	2013	2014	2015	%
Anthracite	71	113	91	61	67	264	52	0	
Bituminous Coal	2 965	5 883	5 121	4 095	4 077	4 664	4 564	4 479	-93.4
Diesel Oil	38	49	48	38	28	43	29	6	-99.8
Kerosene for oven	0	3	0	0	0	0	0	0	-100.0
Residual Fuel Oil	718	1 783	1 635	1 290	1 076	1 078	1 036	602	-99.3

[31] The methodology used to measure SO_2 emissions is described in Annex 3-1.1 of this Report.

	2008	2009	2010	2011	2012	2013	2014	2015	%
Other Petroleum Products	0	0	0	0	17	1	0	0	
Natural Gas	52 519	66 716	70 700	65 689	66 166	49 139	62 312	65 437	-40.3
Liquefied Petroleum Gases	3	7	1	1	0	0	0	0	-100.0
Fuel Wood	1	1	2	1	1	37	29	0	-100.0
Wood Waste	1	2	2	1	3	3	5	0	-100.0
Agricultural Residues	373	435	514	399	226	229	321	0	
Biogas	0	0	0	0	0	46	196	14	

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 source 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' source 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 Energy Sector 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", 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 subcategory included in 1A1 "Energy Industries" complies with the requirements set out in the description of each subcategory in the 2006 IPCC Guidelines; verifying the correctness of EFs use for each subcategory; verifying if the primary reference sources are correctly indicated; the accuracy of calculations for subcategories included in 1A1 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 calculations files the EFs are specified in tabular formats for each subcategory, the import of the respective values into calculation formulas is ensured by automatic connections;
- the consistency of the calculations is also ensured by verifying the correctness of applying conversion factors of natural units to energy units for all subcategories and the entire range of years covered by the inventory;
- verification if the same method is used for the entire range of years covered by the inventory;
- verifying if GHG emissions calculations have been made for all years and for all types of fuels mentioned in the Energy Balances of the RM 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, etc.

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

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 1A1 "Energy Industries".

The main causes of these recalculations are, as follows: in order to estimate GHG emissions were used AD expressed in energy units (TJ) and not in natural units (kt or thousand m^3); GHG emissions were esimated for 3 subcategories: 1A1ai, 1A1aii, 1A1aiii; previously these were calculated aggregated at category level; AD were updated and specified based on the existing reference sources, for example in the Energy Balances of the RM for 2015 were published for the first time AD on fuel consumption within 1A1ai subcategory for the right bank of Dniester River between 2010 and 2015; within this category sources a number of new fuels have been identified and recorded for the first time (including for 1990); to be noted that previously the consumption of certain fuel types were considered insignificant withount being accounted for in the national inventory, whereas with the use of data on fuel consumption in energy units information on insignificant consumption of new fuels within the respective category became available; also, in order to convert direct GHG emissions in CO_2 equivalent, in the current inventory cycle, the 100-year Global Warming Potential (GWP_{100}) values available in the Fourth IPCC Assessment Report (AR4) (CH_4 – 25 and N_2O – 298), were used in the detriment of GWP_{100} values in the Second IPCC Assessment Report (SAR) (CH_4 – 21 and N_2O – 310).

Overall, the recalculations performed showed insignificant differences compared to the results from the previous inventory cycle. In comparison with the results included into the First Biennial Report of the RM under the UNFCCC, the performed recalculations resulted in a small increase of direct GHG emissions in 1990-1992, 1996, 1998, 2000-2001 and 2008-2013, respectively a slight decrease in the following years 1993-1995, 1997, 1999, 2002-2005, 2007 and 2009 (Table 3-30). For 2014-2015, direct GHG emissions from source category 1A1 were estimated for the first time. Between 1990 and 2015, the respective emissions decreased by circa 78.6 per cent.

Table 3-30: Comparative Results of GHG Emissions Originated from 1A1 "Energy Industries" included into the BUR1 and the NC4 of the RM under the UNFCCC, kt CO_2 equivalent

	1990	1991	1992	1993	1994	1995	1996	1997	1998
BUR1	19 393.2858	17 414.4185	13 049.3384	11 360.3417	10 029.8177	6 931.7635	7 152.4697	5 651.6191	4 854.8011
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
Difference, %	0.03	0.01	0.01	-5.19	-0.64	-0.39	0.29	-0.46	0.04
	1999	2000	2001	2002	2003	2004	2005	2006	2007
BUR1	3 674.2878	3 152.4214	3 678.7653	2 943.9751	3 041.9389	3 113.0195	3 236.0698	2 494.1332	2 895.5143
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
Difference, %	-0.26	0.22	0.09	-0.24	-0.05	-0.07	-0.09	0.07	-0.06
	2008	2009	2010	2011	2012	2013	2014	2015	%
BUR1	3 295.1211	4 460.5118	4 595.0003	4 185.5488	4 190.7797	3 313.9206			
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	-78.6
Difference, %	0.07	0.00	0.06	0.06	0.15	0.08			

Abbreviations: NC4 – Fourth National Communication; BUR1 – First Biennial Update Report.

3.2.6. Planned Improvements

Potential improvements within the 1A1 "Energy Industries" could be possible once new AD regarding the fuel consumption for electricity and heat generation in the ATULBD are available (filling the gaps for certain years). Another possible improvement could be using real reported caloric values for natural gas imported annually in the Republic of Moldova, based on the information provided by J.S.C. "Moldovagaz".

3.3. Manufacturing Industries and Construction (Category 1A2)

In 2015, circa 4 834 enterprises and production units were active in the industrial sector, including 95 in mining industry, 4 232 in manufacturing industry, respectively 58 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 "Industrial Processes and Product Use" Sector).

GHG emissions from manufacturing industries and construction are being monitored within the following subcategories (which, correspond to the ISIC Rev. 3.1[32] Registry - International Standard Industrial Classification of all Economic Activities):

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

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

1A2c Chemical Industry (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, ciment) (ISIC Division 26);

1A2g Other (Transport equipment – ISIC Divisions 34 and 35; Machinery – ISIC Divisions 28, 29, 30, 31 and 32; Mining (excluding fuels) and Quarrying – ISIC Divisions 13 and 14; Wood and Wood Products – ISIC Division 20; Construction – ISIC Division 45; Textile and Leather – ISIC Divisions 17, 18 and 19; Non-specified Industry (not included above) – ISIC Divisions 25, 33, 36 and 37).

Between 1990 and 2015, the GHG emissions from category 1A2 "Manufacturing Industries and Construction" tended to decrease by circa 69.8 per cent: from 2,213.82 kt CO_2 equivalent recorded in 1990, to circa 668.29 kt CO_2 equivalent in 2015 (Table 3-31, Figure 3-11).

Table 3-31: GHG Emissions from 1A2 "Manufacturing Industries and Construction" within 1990-2015 periods

	1990	1991	1992	1993	1994	1995	1996	1997	1998
1A2, kt CO_2 equivalent	2 213.8153	1 757.4603	1 016.9115	565.0857	830.3854	465.0111	378.5707	599.1025	560.0565
%, compared to 1990	100	79.4	45.9	25.5	37.5	21.0	17.1	27.1	25.3
	1999	2000	2001	2002	2003	2004	2005	2006	2007
1A2, kt CO_2 equivalent	492.3400	537.9965	619.7443	432.4170	457.2714	471.8730	604.8584	669.4305	832.1733
%, compared to 1990	22.2	24.3	28.0	19.5	20.7	21.3	27.3	30.2	37.6
	2008	2009	2010	2011	2012	2013	2014	2015	%
1A2, kt CO_2 equivalent	916.7788	509.1528	541.0995	601.4892	565.1582	601.6466	587.5527	668.2922	-69.8
%, compared to 1990	41.4	23.0	24.4	27.2	25.5	27.2	26.5	30.2	

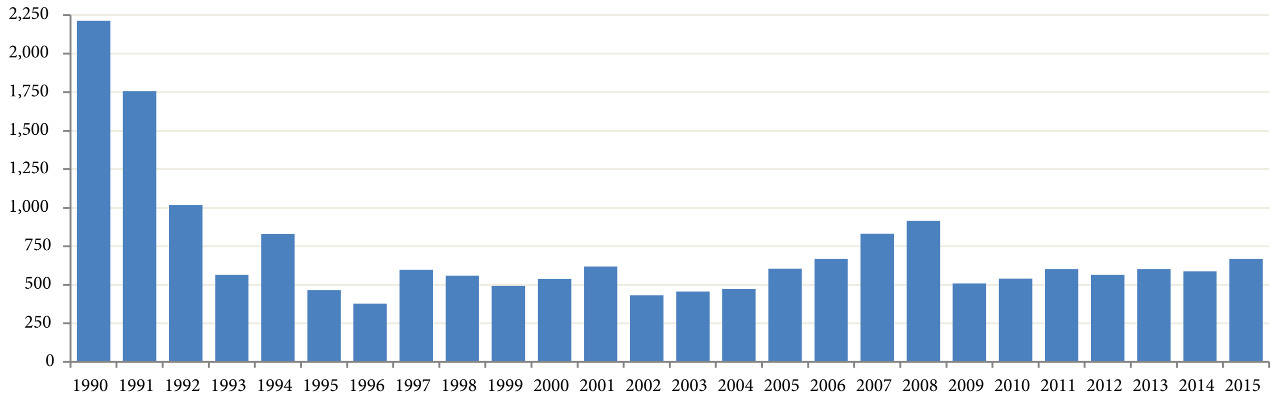


Figure 3-11: Direct GHG Emissions from 1A2 "Manufacturing Industries and Construction" within 1990-2015 periods, kt CO_2 equivalent

Compared to 1990, in 2015, the total direct GHG emissions within the source category 1A2 "Manufacturing Industries and Construction" accounted only for circa 30.2 per cent of emissions registered during the reference year, CO_2 emissions – 30.2 per cent, CH_4 – 41.4 per cent, while N_2O – 32.6 per cent (Table 3-32).

[32] 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 3-32: Direct GHG Emissions from 1A2 "Manufacturing Industries and Construction" within 1990-2015 periods

	1A2, kt CO_2 equivalent				% from the total			in %, compared to 1990			
	CO_2	CH_4	N_2O	Total	CO_2	CH_4	N_2O	CO_2	CH_4	N_2O	Total
1990	2 206.2753	2.4544	5.0856	2 213.8153	99.7	0.1	0.2	100.0	100.0	100.0	100.0
1991	1 751.5621	1.9274	3.9708	1 757.4603	99.7	0.1	0.2	79.4	78.5	78.1	79.4
1992	1 013.7705	1.0293	2.1117	1 016.9115	99.7	0.1	0.2	45.9	41.9	41.5	45.9
1993	563.0714	0.6825	1.3318	565.0857	99.6	0.1	0.2	25.5	27.8	26.2	25.5
1994	828.8950	0.5723	0.9181	830.3854	99.8	0.1	0.1	37.6	23.3	18.1	37.5
1995	463.9562	0.3873	0.6676	465.0111	99.8	0.1	0.1	21.0	15.8	13.1	21.0
1996	377.6208	0.3440	0.6059	378.5707	99.7	0.1	0.2	17.1	14.0	11.9	17.1
1997	597.7916	0.5052	0.8056	599.1025	99.8	0.1	0.1	27.1	20.6	15.8	27.1
1998	559.0312	0.4007	0.6246	560.0565	99.8	0.1	0.1	25.3	16.3	12.3	25.3
1999	491.5201	0.3307	0.4892	492.3400	99.8	0.1	0.1	22.3	13.5	9.6	22.2
2000	537.2463	0.3069	0.4433	537.9965	99.9	0.1	0.1	24.4	12.5	8.7	24.3
2001	618.7855	0.3762	0.5826	619.7443	99.8	0.1	0.1	28.0	15.3	11.5	28.0
2002	431.7808	0.2573	0.3789	432.4170	99.9	0.1	0.1	19.6	10.5	7.4	19.5
2003	456.6402	0.2578	0.3734	457.2714	99.9	0.1	0.1	20.7	10.5	7.3	20.7
2004	471.0767	0.3169	0.4794	471.8730	99.8	0.1	0.1	21.4	12.9	9.4	21.3
2005	603.9661	0.3633	0.5291	604.8584	99.9	0.1	0.1	27.4	14.8	10.4	27.3
2006	668.5271	0.3703	0.5330	669.4305	99.9	0.1	0.1	30.3	15.1	10.5	30.2
2007	831.1775	0.4229	0.5730	832.1733	99.9	0.1	0.1	37.7	17.2	11.3	37.6
2008	914.5002	0.8725	1.4061	916.7788	99.8	0.1	0.2	41.4	35.5	27.6	41.4
2009	507.6894	0.5520	0.9113	509.1528	99.7	0.1	0.2	23.0	22.5	17.9	23.0
2010	539.5862	0.5704	0.9429	541.0995	99.7	0.1	0.2	24.5	23.2	18.5	24.4
2011	599.6756	0.6826	1.1310	601.4892	99.7	0.1	0.2	27.2	27.8	22.2	27.2
2012	563.6377	0.5797	0.9409	565.1582	99.7	0.1	0.2	25.5	23.6	18.5	25.5
2013	599.5639	0.7754	1.3073	601.6466	99.7	0.1	0.2	27.2	31.6	25.7	27.2
2014	585.7254	0.6849	1.1423	587.5527	99.7	0.1	0.2	26.5	27.9	22.5	26.5
2015	665.6173	1.0172	1.6577	668.2922	99.6	0.2	0.2	30.2	41.4	32.6	30.2

Compared to 1990, in 2015, the GHG emissions within the source category 1A2 "Manufacturing Industries and Construction" accounted for: NO_x only circa 32.2 per cent of emissions registered during the reference year, CO – 158.6 per cent, NMVOC – 50.2 per cent, while SO_x – 10.7 per cent (Table 3-33).

Table 3-33: Direct and Indirect GHG Emissions from 1A2 "Manufacturing Industries and Construction" within 1990-2015 periods

	1A2, kt							in %, compared to 1990						
	CO_2	CH_4	N_2O	NO_x	CO	NMVOC	SOx	CO_2	CH_4	N_2O	NO_x	CO	NMVOC	SO_x
1990	2 206.28	0.0982	0.0171	5.9159	1.4020	0.2003	24.18	100.0	100.0	100.0	100.0	100.0	100.0	100.0
1991	1 751.56	0.0771	0.0133	4.6859	0.7688	0.1609	19.23	79.4	78.5	78.1	79.2	54.8	80.3	79.5
1992	1 013.77	0.0412	0.0071	2.6879	0.4219	0.0896	10.94	45.9	41.9	41.5	45.4	30.1	44.8	45.2
1993	563.07	0.0273	0.0045	1.5266	0.5219	0.0587	5.11	25.5	27.8	26.2	25.8	37.2	29.3	21.1
1994	828.89	0.0229	0.0031	2.2333	0.5059	0.0787	1.62	37.6	23.3	18.1	37.8	36.1	39.3	6.7
1995	463.96	0.0155	0.0022	1.2541	0.3118	0.0458	1.18	21.0	15.8	13.1	21.2	22.2	22.9	4.9
1996	377.62	0.0138	0.0020	1.0218	0.2688	0.0383	1.28	17.1	14.0	11.9	17.3	19.2	19.1	5.3
1997	597.79	0.0202	0.0027	1.6209	0.8510	0.0631	1.04	27.1	20.6	15.8	27.4	60.7	31.5	4.3
1998	559.03	0.0160	0.0021	1.5075	0.5420	0.0551	0.96	25.3	16.3	12.3	25.5	38.7	27.5	4.0
1999	491.52	0.0132	0.0016	1.3246	0.5065	0.0485	0.49	22.3	13.5	9.6	22.4	36.1	24.2	2.0
2000	537.25	0.0123	0.0015	1.4419	0.2952	0.0496	0.48	24.4	12.5	8.7	24.4	21.1	24.8	2.0
2001	618.79	0.0150	0.0020	1.6750	0.3269	0.0567	0.63	28.0	15.3	11.5	28.3	23.3	28.3	2.6
2002	431.78	0.0103	0.0013	1.1589	0.2403	0.0403	0.43	19.6	10.5	7.4	19.6	17.1	20.1	1.8
2003	456.64	0.0103	0.0013	1.2246	0.2474	0.0418	0.45	20.7	10.5	7.3	20.7	17.6	20.9	1.9
2004	471.08	0.0127	0.0016	1.2718	0.3512	0.0458	0.62	21.4	12.9	9.4	21.5	25.0	22.9	2.6
2005	603.97	0.0145	0.0018	1.6266	0.3974	0.0569	0.54	27.4	14.8	10.4	27.5	28.3	28.4	2.2
2006	668.53	0.0148	0.0018	1.7956	0.3704	0.0609	0.57	30.3	15.1	10.5	30.4	26.4	30.4	2.3
2007	831.18	0.0169	0.0019	2.2278	0.4592	0.0748	0.38	37.7	17.2	11.3	37.7	32.8	37.4	1.6
2008	914.50	0.0349	0.0047	2.5416	0.7142	0.1050	2.62	41.4	35.5	27.6	43.0	50.9	52.4	10.8
2009	507.69	0.0221	0.0031	1.4245	0.4309	0.0619	1.79	23.0	22.5	17.9	24.1	30.7	30.9	7.4
2010	539.59	0.0228	0.0032	1.5074	0.4630	0.0644	1.73	24.5	23.2	18.5	25.5	33.0	32.2	7.2
2011	599.68	0.0273	0.0038	1.6749	0.5802	0.0746	2.14	27.2	27.8	22.2	28.3	41.4	37.3	8.8
2012	563.64	0.0232	0.0032	1.5729	0.5298	0.0671	1.60	25.5	23.6	18.5	26.6	37.8	33.5	6.6
2013	599.56	0.0310	0.0044	1.6913	0.6181	0.0799	2.62	27.2	31.6	25.7	28.6	44.1	39.9	10.8
2014	585.73	0.0274	0.0038	1.6513	0.5392	0.0740	2.24	26.5	27.9	22.5	27.9	38.5	37.0	9.3
2015	665.62	0.0407	0.0056	1.9040	2.2239	0.1007	2.58	30.2	41.4	32.6	32.2	158.6	50.3	10.7

3.3.2. Methodological Issues, Emissions Factor and Activity Data

GHG emissions originated from the 1A2 "Manufacturing Industries and Construction" was estimated following a Tier 1 methodology (Table 3-34) using default emission factors. To assure the natural conversion from natural measure units to energy units, country specific net calorific values were used see Table 3-9). The value used for carbon oxidation fraction is recommended by 2006 IPCC Guidelines.

Table 3-34: Methods and Coefficients Used for Assessing the Direct GHG Emissions Originated from 1A2 "Manufacturing Industries and Construction" Source 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
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.

Default EF available in the Revised 1996 IPCC Guidelines (IPCC, 1997) were used for estimating non-CO_2[33] emissions (Table 3-35).

Table 3-35: Emission Factors Used for Estimating non-CO_2 Emissions Originated from 1A2 "Manufacturing Industries and Construction", kg/TJ

	CO_2	CH_4	N_2O	NO_x	CO	NMVOC
Fuel wood and wood waste	112 000	30	4	100	2 000	50
Other types of solid biomass	100 000	30	4	100	4 000	50
Charcoal	112 000	200	4	100	4 000	100
Aviation Gasoline	70 000	3	0.6	200	10	5
Gasoline	69 300	3	0.6	200	10	5
Fuel for jet engines	71 500	3	0.6	200	10	5
Other fuel types	71 900	3	0.6	200	10	5
LPG	64 200	3	0.6	200	10	5
Diesel	74 100	3	0.6	200	10	5
Residual Fuel Oil	77 400	3	0.6	200	10	5
Other petroleum products	73 300	3	0.6	200	10	5
Natural Gas	56 100	1	0.1	150	30	5
Anthracite	98 300	10	1.5	300	150	20
Other bituminous coal	94 600	10	1.5	300	150	20
Brown Coal (lignite)	101 000	10	1.5	300	150	20
Brown Coal Briquettes	97 500	10	1.5	300	150	20
Coke	107 000	10	1.5	300	150	20

Source: NO_x, CO and NMVOC – Revised 1996 IPCC Guidelines, Volume 3, Tables 1-9, 1-10 and 1-11, pages 1.37-1.42; CH_4, N_2O – 2006 IPCC Guidelines, Volume 2, Chapter 2, Table 2.3, pages 2.18 – 2.19.

The AD related to fuel consumption with energy purposes within the 1A2 "Manufacturing Industries and Construction" were collected from the Energy Balances for 1990, 1993-2015, as well as from the Statistical Yearbooks of the ATULBD (Table 3-36).

Table 3-36: Fuel Consumption with Energy Purposes within the 1A2 "Manufacturing Industries and Construction" within 1990-2015 on the Left Bank of Dniester River

	Bituminous Coal	Residual Fuel Oil	Natural Gas	LPG	Bituminous Coal	Residual Fuel Oil	Natural Gas	LPG
	kt	kt	mill. m^3	kt	TJ	TJ	TJ	TJ
1994			275.1				9 314.89	
1995			71.7				2 428.44	
1996			52.1				1 764.44	
1997			151.5				5 129.79	
1998			146.5				4 960.49	
1999			136.1				4 608.35	
2000			143.9				4 872.45	
2001			174.5				5 908.57	
2002			73.2				2 478.55	
2003			79.0				2 674.94	
2004			71.9				2 434.53	
2005			102.5				3 470.65	
2006			133.9				4 533.85	
2007			232.6				7 875.84	
2008	0.0734	0.8716	250.2		1.87	35.04	8 471.77	
2009	0.1480	0.5705	121.9		3.77	22.93	4 127.53	

[33] The methodology used to estimate SO_2 emissions is described in Annex 3-1.1 of this Report.

	Bituminous Coal	Residual Fuel Oil	Natural Gas	LPG	Bituminous Coal	Residual Fuel Oil	Natural Gas	LPG
	kt	kt	mill. m³	kt	TJ	TJ	TJ	TJ
2010	0.1108	0.3208	113.5		2.82	12.90	3 843.11	
2011	0.1102	0.3089	123.0	0.0570	2.80	12.42	4 164.78	2.63
2012	0.0840	0.2581	134.9	0.0346	2.14	10.38	4 567.71	1.59
2013	0.0324	0.3713	110.8	0.0291	0.82	14.93	3 751.69	1.34
2014	0.0772	0.3713	129.7	0.0249	1.96	14.93	4 391.64	1.15
2015	0.0641	0.3713	108.0	0.0204	1.63	14.93	3 656.88	0.94

Source: for natural gas – JSC "Moldovagaz" through Official Letter No. 07-730 dated 6.6.2007, answer to Letter No. 47/21-103 dated 31.05.2007; Official Letter No. 02/1-476 dated 23.02.2011, answer to Letter No. 03-07/175 dated 02.02.2011; Official Letter No. 02/1-288 dated 22.01.2014, answer to Letter No. 320/2014-01-01 dated 03.01.2014; Official Letter No. 02/1-507 dated 10.02.2015, answer to Letter No. 407/2015-01-09 dated 29.01.2015; Official Letter No. 02/1-2183 dated 03.06.2016, answer to Letter No.512/2016-05-01 dated 10.05.2016; for residual fuel oil, coal and LPG – Socio-economic development of the TMR for 2009-2015 and Press Release "The State of housing and communal services of the Republic for 2011-2015".

For 1993-2015 time series gasoline and diesel oil consumption in the ATULBD was included (estimated indirectly from specific fuel consumption per head on the Right Bank of Dniester River) (Table 3-37). For 1990-1992, AD on fuel consumption within this category are available for the entire country.

Table 3-37: Diesel and Gasoline Consumption within the 1A2 "Manufacturing Industries and Construction" on the Left Bank of Dniester River, 1990-2015, TJ

	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
Diesel oil	155.52	150.30	163.05	114.26	102.39	64.58	37.24	36.78	36.23	35.80	35.34	44.11
Gasoline	6.36	5.57	0.00	5.39	5.33	5.31	0.00	0.00	0.00	0.00	0.00	2.46
	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	%
Diesel oil	48.97	55.12	48.86	47.84	31.78	39.39	38.93	41.65	44.42	37.15	27.66	-82.2
Gasoline	3.50	2.71	3.13	2.95	1.90	1.74	2.31	1.29	0.00	1.55	1.87	-70.6

AD on total fuel consumption within the 1A2 "Manufacturing Industries and Construction" are presented in Table 3-38.

Table 3-38: Total Fuel Consumption with Energy Purposes within the 1A2 "Manufacturing Industries and Construction" within 1990-2015 periods, TJ

	1990	1991	1992	1993	1994	1995	1996	1997	1998
Engine fuel	0	0	0	27	0	0	0	0	0
Other types of fuel	0	0	0	0	0	0	0	117	59
Wood Waste	176	0	0	67	29	0	0	0	0
Fuel Wood	135	0	0	65	0	29	29	29	0
LPG	92	0	0	15	0	0	0	0	0
Natural Gas	8 871	6 907	5 011	3 131	11 603	5 509	4 111	8 416	8 159
Kerosene	647	0	0	197	29	0	0	0	29
Gasoline	568	354	0	39	35	0	34	34	34
Aviation Gasoline	0	0	0	3	0	0	0	0	0
Fuel for Jet Engines	298	0	0	27	0	0	0	0	0
Residual Fuel Oil	14 070	10 492	6 251	2 644	558	323	411	294	323
Coking Coal	468	0	0	62	59	29	88	117	59
Diesel Oil	3 446	3 191	1 489	963	932	1 025	729	659	418
Coke	1 030	1 717	1 294	487	323	381	411	352	264
Bituminous Coal	0	0	0	200	206	117	59	29	29
Lignite	12	12	0	41	29	0	0	0	0
Anthracite	1 079	1 079	0	100	0	0	29	29	58
	1999	2000	2001	2002	2003	2004	2005	2006	2007
Other types of fuel	59	0	0	0	0	0	0	0	0
Wood Waste	0	0	0	0	0	39	26	1	5
Fuel Wood	0	0	0	0	0	9	11	7	6
LPG	0	0	557	0	29	17	20	30	22
Natural Gas	7 688	8 511	9 224	6 703	7 218	7 193	9 596	10 676	13 888
Other Petroleum Products	0	0	0	0	0	4	9	12	0
Kerosene	0	0	0	0	0	5	10	0	0
Gasoline	0	0	0	0	0	19	27	21	24
Residual Fuel Oil	117	117	146	88	147	203	164	197	139
Coking Coal	117	117	117	88	29	29	25	15	7
Diesel Oil	242	242	241	241	240	331	371	421	377
Coke	205	176	235	205	147	58	8	11	11
Bituminous Coal	0	29	0	0	0	29	18	13	8
Anthracite	29	29	29	29	29	135	169	157	80

	2008	2009	2010	2011	2012	2013	2014	2015	%
Biogas	0	0	0	0	0	0	0	387	
Pelllets and Briquettes from Vegetable Waste	0	0	0	0	0	0	0	62	
Agricultural Fuel Residues	0	0	0	5	2	10	0	345	
Wood Waste	14	10	16	25	36	5	16	11	-93.8
Fuel Wood	7	4	11	17	17	20	13	33	-75.5
LPG	40	25	115	68	63	18	83	16	-82.7
Natural Gas	12 016	6 093	6 536	6 997	7 255	6 197	6 668	8 138	-8.3
Other Petroleum Products	0	0	0	0	0	0	0	18	
Kerosene	0	0	1	0	0	0	0	0	-100.0
Gasoline	23	15	14	18	10	0	13	16	-97.2
Residual Fuel Oil	181	88	81	90	53	35	80	330	-97.7
Coking Coal	16	7	26	4	2	0	0	0	-100.0
Diesel Oil	372	249	310	309	333	357	301	235	-93.2
Coke	9	63	126	7	30	4	52	1	-99.9
Bituminous Coal	1 801	1 286	988	3	1 105	6	1 258	1 659	
Anthracite	226	93	269	1 733	155	2 244	533	58	-94.6

Source: Energy Balances of the RM for 1990, 1993-2015; Socio-economic development of the TMR for 2009-2015; Press Release "The State of housing and communal services of the Republic for 2011-2015".

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 source 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", 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 subcategory included in 1A2 "Manufacturing Industries and Construction" complies with the requirements set out in the description of each subcategory in the 2006 IPCC Guidelines (in the current inventory cycle, GHG emissions were calculated separately for 12 industrial subcategories for each subcategory, AD are available in separate files in energy units; GHG emissions were originally calculated for each subcategory but the statistical evidence of fuel consumption within each subcategory revealed uneven and fragmented trends associated with the consumption of certain limited types of fuels during the period under review; based on this, it was decided to present aggregated GHG emissions at the source category level); verifying the correctness of EFs use for each subcategory; verifying if the primary reference sources are correctly indicated; the accuracy of calculations for subcategories included in 1A2 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 calculations files the EFs are specified in tabular formats for each subcategory, the import of the respective values into calculation formulas is ensured by automatic connections;
- the consistency of the calculations is also ensured by verifying the correctness of applying conversion factors of natural units to energy units for all subcategories and the entire range of years covered by the inventory;
- verification if the same method is used for the entire range of years covered by the inventory;
- verifying if GHG emissions calculations have been made for all years and for all types of fuels mentioned in the Energy Balances of the RM 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, etc.

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". The main causes of these recalculations are, as follows: in order to estimate GHG emissions were used AD expressed in energy units (TJ) and not in natural units (kt or thousand m^3); GHG emissions from oil and lubricants consumption, previously included in source category 1A2 were transferred to 2D1 within the current inventory cycle; the value of EF associated with coke consumption for 1991 and 1992 was corrected, previously the value of the respective factor was indicated mistakenly in the calculation files; within this category sources a number of new fuels have been recorded for the first time, including due to discrepances identified in the Energy Balances of the RM associated with fuel consumption presented in natural units and energy units (for example, in the Energy Balances for 1998-2001), wood consumption is presented as null in TJ, while in natural units there are values for this type of fuel; in the Energy Balances for 2011, coke consumption, coking coal and gasoline are presented as null in natural units, while in TJ there are values for these types of fuel; in the Energy Balances for 2013, coke consumption is presented as null in natural units, while in TJ there are values for this type of fuel; in the Energy Balances for 2014, gasoline consumption is presented as null in natural units, while in TJ there are values for this type of fuel); to be noted that previously the consumption of certain fuel types were considered insignificant withount being accounted for in the national inventory, whereas with the use of data on fuel consumption in energy units information on insignificant consumption of new fuels within the respective category became available; also, in order to convert direct GHG emissions in CO_2 equivalent, in the current inventory cycle, the 100-year Global Warming Potential (GWP_{100}) values available in the Fourth IPCC Assessment Report (AR4) (CH_4 – 25 and N_2O – 298), were used in the detriment of GWP_{100} values in the Second IPCC Assessment Report (SAR) (CH_4 – 21 and N_2O – 310).

In comparison with the results included into the First Biennial Report of the RM under the UNFCCC, the performed recalculations resulted in a small increase of direct GHG emissions in 1990-1998, 2000-2010 and 2012, respectively an insignificant decrease in 1999, 2011 and 2013 (Table 3-39). For the 2014-2015 periods, the respective emissions were estimated for the first time. The results allow assert that between 1990 and 2015, GHG emissions from 1A2 "Manufacturing Industries and Construction" source category decreased by 69.8 per cent.

Table 3-39: Comparative Results of GHG Emissions from 1A2 "Manufacturing Industries and Construction" included into the BUR1 and the NC4 of the RM under the UNFCCC, kt CO_2 equivalent

	1990	1991	1992	1993	1994	1995	1996	1997	1998
BUR1	2 195.8930	1 690.8854	965.3383	541.7823	809.2528	453.0153	360.9377	587.4922	538.3181
NC4	2 213.8153	1 757.4603	1 016.9115	565.0857	830.3854	465.0111	378.5707	599.1025	560.0565
Difference, %	0.8	3.9	5.3	4.3	2.6	2.6	4.9	2.0	4.0
	1999	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**
BUR1	496.0956	531.7701	617.8880	424.1633	451.5848	456.5067	591.8781	651.7256	817.8938
NC4	492.3400	537.9965	619.7443	432.4170	457.2714	471.8730	604.8584	669.4305	832.1733
Difference, %	-0.8	1.2	0.3	1.9	1.3	3.4	2.2	2.7	1.7
	2008	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**%**
BUR1	913.0712	508.5564	540.7465	606.0959	563.2148	609.7587			
NC4	916.7788	509.1528	541.0995	601.4892	565.1582	601.6466	587.5527	668.2922	-69.8
Difference, %	0.4	0.1	0.1	-0.8	0.3	-1.3			

Abbreviations: NC4 – Fourth National Communication; BUR1 – First Biennial Update Report.

3.3.6. Planned Improvements

Potential improvements within the 1A2 "Manufacturing Industries and Construction" could be possible once updated AD regarding the fuel consumption with energy purposes for ATULBD are available (filling the gaps for certain years). Another possible improvement could be using real reported caloric values for natural gas imported annually in the Republic of Moldova, based on the information provided by J.S.C. "Moldovagaz".

3.4. Transport (Category 1A3)

3.4.1. Source Category Description

The 1A3 'Transport' category includes greenhouse gases generated by the following sources: 1A3a 'Domestic Aviation', 1A3b 'Road Transportation', 1A3c 'Railways', 1A3d 'Domestic Navigation' and 1A3e 'Other Transportation' (pipeline transportation and other transportation, including off-road).

Total GHG emissions from source category 1A3 'Transport' recorded a decreasing trend between 1990 and 2015, from 4,481.76 kt CO_2 equivalent, to 2,202.98 kt CO_2 equivalent (Table 3-40).

Table 3-40: GHG Emissions from 1A3 'Transport' Category within 1990-2015 periods

	1990	1991	1992	1993	1994	1995	1996	1997	1998
1A3, kt CO_2 equivalent	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
%, compared to 1990	100.0	101.9	49.4	39.7	34.1	34.0	33.3	33.7	29.2
	1999	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**
1A3, kt CO_2 equivalent	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
%, compared to 1990	19.5	21.2	22.6	28.9	33.8	38.1	39.4	37.9	40.3
	2008	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**%**
1A3, kt CO_2 equivalent	1 896.0664	1 853.8302	2 053.6866	2 164.2599	1 905.5612	2 015.0035	2 090.2898	2 202.9754	-50.8
%, compared to 1990	42.3	41.4	45.8	48.3	42.5	45.0	46.6	49.2	

Compared to 1990, in 2015, the GHG emissions within the source category 1A3 'Transport' accounted for: CO_2 only circa 49.7 per cent of emissions registered during the reference year, CH_4 – 30.2 per cent, N_2O – 34.0 per cent, NO_x – 50.8 per cent, CO – 30.1 per cent, NMVOC – 30.3 per cent, while SO_x – 65.8 per cent (Table 3-41).

Table 3-41: GHG Emissions from 1A3 'Transport' Category within 1990-2015 periods

	1A3, kt							in %, compared to1990						
	CO_2	CH_4	N_2O	NO_x	CO	NMVOC	SO_x	CO_2	CH_4	N_2O	NO_x	CO	NMVOC	SO_x
1990	4 346.03	1.31	0.35	43.35	299.71	56.45	5.11	100.0	100.0	100.0	100.0	100.0	100.0	100.0
1991	4 435.32	1.19	0.34	44.71	282.83	53.38	5.61	102.1	90.9	99.5	103.1	94.4	94.6	110.0
1992	2 142.40	0.57	0.19	21.92	134.44	25.37	2.70	49.3	43.5	55.7	50.6	44.9	44.9	52.9
1993	1 699.79	0.46	0.22	16.54	103.25	19.47	2.20	39.1	35.3	63.8	38.2	34.5	34.5	43.0
1994	1 485.68	0.42	0.11	14.31	96.59	18.20	1.72	34.2	31.9	30.4	33.0	32.2	32.2	33.6
1995	1 482.09	0.43	0.10	14.12	100.42	18.92	1.67	34.1	32.8	29.3	32.6	33.5	33.5	32.7
1996	1 451.65	0.41	0.10	13.58	95.35	17.96	1.59	33.4	31.6	28.1	31.3	31.8	31.8	31.2
1997	1 469.77	0.46	0.10	14.03	108.15	20.36	1.63	33.8	35.0	27.9	32.4	36.1	36.1	31.9
1998	1 273.62	0.39	0.08	12.09	92.01	17.33	1.42	29.3	29.9	23.2	27.9	30.7	30.7	27.8
1999	854.36	0.23	0.05	8.04	54.83	10.34	1.00	19.7	17.9	14.6	18.5	18.3	18.3	19.6
2000	926.21	0.24	0.06	8.97	55.66	10.51	1.18	21.3	18.2	16.2	20.7	18.6	18.6	23.1
2001	989.36	0.25	0.06	9.77	59.32	11.20	1.29	22.8	19.3	17.6	22.5	19.8	19.8	25.3
2002	1 261.70	0.32	0.09	12.52	76.61	14.47	1.62	29.0	24.8	25.8	28.9	25.6	25.6	31.7
2003	1 477.19	0.38	0.09	14.50	90.85	17.15	1.92	34.0	29.2	25.2	33.4	30.3	30.4	37.5

	1A3, kt							in %, compared to1990						
	CO_2	CH_4	N_2O	NO_x	CO	NMVOC	SO_x	CO_2	CH_4	N_2O	NO_x	CO	NMVOC	SO_x
2004	1 668.73	0.41	0.10	16.43	97.76	18.47	2.19	38.4	31.4	29.4	37.9	32.6	32.7	43.0
2005	1 723.99	0.42	0.11	17.11	100.59	19.01	2.28	39.7	32.3	32.4	39.5	33.6	33.7	44.6
2006	1 651.90	0.39	0.12	16.81	93.44	17.67	2.28	38.0	29.9	33.8	38.8	31.2	31.3	44.6
2007	1 757.80	0.41	0.12	17.98	96.86	18.33	2.46	40.4	31.1	35.1	41.5	32.3	32.5	48.3
2008	1 848.76	0.42	0.12	18.86	101.03	19.12	2.62	42.5	32.3	35.6	43.5	33.7	33.9	51.3
2009	1 807.33	0.43	0.12	18.31	100.37	18.98	2.52	41.6	33.0	34.7	42.2	33.5	33.6	49.3
2010	2 007.44	0.44	0.12	20.42	100.26	18.99	2.95	46.2	33.4	34.3	47.1	33.5	33.6	57.8
2011	2 116.70	0.44	0.12	21.54	104.18	19.76	3.13	48.7	33.6	35.5	49.7	34.8	35.0	61.4
2012	1 862.86	0.37	0.11	19.05	87.99	16.70	2.81	42.9	28.6	32.4	43.9	29.4	29.6	55.1
2013	1 972.46	0.37	0.11	20.12	86.16	16.37	3.03	45.4	28.6	32.2	46.4	28.7	29.0	59.4
2014	2 049.61	0.37	0.11	20.78	86.96	16.53	3.18	47.2	28.7	30.4	47.9	29.0	29.3	62.2
2015	2 158.12	0.39	0.12	22.00	90.09	17.13	3.36	49.7	30.2	34.0	50.8	30.1	30.3	65.8

Compared to the reference year (1990), by 2015 the share of CO_2 emissions in the total sectoral GHG emissions increased from 97.0 to 98.0 per cent, the share of CH_4 emissions decreased from 0.7 to 0.4 per cent, while the share of N_2O emissions decreased from 2.3 to 1.6 per cent (Table 3-42).

Table 3-42: Total Direct GHG Emissions from 1A3 'Transport' Category within 1990-2015 periods

	1A3, kt CO_2 equivalent				% from the total		
	CO_2	CH_4	N_2O	Total	CO_2	CH_4	N_2O
1990	4 346.0289	32.6324	103.1032	4 481.7645	97.0	0.7	2.3
1991	4 435.3173	29.6577	102.6323	4 567.6074	97.1	0.6	2.2
1992	2 142.4037	14.2055	57.4796	2 214.0887	96.8	0.6	2.6
1993	1 699.7939	11.5341	65.8268	1 777.1549	95.6	0.6	3.7
1994	1 485.6786	10.4212	31.3512	1 527.4509	97.3	0.7	2.1
1995	1 482.0856	10.6891	30.1708	1 522.9456	97.3	0.7	2.0
1996	1 451.6525	10.3124	28.9638	1 490.9287	97.4	0.7	1.9
1997	1 469.7744	11.4066	28.7902	1 509.9711	97.3	0.8	1.9
1998	1 273.6172	9.7440	23.9388	1 307.3000	97.4	0.7	1.8
1999	854.3647	5.8532	15.0693	875.2873	97.6	0.7	1.7
2000	926.2051	5.9241	16.7172	948.8464	97.6	0.6	1.8
2001	989.3629	6.2887	18.1976	1 013.8491	97.6	0.6	1.8
2002	1 261.6952	8.1078	26.5949	1 296.3979	97.3	0.6	2.1
2003	1 477.1916	9.5268	26.0088	1 512.7271	97.7	0.6	1.7
2004	1 668.7316	10.2351	30.3077	1 709.2744	97.6	0.6	1.8
2005	1 723.9901	10.5545	33.4283	1 767.9729	97.5	0.6	1.9
2006	1 651.9002	9.7414	34.8018	1 696.4435	97.4	0.6	2.1
2007	1 757.8033	10.1642	36.2225	1 804.1901	97.4	0.6	2.0
2008	1 848.7566	10.5535	36.7563	1 896.0664	97.5	0.6	1.9
2009	1 807.3330	10.7543	35.7429	1 853.8302	97.5	0.6	1.9
2010	2 007.4377	10.8858	35.3630	2 053.6866	97.7	0.5	1.7
2011	2 116.7005	10.9596	36.5998	2 164.2599	97.8	0.5	1.7
2012	1 862.8628	9.3348	33.3636	1 905.5612	97.8	0.5	1.8
2013	1 972.4617	9.3392	33.2027	2 015.0035	97.9	0.5	1.6
2014	2 049.6073	9.3704	31.3121	2 090.2898	98.1	0.4	1.5
2015	2 158.1164	9.8514	35.0077	2 202.9754	98.0	0.4	1.6

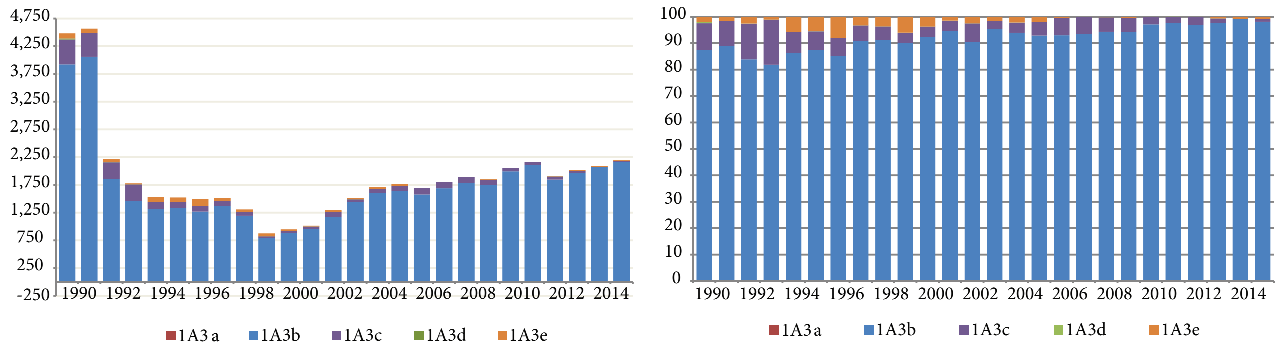


Figure 3-12: Direct GHG Emissions from 1A3 'Transport' Category within 1990-2015 periods, kt CO_2 equivalent

The largest share in the structure of total direct GHG emissions within this source category between 1990 and 2015 is represented by 1A3b "Road Transportation", with a share varying from 81.8 to 99.0 per cent of the total, followed by 1A3c "Railways", with a share varying from 0.1 and 17.1 per cent of the total, respectively by 1A3e "Other Transportation" – from 0.1 and 8.0 per cent of the total (Table 3-43).

Table 3-43: Breakdown of Direct GHG Emissions from 1A3 "Transport", by Sources, within 1990-2015 periods

	1A3, kt CO_2 equivalent						% from the total					in %, compared to 1990				
	1A3a	1A3b	1A3c	1A3d	1A3e	1A3	1A3a	1A3b	1A3c	1A3d	1A3e	1A3a	1A3b	1A3c	1A3d	1A3e
1990	6.1	3 914.8	450.5	19.1	91.3	4 481.8	0.1	87.3	10.1	0.4	2.0	100.0	100.0	100.0	100.0	100.0
1991	0.0	4 060.1	431.2	0.2	76.1	4 567.6	0.0	88.9	9.4	0.0	1.7	0.0	103.7	95.7	1.3	83.3
1992	0.0	1 856.8	300.1	0.2	57.0	2 214.1	0.0	83.9	13.6	0.0	2.6	0.0	47.4	66.6	1.1	62.5
1993	0.8	1 453.7	303.7	0.2	18.6	1 777.2	0.0	81.8	17.1	0.0	1.0	13.7	37.1	67.4	1.3	20.4
1994	0.0	1 318.4	121.5	0.2	87.3	1 527.5	0.0	86.3	8.0	0.0	5.7	0.0	33.7	27.0	1.0	95.7
1995	0.0	1 331.9	106.8	0.2	84.0	1 522.9	0.0	87.5	7.0	0.0	5.5	0.0	34.0	23.7	1.0	92.0
1996	0.0	1 268.5	103.6	0.2	118.6	1 490.9	0.0	85.1	6.9	0.0	8.0	0.0	32.4	23.0	1.0	129.9
1997	0.0	1 371.2	89.1	0.2	49.4	1 510.0	0.0	90.8	5.9	0.0	3.3	0.0	35.0	19.8	1.1	54.1
1998	0.0	1 193.3	66.1	0.1	47.8	1 307.3	0.0	91.3	5.1	0.0	3.7	0.0	30.5	14.7	0.7	52.4
1999	0.0	787.9	34.4	0.2	52.7	875.3	0.0	90.0	3.9	0.0	6.0	0.0	20.1	7.6	1.2	57.8
2000	0.0	876.3	37.2	0.1	35.3	948.8	0.0	92.4	3.9	0.0	3.7	0.0	22.4	8.3	0.5	38.6
2001	0.1	958.8	39.9	0.2	14.8	1 013.8	0.0	94.6	3.9	0.0	1.5	1.6	24.5	8.9	0.9	16.2
2002	0.1	1 172.6	91.0	0.4	32.3	1 296.4	0.0	90.5	7.0	0.0	2.5	1.4	30.0	20.2	2.2	35.4
2003	0.6	1 440.4	48.3	0.4	23.0	1 512.7	0.0	95.2	3.2	0.0	1.5	10.5	36.8	10.7	2.0	25.2
2004	0.4	1 605.4	65.9	0.4	37.2	1 709.3	0.0	93.9	3.9	0.0	2.2	6.6	41.0	14.6	2.0	40.8
2005	0.1	1 642.3	90.1	0.3	35.2	1 768.0	0.0	92.9	5.1	0.0	2.0	1.8	42.0	20.0	1.7	38.6
2006	0.2	1 577.1	112.3	0.3	6.6	1 696.4	0.0	93.0	6.6	0.0	0.4	3.2	40.3	24.9	1.4	7.2
2007	0.1	1 688.0	112.7	0.3	3.0	1 804.2	0.0	93.6	6.2	0.0	0.2	2.0	43.1	25.0	1.7	3.3
2008	0.1	1 788.1	103.4	0.3	4.0	1 896.1	0.0	94.3	5.5	0.0	0.2	2.4	45.7	23.0	1.8	4.4
2009	0.1	1 747.2	96.8	0.3	9.5	1 853.8	0.0	94.2	5.2	0.0	0.5	1.2	44.6	21.5	1.4	10.4
2010	0.1	1 993.9	57.3	0.2	2.1	2 053.7	0.0	97.1	2.8	0.0	0.1	1.9	50.9	12.7	1.2	2.3
2011	0.1	2 111.2	52.7	0.2	0.0	2 164.3	0.0	97.5	2.4	0.0	0.0	1.9	53.9	11.7	1.3	0.0
2012	0.2	1 845.1	56.6	0.3	3.3	1 905.6	0.0	96.8	3.0	0.0	0.2	3.3	47.1	12.6	1.4	3.6
2013	0.2	1 965.7	36.2	0.3	12.6	2 015.0	0.0	97.6	1.8	0.0	0.6	3.2	50.2	8.0	1.4	13.8
2014	0.1	2 070.4	3.0	0.3	16.5	2 090.3	0.0	99.0	0.1	0.0	0.8	1.9	52.9	0.7	1.8	18.0
2015	0.3	2 161.7	24.2	0.1	16.7	2 203.0	0.0	98.1	1.1	0.0	0.8	5.0	55.2	5.4	0.6	18.3

3.4.2. Methodological Issues, Emission Factors and Activity Data

GHG emissions from 1A3 "Transport" were estimated following a Tier 1 methodological approach, based on activity data on fuel consumption and default values of emission factors (Table 3-44). To assure the natural conversion from natural units to energy units (TJ), country specific net calorific values were used.

Table 3-44: Emission Factors Used for Estimating GHG Emissions from 1A3 "Transport", kg/TJ

Category	Fuel Type	CO_2	CH_4	N_2O	NOx	CO	NMVOC	Sources of reference for: CO_2, CH_4, N_2O	Sources of reference for: NOx, CO and NMVOC
1A3a	Kerosene	71500	0.5	2	300	100	50	2006 IPCC Guidelines, Volume 2, Chapter 3, CO_2 – Table 3.6.4, page 3.64, CH_4 and N_2O – Table 3.6.5, page 3.64	Revised 1996 IPCC Guidelines, Volume 3; NOx - Table 1.9, page 1.38, CO - Table 1.10, page 1.40, NMVOC - Table 1.11, page 1.42; 2006 IPCC Guidelines, Volume 2, Chapter 3, NOx – Table 3.6.5, page 3.64
	Aviation Gasoline	70000	0.5	2	250	100	50		
1A3b	Gasoline	69300	33	3.2	600	8000	1500	2006 IPCC Guidelines, Volume 2, Chapter 3, CO_2 – Table 3.2.1, page 3.16; CH_4 and N_2O – Table 3.2.2, page 3.21, Table 3.2.3, page 3.22, Table 3.2.4, page 3.23, Table 3.2.5, page 3.24	Revised 1996 IPCC Guidelines, Volume 3; NOx - Table 1.9, page 1.38, CO - Table 1.10, page 1.40, NMVOC - Table 1.11, page 1.42
	Diesel Oil	74100	3.9	3.9	800	1000	200		
	Natural Gas	56100	92	3	600	400	5		
	LPG	63100	33	3.2	600	8000	1500		
	Kerosene	71900	3.9	3.9	800	1000	200		
	Other Petroleum Products	74100	3.9	3.9	800	1000	200		
1A3c	Diesel Oil	74100	4.15	28.6	1200	1000	200	2006 IPCC Guidelines, Volume 2, Chapter 3, CO_2, CH_4 and N_2O – Table 3.4.1, page 3.43	Revised 1996 IPCC Guidelines, Volume 3; NOx - Table 1.9, page 1.38, CO - Table.1.10, page 1.40, NMVOC - Table 1.11, page 1.42
1A3d	Diesel Oil	74100	7	2	1500	1000	200	2006 IPCC Guidelines, Volume 2, Chapter 3, CO_2 – Table 3.5.2, page 3.50, CH_4 and N_2O – Table 3.5.3, page 3.50	Revised 1996 IPCC Guidelines, Volume 3; NOx - Table 1.9, page 1.38, CO - Table.1.10, page 1.40, NMVOC - Table.1.11, page 1.42
1A3e	Natural Gas	56100	1	0.1	150	20	5	2006 IPCC Guidelines, Volume 2, Chapter 3, CO_2 – Table 3.2.1, page 3.16; CH_4 and N_2O – Table 3.2.2, page 3.21, Table 3.2.3, page 3.22, Table 3.2.4, page 3.23, Table 3.2.5, page 3.24	Revised 1996 IPCC Guidelines, Volume 3; NOx - Table 1.9, page 1.38, CO - Table 1.10, page 1.40, NMVOC - Table 1.11, page 1.42
	Diesel Oil	74100	4.15	28.6	50	16	7.3		
	Gasoline	69300	33	3.2	600	8000	1500		
	Kerosene	71900	3.9	3.9	800	1000	200		
	LPG	63100	33	3.2	600	8000	1500		

The main source of information related to fuel consumption in the transport sector for the Right Bank of Dniester River is the Energy Balances of the Republic of Moldova. As for naval and air transport, additional AD provided through Official Letters by the Ministry of Transport and Road Infrastructure, the State Enterprise "Moldovan Railways", respectively by the Civil Aeronautical Authority of the RM are used. For the Left Bank of the Dniester territory, there are available 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 area. The information on fuel consumption within 1993-2015 periods is available in the Energy Balances of the RM in energy units (TJ). For 1990-1992, available data in natural units was converted to energy units. For the Left Bank of the Dniester territory, the main reference sources are the information provided by J.S.C. "Moldovagaz", as well as the statistical compilations "The State of housing and communal services of the TMR" (generated only for 2011-2014 time series) (Table 3-45).

Table 3-45: Fuel Consumption on the Left Bank of Dniester River for the Transport Sector (Source Category 1A3), TJ

	Fuel	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
1A3b	Natural Gas							139	234	61	74	176	163	169
1A4c*	Diesel Oil (K1)	366	328	226	190	139	125	166	350	397	437	496	484	459
1A3b	0.1* K1	37	33	23	19	14	13	17	35	40	44	50	48	46

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).

While undertaking recalculations due to converting in TJ units, the caloric values accepted in the current inventory cycle were used. 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 1993-2015 time series – 10 to 90 per cent). Fuel consumed on roads of national importance was considered in the assessment of GHG emissions from 1A3 source category, while fuel consumed by transport units on agricultural fields was considered in the assessment of GHG emissions from 1A4c source category. Regarding the consumption of certain types of fuels unusual to the transport sector (anthracite, bituminous coal, lignite, residual fuel oil), despite the allocation of these consumptions in the Energy Balances of the RM to the transport sector, the national inventory team redistributed them to sector 1A4a, since these fuels are used for the stationary combustion and not for mobile combustion (Table 3-46).

Table 3-46: Fuel Consumption Redistributed from 1A3 to 1A4a, TJ

	1990	1993	1994	1995	1996	1997	1998	2005	2007	2008	2010	2011	2012
Residual Fuel Oil		300	88	59	29	29	59				4	5	8
Anthracite					59	59		1	1	2	2		
Bituminous Coal	146.5	103	29	29									8
Lignite				59	29	59							

Source: Energy Balances of the RM for 1990, 1993-2015.

To be noted that the consumption of lubricants and greases in accordance with the assessment methods available in the 2006 IPCC Guidelines was excluded from the Energy Sector, being considered in the current inventory cycle in the "Industrial Processes and Product Use" Sector.

1A3a Domestic Aviation

Domestic aviation in the Republic of Moldova performs annually a small number of flights, with an increasing trend in activity – from 8 (2001) to 3609 (2014) flights, while in 2015, 1543 flights were performed. Respectively, there is an increase in fuel consumption, although it remains low. Primary data on the use of fuel in domestic air transport were provided by the Civil Aviation Administration of the RM (subsequently renamed the Civil Aeronautical Authority of the RM). The data presented in Table 3-47 were recalculated in energy units (TJ) based on country specific caloric values.

Table 3-47: AD Used to Estimate GHG Emissions from 1A3a "Domestic Aviation" in the RM within 2001-2015

	2001	2002	2003	2004	2005	2006	2007	2008
Aviation Gasoline, kt	0.0321	0.0278	0.2146	0.1352	0.0369	0.0645	0.0411	0.0496
Aviation Gasoline, TJ (NCV = 43.13 TJ/kt)	1.385	1.199	9.255	5.831	1.591	2.783	1.774	2.138
	2009	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**%**
Aviation Gasoline, kt	0.0249	0.0383	0.0395	0.0676	0.0643	0.0390	0.1019	317
Aviation Gasoline, TJ (NCV=43.13 TJ/kt)	1.072	1.650	1.704	2.916	2.773	1.682	4.393	

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.

1A3b Road Transportation

The park of auto transport units in the RM is growing. The largest share in the total structure is represented by cars (Table 3-48). Activity data pertaining to fuel consumption (for 1993-2015 time series data is available in energy units – TJ) within Road Transportation Sector were collected from the Energy Balances of the RM for the Right Bank of Dniester River. In the absence of complete information on fuel consumption on the Left Bank of Dniester River (1993-2015), AD associated with diesel oil and gasoline consumption were calculated indirectly on specific consumption per capita (it was determined the diesel oil and gasoline consumption per capita for the population on the Right Bank of Dniester River, and this was extended to the population on the Left Bank of Dniester River).

Table 3-48: The Structure of Vehicle Units Fleet in the RM, as of 31.12.2016, units

Cars	Trucks	Trailers	Tractoare	Motorcycles	Buses	Semitrailers	Other	Total
544 842	177 189	50 553	39 376	37 867	20 974	16 127	3 128	890 056

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

AD on diesel oil consumption in transportation (Table 3-49) are available in 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".

In order to estimate the total amount of diesel oil consumed by road transportation means in the country between 1993-2015, the amount of diesel oil consumed for transport operation, the ones sold to the population and 10 per cent of the the amount consumed in the agriculture sector were summed (both for the Right and Left Banks of Dniester River; while the remaining 90 per cent are considered within category 1A4c "Other sectors: 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.

Table 3-49: Diesel Oil Consumption by Road Transportation Means (1A3b) in the Republic of Moldova within 1990-2015, TJ

		1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
Right Bank	1A3b	10975	11869	8253	4157	4900	4812	4225	3726	3227	2494	2729	2871	4041
	1A4b	85	8593	553	41	235	293	645	1174	1379	1232	2230	2846	2377
	1A4c (K)	25949	16846	10337	9377	9007	6330	6690	6220	4518	2875	2435	2347	3081
	0.3K*(1990); 0.2*K (1991); 0.15*K (1992); 0.1*K (1993-2015)	7785	3369	1551	938	901	633	669	622	452	288	244	235	308
Left Bank	1A4c (K1)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	0.1* K1	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	1A3b estimated	IE	IE	IE	801	942	910	785	685	590	453	490	508	706
Total	**1A3b**	**13655**	**11869**	**8253**	**5937**	**6978**	**6648**	**6324**	**6207**	**5648**	**4467**	**5693**	**6460**	**7432**
		2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Right Bank	1A3b	5364	5266	5623	6410	7772	8179	7274	9985	10581	10601	12284	16724	17605
	1A4b	2902	4729	4536	3691	3396	3929	4304	4825	5501	3641	3660	0	0
	1A4c (K)	2960	2633	2386	2396	2094	2005	1821	1856	1753	1627	1782	2347	2668
	0.1* K	296	263	239	240	209	201	182	186	175	162.7	178	235	267
Left Bank	1A4c (K1)	366	328	226	190	139	125	166	350	397	437	496	484	459
	0.1* K1	37	33	23	19	14	13	17	35	40	44	50	48	46
	1A3b estimated	925	809	855	965	1158	1208	1065	1451	1526	1517	1743	2354	2353
Total	**1A3b**	**9524**	**11100**	**11276**	**11325**	**12549**	**13530**	**12842**	**16482**	**17823**	**15966**	**17915**	**19361**	**20271**

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

A similar approach was used to deduce AD pertaining to the gasoline consumption within 1A3b 'Road Transportation', for which there were summed up the total amount of gasoline used for 'transport operation' and 'sold to population' (Table 3-50).

Table 3-50: Gasoline Consumption under the 1A3b 'Road Transportation' in the Republic of Moldova within 1990-2015, TJ

		1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
Right Bank	Transport operation	28509	30910	14568	9134	6954	6249	5839	4841	4020	2406	2112	2373	3454
	Sold to population	5098			293	2054	3286	3198	5575	4812	2641	2875	3081	3550
Left Bank	Estimated consumption				1825	1731	1809	1684	1920	1621	922	900	970	1225
Total RM	**Total consumption**	**33607**	**30910**	**14568**	**11252**	**10739**	**11344**	**10721**	**12336**	**10453**	**5969**	**5887**	**6424**	**8229**

		2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Right Bank	Transport operation	4309	3036	2895	3131	3460	3344	2798	2981	3573	2627	6871	6849	7081
	Sold to population	4015	6003	6376	5379	5297	5631	6209	5546	5392	4606			
Left Bank	Estimated consumption	1440	1397	1421	1291	1305	1325	1315	1237	1295	1041	991	968	949
Total RM	**Total consumption**	**9764**	**10436**	**10692**	**9801**	**10062**	**10300**	**10322**	**9764**	**10260**	**8274**	**7862**	**7817**	**8030**

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

Table 3-51: Liquefied Petroleum Gases and Compressed Natural Gases Consumption under the 1A3b 'Road Transportation' in the Republic of Moldova within 1990-2015 periods, TJ

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
Compressed Natural Gas	762	261	166	317	205	147	205	117	117	88	88	88	102
Liquefied Petroleum Gases	469	796	478	387	264	176	205	235	205	235	264	88	230
	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Compressed Natural Gas	88	87	99	71	108	92	207	282	139	152	241	222	293
Liquefied Petroleum Gases	293	238	249	222	296	476	461	598	433	590	590	587	628

Source: Energy Balances of the RM for 1990, 1993-2010; "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); Energy Balances of the RM for 2011-2015.

AD pertaining to consumption of LPG and compressed natural gas under the 1A3b 'Road Transportation' are provided by "Moldovagaz" J.S.C. (Table 3-51).

1A3c Railways

The railway transport in the RM includes railways, locomotives, passenger and cargo trains, buildings and edificies. At the end of 2015 operated: diesel locomotives - 138, maneuvering locomotives - 67, diesel trains (sections) - 21, cargo wagons - 6866, passenger coaches - 381. Fuel consumption within Railways Sector 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 and energy units (including in TJ), as well as the information on residual fuel oil and coal consumption for a number of years. The amount of residual fuel oil and coal consumed were considered under the 1A4a category, as these fuels are used in stationary combustion sources of fossil fuels. For the 1990-1992 period, AD associated with fuel consumption are available only in natural units, with conversion to TJ using country specific net caloric values.

Table 3-52: Diesel Oil Consumption for Railways Operation (1A3c) in the Republic of Moldova within 1990-2015 periods, TJ (according to data available in the Energy Balances)

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
Diesel Oil, TJ	5508	5212	3627	3078	1232	1086	1056	910	675	352	381	410	936
	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Diesel Oil, TJ	498	690	945	1180	1186	1089	1021	605	557	599	383	32	258

Sources: Energy Balances of the RM for 1990 and 1993-2015.

For comparison, the table below presents AD associated with diesel oil consumption for railways provided by S.O.E. "Moldavian Railways" (Table 3-53).

Table 3-53: Diesel Oil Consumption for Railways Operation (1A3c) in the Republic of Moldova within 1990-2015 periods, kt (according to data provided by the State Owned Enterprise "Moldavian Railways")

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
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
	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Diesel Oil, kt	42.300	35.700	36.536	47.149	39.575	36.505	21.495	21.323	13.000	14.000	19.818	18.957	15.052

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; and Letter dated 02.06.2016 No. H-4/1186.

For the Left Bank of Dniester River, AD associated with diesel oil consumption between 1993 and 2015 were calculated indirectly (Table 3-54), based on specific consumption per capita (it was determined the diesel oil consumption average per capita for the population on the Right Bank of Dniester River, and this was extended to the population on the Left Bank of Dniester River).

Table 3-54: Diesel Oil Consumption for Railways (1A3c) on the Left Bank of Dniester River within 1990-2015 periods, TJ

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
Diesel Oil, TJ	IE	IE	IE	593	237	205	196	167	123	64	68	73	163
	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Diesel Oil, TJ	86	106	144	178	177	161	150	88	80	86	54	5	34

The total diesel oil consumption for railways operation in the Republic of Moldova within 1990-2015 periods is presented below in Table 3-55.

Table 3-55: Total Diesel Oil Consumption for Railways (1A3c) in the Republic of Moldova within 1990-2015 periods, TJ

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
Right Bank	5445	5212	3627	3078	1232	1086	1056	910	675	352	381	410,2	936
Left Bank	IE	IE	IE	593	237	205	196	167	123	64	68	73	163
Total in the RM	**5445**	**5212**	**3627**	**3671**	**1469**	**1291**	**1252**	**1077**	**798**	**416**	**449**	**483**	**1099**
	2003	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**
Right Bank	498	690	945	1180	1186	1089	1021	605	557	599	383	32	258
Left Bank	86	106	144	178	177	161	150	88	80	86	54	5	34
Total in the RM	**584**	**796**	**1089**	**1358**	**1363**	**1250**	**1171**	**693**	**637**	**685**	**437**	**37**	**292**

1A3d Domestic Navigation

Naval transport in the RM includes a small number of ships, the fuel consumption being equally insignificant (for a great number of years, for example for 1991-2003, 2005 and 2009, in the Energy Balances of the Republic of Moldova, fuel consumption for navigation was indicated as zero). Under these circumstances, the main source of information on diesel oil consumption for domestic navigation was the Ministry of Transport and Road Infrastructure (Table 3-56).

Table 3-56: Diesel Oil Consumption for Domestic Navigation (1A3d) in the Republic of Moldova within 1990-2015 periods, TJ

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
Diesel Oil, TJ *	255.24	3.23	2.77	3.19	2.51	2.42	2.64	2.85	1.79	2.98	1.32	2.38	5.53
Diesel Oil, TJ **	263.70												
	2003	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**
Diesel Oil, TJ *	5.02	5.10	4.34	3.66	4.21	4.64	3.66	3.11	3.19	3.65	3.67	4.65	1.57
Diesel Oil, TJ **		3		5	4	4		3	3	3	3	27	28

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 1993-2015.

1A3e Other Transportation - Pipeline Transportation

The Republic of Moldova has a developed natural gas transportation and distribution network (Table 3-57).

Table 3-57: Natural Gas Transportation and Distribution Networks in the Republic of Moldova (situation as of 01.01.2015)

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.	Odesa - Chisinau	530	44	55
6.	Ribnita - 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	364.626	55
2.		Up to 300	354.97	55
3.		Up to 400	176.94	55
4.		Up to 500	6.795	55
III.	**Natural Gas Distribution Networks**			
1.			17	3-12 (high)
2.		Up to 50	1247.884	0.05-3 (average)
3.			6362.395	Up to 0.05 (low)
4.			816.132	3-12 (high)
5.		Up to 100	2868.341	0.05-3 (average)
6.			5137.436	Up to 0.05 (low)
7.			2431.807	3-12 (high)
8.		Up to 200	1183.487	0.05-3 (average)
9.			775.733	Up to 0.05 (low)
10.			458.043	3-12 (high)
11.		Up to 400	249.915	0.05-3 (average)
12.			89.078	Up to 0.05 (low)
13.			49.491	3-12 (high)
14.		Up to 700	106.515	0.05-3 (average)
15.			0.944	Up to 0.05 (low)

Source: "Moldovagaz" J.S.C. through Letter No. 02/1-2183 dated 03.06.2016, answer to Letter No. 512/2016-05-01 dated 10.05.2016.

AD associated with fuel consumption for pipeline transportation (Table 3-58) 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 3-58: Natural Gas Consumption for Pipeline Transportation (1A3e) in the Republic of Moldova within 1990-2015 periods, TJ

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
1A3ei	1611.5	1354	1016	332	1555	1496	2112	880	851	939	628	264	576
	2003	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**
1A3ei	410	663	627	117	54	72	169	38	0	59	225	293	297

Source: Energy Balances of the RM for 1990 and 1993-2015; activity data for the 1991-1992 period were interpolated, as in these years the Energy Balances were not generated.

Other Transportation

In the Energy Balances of the RM there is a subcategory with this name. The fuels allocated to this subcategory were considered within the Road Transportation category (1A3b) (Table 3-59).

Table 3-59: Fuel Consumption for "Other Transportation", TJ

	1990	1991	1992	1993	1994	1995	1996	1997	1998
Diesel Oil	127.62			1895		29	29	29	29
Gasoline	480.92			41		29	29	29	29
Kerosene				26					
LPG	138.18								
	1999	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**
Diesel Oil	29	29	29	43	29	34	48	44	3
Gasoline	29	29	29	44	29	51	73	60	2
Kerosene	29	29							12
Lubricants and greases						1	4	3	
LPG						1	6	8	
	2008	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**%**
Diesel Oil	2	43	18	13	39	42	29	48	-62.4
Gasoline			6	13	40	11	29	17	-96.5
Lubricants and greases					2				
LPG			2	2	5			1	

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', 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. Following the recommendations included into the GPG, GHG emissions were estimated using 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 subcategory included in 1A3 "Transport" complies with the requirements set out in the description of each subcategory in the 2006 IPCC Guidelines (in the current inventory cycle, separate GHG emissions were calculated for 6 transport subcategories (aviation, road transportation, railways, navigation, pipeline transportation and other types of transportation, including by land); for each subcategory, AD is available in separate files in energy units; verifying the correctness of EFs use for each subcategory; verifying if the primary reference sources are correctly indicated; the accuracy of calculations for subcategories included in 1A3 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 calculations files the EFs are specified in tabular formats for each subcategory, the import of the respective values into calculation formulas is ensured by automatic connections;
- the consistency of the calculations is also ensured by verifying the correctness of applying conversion factors of natural units to energy units for all subcategories and the entire range of years covered by the inventory;
- verification if the same method is used for the entire range of years covered by the inventory;
- verifying if GHG emissions calculations have been made for all years and for all types of fuels mentioned in the Energy Balances of the RM 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, etc.

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".

The main causes of these recalculations are, as follows: in order to estimate GHG emissions were used AD expressed in energy units (TJ) and not in natural units (kt); the amount of aviation gasoline consumed (in energy units – TJ) were updated based on the information available in the Energy Balances of the Republic of Moldova; for the first time GHG emissions from category 1A3b were estimated for the Left Bank of Dniester River (the amount of diesel oil and gasoline consumed were estimated indirectly based on the specific consumption per capita on the right bank of Dniester River); diesel oil consumption for the 1990-1993 time series were updated due to the reallocations between 1A4c and 1A3c; GHG emissions from 1A3c were estimated based on AD available in the Energy Balances of the RM, in the previous inventory cycles, the respective emissions were calculated based on AD provided by the S.E. "Moldavian Railways"; GHG emissions from coal and residual fuel oil consumption, previously estimated within 1A3c category, were now reallocated to 1A4a; GHG emissions from lubricants and greases consumption previously estimated within 1A3 category, were now reallocated to 2D1; fuel consumption (gasoline, LPG, diesel oil, kerosene and lubricants and greases) allocated in the Energy Balances of the RM to category "Other transportation", unincluded in the previous inventory cycles, were now reallocated to 1A3b; also, in order to convert direct GHG emissions in CO_2 equivalent, in the current inventory cycle, the 100-year Global Warming Potential (GWP_{100}) values available in the Fourth IPCC Assessment Report (AR4) (CH_4 – 25 and N_2O – 298), were used in the detriment of GWP_{100} values in the Second IPCC Assessment Report (SAR) (CH_4 – 21 and N_2O – 310).

In comparison with the results included into the First Biennial Update Report of the RM under the UNFCCC, the performed recalculations revealed an increasing trend of direct GHG emissions for 1990-2013 time series, varying from a minimum increase by 3.9 per cent in 2003 and a maximum increase by 24.7 per cent in 1991 (Table 3-60). For 2014-2015 periods, the direct GHG emissions originated from 1A3 "Transport" were estimated for the first time. Between 1990 and 2015, the respective emissions decreased by circa 50.8 per cent.

Table 3-60: Comparative Results of GHG Emissions Inventory from 1A3 "Transport" included into the BUR1 and NC4 of the RM under the UNFCCC, kt CO_2 equivalent

	1990	1991	1992	1993	1994	1995	1996	1997	1998
BUR1	4056.6151	3663.9848	2052.0292	1513.9925	1317.5788	1338.3695	1305.8589	1331.6625	1161.5385
NC4	4481.7645	4567.6074	2214.0887	1777.1549	1527.4509	1522.9456	1490.9287	1509.9711	1307.3000
Difference, %	10.5	24.7	7.9	17.4	15.9	13.8	14.2	13.4	12.5
	1999	2000	2001	2002	2003	2004	2005	2006	2007
BUR1	792.1933	863.4656	920.4987	1166.7509	1455.7657	1624.9498	1656.7370	1582.1066	1651.3635
NC4	875.2873	948.8464	1013.8491	1296.3979	1512.7271	1709.2744	1767.9729	1696.4435	1804.1901
Difference, %	10.5	9.9	10.1	11.1	3.9	5.2	6.7	7.2	9.3
	2008	2009	2010	2011	2012	2013	2014	2015	%
BUR1	1742.5257	1659.1092	1905.7039	2020.2412	1763.4096	1877.1767			
NC4	1896.0664	1853.8302	2053.6866	2164.2599	1905.5612	2015.0035	2090.2898	2202.9754	-50.8
Difference, %	8.8	11.7	7.8	7.1	8.1	7.3			

Below are presented the results of recalculations performed for the most relevant sources of GHG emissions within 1A3 "Transport" category (Tables 3-61 and 3-62).

Table 3-61: Comparative Results of GHG Emissions Inventory from 1A3b "Road Transportation" included into the BUR1 and NC4 of the RM under the UNFCCC, kt CO_2 equivalent

	1990	1991	1992	1993	1994	1995	1996	1997	1998
BUR1	3438.3000	3155.0000	1696.8000	1268.8000	997.5000	1092.9000	1038.1000	1141.5000	982.6000
NC4	3914.7862	4060.0997	1856.7585	1453.7302	1318.4350	1331.9217	1268.5430	1371.2221	1193.3229
Difference, %	13.8	28.7	9.6	14.6	32.2	21.9	22.2	20.1	21.5
	1999	2000	2001	2002	2003	2004	2005	2006	2007
BUR1	662.5000	739.9000	800.6000	1004.4000	1282.5000	1460.1000	1491.2000	1409.4000	1507.3000
NC4	787.9251	876.3093	958.8336	1172.5992	1440.3805	1605.4001	1642.2631	1577.0875	1687.9880
Difference, %	18.9	18.4	19.8	16.7	12.3	10.0	10.1	11.9	12.0
	2008	2009	2010	2011	2012	2013	2014	2015	%
BUR1	1609.3000	1573.3000	1828.1000	1939.4000	1698.3000				
NC4	1788.1359	1747.1567	1993.8803	2111.1788	1845.1261	1965.7193	2070.3511	2161.6771	-44.8
Difference, %	11.1	11.0	9.1	8.9	8.6				

Table 3-62: Comparative Results of GHG Emissions Inventory from 1A3c "Railways" included into the BUR1 and NC4 of the RM under the UNFCCC, kt CO_2 equivalent

	1990	1991	1992	1993	1994	1995	1996	1997	1998
BUR1	507.0409	432.7382	301.1449	226.3196	232.4823	161.6583	149.7637	140.3306	131.3567
NC4	450.4560	431.2096	300.0811	303.7035	121.5073	106.8347	103.5893	89.1194	66.0556
Difference, %	-11.2	-0.4	-0.4	34.2	-47.7	-33.9	-30.8	-36.5	-49.7
	1999	2000	2001	2002	2003	2004	2005	2006	2007
BUR1	76.2486	93.0946	104.4171	129.5661	149.3893	126.0804	129.0328	166.5144	139.7656
NC4	34.4099	37.1731	39.9323	90.9557	48.3004	65.8538	90.0646	112.3174	112.7303
Difference, %	-54.9	-60.1	-61.8	-29.8	-67.7	-47.8	-30.2	-32.5	-19.3
	2008	2009	2010	2011	2012	2013	2014	2015	%
BUR1	128.9234	75.9131	75.3057	80.5219	64.6294	69.9269			
NC4	103.3907	96.8345	57.3245	52.7231	56.6452	36.1808	3.0198	24.1957	-94.6
Difference, %	-19.8	27.6	-23.9	-34.5	-12.4	-48.3			

3.4.6. Planned Improvements

Potential improvements within the 1A3 "Transport" category could be possible once updating the available AD on fuel consumption in ATULBD, as well as applying a higher level calculation methodology (for exemple, the COPERT model). For the Left Bank of Dniester River, there are no complete information for the entire time period. It would be possible to carry out a study focused on indirect generation of AD associated with fuel consumption in the transport sector based on the existing information on the structure of vehicle fleet, respectively on the specific fuel consumption within this sector on the Right Bank of Dniester River, applying the methods available in the 2006 IPCC Guidelines for obtaining AD for the missing year series.

In order to apply higher-ranking calculation methods there are premises as well as difficulties, the most important is the lack of information for the entire time period (1990-2015) on the distribution of car fleet by types of transport units, consumed fuels, engines, etc. Also, relieble information is needed in relation to the distance traveled (km) and the average speed of the vehicles, separated in the urban and rural areas of the country. If to consider the list of parameters and AD required to use the COPERT model, at the moment, the inventory team has only partial information needed to estimate direct GHG emissions by applying the respective model. For railways and domestic aviation it would be possible to use higher-ranked estimations methods (Tier 2, respectively Tier 2b), but since these sources are not key categories, this activity was not prioritized as being relevant in the short term.

3.5. Other Sectors (Category 1A4)

3.5.1. Source Category Description

The 1A4 'Other Sectors' category includes greenhouse gases generated by the following emission sources: 1A4a 'Commercial/Institutional'; 1A4b 'Residential'; 1A4c 'Agriculture/Forestry/ Fishing'. Between 1990 and 2015, GHG emissions from source category 1A4 'Other Sectors' tended to decrease by circa 74.8 per cent: from 7,608.4 kt CO_2 equivalent recorded in 1990, to circa 1,916.1 kt CO_2 equivalent in 2015 (Table 3-63).

Table 3-63: GHG Emissions from Source Category 1A4 'Other Sectors' within 1990-2015 periods

	1990	1991	1992	1993	1994	1995	1996	1997	1998
1A4, kt CO_2 equivalent	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
%, compared to 1990	100.0	81.4	57.0	30.3	28.3	29.1	30.8	33.5	27.5
	1999	2000	2001	2002	2003	2004	2005	2006	2007
1A4, kt CO_2 equivalent	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
%, compared to 1990	24.1	19.9	19.0	23.4	28.1	30.3	29.8	29.6	22.4
	2008	2009	2010	2011	2012	2013	2014	2015	%
1A4, kt CO_2 equivalent	1 716.3136	1 866.5664	2 031.0012	2 358.7490	2 326.6485	2 004.7593	2 046.0694	1 916.0651	-74.8
%, compared to 1990	22.6	24.5	26.7	31.0	30.6	26.3	26.9	25.2	

Compared to 1990, the level of GHG emissions from source category 1A4 "Other Sectors" represented by 2015, for CO_2 – only 24.6 per cent of the reference year level, while for CH_4 – 37.7 per cent, N_2O – 61.2 per cent, NO_x – 21.5 per cent, CO – 57.4 per cent, NMVOC – 59.6 per cent, and SO_x – 15.6 per cent (Table 3-64).

Table 3-64: Direct and Indirect GHG Emissions from Source Category 1A4 'Other Sectors' within 1990-2015 periods

	1A4, kt							in %, compared to 1990						
	CO_2	CH_4	N_2O	NO_x	CO	NMVOC	SO_x	CO_2	CH_4	N_2O	NO_x	CO	NMVOC	SO_x
1990	7 291.57	11.57	0.09	28.91	122.32	14.30	59.79	100.0	100.0	100.0	100.0	100.0	100.0	100.0
1991	5 984.16	7.64	0.06	21.91	73.95	8.82	45.43	82.1	66.0	69.3	75.8	60.5	61.7	76.0
1992	4 257.38	2.73	0.03	14.58	27.92	3.73	26.54	58.4	23.6	32.2	50.4	22.8	26.1	44.4
1993	2 253.39	1.84	0.02	11.94	32.28	4.19	13.83	30.9	15.9	26.8	41.3	26.4	29.3	23.1
1994	2 086.38	2.48	0.03	11.49	34.31	4.38	13.56	28.6	21.4	27.7	39.7	28.1	30.6	22.7
1995	2 172.16	1.35	0.02	12.83	30.22	4.15	8.73	29.8	11.7	24.8	44.4	24.7	29.0	14.6
1996	2 274.88	2.39	0.03	10.83	36.20	4.60	11.49	31.2	20.7	30.1	37.5	29.6	32.2	19.2
1997	2 496.01	1.79	0.02	10.93	31.64	4.15	8.33	34.2	15.4	26.9	37.8	25.9	29.0	13.9
1998	2 056.96	1.19	0.02	8.23	25.36	3.30	6.05	28.2	10.3	21.9	28.5	20.7	23.1	10.1
1999	1 798.58	1.22	0.02	6.22	22.33	2.84	5.01	24.7	10.6	19.6	21.5	18.3	19.9	8.4
2000	1 478.85	1.22	0.02	4.97	20.89	2.62	4.47	20.3	10.5	18.4	17.2	17.1	18.3	7.5
2001	1 416.76	1.06	0.02	4.80	19.85	2.50	4.05	19.4	9.2	17.6	16.6	16.2	17.5	6.8
2002	1 743.45	1.37	0.02	5.69	23.69	2.96	5.40	23.9	11.8	20.8	19.7	19.4	20.7	9.0
2003	2 082.50	1.81	0.02	5.78	30.22	3.64	7.73	28.6	15.6	26.5	20.0	24.7	25.5	12.9
2004	2 258.99	1.48	0.02	5.48	25.11	3.03	6.38	31.0	12.8	22.6	19.0	20.5	21.2	10.7
2005	2 218.78	1.57	0.02	5.09	24.57	2.95	6.13	30.4	13.5	22.2	17.6	20.1	20.6	10.2
2006	2 203.52	1.81	0.02	5.09	27.59	3.30	6.46	30.2	15.6	24.7	17.6	22.6	23.1	10.8
2007	1 666.75	1.31	0.02	4.18	21.44	2.60	4.71	22.9	11.3	19.2	14.4	17.5	18.2	7.9
2008	1 677.37	1.34	0.02	4.10	22.24	2.70	4.54	23.0	11.5	20.1	14.2	18.2	18.9	7.6
2009	1 824.72	1.44	0.02	4.12	23.10	2.78	5.01	25.0	12.5	21.0	14.3	18.9	19.5	8.4
2010	1 985.99	1.57	0.02	4.47	22.40	2.70	5.07	27.2	13.6	20.4	15.4	18.3	18.9	8.5
2011	2 309.81	1.70	0.02	4.77	24.94	3.01	5.02	31.7	14.7	23.0	16.5	20.4	21.0	8.4
2012	2 271.47	1.93	0.02	4.68	27.18	3.24	5.57	31.2	16.7	24.7	16.2	22.2	22.7	9.3
2013	1 947.94	1.99	0.02	4.63	28.40	3.40	6.22	26.7	17.2	25.3	16.0	23.2	23.8	10.4
2014	1 927.74	4.10	0.05	5.96	65.67	7.95	9.60	26.4	35.4	57.4	20.6	53.7	55.6	16.1
2015	1 790.21	4.36	0.06	6.21	70.23	8.53	9.33	24.6	37.7	61.2	21.5	57.4	59.6	15.6

Between 1990 and 2015, CO_2 emissions had the biggest share in the structure of total direct GHG emissions from 1A4 "Other Sectors" category, varying from 93.4 per cent to 98.3 per cent, followed by CH_4 emissions, with a share varying from 1.4 per cent to 5.7 per cent, respectively by N_2O emissions, with a share varying from 0.2 per cent to 0.9 per cent of the total (Table 3-65).

Table 3-65: DirectGHG Emissions from Source Category 1A4 'Other Sectors' in the RM within 1990-2015 periods

	1A4, kt CO_2 equivalent				% from the total			in %, compared to 1990		
	CO_2	CH_4	N_2O	Total	CO_2	CH_4	N_2O	CO_2	CH_4	N_2O
1990	7 291.5661	289.1794	27.6563	7 608.4017	95.8	3.8	0.4	100.0	100.0	100.0
1991	5 984.1624	190.9006	19.1687	6 194.2317	96.6	3.1	0.3	82.1	66.0	69.3
1992	4 257.3797	68.2375	8.8965	4 334.5137	98.2	1.6	0.2	58.4	23.6	32.2
1993	2 253.3852	46.0140	7.4045	2 306.8036	97.7	2.0	0.3	30.9	15.9	26.8
1994	2 086.3753	61.9720	7.6567	2 156.0040	96.8	2.9	0.4	28.6	21.4	27.7
1995	2 172.1646	33.7536	6.8659	2 212.7842	98.2	1.5	0.3	29.8	11.7	24.8
1996	2 274.8811	59.7762	8.3157	2 342.9730	97.1	2.6	0.4	31.2	20.7	30.1
1997	2 496.0098	44.6268	7.4329	2 548.0695	98.0	1.8	0.3	34.2	15.4	26.9
1998	2 056.9647	29.7831	6.0686	2 092.8164	98.3	1.4	0.3	28.2	10.3	21.9
1999	1 798.5838	30.5267	5.4281	1 834.5386	98.0	1.7	0.3	24.7	10.6	19.6
2000	1 478.8536	30.3852	5.0960	1 514.3349	97.7	2.0	0.3	20.3	10.5	18.4
2001	1 416.7615	26.5451	4.8642	1 448.1708	97.8	1.8	0.3	19.4	9.2	17.6
2002	1 743.4526	34.2532	5.7503	1 783.4561	97.8	1.9	0.3	23.9	11.8	20.8
2003	2 082.5048	45.1340	7.3205	2 134.9593	97.5	2.1	0.3	28.6	15.6	26.5
2004	2 258.9904	37.0540	6.2527	2 302.2970	98.1	1.6	0.3	31.0	12.8	22.6
2005	2 218.7801	39.1561	6.1343	2 264.0705	98.0	1.7	0.3	30.4	13.5	22.2
2006	2 203.5166	45.2403	6.8341	2 255.5911	97.7	2.0	0.3	30.2	15.6	24.7
2007	1 666.7458	32.7824	5.3158	1 704.8440	97.8	1.9	0.3	22.9	11.3	19.2
2008	1 677.3708	33.3909	5.5519	1 716.3136	97.7	2.0	0.3	23.0	11.6	20.1
2009	1 824.7201	36.0368	5.8095	1 866.5664	97.8	1.9	0.3	25.0	12.5	21.0
2010	1 985.9921	39.3569	5.6522	2 031.0012	97.8	1.9	0.3	27.2	13.6	20.4
2011	2 309.8144	42.5649	6.3697	2 358.7490	97.9	1.8	0.3	31.7	14.7	23.0
2012	2 271.4679	48.3530	6.8275	2 326.6485	97.6	2.1	0.3	31.2	16.7	24.7
2013	1 947.9381	49.8318	6.9895	2 004.7593	97.2	2.5	0.4	26.7	17.2	25.3
2014	1 927.7357	102.4512	15.8826	2 046.0694	94.2	5.0	0.8	26.4	35.4	57.4
2015	1 790.2120	108.9172	16.9359	1 916.0651	93.4	5.7	0.9	24.6	37.7	61.2

The breakdown of direct GHG emissions by source categories within 1A4 "Other Sectors" are presented below (Table 3-66, Figure 3-13).

Table 3-66: Breakdown of Direct GHG Emissions by Source Categories within 1A4 "Other Sectors", 1990-2015, kt CO_2 equivalent

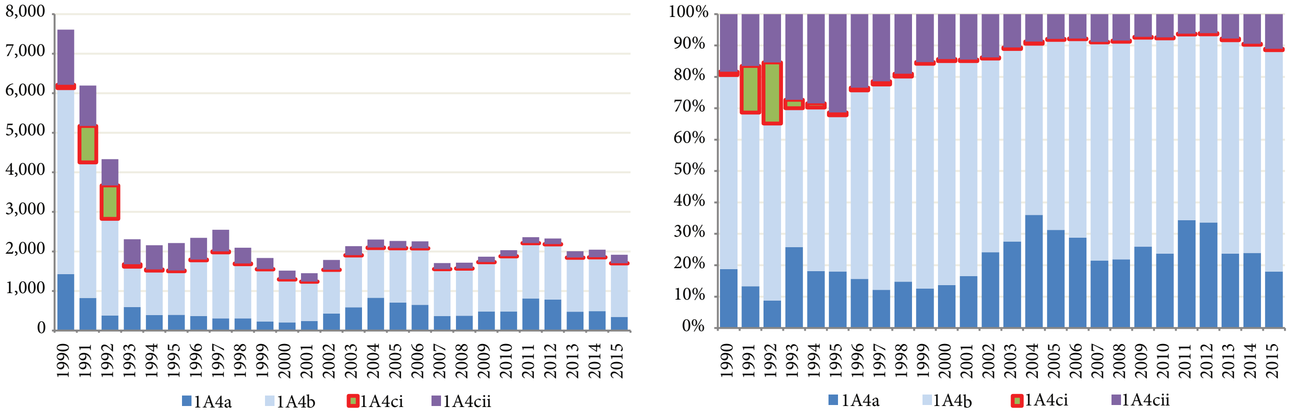
	1990	1991	1992	1993	1994	1995	1996	1997	1998
1A4a "Commercial /Institutional Sectors"	1 427.3919	824.9777	380.0979	594.6681	390.5659	399.0975	366.3592	310.2782	308.6055
1A4b "Residential Sector"	4 701.8620	3 427.1398	2 444.5033	1 020.7909	1 123.4333	1 100.7051	1 407.4316	1 666.2543	1 367.6078
1A4 ci "Agriculture/ Forestry/Fishing Sectors" (stationary sources)	83.3556	918.2033	843.4706	61.7380	29.6937	19.7505	19.5364	26.4089	19.7086
1A4 cii "Agriculture/ Forestry/Fishing Sectors" (mobile sources)	1 395.7922	1 023.9109	666.4420	629.6067	612.3111	693.2311	549.6458	545.1281	396.8946
1A4 "Other Sectors"	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
	1999	2000	2001	2002	2003	2004	2005	2006	2007
1A4a "Commercial /Institutional Sectors"	230.6187	207.2302	239.0809	430.0990	588.0153	829.0842	707.3816	649.6049	366.0731
1A4b "Residential Sector"	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
1A4 ci "Agriculture/ Forestry/Fishing Sectors" (stationary sources)	9.9008	9.9008	6.8339	6.5818	10.2356	16.2032	7.7823	4.6188	1.9669
1A4 cii "Agriculture/ Forestry/Fishing Sectors" (mobile sources)	280.8770	216.8551	210.1217	245.7825	226.9222	201.1128	178.2636	175.5576	151.4513
1A4 "Other Sectors"	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
	2008	2009	2010	2011	2012	2013	2014	2015	%
1A4a "Commercial /Institutional Sectors"	375.1371	483.5828	481.5109	811.0471	782.6299	475.3008	488.8411	344.5964	-75.9
1A4b "Residential Sector"	1 190.4035	1 242.8935	1 392.5754	1 394.6003	1 393.9820	1 362.6801	1 357.3577	1 350.9580	-71.3
1A4 ci "Agriculture/ Forestry/Fishing Sectors" (stationary sources)	6.3261	4.7492	6.1065	5.8588	8.7814	11.0017	6.2721	8.4665	-89.8
1A4 cii "Agriculture/ Forestry/Fishing Sectors" (mobile sources)	144.4469	135.3409	150.8083	147.2428	141.2553	155.7768	193.5986	212.0442	-84.8
1A4 "Other Sectors"	1 716.3136	1 866.5664	2 031.0012	2 358.7490	2 326.6485	2 004.7593	2 046.0694	1 916.0651	-74.8

The emission source with the largest share in the structure of total direct GHG emissions from 1A4 "Other Sectors" is represented by 1A4b "Residential Sector", with a share varying during the reference period between 44.3 per cent (1993) and 70.5 per cent (2015). On the second place ranks 1A4a

“Commercial/Institutional Sectors”, with a share varying from 8.8 per cent (1992) and 36.0 per cent (2004), followed by 1A4cii “Agriculture/Forestry/Fishing” (mobile sources), with a share varying from 6.1 per cent (2012) and 31.3 per cent (1995) (Figure 3-13b, Table 3-67).

Table 3-67: The Share of Different Categories in the Structure of Total Direct GHG Emissions from 1A4 “Other Sectors”, % from the total

	1990	1991	1992	1993	1994	1995	1996	1997	1998
1A4a	18.8	13.3	8.8	25.8	18.1	18.0	15.6	12.2	14.7
1A4b	61.8	55.3	56.4	44.3	52.1	49.7	60.1	65.4	65.3
1A4ci	1.1	14.8	19.5	2.7	1.4	0.9	0.8	1.0	0.9
1A4cii	18.3	16.5	15.4	27.3	28.4	31.3	23.5	21.4	19.0
	1999	2000	2001	2002	2003	2004	2005	2006	2007
1A4a	12.6	13.7	16.5	24.1	27.5	36.0	31.2	28.8	21.5
1A4b	71.6	71.3	68.5	61.7	61.3	54.5	60.5	63.2	69.5
1A4ci	0.5	0.7	0.5	0.4	0.5	0.7	0.3	0.2	0.1
1A4cii	15.3	14.3	14.5	13.8	10.6	8.7	7.9	7.8	8.9
	2008	2009	2010	2011	2012	2013	2014	2015	%
1A4a	21.9	25.9	23.7	34.4	33.6	23.7	23.9	18.0	-4.1
1A4b	69.4	66.6	68.6	59.1	59.9	68.0	66.3	70.5	14.1
1A4ci	0.4	0.3	0.3	0.2	0.4	0.5	0.3	0.4	-59.7
A4cii	8.4	7.3	7.4	6.2	6.1	7.8	9.5	11.1	-39.7



a) b)

Figure 3-13: Breakdown of Direct GHG Emissions by Source Categories within 1A4 “Other Sectors”, 1990-2015, kt CO_2 equivalent

3.5.2. Methodological Issues, Emission Factors and Activity Data

GHG emissions originated from the 1A4 source category were estimated following a Tier 1 methodology. EFs used are presented below in Tables 3-68, 3-69 and 3-70.

Table 3-68: Emission Factors Used to Estimate GHG Emissions from 1A4a “Commercial / Institutional” Source Category, kg/TJ

Fuel Type	CO_2	CH_4	N_2O	NO_x	CO	NMVOC
Gasoline	69300	10	0.6	100	20	5
Diesel Oil	74100	10	0.6	100	20	5
Residual Fuel Oil	77400	10	0.6	100	20	5
Kerosene	71900	10	0.6	100	20	5
LPG	63100	5	0.1	100	20	5
Other Petroleum Products	73300	10	0.6	100	20	5
Anthracite	98300	10	1.5	100	2000	200
Bituminous Coal	94600	10	1.5	100	2000	200
Lignite	101000	10	1.5	100	2000	200
Brown coal - briquettes	97500	10	1.5	100	2000	200
Coke	107000	10	1.5	100	2000	200
Natural Gas	56100	5	0.1	50	50	5
Fuel Wood and Wood Waste	112000	300	4	100	5000	600
Other Solid Biomass	100000	300	4	100	5000	600
Fuel Wood	112000	200	1	100	7000	100

Source: for NO_x, CO and NMVOC: *Revised 1996 IPCC Guidelines*, Vol. 3, Tab. 1-9, 1-10 and 1-11, Pages 1.37-1.42; for CO_2,CH_4, N_2O – *2006 IPCC Guidelines*, Vol. 2, Chap. 2, Tab. 2.4, pages 2.20-2.21.

Table 3-69: Emission Factors Used to Estimate GHG Emissions from 1A4b "Residential" and 1A4ci "Agriculture / Forestry / Fishing" (stationary sources) Source Categories, kg/TJ

Fuel Type	CO_2	CH_4	N_2O	NO_x	CO	NMVOC
Residual Fuel Oil	77400	10	0.6	100	20	5
Kerosene	71900	10	0.6	100	20	5
LPG	63100	5	0.1	100	20	5
Bitumen	80700	10	0.6	100	20	5
Other Petroleum Products	73300	10	0.6	100	20	5
Anthracite	98300	300	1.5	100	2000	200
Bituminous coal	94600	300	1.5	100	2000	200
Lignite	101000	300	1.5	100	2000	200
Coke	107000	300	1.5	100	2000	200
Peat	106000	300	1.4	100	2000	200
Natural Gas	56100	5	0.1	50	50	5
Fuel Wood and Wood Waste	112000	300	4	100	5000	600
Other Solid Biomass	100000	300	4	100	5000	600
Charcoal	112000	200	1	100	7000	100

Source: for NO_x, CO and NMVOC: Revised 1996 IPCC Guidelines, Vol. 3, Tab. 1-9, 1-10 and 1-11, pages 1.37-1.42; for CO_2, CH_4, N_2O – 2006 IPCC Guidelines, Vol. 2, Chap. 2, Tab. 2.5, pages 2.22-2.23.

Table 3-70: Emission Factors Used to Estimate GHG Emissions from 1A4cii "Agriculture/Forestry/Fishing" (mobile sources) Source Categories, kg/TJ

Fuel Type	CO_2	CH_4	N_2O	NO_x	CO	NMVOC
Gasoline	69300	10	0.6	1200	1000	200
Diesel Oil	74100	10	0.6	1200	1000	200
LPG	63100	5	0.1	1200	1000	200

AD on fuel consumption are available in the Energy Balances of the RM and the statistical publications "Socio-economic development of the TMR". A part of the information used was provided by the J.S.C. "Moldovagaz". To be noted that in the current inventory cycle, the AD used were taken from the Energy Balances of the RM directly in energy units (TJ).

For the Right Bank of Dniester River, information associated with fuel consumption between 1993 and 2015 from the Energy Balances of the RM is available as follows: AD for the "Commercial Sector" and "Institutional Sector" are aggregated, as a rule, while for the "Residential Sector", respectively "Agriculture/Forestry/Fishing" separately. AD associated with fuel consumption from the "Agriculture Sector" were disaggregated into two subcategories: 1A4ci "Stationary sources" (it includes consumption of coal, residual fuel oil, natural gas and others) and 1A4cii "Mobile sources" (it includes consumption of diesel oil, gasoline and LPG). AD associated with fuel consumption from the Left Bank of Dniester River are only partially available. This information is available only in natural units, being recalculated in energy units (TJ) by using country specific caloric factors. AD available for each subcategory considered under 1A4 "Other Sectors" category are examined below.

1A4a "Commercial / Institutional Sector"

Activity data for commercial and institutional sectors on the Left Bank of Dniester River are available regarding natural gas consumption between 1999 and 2015, respectively for LPG consumption between 2011 and 2015 (Table 3-71).

Table 3-71: Fuel Consumption under the 1A4a "Commercial/Institutional" Source Category in the ATULBD within 1999-2015 periods

	1999	2000	2001	2002	2003	2004
Natural Gas, TJ	230	315	460	2770	2959	7754
	2005	**2006**	**2007**	**2008**	**2009**	**2010**
Natural Gas, TJ	6149	5143	488	670	545	1277
	2011	**2012**	**2013**	**2014**	**2015**	**%**
LPG, TJ	0.12	0.09	0.06	0.05	0.06	
Natural Gas, TJ	7084	6850	3383	3559	914	297.4

As for the Right Bank of Dniester River, in the current inventory cycle it was considered necessary to transfer certain fuels consumption (residual fuel oil, anthracite, lignite, bituminous coal) from 1A3c category to 1A4a (Table 3-72).

Table 3-72: Fuel Consumption within 1990-2015 periods, reallocated from 1A3c "Railways" to 1A4a "Commercial/ Institutional Sector", TJ

	1990	1991	1992	1993	1994	1995	1996	1997	1998
Residual Fuel Oil				300	88	59	29	29	59
Anthracite							59	59	
Bituminous Coal	146.5			103	29	29			
Lignite						59	29	59	
	1999	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**
Anthracite							1		1
	2008	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**%**
Residual Fuel Oil	3.5	5.5	8.3	6.6	9.6	1.7	3.3	1.14	
Anthracite	2		2						
Bituminous Coal	1.6	1.6	0.3	1.1	8.2	0.9	0.3	0.1	-99.9

Source: Energy Balances of the RM for 1990 and 1993-2015.

During the period under review (1990-2015), fuel consumption within source category 1A4a "Commercial/Institutional Sector" significantly decreased for most of fuel types, for example, diesel oil consumption decreased by circa 67.3 per cent, residual fuel oil – by circa 99.4 per cent, LPG – by 74.7 per cent, anthracite – by 94.4 per cent, fire wood consumption – by circa 33.9 per cent, etc. At the same time, in the respective period natural gas consumption increased significantly, by circa 149.3 per cent (Table 3-73).

Table 3-73: Fuel Consumption under the 1A4a "Commercial/Institutional" Source Category on the Right Bank of Dniester River within 1990-2015 periods, TJ

	1990	1991	1992	1993	1994	1995	1996	1997	1998
Gasoline				3					
Diesel Oil	468	1064	638	144	88	117	88	59	59
Kerosene		203	457	47					
Residual Fuel Oil	844	1327	1608	508	235	235	205	59	29
Fuel for Oven	733			50	29				29
Fuel for Engines	43			12					
LPG	276			44		59	59	29	
Other Petroleum Products									
Anthracite	11616	4575		1546	675	440	440	352	323
Bituminous Coal		799	804	2363	2200	2553	2171	1966	2200
Lignite	12	12		557	411	352	352	205	176
Coal-briquettes	36								
Coke				3					
Natural Gas	1422	1422	1737	1138	616	557	734	734	616
Fuel Wood	333			109	117	117	147	117	117
Wood Waste				6			29		
	1999	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**
Gasoline						2	1	3	36
Diesel Oil	88	59	29	29	59	50	46	29	29
Kerosene						2			
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			29		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			
Coke									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					146	78	31	26	18
Agriculture Residues						14	5	2	14
Other types of fuel			29						3
	2008	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**%**
Gasoline	34	6	3	6					
Diesel Oil	26	35	130	121	15			153	-67.3
Residual Fuel Oil	96	177	30	10	1	6		5	-99.4
Fuel for Oven	19	17	59	15	5	1	4	1	-99.9
LPG	42	382	291	82	125	135	193	70	-74.7
Other Petroleum Products	2	28	7			1		3	
Anthracite	801	1191	828	867	898	1032	587	672	-94.4
Bituminous Coal	673	315	243	217	100	67	197	77	
Coal-briquettes					1				
Natural Gas	3105	4535	4722	5094	5061	2925	3462	3545	149.3
Fuel Wood	268	240	209	219	244	185	232	220	-33.9
Wood Waste	15	36	36	17	18	35	26	14	
Agriculture Residues	28		41	31	88	68	118	50	
Other types of fuel	2								
Charcoal						3	21	16	
Briquettes and Wood Pellets							94	83	

1A4b "Residential Sector"

Activity data for residential sector on the Left Bank of Dniester River are available regarding natural gas and LPG consumption between 1995 and 2015, respectively for fire wood consumption between 2009 and 2015 (Table 3-74).

Table 3-74: Fuel Consumption under the Residential Sector in the ATULBD within 1995-2015

	1995	1996	1997	1998	1999	2000	2001
LPG, TJ	115	106	64	60	37	18	14
Natural Gas, TJ	7334	5533	12014	10889	9928	7378	6650
	2002	2003	2004	2005	2006	2007	2008
LPG, TJ	18	23	23	23	23	21	23
Natural Gas, TJ	5939	5980	5512	5580	5458	5106	5079
	2009	2010	2011	2012	2013	2014	2015
LPG, TJ	18	27	28	22	18	16	12.7
Natural Gas, TJ	5282	5902	6247	6234	6115	6098	5939
Fire Wood, TJ	92	97	90	48	42	69	98

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; and No. 02/1-2183 dated 03.06.2016.

During the period under review (1990-2015), fuel consumption within source category 1A4b "Residential Sector" significantly decreased for most of fuel types, for example, LPG consumption decreased by circa 52.7 per cent, anthracite – by circa 95.3 per cent, fire wood – by 33.9 per cent, etc. At the same time, in the respective period bituminous coal consumption increased significantly, by circa 485.7 per cent while fire wood consumption increased by circa 987.1 per cent (Table 3-75).

Table 3-75: Fuel Consumption under the 1A4b "Residential Sector" on the Right Bank of Dniester River within 1990-2015 periods, TJ

	1990	1991	1992	1993	1994	1995	1996	1997	1998
Residual Fuel Oil		1065	7714		29				
Kerosene	431			26					
Diesel Oil	1191	8593	553	15			29		29
LPG	5757		866	1317	557	528	704	910	910
Anthracite	32485	5140		2473	3491	1350	1584	1936	440
Bituminous Coal	25	9792	3961	1468	2847	440	3199	734	558
Lignite	1915	5151		214	29	29	29	29	
Coke				6			29		
Natural Gas	8702	10530	23854	8717	7306	7834	9301	11120	10152
Fuel Wood	1052			766	822	1526	1848	1907	1966
Other Solid Biomass	234								
	1999	2000	2001	2002	2003	2004	2005	2006	2007
Residual Fuel Oil							2		
Kerosene							1		
Diesel Oil	29	59	29						
LPG	1144	1320	1232	1936	1934	2098	2079	1977	2070
Other Petroleum Products							9	1	3
Anthracite	939	1115	763	1526	2286	1749	2012	2345	1334
Bituminous Coal	323	147	21		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		29			117	130	214	245	197
	2008	2009	2010	2011	2012	2013	2014	2015	%
Diesel Oil		2		11					
LPG	1982	1913	1849	2486	2591	2659	2664	2722	-52.7
Other Petroleum Products	1	1		2					
Anthracite	1127	1409	2161	1885	2446	2538	1758	1584	-95.3
Bituminous Coal	42	17	7	70	17	10	9	149	485.7
Peat								8	
Natural Gas	11240	11599	12308	11597	10498	9788	10012	9893	13.7
Fuel Wood	1942	1767	1808	2134	2543	2880	10425	11439	987.1
Other Solid Biomass	212		66	419	96	134	181	244	
Charcoal					17	11		2	

Source: Energy Balances of the RM for 1990 and 1993-2015.

1A4c "Agriculture/Forestry/Fishing Sectors"

Fuel consumption from source category 1A4c "Agriculture/Forestry/Fishing" was considered under two subcategories 1A4cii "Mobile sources" and lA4ci "Stationary sources". Activity data related to fuel consumption in agriculture, forestry and fishing on the Left Bank of Dniester River are available partially, only for a number of years, for natural gas, residual fuel oil and bituminous coal consumption (Table 3-76).

Table 3-76: Fuel Consumption under the 1A4c "Agriculture/Forestry/Fishing" Source Category (Stationary Sources) on the Left Bank of Dniester River within 2003-2015 periods

	2003	2004	2005	2006	2008	2009
Residual Fuel Oil, TJ					0.1	0.1
Natural Gas, TJ	30.5	23.7	13.5	3.4	3.4	
Bituminous Coal, TJ					0.4	0.3
	2010	**2011**	**2012**	**2013**	**2014**	**2015**
Residual Fuel Oil, TJ	0.1	0.1	0.1	0.1		
Natural Gas, TJ	3.4	3.4	6.8			
Bituminous Coal, TJ	0.2	0.8	0.6	0.6	0.6	0.6

As for the diesel oil consumption, it should be noted that 30 to 10 per cent of the amount initially allocated in the Energy Balances to the agriculture, forestry and fishing sector were reallocated to source category 1A3b. The table below presents the evolution ttends for fuel consumption within 1A4c between 1990 and 2015 (Table 3-77). During the period under review, fuel consumption within source category 1A4c "Agriculture/Forestry/Fishing Sector" significantly decreased for most of fuel types, for example, diesel oil consumption decreased by 88.1 per cent, gasoline – by 90.8 per cent, while LPG consumption – by 89.1 per cent.

Table 3-77: Fuel Consumption under the 1A4c "Agriculture/Forestry/Fishing" Source Category (Stationary Sources) in the Republic of Moldova within 1990-2015 periods, TJ

		1990	1991	1992	1993	1994	1995	1996	1997	1998
RBDR	Diesel Oil (M)	25949			9277	9007	8538	6690	6220	4518
	Diesel Oil (0.7 to 0.9*M)	23354	16846	10337	8349	8106	7684	6021	5598	4066
	Gasoline	306	280	166	59	117	88	205	147	88
	Fuel for Engines	340			34					
	LPG	46			15					
LBDR	Diesel Oil (M)						1266	1013	1352	1044
	Diesel Oil (0.7 to 0.9*M)						1139	912	1216	940
	Gasoline						423	267	387	253
RM – total	Diesel Oil (M)	26290	18718	11486	9311	9007	9803	7703	7572	5562
	Diesel Oil (0.7 to 0.9*M) + Fuel for Engines	23661	16846	10337	8380	8106	8823	6933	6814	5006
	Gasoline	306	278	166	59	117	511	472	534	341
	LPG	46			15					
		1999	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**
RBDR	Diesel Oil (M)	3022	2435	2347	3081	2960	2633	2386	2396	2094
	Diesel Oil (0.9*M)	2720	2191	2112	2773	2664	2370	2147	2156	1885
	Gasoline	59	29	29				12	3	6
	LPG						2	2	2	1
LBDR	Diesel Oil (M)	964	688	679	528	366	328	229	190	139
	Diesel Oil (0.9*M)	868	619	611	475	329	295	207	171	125
	Gasoline	134	77	74	53	55	34	27	25	17
RM – total	Diesel Oil (M)	3986	3123	3026	3609	3326	2961	2615	2586	2233
	Diesel Oil (0.9*M)	3588	2811	2723	3248	2993	2665	2354	2328	2009
	Gasoline	193	106	103	53	55	34	39	28	23
	LPG						2	2	2	1
		2008	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**%**
RBDR	Diesel Oil (M)	2005	1821	1856	1753	1627	1782	2347	2668	-89.7
	Diesel Oil (0.9*M)	1805	1639	1670	1578	1464	1604	2112	2401	-89.7
	Gasoline	5	6	4	11	9		15		
	LPG	3	6	9	8	5	6	7	5	-89.1
LBDR	Diesel Oil (M)	125	166	350	397	437	496	484	459	
	Diesel Oil (0.9*M)	113	149	315	357	393	447	436	413	
	Gasoline	15	18	28	25	27	37	32	28	
RM – total	Diesel Oil (M)	2130	1987	2206	2150	2064	2278	2831	3127	-88.1
	Diesel Oil (0.9*M)	1917	1788	1986	1935	1858	2050	2548	2815	-88.1
	Gasoline	20	24	32	36	36	37	47	28	-90.8
	LPG	3	6	9	8	5	6	7	5	-89.1

Sources: Energy Balances of the RM for 1990 and 1993-2015; Statistical Yearbooks of the ATULBD for 1998-2016.

Trends in Total Fuel Consumption

Next it will be presented the total fuel consumption in the Republic of Moldova (aggregated information for both Banks of the Dniester River) within source category 1A4a "Commercial/ Institutional". As can be seen in Table 3-78, between 1990 and 2015, fuel consumption from the respective sector tended to decrease. Thus, with the exception of natural gas consumption (which increased by circa 213.5 per cent), consumption of other fuels significantly decreased: anthracite consumption decreased by circa 94.2 per cent, residual fuel oil – by circa 99.3 per cent, diesel oil - by circa 87.6 per cent, while LPG consumption – by circa 74.6 per cent.

Table 3-78: Fuel Consumption under the 1A4a "Commercial/Institutional" Source Category in the Republic of Moldova within 1990-2015 periods, TJ

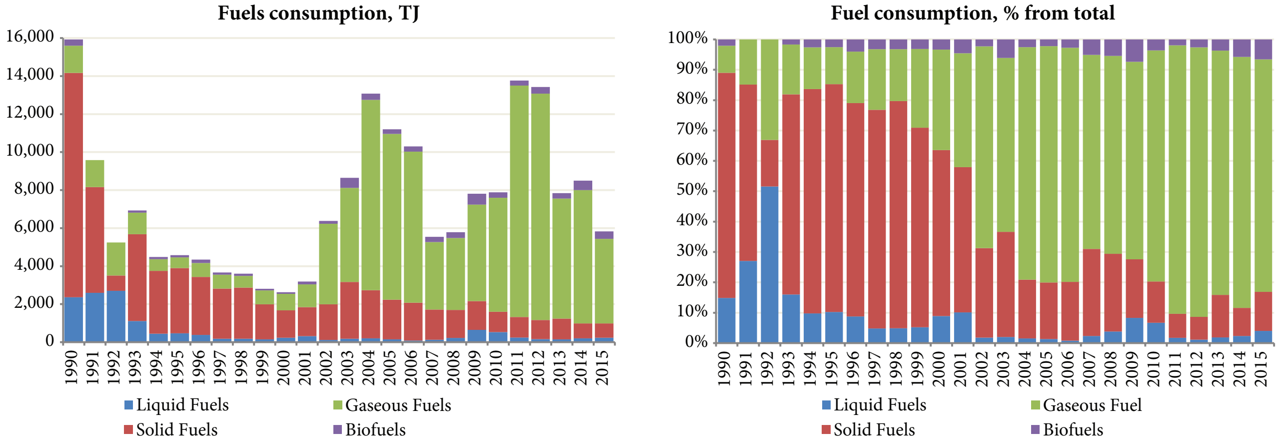
	1990	1991	1992	1993	1994	1995	1996	1997	1998
Gasoline	0	0	0	3	0	0	0	0	0
Diesel Oil	1244	1064	638	206	117	117	88	59	88
Residual Fuel Oil	844	1327	1608	808	323	294	234	88	88
Kerosene	0	203	457	47	0	0	0	0	0
LPG	276	0	0	44	0	59	59	29	0
Anthracite	11616	4575	0	1546	675	440	499	411	323
Bituminous Coal	146	799	803.9	2466	2229	2582	2171	1966	2200
Lignite	12	12	0	557	411	411	381	264	176
Brown Coal - Briquettes	36	0	0	0	0	0	0	0	0
Coke	0	0	0	3	0	0	0	0	0
Natural Gas	1422	1422	1737	1138	616	557	734	734	616
Fuel Wood and Wood Waste	333	0	0	115	117	117	176	117	117
	1999	2000	2001	2002	2003	2004	2005	2006	2007
Gasoline	0	0	0	0	0	2	1	3	36
Diesel Oil	117	206	234	87	88	120	57	44	48
Residual Fuel Oil	29	29	59	30	58	47	19	7	6
Kerosene	0	0	0	0	0	2	0	0	0
LPG	0	0	29	0	29	32	72	32	41
Anthracite	323	645	264	675	1846	1788	1359	1136	1017
Bituminous Coal	1437	734	1203	1174	1115	745	732	859	570
Lignite	88	59	59	29	29	1	0	0	0
Coke	0	0	0	0	0	0	0	0	1
Natural Gas	729	872	1194	4237	4952	10011	8721	7942	3544
Fuel Wood and Wood Waste	88	88	117	147	527	320	241	280	265
Other Solid Biomass	0	0	29	0	0	14	5	2	17
	2008	2009	2010	2011	2012	2013	2014	2015	%
Gasoline	34	6	3	6	0	0	0	0	
Diesel Oil	45	52	189	136	20	1	4	154	-87.6
Residual Fuel Oil	100	183	38	17	11	8	3	6	-99.3
LPG	42	382	291	82	125	135	193	70.1	-74.6
Other Petroleum Products	2	28	7	0	0	1	0	3	
Anthracite	803	1191	830	867	898	1032	587	672	-94.2
Bituminous Coal	674.6	316.6	243.3	218.1	108.2	67.9	197.3	77.1	-47.4
Brown Coal - Briquettes	0	0	0	0	1	0	0	0	
Natural Gas	3775	5080	5999	12178	11911	6308	7021	4459	213.5
Fuel Wood and Wood Waste	283	276	245	236	262	220	258	234	-29.7
Other Solid Biomass	30	300	41	31	88	68	212	133	
Charcoal	0	0	0	0	0	3	21	16	

Table 3-79, respectively Figure 3-14, present the consumption by fuel groups recorded in 1990-2015 time series in the RM within source category 1A4a "Commercial/Institutional".

Table 3-79: Consumption by Fuel Groups for Source Category 1A4a "Commercial/Institutional" in the Republic of Moldova within 1990-2015 periods, TJ

	1990	1991	1992	1993	1994	1995	1996	1997	1998
Liquid Fuels	2364	2593	2703	1108	440	470	381	176	176
Solid Fuels	11810	5563	804	4572	3315	3433	3051	2641	2699
Gaseous Fuels	1422	1422	1737	1138	616	557	734	734	616
Biofuels	333			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	729	872	1194	4237	4952	10011	8721	7942	3544
Biofuels	88	88	146	147	527	334	246	282	282
	2008	2009	2010	2011	2012	2013	2014	2015	%
Liquid Fuels	222	650	528	241	156	145	200	233	-90.1
Solid Fuels	1478	1508	1073	1085	1007	1100	784	749	-93.9
Gaseous Fuels	3775	5080	5999	12178	11911	6308	7021	4459	213.5
Biofuels	313	576	286	267	350	291	491	383	15.1

As it can be noted, between 1990 and 2015, significantly decreased the consumption of solid fuels (-93.9 per cent) as well as liquid fuels (-90.1 per cent), while it increased for the consumption of biofuels (15.1 per cent) and gaseous fuels (213.5 per cent).



a) **b)**

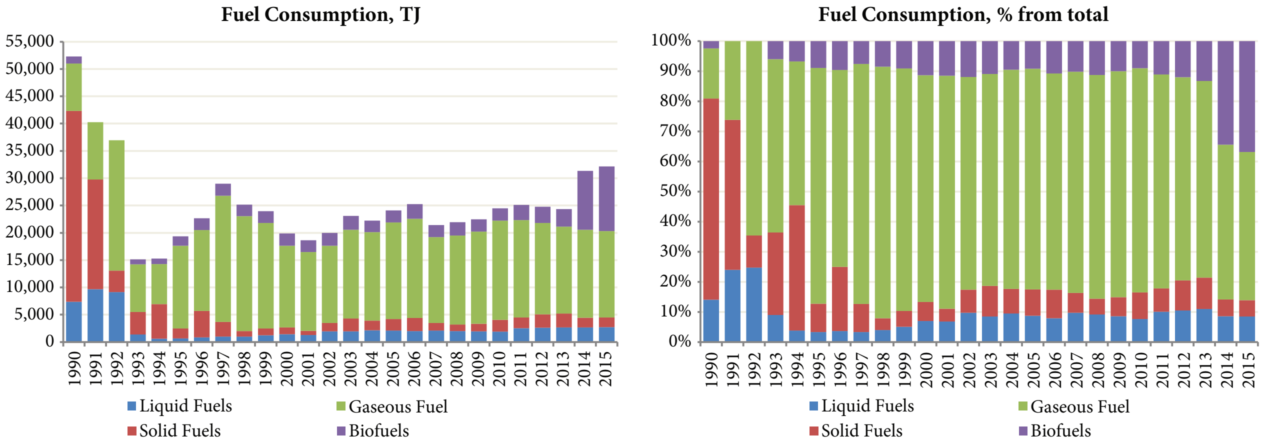
Figure 3-14: Consumption by Fuel Groups for Source Category 1A4a "Commercial/Institutional" in the Republic of Moldova within 1990-2015 periods

Next it will be presented the total fuel consumption in the Republic of Moldova (aggregated information for both Banks of the Dniester River) within source category 1A4b "Residential". As can be seen in Table 3-80, between 1990 and 2015, fuel consumption from the respective sector tended to decrease for anthracite – by circa 95.1 per cent and LPG consumption – by circa 52.5 per cent, while it increased for natural gas consumption – by circa 81.9 per cent, bituminous coal – by circa 485.7 per cent and fire woods - by circa 10 times.

Table 3-80: Fuel Consumption under the 1A4b "Residential" Source Category in the Republic of Moldova within 1990-2015 periods, TJ

	1990	1991	1992	1993	1994	1995	1996	1997	1998
Residual Fuel Oil		1065	7714		29				
Kerosene	431			26					
Diesel Oil	1191	8593	553	15			29		29
LPG	5758		866	1317	557	643	810	974	970
Anthracite	32485	5140		2473	3491	1350	1584	1936	440
Bituminous Coal	25	97912	3961	1468	2847	440	3199	734	558
Lignite	1916	5151		214	29	29	29	29	
Coke				6			29		
Natural Gas	8702	10530	23854	8717	7306	15168	14834	23134	21041
Fuel Wood and Wood Waste	1052			913	1027	1731	2171	2200	2142
Other Solid Biomass	234								
	1999	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**
Residual Fuel Oil							2		
Kerosene							1		
Diesel Oil	29	59	29						
LPG	1181	1338	1246	1954	1957	2121	2102	2000	2091
Other Petroleum Products							9	1	3
Anthracite	939	1115	763	1526	2286	1749	2012	2345	1334
Bituminous Coal	323	147	21		59	57	92	45	73
Natural Gas	19317	14977	14425	14125	16268	16205	17676	18166	15726
Fuel Wood and Wood Waste	2171	2230	2142	2377	2404	1993	1998	2463	1987
Other Solid Biomass		29			117	130	214	245	197
	2008	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**%**
Diesel Oil		2		11					
LPG	2005	1931	1876	2514	2613	2677	2680	2734.7	-52.5
Other Petroleum Products	1	1		2					
Anthracite	1127	1409	2161	1885	2446	2538	1758	1584	-95.1
Bituminous Coal	42	17	7	70	17	10	9	149	485.7
Peat								8	
Natural Gas	16319	16881	18210	17844	16732	15903	16110	15832	81.9
Fuel Wood and Wood Waste	2254	2254	2142	2361	2864	3086	10618	11589	1001.4
Other Solid Biomass	212		66	419	96	134	181	244	
Charcoal					17	11		2	

Table 3-81, respectively Figure 3-15, present the consumption by fuel groups recorded in 1990-2015 time series in the Republic of Moldova within source category 1A4b "Residential". As it can be noted, between 1990 and 2015, significantly decreased the consumption of solid fuels (-95.0 per cent) as well as liquid fuels (-62.9 per cent), while it increased for the consumption of gaseous fuels (81.9 per cent) and biofuels (819.8 per cent).



a) **b)**

Figure 3-15: Consumption by Fuel Groups for Source Category 1A4b "Residential" in the Republic of Moldova within 1990-2015 periods

Table 3-81: Consumption by Fuel Groups for Source Category 1A4b "Residential" in the Republic of Moldova within 1990-2015 periods, TJ

	1990	1991	1992	1993	1994	1995	1996	1997	1998
Liquid Fuels	7380	9658	9133	1358	586	643	839	974	999
Solid Fuels	34940	20083	3961	4161	6367	1819	4841	2699	998
Gaseous Fuels	8702	10530	23854	8717	7306	15168	14834	23134	21041
Biofuels	1287			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	19317	14977	14425	14125	16268	16205	17676	18166	15726
Biofuels	2171	2259	2142	2377	2521	2123	2212	2708	2184
	2008	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**%**
Liquid Fuels	2006	1934	1876	2527	2613	2677	2680	2734.7	-62.9
Solid Fuels	1169	1426	2168	1955	2463	2548	1767	1741	-95.0
Gaseous Fuels	16319	16881	18210	17844	16732	15903	16110	15832	81.9
Biofuels	2466	2254	2208	2780	2977	3231	10799	11835	819.8

Next it will be presented the total fuel consumption in the Republic of Moldova (aggregated information for both Banks of the Dniester River) within source category 1A4ci "Agriculture / Forestry / Fishing" (stationary sources). As can be seen in Table 3-82, between 1990 and 2015, fuel consumption from the respective sector tended to decrease, with the exception of natural gas consumption (which increased by circa 31.4 per cent.

Table 3-82: Fuel Consumption under the 1A4ci "Agriculture/Forestry/Fishing" Source Category (Stationary Sources) in the Republic of Moldova within 1990-2015 periods, TJ

	1990	1991	1992	1993	1994	1995	1996	1997	1998
Diesel Oil	1078	408	204	235	59		117	88	264
Residual Fuel Oil	241	1005	683	200	88			29	
Kerosene	43	3429	2428	246	29	29			
Anthracite	540			94	59	29	29	29	
Bituminous Coal		3910	3834	120	88	59	59		29
Lignite				18					
Natural Gas	68	2854	3667	67	88	147	176	352	293
Fuel Wood and Wood Waste	36			12	29	29	29	29	
Other Solid Biomass				29	29		29	117	29
	1999	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**
Diesel Oil	117	147	205	59	29	14	4	2	
Residual Fuel Oil						1	3	2	
Kerosene						6	5		
Other Petroleum Products							2		
Anthracite						7	4	3	

	1999	2000	2001	2002	2003	2004	2005	2006	2007
Bituminous Coal						3	2	2	2
Natural Gas	176	176	117	117	177	259	111	65	29
Fuel Wood and Wood Waste			29		29	8	15	18	13
Other Solid Biomass						2	7	12	2
	2008	2009	2010	2011	2012	2013	2014	2015	%
Diesel Oil		1		2					
Residual Fuel Oil	2	1	0	1	0	3			
Other Petroleum Products		1						1	
Anthracite	1	2	2	5		11	12	29	-94.6
Bituminous Coal	1	0	0	1	7	10	7	1	
Natural Gas	103	74	99	89	139	148	70	89	31.4
Fuel Wood and Wood Waste	10	19	25	15	31	29	39	27	-24.9
Other Solid Biomass	1	2	6		2	3	5	1	

Table 3-83 presents the consumption by fuel groups recorded in 1990-2015 time series in the RM within source category 1A4ci "Agriculture/Forestry/Fishing" (stationary sources).

Table 3-83: Consumption by Fuel Groups for Source Category 1A4ci "Agriculture / Forestry / Fishing" Source Category (Stationary Sources) in the RM within 1990-2015 periods, TJ

	1990	1991	1992	1993	1994	1995	1996	1997	1998
Liquid Fuels	1363	4842	3316	681	176	29	117	117	264
Solid Fuels	540	3910	3834	232	147	88	88	29	29
Gaseous Fuels	68	2854	3667	67	88	147	176	352	293
Biofuels	36			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	
Solid Fuels						10	6	5	2
Gaseous Fuels	176	176	117	117	177	259	111	65	29
Biofuels			29		29	10	22	30	15
	2008	2009	2010	2011	2012	2013	2014	2015	%
Liquid Fuels	2.1	3.1	0.1	3.1	0.1	3.1		1.0	-99.9
Solid Fuels	2	2	2	6	7	21	19	30	-94.5
Gaseous Fuels	103	74	99	89	139	148	70	89	31.4
Biofuels	11	21	31	15	33	32	44	28	-22.2

As it can be noted, between 1990 and 2015, significantly decreased the consumption of liquid fuels (-99.9 per cent), solid fuels (-94.5 per cent), as well as biofuels (-22.2 per cent) while it slightly increased for the consumption of gaseous fuels (31.4 per cent).

Next it will be presented the total fuel consumption in the Republic of Moldova (aggregated information for both Banks of the Dniester River) within source category 1A4ci "Agriculture / Forestry / Fishing" (mobile sources). As can be seen in Table 3-84, between 1990 and 2015, fuel consumption from the respective sector tended to decrease.

Table 3-84: Fuel Consumption under the 1A4cii "Agriculture/Forestry/Fishing" Source Category (Mobile Sources) in the Republic of Moldova within 1990-2015 periods, TJ

	1990	1991	1992	1993	1994	1995	1996	1997	1998
Diesel Oil	18402.8	13476.7	8786.6	8379.9	8106.3	8823.1	6933.0	6814.4	5006.2
Gasoline	306.0	279.8	166.1	59.0	117.0	511.3	472.4	534.3	341.2
LPG	46.1			15.0					
	1999	2000	2001	2002	2003	2004	2005	2006	2007
Diesel Oil	3587.8	2810.8	2723.0	3247.8	2993.3	2664.8	2353.9	2327.6	2009.4
Gasoline	193.4	105.7	103.0	53.4	55.0	34.1	38.8	28.1	23.4
LPG						2	2	2	1
	2008	2009	2010	2011	2012	2013	2014	2015	%
Diesel Oil	1917.2	1787.9	1985.7	1934.8	1857.6	2050.3	2548.2	2814.6	-84.7
Gasoline	19.6	24.5	32.2	36.5	35.8	37.1	46.5	28.1	-90.8
LPG	3	6	9	8	5	6	7	5	-89.1

Table 3-85 presents the consumption by fuel groups recorded in 1990-2015 time series in the Republic of Moldova within source category 1A4 "Other Sectors". As it can be noted, between 1990 and 2015, significantly decreased the total fuel consumption (by circa 56.2 per cent or from circa 86,737 TJ in 1990 to circa 38,009 TJ in 2015). It should be mentioned that the structure of fuel consumption significantly changed during the period under review. Thus, the share of liquid fuels decreased from

31.9 per cent in 1990 to 7.5 per cent in 2015, the share of solid fuels decreased from circa 54.5 per cent in 1990 up to circa 6.6 per cent in 2015; at the same time, the share of gaseous fuels and biofuels increased from circa 11.8 per cent and 1.9 per cent in 1990, up to circa 53.6 per cent and 32.2% în 2015.

Table 3-85: Consumption by Fuel Groups for Source Category 1A4 "Other Sectors" in the Republic of Moldova within 1990-2015 periods, TJ

	Fuel Consumption within source category 1A4, TJ					% of the total			
	Liquid	Solid	Gaseous	Biofuel	Total	Liquid	Solid	Gaseous	Biofuel
1990	27634	47255	10192	1655	86737	31.9	54.5	11.8	1.9
1991	30442	29556	14807		74804	40.7	39.5	19.8	
1992	23901	8599	29258		61758	38.7	13.9	47.4	
1993	7471	8965	9922	1069	27427	23.9	34.2	37.8	4.1
1994	11208	9829	8010	1202	30249	37.1	32.5	26.5	4.0
1995	2932	5340	15872	1877	26021	11.3	20.5	61.0	7.2
1996	2031	7980	15744	2405	28160	7.2	28.3	55.9	8.5
1997	1830	5369	24220	2463	33882	5.4	15.8	71.5	7.3
1998	1516	3726	21950	2288	29480	5.1	12.6	74.5	7.8
1999	1637	3110	20222	2259	27228	6.0	11.4	74.3	8.3
2000	1620	2700	16025	2347	22692	7.1	11.9	70.6	10.3
2001	1818	2310	15736	2317	22181	8.2	10.4	70.9	10.4
2002	2300	3404	18479	2524	26707	8.6	12.7	69.2	9.5
2003	2511	5335	21397	3077	32320	7.8	16.5	66.2	9.5
2004	2713	4350	26475	2467	36005	7.5	12.1	73.5	6.9
2005	2401	4201	26508	2480	35589	6.7	11.8	74.5	7.0
2006	2190	4390	26173	3020	35773	6.1	12.3	73.2	8.4
2007	2334	2997	19299	2481	27111	8.6	11.1	71.2	9.2
2008	2266	2649	20197	2790	27903	8.1	9.5	72.4	10.0
2009	2603	2936	22035	2851	30425	8.6	9.6	72.4	9.4
2010	2296	3244	24308	2525	32373	7.1	10.0	75.1	7.8
2011	2703	3046	30111	3062	38923	6.9	7.8	77.4	7.9
2012	2840	3476	28782	3360	38457	7.4	9.0	74.8	8.7
2013	3050	3669	22359	3554	32632	9.3	11.2	68.5	10.9
2014	3072	2570	23201	11334	40177	7.6	6.4	57.7	28.2
2015	2863	2520	20380	12246	38009	7.5	6.6	53.6	32.2

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", 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 "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 Energy Sector, 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" 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 subcategory included in 1A4 "Other Sectors" complies with the requirements set out in the description of each subcategory in the 2006 IPCC Guidelines (in the current inventory cycle, separate GHG emissions were calculated for 3 subcategories (1A4a Commercial/Institutional, 1A4b Residential and 1A4c Agriculture / Forestry / Fishing (the last one was disaggregated in stationary and mobile sources)); for each subcategory, AD is available in separate files in energy units; verifying the correctness of EFs use for each subcategory; verifying if the primary reference sources are correctly indicated; the accuracy of calculations for subcategories included in 1A4 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 calculations files the EFs are specified in tabular formats for each subcategory, the import of the respective values into calculation formulas is ensured by automatic connections;
- the consistency of the calculations is also ensured by verifying the correctness of applying conversion factors of natural units to energy units for all subcategories and the entire range of years covered by the inventory;
- verification if the same method is used for the entire range of years covered by the inventory;
- verifying if GHG emissions calculations have been made for all years and for all types of fuels mentioned in the Energy Balances of the RM (in the current inventory cycle, for the first time were monitored the consumption of new fuel types, such as peat and charcoal; the consumption of lubricants and grease was reallocated to source category 2D1 within the "Industrial Processes and Products Use" Sector; also, the consumption of certain fuels such as residual fuel oil and coal from 1A3c category were reallocated to 1A4a) 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, etc.

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". The main causes of these recalculations are, as follows: in order to estimate GHG emissions were used AD expressed in energy units (TJ) and not in natural units (kt); for the first time, GHG emissions from stationary and mobile sources under the 1A4c "Agriculture/Forestry/Fishing" sector were estimated separately; fuel consumption for 1990-2013 time series was updated due to performed reallocations between categories 1A3c and 1A4a; GHG emissions from coal and residual fuel oil consumption, previously included in 1A3c, in the current inventory cycle were reallocated to 1A4a; GHG emissions from lubricants and grease consumption previously included in 1A4, in the current inventory cycle were reallocated to 2D1; also, in order to convert direct GHG emissions in CO_2 equivalent, in the current inventory cycle, the 100-year Global Warming Potential (GWP_{100}) values available in the Fourth IPCC Assessment Report (AR4) (CH_4 – 25 and N_2O – 298), were used in the detriment of GWP_{100} values in the Second IPCC Assessment Report (SAR) (CH_4 – 21 and N_2O – 310).

In comparison with the results included into the BUR1 of the Republic of Moldova under the UNFCCC, the performed recalculations in the current inventory cycle resulted in a decreasing trend of direct

GHG emissions within 1990-2002 and 2010-2013, varying from a minimum decrease by 0.9 per cent in 1997 and a maximum decrease by 5.3 per cent in 1990 (Table 3-86); respectively, in an increasing trend within 2003-2008 periods, varying from a minimum increase by 0.1 per cent in 2004 and a maximum increase by 0.7 per cent in 2009. For 2014-2015 time periods the direct GHG emissions from 1A4 "Other Sectors" were estimated for the first time. The results allow assert that between 1990 and 2015, the GHG emissions originated from this sector decreased by 74.8 per cent.

Table 3-86: Comparative Results of GHG Emissions Inventory from 1A4 "Other Sectors" included into the BUR1 and NC4 of the RM under the UNFCCC, kt CO_2 equivalent

	1990	1991	1992	1993	1994	1995	1996	1997	1998
BUR1	8 037.7787	6 507.3984	4 494.1909	2 338.1399	2 203.3690	2 258.4776	2 372.8651	2 571.3352	2 147.0139
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
Difference, %	-5.3	-4.8	-3.6	-1.3	-2.1	-2.0	-1.3	-0.9	-2.5
	1999	2000	2001	2002	2003	2004	2005	2006	2007
BUR1	1 888.7497	1 550.3379	1 484.7254	1 808.0977	2 122.2620	2 299.7274	2 255.7659	2 250.6673	1 698.2365
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
Difference, %	-2.9	-2.3	-2.5	-1.4	0.6	0.1	0.4	0.2	0.4
	2008	2009	2010	2011	2012	2013	2014	2015	%
BUR1	1 706.1998	1 853.3520	2 059.6768	2 390.2800	2 361.6297	2 050.5388			
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	-74.8
Difference, %	0.6	0.7	-1.4	-1.3	-1.5	-2.2			

The tables below present the performed recalculations for the most important emission sources within 1A4 "Other Sectors" (Tables 3-87, 3-88 and 3-89).

Table 3-87: Comparative Results of GHG Emissions Inventory from 1A4a "Commercial / Institutional" included into the BUR1 and NC4 of the RM under the UNFCCC, kt CO_2 equivalent

	1990	1991	1992	1993	1994	1995	1996	1997	1998
BUR1	1 424.0685	808.9106	380.6989	569.3391	403.6435	395.0255	365.6557	326.1969	334.8629
NC4	1 427.3919	824.9777	380.0979	594.6681	390.5659	399.0975	366.3592	310.2782	308.6055
Difference, %	0.2	2.0	-0.2	4.4	-3.2	1.0	0.2	-4.9	-7.8
	1999	2000	2001	2002	2003	2004	2005	2006	2007
BUR1	263.1959	230.0159	262.1940	451.1369	580.9628	831.4972	710.9191	652.8965	366.2886
NC4	230.6187	207.2302	239.0809	430.0990	588.0153	829.0842	707.3816	649.6049	366.0731
Difference, %	-12.4	-9.9	-8.8	-4.7	1.2	-0.3	-0.5	-0.5	-0.1
	2008	2009	2010	2011	2012	2013	2014	2015	%
BUR1	371.7121	471.5949	485.0870	809.2339	785.2225	475.4756			
NC4	375.1371	483.5828	481.5109	811.0471	782.6299	475.3008	488.8411	344.5964	-75.9
Difference, %	0.9	2.5	-0.7	0.2	-0.3	0.0			

Table 3-88: Comparative Results of GHG Emissions Inventory from 1A4b "Residential Sector" included into the BUR1 and NC4 of the RM under the UNFCCC, kt CO_2 equivalent

	1990	1991	1992	1993	1994	1995	1996	1997	1998
BUR1	4 657.3239	3 511.6971	2 489.8212	1 060.5292	1 164.6211	1 132.1712	1 428.2501	1 668.2665	1 372.0178
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
Difference, %	1.0	-2.4	-1.8	-3.7	-3.5	-2.8	-1.5	-0.1	-0.3
	1999	2000	2001	2002	2003	2004	2005	2006	2007
BUR1	1 314.8603	1 081.0535	990.3885	1 098.8397	1 303.6011	1 252.3923	1 361.4120	1 419.4916	1 179.8472
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
Difference, %	-0.1	-0.1	0.2	0.2	0.5	0.3	0.7	0.4	0.5
	2008	2009	2010	2011	2012	2013	2014	2015	%
BUR1	1 185.0593	1 242.7960	1 417.5418	1 429.8049	1 429.0009	1 408.8471			
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	-71.3
Difference, %	0.5	0.0	-1.8	-2.5	-2.5	-3.3			

Table 3-89: Comparative Results of GHG Emissions Inventory from 1A4c "Agriculture / Forestry / Fishing" included into the BUR1 and NC4 of the RM under the UNFCCC, kt CO_2 equivalent

	1990	1991	1992	1993	1994	1995	1996	1997	1998
BUR1	1 956.3862	2 186.7907	1 623.6708	708.2716	635.1044	731.2809	578.9593	579.9885	440.1331
NC4	1 479.1478	1 942.1142	1 509.9125	691.3447	642.0048	712.9816	569.1822	571.5371	416.6032
Difference, %	-24.4	-11.2	-7.0	-2.4	1.1	-2.5	-1.7	-1.5	-5.3

	1999	2000	2001	2002	2003	2004	2005	2006	2007
BUR1	310.7029	239.2779	232.1523	258.1304	237.6981	215.8473	183.4348	178.2885	152.1100
NC4	290.7778	226.7560	216.9555	252.3643	237.1578	217.3160	186.0459	180.1764	153.4182
Difference, %	-6.4	-5.2	-6.5	-2.2	-0.2	0.7	1.4	1.1	0.9
	2008	2009	2010	2011	2012	2013	2014	2015	%
BUR1	149.4284	138.9611	157.0480	151.2413	147.4063	166.2161			
NC4	150.7730	140.0901	156.9148	153.1016	150.0367	166.7785	199.8706	220.5107	-85.1
Difference, %	0.9	0.8	-0.1	1.2	1.8	0.3			

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 ATULBD for the entire period under review (for example, by applying techniques for data recovery for the missing years; by updating AD on fuel consumption within this sector for 1991 and 1992, when the Energy Balances of the RM were not generated, through reallocations from other source categories based on expert opinion or through the application of certain methods of data recovery according to the reccommendations and the good practices presented in the 2006 IPCC Guidelines; by obtaining and using annual AD asdociated with real caloric values for natural gas imported and consumed each year in the RM within the 1A4 source category (according to the information provided by J.S.C. "Moldovagaz", these data are available starting with 1994).

3.6. Other (Category 1A5)

3.6.1. Source Category Description

The 1A5 "Other" category includes GHG emissions from fuels combustion for other works and needs within the energy sector, including military transport. The respective category includes three subcategories: 1A5a Stationary combustion (all types of fuels, with the exception of diesel oil, gasoline, aviation gasoline, kerosene and lubricants), 1A5bi Mobile combustion of fuels for aviation transport (aviation gasoline and kerosene) and 1A5bi Mobile combustion of fuels for other types of fuels (diesel oil and gasoline).

Between 1990 and 2015, GHG emissions originated from 1A5 "Other" category registered a decreasing trend (Table 3-90). Compared to 1990, in 2015 the level of GHG emissions from 1A5 "Other" category accounted for CO_2 circa 2.0 per cent, CH_4 – 2.2 per cent, N_2O – 1.6 per cent, NO_x – 1.6 per cent, CO – 2.4 per cent, NMVOC – 2.4 per cent and SO_2 – 3.8 per cent.

Table 3-90: GHG Emissions from 1A5 "Other" Category within 1990-2015 periods

	GHG Emissions, kt							In comparison 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	0.8821	2.2609	0.4285	0.5951	100.0	100.0	100.0	100.0	100.0	100.0	100.0
1991	80.4355	0.0070	0.0031	0.6447	1.5175	0.2932	0.5653	70.6	63.9	69.1	73.1	67.1	68.4	95.0
1992	62.2278	0.0044	0.0020	0.4417	0.8504	0.1655	0.5892	54.6	40.7	45.8	50.1	37.6	38.6	99.0
1993	91.8254	0.0054	0.0023	0.5163	0.9899	0.1879	0.7113	80.6	49.4	52.8	58.5	43.8	43.8	119.5
1994	73.4680	0.0070	0.0015	0.3411	1.1855	0.2211	0.5889	64.5	63.8	32.7	38.7	52.4	51.6	99.0
1995	117.6762	0.0100	0.0021	0.4726	1.3732	0.2535	1.6050	103.2	92.0	47.6	53.6	60.7	59.2	269.7
1996	82.9580	0.0110	0.0023	0.4319	1.5836	0.2846	0.9687	72.8	101.3	52.2	49.0	70.0	66.4	162.8
1997	72.6527	0.0077	0.0019	0.3784	1.2383	0.2275	0.7711	63.7	70.8	42.7	42.9	54.8	53.1	129.6
1998	55.7495	0.0077	0.0018	0.3359	1.2324	0.2221	0.3803	48.9	70.6	40.9	38.1	54.5	51.8	63.9
1999	44.3448	0.0063	0.0015	0.2691	0.8867	0.1568	0.4037	38.9	57.9	34.6	30.5	39.2	36.6	67.8
2000	25.9774	0.0036	0.0008	0.1449	0.6314	0.1156	0.1704	22.8	32.9	17.1	16.4	27.9	27.0	28.6
2001	27.9644	0.0047	0.0012	0.1934	0.7332	0.1312	0.2170	24.5	42.7	26.0	21.9	32.4	30.6	36.5
2002	35.1345	0.0081	0.0015	0.2143	1.0185	0.1726	0.3494	30.8	74.7	34.8	24.3	45.1	40.3	58.7
2003	26.8027	0.0036	0.0008	0.1422	0.4499	0.0775	0.2519	23.5	32.9	18.6	16.1	19.9	18.1	42.3
2004	33.7244	0.0034	0.0011	0.2205	0.5588	0.1037	0.1264	29.6	31.1	24.2	25.0	24.7	24.2	21.2
2005	34.6426	0.0028	0.0010	0.2115	0.3529	0.0646	0.1261	30.4	25.3	23.1	24.0	15.6	15.1	21.2
2006	50.9179	0.0034	0.0014	0.2844	0.4406	0.0815	0.3090	44.7	31.0	30.9	32.2	19.5	19.0	51.9
2007	61.2028	0.0046	0.0019	0.3845	0.6790	0.1271	0.2434	53.7	42.3	42.0	43.6	30.0	29.7	40.9
2008	62.8705	0.0042	0.0017	0.3607	0.6564	0.1236	0.4105	55.2	38.9	38.9	40.9	29.0	28.8	69.0
2009	12.9193	0.0010	0.0003	0.0593	0.1482	0.0271	0.1172	11.3	9.2	6.3	6.7	6.6	6.3	19.7

	GHG Emissions, kt							In comparison 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
2010	24.0285	0.0022	0.0006	0.0989	0.2105	0.0343	0.2890	21.1	20.5	13.1	11.2	9.3	8.0	48.6
2011	21.7672	0.0013	0.0005	0.0928	0.1631	0.0292	0.2251	19.1	11.7	10.4	10.5	7.2	6.8	37.8
2012	7.7134	0.0006	0.0002	0.0466	0.1251	0.0239	0.0466	6.8	5.5	4.8	5.3	5.5	5.6	7.8
2013	3.7983	0.0003	0.0001	0.0271	0.0682	0.0131	0.0335	3.3	2.7	3.0	3.1	3.0	3.1	5.6
2014	2.2750	0.0003	0.0001	0.0156	0.0705	0.0134	0.0196	2.0	2.7	1.8	1.8	3.1	3.1	3.3
2015	2.2468	0.0002	0.0001	0.0144	0.0551	0.0105	0.0226	2.0	2.2	1.6	1.6	2.4	2.4	3.8

Between 1990 and 2015, GHG emissions originated from 1A5 "Other" category tended to decrease by circa 98.5 per cent: from circa 115.57 kt CO_2 equivalent in 1990, up to circa 2.27 kt CO_2 equivalent in 2015 (Table 3-91, Figure 3-16).

Table 3-91: Direct GHG Emissions from 1A5 "Other" Category within 1990-2015 periods

	1A5a Stationary combustion				1A5b Mobile combustion				1A5 Other		
	Direct GHG Emissions, kt CO_2 equivalent									Share, in % from the total	
	CO_2	CH_4	N_2O	Total	CO_2	CH_4	N_2O	Total	Total	1A5a Stationary	1A5b Mobile
1990	41.9609	0.0495	0.2192	42.2296	72.0113	0.2231	1.1061	73.3405	115.5701	36.5	63.5
1991	25.5778	0.0217	0.0698	25.6692	54.8577	0.1524	0.8458	55.8559	81.5251	31.5	68.5
1992	27.0699	0.0262	0.0625	27.1586	35.1579	0.0848	0.5444	35.7871	62.9457	43.1	56.9
1993	59.9669	0.0387	0.2104	60.2160	31.8585	0.0961	0.4898	32.4444	92.6604	65.0	35.0
1994	54.4786	0.0569	0.1520	54.6875	18.9894	0.1169	0.2811	19.3874	74.0749	73.8	26.2
1995	96.6955	0.1183	0.3209	97.1347	20.9807	0.1325	0.3100	21.4232	118.5579	81.9	18.1
1996	56.4752	0.1274	0.2975	56.9001	26.4828	0.1486	0.3947	27.0262	83.9263	67.8	32.2
1997	49.2792	0.0736	0.2152	49.5680	23.3735	0.1193	0.3505	23.8432	73.4112	67.5	32.5
1998	33.1070	0.0763	0.2031	33.3864	22.6425	0.1161	0.3394	23.0980	56.4845	59.1	40.9
1999	26.2608	0.0771	0.1847	26.5225	18.0840	0.0808	0.2733	18.4381	44.9606	59.0	41.0
2000	16.1734	0.0285	0.0820	16.2838	9.8040	0.0613	0.1450	10.0103	26.2941	61.9	38.1
2001	13.3407	0.0479	0.1235	13.5121	14.6237	0.0685	0.2204	14.9126	28.4247	47.5	52.5
2002	21.0485	0.1147	0.2533	21.4165	14.0860	0.0890	0.2081	14.3832	35.7997	59.8	40.2
2003	18.7910	0.0501	0.1261	18.9672	8.0117	0.0395	0.1204	8.1716	27.1388	69.9	30.1
2004	17.4853	0.0315	0.0724	17.5892	16.2391	0.0534	0.2489	16.5414	34.1306	51.5	48.5
2005	20.3994	0.0372	0.0851	20.5217	14.2432	0.0317	0.2210	14.4959	35.0177	58.6	41.4
2006	33.3608	0.0444	0.1373	33.5425	17.5571	0.0400	0.2723	17.8694	51.4118	65.2	34.8
2007	34.4911	0.0518	0.1426	34.6855	26.7117	0.0636	0.4138	27.1890	61.8745	56.1	43.9
2008	39.6045	0.0435	0.1568	39.8048	23.2659	0.0625	0.3591	23.6875	63.4923	62.7	37.3
2009	9.9033	0.0111	0.0379	9.9523	3.0161	0.0139	0.0455	3.0755	13.0278	76.4	23.6
2010	20.5266	0.0393	0.1212	20.6871	3.5018	0.0166	0.0527	3.5712	24.2583	85.3	14.7
2011	17.9050	0.0175	0.0795	18.0020	3.8622	0.0145	0.0583	3.9350	21.9369	82.1	17.9
2012	4.3648	0.0024	0.0124	4.3796	3.3486	0.0125	0.0506	3.4116	7.7913	56.2	43.8
2013	1.6550	0.0004	0.0073	1.6627	2.1433	0.0069	0.0327	2.1828	3.8456	43.2	56.8
2014	0.9603	0.0002	0.0043	0.9648	1.3147	0.0072	0.0193	1.3412	2.3060	41.8	58.2
2015	1.1524	0.0003	0.0051	1.1578	1.0944	0.0056	0.0164	1.1164	2.2742	50.9	49.1

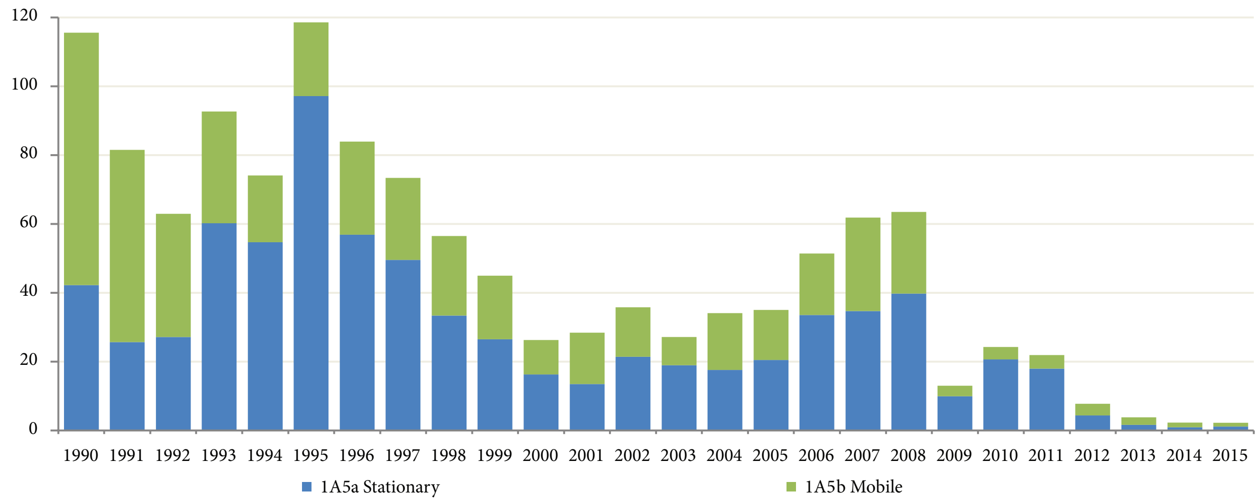


Figure 3-16: Direct GHG Emissions from 1A5 "Other" Category within 1990-2015 periods, kt CO_2 equivalent

If in the reference year circa 36.5 per cent of the total emissions oroginated from the stationary combustion of fuels and other circa 63.5 per cent from the mobile combustion of fuels, by 2015 the share of emissions from stationary and mobile combustion was approximately equal (50.9 per cent and 49.1 per cent respectively).

3.6.2. Methodological Issues, Emission Factors and Activity Data

GHG emissions originated from the 1A5 "Other" category was estimated following a Tier 1 methodology. EFs used for estimating CO_2 emissions are described in Table 3-92.

Table 3-92: Emission Factors Used to Estimate GHG Emissions from Source Category 1A5 "Other", kg/TJ

	EF, kg/TJ						Notes
	CO_2	CH_4	N_2O	NOx	CO	NMVOC	
1A5a Stationary Combustion							
Anthracite	98300	1	1.5	300	20	5	
Brown Coal, Lignite	101000	1	1.5	300	20	5	
Other Bituminous Coal	94600	1	1.5	300	20	5	
Coke	107 000	1	1.5	300	20	5	
Kerosene for Oven	71900	3	0.6	200	15	5	
Residual Fuel Oil	77400	3	0.6	200	15	5	
Kerosene	71900	3	0.6	200	15	5	
Bitumen	80 700	3	0.6	200	15	5	
Other Petroleum Products	73300	3	0.6	200	15	5	
Natural Gas	56100	1	0.1	150	20	5	
LPG	63100	1	0.1	200	15	5	
Fuel Woods	112000	30	4	100	1000	50	
Wood Waste	112000	30	4	100	1000	50	
Agriculture Residues	100000	30	4	100	1000	50	
Charcoal	112000	200	4	100	1000	50	
Pellets and Briquettes	100000	30	4	100	1000	50	
Biogas	54600	1	0.1	100	1000	50	
1A5bi Mobile Combustion for Aviation Transport							
Aviation Gasoline	71500	0.5	2	300	100	50	EFs values are similar to those used within 1A3a
Kerosene	69300	0.5	2	300	100	50	
1f5bi Mobile Combustion for Other Types of Transport							
Gasoline	69300	33	3.2	600	8000	1500	EFs values are similar to those used within 1A3b
Diesel Oil	74100	3.9	3.9	800	1000	200	
Lubricants	73300	3	0.6	200	15	5	
Reference:	2006 IPCC Guidelines			1996 Revised IPCC Guidelines			

The Energy Balances of the RM (column "Used for other purposes", Chapter S.2.1 "Consumed as Fuel or Energy" and column: "for other works and needs") represented the main source of reference for AD associated to fuel consumption on the Right Bank of Dniester River. Another relevant source of reference was the Ministry of Defence (fuel combustion for military transport).

Activity data pertaining to the fuel consumption on the Left Bank of Dniester River were collected from the Statistical Yearbooks of the ATULBD (these are available for certain types of fuels (residual fuel oil and coal) only for 2008-2015 time series) (Table 3-93).

Table 3-93: Fuel Consumption under the 1A5 "Other" Category for the ATULBD within 2008-2015 periods, TJ

	2008	2009	2010	2011	2012	2013	2014	2015
Bituminous Coal	51.640	28.971	28.240	24.989	16.541	16.386	9.508	11.410
Residual Fuel Oil	1.929	1.310						

AD used to estimate GHG emissions from source category 1A5 "Other" (by subcategories) are presented below in Tables 3-94, 3-95, 3-96 and 3-97.

Table 3-94: Fuel Consumption under the 1A5 "Other" Category (subcategory 1A5a Stationary combustion of fuels) within 1990-2015 periods, TJ

	1990	1991	1992	1993	1994	1995	1996	1997	1998
Anthracite	334.1	0	0	46	59	88	60	60	30
Lignite	0	0	0	230	0	59	85	116	88

	1990	1991	1992	1993	1994	1995	1996	1997	1998
Bituminous Coal	0	46.72	0	91	29	29	30	30	59
Coke	0	0	0	3	29	30	1	0	29
Kerosene	43.13	0	0	0	0	0	0	0	0
Residual Fuel Oil	40.2	273.36	349.74	27	264	850	411	264	0
Lamp oil	0	0	0	0	29	0	0	0	0
Other Petroleum Products	0	0	0	0	0	0	0	0	0
Natural Gas	0	0	0	100	235	118	30	117	59
LPG	46.06	0	0	247	113	59	88	29	147
Fuel Wood	44.97	0	0	13	30	30	89	30	88
Wood Waste	0	0	0	12	1	30	30	30	0
Agriculture Residues	0	0	0	0	0	0	0	0	0
Total	**508.46**	**320.08**	**349.74**	**769**	**789**	**1293**	**824**	**676**	**500**
	1999	2000	2001	2002	2003	2004	2005	2006	2007
Anthracite	0	30	59	58	1	16	27	33	98
Lignite	118	0	58	118	116	26	20	108	15
Bituminous Coal	29	29	0	0	0	0	0	0	0
Coke	0	29	0	0	0	1	0	0	0
Kerosene	0	0	0	0	0	0	0	0	0
Residual Fuel Oil	59	30	0	0	0	5	3	7	7
Lamp oil	0	0	0	0	0	94	130	168	245
Other Petroleum Products	0	0	0	0	0	1	1	1	1
Natural Gas	59	89	30	60	58	104	106	115	90
LPG	59	1	0	1	59	2	2	1	1
Fuel Wood	59	29	30	87	59	24	24	27	26
Wood Waste	29	0	29	29	0	3	7	4	10
Agriculture Residues	0	0	0	29	0	0	0	2	1
Total	**412**	**237**	**206**	**382**	**293**	**276**	**320**	**466**	**494**
	2008	2009	2010	2011	2012	2013	2014	2015	%
Anthracite	49	13	25	30	5	0	0	0	
Lignite	136.64	33.97	118.24	98.99	16.54	16.37	9.51	11.41	
Bituminous Coal	0	0	0	0	0	0	0	0	
Coke	0	1	0	0	0	0	0	0	
Kerosene	0	0	0	0	0	0	0	0	
Residual Fuel Oil	19.93	21.31	19	1	3	0	0	0	
Lamp oil	197	1	0	0	0	0	0	0	
Other Petroleum Products	0	0	0	0	0	0	0	0	
Natural Gas	93	60	83	87	34	0	0	0	
LPG	1	0	0	0	1	0	0	0	
Fuel Wood	23	9	28	12	0	0	0	0	
Wood Waste	3	0	8	2	1	0	0	0	
Agriculture Residues	1	0	7	2	0	0	0	0	
Total	**523.57**	**139.28**	**288.24**	**232.99**	**60.54**	**16.39**	**9.51**	**11.41**	

Table 3-95: Fuel Consumption under the 1A5 “Other” Category (subcategory 1A5bi Mobile combustion of fuels for aviation transport) within 1990-2015 periods, TJ

	2011	2012	2013	2014	2015
Aviation Gasoline	0.9169	0.7859	0.3297	0.5175	0.01
Kerosene	0.1294	0.0863	0.0346	0.0910	0.00

Table 3-96: Fuel Consumption under the 1A5 “Other” Category (subcategory 1A5bii Mobile combustion of fuels for other transport), within 1990-2015 periods, TJ

	1990	1991	1992	1993	1994	1995	1996	1997	1998
Gasoline	174.880	109.300	52.464	73.808	125.280	142.950	155.085	120.601	117.672
Diesel Oil (also includes “fuel for oven” and “fuels for engines”)	808.260	638.100	425.400	360.912	139.103	149.449	212.354	202.642	195.517
Lubricants	0	1446.840	843.990	0	0	1	1	58	1
	1999	2000	2001	2002	2003	2004	2005	2006	2007
Gasoline	77.670	65.968	67.084	96.071	39.400	43.618	17.634	23.050	38.738
Diesel Oil (also includes “fuel for oven” and “fuels for engines”)	171.410	70.613	134.612	100.247	71.273	178.358	175.725	215.380	324.252
Lubricants	30	30	59	30	147	175	163	163.51	8.50
	2008	2009	2010	2011	2012	2013	2014	2015	%
Gasoline	43.389	13.586	16.339	12.957	11.115	5.552	7.520	5.684	-96.7
Diesel Oil (also includes “fuel for oven” and “fuels for engines”)	273.402	27.997	31.977	38.998	33.956	23.381	10.125	9.444	-98.8
Lubricants	20.470	6.630	3.340	11.250	4.210	0.210	0.510	0	

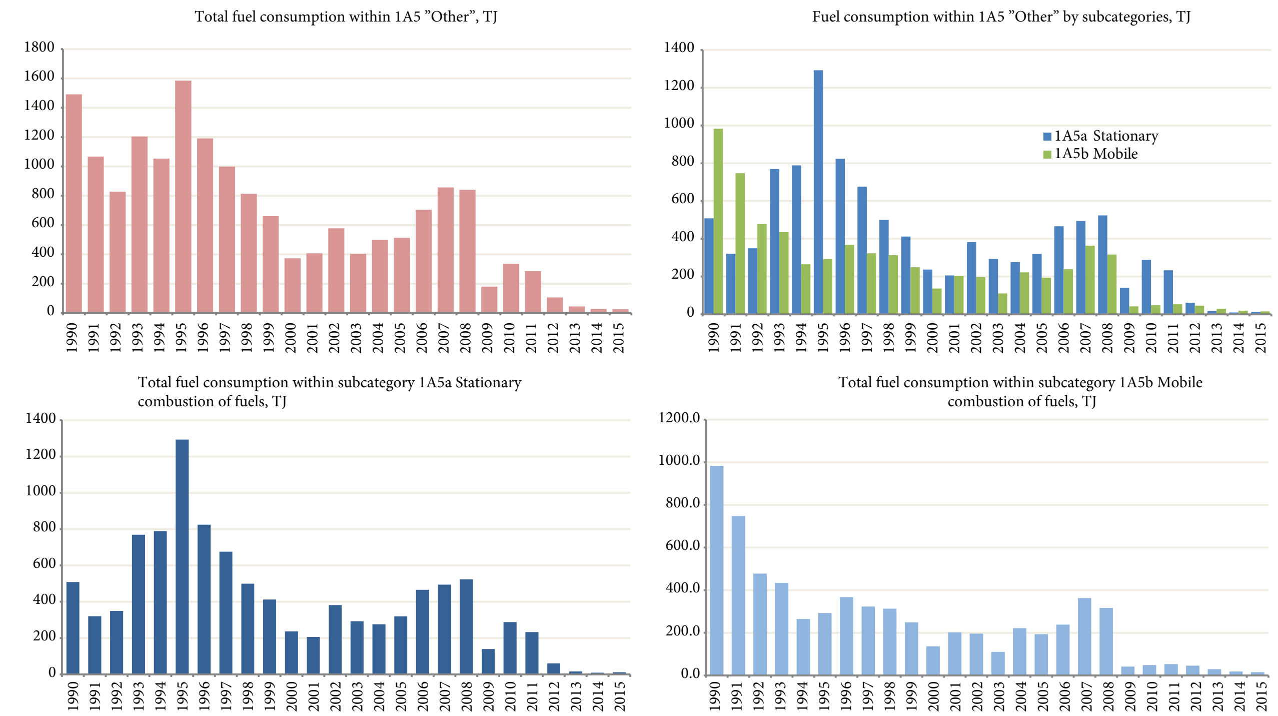


Figure 3-17: Total Fuel Consumption under the 1A5 "Other" Category in the RM within 1990-2015 periods, TJ

Table 3-97: Total Fuel Consumption (by types) under the 1A5 "Other" Category within 1990-2015 periods, TJ

	Fuel consumption by types, TJ					Share from the total, %			
	Solid	Liquid	Gaseous	Biofuels	Total	Solid	Liquid	Gaseous	Biofuels
1990	334.1	129.4	0.0	45.0	508.5	65.7	25.4	0.0	8.8
1991	46.7	1 020.8	0.0	0.0	1 067.5	4.4	95.6	0.0	0.0
1992	0.0	827.6	0.0	0.0	827.6	0.0	100.0	0.0	0.0
1993	370.0	708.7	100.0	25.0	1 203.7	30.7	58.9	8.3	2.1
1994	117.0	670.4	235.0	31.0	1 053.4	11.1	63.6	22.3	2.9
1995	206.0	1 201.4	118.0	60.0	1 585.4	13.0	75.8	7.4	3.8
1996	176.0	866.4	30.0	119.0	1 191.4	14.8	72.7	2.5	10.0
1997	206.0	616.2	117.0	60.0	999.2	20.6	61.7	11.7	6.0
1998	206.0	460.2	59.0	88.0	813.2	25.3	56.6	7.3	10.8
1999	147.0	367.1	59.0	88.0	661.1	22.2	55.5	8.9	13.3
2000	88.0	167.6	89.0	29.0	373.6	23.6	44.9	23.8	7.8
2001	117.0	201.7	30.0	59.0	407.7	28.7	49.5	7.4	14.5
2002	176.0	197.3	60.0	145.0	578.3	30.4	34.1	10.4	25.1
2003	117.0	169.7	58.0	59.0	403.7	29.0	42.0	14.4	14.6
2004	43.0	324.0	104.0	27.0	498.0	8.6	65.1	20.9	5.4
2005	47.0	329.4	106.0	31.0	513.4	9.2	64.2	20.6	6.0
2006	141.0	415.4	115.0	33.0	704.4	20.0	59.0	16.3	4.7
2007	113.0	617.0	90.0	37.0	857.0	13.2	72.0	10.5	4.3
2008	185.6	534.7	93.0	27.0	840.4	22.1	63.6	11.1	3.2
2009	48.0	63.9	60.0	9.0	180.9	26.5	35.3	33.2	5.0
2010	143.2	67.3	83.0	43.0	336.6	42.6	20.0	24.7	12.8
2011	129.0	54.0	87.0	16.0	286.0	45.1	18.9	30.4	5.6
2012	21.5	49.9	34.0	1.0	106.5	20.2	46.9	31.9	0.9
2013	16.4	29.3	0.0	0.0	45.7	35.9	64.1	0.0	0.0
2014	9.5	18.3	0.0	0.0	27.8	34.2	65.8	0.0	0.0
2015	11.4	15.1	0.0	0.0	26.5	43.0	57.0	0.0	0.0

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" 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 subcategory included in 1A5 "Other" complies with the requirements set out in the description of each subcategory in the 2006 IPCC Guidelines in the current inventory cycle, separate GHG emissions were calculated for 3 subcategories (1A5a Stationary combustion of fuels, 1A5bi Mobile combustion of fuels for aviation transport and 1A5ii Mobile combustion of fuels for other transport); for each subcategory, AD is available in separate files in energy units; verifying the correctness of EFs use for each subcategory; verifying if the primary reference sources are correctly indicated; the accuracy of calculations for subcategories included in 1A5 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;
- verification if the same method is used for the entire range of years covered by the inventory;
- in the calculations files the EFs are specified in tabular formats for each subcategory, the import of the respective values into calculation formulas is ensured by automatic connections;
- the consistency of the calculations is also ensured by verifying the correctness of applying conversion factors of natural units to energy units for all subcategories and the entire range of years covered by the inventory;
- 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 and grease were reallocated to source category 2D1 from "Industrial Processes and Product Use" sector;
- verifying to what extent the full geographical coverage of the national GHG inventory of the RM is ensured (for 1990-1992 and 2008-2015 time series GHG emissions were estimated for the entire country, while for 1993-2007 time series – only for the Right Bank of Dniester River);
- 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, etc.

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". The main causes of these recalculations are, as follows: in order to estimate GHG emissions were used AD expressed in energy units (TJ) and not in natural units (kt); for the first time were estimated separately GHG emissions from stationary and mobile sources within source category 1A5 "Other"; fuel consumption was updated due to reallocations between certain categories and the decrease of fuel types considered within this source category, from nine to seven; GHG emissions from grease and lubricants use, previously included in 1A5, were reallocated to category 2D1 within this inventory cycle; also, in order to convert direct GHG emissions in CO_2 equivalent, in the current inventory cycle, the 100-year Global Warming Potential (GWP_{100}) values available in the Fourth IPCC Assessment Report (AR4) (CH_4 – 25 and N_2O – 298), were used in the detriment of GWP_{100} values in the Second IPCC Assessment Report (SAR) (CH_4 – 21 and N_2O – 310). In comparison with the results included into the First Biennial Report of the RM under the UNFCCC, the performed recalculations resulted in a decreasing trend of direct GHG emissions in 1990-1999 and 2003-2013 time series, varying from a minimum decrease by 0.1 per cent in 1999 up to a maximum decrease of 73.5 per cent in 1990; respectively, it was revealed an increasing trend of direct GHG emissions between 2000-2002, varying from a minimum of 2.1 per cent in 2000 up to a maximum of 4.4 per cent in 2001 (Table 3-98). For 2014-2015, time periods the direct GHG emissions from 1A5 'Other' category were estimated for the first time. The results allow assert that between 1990 and 2015, the GHG emissions originated from this category decreased by 98 per cent.

Table 3-98: Comparative Results of GHG Emissions from 1A5 "Other" Category included into the BUR1 and NC4 of the RM under the UNFCCC, kt CO_2 equivalent

	1990	1991	1992	1993	1994	1995	1996	1997	1998
BUR1	154.8111	304.0746	237.8193	196.5047	156.7369	181.5126	147.6613	144.442	100.5624
NC4	115.5701	81.5251	62.9457	92.6604	74.0749	118.5579	83.9263	73.4112	56.4845
Difference, %	-25.3	-73.2	-73.5	-52.8	-52.7	-34.7	-43.2	-49.2	-43.8
	1999	2000	2001	2002	2003	2004	2005	2006	2007
BUR1	56.4785	62.2763	66.0531	65.9448	80.1935	69.2504	67.6491	79.8003	70.4336
NC4	44.9606	26.2941	28.4247	35.7997	27.1388	34.1306	35.0177	51.4118	61.8745
Difference, %	-0.1	2.1	4.4	2.2	-31.9	-43.7	-42.9	-46.8	-54.2
	2008	2009	2010	2011	2012	2013	2014	2015	%
BUR1	85.6930	49.9653	57.4318	66.7006	41.471	30.4188			
NC4	63.4923	13.0278	24.2583	21.9369	7.7913	3.8456	2.3060	2.2742	-98.0
Difference, %	-47.3	-38.3	-54.0	-54.0	-54.0	-54.0			

3.6.6. Planned Improvements

For the next inventory cycle, potential improvements in 1A5 "Other" category could be performed if new AD would be available for the ATULBD.

3.7. Fugitive Emissions from Oil and Natural Gas (Category 1B2)

In the Republic of Moldova, oil extraction is performed nearby Valeni village, Cahul district. 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 in the city of Comrat, 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 3-99 and Figure 3-18). The specific density of the oil extracted in Valeni is circa 0.941 t/m^3 (according to the information from the "Norms on Limitted Permitted Pollutant Emissions in Atmospheric Air Report at Oil Exploration Valeni", 2015).

Table 3-99: Oil Extraction in the Republic of Moldova within 2003-2015 periods

	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Oil, kt *	1	8	5	4	8	15	17	11	13	11	10	8	7
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

Source: * - Energy Balances of the RM for 2003-2015.

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".

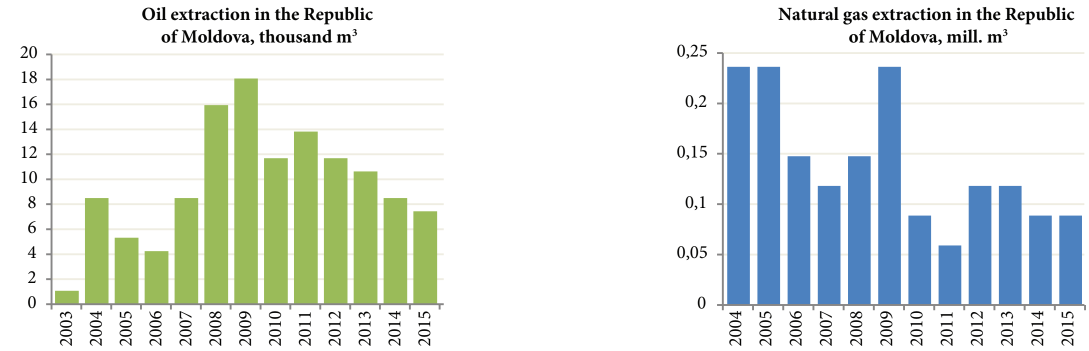


Figure 3-18: Oil and Natural Gas Extracted in the Republic of Moldova

Natural gas extraction is performed at 6 wells nearby Victorovca village, Cantemir district. Natural gas extracted from the respective reserves at Victorovca field is of good quality, containing about 86-92% methane. 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 (Table 3-100, Figure 3-18), 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, whent natural gas consumption is increased (during this time of the year, the capacities of the Victorovca reservoir can not meet the needs of the population in these localities).

Table 3-100: Natural Gas Extraction in the Republic of Moldova within 2004-2015 periods

	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Natural Gas, TJ *	8	8	5	4	5	8	3	2	4	4	3	3
Natural Gas, mill. m^3	0.236	0.236	0.148	0.118	0.148	0.236	0.089	0.059	0.118	0.118	0.089	0.089

Source: * - Energy Balances of the RM for anii 2004-2015.

The infrastructure of the 'Natural Gas Supply Sector' currently includes: high, medium and low pressure main gas pipelines, (Table 3-57). Natural gas supply is operated by the Moldovan-Russian joint venture "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 in the RM is available for both banks of Dniester river. Total natural gas consumption is presented in Table 3-101 and Figure 3-19.

Table 3-101: Natural Gas Extracted in the RM and Transiting the Territory of the RM

	1990	1991	1992	1993	1994	1995	1996	1997	1998
Natural gas transiting the RM, billion m^3	25.0	23.0	21.0	19.0	18.2650	20.9090	22.3960	16.9340	16.0210
Natural gas extracted in the RM, mill m^3	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 m^3	17.1424	19.3649	18.6248	21.3323	22.1319	23.8727	25.3129	22.3388	23.6928
Natural gas extracted in the RM, mill m^3	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	%
Natural gas transiting the RM, billion m^3	23.2902	17.8911	17.0343	19.8895	19.6200	19.6511	17.9859	16.9700	-32.1
Natural gas extracted in the RM, mill m^3	2505.0	2775.0	2970.9	3099.5	3078.1	2386.0	2823.5	2782.0	-27.1

Source: "Moldovagaz" J.S.C. through Officoial 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.

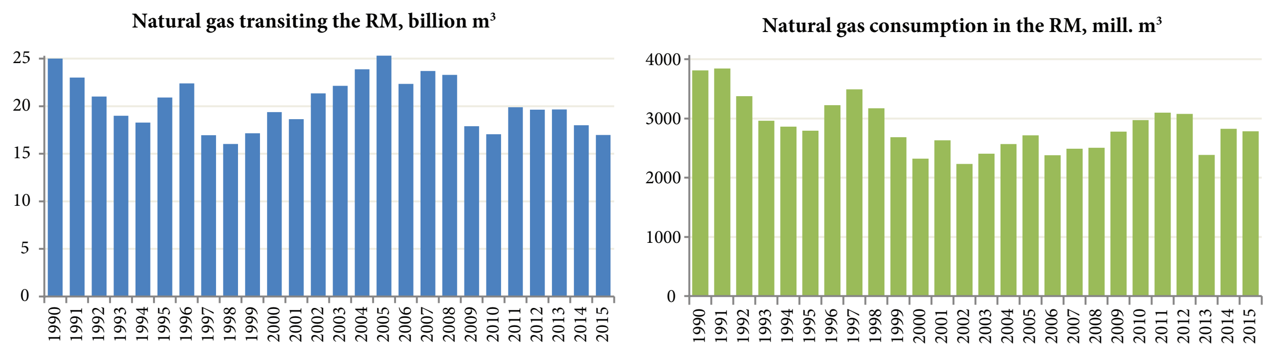


Figure 3-19: Natural Gas Extracted in the RM and Transiting the Territory of the RM in order to supply South-Eastern European countries within 1990-2015 periods

Information on LPG amounts are available for the Right Bank of Dniester River for the entire period under review (1990-2015), while for the Left Bank of Dniester River, only for 2011-2015 time series (Table 3-102, Figure 3-20).

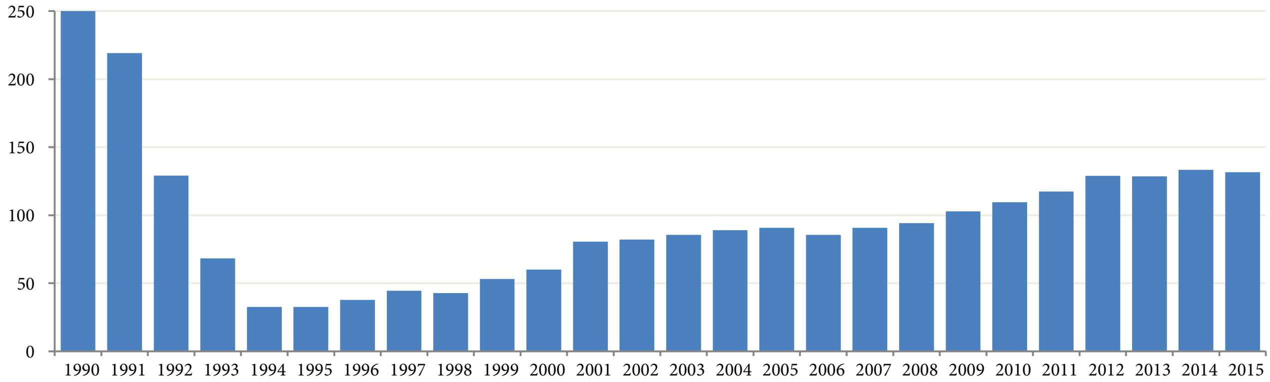


Figure 3-20: LPG Consumption in the RM within 1990-2015 periods, mill. m^3

Table 3-102: LPG Consumption in the RM within 1990-2015 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	%
RBDR	kt	55	60	64	67	74	74	77	76	-47.9
	thousand m^3	94.18	102.74	109.59	114.73	126.71	126.71	131.85	130.14	
LBDR	thousand m^3				2.68	2.18	1.87	1.56	1.41	
Total: RM	thousand m^3	94.18	102.74	109.59	117.41	128.89	128.59	133.41	131.54	

Sources: Energy Balances of the RM for 1990, 1993-2015 for the Right Bank of Dniester River; Press Release "The State of Housing and Communal Services of the Republic for 2011-2015", for the Left Bank of Dniester River.

3.7.1. Source Category Description

The 1B2 "Fugitive Emissions from Oil and Natural Gas" 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.).

Between 1990 and 2015, GHG emissions originated from the 1B2 "Fugitive Emissions from Oil and Natural Gas" category tended to reveal lower values, decreasing by circa 30%: from 812.87 kt CO_2 equivalent recorded in 1990 to 568.26 kt CO_2 equivalent in 2015 (Table 3-103, Figure 3-15).

Table 3-103: GHG Emissions from 1B2 "Fugitive Emissions from Oil and Natural Gas" Category within 1990-2015 periods

	1990	1991	1992	1993	1994	1995	1996	1997	1998
CO_2, kt	0.6377	0.6140	0.5175	0.4382	0.4085	0.4194	0.4726	0.4651	0.4274
CH_4, kt	**32.4897**	**30.4926**	**27.6043**	**24.8026**	**23.8714**	**26.4555**	**28.7555**	**23.6428**	**22.1250**
N_2O, kt	5.50E-07	4.82E-07	2.84E-07	1.50E-07	7.16E-08	7.16E-08	8.29E-08	9.79E-08	9.42E-08
NMVOC, kt	0.5817	0.5438	0.4931	0.4437	0.4269	0.4761	0.5160	0.4176	0.3916
Total, kt CO_2 equiv.	**812.8794**	**762.9286**	**690.6247**	**620.5042**	**597.1941**	**661.8075**	**719.3601**	**591.5343**	**553.5516**
	1999	2000	2001	2002	2003	2004	2005	2006	2007
CO_2, kt	0.3931	0.3759	0.4092	0.3901	1.0592	1.1045	1.1219	1.2260	1.2577
CH_4, kt	**22.4045**	**24.0254**	**23.8208**	**25.8825**	**27.0585**	**29.3699**	**31.0174**	**27.3303**	**29.0538**
N_2O, kt	1.17E-07	1.32E-07	1.77E-07	1.81E-07	4.86E-06	4.87E-06	4.87E-06	6.03E-06	6.04E-06
NMVOC, kt	0.4007	0.4341	0.4278	0.4697	0.5383	0.8693	0.7790	0.6793	0.8710
Total, kt CO_2 equiv.	**560.5056**	**601.0105**	**595.9298**	**647.4523**	**677.5233**	**735.3523**	**776.5573**	**684.4862**	**727.6056**

	2008	2009	2010	2011	2012	2013	2014	2015	%
CO_2, kt	1.2748	1.2732	1.2747	1.3141	1.3104	1.6441	1.6721	1.6581	160.0
CH_4, kt	**28.8986**	**23.9173**	**23.1928**	**26.4162**	**26.0365**	**24.7983**	**23.8129**	**22.6641**	**-30.2**
N_2O, kt	6.05E-06	6.07E-06	6.08E-06	6.10E-06	6.12E-06	9.04E-06	9.05E-06	9.05E-06	1545.3
NMVOC, kt	1.1483	1.1325	0.8770	1.0167	0.9297	0.8793	0.7772	0.7158	23.1
Total, kt CO_2 equiv.	**723.7414**	**599.2069**	**581.0975**	**661.7214**	**652.2248**	**621.6035**	**596.9973**	**568.2625**	**-30.1**

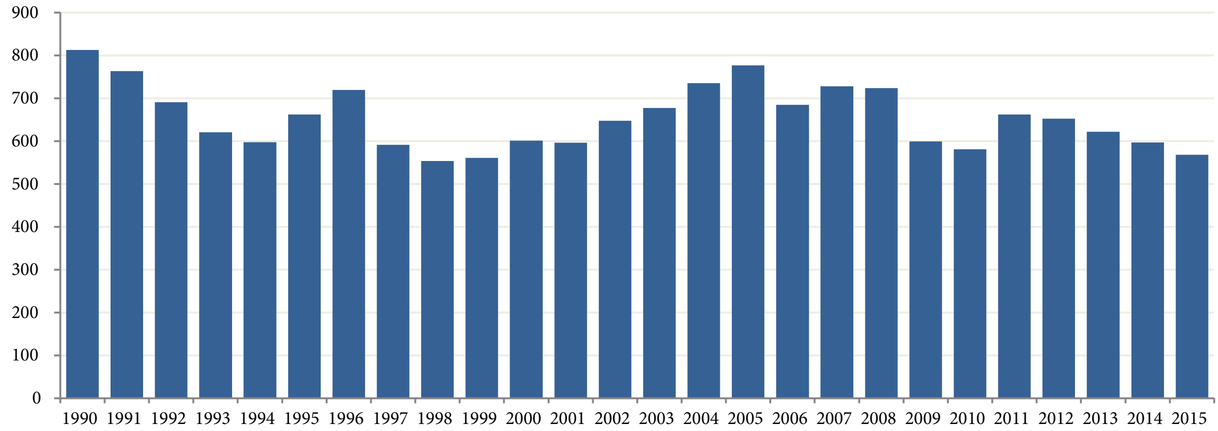


Figure 3-21: Direct GHG Emissions from 1B2 "Fugitive Emissions from Oil and Natural Gas" Category in the Republic of Moldova within 1990-2015 periods, kt CO_2 equivalent

3.7.2. Methodological Issues, Emission Factors and Data Sources

GHG emissions originated from the 1B2 "Fugitive Emissions from Oil and Natural Gas" 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 category are:

$$E_{gas,\ industry\ segment} = A_{industry\ segment} \bullet EF_{gas,\ industry\ segment}$$
$$E_{gas} = \Sigma E_{gas,\ industry\ segment}$$

Where:

$E_{gas,\ industry\ segment}$ – annual emissions (kt);
$A_{industry\ segment}$ – activity data for the respective industry segment;
$EF_{gas,\ industry\ segment}$ – emission factor (kt/activity unit).

Default EF values were used to estimate GHG emission according to 2006 IPCC Guidelines (Tables 3-104, 3-105, 3-106 and 3-107).

Table 3-104: 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	1B2a iii 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	1B2a iii 2	1.9-32.0	110-1800	-	17-2800
		17	**955**		**1408.5**

Table 3-105: 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 m^3/yr	1B2a iii 2	0.1-4300	2-60000	-	1.8-75000
		2150	**30000**		**37500.9**
Ventilation at oil extraction, kg/1000 m^3/yr	1B2a i	95-130	720-990	-	430-590
		112.5	**855**		**510**
Flaring at oil production, kg/1000 m^3/yr	1B2a i	41000-56000	25-34	0.64-0.88	21-29
		48500	**30**	**0.76**	**25**
Oil transportation in tanks, kg/1000 m^3/yr	1B2a iii 3	**2.30**	**25**	-	**250**
Oil refining, kg/1000 m^3/yr	1B2a iii 4	-	**21.8**	-	-

Table 3-106: 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	1B2b ii 2	14-180	380-24000	-	91-1200
		97	**12190**		**645.5**
Fugitives from natural gas transportation, kg/mill. m³/yr	1B2b ii 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	1B2b ii 5	51-140	1100-2500	-	16-36
		95.5	**1800**		**26**
Flaring at natural gas production, kg/mill. m³/yr	1B2b ii	1200-1600	0.76-1.00	0.021-0.029	0.62-0.85
		1400	**0.88**	**0.025**	**0.74**
Ventilation at natural gas transportation, kg/mill. m³/yr	1B2b i	3.1-7.3	44-740	-	4.6-11.0
		5.20	**392**		**7.80**

Table 3-107: 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	1B2a iii 3	**430**	-	**0.0022**	-

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 3-108). 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. 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)[34].

Table 3-108: Natural Gas Transited, Imported and Consumed in the RM within 1990-2015 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/mln 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**	**3377.38**	**2959.8**	**2861**	**2791**	**3222**	**3491.9**	**3168.58**
On the Right Bank of the Dniester					1149.95	1557.88	1769.61	1882.9	1699.58
On the Left Bank of Dniester					1711.05	1233.12	1452.39	1609	1469
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/mln 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	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**	**2231.6**	**2405.4**	**2565.7**	**2715.6**	**2376.2**	**2489.9**
On the Right Bank of the Dniester	1219.8	918.3	1055.7	1050.6	1129.9	1141.5	1314.9	1322	1208
On the Left Bank of Dniester	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**	**%**
Natural Gas Imported, million m³	**2725.5**	**2979.4**	**3176.2**	**3213.1**	**3182.5**	**2472.5**	**2915.6**	**2926**	**-23.9**
Net caloric values for natural gas, Kcal/m³	8041	8074	8071	8081	8107	8137	8175	8246	
Net caloric values for natural gas, TJ/mln m³	33.660	33.798	33.785	33.827	33.936	34.061	34.221	34.518	
Methane density, kg/m³	0.683	0.683	0.683	0.6914	0.6906	0.6946	0.6992	0.705	
Share of methane in natural gas imported, %	97.9	97.9	97.9	96.9	97	96.5	96.1	95.5	
Technological Losses, including:	**94.7**	**93.9**	**98.6**	**113.6**	**104.4**	**86.5**	**92.1**	**144**	
in distribution networks	55.5	55.7	57.9	54.4	52.1	49.8	48.3	43	
in main networks	39.2	38.2	40.7	59.2	52.3	36.7	43.8	101	
Natural Gas Transited, billion. m³	**23.2902**	**17.8911**	**17.0343**	**19.8895**	**19.62**	**19.6511**	**17.9859**	**16.97**	
Natural Gas sold in the RM:	**2505**	**2775**	**2970.9**	**3099.5**	**3078.1**	**2386**	**2823.5**	**2782**	**-27.1**
On the Right Bank of the Dniester	1130.8	1029.9	1089.8	1152.1	1095.5	1031.2	1053.1	928	
On the Left Bank of Dniester	1374.2	1745.1	1881.1	1974.4	1982.6	1354.8	1770.4	1854	
Technological Losses, % of the total	**3.47**	**3.15**	**3.10**	**3.54**	**3.28**	**3.50**	**3.16**	**4.92**	

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.

[34] <http://anre.md/ro/reports/8>.

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", 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", 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" 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 subcategory included in 1B2 "Fugitive Emissions from Oil and Natural Gas" complies with the requirements set out in the description of each subcategory in the 2006 IPCC Guidelines (1B2a Oil, 1B2b Natural Gas, 1B2c Venting, 1B2d Other); for each subcategory AD are available in separate files in natural and energy units; verifying the correctness of EFs use for each subcategory; verifying if the primary reference sources are correctly indicated; the accuracy of calculations for subcategories 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 calculations files the EFs are specified in tabular formats for each subcategory, the import of the respective values into calculation formulas is ensured by automatic connections;
- verification if the same method is used for the entire range of years covered by the inventory;
- 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;
- 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, etc.

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 GHG emissions from 1B2 "Fugitive Emissions from Oil and Natural Gas". The main causes of these recalculations are, as follows: for the first time GHG emissions from the following sources were estimated separately (1B2a Oil, 1B2b Natural Gas, 1B2c Venting, 1B2d Other), within 1B2 "Fugitive Emissions from Oil and Natural Gas" category; also, in order to convert direct GHG emissions in CO_2 equivalent, in the current inventory cycle, the 100-year Global Warming Potential (GWP_{100}) values available in the Fourth IPCC Assessment Report (AR4) (CH_4 – 25 and N_2O – 298), were used in the detriment of GWP_{100} values in the Second IPCC Assessment Report (SAR) (CH_4 – 21 and N_2O – 310).

In comparison with the results included into the First Biennial Report of the RM under the UNFCCC, the performed recalculations resulted in an increase of direct GHG emissions between 1990 and 2013, varying from a minimum increase by 17.6 per cent in 2005 and a maximum increase by 20.5 per cent in 1999 (Table 3-109). For 2014-2015 time periods, direct GHG emissions from 1B2 "Fugitive Emissions from Oil and Natural Gas" were estimated for the first time. The results allow assert that between 1990 and 2015, the GHG emissions originated from this sector decreased by circa 30 per cent.

Table 3-109: Comparative Results of GHG Emissions from 1B2 "Fugitive Emissions from Oil and Natural Gas" included into the BUR1 and NC4 of the RM under the UNFCCC, kt CO_2 equivalent

	1990	1991	1992	1993	1994	1995	1996	1997	1998
BUR1	682.9320	640.9545	580.1931	521.3013	501.7084	555.9854	604.3381	498.1270	466.2276
NC4	812.8794	762.9286	690.6247	620.5042	597.1941	661.8075	719.3601	591.5343	553.5516
Difference, %	19.0	19.0	19.0	19.0	19.0	19.0	19.0	18.8	18.7
	1999	2000	2001	2002	2003	2004	2005	2006	2007
BUR1	465.0927	503.4185	500.1666	542.2695	573.3672	617.5696	660.3041	575.2321	611.7275
NC4	560.5056	601.0105	595.9298	647.4523	677.5233	735.3523	776.5573	684.4862	727.6056
Difference, %	20.5	19.4	19.1	19.4	18.2	19.1	17.6	19.0	18.9
	2008	2009	2010	2011	2012	2013	2014	2015	%
BUR1	608.8065	504.3022	488.7817	556.6107	548.5296	522.8092			
NC4	723.7414	599.2069	581.0975	661.7214	652.2248	621.6035	596.9973	568.2625	-30.1
Difference, %	18.9	18.8	18.9	18.9	18.9	18.9			

3.7.6. Planned Improvements

Potential improvements within the 1B2 "Fugitive Emissions from Oil and Natural Gas" 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 Left Bank of Dniester River for the entire period under review.

3.8. International Aviation (Memo Items)

3.8.1. Source Category Description

GHG emissions from 'International Bunkers: Aviation' (Memo Items) comes from the combustion of jet fuel used in the international air transport (in case of aircrafts which operates international flights, emissions are allocated to the country in which the aircraft was fueled). In the Republic of Moldova, international air transport 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); Boeing-707 (737, 739, 747,757), EMB-190 (120, 135, 145, 170), Fokker 70 and Fokker 100, MD-81 (82, 83) RJ-85, RJ-100, CRJ, Rombac-561 Rc; turbopropelled aircrafts for short and medium distances: Saab-340 (SF-340), Saab-2000 (SF-2000), L410, DHC8, ATR-42; light turbopropelled aircrafts - X-32 Becas; small jet aircrafts: Falcon-2000EX, Learjet-35. The aircrafts produced in the CIS countries include TU-134, TU-154, AN-2 (12, 24, 26, 28, 32, 72, 74), IL-18, IL-76, YAK-18 (40, 42), and helicopters Mi-8 (17, 26), Ka-26 and Ka-32. The total number of flights in 1995-2005, respectively 2013-2015 time series, tended to increase continuously (Figure 3-22).

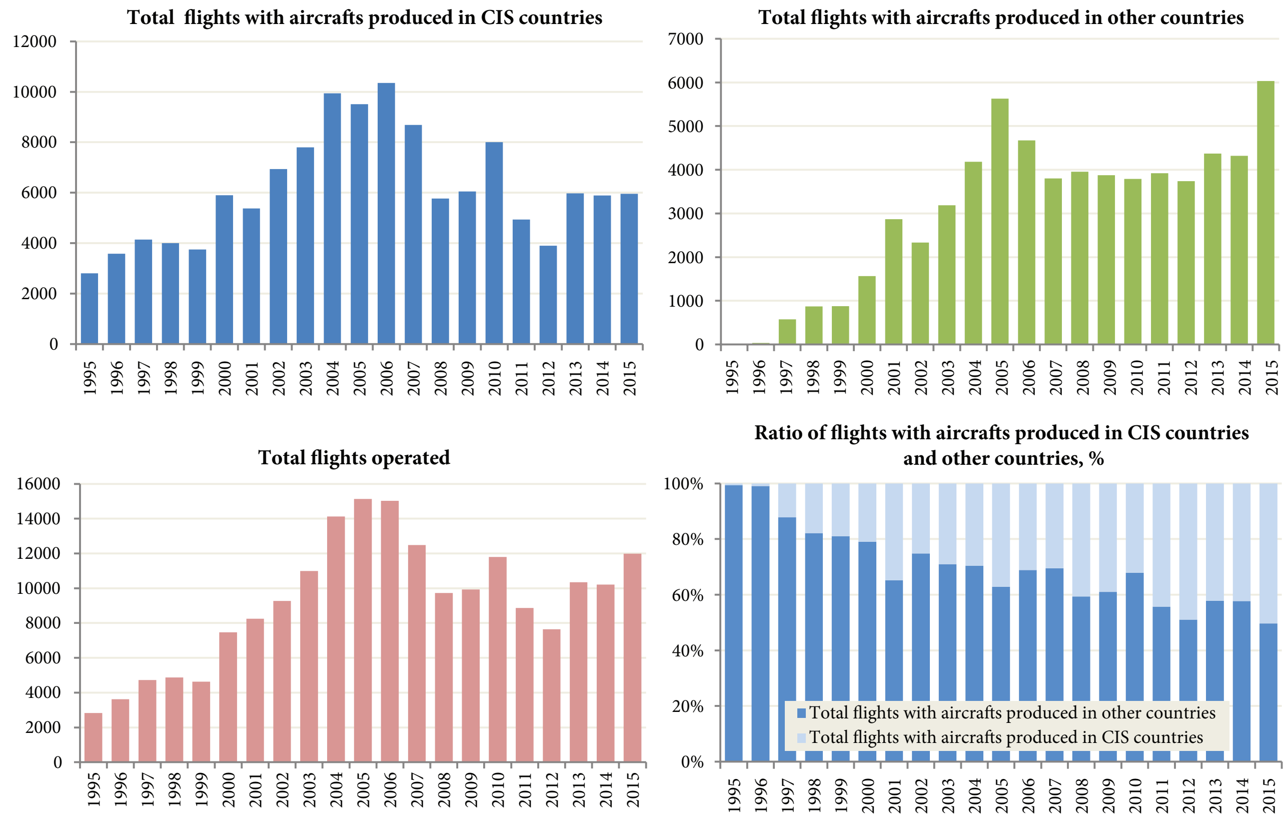


Figure 3-22: Total Flights in the RM within 1995-2015

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 and 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) (2006 IPCC Guidelines).

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.

GHG emissions from source category International Bunkers: Aviation' (Memo Items) is presented below in Table 3-110. By 2015, CO_2 emissions reached the level of the reference year.

Table 3-110: GHG Emissions from "International Bunkers: Aviation" in the Republic of Moldova within 1990-2015 periods, kt

	1990	1991	1992	1993	1994	1995	1996	1997	1998
CO_2	217.3668	232.8115	96.2635	62.0927	37.8235	41.9184	65.8650	75.6418	72.4923
CH_4	0.0430	0.0487	0.0189	0.0099	0.0058	0.0059	0.0048	0.0054	0.0041
N_2O	0.0070	0.0074	0.0031	0.0020	0.0012	0.0013	0.0021	0.0024	0.0023
NO_x	0.7949	0.8447	0.3512	0.2331	0.1433	0.1572	0.2563	0.3033	0.2935
CO	0.8733	0.9641	0.3847	0.2215	0.1323	0.1403	0.1684	0.1927	0.1739
NMVOC	0.5202	0.5792	0.2288	0.1293	0.0766	0.0813	0.0900	0.1018	0.0883
SO_2	0.0689	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	%
CO_2	89.2738	82.6571	82.6894	95.4144	107.6790	130.4626	154.5065	218.4093	0.5
CH_4	0.0017	0.0018	0.0027	0.0032	0.0031	0.0046	0.0034	0.0058	-86.5
N_2O	0.0029	0.0027	0.0027	0.0031	0.0034	0.0042	0.0049	0.0070	-0.6
NO_x	0.3939	0.3672	0.3600	0.3984	0.4332	0.5235	0.6256	0.9142	15.0
CO	0.1807	0.1729	0.1894	0.2213	0.2338	0.3098	0.3250	0.4451	-49.0
NMVOC	0.0752	0.0709	0.0734	0.0959	0.1073	0.1345	0.1444	0.2206	-57.6
SO_2	0.0283	0.0262	0.0262	0.0303	0.0342	0.0414	0.0490	0.0693	0.6

In comparison with the reference year level, in 2015 the GHG emissions from "International Bunkers: Aviation" source category represented: for CO_2 circa 100.5 per cent, CH_4 – 13.5 per cent, N_2O – 99.4 per cent, NO_x – 115.0 per cent, CO – 51.0 per cent, NMVOC – 42.4 per cent, respectively for SO_2 – 100.5 per cent (Table 3-111).

Table 3-111: GHG Emissions from "International Bunkers: Aviation" in the Republic of Moldova within 1990-2015 periods, where 1990 represents 100 per cent

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
CO_2	100.0	107.1	44.3	28.6	17.4	19.3	30.3	34.8	33.4	33.3	30.5	28.5	28.6
CH_4	100.0	113.3	44.0	23.0	13.5	13.8	11.1	12.5	9.5	9.2	10.1	9.1	8.5
N_2O	100.0	105.7	44.3	28.6	17.1	19.2	30.2	34.7	33.3	33.2	30.7	28.7	29.0
NO_x	100.0	106.3	44.2	29.3	18.0	19.8	32.2	38.2	36.9	36.6	34.3	30.2	31.5
CO	100.0	110.4	44.1	25.4	15.1	16.1	19.3	22.1	19.9	19.7	19.9	18.9	18.9
NMVOC	100.0	111.3	44.0	24.9	14.7	15.6	17.3	19.6	17.0	16.9	15.4	14.0	12.9
SO_2	100.0	107.1	44.3	28.6	17.4	19.3	30.3	34.8	33.4	33.4	30.5	28.5	28.5
	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
CO_2	32.3	31.0	31.1	34.9	36.8	41.1	38.0	38.0	43.9	49.5	60.0	71.1	100.5
CH_4	8.1	8.1	8.1	9.2	6.4	3.9	4.2	6.2	7.5	7.1	10.8	7.8	13.5
N_2O	32.7	31.8	31.9	35.8	37.3	41.2	38.2	38.4	43.7	49.2	59.6	70.6	99.4
NO_x	36.3	34.8	35.2	40.4	43.4	49.6	46.2	45.3	50.1	54.5	65.9	78.7	115.0
CO	20.4	20.8	21.0	23.3	21.4	20.7	19.8	21.7	25.3	26.8	35.5	37.2	51.0
NMVOC	13.6	12.0	12.1	13.9	13.4	14.4	13.6	14.1	18.4	20.6	25.9	27.8	42.4
SO_2	32.2	31.0	31.1	34.9	36.8	41.1	38.0	38.0	43.9	49.6	60.1	71.1	100.6

Between 1990 and 2001, direct GHG emissions originated from the "International Bunkers: Aviation" tended to decrease, from circa 220.53 kt CO_2 equivalent in 1990, up to circa 62.59 kt CO_2 equivalent in 2001, while later, from 2002 to 2015 it slightly increased from circa 62.76 kt CO_2 equivalent in 2002, up to circa 220.63 kt CO_2 equivalent in 2015 (Table 3-112, Figure 3-23).

Table 3-112: Direct GHG Emissions from "International Bunkers: Aviation" in the Republic of Moldova within 1990-2015 periods

	Direct GHG Emissions, kt CO_2 equivalent				În %, compared to 1990				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	217.3668	1.0750	2.0860	220.5278	100.0	100.0	100.0	100.0	98.6	0.5	0.9
1991	232.8115	1.2175	2.2052	236.2342	107.1	113.3	105.7	107.1	98.6	0.5	0.9
1992	96.2635	0.4725	0.9238	97.6598	44.3	44.0	44.3	44.3	98.6	0.5	0.9
1993	62.0927	0.2475	0.5960	62.9362	28.6	23.0	28.6	28.5	98.7	0.4	0.9
1994	37.8235	0.1450	0.3576	38.3261	17.4	13.5	17.1	17.4	98.7	0.4	0.9
1995	41.9184	0.1487	0.4001	42.4672	19.3	13.8	19.2	19.3	98.7	0.4	0.9
1996	65.8650	0.1196	0.6300	66.6146	30.3	11.1	30.2	30.2	98.9	0.2	0.9
1997	75.6418	0.1341	0.7235	76.4994	34.8	12.5	34.7	34.7	98.9	0.2	0.9
1998	72.4923	0.1025	0.6940	73.2888	33.4	9.5	33.3	33.2	98.9	0.1	0.9
1999	72.4890	0.0994	0.6934	73.2819	33.3	9.2	33.2	33.2	98.9	0.1	0.9
2000	66.2279	0.1086	0.6399	66.9765	30.5	10.1	30.7	30.4	98.9	0.2	1.0
2001	61.8894	0.0978	0.5990	62.5861	28.5	9.1	28.7	28.4	98.9	0.2	1.0
2002	62.0647	0.0909	0.6047	62.7602	28.6	8.5	29.0	28.5	98.9	0.1	1.0
2003	70.1110	0.0875	0.6823	70.8808	32.3	8.1	32.7	32.1	98.9	0.1	1.0
2004	67.3304	0.0866	0.6628	68.0797	31.0	8.1	31.8	30.9	98.9	0.1	1.0
2005	67.6488	0.0874	0.6661	68.4023	31.1	8.1	31.9	31.0	98.9	0.1	1.0
2006	75.9610	0.0989	0.7468	76.8068	34.9	9.2	35.8	34.8	98.9	0.1	1.0
2007	79.8999	0.0690	0.7782	80.7471	36.8	6.4	37.3	36.6	99.0	0.1	1.0
2008	89.2738	0.0421	0.8591	90.1750	41.1	3.9	41.2	40.9	99.0	0.0	1.0
2009	82.6571	0.0455	0.7970	83.4996	38.0	4.2	38.2	37.9	99.0	0.1	1.0
2010	82.6894	0.0663	0.8016	83.5573	38.0	6.2	38.4	37.9	99.0	0.1	1.0
2011	95.4144	0.0810	0.9115	96.4069	43.9	7.5	43.7	43.7	99.0	0.1	0.9
2012	107.6790	0.0765	1.0257	108.7812	49.5	7.1	49.2	49.3	99.0	0.1	0.9
2013	130.4626	0.1157	1.2430	131.8213	60.0	10.8	59.6	59.8	99.0	0.1	0.9
2014	154.5065	0.0840	1.4725	156.0630	71.1	7.8	70.6	70.8	99.0	0.1	0.9
2015	218.4093	0.1451	2.0736	220.6280	100.5	13.5	99.4	100.0	99.0	0.1	0.9

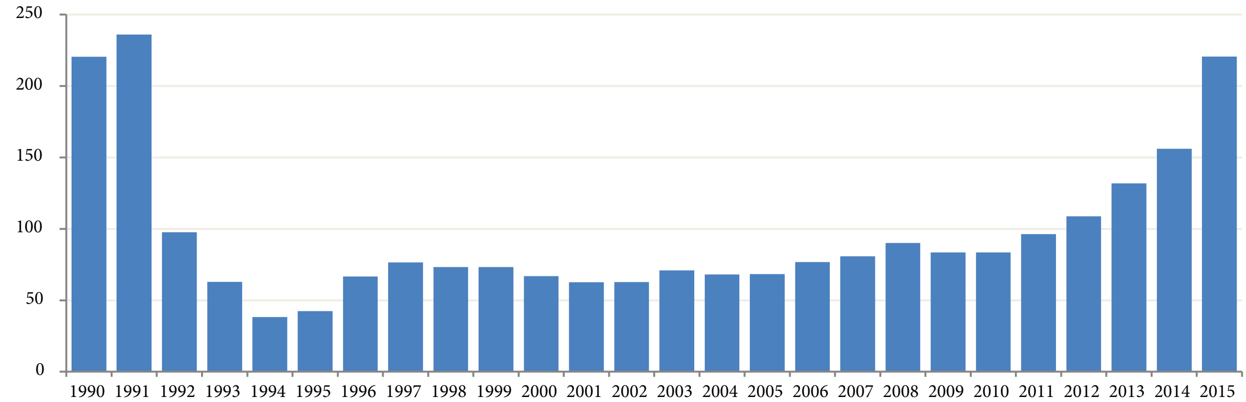


Figure 3-23: Direct GHG Emissions from "International Bunkers: Aviation" in the Republic of Moldova within 1990-2015 periods, kt CO_2 equivalent

3.8.2. Methodological Issues, Emission Factors and Data Sources

GHG emissions from the "International Bunkers: Aviation" 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 in the Revised 1996 IPCC Guidelines (IPCC, 1997), as well as in 2006 IPCC Guidelines were used to estimate GHG emissions originated from this source category (Tables 3-113 and 3-115).

Table 3-113: Default Emission Factors Available in the Revised 1996 IPCC Guidelines, Used to Estimate GHG Emissions from International Aviation

	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

Source: 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, Table 3.6.9, pages 3.70-3.71). In the process of selecting emission factors, information on the suitability of different types of aircrafts to representetive classes can be useful (2006 IPCC Guidelines, Volume 2, Chapter 3, Table 3.6.3, page 3.63). Where EFs for a given type of aircraft are missing, the emission factors characteristic of the representetive classes are used. For the types of aircrafts operating international flights in the RM, a table of their correspondence to the representetive classes was completed, with a short description of their technical characteristics (Table 3-114).

Table 3-114: The Correspondence between the Most Representetive 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: lenght – 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: lenght – 37.6 м; weight –151.3 t; maximum speed – 890 km/h; number of passengers – 189 (econom); flight interval – 6000 km; engines: P&WJT.
Boeing 737	Large commercial jet aircrafts	B737 (EFs similar for B737-300/400/500)	B737: lenght – 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 şi 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: lenght 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: lenght 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: lenght – 26 m, weight – 44 t, maximum speed – 831 km/h, number of passengers – 85 sau 100, flight interval – 2963 km, engines: 4 turbopropelled jet engines.
Embraer 190	Aircraft family E-Jet, with 4 types (E170, E175, E190, E195)	E190	E190: lenght 36 m, weight – 50.3 t, maximum speed – 890 км/h, number of passengers – 98/106, flight interval – 2963 km, engines: 2 turbopropelled jet engines.
Embraer 170	Regional aircrafts, the smallest type of E-Jet class, extended name E175	E170	E170: lenght 29.9 m, weight – 21.1 t, maximum speed – 890 km/h, number of passengers – 70/110, flight interval – 2963 km, engines: 2 turbopropelled jet engines.
BAC-111	Large commercial jet aircrafts for regional lines	Rombac-561 Rc	BAC-111: lenght 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: lenght – 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.
Medium turbopropelled aircraft			
Saab-340	Jet aircrafts for regional lines with short haul	Saab-340 (SF-340) (EFs similar for DHC8-100)	Saab-340 (SF-340): lenght - 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	Turbopropelled aircrafts for regional lines	Saab-2000 (SF-2000) (EFs similar for ATR-42)	Saab-2000 (SF-2000): lenght – 27 m, weight – 23 t, maximum speed – 560 km/h, number of passengers – 50, flight interval – 2300 km, engines: 2 x 4155 c.p.
ATR-42 (ATR-42-320, ATR-42-500)	Turbopropelled aircrafts for regional lines	L410 – Turbopropelled aircraft for 20 passengers (EFs similar for ATR-42)	ATR-42: lenght – 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	Turbopropelled aircrafts produced in Canada with Pratt & Whitney engines	SA-227 (EFs similar for DHC8)	DHC8-100: lenght – 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 turbopropelled aircraft for private and corporate flights	X-32 Becas (EFs similar for Beech King Air)	Beech King Air: lenght – 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: lenght – 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 turbopropelled aircraft			
Cessna 525/560	Light turbopropelled jet aircraft	Falcon-2000EX Turbopropelled 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: lenght –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 representetive EFs (ATR-42; DHC8-100; Beech Kipr Air). For the light turbopropelled aircrafts, in case of missing EFs, it will be applied emission factors characteristic for aircraft model Cesna 525/560.

Table 3-115: Default Emission Factors Available in the 2006 IPCC Guidelines, Used to Estimate GHG Emissions from "International Bunkers: Aviation"

The generic name of the aircraft	Representetive aircrafts (according to the 2006 IPCC Guidelines, Vol. 2, Ch. 3, Tab. 3.6.3 and 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

The generic name of the aircraft	Representetive aircrafts (according to the 2006 IPCC Guidelines, Vol. 2, Ch. 3, Tab. 3.6.3 and 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
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	0.1	0.1	7.4	12
SA-227	DHC-8-400	0.2	640	3150	0	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

Table 3-115: Default Emission Factors Available in the 2006 IPCC Guidelines, Used to Estimate GHG Emissions from "International Bunkers: Aviation" (continuation)

The generic name of the aircraft	Representetive aircrafts (according to the 2006 IPCC Guidelines, Vol. 2, Ch. 3, Tab. 3.6.3 and 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	TY-154B	2.23	143.05	5	107.13	2.7	2.22	1
TU-134	TY-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

The generic name of the aircraft	Representetive aircrafts (according to the 2006 IPCC Guidelines, Vol. 2, Ch. 3, Tab. 3.6.3 and 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
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

In the Republic of Moldova, large commercial jet aircrafts produced in the CIS countries were less exploited during the 2005-2015 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 2015 (Table 3-116). To be noted that, over the period under review the aircraft park used in the Republic of Moldova for international air transport has essentially changed its structure.

Table 3-116: Number of International Flights Operated by Aircrafts from the Republic of Moldova within 1995-2015 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
Others	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
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

Tabelul 3-116: Number of International Flights Operated by Aircrafts from the Republic of Moldova within 1995-2015 periods (continuation)

	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
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
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
Ka-32	42	283	126	126	139	300	284	309	268	171
Mi-2						1297	1022			1249
Mi-8	3088	3974	5032	4321	6720	2315	1264	3462	4133	2661
Mi-17						320	493	1129	969	376
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**
A319										445
A320	1679	1340	1517	1935	1779	1524	1399	1041.5	1239	1955
A321	2									640
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
B739									1	
B747										361
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
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			
SA-227								95		
Falcon 2000EX								350	298	
X32-912 BECAS										228
Total Flights with Other Aircrafts	**4675**	**3803**	**3954**	**3874**	**3789**	**3924.5**	**3742**	**4369**	**4321**	**5933**
Total Flights Performed	**15025**	**12492**	**9728**	**9927**	**11796**	**8866.5**	**7637**	**10344**	**10212**	**11933**

Source: 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.

Table 3-117: Share of International Flights Operated in the RM within 1995-2015 periods

	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**	**%**
Flights with Aircrafts from CIS, %	68.9	69.6	59.4	61.0	67.9	55.7	51	57.8	57.7	49.7	-50.0
Flights with Other Aircrafts, %	31.1	30.4	40.6	39.0	32.1	44.3	49	42.2	42.3	50.3	300 times

Source: 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.

AD related to the consumption of fuel 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 aviation kerosene consumption for international aviation included in the Energy Balances of the Republic of Moldova for 1990 and 1993-2015 years and data provided by CAA (for 2003-2015 the difference being quite significant) (Table 3-118). Under such circumstances, in order to estimate GHG emissions from "International Bunkers: 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 Republic of Moldova.

Table 3-118: Jet Kerosene Consumption for International Aviation in the Republic of Moldova within 1990-2015 periods, kt

	1990	1991	1992	1993	1994	1995	1996	1997	1998
Data available in the EBs	69			19.7	11	11	18	21	17
Data provided by CAA	68.69	73.85	30.54	19.7	12	13.3	20.9	24	23
Difference, %	-0.4			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	20	16	19	11	11	12	12	14
Data provided by CAA	23	21	19.62	19.67	22.22	21.33	21.44	24.07	25.33
Difference, %	15	5	22.60	3.50	102.00	93.90	78.60	100.60	80.90
	2008	2009	2010	2011	2012	2013	2014	2015	%
Data available in the EBs	14	14	13	13	15	13	17	18	-73.9
Data provided by CAA	28.32	26.22	26.21	30.26	34.16	41.38	49.01	69.30	0.9
Difference, %	102.30	87.30	101.70	132.80	127.70	218.30	188.30	285.00	

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.

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 Bunkers: Aviation", and quality of activity data 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 Bunkers: Aviation', 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. 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 originated from the "International Bunkers: Aviation" were estimated based on AD and country specific 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 Bunkers: Aviation". The main causes of these recalculations are, as follows: the GHG emission factors from the respective category were readjusted due to the use of the complience table for the types of aircrafts operating international flights in the RM with the representetive aircrafts for which the 2006 IPCC Guidelines provides representetive EFs; also, in order to convert direct GHG emissions in CO_2 equivalent, in the current inventory cycle, the 100-year Global Warming Potential (GWP_{100}) values available in the Fourth IPCC Assessment Report (AR4) (CH_4 – 25 and N_2O – 298), were used in the detriment of GWP_{100} values in the Second IPCC Assessment Report (SAR) (CH_4 – 21 and N_2O – 310). In comparison with the results included into the First Biennial Report of the RM under the UNFCCC, the performed recalculations resulted in an insignificant variation (the order of hundreds and tenths of percent) of direct GHG emissions between 1990 and 2013, with the exception of 2003 and 2013, for which the difference was much more significant (Table 3-119). For the 2014-2015 periods, the direct GHG emissions from "International Bunkers: Aviation" were estimated for the first time. The results allow assert that, by 2015, the level of direct GHG emissions originated from this source category reached similar values recorded in the reference year (1990).

Table 3-119: Comparative Results of GHG Emissions from "International Bunkers: Aviation" included into the BUR1 and NC4 of the RM under the UNFCCC, kt CO_2 equivalent

	1990	1991	1992	1993	1994	1995	1996	1997	1998
BUR1	220.4265	236.1412	97.6150	62.9173	38.3208	42.4613	66.6212	76.5157	73.3224
NC4	220.5278	236.2342	97.6598	62.9362	38.3261	42.4672	66.6146	76.4994	73.2888
Difference, %	0.05	0.04	0.05	0.03	0.01	0.01	-0.01	-0.02	-0.05
	1999	2000	2001	2002	2003	2004	2005	2006	2007
BUR1	73.2552	66.9503	62.6303	62.7983	74.3935	68.1588	68.5066	76.9051	80.8360
NC4	73.2819	66.9765	62.5861	62.7602	70.8808	68.0797	68.4023	76.8068	80.7471
Difference, %	0.04	0.04	-0.07	-0.06	-4.72	-0.12	-0.15	-0.13	-0.11
	2008	2009	2010	2011	2012	2013	2014	2015	%
BUR1	90.2738	83.5638	83.6467	96.5155	108.3493	116.6838			
NC4	90.1750	83.4996	83.5573	96.4069	108.7812	131.8213	156.0630	220.6280	0.05
Difference, %	-0.11	-0.08	-0.11	-0.11	0.40	12.97			

3.8.6. Planned Improvements

Within the "International Bunkers: Aviation", potential improvements could be achieved once a higher methodology is used (for exemple, 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.

3.9. CO_2 Emissions from Biomass (Memo Items)

3.9.1. Source Category Description

Under "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 Energy Sector: 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 2015 the CO_2 emissions from biomass increased by circa 527.9 per cent (Table 3-120, Figure 3-24).

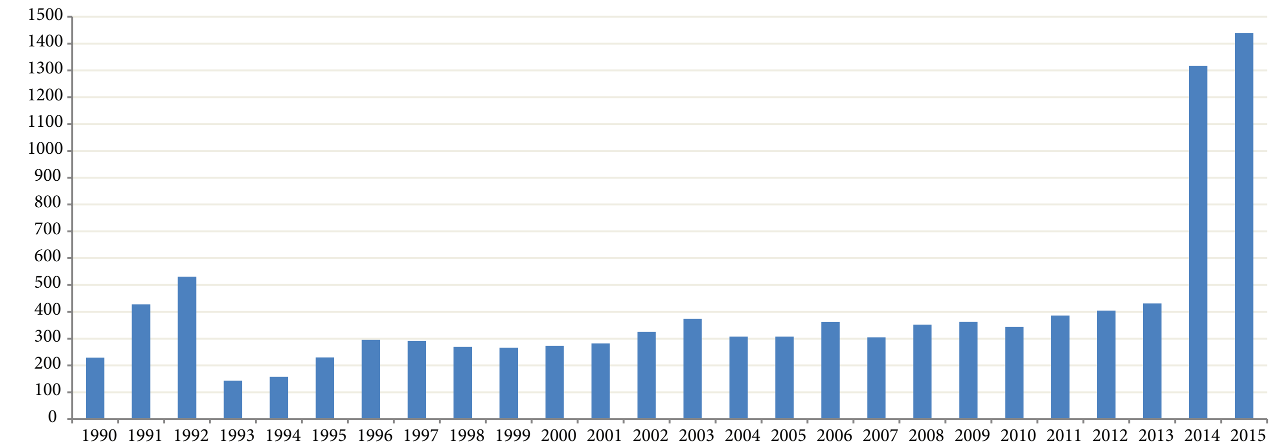


Figure 3-24: CO_2 Emissions from Biomass in the RM within 1990-2015 periods, kt

Table 3-120: CO_2 Emissions from Biomass in the RM within 1990-2015 periods, kt

	1990	1991	1992	1993	1994	1995	1996	1997	1998
CO_2 emissions from biomass	229.3072	427.7268	531.1505	143.2360	157.4600	230.0502	295.4440	291.0280	269.0120
	1999	2000	2001	2002	2003	2004	2005	2006	2007
CO_2 emissions from biomass	266.1120	272.3720	282.2280	324.9000	373.5760	307.6800	307.3920	361.4360	304.6560
	2008	2009	2010	2011	2012	2013	2014	2015	%
CO_2 emissions from biomass	352.4520	362.1000	343.3412	386.2234	404.3122	431.4636	1 317.1650	1 439.8048	527.9

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 m^3) • conversion factor in natural units (t/m^3) • 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

Where: 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 Revised 1996 IPCC Guidelines (Table 3-121).

Table 3-121: EFs Used to Estimate GHG Emissions from Biomass Within the Energy Sector, kg/TJ

IPCC Category	Fuel Type	CO_2	CH_4	N_2O	NO_x	CO	NMVOC
1A1	Fuel Wood /Wood Waste	112 000	30	4	100	1000	50
	Other types of solid biomass	100 000	30	4	100	1000	50
	Charcoal	112 000	200	4	100	1000	100
	Biogas	54 600	1	0.1	100	1000	50
1A2	Fuel Wood /Wood Waste	112 000	30	4	100	2000	50
	Other types of solid biomass	100 000	30	4	100	4000	50
	Charcoal	112 000	200	4	100	4000	100
	Biogas	54 600	1	0.1	100	4000	50
1A4a	Fuel Wood /Wood Waste	112 000	300	4	100	5000	600
	Other types of solid biomass	100 000	300	4	100	5000	600
	Charcoal	112 000	200	1	100	7000	100
	Biogas	54 600	5	0.1	100	5000	600
1A4b	Fuel Wood /Wood Waste	112 000	300	4	100	5000	600
	Other types of solid biomass	100 000	300	4	100	5000	600
	Charcoal	112 000	200	1	100	7000	100
	Biogas	54 600	5	0.1	100	5000	600
1A4c	Fuel Wood /Wood Waste	112 000	300	4	100	5000	600
	Other types of solid biomass	100 000	300	4	100	5000	600
	Charcoal	112 000	200	1	100	7000	100
	Biogas	54 600	5	0.1	100	5000	600
1A5	Fuel Wood /Wood Waste	112 000	30	4	100	1000	50
	Other types of solid biomass	100 000	30	4	100	1000	50
	Charcoal	112 000	200	4	100	1000	100
	Biogas	54 600	1	0.1	100	1000	50

Sources: For CO_2, CH_4 and N_2O emissions – 2006 IPCC Guidelines, Vol. 2, Ch. 2, Tab. 2.2-2.5, p.17, 19, 21, 23; For NOx, CO and NMVOC – Revised 1996 IPCC Guidelines, Vol. 3, Ch. 1.4.3.

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 pelletes and vegetal waste; biogas) in such sectors 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 1993-2015, respectively from the sectoral statistical publications of the ATULBD.

In the Energy Balances of the Republic of Moldova 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 Energy Balances for 1990, in which the information is available only in natural units and in tonnes 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 (Table 3-122).

Table 3-122: 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**

The Energy Balances of the RM for 2013, provide information on fuel wood, wood waste, agricultural residues and biogas; while in the Energy Balances for 2014-2015 time series all types of biomass include the consumption of fuel wood, wood waste, agricultural residues, briquettes and wood pelettes, charcoal and biogas (Table 3-123).

Table 3-123: Biomass Consumption in the Republic of Moldova within 2003-2015 periods, TJ

IPCC Category	Fuel Type	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
1A1	Fuel Wood /Wood Waste	29	19	19	3	1	2	3	4	1	4	40	34	0
	Other types of solid biomass		315	226	214	239	373	435	514	399	226	229	321	0
	Biogas											36	99	21
1A2	Fuel Wood /Wood Waste		48	37	8	11	21	14	27	42	53	25	29	44
	Other types of solid biomass									5	2	10		407
	Biogas													387
1A4a	Fuel Wood /Wood Waste	527	320	241	280	265	283	276	249	236	262	220	258	234
	Other types of solid biomass		14	5	2	14	28	300	41	31	88	68	212	133
	Charcoal											3	21	16
1A4b	Fuel Wood /Wood Waste	2404	1993	1998	2463	1987	2254	2254	2137	2361	2864	3086	10618	11887
	Other types of solid biomass	117	130	214	245	197	212		66	419	96	134	181	244
	Charcoal										13	11		2
1A4c	Fuel Wood /Wood Waste	29	8	15	18	13	10	19	25	15	31	29	39	27
	Other types of solid biomass		2	7	12	2	1	2	6	12	2	3	5	2
1A5	Fuel Wood /Wood Waste	59	27	31	31	36	26	9						
	Other types of solid biomass				2	1	1							
1A	**Total biomass consumption**	**3165**	**2876**	**2793**	**3278**	**2766**	**3211**	**3312**	**3069**	**3521**	**3645**	**3894**	**11817**	**14327**

Note: starting with 2003, in the biomass category "Fuel wood/Wood waste" includes fuel wood and wood waste, while biomass category "Other types of solid biomass" includes agricultural residues, pelettes and wood briquettes.

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 2009-2015 time series (Table 3-124).

Table 3-124: Fuel Wood Consumption in the ATULBD within 1A4b "Residential", 2009-2015

	2009	2010	2011	2012	2013	2014	2015
Fuel Wood, thousand m^3 comp.	10.1793	10.8175	9.2527	5.5379	4.8690	7.6844	10.9011
Fuel Wood, TJ	91.55	91.57	89.51	48.37	42.17	69.11	98.00

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 emission factors represented circa 80 per cent while those related to activity data – 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. Following the recommendations included into the 2006 IPCC Guidelines, GHG emissions originated from the "CO_2 emissions from biomass" (Memo Items) were estimated based on AD and CS coefficients and parameters 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 subcategory included in 1A "Fuel Combustion activities" complies with the requirements set out in the description of each subcategory 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 subcategory; verifying if the primary reference sources are correctly indicated; the accuracy of calculations for subcategories included in 1A 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 calculations files the EFs are specified in tabular formats for each subcategory, the import of the respective values into calculation formulas is ensured by automatic connections;
- the consistency of the calculations is also ensured by verifying the correctness of applying conversion factors of natural units to energy units for all subcategories and the entire range of years covered by the inventory;
- verification if the same method is used for the entire range of years covered by the inventory;
- verifying if GHG emissions calculations have been made for all years and for all types of fuels mentioned in the Energy Balances of the RM;
- verifying to what extent the full geographical coverage of the inventory 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, etc.

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 due to the use of new activity data. In the previous inventories there were used especially AD on biomass consumption expressed in natural units (kt and thousand m^3 comp.), while in the current inventory cycle the transit was made to AD expressed in TJ, as these are available in the Energy Balances of the RM for 1990 and 1993-2015 time series. In comparison with the results included into the First Biennial Report of the RM under the UNFCCC, the performed recalculations resulted in an increase of CO_2 emissions in 1990 and 2003-2013 time periods, varying from a minimum increase by 1.1 per cent in 2011 and a maximum increase by 18.8 per cent in 2010; respectively a decrease of the CO_2 emissions between 1993 and 2002, varying from a minimum decrease by 9.7 per cent in 1997 and a maximum decrease by 81.2 per cent by 1993 (Table 3-125). For 2014-2015 years, the CO_2 emissions from "CO_2 emissions from biomass" (Memo Items) were estimated for the first time. The results allow assert that between 1990 and 2015, the GHG emissions originated from this source category increased by circa 527.9 per cent.

Table 3-125: Comparative Results of GHG Emissions from "CO_2 emissions from biomass" (Memo Items) included into the BUR1 and NC4 of the RM under the UNFCCC, kt

	1990	1991	1992	1993	1994	1995	1996	1997	1998
BUR1	210.8270	427.7270	531.1510	763.4130	599.5040	645.5670	615.3430	322.4370	409.1760
NC4	229.3072	427.7268	531.1505	143.2360	157.4600	230.0502	295.4440	291.0280	269.0120
Difference, %	8.8	0.0	0.0	-81.2	-73.7	-64.4	-52.0	-9.7	-34.3
	1999	2000	2001	2002	2003	2004	2005	2006	2007
BUR1	373.6050	367.8560	353.0870	389.5020	359.7900	296.5060	295.0370	323.6620	293.1870
NC4	266.1120	272.3720	282.2280	324.9000	373.5760	307.6800	307.3920	361.4360	304.6560
Difference, %	-28.8	-26.0	-20.1	-16.6	3.8	3.8	4.2	11.7	3.9
	2008	2009	2010	2011	2012	2013	2014	2015	%
BUR1	336.6570	321.2480	288.9640	381.8930	396.4310				
NC4	352.4520	362.1000	343.3412	386.2234	404.3122	431.4636	1 317.1650	1 439.8048	527.9
Difference, %	4.7	12.7	18.8	1.1	2.0				

3.9.6. Planned Improvements

Potential improvements within the "CO_2 emissions from biomass" (Memo Items) could be achieved by collecting more accurate AD for the Right Bank of Dniester River (AD on biomass consumption were recently revised by the NBS using a new methodology, though it did not covered the entire historical period, revealing thus the time-series inconsistency related to inventory results for CO_2 emissions from biomass); respectively, by collecting AD on biomass consumption in the ATULBD for a longer period of time.

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 3-126). 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.

Table 3-126: Comparison of CO_2 Emissions Estimated by using Reference and Sectoral Approaches in the Republic of Moldova for 1990-2015 periods, kt

	1990	1991	1992	1993	1994	1995	1996	1997	1998
Reference Approach	33079.1329	28955.1299	19859.8238	15140.2072	14214.9205	10850.6415	10981.6121	9885.5299	8452.9294
Sectoral Approach	33296.4997	29187.9414	19956.0873	15202.2999	14252.7440	10892.5599	11047.4771	9961.1717	8525.4217
Difference, %	0.7	0.8	0.5	0.4	0.3	0.4	0.6	0.8	0.9
	1999	2000	2001	2002	2003	2004	2005	2006	2007
Reference Approach	6511.0495	5785.8102	6386.8850	6018.6987	6637.2547	7165.6988	7436.9102	6631.6217	6824.0792
Sectoral Approach	6583.5385	5852.0381	6448.7744	6080.7634	6707.3657	7233.0292	7504.5590	6707.5827	6903.9790
Difference, %	1.1	1.1	1.0	1.0	1.1	0.9	0.9	1.1	1.2
	2008	2009	2010	2011	2012	2013	2014	2015	%
Reference Approach	7355.3863	8161.8826	8722.0781	8748.9114	8385.8281	7274.0497	7110.2713	7100.8567	-78.5
Sectoral Approach	7444.6601	8244.5397	8804.7675	8844.3258	8493.5071	7404.5123	7264.7778	7319.2659	-78.0
Difference, %	1.2	1.0	0.9	1.1	1.3	1.8	2.2	3.1	

4. INDUSTRIAL PROCESSES AND PRODUCT USE SECTOR

4.1. Overview

'Industrial Processes and Product Use' (IPPU) Sector 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, Synthetic Resins and Detergents 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 2015, IPPU sector accounted for circa 5.7 per cent of total national GHG direct emissions (without LULUCF), being a relevant source of GHG emissions. This sector represented an important source of CO_2 national emissions (6.5 per cent of national total) and F-gas emissions (HFC, PFC and SF_6).

Table 4-1: Direct GHG Emissions from IPPU Sector in the Republic of Moldova within 1990-2015, kt CO_2 equivalent

	1990	1991	1992	1993	1994	1995	1996	1997	1998
CO_2	1580.9940	1402.6293	814.3567	733.1321	552.8842	448.9341	407.6878	449.0073	373.4402
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	4.5879	5.1847	5.9997	7.4843
PFC	NO	NO	NO	NO	NO	NO	NO	NO	NO
SF_6	NO	NO	NO	NO	NO	NO	NO	NO	NO
Total GHG emissions	1581.0137	1402.6457	814.3716	733.1500	552.8991	453.5222	412.8731	455.0080	380.9260
	1999	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**
CO_2	336.6304	308.5696	311.3929	360.0955	388.2276	458.6192	556.3237	654.1156	901.0373
N_2O	0.0128	0.0131	0.0131	0.0131	0.0131	0.0149	0.0182	0.0176	NO
HFC	8.5714	10.4630	12.8513	16.8928	23.6694	31.0742	42.1522	54.7020	69.8086
PFC	NO	NO	NO	NO	NO	NO	NO	0.0231	0.0231
SF_6	NO	NO	NO	NO	0.0071	0.0071	0.0569	0.3302	0.4298
Total GHG emissions	345.2145	319.0457	324.2573	377.0015	411.9173	489.7155	598.5509	709.1884	971.2988
	2008	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**%**
CO_2	978.6462	466.2423	490.8096	578.2196	586.7346	631.7162	652.4526	614.5157	-61.1
N_2O	NO	NO	NO	NO	NO	NO	NO	NO	-100.0
HFC	84.6748	93.2489	113.4282	119.5378	128.8468	137.5611	151.3701	179.4375	3811.1
PFC	0.0288	0.0288	0.0403	0.0403	0.0403	0.0403	0.0403	0.0403	75.0
SF_6	0.5175	0.5602	0.6796	0.7140	0.7710	0.9700	1.0575	1.0575	14765.7
Total GHG emissions	1063.8673	560.0802	604.9577	698.5117	716.3927	770.2877	804.9205	795.0511	-49.7

Abbreviations: NO – 'Not Occurring'.

Between 1990 and 2015, the total GHG emissions originated from the IPPU sector tended to lower values, decreasing by circa 49.7 per cent, from 1.581 Mt CO_2 equivalent in 1990 to 0.795 Mt CO_2 equivalent in 2015 (Table 4-1, Figure 4-1), in particular due to reduced industrial output, such as mineral products (clinker production decreased by 53.9 per cent; lime production – by 90.6 per cent; glass production – by 31.0 per cent; bricks production – by 80.1 per cent; soda ash use – by 48.3 per cent), steel production – by

39.5 per cent, rolling mills production – by 48.1 per cent and non-energy products from fuels and solvent use (lubricants use decreased by 79.5 per cent, while paraffin wax use – by 78.9 per cent), etc.

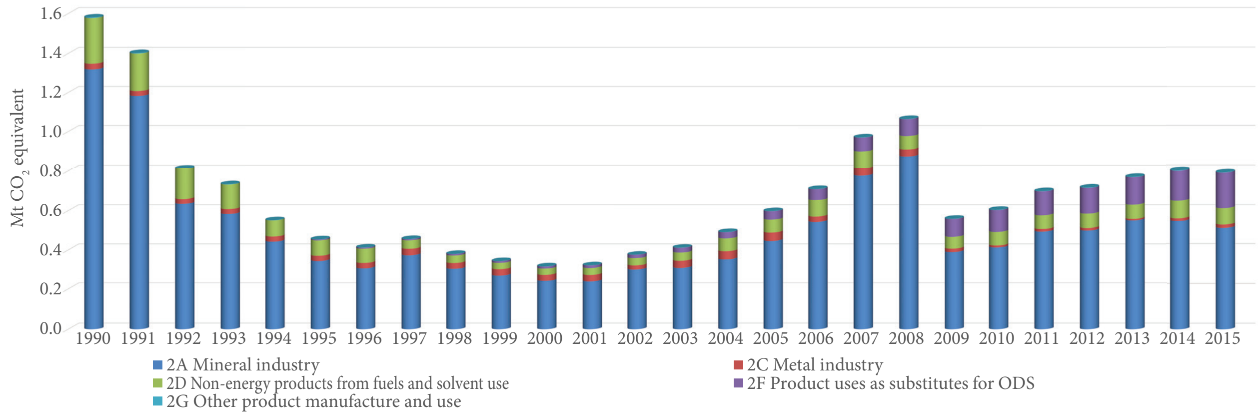


Figure 4-1: Direct GHG Emissions from IPPU Sector in the Republic of Moldova within 1990-2015

To be noted that in 1990, there were registered only CO_2 and N_2O emissions within this sector, while in 2015, the share in the total GHG emissions covered by IPPU Sector represented: CO_2 – 77.3 per cent, HFC – 22.6 per cent, PFC – 0.005 per cent and SF_6 – 0.133 per cent.

From Tables 4-2 and 4-3 one can notice 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 IPPU sector, with a share varying from a minimum of 64.1 per cent (2015) to a maximum of 84.3 per cent (1991), from a minimum of 6.3 per cent (2008) to a maximum of 18.9 per cent (1992), respectively from a minimum of 1.0 per cent (1995) up to a maximum of 22.6 per cent (2015) of the total.

Table 4-2: Total Direct GHG Emissions from the IPPU Sector by Category in the Republic of Moldova within 1990-2015, kt CO_2 equivalent

	1990	1991	1992	1993	1994	1995	1996	1997	1998
2A. Mineral industry	1316.1041	1182.6733	634.3365	583.4616	441.6001	345.1199	308.9247	373.6804	306.5335
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	233.2089	192.3631	153.7706	123.3910	84.6033	76.4826	70.9984	42.0075	37.5225
2F. Product uses as substitutes for ODS	NO	NO	NO	NO	NO	4.5879	5.1847	5.9997	7.4843
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	1581.0137	1402.6457	814.3716	733.1500	552.8991	453.5222	412.8731	455.0080	380.9260
	1999	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**
2A. Mineral industry	272.6662	240.0428	237.3637	302.8397	311.0548	353.3699	444.8424	543.7505	776.1316
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	31.5638	31.3591	34.6288	36.0221	40.8564	63.7753	68.4829	82.3885	85.3456
2F. Product uses as substitutes for ODS	8.5714	10.4630	12.8513	16.8928	23.6694	31.0742	42.1522	54.7020	69.8086
2G. Other products manufacture and use	0.6190	0.9118	0.7861	0.7438	0.9083	0.9876	1.1377	1.3293	1.4002
2. IPPU	345.2145	319.0457	324.2573	377.0015	411.9173	489.7155	598.5509	709.1884	971.2988
	2008	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**%**
2A. Mineral industry	874.7129	389.8573	412.7424	491.5026	496.8003	551.5523	548.2551	509.6941	-61.3
2C. Metal industry	35.4118	17.0619	9.6985	12.8556	12.6973	7.6569	13.7976	17.2258	-39.6
2D. Non-energy products from fuel and solvent use	67.5356	58.6232	67.4640	72.7635	76.1943	71.3632	89.3660	86.8119	-62.8
2F. Product uses as substitutes for ODS	84.6748	93.2489	113.4282	119.5378	128.8468	137.5611	151.3701	179.4375	3811.1
2G. Other products manufacture and use	1.5322	1.2888	1.6246	1.8522	1.8540	2.1542	2.1317	1.8818	-41.2
2. IPPU	1063.8673	560.0802	604.9577	698.5117	716.3927	770.2877	804.9205	795.0511	-49.7

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 the IPPU sector, tends to increase significantly lately (Table 4-3).

Table 4-3: Breakdown of the IPPU Sector GHG Emissions by Category within 1990-2015 periods

	1990	1991	1992	1993	1994	1995	1996	1997	1998
2A. Mineral industry	83.2	84.3	77.9	79.6	79.9	76.1	74.8	82.1	80.5
2C. Metal industry	1.8	1.8	2.9	3.3	4.6	5.8	6.5	7.1	7.5
2D. Non-energy products from fuel and solvent use	14.8	13.7	18.9	16.8	15.3	16.9	17.2	9.2	9.9
2F. Product uses as substitutes for ODS	NO	NO	NO	NO	NO	1.0	1.3	1.3	2.0
2G. Other products manufacture and use	0.20	0.21	0.28	0.26	0.25	0.24	0.25	0.21	0.18
2. IPPU	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

	1999	2000	2001	2002	2003	2004	2005	2006	2007
2A. Mineral industry	79.0	75.2	73.2	80.3	75.5	72.2	74.3	76.7	79.9
2C. Metal industry	9.2	11.4	11.9	5.4	8.6	8.3	7.0	3.8	4.0
2D. Non-energy products from fuel and solvent use	9.1	9.8	10.7	9.6	9.9	13.0	11.4	11.6	8.8
2F. Product uses as substitutes for ODS	2.5	3.3	4.0	4.5	5.7	6.3	7.0	7.7	7.2
2G. Other products manufacture and use	0.18	0.29	0.24	0.20	0.22	0.20	0.19	0.19	0.14
2. IPPU	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
	2008	2009	2010	2011	2012	2013	2014	2015	%
2A. Mineral industry	82.2	69.6	68.2	70.4	69.3	71.6	68.1	64.1	-23.0
2C. Metal industry	3.3	3.0	1.6	1.8	1.8	1.0	1.7	2.2	20.2
2D. Non-energy products from fuel and solvent use	6.3	10.5	11.2	10.4	10.6	9.3	11.1	10.9	-26.0
2F. Product uses as substitutes for ODS	8.0	16.6	18.7	17.1	18.0	17.9	18.8	22.6	2131.0
2G. Other products manufacture and use	0.14	0.23	0.27	0.27	0.26	0.28	0.26	0.24	17.0
2. IPPU	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	0.0

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 IPPU Sector.

Table 4-4: Key Categories Identified under the IPPU Sector

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 source 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 IPPU Sector

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 IPPU Sector (by source 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 ±8.81 per cent. The uncertainties introduced in trend in sectoral emissions were estimated at ±4.72 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. 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 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 IPPU sector 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 2005-2015'; respectively, due to use of new methodological approach and new EFs available into the 2006 IPCC Guidelines, as well as in the EMEP/EEA Air Pollutant Emission Inventory Guidebook (2016), thus replacing methodological approaches and EFs available in the Revised 1996 IPCC Guidelines, in the Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories, as well as in the EMEP/EEA Air Pollutant Emission Inventory Guidebook (2009). Also, in order to transfer direct GHG emissions into CO_2 equivalent, within the current inventory cycle were used the GWP_{100} values available in the IPCC AR4, thus replacing the GWP_{100} values from the IPCC SAR.

In comparison with the results included into the BUR1 of the Republic of Moldova under the UNFCCC (2016), the performed recalculation resulted in a decrease of direct GHG emissions between 1990 and 1997, varying from a minimum of 0.8 per cent in 1993, to a maximum of 29.0 per cent in 1992, respectively in an increase within the 1998-2013 periods, varying from a minimum of 3.5 per cent in 2007, up to a maximum of 23.8 per cent in 2001 (Table 4-6).

Table 4-6: Recalculated GHG Emissions under the IPPU Sector for the 1990-2013, included in the BUR1 of the Republic of Moldova under the UNFCCC, kt CO_2 equivalent

	1990	1991	1992	1993	1994	1995	1996	1997
BUR1	1842.0368	1755.9756	1147.1632	739.4274	607.7326	478.3798	425.5691	477.8304
NC4	1581.0137	1402.6457	814.3716	733.1500	552.8991	453.5222	412.8731	455.0080
Difference, %	-14.2	-20.1	-29.0	-0.8	-9.0	-5.2	-3.0	-4.8
	1998	1999	2000	2001	2002	2003	2004	2005
BUR1	332.1432	297.0876	270.1846	261.9524	320.4080	371.4758	420.0876	560.4734
NC4	380.9260	345.2145	319.0457	324.2573	377.0015	411.9173	489.7155	598.5509
Difference, %	14.7	16.2	18.1	23.8	17.7	10.9	16.6	6.8
	2006	2007	2008	2009	2010	2011	2012	2013
BUR1	656.2753	938.5377	1015.0149	513.6632	559.4372	601.0675	622.6759	672.5900
NC4	709.1884	971.2988	1063.8673	560.0802	604.9577	698.5117	716.3927	770.2877
Difference, %	8.1	3.5	4.8	9.0	8.1	16.2	15.1	14.5

Abbreviations: NC4 – Fourth National Communication; BUR1 – First Biennial Update Report.

4.1.7. Assessment of Completeness

The current inventory covers GHG emissions from 7 source categories of the 8 included in IPPU sector (Table 4-7).

Table 4-7: Assessment of Completeness under the IPPU Sector

IPCC Codes	Category name	CO_2	N_2O	HFC	PFC	SF_6
2A.	Mineral industry	X	NO	NA	NA	NA
2B.	Chemical industry	NO	NO	NA	NA	NA
2C.	Metal industry	X	NO	NA	NA	NO
2D.	Non-energy products from fuel and solvent use	X	NO	NA	NA	NA
2E.	Electronic industry	NA	NA	NA	NO	NO
2F.	Product uses as substitutes for ODS	NA	NA	X	NA	NA
2G.	Other products manufacture and use	X	X	NA	X	X
2H.	Other	NO	NO	NA	NA	NA

Abbreviations: X – source categories included into inventory; NA – 'Not Applicable'; NO – 'Not Occurring'.

4.1.8. Planned Improvements

Planned improvements at the source categories level within the IPPU sector 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, 1990-2015, the direct GHG emissions originated from the source category 2A 'Mineral Industry' decreased by circa 61.3 per cent (Table 4-8).

Table 4-8: Total Direct GHG Emissions from the Category 2A 'Mineral Industry' by Source within 1990-2015, 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	86.6865	80.3098	44.3047	66.2737	33.2410	22.5003	19.8100	23.1676	21.6739
2A. Mineral Industry	1316.1041	1182.6733	634.3365	583.4616	441.6001	345.1199	308.9247	373.6804	306.5335
	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	21.8274	21.0475	20.9031	25.4017	26.1452	30.0814	27.6907	29.8885	29.7100
2A. Mineral Industry	272.6662	240.0428	237.3637	302.8397	311.0548	353.3699	444.8424	543.7505	776.1316
	2008	2009	2010	2011	2012	2013	2014	2015	%
2A1. Cement Production	789.9160	340.5679	349.8333	427.2624	442.1615	476.9104	464.6082	443.2441	-54.4
2A2. Lime Production	35.5041	10.5446	21.6512	22.0613	20.6563	30.1662	39.1904	21.7547	-90.6
2A3. Glass Production	21.5408	16.3507	19.5231	22.9484	17.8264	25.7612	26.0660	27.9127	10.7
2A4. Other Process Uses of Carbonates	27.7519	22.3942	21.7348	19.2305	16.1560	18.7145	18.3906	16.7826	-80.6
2A. Mineral Industry	874.7129	389.8573	412.7424	491.5026	496.8003	551.5523	548.2551	509.6941	-61.3

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, while in 2015 they decreased by another 7.0 per cent in comparison with the previous year (Figure 4-2).

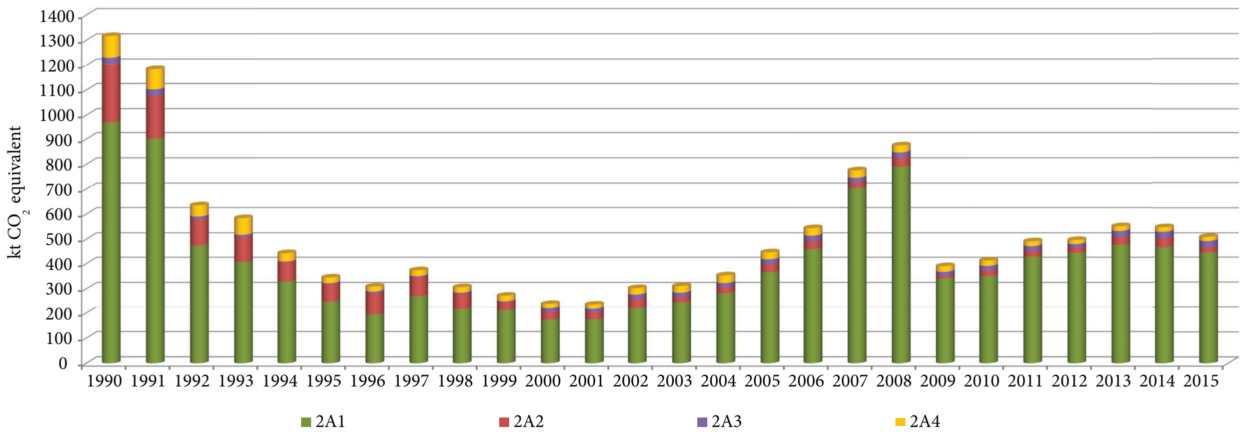


Figure 4-2: Direct GHG Emissions from the Category 2A 'Mineral Industry' by Source, 1990-2015

Similar trends were recorded for the indirect GHG emissions (NO_x, CO, NMVOC) and SO_x originated from the source category 2A 'Mineral Industry' (Table 4-9).

Table 4-9: Ozone and Aerosol Precursors Emissions from the Category 2A 'Mineral Industry' by Gas in the Republic of Moldova within 1990-2015, kt

	1990	1991	1992	1993	1994	1995	1996	1997	1998
NO_x	3.5018	3.2328	1.6705	1.5838	1.2292	1.0299	0.8768	1.0765	0.9467
CO	3.3740	3.0205	1.6235	1.4688	1.1396	0.8868	0.7855	0.9626	0.7826
NMVOC	0.0339	0.0315	0.0165	0.0143	0.0115	0.0089	0.0069	0.0096	0.0078
SO_2	1.2687	1.2004	0.6003	0.5859	0.4588	0.4070	0.3371	0.4145	0.3842
	1999	2000	2001	2002	2003	2004	2005	2006	2007
NO_x	0.8205	0.9286	0.8809	1.0903	1.0778	1.2047	1.4802	1.6749	2.1837
CO	0.6987	0.5791	0.5760	0.7351	0.7592	0.8754	1.1266	1.3863	2.0250
NMVOC	0.0075	0.0067	0.0066	0.0083	0.0091	0.0104	0.0133	0.0164	0.0244
SO_2	0.3257	0.4358	0.4048	0.4942	0.4777	0.5252	0.6300	0.6789	0.8179
	2008	2009	2010	2011	2012	2013	2014	2015	%
NO_x	2.3984	1.1819	1.2872	1.5377	1.4504	1.6760	1.6573	1.5815	-54.8
CO	2.3142	0.9974	1.0448	1.2638	1.2952	1.4190	1.4047	1.2964	-61.6
NMVOC	0.0277	0.0122	0.0126	0.0155	0.0157	0.0171	0.0167	0.0160	-52.9
SO_2	0.8718	0.4733	0.5294	0.6282	0.5606	0.6722	0.6644	0.6478	-48.9

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".

$$CaCO_3 \text{ (limestone)} + \text{heat} \rightarrow CaO \text{ (lime)} + CO_2$$

$$CaMg(CO_3)_2 \text{ (dolomite)} + \text{heat} \rightarrow CaO \bullet MgO \text{ (dolomite lime)} + 2CO_2$$

Lime and/or dolomite lime is then combined with silicon containing materials (SiO_2), aluminium (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 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, fibre 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_x. 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_x 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_x.

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 non-carbonate sources were available, it was no need to adjust (reduce) the emission factors. The value of CKD correction factor was also taken into account. 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 1990-2015 from a maximum of 1.013 to a minimum of 1.0002 (Table 4-10).

Table 4-10: Country Specific Emission Factors used to estimate CO_2 emissions from Clinker Production in the Republic of Moldova, 1990-2015

	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
	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

	2008	2009	2010	2011	2012	2013	2014	2015	%
CaO fraction	0.6570	0.6510	0.6550	0.6529	0.6521	0.6551	0.6569	0.6565	-0.2
CO_2/CaO stoichiometric ratio	0.7848	0.7848	0.7848	0.7848	0.7848	0.7848	0.7848	0.7848	0.0
MgO fraction	0.0120	0.0170	0.0160	0.0166	0.0168	0.0156	0.0158	0.0166	3.7
CO_2/MgO stoichiometric ratio	1.0919	1.0919	1.0919	1.0919	1.0919	1.0919	1.0919	1.0919	0.0
CKD fraction	1.0050	1.0030	1.0040	1.0008	1.0015	1.0003	1.0002	1.0002	-1.1
$EF_{clinker}$	0.5314	0.5311	0.5336	0.5310	0.5309	0.5313	0.5329	0.5335	-1.1

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.

Below are presented the default EFs values used to estimate indirect GHG and SO_2 emissions from cement production (Table 4-11).

Table 4-11: Default Emission Factors used to Estimate Indirect GHG and SO_x Emissions from 2A1 'Cement Production' Source Category

Category	Process Description	NO_x	CO	NMVOC	SO_x
		g / t clinker			
Mineral Industry	Cement Production	1241	1455	18	374

Source: EMEP/EEA Atmospheric Emissions Inventory Guidebook, November 2016, Code SNAP 030311 Cement, Category 1.A.2.f.i, Table 3-24.

Information on clinker production was received directly from the main producer in the Republic of Moldova, which is Lafarge Cement (Moldova) J.S.C. in Rezina, while activity data on clinker production at Cement and Slate Combined Works in Ribnita were obtained, since 2009[35] from the Statistical Yearbooks of the ATULBD (for 2007-2015 years). 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, 1990-2015, 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**	**%**
Cement Production	1775.9	869.4	861.4	1018.0	1051.4	1095.3	1086.2	1122.8	-50.9
Clinker Production	1486.6	641.3	655.6	804.7	832.8	897.6	871.9	830.9	-53.9

Source: Lafarge Cement (Moldova) J.S.C. in Rezina, 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).

[35] 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.

$$EF_{quicklime} = \text{Stoichiometric Ratio } (CO_2/CaO)\ (0.785) \bullet \text{CaO Content}$$

$$EF_{dolomitic\ quicklime} = \text{Stoichiometric Ratio } (CO_2/CaO{\bullet}MgO)\ (0.913) \bullet (CaO{\bullet}MgO) \text{ Content}$$

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_x 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_x Emissions from 2A2 'Lime Production' Source Category

Category	Process Description	NO_x	CO	SO_x
		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 2015, 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). As revealed below, 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 4-15: Activity Data on Lime Production in the Republic of Moldova within 1990-2015, 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	%
RM: left bank of Dniester River	14.00	4.28	3.18	7.44	6.84	5.49	8.33	8.01	-91.1
RM: right bank of Dniester River	0.34	0.33	0.19	0.18	0.13	0.08	0.05	0.17	-99.9
RM: total	14.34	4.61	3.37	7.61	6.97	5.57	8.38	8.18	-96.0

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 PRODMOLD-A „Total production, as a natural expression, in the Republic, by product type for 2005-2015"; 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).

Table 4-16 provides statistical data on lime imports during 1995-2015, according to these data, lime imports increased by 73.6 times within this time period.

Table 4-16: Lime Imports in the Republic of Moldova (Right Bank of Dniester River), 1995-2015

	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	%
Lime imports, kt	5.121	6.423	7.540	3.798	4.826	4.699	5.053	4.256	5.260	4.657	7257.5

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.

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[36].

Table 4-17: Activity Data on Lime Production at Sugar Mills, 1990-2015

	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	%
Granulated sugar from sugar beet, kt [1]	133.966	38.373	103.209	88.436	83.440	140.297	177.695	84.519	-80.6
Lime used for sugar production, kt [2]	33.4915	9.5933	25.8023	22.1090	20.8599	35.0743	44.4237	21.1298	-80.6

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 2005-2015'; 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 2015 (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, 1990-2015

	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	%
Commercial lime, kt	14.344	4.614	3.369	7.615	6.971	5.569	8.378	8.181	-96.0
Lime produced at sugar mills, kt	33.492	9.593	25.802	22.109	20.860	35.074	44.424	21.130	-80.6
Total lime produced, kt	47.835	14.207	29.171	29.723	27.831	40.643	52.802	29.310	-90.6

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 Republic of Moldova (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, 1990-2015

	1990	1991	1992	1993	1994	1995	1996	1997	1998
High-calcium lime, kt	266.2625	202.1513	118.8300	115.2175	87.1888	79.4538	102.0213	86.7213	74.2263
Dolomitic lime, kt	46.9875	35.6738	20.9700	20.3325	15.3863	14.0213	18.0038	15.3038	13.0988
Total hydrated lime produced, kt	313.2500	237.8250	139.8000	135.5500	102.5750	93.4750	120.0250	102.0250	87.3250

[36] Ukrainian Association for Lime Industry: <http://limeindustry.org/ru/analytics/show/10>.

	1999	2000	2001	2002	2003	2004	2005	2006	2007
High-calcium lime, kt	41.9263	35.2325	32.6825	45.2200	25.2238	26.2013	36.0772	40.3022	28.5822
Dolomitic lime, kt	7.3988	6.2175	5.7675	7.9800	4.4513	4.6238	6.3666	7.1121	5.0439
Total hydrated lime produced, kt	49.3250	41.4500	38.4500	53.2000	29.6750	30.8250	42.4438	47.4143	33.6261
	2008	2009	2010	2011	2012	2013	2014	2015	%
High-calcium lime, kt	40.6599	12.0758	24.7953	25.2649	23.6560	34.5468	44.8815	24.9138	-90.6
Dolomitic lime, kt	7.1753	2.1310	4.3756	4.4585	4.1746	6.0965	7.9203	4.3966	-90.6
Total hydrated lime produced, kt	47.8352	14.2069	29.1710	29.7235	27.8306	40.6433	52.8017	29.3104	-90.6

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, taking into account 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:

- $Total_{l}$ – 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 aluminium (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%
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 Republic of Moldova: 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 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, by product type" (Table 4-21).

Table 4-21: Activity Data on Glass Production in the RM, 1990-2015

	1990	1991	1992	1993	1994	1995	1996	1997	1998
Flat glass for windows, thousand m^2	226.000	287.000	184.000						
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							31.397	85.233	79.742
Glassware, tonnes					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, tonnes							0.055	0.011	40.638
Other products not included elsewhere, tonnes							141.184	291.123	77.990
	2008	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**%**
Multi-layer insulating glass, thousand m^2	246.673	185.955	339.589	352.126	389.882	449.631	531.659	476.770	
Glassware, tonnes	278.583	81.408	10.760	11.680	19.547	19.775	13.473	21.191	
Glass jars, mill. conventional units	80.700	92.200	99.800	48.181	65.942	139.629	186.203	229.100	-65.2
Glass containers and bottles, mill. units	284.707	201.299	246.213	326.270	223.109	272.534	243.722	228.942	38.3
Products from fiberglass, tonnes	32.612	14.785	18.148	26.365	392.821	1711.140			
Other products not included elsewhere, tonnes	87.905	61.682	35.988	51.108	63.127	89.829	147.435	182.205	

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 2005-2015".

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 taken into account, 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 tonne of glass produced. Country specific (CS) emission factors (EF) were calculated considering the annual country specific CR values (Table 4-22).

Table 4-22: CS EF Used to Estimate CO_2 Emissions from Glass Production (glass jars, glass containers and bottles) in the RM, 1990-2015

	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	%
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	-61.9
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	61.2

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.

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[37] – 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[38]; the average weight of a conventional glass container – 0.43 kg; the average weight of a glass jar – 0.25 kg[39]. 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 1990-2015, 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	%
Multi-layer insulating glass	4.163	3.138	5.731	5.942	6.579	7.588	8.972	8.045	
Glassware	0.279	0.081	0.011	0.012	0.020	0.020	0.013	0.021	
Glass jars	20.175	23.050	24.950	12.045	16.486	34.907	46.551	57.275	-65.2
Glass containers and bottles	122.424	86.559	105.871	140.296	95.937	117.189	104.801	98.445	38.3
Products from fiberglass	0.033	0.015	0.018	0.026	0.393	1.711	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	
Total glass production in the RM	147.161	112.904	136.617	158.373	119.477	161.505	160.484	163.969	-31.0

Default EF values used for NO_x, NMVOC and SO_x are available in Table 4-24.

Table 4-24: Default EF values used for Estimating Indirect GHG Emissions from Glass Production

Category	Process Description	NO_x	NMVOC	SO_x
		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

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

[37] 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.

[38] Airapetov G.A., Bezrodnii O.C., Jolobov A.L. (2005), Building materials: teaching handbook. – Rostov-on-Don, Pheonix, 2005.

[39] 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>.

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[40]. The data provided by the main national producer of bricks (the share of bricks production from „MACON" J.S.C. between 1998 and 2015 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 4-25).

Table 4-25: Country Specific Emission Factors Used to Estimate CO_2 Emissions from Bricks, Expanded Clay and Ceramics Production, 1990-2015

	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
	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
	2008	2009	2010	2011	2012	2013	2014	2015	%
Content of CaO in clay used	0.0530	0.0769	0.0787	0.0669	0.0667	0.0668	0.0668	0.0666	-21.0
Stoichiometric Ratio CO_2/CaO	0.7848	0.7848	0.7848	0.7848	0.7848	0.7848	0.7848	0.7848	
EF, t CO_2/t clay used (only CaO)	0.0416	0.0604	0.0618	0.0525	0.0524	0.0524	0.0524	0.0523	-21.0
Content of MgO in clay used	0.0305	0.0319	0.0326	0.0288	0.0283	0.0285	0.0286	0.0288	-5.0
Stoichiometric Ratio CO_2/MgO	1.0919	1.0919	1.0919	1.0919	1.0919	1.0919	1.0919	1.0919	
EF, t CO_2/t clay used (only MgO)	0.0334	0.0349	0.0356	0.0314	0.0310	0.0311	0.0312	0.0314	-5.0
EF, t CO_2/t clay used (total)	0.0750	0.0952	0.0974	0.0839	0.0833	0.0835	0.0836	0.0837	-15.7

As the table reveals, the annual values of the EF varied between 1990 and 2015 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.

Statistical Yearbooks of the Republic of Moldova and those of the ATULBD contain activity data regarding brick production (*expressed in million conventional unit)* (Table 4-26).

[40] 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.

Table 4-26: AD on Brick Production within 1990-2015, 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	%
RM: right bank of Dniester River	53.000	38.100	37.373	40.995	28.325	35.765	35.895	37.775	-80.2
RM: left bank of Dniester River	20.697	13.523	11.582	13.010	14.657	14.618	14.669	9.063	-79.9
RM: total	73.697	51.623	48.955	54.005	42.982	50.383	50.564	46.838	-80.1

Source: Statistical Yearbooks for 1988 (page 228), 1994 (page 287), 1999 (page 303), 2005 (page 322), 2010 (page 305); Statistical Reports PRODMOLD-A „Total production, as a natural expression, in the Republic, by product type, for 2005-2015"; 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).

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[41]. 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 1550 and 1800 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 – 1550 • 0.00195/1 = 3.02 kg; the maximum weight – 1800 • 0.00195/1 = 3.51 kg; the average weight – 1675 • 0.00195/1 = 3.27 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 4-27).

Table 4-27: Activity Data on the Amount of Clay Used in Brick Production in the Republic of Moldova within 1990-2015, kt

	1990	1991	1992	1993	1994	1995	1996	1997	1998
Total brick production	769.2019	710.4094	386.0708	586.9451	291.6761	193.3620	173.7645	194.9951	181.9301
Clay used in brick production	846.1221	781.4503	424.6778	645.6396	320.8437	212.6982	191.1410	214.4946	200.1231
	1999	2000	2001	2002	2003	2004	2005	2006	2007
Total brick production	185.5230	172.7846	173.4379	205.1205	222.7583	247.9084	240.7226	231.2505	244.6421
Clay used in brick production	204.0753	190.0631	190.7817	225.6326	245.0341	272.6992	264.7949	254.3756	269.1063
	2008	2009	2010	2011	2012	2013	2014	2015	%
Total brick production	240.7128	168.6136	159.8980	176.3951	140.3893	164.5641	165.1561	152.9862	-80.1
Clay used in brick production	264.7841	185.4750	175.8878	194.0347	154.4282	181.0205	181.6717	168.2848	-80.1

AD regarding expanded clay production in the 2001-2015 periods (expressed in *thousand m^3*) were provided directly by MACON J.S.C., the only expanded clay producer in the Republic of Moldova (Table 4-28).

Table 4-28: Activity Data on the Amount of Clay Used in Expanded Clay Production in the Republic of Moldova, 2001-2015

	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, kilotons	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, kilotons	2.5710	12.2100	9.1450	40.2416	45.0140	51.3342	44.3053	40.5369
	2009	2010	2011	2012	2013	2014	2015	%
Expanded clay production, thousand m^3	61.1990	61.4200	30.3630	38.1500	42.0110	34.5680	22.9780	539.0
Specific weight, kg/m^3	399.4	353.3	324.8	403.5	376.9	375.7	398.8	2.2
Expanded clay production, kilotons	24.4404	21.6991	9.8631	15.3939	15.8331	12.9875	9.1636	553.3
Clay used, t/m^3 expanded clay	0.629	0.572	0.617	0.717	0.639	0.639	0.680	-4.9
Clay used in expanded clay production, kilotons	38.4942	35.1322	18.7340	27.3536	26.8450	22.0890	15.6250	507.7

AD regarding the production of ceramics in the 2005-2015 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 4-29).

[41] <http://aquagroup.ru/articles/ves-kirpicha.html>, <http://www.lucceram.ro/index.php/products>.

Table 4-29: AD on the Amount of Clay Used in Expanded Clay Production in the Republic of Moldova, 2005-2015

	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, tonnes	303.800	260.800	201.300	150.500	138.800	68.900
Table and ornamental ware (household ceramics), tonnes	579.719	478.955	838.189	276.802	188.722	169.089
Wall and floor tiles, thousand m^2	625.200	734.000	1 248.500	808.700	9.800	1.900
Total ceramics produced, kilotons	34.9369	40.3076	68.2507	44.1091	1.1927	0.3674
Total clay used to produce ceramics, kilotons	38.4306	44.3384	75.0758	48.5200	1.3120	0.4041
	2011	**2012**	**2013**	**2014**	**2015**	**%**
Roof tiles, pieces	66.870		1.890			-100.0
Non-refractory ceramics for construction, tonnes	55.400	12.700	24.400			-100.0
Table and ornamental ware (household ceramics), tonnes	136.854	118.369	89.630	105.969	89.866	-84.5
Wall and floor tiles, thousand m^2	1.600	0.700	0.500	0.600	1.500	-99.8
Total ceramics produced, kilotons	0.5444	0.1681	0.1480	0.1377	0.1692	-99.5
Total clay used to produce ceramics, kilotons	0.5988	0.1849	0.1628	0.1515	0.1862	-99.5

Source: Statistical Reports PRODMOLD-A „Total production, as a natural expression, in the Republic, by product type, for 2005-2015"

As one can see, AD regarding roof tiles production are available in pieces. In order to transform these data in tonnes, 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 - 2015[42]. According to this, the mass of 1 m^2 of roof tile varies between 54 and 74 kg, while 1 m^2 of light roof tile contains circa 14.8-16.6 pieces with an average weight of circa 3.4 kg, and 1 m^2 of heavy roof tile contains circa 15-17 pieces with an average weight of circa 4.6 kg. For comparing, web pages of companies importing roof tiles in the Republic of Moldova and Romania were consulted[43], and similar values of the conversion factors were found.

AD regarding the production of wall and floor tiles are available in thousand m^2. In order to transform these data, the following conversion factor was used: 18.9 kg for 1 m^2 of wall and floor tiles (Table 4-30), determined after consulting the web pages of those companies that sell these products[44]. In comparison, the similar conversion factors used in the Russian Federation are 19 kg for 1 m^2 of floor tiles and 14 kg for 1 m^2 of wall tiles[45].

Table 4-30: 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**

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 (in kilotons) by the default factor – 1.1 (Volume 3, Chapter 2.5, Page 2.36)

The methodology for estimating indirect GHG emissions from brick and ceramics production is available in the EMEP/EEA Atmospheric Emissions Inventory Guidebook (2016) (Table 4-31).

Table 4-31: EF Used to Estimate Indirect GHG Emissions from Brick and Ceramics Production

Category	Process Description	NO_x	CO	SO_x
		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.

[42] 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>.
[43] <http://www.acoperisuldetigla.ro/tigla-ceramica-tondach/>, <https://acoperisuldetigla.wordpress.com/tigla-ceramica-siceram/>.
[44] <http://www.cesarom.ro/calculator-placi-gresie-si-faianta>.
[45] 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 1990-2015 are available in Table 4-32, 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 tonne of glass (250 kg of soda ash per tonne of glass).

Table 4-32: AD on Soda Ash Imports in the Republic of Moldova within 1990-2015, kt

	1990	1991	1992	1993	1994	1995	1996	1997	1998
Soda ash consumption	67.8693	69.0646	54.4697	55.0431	35.2249	35.2333	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	%
Soda ash consumption	33.7002	24.2468	29.0280	37.0516	22.5167	37.4016	33.8123	26.3379	-61.2

Source: Custom Service of the Republic of Moldova, 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 2015, about 90.3 per cent (average for 26 years) of the annual soda ash consumption was used in the glass industry (Table 4-33).

Table 4-33: AD on Soda Ash Consumption in the RM within 1990-2015, kt

	1990	1991	1992	1993	1994	1995	1996	1997	1998
Average annual consumption	65.7648	66.9231	52.7807	53.3364	34.1326	34.1487	20.5051	24.0729	23.9158
Soda ash used in the glass industry	59.3856	60.4316	47.6610	48.1628	30.8218	30.8363	18.5161	21.7379	21.5960
Soda ash used in other industries	6.3792	6.4915	5.1197	5.1736	3.3109	3.3124	1.9890	2.3351	2.3198
	1999	2000	2001	2002	2003	2004	2005	2006	2007
Average annual consumption	17.5665	34.2195	31.6393	37.5070	34.2465	34.9337	38.8254	37.2388	34.5005
Soda ash used in the glass industry	15.8626	30.9002	28.5703	33.8688	30.9246	31.5451	35.0593	33.6266	31.1539
Soda ash used in other industries	1.7040	3.3193	3.0690	3.6382	3.3219	3.3886	3.7661	3.6122	3.3465
	2008	2009	2010	2011	2012	2013	2014	2015	%
Average annual consumption	30.5556	23.4061	28.3219	32.8321	24.7687	33.4814	33.2697	33.9923	-48.3
Soda ash used in the glass industry	27.5917	21.1357	25.5747	29.6473	22.3662	30.2337	30.0426	30.6950	-48.3
Soda ash used in other industries	2.9639	2.2704	2.7472	3.1847	2.4026	3.2477	3.2272	3.2972	-48.3

The amount of soda ash used in the glass industry was deducted from the specific consumption of soda ash per tonne of glass produced. The average value of the specific consumption (187.2 kg of soda ash per tonne of glass produced) was estimated on the basis of the information regarding the 2002–2015 years, provided by two glass factories in the RM (the SOE "Chisinau Glass Factory No.1" and "Glass Container Company" from Chisinau). This value was used for estimating AD on the consumption of soda ash in the glass production industry for the period from 1996 to 2015.

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 tonne of glass produced[46]), 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 (0.41492t 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 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 ±10 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 ±14.14 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 ±*10* 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 factors, 1.1 tonnes of clay to 1.0 tonne of production). Thus, combined uncertainties related to GHG

[46] 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>.

emissions from 2A4 'Other Process Uses of Carbonates' source category account for 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.

4.2.4. 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 BUR1 of the Republic of Moldova under UNFCCC (2016), GHG emissions from the clinker production were not recalculated. The respective emissions were estimated for the first time for the 2014-2015 years (Table 4-34).

Table 4-34: GHG Emissions from the 2A1 'Cement Production', 1990-2015, kilotons

	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_x	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_x	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	%
CO_2	789.9160	340.5679	349.8333	427.2624	442.1615	476.9104	464.6082	443.2441	-54.4
NO_x	1.8448	0.7959	0.8135	0.9986	1.0335	1.1139	1.0820	1.0311	-53.9
CO	2.1630	0.9331	0.9538	1.1709	1.2118	1.3060	1.2686	1.2089	-53.9
NMVOC	0.0268	0.0115	0.0118	0.0145	0.0150	0.0162	0.0157	0.0150	-53.9
SO_x	0.5560	0.2398	0.2452	0.3010	0.3115	0.3357	0.3261	0.3107	-53.9

2A2. Lime Production

CO_2 emissions from the lime production were recalculated for the 1990-2013 periods, as result of taking into consideration, for the first time, the lime production from other producers (sugar mils). In comparison with the results obtained in the BUR1 of the Republic of Moldova under UNFCCC (2016), the recalculations resulted in an increase of CO_2 emissions from lime production, varying from a minimum increase of circa 35.8 per cent in 1991, to a maximum increase of circa 943.7 per cent in 2003. For 2014-2015 the respective emissions were estimated for the first time (Table 4-35).

Table 4-35: Comparative Results of CO_2 Emissions from 2A2 'Lime Production' included into the BUR1 and NC4 of the RM under the UNFCCC, kilotons

	1990	1991	1992	1993	1994	1995	1996	1997	1998
BUR1	148.6611	129.9602	63.8886	56.7575	44.3145	28.2332	39.2209	35.4371	28.1605
NC4	232.4996	176.5179	103.7620	100.6076	76.1330	69.3788	89.0847	75.7247	64.8141
Difference, %	56.4	35.8	62.4	77.3	71.8	145.7	127.1	113.7	130.2
	1999	2000	2001	2002	2003	2004	2005	2006	2007
BUR1	17.6094	10.9877	3.8566	8.2226	2.1102	2.2557	6.6217	7.4221	10.9877
NC4	36.6099	30.7649	28.5383	39.4860	22.0253	22.8789	31.5025	35.1917	24.9579
Difference, %	107.9	180.0	640.0	380.2	943.7	914.2	375.7	374.1	127.1

	2008	2009	2010	2011	2012	2013	2014	2015	%
BUR1	10.4055	3.3327	2.3140	5.5408	5.0723	4.0523			
NC4	35.5041	10.5446	21.6512	22.0613	20.6563	30.1662	39.1904	21.7547	-90.6
Difference, %	241.2	216.4	835.7	298.2	307.2	644.4			

Abbreviations: BUR1 – First Biennial Update Report and NC4 – Fourth National Communication.

Indirect GHG emissions from lime production (Table 4-36) were recalculated for the 1990-2013 time series due to updating the AD, respectively the transition to a new assessment method and default emission factors. In the previous inventory cycle, the respective emissions have been calculated following the EMEP/CORINAIR Atmospheric Emissions Inventory Guidebook (1996), while under the current inventory cycle the indirect GHG emissions were estimated following the EMEP/EEA Atmospheric Emissions Inventory Guidebook (2016). In comparison with the results obtained in the BUR1 of the Republic of Moldova under UNFCCC (2016), the recalculations resulted in an increase of NO_x emissions, respectively in a decrease of CO and SO_x emissions from lime production.

Table 4-36: Indirect GHG Emissions and SO_x from the 2A2 'Lime Production' in the Republic of Moldova within 1990-2015, kilotons

	1990	1991	1992	1993	1994	1995	1996	1997	1998
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_x	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
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_x	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	%
NO_x	0.0655	0.0194	0.0399	0.0407	0.0381	0.0556	0.0723	0.0401	-90.6
CO	0.0928	0.0276	0.0566	0.0577	0.0540	0.0788	0.1024	0.0569	-90.6
SO_x	0.0151	0.0045	0.0092	0.0094	0.0088	0.0128	0.0167	0.0093	-90.6

2A3. Glass Production

CO_2 emissions from the glass production were calculated for the first time based on an assessment method available in the 2006 IPCC Guidelines. At the same time, the indirect GHG emissions were recalculated for 1990-2013 time series due to updated AD regarding the 2005-2013 time periods, data provided by NBS with the Statistical Reports PRODMOLD-A "Total production, as a natural expression, in the Republic, by product type", respectively due to the change of assessment method and default EF (during the previous inventory cycle, NMVOC emissions were estimated according to the IPCC 1996 Revised Guidelines, while the NO_x and SO_x emissions – according to the EMEP/CORINAIR Atmospheric Emissions Inventory Guidebook (2005), while in the latest inventory cycle the indirect GHG emissions were estimated according to the EMEP/EEA Atmospheric Emissions Inventory Guidebook (2016). In comparison with the results obtained in the BUR1 of the Republic of Moldova under UNFCCC (2016), the recalculations resulted in a decrease of NO_x and NMVOC emissions, respectively an increase of SO_x emissions. For 2014-2015, GHG emissions from glass production were estimated for the first time (Table 4-37).

Table 4-37: GHG Emissions from the 2A3 'Glass Production' in the RM within 1990-2015, kt

	1990	1991	1992	1993	1994	1995	1996	1997	1998
CO_2	25.2212	25.0580	11.9560	10.8638	3.7901	4.7151	6.9080	4.6608	4.9882
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_x	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
CO_2	3.4167	15.4704	14.0377	18.7603	17.2567	17.8332	20.5674	21.5950	18.7981
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_x	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	%
CO_2	21.5408	16.3507	19.5231	22.9484	17.8264	25.7612	26.0660	27.9127	10.7
NO_x	0.4312	0.3308	0.4003	0.4640	0.3501	0.4732	0.4702	0.4804	-31.0
NMVOC	0.0009	0.0007	0.0008	0.0010	0.0007	0.0010	0.0010	0.0010	-31.0
SO_x	0.2884	0.2213	0.2678	0.3104	0.2342	0.3165	0.3145	0.3214	-31.0

2A4. Other Process Uses of Carbonates

'Ceramics'

CO_2 emissions from the production of ceramics were recalculated for the 1990-2013 periods due to updating the AD regarding the amount of bricks produced, data provided by NBS with the Statistical Reports PRODMOLD-A "Total production, as a natural expression, in the Republic, by product type", respectively due to use of conversion factors (explained above).

In comparison with the results obtained in the BUR1 of the Republic of Moldova under UNFCCC (2016), the recalculations resulted in an increase of CO_2 emissions from brick production, varying from a minimum increase of circa 9.4 per cent in 2012, to a maximum increase of circa 88.9 per cent in 1995. For 2014-2015 the respective emissions from brick production were estimated for the first time (Table 4-38).

Table 4-38: Comparative Results of CO_2 Emissions from Brick Production included into the BUR1 and NC4 of the RM under the UNFCCC, kt

	1990	1991	1992	1993	1994	1995	1996	1997	1998
BUR1	49.4409	47.0408	24.9002	41.2877	20.7364	11.1839	10.6970	13.2840	12.3939
NC4	84.0397	77.6163	42.1804	64.1271	31.8673	21.1259	18.9848	22.1988	20.7114
Difference, %	70.0	65.0	69.4	55.3	53.7	88.9	77.5	67.1	67.1
	1999	2000	2001	2002	2003	2004	2005	2006	2007
BUR1	12.6243	11.7709	11.5904	13.5633	14.2875	15.1908	11.6881	12.0564	12.0040
NC4	21.1204	19.6702	19.3687	22.6656	23.8757	24.9880	19.8673	20.6304	19.6184
Difference, %	67.3	67.1	67.1	67.1	67.1	64.5	70.0	71.1	63.4
	2008	2009	2010	2011	2012	2013	2014	2015	%
BUR1	12.1211	10.0946	10.3310	14.6101	11.7592	13.4504			
NC4	19.8469	17.6617	17.1333	16.2864	12.8650	15.1122	15.1918	14.0906	-82.0
Difference, %	63.7	75.0	65.8	11.5	9.4	12.4			

Abbreviations: BUR1 – First Biennial Update Report and NC4 – Fourth National Communication.

SO_2 emissions from brick production were recalculated for the 1990-2013 time series due to updating the AD on brick production, including due to due to the change of assessment method and default EF (during the previous inventory cycle, SO_x emissions were estimated according to the EMEP/CORINAIR Atmospheric Emissions Inventory Guidebook (1996), while in the latest inventory cycle, the respective emissions were estimated according to the EMEP/EEA Atmospheric Emissions Inventory Guidebook (2016).

In comparison with the results obtained in the BUR1 of the Republic of Moldova under UNFCCC (2016), the recalculations resulted in a significant decrease (by circa 83 per cent) of SO_x emissions. For 2014-2015, SO_x, NO_x and CO emissions from brick production were estimated for the first time (Table 4-39).

Table 4-39: Indirect GHG Emissions from Brick Production within 1990-2015, kt

	1990	1991	1992	1993	1994	1995	1996	1997	1998
NO_x	0.1415	0.1307	0.0710	0.1080	0.0537	0.0356	0.0320	0.0359	0.0335
CO	0.1454	0.1343	0.0730	0.1109	0.0551	0.0365	0.0328	0.0369	0.0344
SO_x	0.0305	0.0281	0.0153	0.0232	0.0116	0.0077	0.0069	0.0077	0.0072
	1999	2000	2001	2002	2003	2004	2005	2006	2007
NO_x	0.0341	0.0318	0.0322	0.0390	0.0419	0.0494	0.0553	0.0553	0.0633
CO	0.0351	0.0327	0.0330	0.0400	0.0430	0.0507	0.0568	0.0568	0.0650
SO_x	0.0073	0.0068	0.0069	0.0084	0.0090	0.0106	0.0119	0.0119	0.0136
	2008	2009	2010	2011	2012	2013	2014	2015	%
NO_x	0.0569	0.0357	0.0335	0.0344	0.0287	0.0332	0.0328	0.0299	-78.9
CO	0.0585	0.0367	0.0344	0.0353	0.0295	0.0341	0.0337	0.0307	-78.9
SO_x	0.0122	0.0077	0.0072	0.0074	0.0062	0.0071	0.0071	0.0064	-78.9

'Expanded Clay Production'

GHG emissions from expanded clay production were not recalculated for 2001-2013 periods. For 2014-2015 the respective emissions were estimated for the first time (Table 4-40).

Table 4-40: GHG Emissions from Expanded Clay Production in the Republic of Moldova within 2001-2015, 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_x	0.0001	0.0003	0.0002	0.0008	0.0010	0.0011	0.0012	0.0010
	2009	2010	2011	2012	2013	2014	2015	%
CO_2	3.6656	3.4223	1.5724	2.2787	2.2411	1.8471	1.3083	401.2
NO_x	0.0045	0.0040	0.0018	0.0028	0.0029	0.0024	0.0017	553.3
CO	0.0046	0.0041	0.0019	0.0029	0.0030	0.0025	0.0017	553.3
SO_x	0.0010	0.0009	0.0004	0.0006	0.0006	0.0005	0.0004	553.3

'Ceramics'

For 2005-2015, GHG emissions from the production of ceramics were estimated for the first time (Table 4-41).

Table 4-41: GHG Emissions from the Production of Ceramics in the RM within 2005-2015, kt

	2005	2006	2007	2008	2009	2010
CO_2	2.88341	3.59595	5.47317	3.63681	0.12493	0.03936
NO_x	0.00643	0.00742	0.01256	0.00812	0.00022	0.00007
CO	0.00660	0.00762	0.01290	0.00834	0.00023	0.00007
SO_x	0.00138	0.00160	0.00270	0.00175	0.00005	0.00001
	2011	2012	2013	2014	2015	%
CO_2	0.05026	0.01540	0.01360	0.01267	0.01559	-99.5
NO_x	0.00010	0.00003	0.00003	0.00003	0.00003	-99.5
CO	0.00010	0.00003	0.00003	0.00003	0.00003	-99.5
SO_x	0.00002	0.00001	0.00001	0.00001	0.00001	-99.5

'Other Uses of Soda Ash'

CO_2 emissions from the production of ceramics were recalculated for the 1990-2013 time series due to eliminating from the calculation of the amount of soda ash used in glass production (the respective emissions are estimated within the 2A3 'Glass Production' source category), also due to use of a revised value of the default EF (during the previous inventory cycle it was used the rounded EF value of 415 kg CO_2 per tonne of soda ash used, while the current inventory cycle it was used the value of 414.92 kg CO_2 per tonne of soda ash, which is according to the 2006 IPCC Guidelines).

In comparison with the results obtained in the BUR1 of the Republic of Moldova under UNFCCC (2016), the recalculations resulted in a decrease of CO_2 emissions from other uses of soda ash, varying from a minimum decrease of circa 88.6 per cent in 1998, to a maximum decrease of circa 92.0 per cent in 1990. For 2014-2015 the respective emissions were estimated for the first time (Table 4-42).

Table 4-42: Comparative Results of CO_2 Emissions from Other Uses of Soda Ash included into the BUR1 and NC4 of the RM under the UNFCCC, kt

	1990	1991	1992	1993	1994	1995	1996	1997	1998
BUR1	32.9560	28.0686	23.7070	19.7592	16.3566	14.6218	8.1701	10.4874	8.4235
NC4	2.6469	2.6935	2.1243	2.1466	1.3737	1.3744	0.8253	0.9689	0.9625
Difference, %	-92.0	-90.4	-91.0	-89.1	-91.6	-90.6	-89.9	-90.8	-88.6
	1999	2000	2001	2002	2003	2004	2005	2006	2007
BUR1	6.7014	14.0080	14.3793	14.2074	12.6321	15.9454	18.1607	16.0597	14.1588
NC4	0.7070	1.3772	1.2734	1.5096	1.3783	1.4060	1.5626	1.4988	1.3885
Difference, %	-89.4	-90.2	-91.1	-89.4	-89.1	-91.2	-91.4	-90.7	-90.2
	2008	2009	2010	2011	2012	2013	2014	2015	%
BUR1	13.9856	10.0624	12.0466	15.3764	9.3444	15.5217			
NC4	1.2298	0.9420	1.1399	1.3214	0.9969	1.3475	1.3390	1.3681	-48.3
Difference, %	-91.2	-90.6	-90.5	-91.4	-89.3	-91.3			

Abbreviations: BUR1 – First Biennial Update Report and NC4 – Fourth National Communication

4.2.6. Planned Improvements

Possible improvements under the 2A 'Mineral Industry' category aim at updating/précising the activity data used to estimate GHG emissions within this category for 1990-2004 time periods (until 2004, Republic of Moldova used a classifier of the industrial production specific to the USSR, while the 'PRODMOLD-A' classifier was introduced only since 2004, respectively it offers detailed information on the industrial production collected through the Statistical Reports PRODMOLD-A 'Total production, as a natural expression, in the Republic, by product type' covering the 2005-2015 time series).

4.3. Chemical Industry (Category 2B)

4.3.1. Source Category Description

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 2015, 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 2015, the NMVOC emissions from 2B 'Chemical Industry' decreased by 82.5 per cent, from circa 0.0650 kt in 1990 to 0.0114 kt in 2015 (Table 4-43).

Table 4-43: NMVOC emissions from the 2B10 'Other', by source, within 1990-2015, 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
Polystyrene Production	NO	NO	NO	NO	NO	NO	NO	NO	NO
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	%
Polyethylene Production	0.0088	0.0070	0.0092	0.0101	0.0090	0.0098	0.0104	0.0081	-34.9
ABS Resins Production	0.0029	0.0023	0.0045	0.0050	0.0053	0.0055	0.0052	0.0028	-94.7
Polystyrene Production	0.0006	0.0007	0.0005	0.0006	0.0007	0.0005	0.0005	0.0005	
2B10 „Other"	0.0122	0.0100	0.0143	0.0157	0.0150	0.0159	0.0161	0.0114	-82.5

2B10 'Other'

'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. The major emissions to air are NMVOC - un-reacted monomer (i.e. ethylene), some partially reacted monomer (alkenes and alkane) together with small amounts of additives. 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.

'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.

'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'

a) *'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: 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 within 1990-2015, 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	%
RM: right bank of Dniester River	3.417	2.795	3.626	4.105	3.635	3.987	4.196	3.290	-6.5
RM: left bank of Dniester River	0.234	0.131	0.201	0.116	0.125	0.112	0.136	0.097	-94.2
RM: total	3.651	2.926	3.827	4.221	3.760	4.099	4.332	3.387	-34.9

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 2005-2015"; 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), 2016 (page 100).

'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 1990-2015, kilotons

	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	%
Production of ABS Resins	0.961	0.777	1.516	1.657	1.774	1.842	1.739	0.929	-94.7

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), 2016 (page 98).

'Polystyrene Production'

Methodological issues for estimating the NMVOC emissions from polystyrene production are addressed in the EMEP/EEA Atmospheric Emissions Inventory Guidebook (November 2016 Edition). 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 2005-2015, 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
Expandable polystyrene in primary forms	0.210	0.347	0.343	0.160	0.154	0.099
Polystyrene in primary forms, other than expandable	NO	0.078	0.095	0.073	0.101	NO
Total polystyrene production	0.459	1.131	1.242	0.794	1.837	1.975
	2011	**2012**	**2013**	**2014**	**2015**	**%**
Polystyrene plates, sheets and alveolar strips	2.169	2.013	2.119	2.471	2.806	1029.0
Polystyrenes, copolymers and other styrene polymers in primary forms	0.093	0.143	0.075	0.060	0.038	-81.8
Expandable polystyrene in primary forms	0.093	0.143	0.075	0.060	0.038	-81.8
Polystyrene in primary forms, other than expandable	NO	NO	NO	NO	NO	
Total polystyrene production	2.262	2.155	2.194	2.532	2.844	520.0

Source: Statistical Reports PRODMOLD-A „Total production, as a natural expression, in the Republic of Moldova, by product type, for 2005-2015".

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 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 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' were recalculated for 1990-2013 time periods due to updating the AD provided by the NBS with the Statistical Reports PRODMOLD-A "Total production, as a natural expression, in the Republic, by product type", due to adding a new source of emissions (polystyrene production), respectively due to the change of the assessment method and default EF values: in the previous inventory cycle, the indirect GHG emissions were calculated according to the EMEP/CORINAIR Atmospheric Emissions Inventory Guidebook (1996), while within the latest inventory cycle, the respective emissions were estimated according to the EMEP/EEA Atmospheric Emissions Inventory Guidebook (2016).

In comparison with the results recorded in the BUR1 of the RM under UNFCCC (2016), the above-mentioned changes resulted in a significant decrease of NMVOC emissions, varying between a minimum decrease by 19.0 per cent in 1997, to a maximum decrease by 84.9 per cent in 1992; with the exception of 1998-2000 when it was registered an increase in the emissions, varying between a minimum increase of circa 5.9 per cent in 2000, up to a maximum increase of 14.6 per cent in 1998 (Table 4-50). For 2014-2015 years, NMVOC emissions from the 2B10 'Other' source category was estimated for the first time.

Table 4-50: Comparative Results of NMVOC Emissions from 2B10 'Other' included into the BUR1 and NC4 of the Republic of Moldova under the UNFCCC, kt

	1990	1991	1992	1993	1994	1995	1996	1997	1998
BUR1	0.3657	0.2883	0.1580	0.1074	0.0323	0.0270	0.0155	0.0046	0.0037
NC4	0.0650	0.0544	0.0238	0.0199	0.0074	0.0051	0.0046	0.0037	0.0042
Difference, %	-82.2	-81.1	-84.9	-81.5	-77.3	-81.3	-70.6	-19.0	14.6
	1999	2000	2001	2002	2003	2004	2005	2006	2007
BUR1	0.0032	0.0061	0.0099	0.0196	0.0203	0.0237	0.0276	0.0252	0.0300
NC4	0.0035	0.0065	0.0080	0.0104	0.0123	0.0118	0.0149	0.0130	0.0139
Difference, %	8.8	5.9	-19.9	-47.1	-39.4	-50.1	-46.0	-48.2	-53.8
	2008	2009	2010	2011	2012	2013	2014	2015	%
BUR1	0.0238	0.0203	0.0326	0.0359	0.0377	0.0404			
NC4	0.0122	0.0100	0.0143	0.0157	0.0150	0.0159	0.0161	0.0114	-82.5
Difference, %	-48.5	-50.6	-56.2	-56.4	-60.1	-60.8			

Abbreviations: BUR1 – First Biennial Update Report and NC4 – Fourth National Communication.

4.3.6. Planned Improvements

Possible improvements under the 2B 'Chemical Industry' category aim at updating/précising the activity data used to estimate GHG emissions within this category for 1990-2004 time periods (until 2004, Republic of Moldova used a classifier of the industrial production specific to the USSR, while the "PRODMOLD-A" classifier was introduced only since 2004, respectively it offers detailed information on the industrial production collected through the Statistical Reports PRODMOLD-A "Total production, as a natural expression, in the Republic, by product type" covering the 2005-2015 time series).

4.4. Metal Industry (Category 2C)

4.4.1. Source Category Description

The 2C 'Metal Industry' category covers GHG emissions from the following 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[47]). 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 2015 years, CO_2 emissions from the source category 2C 'Metal Industry' decreased in the Republic of Moldova by circa 40 per cent (Table 4-51).

[47] <http://ukrgrafit.zp.ua/elektrody>, <http://tdvial.ru/ge.htm>, <http://www.ruscastings.ru/work/168/441/449/4785>

Table 4-51: CO_2 Emissions from 2C 'Metal Industry' within 1990-2015 period, kilotons

	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	%
RM: left bank of Dniester River	35.3429	17.0110	9.6449	12.8029	12.6474	7.5915	13.7620	17.1721	-39.3
RM: right bank of Dniester River	0.0689	0.0509	0.0536	0.0527	0.0499	0.0654	0.0356	0.0537	-74.5
RM: total	35.4118	17.0619	9.6985	12.8556	12.6973	7.6569	13.7976	17.2258	-39.6

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.

4.4.2. Methodologies Issues, Emission Factors and Data Sources

CO_2 emissions from 2C1 'Iron and Steel Production' were estimated using a Tier 2 methodology (2006 IPCC Guidelines), based on carbon track through the production process.

Total CO_2 emission from 2C1 'Iron and Steel Production' 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, tonnes;
L – quantity of limestone consumed in steel production, tonnes;
C_L – carbon content in limestone consumed in steel production, tC/t limestone;
D – quantity of dolomite consumed in steel production, tonnes;
C_D – carbon content in dolomite consumed in steel production, tC/t dolomite;
CE – quantity of carbon electrodes consumed in EAFs, tonnes;
C_{CE} – carbon content in electrodes consumed in EAFs, tC/t electrodes;
S – quantity of steel produced, tonnes;
C_S – carbon content in steel produced, tC/t steel;
44/12 – 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)[48]. 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

[48] Metal Integrated Works from Ribnita, <http://www.aommz.com/pls/webus/webus.main.show>.

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 tonne 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 tonnes, specific to enterprises on the right bank of Dniester River, was agreed to be 7 kg/t of steel produced[49]. The specific consumption of graphite electrodes in electric furnaces with higher capacity (such as that from the Metal Integrated Works in Ribnita with a capacity of 120 tonnes[50]) was agreed to be 1.3 kg/t of steel produced[51]. The specific consumption of lime with high calcium content and/or dolomite lime is considered to be 55 kg/tonne of steel produced[52] (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 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 neighbouring 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 tonnes). 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 within 1990-2015, 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	%
RM: right bank of Dniester River	1.145	0.845	0.890	0.876	0.828	1.087	0.591	0.892	-74.5
RM: left bank of Dniester River	884.958	425.943	241.501	320.574	316.682	190.086	344.590	429.976	-39.3
RM: total	886.103	426.788	242.391	321.450	317.510	191.173	345.181	430.868	-39.5

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 2005-2015"; 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 98).

Table 4-54: Activity Data on Rolling Mills Production within 1990-2015, 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	%
Production of Rolling Mills	818.035	437.515	237.710	302.162	360.402	173.146	389.260	318.840	-48.1

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 98).

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).

[49] <http://metal-archive.ru/tyazhelye-metally/1468-vyplavka-stali-v-dugovyh-pechah.html>.
[50] <http://www.aommz.com/pls/web/web.main.show?main_id=10&m_id=11>.
[51] <http://elar.urfu.ru/bitstream/10995/40661/1/978-5-7996-1725-7_2016.pdf>.
[52] <https://rep.bntu.by/bitstream/handle/data/6984/%D0%A1.%20128-130.pdf?sequence=1>.

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.

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).

4.4.3. Uncertainties Assessment and Time-Series Consistency

Uncertainties associated with EFs used to estimate CO_2 emissions from this source 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[53], 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 category 2C1 'Iron and Steel Production' 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 the 1990-2013 periods, due to the change of the assessment method according to the 2006 IPCC Guidelines, as well as due to updating the AD on steel and rolling mills production provided by the Statistical Reports PRODMOLD-A "Total production, as a natural expression, in the Republic, by product type".

In comparison with the results recorded in the BUR1 of the RM under UNFCCC (2016), the above-mentioned changes resulted in a significant increase of CO_2 emissions from steel production (by circa 142 per cent) (Table 4-56). For 2014-2015, CO_2 emissions from the 2C1 'Iron and Steel Production' source category were estimated for the first time. The results allow assert that between 1990 and 2015 the respective emissions decreased by circa 40 per cent.

Table 4-56: Comparative Results of CO_2 Emissions from 2C1 'Iron and Steel Production' included into the BUR1 and NC4 of the RM under the UNFCCC, kt

	1990	1991	1992	1993	1994	1995	1996	1997	1998
BUR1	11.7700	10.2135	9.9136	10.0981	10.4777	10.8590	11.0623	13.4027	11.8728
NC4	28.5023	24.7297	23.9922	24.4250	25.3289	26.2369	26.7261	32.3806	28.6822
Difference, %	142.2	142.1	142.0	141.9	141.7	141.6	141.6	141.6	141.6
	1999	2000	2001	2002	2003	2004	2005	2006	2007
BUR1	13.1615	15.0137	15.9898	8.4857	14.6604	16.7624	17.3492	11.1765	15.9746
NC4	31.7942	36.2689	38.6274	20.5030	35.4283	40.5084	41.9358	27.0182	38.6127
Difference, %	141.6	141.6	141.6	141.6	141.7	141.7	141.7	141.7	141.7

[53] <https://www.worldsteel.org/steel-by-topic/statistics/Steel-Statistical-Yearbook-.html>.

	2008	2009	2010	2011	2012	2013	2014	2015	%
BUR1	14.6501	7.0562	4.0075	5.3146	5.2495	3.1607			
NC4	35.4118	17.0619	9.6985	12.8556	12.6973	7.6569	13.7976	17.2258	-39.6
Difference, %	141.7	141.8	142.0	141.9	141.9	142.3			

Abbreviations: BUR1 – First Biennial Update Report and NC4 – Fourth National Communication.

The non-CO_2 emissions from the 2C1 'Iron and Steel Production' source category were recalculated as well for 1997-2013 time series, in particular due to due to updating the AD on steel production on the right bank of Dniester River, data available in the Statistical Yearbooks of the RM and the Statistical Reports PRODMOLD-A "Total production, as a natural expression, in the Republic, by product type".

In comparison with the results recorded in the BUR1 of the RM under UNFCCC (2016), the above-mentioned changes resulted in an insignificant increase of non-CO_2 emissions (by maximum 0.5 per cent). For 2014-2015 years, non-CO_2 emissions from steel and rolling mills production were estimated for the first time. The results allow assert that between 1990 and 2015 the respective emissions decreased by circa 40 per cent (Table 4-57).

Table 4-57: Non-CO_2 Emissions from the 2C1 'Iron and Steel Production' in the Republic of Moldova within 1990-2015 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	%
NO_x	0.1152	0.0555	0.0315	0.0418	0.0413	0.0249	0.0449	0.0560	-39.5
CO	1.5064	0.7255	0.4121	0.5465	0.5398	0.3250	0.5868	0.7325	-39.5
NMVOC	0.0465	0.0227	0.0128	0.0169	0.0171	0.0100	0.0186	0.0221	-40.5
SO_2	0.0532	0.0256	0.0145	0.0193	0.0191	0.0115	0.0207	0.0259	-39.5

4.4.6. Planned Improvements

Possible improvements under the 2C 'Metal Industry' category aim at updating/précising the activity data regarding the consumption of raw materials per tonne of production, as well as the specific consumption of electrodes per tonne of steel produced by the national enterprises. If new country specific data will be available, the uncertainties associated with GHG emissions from this 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 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 IPPU sector and not in the Energy sector.

2D2. Paraffin Wax Use

Within this category, CO_2 emissions from the use 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 2015, direct GHG emissions from 2D 'Non-energy Products from Fuels and Solvent Use' decreased by circa 62.8 per cent (Table 4-58). In comparison with the 2013-year level, in 2014 GHG emissions increased by 25.2 per cent, while in 2015, compared to the previous year level, a decrease by 2.9 per cent was recorded.

Table 4-58: CO_2 Emissions from 2D 'Non-Energy Products from Fuels and Solvent Use', by Source, within 1990-2015 periods, kt

	1990	1991	1992	1993	1994	1995	1996	1997	1998
2D1. Lubricant Use	23.4455	19.6288	11.4501	10.3596	10.1157	10.1316	9.7676	9.2158	7.0099
2D2. Paraffin Wax Use	0.2787	0.2347	0.1907	0.1467	0.1173	0.0880	0.0733	0.0587	0.0440
2D3. Solvent Use	204.1460	167.7797	138.5232	110.2218	72.1539	64.2796	59.4607	31.0928	29.1244
2D4. Other	5.3387	4.7200	3.6067	2.6630	2.2163	1.9834	1.6968	1.6402	1.3442
2D. Non-Energy Products from Fuels and Solvent Use	233.2089	192.3631	153.7706	123.3910	84.6033	76.4826	70.9984	42.0075	37.5225
	1999	2000	2001	2002	2003	2004	2005	2006	2007
2D1. Lubricant Use	4.9993	4.7117	5.1876	4.3240	6.5825	6.5215	6.5370	7.0202	5.7882
2D2. Paraffin Wax Use	0.0440	0.0293	0.0293	0.0293	0.0293	0.0440	0.0440	0.0587	0.0733
2D3. Solvent Use	25.4949	25.5444	28.2768	30.3579	32.6846	55.5043	60.0843	73.4778	77.5617
2D4. Other	1.0256	1.0736	1.1350	1.3108	1.5601	1.7055	1.8177	1.8318	1.9224
2D. Non-Energy Products from Fuels and Solvent Use	31.5638	31.3591	34.6288	36.0221	40.8564	63.7753	68.4829	82.3885	85.3456
	2008	2009	2010	2011	2012	2013	2014	2015	%
2D1. Lubricant Use	6.1680	5.1273	5.5099	5.8338	4.9558	4.8761	4.7900	4.8162	-79.5
2D2. Paraffin Wax Use	0.0733	0.1027	0.1760	0.0733	0.0293	0.0733	0.0293	0.0587	-78.9
2D3. Solvent Use	59.2811	51.5516	59.4960	64.4348	69.0187	64.0079	82.0236	79.2460	-61.2
2D4. Other	2.0131	1.8416	2.2821	2.4216	2.1904	2.4059	2.5230	2.6910	-49.6
2D. Non-Energy Products from Fuels and Solvent Use	67.5356	58.6232	67.4640	72.7635	76.1943	71.3632	89.3660	86.8119	-62.8

A similar trend was recorded for indirect GHG emissions (NO_x, CO, NMVOC) and SO_x from this category (Table 4-59).

Table 4-59: Indirect GHG Emissions from 2D 'Non-energy Products from Fuels and Solvent Use', by Source, within 1990-2015 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	13.2383
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	0.0132	0.0107	0.0134	0.0117	0.0145	0.0459	0.0431	0.0697	0.0732
NMVOC	11.5886	11.6111	12.8531	13.7991	14.8566	25.2292	27.3110	33.3990	35.2553
SO_x	0.0012	0.0009	0.0012	0.0010	0.0013	0.0041	0.0038	0.0062	0.0065
	2008	2009	2010	2011	2012	2013	2014	2015	%
NO_x	0.0075	0.0056	0.0069	0.0078	0.0088	0.0088	0.0128	0.0089	-79.5
CO	0.0427	0.0316	0.0392	0.0443	0.0500	0.0501	0.0723	0.0503	-79.4
NMVOC	26.9460	23.4326	27.0436	29.2885	31.3721	29.0945	37.2835	36.0209	-61.2
SO_x	0.0037	0.0028	0.0034	0.0039	0.0044	0.0044	0.0064	0.0044	-79.5

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 publications of the

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, tonne CO_2;
LC – total lubricant consumption, TJ;
$CC_{Lubricant}$ – carbon content of lubricant, tonne 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 (oxidised 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 1990-2015 periods, TJ

	1990	1991	1992	1993	1994	1995	1996	1997	1998
Total lubricant used, of which:	1728.2	1446.8	844.0	763.6	745.6	746.8	720.0	679.3	516.7
Oil	1555.4	1302.2	759.6	687.2	671.1	672.1	648.0	611.4	465.0
Grease	172.8	144.7	84.4	76.4	74.6	74.7	72.0	67.9	51.7
	1999	2000	2001	2002	2003	2004	2005	2006	2007
Total lubricant used, of which:	368.5	347.3	382.4	318.7	485.2	480.7	481.8	517.5	426.7
Oil	331.7	312.6	344.1	286.8	436.7	432.6	433.7	465.7	384.0
Grease	36.9	34.7	38.2	31.9	48.5	48.1	48.2	51.7	42.7
	2008	2009	2010	2011	2012	2013	2014	2015	%
Total lubricant used, of which:	454.6	377.9	406.1	430.0	365.3	359.4	353.1	355.0	-79.5
Oil	409.2	340.1	365.5	387.0	328.8	323.5	317.8	319.5	-79.5
Grease	45.5	37.8	40.6	43.0	36.5	35.9	35.3	35.5	-79.5

Source: Energy Balances of the Republic of Moldova for 1990-2015; Statistical Yearbooks of the ATULBD for 1998-2016.

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. CO_2 emissions 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, tonne CO_2;
PW – total wax consumption, TJ;
CC_{Wax} – carbon content of paraffin wax, tonne 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 (oxidised 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 1990-2015 periods, TJ

	1990	1991	1992	1993	1994	1995	1996	1997	1998
Paraffin Wax Used	19	16	13	10	8	6	5	4	3
	1999	2000	2001	2002	2003	2004	2005	2006	2007
Paraffin Wax Used	3	2	2	2	2	3	3	4	5
	2008	2009	2010	2011	2012	2013	2014	2015	%
Paraffin Wax Used	5	7	12	5	2	5	2	4	-78.9

Source: Energy Balances of the Republic of Moldova for 1990-2015.

2D3. Solvent Use

Between 1990 and 2015, indirect CO_2 emissions from 2D3 'Solvent Use' category decreased by circa 61.2 per cent (Table 4-62). Similar trends were recorded for indirect GHG emissions (NO_x, CO, NMVOC) and SO_x from the respective category (Table 4-59).

Table 4-62: Indirect CO_2 Emissions from 2D3 'Solvent Use', by Source, 1990-2015 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	11.3644
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 (Total)	204.1460	167.7797	138.5232	110.2218	72.1539	64.2796	59.4607	31.0928	29.1244

	1999	2000	2001	2002	2003	2004	2005	2006	2007
2D3a. Domestic Solvent Use	11.3335	11.3032	11.2929	11.2501	11.1991	10.9872	10.9505	10.9045	10.8625
2D3b. Production and Use of Asphalt for Road Paving	4.3631	3.5305	4.4200	3.8675	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	4.9294	4.3081	5.1388	4.8432	5.7191	15.3407	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 (Total)	25.4949	25.5444	28.2768	30.3579	32.6846	55.5043	60.0843	73.4778	77.5617

	2008	2009	2010	2011	2012	2013	2014	2015	%
2D3a. Domestic Solvent Use	10.8245	10.7976	10.7757	10.7549	10.7421	10.7307	10.7140	10.6400	-7.6
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	-79.5
2D3c. Asphalt Roofing	0.0259	0.0050	0.0107	0.0098	0.0113	0.0117	0.0092	0.0064	
2D3d. Paint Application	11.1305	10.6405	11.6314	14.5764	14.0092	10.6746	13.8369	18.8792	-14.4
2D3e. Degreasing	0.5382	0.4990	0.6128	0.6838	1.9442	1.2663	1.1002	0.9206	-64.6
2D3f. Dry Cleaning	0.2898	0.2687	0.3300	0.3682	1.0469	0.6819	0.5924	0.4957	-64.6
2D3g. Chemical Products Manufacturing and Processing	17.2385	13.9175	17.2798	17.9677	19.7555	19.4641	26.7988	20.7863	-73.6
2D3h. Printing	0.2652	0.2378	0.2957	0.2786	0.2569	0.2894	0.3099	0.4044	-25.2
2D3i. Other Solvent Use	5.1514	4.8282	5.7271	5.2878	4.8721	4.4989	4.8962	10.5855	55.8
2D3. Solvent Use (Total)	59.2811	51.5516	59.4960	64.4348	69.0187	64.0079	82.0236	79.2460	-61.2

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 low (Table 4-63).

Table 4-63: AD on the Production of Domestic Products in the RM within 2005-2015 periods

	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Preparations for perfuming and deodorizing rooms, tonnes					2.450	2.241	12.226	12.886	15.365		
Perfumery and cosmetics (exclusively perfumes and eau de toilette), mill. pieces	2.235	1.731	2.044	1.380	1.145	1.557	1.315	2.723	4.146	3.733	3.455
Perfumes, thousand litres	0.679	0.126	0.312				0.025	3.019	2.835		
Eau de toilette, thousand litres	328.175	407.644	414.315	384.966	295.415	307.241	285.723	130.635	77.908		10.092
Other beauty products, mill pieces	0.983	0.654	0.833	0.629	0.395	0.624	0.523	0.752	1.271	1.350	0.854
Shampoo, mill pieces	1.540	1.220	1.355	0.723	0.589	0.816	0.567	0.451	0.384	0.253	0.347
Other cosmetics and perfumery, mill. pieces	0.363	0.652	0.386	0.609	0.684	0.826	0.958	3.773	2.350	1.914	2.043

Source: NBS through Statistical Reports PRODMOLD-A „Total production, as a natural expression, in the Republic, by product type".

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 2005-2015 periods (Table 4-64) and thus cannot be considered complete for the entire period under review. Activity data are not always available in tonnes or litres thus requesting the use of conversion factors. 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.

Table 4-64: Activity Data on Domestic Solvents Import in the RM within 1995-2015 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**	**%**
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	8.8
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	1 365.9
Hair care products	2.4143	2.8395	2.6788	2.6876	2.7463	2.8667	3.0558	2.9765	3.1153	1.1279	429.6
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	3 325.0

Source: Customs Service, 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. 28/07-2231 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. 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. 28/07-1893 dated 23.02.2011, as a response to the request from the Ministry of Environment No. 03-07/175 dated 02.02.2011.

The methodology used to estimate NMVOC emissions from source category 2D3a 'Domestic 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

Source Category	NMVOC EF	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 1990-2015 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	4304.7
	1999	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**
Total population (including ATULBD), thousand inhabitants	4293.0	4281.5	4277.6	4261.4	4242.1	4161.8	4147.9	4130.5	4114.6
	2008	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**%**
Total population (including ATULBD), thousand inhabitants	4100.2	4090.0	4081.7	4073.8	4069.0	4064.7	4058.3	4030.3	-7.6

Source: Statistical Yearbooks of the RM for 1990-2016. Statistical Yearbooks of the ATULBD for 1998-2016.

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 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 1990-2004 periods, respectively by the National Bureau of Statistics for 2005-2015 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_x	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 1990-2015 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	66.108	53.492	66.970	58.598	72.200	229.300	215.073	347.899	365.390
	2008	2009	2010	2011	2012	2013	2014	2015	%
Road paving with asphalt	209.351	156.931	194.440	219.812	248.191	248.339	360.090	250.423	-79.5

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, regarding the period 2001-2005; Statistical Reports PRODMOLD-A „Total production, as a natural expression, in the Republic of Moldova, by product type, for 2005-2015".

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 2003-2015 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 2003-2015 periods, kt

	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
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	22.4

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 2005-2015".

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). The breakdown of AD on paint and varnish consumption in the RM by sectors was not possible, so 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). To be noted that while determining 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 Category

Source	NMVOC EF	Unit
Decorative Coating Application	150	g/kg paint
Industrial Coating Application	400	g/kg paint
Other Coating Application	200	g/kg paint

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 taking into account 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 National Bureau of Statistics 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 in the Republic of Moldova within 1990-2015 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	%
Production of conventional solvent paints	8.768	8.270	9.657	12.915	13.673	9.474	13.540	20.573	103.7
Production of waterborne paints	2.789	3.553	3.208	5.097	4.234	2.857	4.131	6.268	291.8
Total paints production	11.557	11.822	12.864	18.011	17.907	12.345	17.685	26.858	129.6

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 2005-2015".

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).

Table 4-74: Activity data on import of varnishes and paints in the RM within 1990-2015, 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	%
Imports of conventional solvent paints	5.197	4.634	5.142	4.888	3.892	3.668	3.904	3.673	-77.8
Imports of waterborne paints	3.087	2.511	2.726	3.084	3.172	3.028	3.090	3.138	-71.8
Total paints import	8.283	7.145	7.869	7.972	7.064	6.696	6.994	6.811	-75.4

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.

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 4-75: Activity data on consumption of varnishes and paints in the Republic of Moldova within 1990-2015 periods, 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**	**%**
Consumption of conventional solvent paints	13.964	12.904	14.799	17.802	17.565	13.142	17.444	24.246	-8.9
Consumption of waterborne paints	5.876	6.063	5.934	8.181	7.406	5.886	7.221	9.407	-26.0
Total paints consumption	19.840	18.967	20.733	25.983	24.972	19.028	24.665	33.653	-14.4

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 1990-2015 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**	**%**
Decorative Coating Application	9.920	9.483	10.367	12.991	12.486	9.514	12.332	16.826	-14.4
Industrial Coating Application	7.936	7.587	8.293	10.393	9.989	7.611	9.866	13.461	-14.4
Other Coating Application	1.984	1.897	2.073	2.598	2.497	1.903	2.466	3.365	-14.4
Total consumption	19.840	18.967	20.733	25.983	24.972	19.028	24.665	33.653	-14.4

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 source category 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. 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 Source Category 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:

$$Total\ Consumption = Production + Import - Export$$

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 in the RM (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.

Table 4-78: Activity Data on Consumption of Solvents Used in Degreasing in the Republic of Moldova within 1990-2015 periods, kilotons

	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	%
Cyclic and Acyclic Hydrocarbons	0.1115	0.1165	0.1752	0.2036	0.9318	0.3641	0.1567	0.1937	-84.2
Alcohols	0.2649	0.2325	0.2534	0.2746	0.4277	0.5214	0.6126	0.4500	-24.4
Total solvents	0.3764	0.3489	0.4285	0.4782	1.3596	0.8855	0.7694	0.6438	-64.6

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.

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 1990-2015 periods, kilotons

	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	%
Cyclic and Acyclic Hydrocarbons	0.0725	0.0757	0.1138	0.1323	0.6057	0.2367	0.1019	0.1259	-84.2
Alcohols	0.1722	0.1511	0.1647	0.1785	0.2780	0.3389	0.3982	0.2925	-24.4
Total solvents	0.2446	0.2268	0.2785	0.3108	0.8837	0.5756	0.5001	0.4185	-64.6

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 source category 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 Source Category 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), 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:

$$Total\ Consumption = Production + Import - Export$$

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 1990-2015 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	%
Cyclic and Acyclic Hydrocarbons	0.0390	0.0408	0.0613	0.0712	0.3261	0.1274	0.0549	0.0678	-84.2
Alcohols	0.0927	0.0814	0.0887	0.0961	0.1497	0.1825	0.2144	0.1575	-24.4
Total solvents	0.1317	0.1221	0.1500	0.1674	0.4758	0.3099	0.2693	0.2253	-64.6

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 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' source category 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 Source Category 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, Tyre production	10	g/kg tyre
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).

Table 4-83: Selective Activity Data on Manufacturing Industrial Commodities in the Republic of Moldova within 1990-2015 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 Tyres, thousand pieces	75.300	73.100	40.100	1.500	4.500	6.600	8.000	9.800	7.100
Refurbished Tyres, 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							0.853	1.465	0.773
Asphalt Production, kt	66.108	53.492	66.970	58.598	72.200	229.300	215.073	347.899	365.390
Refurbished Tyres, thousand pieces	10.200	7.000	9.200	4.600	6.000	4.600	3.200	2.800	2.600
Refurbished Tyres, kt	0.195	0.134	0.176	0.088	0.115	0.088	0.061	0.054	0.050
Shoes, mill. pairs	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	%
Polyurethane Processing, kt	2.551	2.134	2.376	2.220	1.583	1.593	1.531	2.706	226.0
Polystyrene Processing, kt	4.449	4.889	5.711	5.944	6.141	6.209	7.019	7.839	32.5
Rubber Processing, kt	0.189	0.036	0.058	0.063	0.070	0.072	0.066	0.049	-99.9
Pharmaceutical Products Manufacturing, kt	3.713	3.832	4.994	3.347	3.745	3.347	4.101	4.063	119.2
Paints Manufacturing, kt	11.557	11.822	12.864	18.011	17.907	12.345	17.685	26.858	129.6
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	
Asphalt Production, kt	209.351	156.931	194.440	219.812	248.191	248.339	360.090	250.423	-79.5
Refurbished Tyres, thousand pieces	2.252	5.829	6.735	6.852	18.361	17.299	11.947	6.035	-92.0
Refurbished Tyres, kt	0.055	0.080	0.161	0.157	0.248	0.268	0.200	0.139	-90.3
Shoes, mill. pairs	7.083	4.829	6.247	7.692	7.448	8.329	7.607	5.767	-75.1

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 2005-2015"; 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.

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 (tonnes), the following conversion coefficient was used: a car tyre weights about 7.1 kg; a minibus and small tonnage truck tyre – about 11.1 kg; bus and heavy truck tyre – 46.0 kg; a tractor tyre – about 69.9 kg).

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 Source Category 2D3h 'Printing'

	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 Republic of Moldova. 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, in the Republic of Moldova, by product type, for 2005-2015" inks were produced only during 2011-2013; there are no information on the export of inks during the period of reference). 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).

Table 4-85: Activity Data on Inks Import in the Republic of Moldova within 1990-2015 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	%
Inks for printing, writing and drawing, as well as other inks	0.1906	0.1721	0.2209	0.2009	0.1789	0.2008	0.2112	0.2979	-16.2
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	-48.6
Total inks	0.2411	0.2162	0.2688	0.2533	0.2335	0.2631	0.2818	0.3677	-25.2

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.

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. 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 source category 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. In 2015, at the national level, there were 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 1990-2015 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	%
Total crude oil non-chemically modified	79.307	83.881	80.705	89.787	96.828	65.502	113.223	109.534	-12.8
Total refined oil non-chemically modified	34.578	28.446	26.506	20.942	20.618	14.418	16.197	16.697	-71.0
Seeds used for oil extraction	76.840	63.213	58.901	46.539	45.817	32.039	35.992	37.105	-71.0

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), 2016 (page 99).

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 Source Category 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). 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).

Table 4-89: AD on Glues and Other Adhesives Production, Import and Consumption in the Republic of Moldova within 1990-2015 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	%
Glues and Other Adhesives Production	0.5797	0.9211	1.3725	1.3234	1.0774	0.9527	1.1179	5.9971	1560.8
Glues and Other Adhesives Import	1.9713	1.4342	1.8004	1.5226	1.4106	1.2544	1.4043	1.4872	-54.3
Glues and Other Adhesives Consumption	2.5509	2.3552	3.1729	2.8460	2.4880	2.2070	2.5222	7.4843	130.2

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. 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".

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 source category 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
	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).

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).

Table 4-91: AD on Timber Production in the RM within 1990-2015 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	%
Total timber production, thousand m^3	46.5	34.0	25.6	18.5	19.4	16.7	15.8	16.5	-93.8
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	-93.8

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 2005-2015"; Statistical Yearbooks of the ATULBD for 2000 (page 99), 2003 (page 98), 2006 (page 93), 2009 (page 92), 2011 (page 95), 2012 (page 98), 2016 (page 98).

Current technologies for preservation of wood by creosote impregnation imply the use of 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 1990-2015 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	%
Creosote use in preservation of wood	0.5228	0.3822	0.2880	0.2081	0.2183	0.1884	0.1780	0.1856	-93.8

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 population were used (Table 4-94).

Table 4-94: Number of Population in the Republic of Moldova within 1990-2015

	1990	1991	1992	1993	1994	1995	1996	1997	1998
Population – total (including ATULBD), thousand people	4361.6	4366.3	4359.1	4347.8	4352.7	4347.9	4334.4	4320.0	4304.7
	1999	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**
Population – total (including ATULBD), thousand people	4293.0	4281.5	4277.6	4261.4	4242.1	4161.8	4147.9	4130.5	4114.6
	2008	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**%**
Population – total (including ATULBD), thousand people	4100.2	4090.0	4081.7	4073.8	4069.0	4064.7	4058.3	4030.3	-7.6

Source: Statistical Yearbooks of the Republic of Moldova for 1990-2016. Statistical Yearbooks of the ATULBD for 1998-2016.

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 (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 4-95).

Table 4-95: Tier 2 Default Emission Factors for Category 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 4-96).

Table 4-96: AD on New Cars Import in the Republic of Moldova within 1990-2015 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	%
Imported vehicles – total, units	14 368	7 832	7 923	8 237	7 171	9 869	22 103	20 977	261.5

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.

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 consumption (on the average, the activity level is 1 to 3 per cent of diesel consumption by the vehicle). Activity data on diesel consumption are available in the Energy Balances of the RM for 1990 and 1993-2015 periods (in 1991 and 1992 the Energy Balances 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.

Table 4-97 shows data on the number of population between 1990 and 2015, separately for the two banks of Dniester River. In order to generate data on diesel consumption on the left bank of the Dniester River, it was used information on specific consumption of diesel 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 per capita (for 1990 and 1991 the information was representative for the entire country) (Table 4-98).

Table 4-97: Population of the Republic of Moldova within 1990-2015 periods, million persons

	1990	1991	1992	1993	1994	1995	1996	1997	1998
RM: right bank of Dniester River	3.6309	3.6360	3.6295	3.6453	3.6510	3.6563	3.6553	3.6492	3.6390
RM: left bank of Dniester River	0.7307	0.7303	0.7296	0.7025	0.7017	0.6916	0.6791	0.6708	0.6657
RM: total	4.3616	4.3663	4.3591	4.3478	4.3527	4.3479	4.3344	4.3200	4.3047
	1999	2000	2001	2002	2003	2004	2005	2006	2007
RM: right bank of Dniester River	3.6330	3.6303	3.6351	3.6278	3.6183	3.6074	3.6004	3.5899	3.5811
RM: left bank of Dniester River	0.6600	0.6513	0.6425	0.6336	0.6238	0.5544	0.5475	0.5406	0.5335
RM: total	4.2930	4.2815	4.2776	4.2614	4.2421	4.1618	4.1479	4.1305	4.1146
	2008	2009	2010	2011	2012	2013	2014	2015	%
RM: right bank of Dniester River	3.5727	3.5675	3.5637	3.5604	3.5595	3.5595	3.5576	3.5552	-2.1
RM: left bank of Dniester River	0.5275	0.5225	0.5180	0.5134	0.5094	0.5052	0.5007	0.4751	-35.0
RM: total	4.1002	4.0900	4.0817	4.0738	4.0690	4.0647	4.0583	4.0303	-7.6

Source: Statistical Yearbooks of the Republic of Moldova for 1990-2016. Statistical Yearbooks of the ATULBD for 1998-2016.

Table 4-98: Specific Consumption of Diesel within 1990-2015 periods

	1990	1991	1992	1993	1994	1995	1996	1997	1998
Specific Consumption of Diesel, kg/per capita/yr	256.8	226.8	173.6	128.5	106.8	103.7	88.4	83.6	67.6
	1999	2000	2001	2002	2003	2004	2005	2006	2007
Specific Consumption of Diesel, kg/per capita/yr	49.0	52.9	57.8	70.3	79.3	90.1	91.9	93.0	98.0
	2008	2009	2010	2011	2012	2013	2014	2015	%
Specific Consumption of Diesel, kg/per capita/yr	103.0	94.5	117.3	124.7	112.9	124.2	130.4	140.1	-45.5

Below is presented the information on total consumption of diesel in the country between 1990 and 2015 (Table 4-99).

Table 4-99: Consumption of Diesel in the RM within 1990-2015 periods, kt

	1990	1991	1992	1993	1994	1995	1996	1997	1998
RM: right bank of Dniester River	932.4	824.6	630.0	468.4	390.0	379.0	323.0	305.0	246.0
RM: left bank of Dniester River	187.6	165.6	126.6	90.3	75.0	71.7	60.0	56.1	45.0
RM: total	1 120.0	990.2	756.6	558.7	465.0	416.1	356.0	344.1	282.0
	1999	2000	2001	2002	2003	2004	2005	2006	2007
RM: right bank of Dniester River	178.0	192.0	210.0	255.0	287.0	325.0	331.0	334.0	351.0
RM: left bank of Dniester River	32.3	34.4	37.1	44.5	49.5	49.9	50.3	50.3	52.3
RM: total	215.2	225.2	238.1	275.0	327.3	357.8	381.3	384.3	403.3
	2008	2009	2010	2011	2012	2013	2014	2015	%
RM: right bank of Dniester River	368.0	337.0	418.0	444.0	402.0	442.0	464.0	498.0	-46.6
RM: left bank of Dniester River	54.3	49.4	60.8	64.0	57.5	62.7	65.3	66.6	-64.5
RM: total	422.3	386.4	478.8	508.0	459.5	504.7	529.3	564.6	-49.6

Source: NBS through the Energy Balances of the RM for 1990, 1993-2015.

The amount of urea-based additive in catalytic converters was determined indirectly based on the total consumption of diesel, considering that additive consumption represents 2 per cent of the total amount of diesel consumed in the RM (Table 4-100).

Table 4-100: Urea-Based Catalyst Used in the Republic of Moldova, 1990-2015, kt

	1990	1991	1992	1993	1994	1995	1996	1997	1998
Urea-based additive use	22.4	19.8	15.1	11.2	9.3	8.3	7.1	6.9	5.6
	1999	2000	2001	2002	2003	2004	2005	2006	2007
Urea-based additive use	4.3	4.5	4.8	5.5	6.5	7.2	7.6	7.7	8.1
	2008	2009	2010	2011	2012	2013	2014	2015	%
Urea-based additive use	8.4	7.7	9.6	10.2	9.2	10.1	10.6	11.3	-49.6

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 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 estimated for the first time (Table 4-101).

Table 4-101: GHG Emissions from the 2D1 'Lubricant Use' in the Republic of Moldova within 1990-2015 periods, kt

	1990	1991	1992	1993	1994	1995	1996	1997	1998
CO_2 emissions from lubricant use	23.4455	19.6288	11.4501	10.3596	10.1157	10.1316	9.7676	9.2158	7.0099
CO_2 from oil	22.8118	19.0983	11.1407	10.0797	9.8423	9.8578	9.5036	8.9668	6.8204
CO_2 from grease	0.6337	0.5305	0.3095	0.2800	0.2734	0.2738	0.2640	0.2491	0.1895

	1999	2000	2001	2002	2003	2004	2005	2006	2007
CO_2 emissions from lubricant use	4.9993	4.7117	5.1876	4.3240	6.5825	6.5215	6.5370	7.0202	5.7882
CO_2 from oil	4.8642	4.5844	5.0474	4.2071	6.4046	6.3452	6.3603	6.8305	5.6318
CO_2 from grease	0.1351	0.1273	0.1402	0.1169	0.1779	0.1763	0.1767	0.1897	0.1564
	2008	2009	2010	2011	2012	2013	2014	2015	%
CO_2 emissions from lubricant use	6.1680	5.1273	5.5099	5.8338	4.9558	4.8761	4.7900	4.8162	-79.5
CO_2 from oil	6.0013	4.9887	5.3610	5.6762	4.8218	4.7444	4.6606	4.6860	-79.5
CO_2 from grease	0.1667	0.1386	0.1489	0.1577	0.1339	0.1318	0.1295	0.1302	-79.5

2D2. 'Paraffin Wax Use'

CO_2 emissions from paraffin wax use were estimated for the first time (Table 4-102).

Table 4-102: GHG Emissions from the 2D2 'Paraffin Wax Use' in the Republic of Moldova within 1990-2015 periods, kt

	1990	1991	1992	1993	1994	1995	1996	1997	1998
CO_2 emissions from paraffin wax use	0.2787	0.2347	0.1907	0.1467	0.1173	0.0880	0.0733	0.0587	0.0440
	1999	2000	2001	2002	2003	2004	2005	2006	2007
CO_2 emissions from paraffin wax use	0.0440	0.0293	0.0293	0.0293	0.0293	0.0440	0.0440	0.0587	0.0733
	2008	2009	2010	2011	2012	2013	2014	2015	%
CO_2 emissions from paraffin wax use	0.0733	0.1027	0.1760	0.0733	0.0293	0.0733	0.0293	0.0587	-78.9

2D3. 'Solvent Use'

GHG Emissions from the 2D3 'Solvent Use' category were recalculated for 1990-2013 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', respectively due to the change of assessment method and default EF as well as considering new sources of emissions (preservation of wood, underseal treatment and conservation of vehicles). If previously emissions from domestic solvent use, paints application, degreasing, dry cleaning, chemical products, printing, other solvent and product use, such as seed oil extraction, use of glues and other adhesives and vehicles dewaxing were reported under Sector 3 'Solvents and Other Product Use', while emissions from road paving with asphalt and asphalt roofing – under category 2A 'Mineral Industry', being estimated according to the EMEP/CORINAIR Atmospheric Emissions Inventory Guidebook (2009), within the current inventory cycle, the respective emissions were estimated according to the EMEP/EEA Atmospheric Emissions Inventory Guidebook (2016). To be noted also, that within the current inventory cycle, the carbon fraction value in NMVOC emissions used to estimate indirect CO_2 emissions was considered following the 2006 IPCC Guidelines (Volume 3, Chapter 5.5, page 5.17), while in the previous inventory cycle there were used values from the National Inventory Reports of Hungary.

In comparison with the results obtained in the BUR1 of the Republic of Moldova under UNFCCC (2016), the recalculations resulted in an increase of indirect CO_2 emissions between 1990-1998 and in 2004, varying from a minimum increase of 33.2 per cent in 2004, to a maximum increase of 98.4 per cent in 1996, respectively in a decrease of emissions from the 2D3 'Other' category over the periods 1999 through 2003 and 2005 through 2013, varying from a minimum decrease of 0.6 per cent in 2003, to a maximum decrease of circa 56.9 per cent in 2009 (Table 4-103).

Table 4-103: Comparative Results of CO_2 Emissions from 2D3 'Solvent Use' included into NC4 of the RM under the UNFCCC and from Sector 3 'Solvents and Other Products' included into BUR1 of the RM under the UNFCCC, kt

	1990	1991	1992	1993	1994	1995	1996	1997	1998
BUR1	126.1169	100.9398	76.3870	57.6217	43.8224	34.5510	29.9741	25.7906	19.4874
NC4	204.1460	167.7797	138.5232	110.2218	72.1539	64.2796	59.4607	31.0928	29.1244
Difference, %	61.9	66.2	81.3	91.3	64.7	86.0	98.4	20.6	49.5
	1999	2000	2001	2002	2003	2004	2005	2006	2007
BUR1	26.7666	28.8497	42.6372	36.3177	32.8904	41.6628	67.4568	77.1970	98.1325
NC4	25.4949	25.5444	28.2768	30.3579	32.6846	55.5043	60.0843	73.4778	77.5617
Difference, %	-4.8	-11.5	-33.7	-16.4	-0.6	33.2	-10.9	-4.8	-21.0
	2008	2009	2010	2011	2012	2013	2014	2015	%
BUR1	132.8057	119.6617	61.2431	68.9171	75.8660	66.5917			
NC4	59.2811	51.5516	59.4960	64.4348	69.0187	64.0079	82.0236	79.2460	-61.2
Difference, %	-55.4	-56.9	-2.9	-6.5	-9.0	-3.9			

Abbreviations: BUR1 – First Biennial Update Report and NC4 – Fourth National Communication.

As for the NMVOC emissions, in comparison with the total values from 2A5 'Asphalt Roofing', 2A6 'Road Paving with Asphalt' and from Sector 3 'Solvents and Other Product Use' reported in the BUR1 of the RM under UNFCCC (2016), the changes made in the process of compiling the current inventory resulted in a decrease between 1990 and 2013, varying from a minimum decrease of 14.7 per cent in 2004, to a maximum decrease of circa 78.9 per cent in 1992 (Table 4-104).

Table 4-104: Comparative Results of NMVOC Emissions from 2D3 'Solvent Use' included into NC4 of the RM under the UNFCCC and from Sector 3 'Solvents and Other Products' included into BUR1 of the RM under the UNFCCC, kt

	1990	1991	1992	1993	1994	1995	1996	1997	1998
BUR1	433.4827	358.9648	298.7853	236.4087	145.9786	130.0438	117.4805	45.1220	36.2420
NC4	92.7937	76.2635	62.9651	50.1008	32.7972	29.2180	27.0276	14.1331	13.2383
Difference, %	-78.6	-78.8	-78.9	-78.8	-77.5	-77.5	-77.0	-68.7	-63.5
	1999	2000	2001	2002	2003	2004	2005	2006	2007
BUR1	21.9633	20.2111	27.4877	23.8292	23.1635	29.5775	39.9736	50.4762	121.1569
NC4	11.5886	11.6111	12.8531	13.7991	14.8566	25.2292	27.3110	33.3990	35.2553
Difference, %	-47.2	-42.6	-53.2	-42.1	-35.9	-14.7	-31.7	-33.8	-70.9
	2008	2009	2010	2011	2012	2013	2014	2015	%
BUR1	88.2498	60.7150	73.7999	58.7599	80.7096	98.4468			
NC4	26.9460	23.4326	27.0436	29.2885	31.3721	29.0945	37.2835	36.0209	-61.2
Difference, %	-69.5	-61.4	-63.4	-50.2	-61.1	-70.4			

Abbreviations: BUR1 – First Biennial Update Report and NC4 – Fourth National Communication.

2D4 'Other' (Urea-Based Catalysts)

CO_2 emissions from use of urea-based catalysts were estimated for the first time (Table 4-105).

Table 4-105: GHG Emissions from 2D4 'Other' (Urea-Based Catalysts) in the Republic of Moldova within 1990-2015 periods, kt

	1990	1991	1992	1993	1994	1995	1996	1997	1998
CO_2 emissions from urea-based catalysts	5.3387	4.7200	3.6067	2.6630	2.2163	1.9834	1.6968	1.6402	1.3442
	1999	2000	2001	2002	2003	2004	2005	2006	2007
CO_2 emissions from urea-based catalysts	1.0256	1.0736	1.1350	1.3108	1.5601	1.7055	1.8177	1.8318	1.9224
	2008	2009	2010	2011	2012	2013	2014	2015	%
CO_2 emissions from urea-based catalysts	2.0131	1.8416	2.2821	2.4216	2.1904	2.4059	2.5230	2.6910	-49.6

4.5.6. Planned Improvements

Possible improvements under the 2D 'Non-Energy Products from Fuels and Solvent Use' source category aim at updating/précising 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 4-106). 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).

Table 4-106: Global Warming Potentials for 100 years and Atmospheric Lifetimes[54]

GHG	Chemical formula	Atmospheric lifetime, according to AR5	SAR	TAR	AR4	AR5
HFC-23	CHF_3	222	11700	12000	14800	12140
HFC-32	CH_2F_2	5.2	650	550	675	677
HFC-125	C_2HF_5	28.2	2800	3400	3500	3170
HFC-134a	$C_2H_2F_2$ (CH_2FCF_3)	13.4	1300	1300	1430	1300
HFC-143a	$C_2H_3F_3$ (CF_3CH_3)	47.1	3800	4300	4470	4800
HFC-152a	C_2H4F_2 (CH_3CHF_2)	1.5	140	120	124	138
HFC-227ea	CF_3CHFCF_3	38.9	2900	3500	3220	3350
HFC-236fa	$CF_3CH_2CF_3$	242	6300	9400	9810	8060
HFC-245fa	$CHF_2CH_2CF_3$	7.7	NA	950	1030	858
HFC-365mfc	$CH_3CF_2CH_2CF_3$	8.7	NA	890	794	804
HFC-43-10mee	$CF_3CHFCHFCF_2CF_3$	16.1	1300	1500	1640	1650

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

[54] <http://www.epa.gov/climatechange/Downloads/ghgemissions/US-GHG-Inventory-2014-Annex-6-Additional-Information.pdf>.

The 2F 'Product Uses as Substitutes for ODS' includes GHG emissions from the following 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 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[55] 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 49 100 – 2903 49 200; 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 of the Ministry of Environment (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). 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 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 4-107).

Table 4-107: 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-408a	Commercial refrigerant	HCFC-22 (47%)/HFC-143a (46%)/HFC-125 (7%)
R-410a	Air Conditioning	HFC-32 (50%)/HFC-125 (50%)
R-507a	Transport, commercial, industrial refrigerant	HFC-125 (50%)/HFC-143a (50%)

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 produced since 2005. Foams produced as well as imported ones are mostly closed cell foams (the emissions from these last longer, about 20 years).

[55] <http://mediu.gov.md/index.php/activitate/autorizatii>.

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 4-108).

Table 4-108: Import of Carbon Dioxide Based Portable Fire Extinguishers in the Republic of Moldova within 1996-2015 periods, units

	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
Total portable fire extinguishers	11 086	10 078	9 162	8 329	7 572	4 178	9 247	13 806	20 913	18 494
	2006	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**
Total portable fire extinguishers	26 666	41 232	46 428	154 462	43 347	29 374	42 465	51 143	51 942	42 613

Source: Customs Service, Official Letter No. 28/07-8785 dated 26.05.2016, as a response to the request from the Climate Change Office 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 from the Climate Change Office 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 from the Climate Change Office No. 320/2014-01-01 dated 03.01.2014; 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.

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' source category increased in the RM between 1995 and 2015 by 39 times, from 4.59 kt CO_2 equivalent in 1995 to 179.44 kt CO_2 equivalent in 2015 (Table 4-109).

Table 4-109: HFCs Emissions from 2F 'Product Uses as Substitutes for ODS' Source Category in the RM between 1995-2015, kt CO_2 equivalent

	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
HFCs emissions	4.5879	5.1847	5.9997	7.4843	8.5714	10.4630	12.8513	16.8928	23.6694	31.0742	42.1522
	2006	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**%**
HFCs emissions	54.7020	69.8086	84.6748	93.2489	113.4282	119.5378	128.8468	137.5611	151.3701	179.4375	3 811.1

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 (Figure 4-3).

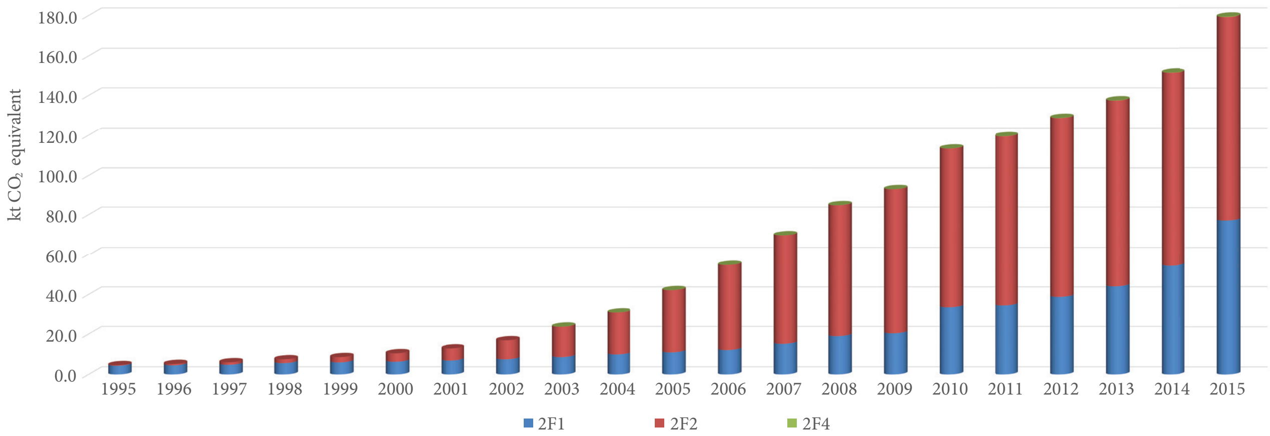


Figure 4-3: F-gases Emissions from 2F 'Product Uses as Substitutes for ODS', by Source, within 1995-2015 periods

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 tonnes) down to small capacities where the mass varies from 0.5 kg to 1 tonne. 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 4-110).

Table 4-110: Estimates for Charge, Lifetime and Emission Factors for 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 ≤ M ≤ 0.5 **0.10**	12 ≤ d ≤ 20 **16**	0.2 ≤ k ≤ 1 **0.6**	0.1 ≤ x ≤ 0.5 **0.5**	0 < $\eta_{rec,d}$ < 70 **0**	0 < p <80 **50**
Chest freezers	0.05 ≤ M ≤ 0.5 **0.20**	12 ≤ d ≤ 20 **16**	0.2 ≤ k ≤ 1 **0.6**	0.1 ≤ x ≤ 0.5 **0.5**	0 < $\eta_{rec,d}$ < 70 **0**	0 < p <80 **50**
Upright freezers	0.05 ≤ M ≤ 0.5 **0.18**	12 ≤ d ≤ 20 **16**	0.2 ≤ k ≤ 1 **0.6**	0.1 ≤ x ≤ 0.5 **0.5**	0 < $\eta_{rec,d}$ < 70 **0**	0 < p <80 **50**
Stand-alone commercial application	0.2 ≤ M ≤ 6 **0.4**	10 ≤ d ≤ 15 **12**	0.5 ≤ k ≤ 3 **1.5**	1 ≤ x ≤ 15 **16.8**	0 < $\eta_{rec,d}$ < 70 **0**	0 < p < 80 **50**
Medium commercial refrigeration	3 ≤ M ≤ 30 **6**	10 ≤ d ≤ 15 **12**	0.5 ≤ k ≤ 3 **1.5**	1 ≤ x ≤ 15 **16.8**	0 < $\eta_{rec,d}$ < 70 **0**	0 < p < 80 **50**
Large commercial refrigeration	100 ≤ M ≤ 200 **150**	10 ≤ d ≤ 15 **12**	0.5 ≤ k ≤ 3 **1.5**	1 ≤ x ≤ 15 **16.8**	0 < $\eta_{rec,d}$ < 70 **50**	0 < p < 80 **50**
Industrial refrigeration	10 ≤ M ≤ 10000 **150**	15 ≤ d ≤ 30 **20**	0.5 ≤ k ≤ 3 **1.5**	7 ≤ x ≤ 25 **16**	0 < $\eta_{rec,d}$ < 90 **50**	50 < p < 100 **75**
Residential and Commercial A/C, including Heat Pumps	0.5 ≤ M ≤ 100 **0.6**	10 ≤ d ≤ 20 **12**	0.2 ≤ k ≤ 1 **0.6**	1 ≤ x ≤ 10 **5**	0 < $\eta_{rec,d}$ < 80 **0**	0 < p < 80 **50**
Mobile A/C – personal cars	0.4 ≤ M ≤ 0.8 **0.6**	9 ≤ d ≤ 16 **16**	0.2 ≤ k ≤ 0.5 **0.5**	10 ≤ x ≤ 20 **15**	0 < $\eta_{rec,d}$ < 50 **0**	0 < p < 50 **50**
Mobile A/C – buses, trains, passenger wagons	10 ≤ M ≤ 20 **12**	9 ≤ d ≤ 16 **12**	0.2 ≤ k ≤ 0.5 **0.5**	10 ≤ x ≤ 20 **15**	0 < $\eta_{rec,d}$ < 50 **0**	0 < p < 50 **50**
Mobile A/C – minibuses	0.5 ≤ M ≤ 1.5 **1.2**	9 ≤ d ≤ 16 **12**	0.2 ≤ k ≤ 0.5 **0.5**	10 ≤ x ≤ 20 **15**	0 < $\eta_{rec,d}$ < 50 **0**	0 < p < 50 **50**
Mobile A/C – trucks	0.5 ≤ M ≤ 1.5 **1**	9 ≤ d ≤ 16 **12**	0.2 ≤ k ≤ 0.5 **0.5**	10 ≤ x ≤ 20 **15**	0 < $\eta_{rec,d}$ < 50 **0**	0 < p < 50 **50**
Refrigeration vehicles	3 ≤ M ≤ 8 **7**	6 ≤ d ≤ 9 **9**	0.2 ≤ k ≤ 1 **0.6**	15 ≤ x ≤ 50 **30**	0 < $\eta_{rec,d}$ <70 **0**	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 Republic of Moldova no domestic refrigerators and freezers are produced (Table 4-111). Refrigerant R-12 was used in the production process at the respective plant.

Table 4-111: AD on Refrigerators and Freezers Production in the RM 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 2015, the import of domestic refrigerators increased by circa 203 per cent, while for domestic freezers – by circa 163 times (Table 4-112).

Table 4-112: Activity Data on Refrigeration Equipment Imported in the Republic of Moldova within 1995-2015, 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**	**%**
Refrigerators	87 034	112 982	78 880	65 306	72 824	66 900	63 433	55 638	60 963	57 382	202.7
Chest freezers	1 713	1 549	2 834	2 529	2 492	3 395	2 107	2 870	3 151	5 413	14936.1
Upright freezers	5 180	9 574	3 169	4 323	8 825	9 239	7 994	6 164	8 242	7 482	17300.0

Source: Custom Service, Official Letter No. 28/07-8785 dated 26.05.2016, as a response to the request from the Climate Change Office 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 from the Climate Change Office 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 from the Climate Change Office 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 from the Ministry of Environment No. 03-07/175 dated 02.02.2011.

The share of refrigerants charged into the domestic refrigeration equipment varied from one year to another (Table 4-113).

Table 4-113: 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	0	15	25	35	45	50	55	50	45
	R-600a	0	0	0	0	0	0	0	5	15	25	35
	R-12	100	100	100	85	75	65	55	45	30	25	20
Freezers	R-134a	0	0	0	10	15	20	23	25	27	24	21
	R-404a	0	0	0	5	5	10	15	25	33	38	45
	R-507a	0	0	0	0	0	0	0	0	0	0	0
	R-12	100	100	100	85	80	70	62	50	40	38	34
Equipment	**Refrigerants**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**
Refrigerators	R-134a	40	35	30	20	15	10	7	3	0	0	0
	R-600a	45	50	55	68	76	85	90	97	100	100	100
	R-22	15	15	15	12	9	5	3	0	0	0	0
Freezers	R-134a	18	15	12	10	9	7	5	3	0	0	0
	R-404a	55	60	64	65	69	75	81	89	95	97	97
	R-507a	5	10	12	15	14	13	11	8	5	3	3
	R-22	22	15	12	10	8	5	3	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 4-107), the share of refrigerants charged into the refrigeration equipment imported in the country over the period from 1995 through 2015 (Table 4-113), the average charge of equipment with refrigerant (Table 4-110) and statistical data on import of refrigeration equipment (Table 4-112), was used to estimate the total amount of freons imported in the country within the domestic refrigeration equipment (Table 4-114) and the cumulative amount of freons used in the domestic refrigeration equipment imported in the Republic of Moldova (Table 4-115).

Table 4-114: AD on Imported Freons Charged into Domestic Refrigeration Equipment in the RM within 1998-2015 periods, t/yr

	1998	1999	2000	2001	2002	2003	2004	2005	2006
R-134a	0.2372	0.2207	0.4470	0.9400	1.5841	2.4615	2.7206	3.2959	3.7109
R-404a	0.0044	0.0028	0.0119	0.0279	0.0496	0.1499	0.1360	0.2730	0.7013
R-507a	NO	NO	NO	NO	NO	NO	NO	NO	0.0638
	2007	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**
R-134a	4.2593	2.5029	1.4345	1.2802	0.8329	0.5370	0.2174		
R-404a	1.2199	0.7278	0.8346	1.4400	1.7565	1.5069	1.4983	2.0081	2.3565
R-507a	0.2033	0.1365	0.1926	0.2922	0.3045	0.2046	0.1347	0.1057	0.0729

Table 4-115: Cumulative Amount of Freons Charged into Domestic Refrigeration Equipment Imported in the Republic of Moldova within 1998-2015 periods, t/yr

	1998	1999	2000	2001	2002	2003	2004	2005	2006
R-134a	0.2372	0.4579	0.9049	1.8449	3.4290	5.8905	8.6111	11.9070	15.6179
R-404a	0.0044	0.0071	0.0190	0.0469	0.0966	0.2465	0.3825	0.6555	1.3568
R-507a	NO	NO	NO	NO	NO	NO	NO	NO	0.0638

	2007	2008	2009	2010	2011	2012	2013	2014	2015
R-134a	19.8772	22.3801	23.8146	25.0948	25.9277	26.4648	26.6822	26.6822	26.6822
R-404a	2.5767	3.3045	4.1390	5.5790	7.3355	8.8424	10.3407	12.3488	14.7053
R-507a	0.2671	0.4035	0.5961	0.8883	1.1927	1.3974	1.5321	1.6378	1.7106

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. However, this information is aggregated across the country, without specifying the share used for domestic refrigeration equipment service. In order to identify this information (Table 4-116), 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, 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 4-116: AD on Imported Freons for Domestic Refrigeration Equipment Service in the RM within 1998-2015 periods, t/yr

	1998	1999	2000	2001	2002	2003	2004	2005	2006
R-134a	0.0013	0.0024	0.0048	0.0098	0.0182	0.0312	0.0456	0.0631	0.0828
R-404a	0.0000	0.0000	0.0001	0.0002	0.0005	0.0013	0.0020	0.0035	0.0072
R-507a	NO	NO	NO	NO	NO	NO	NO	NO	0.0003
	2007	2008	2009	2010	2011	2012	2013	2014	2015
R-134a	0.1053	0.1186	0.1262	0.1330	0.1374	0.1403	0.1414	0.1414	0.1414
R-404a	0.0137	0.0175	0.0219	0.0296	0.0389	0.0469	0.0548	0.0654	0.0779
R-507a	0.0014	0.0021	0.0032	0.0047	0.0063	0.0074	0.0081	0.0087	0.0091

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 2015, the imports of commercial refrigeration equipment increased by circa 57 per cent (Table 4-117).

Table 4-117: AD on Imported Commercial Refrigeration Equipment in the Republic of Moldova within 1995-2015 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	%
Stand-alone commercial application	3 621	8 978	8 692	4 908	4 296	4 997	4 000	5 333	3 961	3 565	32.2
Medium commercial refrigeration	1 246	1 436	478	422	403	441	224	343	252	837	720.6
Total commercial refrigeration equipment	4 867	10 414	9 170	5 330	4 699	5 438	4 224	5 676	4 213	4 402	57.3

Source: Custom Service, Official Letter No. 28/07-8785 dated 26.05.2016, as a response to the request from the Climate Change Office 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 from the Climate Change Office 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 from the Climate Change Office 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 from the Ministry of Environment No. 03-07/175 dated 02.02.2011.

The share of refrigerants charged into the commercial refrigeration equipment varied from one year to another (Table 4-118).

Table 4-118: 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-134a	100	100	100	80	70	60	50	40	30	30	27
	R-404a	0	0	0	10	20	30	40	50	60	60	60
	R-407c	0	0	0	0	0	0	0	0	0	0	3
	R-507a	0	0	0	10	10	10	10	10	10	10	10
Equipment	Refrigerant	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Commercial refrigeration equipment	R-134a	27	25	20	15	15	10	10	5	0	0	0
	R-404a	60	60	60	65	60	60	55	55	55	55	55
	R-407c	3	5	5	5	5	5	5	5	5	5	5
	R-507a	10	10	15	15	20	25	30	35	40	40	40

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 4-107), the share of refrigerants charged into the commercial refrigeration equipment imported in the country over the period from 1995 through 2015 (Table 4-118), the average charge of equipment with refrigerant (Table 4-110) and statistical data on import of commercial refrigeration equipment (Table 4-117), was used to estimate the total amount of freons imported in the country within the commercial refrigeration equipment (Table 4-119) and the cumulative amount of freons used in the commercial refrigeration equipment imported in the Republic of Moldova (Table 4-120).

Table 4-119: AD on Imported Freons Charged into Commercial Refrigeration Equipment in the RM within 1995-2015 periods, t/yr

	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
R-134a	1.6904	3.9128	3.9124	11.8413	2.8680	3.2460	3.2702	3.1973	3.1054	2.5638	2.2059
R-404a	NO	NO	NO	1.4802	0.8194	1.6230	2.6162	3.9966	6.2107	5.1276	4.9020
R-407c	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0.2451
R-507a	NO	NO	NO	1.4802	0.4097	0.5410	0.6540	0.7993	1.0351	0.8546	0.8170
	2006	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**%**
R-134a	2.4096	3.0518	1.2690	0.6743	0.6205	0.4645	0.2944	0.2096			
R-404a	5.3546	7.3243	3.8069	2.9219	2.4818	2.7869	1.6192	2.3052	1.7030	3.5464	
R-407c	0.2677	0.6104	0.3172	0.2248	0.2068	0.2322	0.1472	0.2096	0.1548	0.3224	
R-507a	0.8924	1.2207	0.9517	0.6743	0.8273	1.1612	0.8832	1.4669	1.2386	2.5792	

Table 4-120: Cumulative Amount of Freons Charged into Commercial Refrigeration Equipment Imported in the Republic of Moldova within 1995-2015 periods, t/yr

	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
R-134a	1.6904	5.6032	9.5156	21.3569	24.2249	27.4709	30.7411	33.9384	37.0438	39.6076	41.8135
R-404a	NO	NO	NO	1.4802	2.2996	3.9226	6.5388	10.5354	16.7461	21.8737	26.7757
R-407c	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0.2451
R-507a	NO	NO	NO	1.4802	1.8899	2.4309	3.0849	3.8842	4.9194	5.7740	6.5910
	2006	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**%**
R-134a	44.2230	47.2748	48.5438	49.2181	49.8385	50.3030	50.5974	50.8070	50.8070	50.8070	2 905.6
R-404a	32.1303	39.4546	43.2615	46.1834	48.6652	51.4521	53.0713	55.3765	57.0795	60.6259	
R-407c	0.5128	1.1232	1.4404	1.6652	1.8720	2.1043	2.2515	2.4610	2.6158	2.9382	
R-507a	7.4834	8.7041	9.6558	10.3301	11.1574	12.3186	13.2018	14.6687	15.9073	18.4865	

Activity data on the total amount of freons imported in the country (Table 4-121) were provided through reports submitted by the companies to the Ozone Office and Climate Change Office. However, this information is aggregated across the country, without specifying the share used for commercial refrigeration equipment service.

Table 4-121: AD on Imported Freons for Commercial Refrigeration Equipment Service in the RM within 1995-2015 periods, t/yr

	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
R-134a	0.3010	0.9978	1.6945	3.8032	4.3140	4.8920	5.4744	6.0438	6.5968	7.0533	7.4461
R-404a	NO	NO	NO	0.2636	0.4095	0.6985	1.1644	1.8761	2.9821	3.8953	4.7682
R-407c	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0.0436
R-507a	NO	NO	NO	0.2636	0.3365	0.4329	0.5494	0.6917	0.8760	1.0282	1.1737
	2006	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**%**
R-134a	7.8752	8.4187	8.6447	8.7648	8.8752	8.9580	9.0104	9.0477	9.0477	9.0477	2 905.6
R-404a	5.7218	7.0261	7.7040	8.2243	8.6663	9.1626	9.4509	9.8614	10.1647	10.7963	
R-407c	0.0913	0.2000	0.2565	0.2965	0.3334	0.3747	0.4009	0.4383	0.4658	0.5232	
R-507a	1.3326	1.5500	1.7195	1.8396	1.9869	2.1937	2.3510	2.6122	2.8328	3.2921	

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 2011-2015 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.

III) Industrial Refrigeration

Activity data used to estimate HFC emissions from consumption of hydrofluorocarbons charged into industrial refrigeration equipment (Table 4-122) 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. The share of refrigerants charged into the industrial refrigeration equipment varied from one year to another (Table 4-123).

Table 4-122: AD on Use of Industrial Refrigeration Equipment in the RM within 1995-2015

	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	%
Industrial refrigeration, units	292	285	279	278	273	269	270	271	275	276	-36.1
Share of refrigerants charged into the industrial refrigeration, t	69.0	66.5	64.0	61.7	59.2	55.8	52.7	49.4	48.9	47.4	-53.1

Source: Republican Association of Refrigeration Technicians of the Republic of Moldova.

Table 4-123: 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	1.0	1.0	1.0	1.5	1.5	1.5	2.0	2.0
	R-404a	0	0	0	0.5	0.5	0.5	0.5	1.0	1.0	2.5	2.5
	R-407c	0	0	0	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
	R-507a	0	0	0	0.5	1.0	1.0	1.0	1.0	1.0	2.0	3.0
	R-22	78.0	78.0	78.0	76.0	76.0	76.0	76.0	76.0	76.0	74.0	73.0
	R-717	22.0	22.0	22.0	21.5	21.0	21.0	20.5	20.0	20.0	19.0	19.0
	Refrigerant	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Industrial refrigeration	R-134a	2.0	2.5	2.5	2.5	3.0	3.5	3.5	3.5	3.5	3.5	3.5
	R-404a	3.0	4.0	4.0	4.5	5.5	6.5	7.0	8.5	10.0	12.0	15.0
	R-407c	0.5	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.5	1.5
	R-507a	3.0	3.0	3.0	5.0	5.0	5.0	5.0	10.0	15.0	45.0	45.0
	R-22	73.0	72.0	72.0	70.0	69.0	68.0	68.0	62.0	56.0	24.0	21.0
	R-717	18.5	17.5	17.5	17.0	16.5	16.0	15.5	15.0	14.5	14.0	14.0

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 4-107), the share of refrigerants charged into the industrial refrigeration equipment imported in the country over the period from 1995 through 2015 (Table 4-123), activity data on the charge of industrial equipment with refrigerant (Table 4-122) was used to estimate the total amount of freons depending on the type of refrigerant used within the industrial refrigeration equipment (Table 4-124) and the cumulative amount of freons used in the industrial refrigeration equipment in the Republic of Moldova (Table 4-125).

Table 4-124: AD on the Share of Freons Charged into the Industrial Refrigeration Equipment in the Republic of Moldova within 1998-2015 periods, t/yr

	1998	1999	2000	2001	2002	2003	2004	2005	2006
R-134a	0.9198	0.8892	0.8587	1.2422	1.1963	1.1555	1.4845	1.4336	1.3809
R-404a	0.4599	0.4446	0.4293	0.4141	0.7976	0.7703	1.8557	1.7921	2.0714
R-407c	0.4599	0.4446	0.4293	0.4141	0.3988	0.3852	0.3711	0.3584	0.3452
R-507a	0.4599	0.8892	0.8587	0.8281	0.7976	0.7703	1.4845	2.1505	2.0714
	2007	2008	2009	2010	2011	2012	2013	2014	2015
R-134a	1.6632	1.6007	1.5427	1.7769	1.9546	1.8459	1.7279	1.7102	1.6596
R-404a	2.6610	2.5611	2.7768	3.2577	3.6300	3.6918	4.1963	4.8862	5.6900
R-407c	0.6653	0.6403	0.6171	0.5923	0.5585	0.5274	0.4937	0.4886	0.7113
R-507a	1.9958	1.9208	3.0853	2.9616	2.7923	2.6370	4.9368	7.3293	21.3377

Table 4-125: Cumulative Amount of Freons Charged into Industrial Refrigeration Equipment in the Republic of Moldova within 1998-2015 periods, t/yr

	1998	1999	2000	2001	2002	2003	2004	2005	2006
R-134a	0.9198	1.8090	2.6676	3.9098	5.1061	6.2616	7.7461	9.1798	10.5607
R-404a	0.4599	0.9045	1.3338	1.7479	2.5454	3.3157	5.1714	6.9635	9.0349
R-407c	0.4599	0.9045	1.3338	1.7479	2.1466	2.5318	2.9029	3.2613	3.6066
R-507a	0.4599	1.3491	2.2077	3.0358	3.8334	4.6037	6.0883	8.2387	10.3101
	2007	2008	2009	2010	2011	2012	2013	2014	2015
R-134a	12.2239	13.8245	15.3672	17.1441	19.0987	20.9446	22.6725	24.3827	26.0423
R-404a	11.6959	14.2570	17.0338	20.2915	23.9215	27.6133	31.8095	36.6957	42.3858
R-407c	4.2718	4.9121	5.5292	6.1215	6.6799	7.2073	7.7010	8.1896	8.9009
R-507a	12.3059	14.2267	17.3120	20.2736	23.0659	25.7029	30.6397	37.9690	59.3066

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 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, 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 4-126: AD on Imported Freons for Industrial Refrigeration Equipment Service in the RM within 1998-2015 periods, t/yr

	1998	1999	2000	2001	2002	2003	2004	2005	2006
R-134a	0.1560	0.1508	0.1456	0.3563	0.5592	0.7552	1.0069	1.2501	1.4843
R-404a	0.0780	0.0754	0.0728	0.1430	0.2783	0.4090	0.7237	1.0276	1.3789
R-407c	0.0780	0.0754	0.0728	0.1430	0.2107	0.2760	0.3389	0.3997	0.4583
R-507a	0.0780	0.1508	0.1456	0.2861	0.4213	0.5520	0.8038	1.1685	1.5198
	2007	2008	2009	2010	2011	2012	2013	2014	2015
R-134a	1.7664	2.0378	2.2995	2.6008	2.9323	3.2454	3.5385	3.8285	4.1100
R-404a	1.8302	2.2646	2.7355	3.2880	3.9037	4.5298	5.2415	6.0702	7.0352
R-407c	0.5711	0.6797	0.7843	0.8848	0.9795	1.0690	1.1527	1.2356	1.3562
R-507a	1.8583	2.1840	2.7073	3.2096	3.6832	4.1304	4.9677	6.2107	9.8296

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 2015, the imports of this type of equipment increased by circa 440 per cent (Table 4-127).

Table 4-127: AD on Imported Stationary Air Conditioning Equipment in the Republic of Moldova within 1995-2015 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	%
Air conditioning equipment	11 308	38 291	36 172	8 287	17 607	28 055	25 871	32 607	17 177	12 129	440.3

Source: Custom Service, Official Letter No. 28/07-8785 dated 26.05.2016, as a response to the request from the Climate Change Office 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 from the Climate Change Office 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 from the Climate Change Office 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 from the Ministry of Environment No. 03-07/175 dated 02.02.2011.

The share of refrigerants charged into the stationary air conditioning equipment varied from one year to another (Table 4-128).

Table 4-128: 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	0	5	5	10	10	15	20	25	30
	R-407c	0	0	0	0	0	0	0	0	0	0	0
	R-22	100	100	100	95	85	90	90	85	80	75	70
	Refrigerant	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Air conditioning equipment	R-410a	35	40	45	48	50	53	55	57	60	62	65
	R-407c	0	3	4	5	6	7	9	11	13	15	18
	R-22	65	57	51	47	44	40	36	32	27	23	17

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 4-107), the share of refrigerants charged into the stationary air conditioning equipment imported in the country over the period from 1995 through 2015 (Table 4-128), the average charge of equipment with refrigerant (Table 4-110) and statistical data on import of stationary air conditioning equipment (Table 4-127), was used to estimate the total amount of freons imported in the country within the stationary air conditioning equipment (Table 4-129) and the cumulative amount of freons used in the stationary air conditioning equipment imported in the Republic of Moldova (Table 4-130).

Table 4-129: AD on Imported Freons Charged into Stationary Air Conditioning Equipment in the RM within 1998-2015 periods, t/yr

	1998	1999	2000	2001	2002	2003	2004	2005	2006
R-410a	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	NO	NO	NO
	2007	2008	2009	2010	2011	2012	2013	2014	2015
R-410a	9.1898	9.7664	2.3867	5.2821	8.9215	8.5374	11.1516	6.1837	4.5120
R-407c	0.6892	0.8681	0.2486	0.6339	1.1783	1.3970	2.1521	1.3398	1.0916

Table 4-130: Cumulative Amount of Freons Charged into Stationary Air Conditioning Equipment Imported in the Republic of Moldova within 1998-2015 periods, t/yr

	1998	1999	2000	2001	2002	2003	2004	2005	2006
R-410a	0.0353	0.0591	0.1598	0.2325	0.4310	1.1243	1.9873	3.4055	5.7802
R-407c	NO	NO	NO	NO	NO	NO	NO	NO	NO
	2007	2008	2009	2010	2011	2012	2013	2014	2015
R-410a	14.9700	24.7365	27.1231	32.4052	41.3267	49.8641	61.0157	67.1995	71.7114
R-407c	0.6892	1.5574	1.8060	2.4398	3.6181	5.0152	7.1672	8.5070	9.5987

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 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, 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 4-131: AD on Imported Freons for Stationary Air Conditioning Equipment Service in the RM within 1998-2015 periods, t/yr

	1998	1999	2000	2001	2002	2003	2004	2005	2006
R-410a	0.0019	0.0031	0.0085	0.0123	0.0228	0.0596	0.1053	0.1805	0.3064
R-407c	NO	NO	NO	NO	NO	NO	NO	NO	NO
	2007	2008	2009	2010	2011	2012	2013	2014	2015
R-410a	0.7934	1.3110	1.4375	1.7175	2.1903	2.6428	3.2338	3.5616	3.8007
R-407c	0.0365	0.0825	0.0957	0.1293	0.1918	0.2658	0.3799	0.4509	0.5087

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") 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 4-132 and 4-133), as well as the share of transportation units charged with air conditioning equipment (Table 4-134).

Table 4-132: Number of Transportation Units Registered in the Republic of Moldova within 1995-2015 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	269551	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	%
Passenger car	319 311	338 944	366 351	386 365	404 290	426 973	456 379	487 418	512 561	529 813	219.3
Buses and Minibuses	21 056	21 095	21 491	21 346	21 395	21 349	21 433	21 344	21 359	21 134	130.2
Trucks	84 087	94 828	115 967	120 174	131 243	141 696	151 830	154 163	160 199	164 533	174.7

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 4-133: Railway Transportation Vehicles Existing in the RM within 1995-2015 (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 manoeuvring	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	%
Diesel locomotives	154	154	152	152	152	150	139	138	138	138	-15.3
Locomotives for manoeuvring	56	56	53	39	39	67	67	67	67	67	-41.2
Diesel trains	20	20	18	15	15	21	21	21	21	21	-27.6
Passengers wagons	436	416	398	423	411	399	399	388	381	381	-17.7

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/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 4-134: Transportation Units Charged with Air Conditioning Equipment in the RM between 1996 and 2015 (by the end of calendar year), % of the total

	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
Passenger car	2.4	4.8	6.5	8.1	9.6	11.1	11.4	18.4	19.5	20.2
Buses and Minibuses	1.3	3.9	7.3	8.4	8.9	9.6	10.3	10.7	11.0	11.4
Trucks	1.1	2.4	4.0	6.0	9.0	13.0	13.4	15.1	15.4	16.2
	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Passenger car	20.2	21.3	22.2	23.4	24.2	25.3	26.7	28.2	29.6	31.3
Buses and Minibuses	11.4	12.3	12.8	13.5	15.1	15.8	16.4	17.0	17.3	18.0
Trucks	16.2	16.9	17.9	19.5	21.7	23.3	24.5	25.5	27.0	28.2

Table 4-135: Estimated Number of Transportation Units Charged with Air Conditioning Equipment in the Republic of Moldova between 1996 and 2013 (by the end of calendar year), units

	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
Passenger car	4 156	9 928	14 402	18 709	22 809	28 497	30 705	48 998	52 552	59 115
Buses and Minibuses	125	436	939	1 138	1 137	1 417	1 622	1 679	2 168	2 258
Trucks	632	1 390	2 318	3 126	4 174	5 933	6 214	7 081	11 381	13 252
	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Passenger car	67 856	75 398	85 706	93 504	102 384	113 942	128 792	144 450	160 559	178 398
Buses and Minibuses	2 596	2 698	2 894	3 214	3 389	3 491	3 637	3 698	3 841	3 922
Trucks	14 198	16 993	22 649	26 122	30 522	34 662	38 696	41 621	45 179	48 138

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 4-110), information on total number of transportation units registered in the Republic of Moldova equipped with air conditioning systems (Table 4-135), it was estimated the total amount of HFC-134a charged into the mobile air-conditioning equipment in the Republic of Moldova (Table 4-136), as well as actual HFC-134a emissions from freon charged into the air conditioning equipment of transportation units in the Republic of Moldova within the 1995-2013 (Table 4-83). 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 1995 and 2010, in proportion of 40 per cent, while after 2010, with the increased number of new transportation units comparative to second-hand vehicles, the share of transportation units equipped with functional mobile air-conditioning systems increased by 2015 up to 85 per cent.

Table 4-136: AD on Cumulative Amount of HFC-134a Charged into Mobile Air-Conditioning Systems Registered in the Republic of Moldova within 1995-2015 periods, t

	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
HFC-134a	1.8674	2.5052	3.4553	4.4542	5.1825	5.8594	7.0086	7.4981	9.8915	11.4274	12.6306
	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	%
HFC-134a	14.0447	15.5183	17.9369	19.7673	21.7829	24.1030	26.7480	29.2172	47.8890	104.1128	5475.4

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 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, 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 4-137: AD on Imported Freons for Mobile Air Conditioning Systems Service in the RM within 1995-2015 periods, t/yr

	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
HFC-134a	0.2969	0.3983	0.5494	0.7082	0.8240	0.9316	1.1144	1.1922	1.5728	1.8170	2.0083
	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	%
HFC-134a	2.2331	2.4674	2.8520	3.1430	3.4635	3.8324	4.2529	4.6455	7.6144	16.5539	5475.4

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 tonnes and more, respectively with capacity less than 5 tonnes. 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 4-138).

Table 4-138: Number of Refrigerators in the Republic of Moldova within 1995-2015 periods (by the end of calendar year), units

	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
Refrigerators ≥ 20 t	1 526	1 518	1 511	1 503	1 496	1 488	1 481	1 473	1 466	1 459	1 452
Refrigerators ≤ 5 t	127	121	120	121	111	98	97	98	99	156	173
Total	1 653	1 639	1 631	1 624	1 607	1 586	1 578	1 571	1 565	1 615	1 625
	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	%
Refrigerators ≥ 20 t	1 492	1 683	2 058	2 133	2 329	608	777	1 061	1 361	1 663	8.9
Refrigerators ≤ 5 t	178	201	245	254	278	300	321	326	339	348	174.0
Total	1 670	1 884	2 303	2 387	2 607	908	1 098	1 387	1 700	2 011	21.6

According to the information received from the International Association of Road Hauliers of Moldova (AITA), about 62 enterprises in the country own refrigerators with a capacity of 20 tonnes 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 tonnes (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 10-30 units each.

Based on the information regarding the average charge of freons (R-404a) into transport refrigeration equipment (Table 4-110) and the total number of transportation units used for transport refrigeration (Table 4-138), it was estimated the cumulative amount of R-404a charged into transport refrigeration in the Republic of Moldova (Table 4-139).

Table 4-139: AD on Cumulative Amount of R-404a Charged into Transport Refrigeration in the Republic of Moldova within 1995-2015 periods, t

	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
R-404a	11.5710	11.4730	11.4170	11.3680	11.2490	11.1020	11.0460	10.9970	10.9550	11.3050	11.3750
	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	%
R-404a	11.6900	13.1880	16.1210	16.7090	18.2490	6.3560	7.6860	9.7090	11.8992	14.0736	21.6

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 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, 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 4-140: AD on Imported Freons for Transport Refrigeration Service in the RM within 1995-2015 periods, t/yr

	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
R-404a	1.8398	1.8242	1.8153	1.8075	1.7886	1.7652	1.7563	1.7485	1.7418	1.7975	1.8086
	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	%
R-404a	1.8587	2.0969	2.5632	2.6567	2.9016	1.0106	1.2221	1.5437	1.8920	2.2377	21.6

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 1995-2015 periods (Table 4-141).

Table 4-141: Imported Freons for Refrigeration and Air Conditioning in the Republic of Moldova within 1995-2015 periods, t/yr

	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
R-134a	0.5979	1.3961	2.2439	4.6687	5.2912	5.9741	6.9548	7.8133	8.9559	9.9229	10.7676
R-404a	1.8398	1.8242	1.8153	2.1491	2.2735	2.5367	3.0640	3.9035	5.1342	6.4185	7.6079
R-407c	NO	NO	NO	0.0780	0.0754	0.0728	0.1430	0.2107	0.2760	0.3389	0.4434
R-410a	NO	NO	NO	0.0019	0.0031	0.0085	0.0123	0.0228	0.0596	0.1053	0.1805
R-507a	NO	NO	NO	0.3416	0.4874	0.5785	0.8354	1.1130	1.4280	1.8320	2.3422
	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	%
R-134a	11.6754	12.7578	13.6531	14.3334	15.0726	15.8601	16.6490	17.3731	20.6320	29.8530	4892.7
R-404a	8.9666	10.9669	12.5494	13.6385	14.8855	14.1158	15.2497	16.7015	18.1923	20.1471	995.1
R-407c	0.5496	0.8077	1.0187	1.1766	1.3475	1.5460	1.7357	1.9708	2.1523	2.3882	
R-410a	0.3064	0.7934	1.3110	1.4375	1.7175	2.1903	2.6428	3.2338	3.5616	3.8007	
R-507a	2.8528	3.4097	3.9057	4.5501	5.2012	5.8832	6.4888	7.5880	9.0522	13.1307	

Between 2009 and 2015, Climate Change Office of the Ministry of Agriculture, Regional Development and Environment 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 2003-2015 periods, but due to the low level of responses to these questionnaires from economic agents, this information is considered incomplete, especially with reference to 2003-2015 time series (Coral Ltd reported information for 2004-2005, „Frigoinds" Ltd – for 2003-2015, „Ecolux" Ltd – for 2003-2015, „Frio-Dins" Ltd – for 2010-2015, „York Regrigerent" Ltd – for 2011-2015, CS Dina-Cociug Ltd – for 2013-2015). For the last 5 years (2011-2015), 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 of the Ministry of Agriculture, Regional Development and Environment, 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 2011-2015 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 2015 (Table 4-142).

Table 4-142: AD on Imported Freons for Refrigeration and Air Conditioning Service in the RM within 2011-2015 periods, t/yr

	Annual imports reported by the companies to the Ozone Office of the Ministry of Agriculture, Regional Development and Environment						Estimated amount for equipment service calculated according to the 2006 IPCC Guidelines methodology					
	2011	2012	2013	2014	2015	Total	2011	2012	2013	2014	2015	Total
R-134a	12.0440	13.1040	16.4430	22.3448	36.2990	**100.2348**	15.8601	16.6490	17.3731	20.6320	29.8530	**100.3672**
R-404a	15.5849	5.7770	12.6220	20.7318	29.6480	**84.3637**	14.1158	15.2497	16.7015	18.1923	20.1471	**84.4064**
R-407c	2.0340	2.2600	1.4690	1.6950	2.3165	**9.7745**	1.5460	1.7357	1.9708	2.1523	2.3882	**9.7930**
R-410a	1.1300	1.1300	5.7330	3.3920	3.8420	**15.2270**	2.1903	2.6428	3.2338	3.5616	3.8007	**15.4292**
R-507a	3.9650	4.2940	7.6730	5.0850	20.9050	**41.9220**	5.8832	6.4888	7.5880	9.0522	13.1307	**42.1429**

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*, tonnes;
M_t – total HFC used in manufacturing new closed-cell foam in *t*, tonnes;
EF_{FYL} – first year loss emission factor, fraction (%);
$Bank_t$ – HFC charge blown into closed-cell foam manufacturing between year *t* and year *t-n*, tonnes;
EF_{AL} – annual loss emission factor, fraction (%);
DL_t – decommissioning losses in year *t* = 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, tonnes;
RD_t – HFC emissions prevented by recovery and destruction of foams and their blowing agents in year *t*, tonnes;
n – product lifetime of closed-cell foam;
t – current year;
(t-n) – the total period over which HFCs used in foams could still be present.

This equation 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 4-143).

Table 4-143: 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 4-144).

Table 4-144: Produced Foam Blowing Products in the RM within 2005-2015 periods, kt

	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
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
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
Polyurethane in primary forms	0.4901	0.3787	0.1472	0.5350	0.8896	0.8318	0.6823	0.3711	0.2805	0.2104	0.1578
Cellular products of polyurethane	NO	NO	NO	NO	NO	NO	NO	0.0016	0.2064	0.3429	0.5696

Source: Statistical Reports PRODMOLD-A "Total production, as a natural expression, in the Republic of Moldova, by product type, for 2005-2015".

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 4-145).

Table 4-145: Imported Foam Blowing Products in the Republic of Moldova within 1995-2015, 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**	**%**
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	614.2
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	5 754.1
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	395.4
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	567.5
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	655.0

Source: Custom Service, Official Letter No. 28/07-8785 dated 26.05.2016, as a response to the request from the Climate Change Office 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 from the Climate Change Office 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 from the Climate Change Office 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 from the Ministry of Environment No. 03-07/175 dated 02.02.2011.

The most frequently used blowing agents in polyurethane and polystyrene foam manufacturing can be considered HFC-134a, HFC-152a, HFC-245fa, HFC-365mfc, Pentane (C,I,N) and CO_2/ethanol.

Since the share of blowing agents in foam products in total imports is unknown, it has been decided to determine it considering the expert opinions (Table 4-146 and Table 4-147), 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[56],[57].

Table 4-146: 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

[56] 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.

[57] Danish Ministry of the Environment, Environment Protection Agency (2010), Greenhouse Gases HFCs, PFCs and SF_6, 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>.

	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[58], 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[59].

Considering the AD provided in Table 4-145 as well as the share of different blowing agents used in foam products imported in the RM between 1995 and 2015 (Tables 4-146 and 4-147), respectively considering the volume of blowing agents in foams, it was estimated the share of blowing agents contained in polyurethane products (Table 4-148) and polystyrene products (Table 4-149) imported in the country within 1995-2015 periods.

Table 4-147: 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

Table 4-148: AD on Import of Blowing Agents Charged into the Polyurethane Products in the RM within 1995-2015 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**	**%**
HFC-134a	0.0283	0.0391	0.0327	0.0168	0.0167	0.0125	0.0033	0.0030	0.0026	0.0053	461.8
HFC-365mfc	0.0106	0.0168	0.0163	0.0101	0.0125	0.0125	0.0147	0.0134	0.0119	0.0240	
HFC-245fa	0.0118	0.0186	0.0181	0.0112	0.0139	0.0138	0.0163	0.0149	0.0132	0.0267	
Pentane (C,I,N)	0.0354	0.0628	0.0680	0.0462	0.0625	0.0675	0.0531	0.0485	0.0429	0.0868	
Total	0.0862	0.1373	0.1352	0.0843	0.1056	0.1062	0.0874	0.0799	0.0706	0.1429	651.4

Table 4-149: AD on Import of Blowing Agents Charged into the Polystyrene Products in the RM within 1995-2015 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

[58] 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

[59] 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.

	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	%
HFC-134a	0.1265	0.1175	0.1091	0.0738	0.0656	0.0431	0.0466	0.0235	0.0263	0.0292	774.1
HFC-152a	0.0889	0.0843	0.0940	0.0795	0.0941	0.0928	0.1004	0.1012	0.1131	0.1079	
CO_2+ethanol	0.0417	0.0633	0.0806	0.0766	0.1009	0.1093	0.1184	0.1301	0.1454	0.1753	
Total	0.2571	0.2651	0.2837	0.2299	0.2606	0.2452	0.2654	0.2548	0.2847	0.3124	404.2

Activity data on the cumulative amount of blowing agents charged into the foam blowing products imported between 1995 and 2015 are presented below (Tables 4-150 and 4-151).

Table 4-150: AD on the Cumulative Amount (Bank) of Blowing Agents Charged into Polyurethane Products Imported in the RM within 1995-2015 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**	**%**
HCFC-22	0.0388	0.0388	0.0388	0.0388	0.0388	0.0388	0.0388	0.0388	0.0388	0.0388	307.6
HCFC-141b	0.0358	0.0358	0.0358	0.0358	0.0358	0.0358	0.0358	0.0358	0.0358	0.0358	318.6
HFC-134a	0.1359	0.1750	0.2076	0.2244	0.2411	0.2536	0.2568	0.2598	0.2625	0.2678	28 058.8
HFC-365mfc	0.0179	0.0347	0.0510	0.0611	0.0736	0.0861	0.1008	0.1142	0.1261	0.1501	
HFC-245fa	0.0199	0.0385	0.0567	0.0679	0.0818	0.0956	0.1119	0.1269	0.1401	0.1668	
Pentane (C,I,N)	0.0861	0.1490	0.2170	0.2632	0.3257	0.3932	0.4463	0.4948	0.5377	0.6246	
Total	0.3345	0.4717	0.6069	0.6912	0.7968	0.9031	0.9905	1.0704	1.1410	1.2839	6 649.5

Table 4-151: AD on the Cumulative Amount (Bank) of Blowing Agents Charged into Polystyrene Products Imported in the RM within 1995-2015 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	NO	NO	NO	0.0008	0.0021	0.0066	0.0122	0.0257	0.0535	0.0885	0.1583
CO_2+ethanol	NO	NO	NO	NO	NO	NO	NO	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**	**%**
HCFC-22	0.1183	0.1183	0.1183	0.1183	0.1183	0.1183	0.1183	0.1183	0.1183	0.1183	283.4
HCFC-142b	0.0953	0.0953	0.0953	0.0953	0.0953	0.0953	0.0953	0.0953	0.0953	0.0953	243.3
HFC-134a	0.4806	0.5981	0.7072	0.7810	0.8465	0.8896	0.9362	0.9597	0.9860	1.0152	30 270.0
HFC-152a	0.2472	0.3316	0.4255	0.5050	0.5991	0.6919	0.7924	0.8936	1.0066	1.1145	
CO_2+ethanol	0.0881	0.1513	0.2319	0.3085	0.4094	0.5187	0.6371	0.7672	0.9126	1.0879	
Total	1.0295	1.2946	1.5783	1.8081	2.0687	2.3139	2.5793	2.8341	3.1189	3.4313	5 437.1

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, tonnes;
>
> S_t – quantity of HFC and PFC contained in aerosol products sold in year t, tonnes;
>
> EF – emission factor = fraction of chemical emitted during the first year, fraction (%);
>
> S_{t-1} – quantity of HFC and PFC contained in aerosol products sold in year $t-1$, tonnes.

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 2003-2015 periods (Table 4-152).

Table 4-152: Import of Metered Dose Inhalers Using HFC-134a as Propellant in the RM within 2003-2015 periods, flacons

	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Salbutamol sulphate - Salbutamol pressurized inhalation suspension, 100 mcg/dose-200 doses	-	-	-	87200	60640	68960	109500	100184	118779	109144	85200	90840	-
Salbutamol sulphate - Ventolin Inhaler 100 mcg/dose-200 doses	-	4500	7923	12206	5448	12800	13236	19450	14500	10885	14741	33400	132852
Fenoterol hydrobromide - Berotec N pressurized inhalation solution 100 mcg/dose-200 doses	3014	6548	4320	3524	4363	1558	5138	4164	7984	11348	18576	17926	-
Ipratropium bromide / Fenoterol hydrobromide - Berodual N pressurized inhalation solution 200 doses 10 ml.	-	-	-	200	500	586	1300	1726	4248	5096	-	-	-
Ipratropium bromide / Fenoterol hydrobromide - Berodual N pressurized inhalation solution 20+50mcg/dose 10 ml	-	-	-	-	-	-	-	-	-	-	6568	5712	7212
Fluticasone propionate - Flixotide 50 Evohaler 50 µg /dose 120 doses	-	500	1630	1690	1160	1200	300	1150	1896	3116	2400	2930	3230
Fluticasone propionate - Flixotide 125 Evohaler 125 µg /dose 60 doses	-	-	-	-	-	612	800	250	-	300	496	820	930
Fluticasone propionate - Flixotide 125 Evohaler 125 µg /dose 120 doses	-	282	3170	2650	1370	-	1933	1400	1650	600	3108	4739	5715
Fluticasone propionate - Flixotide 250 Evohaler 250 µg /dose 60 doses	-	250	950	1330	2170	-	2990	620	-	300	200	400	-
Fluticasone propionate - Flixotide 250 Evohaler 250 µg /dose 120 doses	-	-	-	-	-	850	480	2750	3018	-	-	-	-
Salmeterol xinafoate / Fluticasone propionate - Seretide Inhaler 25 µg + 50 µg 120 doses	-	-	-	-	-	250	299	530	-	-	-	-	-
Salmeterol xinafoate / Fluticasone propionate - Seretide Inhaler 25 µg + 125 µg 120 doses	-	-	-	-	-	-	-	-	-	-	50	50	-
Salmeterol xinafoate / Fluticasone propionate - Seretide Inhaler 25 µg + 250 µg 120 doses	-	-	-	-	-	-	-	-	-	-	-	100	-
Salmeterol xinafoate - Serevente Inhaler 25 µg 120 doses	-	-	-	-	-	1200	1637	2100	-	-	-	-	-
Fluticasone propionate - Flixotide 250 Evohaler 250 µg /dose 60 doses	-	-	-	-	-	200	3040	620	-	-	-	-	-
Fluticasone propionate - Flixotide 50 Evohaler 50 µg /dose 120 doses	-	-	-	-	-	850	300	-	-	-	-	-	-
Fluticasone propionate - Flixotide 125 Evohaler 125 µg /dose 120 doses	-	-	-	-	-	1413	-	-	-	-	-	-	-
Fluticasone propionate - Flixotide 250 Evohaler 250 µg /dose 60 doses	-	-	-	-	-	100	2990	620	-	-	-	-	-
Salmeterol xinafoate / Fluticasone propionate - SeretideTM/Diskus TM Inhaler - sol 50 mcg + 100 mcg/dose, 60 doses NI	-	-	-	-	-	-	-	-	-	-	-	-	4207
Salmeterol xinafoate / Fluticasone propionate - SeretideTM/Diskus TM Inhaler - sol. 50 mcg + 250 mcg/dose, 60 doses NI	-	-	-	-	-	-	-	-	-	-	-	-	7475
Salmeterol xinafoate / Fluticasone propionate - SeretideTM/Diskus TM Inhaler - sol. 50 mcg + 500 mcg/dose, 60 doses NI	-	-	-	-	-	-	-	-	-	-	-	-	2710
Totals Metered Dose Inhalers using HFC-134a as propellant	3014	12080	17993	108800	75651	90579	143943	135564	152075	140789	131339	156917	179067

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.

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 4-153).

Table 4-153: Activity Data on HFC-134a Incorporated in Metered Dose Aerosols Imported in the Republic of Moldova within 2003-2015 periods, kg

	2003	2004	2005	2006	2007	2008	2009
HFC-134a	0.0301	0.0603	0.2319	0.3164	4.1284	6.4691	7.6003
	2010	**2011**	**2012**	**2013**	**2014**	**2015**	**%**
HFC-134a	19.8872	45.4319	53.6220	68.1190	60.0683	222.5110	369029.0

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

For 1995-2013 periods recalculations were made for HFCs emissions under the category 2F 'Product Uses as Substitutes for ODS' due to the change of assessment methodology and default EFs available in the 2006 IPCC Guidelines compared to the previous inventory cycle, when the method and default emission factors were provided by the GPG (IPCC, 2000). 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 BUR1 of the Republic of Moldova under UNFCCC (2016), the recalculations resulted in an increase of HFC emissions between 1997-2004, respectively in 2013, varying from a minimum of 3.0 per cent in 2004, to a maximum of 25.2 per cent in 1999, except for 1995-1996 and 2005-2012 years with an increase varying from a minimum of 1.7 per cent in 2012, up to a maximum of 142.0 per cent in 1995 (Table 4-154). For 2014-2015, HFC emissions within the respective category were estimated for the first time. The obtained results allow assert that over the period 1995-2015, HFCs emissions increased by circa 39 times in the Republic of Moldova.

Table 4-154: Comparative Results of HFC Emissions from 2F 'Product Uses as Substitutes for ODS' included into the BUR1and NC4 of the RM under the UNFCCC, kt CO_2 equivalent

	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
BUR1	1.8961	4.0738	6.6059	9.4575	11.4564	13.3755	16.4898	19.5171	25.8600	32.0340	39.4583
NC4	4.5879	5.1847	5.9997	7.4843	8.5714	10.4630	12.8513	16.8928	23.6694	31.0742	42.1522
Difference, %	142.0	27.3	-9.2	-20.9	-25.2	-21.8	-22.1	-13.4	-8.5	-3.0	6.8
	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	%
BUR1	47.3617	60.7298	76.7734	87.5976	102.9981	113.0005	126.6714	142.8948			
NC4	54.7020	69.8086	84.6748	93.2489	113.4282	119.5378	128.8468	137.5611	151.3701	179.4375	3811.1
Difference, %	15.5	14.9	10.3	6.5	10.1	5.8	1.7	-3.7			

Abbreviations: BUR1 – First Biennial Update Report and NC4 – Fourth National Communication.

The table below presents HFC emissions by substances and sources (Table 4-155).

Table 4-155: HFC Emissions from the 2F 'Product Uses as Substitutes for ODS', 1995-2015

	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
	2F1 'Refrigeration and Air Conditioning'										
HFC-32, t	0.9230	0.9152	0.9107	0.9116	0.9025	0.8913	0.8883	0.8860	0.8851	0.9157	0.9256
HFC-125, t	0.9230	0.9152	0.9107	0.9499	0.9597	0.9636	0.9885	1.0306	1.0828	1.1973	1.2784
HFC-134a, t	0.3202	0.4737	0.6769	1.0476	1.2072	1.3650	1.6312	1.7825	2.2411	2.5744	2.8409
HFC-143a, t	0.0000	0.0000	0.0000	0.0410	0.0609	0.0779	0.1090	0.1595	0.2204	0.3148	0.3936
2F1, kt CO_2 eq.	**4.3115**	**4.4983**	**4.7703**	**5.6215**	**5.9668**	**6.2743**	**6.8790**	**7.4672**	**8.5770**	**9.8973**	**10.9213**
	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.	**4.5879**	**5.1847**	**5.9997**	**7.4843**	**8.5714**	**10.4630**	**12.8513**	**16.8928**	**23.6694**	**31.0742**	**42.1522**
	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	%
	2F1 'Refrigeration and Air Conditioning'										
HFC-32, t	0.9568	1.0987	1.3527	1.4064	1.5498	3.5090	3.6268	3.7889	3.9957	4.2761	363.3
HFC-125, t	1.3784	1.6111	1.9233	2.0606	2.9684	4.5868	4.9733	5.5129	6.2112	7.4945	712.0
HFC-134a, t	3.1463	4.3453	5.9067	6.2467	10.6224	7.4841	8.4723	9.4132	13.0394	22.4076	6897.1
HFC-143a, t	0.4730	0.5785	0.6445	0.7369	1.5714	1.2161	1.5260	1.9541	2.5155	3.6243	
2F1, kt CO_2 eq.	**12.0839**	**15.1801**	**18.9723**	**20.3882**	**33.6498**	**34.5607**	**38.7915**	**44.0486**	**54.3268**	**77.3604**	**1694.3**
	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	57.7353	29780.2
HFC-152a, t	11.1246	14.9198	19.1495	22.7251	26.9617	31.1362	35.6560	40.2101	45.2989	50.1538	
HFC-365mfc, t	0.8066	1.5604	2.2953	2.7489	3.3117	3.8723	4.5340	5.1387	5.6732	6.7552	
HFC-245fa, t	0.8962	1.7337	2.5503	3.0543	3.6797	4.3026	5.0377	5.7097	6.3035	7.5057	
2F2, kt CO_2 eq.	**42.6149**	**54.6209**	**65.6924**	**72.8440**	**79.7528**	**84.9304**	**89.9845**	**93.4254**	**96.9516**	**101.8751**	**36770.1**
	2F4 'Aerosols'										
HFC-134a, t	0.0022	0.0053	0.0070	0.0117	0.0178	0.0327	0.0495	0.0609	0.0641	0.1413	
2F4, kt CO_2 eq.	**0.0032**	**0.0076**	**0.0101**	**0.0167**	**0.0255**	**0.0467**	**0.0708**	**0.0870**	**0.0917**	**0.2020**	
	2F 'Product Uses as Substitutes for ODS'										
2F, kt CO_2 eq.	**54.7020**	**69.8086**	**84.6748**	**93.2489**	**113.4282**	**119.5378**	**128.8468**	**137.5611**	**151.3701**	**179.4375**	**3811.1**

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 of the Ministry of Agriculture, Regional Development and Environment 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 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, such enterprises as 'Moldelectrica' SOE, Red Union Fenosa J.S.C. (part of the Gas Natural Fenosa Group), Ministry of Health, Labour 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 former Ministry of Health for the time period since 1990 to 2015; at the Ministry of Economy and Infrastructure ('Moldelectrica' S.O.E. and Red Union Fenosa J.S.C.), by 2015, SF_6 was used in 122 high tension circuit breakers, varying from 0.98 kg to 45 kg of SF_6 including 0.98 kg SF_6 – TXO 36 type, 35kV; 2.29 kg of SF_6 – VOX 36, 35kV; 2.4-2.6 kg of SF_6 – GL-107X type, 35kV; 6 kg of SF_6 – LTB 145D/1B type, 110kV; 7.8 kg of SF_6 – GL-312F1/4031 P type or VR, 110 kV; 9.9 kg of SF_6 – GL-311 F1 P type, 110 kV; 12 kg of SF_6 – GL-311 F1 type, 110 kV; 12 kg of SF_6 – LTB type, 110 kV; 30 kg of SF_6 – LTB 420 E2 type, 400 kV; 41 kg, of which 26 kg of SF_6 and 15 kg of CF_4 – GL-315 F3 type, 330 kV; respectively, 45 kg of SF_6 – Hypact type, 110 kV. 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 including gas insulated switchgear.

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 anaesthetic use (SNAP 060508 – N_2O for anaesthetic 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 2015, direct GHG emissions from the 2G 'Other Product Manufacture and Use' decreased by circa 41.2 per cent (Table 4-58).

Table 4-156: Direct GHG Emissions from 2G 'Other Product Manufacture and Use' Category, by Sources, within 1990-2015 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	0.0569	0.3532	0.4528
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	1.1377	1.3293	1.4002

	2008	2009	2010	2011	2012	2013	2014	2015	%
2G1. Electrical equipment	0.5463	0.5890	0.7200	0.7543	0.8113	1.0104	1.0978	1.0978	
2G3. N_2O from product uses	NO	NO	NO	NO	NO	NO	NO	NO	-100.0
2G4. Other	0.9859	0.6998	0.9046	1.0979	1.0427	1.1438	1.0338	0.7840	-75.3
2G. Other product manufacture and use	1.5322	1.2888	1.6246	1.8522	1.8540	2.1542	2.1317	1.8818	-41.2

The table below presents indirect GHG emissions (NO_x, CO, NMVOC) from the respective category (Table 4-157).

Table 4-157: Indirect GHG Emissions from the 2G 'Other Product Manufacture and Use' Category within 1990-2015 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	%
NO_x	0.0086	0.0105	0.0135	0.0140	0.0101	0.0075	0.0050	0.0038	-80.5
CO	0.2638	0.3225	0.4140	0.4272	0.3078	0.2296	0.1535	0.1174	-80.5
NMVOC	0.4481	0.3181	0.4112	0.4990	0.4739	0.5199	0.4699	0.3564	-75.3

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, tonnes;
M – manufacturing emissions, tonnes;
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, tonnes;
EF – installation EF, total nameplate capacity of new equipment filled on site;
EU – equipment use emissions, tonnes;
EF – equipment use EF; total nameplate capacity of installed equipment (includes emissions due to leakage, servicing, and maintenance as well as failures); default emission factors: 0.2 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, tonnes;
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 (35 kV) and high-tension electrical circuit breakers (110 kV, 330 kV and 400 V), the SF_6 charge in each case varying between 0.98 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 4-158, respectively in Table 4-159.

Table 4-158: The dynamic of medium and high-tension electrical circuit breakers installation process using SF_6 and CF_4 within 2003-2015 periods, units installed per year

Enterprises	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Moldelectrica S.O.E.	1	0	5	28	8	2	0	8	1	3	4	0	0
Red Union Fenosa J.S.C.	0	0	2	6	6	8	6	5	5	4	11	9	0
Total	**1**	**0**	**7**	**34**	**14**	**10**	**6**	**13**	**6**	**7**	**15**	**9**	**0**

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; '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.

Table 4-159: Total medium and high-tension electrical circuit breakers available in bulk at the end of calendar year within 2003-2015 periods, units

	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Circuit breaker THO 36 / 0.98 kg SF_6, 35 kV				5	5	5	5	5	5	5	4	4	4
Circuit breaker VOX 36 / 2.29 kg SF_6, 35 kV										1	1	1	1
Circuit breaker GL-107X (2012) / 2.4 kg SF_6, 35 kV												2	2
Circuit breaker GL-107X (2005) / 2.6 kg SF_6, 35 kV												2	2
Circuit breaker LTB 145D/1B/ 6 kg SF_6 110 kV	1	1	8	27	41	49	55	60	63	65	71	71	71
Circuit breaker GL-312F1/4031 P /VR/7.8 kg SF_6 110 kV								3	4	4	4	4	4
Circuit breaker GL-311 F1 P / 9.9 kg SF_6 110 kV								1	1	1	6	6	6
Circuit breaker GL-311 F1 / 12 kg SF_6 110 kV				2	2	2	2	2	2	2	2	2	2
Circuit breaker LTB / 12 kg SF_6 110 kV									2	4	4	6	6
Circuit breaker Hypact / 45 kg SF_6 110 kV											5	8	8
Circuit breaker GL-315 F3 / 26 kg SF_6 and 15 kg CF_4 330 kV				8	8	10	10	14	14	14	14	14	14
Circuit breaker LTB 420 E2/ 30 kg SF_6 400 kV										2	2	2	2
Total	**1**	**1**	**8**	**42**	**56**	**66**	**72**	**85**	**91**	**98**	**113**	**122**	**122**

The amount of insulating gas (SF_6 and CF_4) in bulk charged in the medium and high-tension electrical circuit breakers in the Republic of Moldova is provided in Table 4-160, respectively in Table 4-161.

Table 4-160: Total amount of insulating gas - SF_6 available in bulk, charged in the medium and high-tension electrical circuit breakers in the Republic of Moldova within 2003-2015, tonnes

	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Circuit breaker THO 36 / 0.98 kg SF_6, 35kV				0.013	0.013	0.013	0.013	0.013	0.013	0.013	0.010	0.010	0.010
Circuit breaker VOX 36 / 2.29 kg SF_6, 35kV										0.002	0.002	0.002	0.002
Circuit breaker GL-107X (2012) / 2.4 kg SF_6, 35kV												0.005	0.005
Circuit breaker GL-107X (2005) / 2.6 kg SF_6 35kV												0.002	0.002
Circuit breaker LTB 145D/1B/ 6 kg SF_6 110kV	0.012	0.012	0.096	0.324	0.492	0.588	0.660	0.720	0.756	0.780	0.852	0.852	0.852
Circuit breaker GL-312F1/4031 P /VR/7.8 kg SF_6 110kV								0.030	0.040	0.040	0.040	0.040	0.040
Circuit breaker GL-311 F1 P / 9.9 kg SF_6 110kV								0.008	0.008	0.008	0.047	0.047	0.047
Circuit breaker GL-311 F1 / 12 kg SF_6 110kV				0.024	0.024	0.024	0.024	0.024	0.024	0.024	0.024	0.024	0.024
Circuit breaker LTB / 12 kg SF_6 110 kV									0.012	0.024	0.024	0.036	0.036
Circuit breaker Hypact / 45 kg SF_6 110 kV											0.225	0.360	0.360
Circuit breaker GL-315 F3 / 26 kg SF_6 and 15 kg CF_4 330 kV				0.208	0.208	0.260	0.260	0.364	0.364	0.364	0.364	0.364	0.364
Circuit breaker LTB 420 E2/ 30 kg SF_6 400kV										0.060	0.060	0.060	0.060
Total SF_6 in bulk	**0.012**	**0.012**	**0.096**	**0.569**	**0.737**	**0.885**	**0.957**	**1.159**	**1.216**	**1.315**	**1.648**	**1.802**	**1.802**

Table 4-161: 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 2006-2015 periods, tonnes

	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Circuit breaker GL-315 F3 / 26 kg SF_6 and 15 kg CF_4, 330 kV	0.120	0.120	0.150	0.150	0.210	0.210	0.210	0.210	0.210	0.210

2G3. N_2O from Product Uses

The methodology used to estimate N_2O emissions from source category 2G3 'N_2O from Product Uses' (in anaesthesia) is represented by the following formula:

$$E_{pollutant} = (AR_{product} \bullet EF_{technology\ pollutant}) / 10^3$$

Where:

$E_{pollutant}$ – pollutant gas emissions from N_2O use in anaesthesia, t/yr;

$AR_{product}$ – activity rate for N_2O consumption in anaesthesia, t/yr;

$EF_{pollutant\ technology}$ – the emission factor for this pollutant technology, t/t (by default, 100 per cent of the whole amount of N_2O used in anaesthesia is deemed to be emitted into the atmosphere).

Estimation of nitrous oxide emissions from use of N_2O in anaesthesia was based on activity data provided by the former Ministry of Health, as a response to the Official Letters of the former Ministry of Environment and Natural Resources (Table 4-162). 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 anaesthesia anymore.

Table 4-162: Amount of Nitrous Oxide Used in Anaesthesia in the Republic of Moldova within 1990-2006 periods, kg

	1990	1991	1992	1993	1994	1995	1996	1997	1998
N_2O consumption in anaesthesia	66	55	50	60	50	1	2	3	5
	1999	2000	2001	2002	2003	2004	2005	2006	2007-2015
N_2O consumption in anaesthesia	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.

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 4-163) for the Tier 2 approach.

Table 4-163: 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 fermented tobacco, 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 2005-2015', as well as in the statistical database which can be accessed on-line on the NBS website[60].

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 4-164), it is considered that cigarettes represent 95 per cent of the total market, while cigars – 5 per cent of the total.

Table 4-164: AD on Cigars and Cigarettes Production in the Republic of Moldova, 1990-2015

	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	%
Cigars and Cigarettes, billion units	3.990	4.878	6.261	6.462	4.656	3.472	2.322	1.776	-80.5
Tobacco in cigars and cigarettes, kt	4.788	5.853	7.513	7.754	5.587	4.166	2.787	2.131	-80.5

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 2005-2015'.

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

[60] 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>.

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 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), 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 4-165) for the Tier 2 approach.

Table 4-165: 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, Table 3-15, page 21.

Statistical data regarding shoes production are available in the Statistical Yearbooks of the RM and 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 2005-2015'.

Table 4-166: AD on Shoes Production in the Republic of Moldova within 1990-2015, 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	%
RM: right bank of Dniester River	3.832	2.221	2.717	2.849	3.053	2.942	2.866	1.886	-82.9
RM: left bank of Dniester River	3.251	2.608	3.530	4.843	4.395	5.387	4.741	3.881	-68.2
RM: total	7.083	4.829	6.247	7.692	7.448	8.329	7.607	5.767	-75.1

Source: Statistical Yearbooks of the ATULBD for 1998-2016; Statistical Yearbooks of the RM for 1990-2016. Statistical Reports PRODMOLD-A 'Total production, as a natural expression, in the Republic of Moldova, by product type, for 2005-2015'.

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 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 ±25.83 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, Labour 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 2003-2013 periods recalculations were made for SF_6 and CF_4 emissions under the category 2G1 'Electrical Equipment' due to the transition to the assessment methodology and default EFs available in the 2006 IPCC Guidelines compared to the previous inventory cycle, when the method and default emission factors were provided by the GPG (IPCC, 2000). Also, in order to transfer SF_6 and CF_4 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 BUR1 of the Republic of Moldova under UNFCCC (2016), the recalculations resulted in an increase of SF_6 and CF_4 emissions, varying from a minimum of 22.8 per cent in 2006, to a maximum of 42.8 per cent in 2003 (Table 4-167). For 2014-2015, SF_6 and CF_4 emissions within the respective category were estimated for the first time. The obtained results allow assert that over the period 2003-2015, SF_6 and CF_4 emissions increased by circa 154 times in the Republic of Moldova.

Table 4-167: Comparative Results of SF_6 and CF_4 Emissions from 2G1 'Electrical Equipment' included into the BUR1 and NC4 of the RM under the UNFCCC, kt CO_2 equivalent

	2003	2004	2005	2006	2007	2008	2009
BUR1	0.0057	0.0057	0.0459	0.2876	0.3679	0.4425	0.4769
NC4	0.0071	0.0071	0.0569	0.3532	0.4528	0.5463	0.5890
Difference, %	24.0	24.0	24.0	22.8	23.1	23.5	23.5
	2010	**2011**	**2012**	**2013**	**2014**	**2015**	**%**
BUR1	0.5811	0.6087	0.6558	0.7076			
NC4	0.7200	0.7543	0.8113	1.0104	1.0978	1.0978	15 332.9
Difference, %	23.9	23.9	23.7	42.8			

Abbreviations: BUR1 – First Biennial Update Report and NC4 – Fourth National Communication

The table below presents SF_6 and CF_4 emissions by substances in metric tonnes and expressed in CO_2 equivalent (Table 4-168).

Table 4-168: SF_6 and CF_4 Emissions from Source Category 2G1 'Electrical Equipment' in the RM within 2003-2015 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**	**0.0569**	**0.3302**	**0.4298**	**0.5175**	**0.5602**
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**	**%**
	2G1„Electrical Equipment"						
SF_6, t	0.0298	0.0313	0.0338	0.0425	0.0464	0.0464	14 765.7
SF_6, kt CO_2 eq.	**0.6796**	**0.7140**	**0.7710**	**0.9700**	**1.0575**	**1.0575**	**14 765.7**
CF_4, t	0.0055	0.0055	0.0055	0.0055	0.0055	0.0055	75.0
CF_4, kt CO_2 eq.	**0.0403**	**0.0403**	**0.0403**	**0.0403**	**0.0403**	**0.0403**	**75.0**

2G3. N_2O from Product Uses

For 1990-2006 periods, recalculations were made for N_2O emissions expressed in CO_2 equivalent under the category 2G3 'N_2O from Product Uses' (Table 4-169), due to the fact that 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 BUR1 of the Republic of Moldova under UNFCCC (2016), the recalculations resulted in a decrease of N_2O emissions by circa 3.9 per cent. For 2007-2015, there are no records of N_2O emissions within the respective category.

Table 4-169: 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, tonnes	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, tonnes	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

GHG emissions from category 2G4 'Other' were estimated in the RM for the first time (Table 4-170).

Table 4-170: GHG Emissions from 2G4 'Other' in the RM within 1990-2006

	1990	1991	1992	1993	1994	1995	1996	1997	1998
Indirect CO_2, kt	3.1787	2.8632	2.2573	1.8544	1.3519	1.0947	1.0386	0.9389	0.7020
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**
Indirect CO_2, kt	0.6062	0.8987	0.7730	0.7307	0.8881	0.9656	1.0626	0.9584	0.9474
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**	**%**
Indirect CO_2, kt	0.9859	0.6998	0.9046	1.0979	1.0427	1.1438	1.0338	0.7840	-75.3
NO_x, kt	0.0086	0.0105	0.0135	0.0140	0.0101	0.0075	0.0050	0.0038	-80.5
CO, kt	0.2638	0.3225	0.4140	0.4272	0.3078	0.2296	0.1535	0.1174	-80.5
NMVOC, kt	0.4481	0.3181	0.4112	0.4990	0.4739	0.5199	0.4699	0.3564	-75.3

4.7.6. Planned Improvements

Potential improvements under the 2G 'Other Product Manufacture and Use' source category could include updating/précising the activity data used to estimate GHG emissions within this category for the 1990-2015 periods. Also, regarding the collecting of AD on fireworks products consumption (code 3604 10 000 – signalling 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 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 source category 2H2 „Food and Beverages Industry". Between 1990 and 2015 the respective emissions decreased by circa 61.4 per cent, from 12.25 kt in 1990 to 4.73kt in 2015 (Table 4-171). At the same time, in comparison with the previous year, in 2015 the NMVOC emissions from 2H2 'Food and Beverages Industry' decreased by circa 25.5 per cent.

Table 4-171: NMVOC Emissions from 2H2 'Food and Beverages Industry' in the RM within 1990-2015 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	%
2H2a. 'Bread Making and Other Food''	3.4029	2.0758	2.8726	2.7869	2.2361	3.4545	3.8966	2.6376	-76.1
2H2b. 'Alcoholic Beverages'	1.7245	1.3825	1.5763	1.8592	2.2435	2.6539	2.4336	2.0963	73.1
2H2. 'Food and Beverages Industry'	5.1274	3.4583	4.4489	4.6461	4.4796	6.1085	6.3301	4.7339	-61.4

To be noted that in the reference year (1990), around 91.1 per cent of the total NMVOC emissions were generated from the subcategory 2H2a 'Bread Making and Other Food'. By 2015, the share of this category in the total NMVOC emissions decreased to circa 55.7 per cent (Figure 4-4).

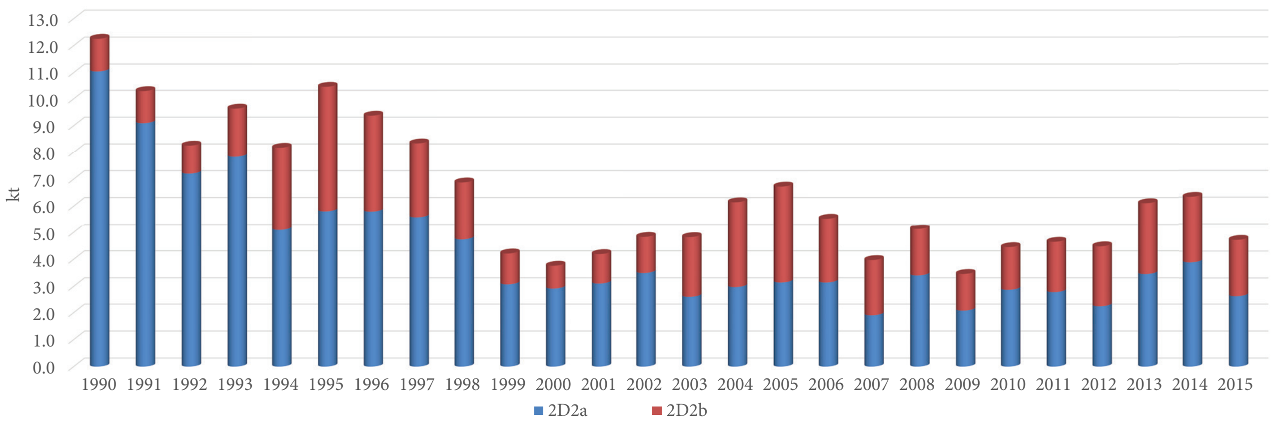


Figure 4-4: NMVOC Emissions from 2H2 'Food and Beverages Industry' in the RM within 1990-2015 periods, kt

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 4-172) by activity data on bread making and other food available in the national statistics of the RM and of the ATULBD (Table 4-173).

Table 4-172: 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	10
	Margarine and solid cooking fats	10
	Cakes, biscuits and breakfast cereals	1
	White Bread	4.5
	Animal Feed	1

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 4-173: Activity Data on Bread Making and Other Food in the Republic of Moldova within 1990-2015 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
Margarine		0.024	1.034	2.616	3.301	3.515	3.390	2.624	2.225
Confectionary Products	8.423	8.745	12.834	15.852	18.036	17.876	20.726	21.692	22.284
Bread	147.045	138.126	133.280	130.779	144.650	145.830	142.026	144.848	154.774
Animal Feed	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	%
Meat	12.809	16.260	24.699	28.509	31.597	35.495	44.072	45.735	-82.3
Fish	4.600	3.700	1.300	7.578	7.732	8.490	8.774	9.241	-2.7
Dried grains in elevators	920.742	658.146	764.898	797.309	402.394	882.585	955.221	713.657	-67.1
Sugar	133.966	38.373	103.209	88.436	83.440	140.297	177.695	84.519	-80.6
Margarine	1.940	1.657	1.274	1.119	0.484	0.706			
Confectionary Products	22.910	23.629	27.718	29.383	31.332	34.633	34.875	34.255	41.0
Bread	169.806	161.564	160.406	162.916	161.765	165.450	160.259	161.328	-73.2
Animal Feed	51.043	60.143	74.405	75.405	96.284	97.787	98.472	80.118	-92.3

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 2005-2015"; 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), 2016 (page 99).

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 4-174). 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.

Table 4-174: Selective AD on Agricultural Crops in the RM within 1990-2015 periods

	1990	1991	1992	1993	1994	1995	1996	1997	1998
Winter and Spring Wheat, kt	1129.0	1056.5	925.8	1392.6	658.8	1154.3	673.7	1152.6	951.9
Winter and Spring 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
Winter and Spring Wheat, kt	797.8	725.0	1180.8	1113.1	102.4	861.2	1048.6	682.3	406.5
Winter and Spring 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	%
Winter and Spring Wheat, kt	1286.5	738.9	749.5	797.0	496.9	1009.6	1102.6	922.3	-18.3
Winter and Spring Barley, kt	362.3	290.5	240.7	211.5	132.7	241.6	244.7	178.8	-57.2
Oat, kt	3.9	1.6	3.1	3.6	2.0	3.8	2.9	1.5	-60.5
Grain maize, kt	1484.1	1159.6	1462.1	1539.6	586.0	1546.8	1642.1	1125.1	27.1
Sunflower, kt	387.2	310.2	440.2	489.9	335.1	602.2	627.1	552.4	119.0
Soy, kt	58.8	50.1	113.0	80.2	48.8	67.6	111.4	49.1	106.1
Rapeseed for grains, kt	100.1	81.6	51.0	67.5	8.1	58.8	90.2	25.5	
Total cereals, kt	3683.0	2632.6	3059.6	3189.2	1609.6	3530.3	3820.9	2854.6	5.3
Share of cereals dried in elevators, % of total	25	25	25	25	25	25	25	25	-68.8
Cereals dried in elevators, kt	920.7	658.1	764.9	797.3	402.4	882.6	955.2	713.7	-67.1

Source: NBS, Statistical database, 'Sown area, average yield on agricultural crops, 1980-2015': <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), 2016 (page 108).

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 4-175) by activity data on production of alcoholic beverages available in national statistics of the RM and of the ATULBD (Table 4-176).

Table 4-175: 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 4-176: Activity Data on Alcoholic Beverages Production within 1990-2015 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	%
Wine, thousand hl	1553.0	1263.1	1285.5	1260.6	1422.0	1551.7	1409.5	1356.5	-16.8
White wine, thousand hl	814.4	600.4	591.7	664.3	679.2	694.3	765.1	622.5	-18.6
Red wine, thousand hl	738.6	662.7	693.8	596.3	742.8	857.4	644.3	734.0	-15.2
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	-83.0
Sparkling wine, thousand hl	57.3	50.0	55.6	68.6	65.4	60.0	52.2	50.2	-37.5
Brandy, thousand hl	103.7	69.8	74.6	91.2	109.4	118.0	93.9	70.2	-49.7
Grain Whisky and Liqueurs, thousand hl	129.1	110.8	127.1	140.2	165.9	196.1	183.4	162.3	190.4
Vodka, thousand hl	35.4	26.5	32.2	49.2	65.0	84.5	81.6	68.4	218.8
Beer, thousand hl	866.6	781.7	952.6	1068.1	1118.4	1029.3	984.8	994.5	30.9

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 2005-2015'; 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), 2016 (page 99).

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' were recalculated for the 1990-2013 periods, in particular due to use of updated EFs available in the EMEP/EEA Air Pollutant Emission Inventory Guidebook (2016), due to updating activity data on bread making and other food and alcoholic beverages according to the Statistical Reports PRODMOLD-A 'Total production, as a natural expression, in the Republic of Moldova, by product type', as well as due to introducing new sources of emissions (fish processing, cereals dried in elevators, vodka and wines of Porto, Madeira, Sherry, Tokay and others).

In comparison with the results obtained in the BUR1 of the Republic of Moldova under UNFCCC (2016), the recalculations resulted in an increase of NMVOC emissions between 1990- 2013, varying from a maximum increase of 56.7 per cent in 1999, to a minimum increase of 20.7 per cent in 2012. For 2014-2015, NMVOC emissions within the respective category were estimated for the first time. The obtained results allow assert that over the period 1990-2015, emissions increased by circa 61.4 per cent in the Republic of Moldova (Table 4-177).

Table 4-177: Comparative Results of NMVOC Emissions from 2H2 'Food and Beverages Industry' included into the BUR1and NC4 of the RM under the UNFCCC, kt

	1990	1991	1992	1993	1994	1995	1996	1997	1998
BUR1	9.7853	7.2390	6.1207	6.2223	5.9020	7.3473	6.9791	5.5263	4.5895
NC4	12.2544	10.2883	8.2577	9.6360	8.1775	10.4463	9.3728	8.3398	6.8761
Difference, %	25.2	42.1	34.9	54.9	38.6	42.2	34.3	50.9	49.8
	1999	2000	2001	2002	2003	2004	2005	2006	2007
BUR1	2.6891	2.4705	2.8999	3.4269	3.4844	4.2303	4.7556	4.1905	3.2601
NC4	4.2144	3.7608	4.1911	4.8266	4.8202	6.1437	6.7243	5.5342	3.9720
Difference, %	56.7	52.2	44.5	40.8	38.3	45.2	41.4	32.1	21.8
	2008	2009	2010	2011	2012	2013	2014	2015	%
BUR1	3.7048	2.4382	3.2984	3.3816	3.7115	4.7530			
NC4	5.1274	3.4583	4.4489	4.6461	4.4796	6.1085	6.3301	4.7339	-61.4
Difference, %	38.4	41.8	34.9	37.4	20.7	28.5			

Abbreviations: BUR1 – First Biennial Update Report and NC4 – Fourth National Communication.

'Bread Making and Other Food'

In comparison with values included in the BUR1 of the Republic of Moldova under UNFCCC (2016), the changes made resulted in an increase of NMVOC emission estimates between 1990 and 2013, with a maximum increase in 1999 (69.4 per cent), and a minimum increase in 2007 (21.3 per cent). For the 2014-2015 years, the NMVOC emissions from bread making and other food source category were estimated for the first time. The results allow assert that over the period since 1990 to 2015, NMVOC emissions from bread making and other food increased by 76.1 per cent (Table 4-178).

Table 4-178: Comparative Results of NMVOC Emissions from 2H2a 'Bread Making and Other Food' included into the BUR1 and NC4 of the RM under the UNFCCC, kt

	1990	1991	1992	1993	1994	1995	1996	1997	1998
BUR1	8.7440	6.2136	5.2761	4.8382	3.5660	3.8191	4.1996	3.4138	3.0234
NC4	11.0434	9.0948	7.2053	7.8286	5.0893	5.8083	5.7982	5.5868	4.7372
Difference, %	26.3	46.4	36.6	61.8	42.7	52.1	38.1	63.7	56.7
	1999	2000	2001	2002	2003	2004	2005	2006	2007
BUR1	1.8152	1.7768	2.0162	2.3784	1.8342	1.9058	2.1175	2.2926	1.5681
NC4	3.0748	2.9202	3.1034	3.4932	2.6133	2.9743	3.1437	3.1424	1.9021
Difference, %	69.4	64.4	53.9	46.9	42.5	56.1	48.5	37.1	21.3
	2008	2009	2010	2011	2012	2013	2014	2015	%
BUR1	2.2483	1.2585	1.9220	1.7846	1.7519	2.3479			
NC4	3.4029	2.0758	2.8726	2.7869	2.2361	3.4545	3.8966	2.6376	-76.1
Difference, %	51.4	64.9	49.5	56.2	27.6	47.1			

Abbreviations: BUR1 – First Biennial Update Report and NC4 – Fourth National Communication.

'Alcoholic Beverages'

In comparison with values included in the BUR1 of the Republic of Moldova under UNFCCC (2016), the changes made resulted in an increase of NMVOC emission estimates between 1990 and 2013, with a maximum increase in 1998 (36.6 per cent), and a minimum increase in 2013 (10.3 per cent). For the 2014-2015 years, the NMVOC emissions from alcoholic beverages source category were estimated for the first time. The results allow assert that over the period since 1990 to 2015, NMVOC emissions from alcoholic beverages increased by 73.1 per cent (Table 4-179). This increase can be explained by a substantial growth of winemaking industry's output in the Republic of Moldova over the period under review: vodka – by 218.8 per cent, grain whiskey and liqueurs – by 190.4 per cent and beer – by 30.9 per cent, despite the fact that the production of grape wine decreased by 16.8 per cent, sparkling wine – by 37.5 per cent, brandy – by 49.7 per cent, and wines of Porto, Madeira, Sherry, Tokay and other – by 83.0 per cent.

Table 4-179: Comparative Results of NMVOC Emissions from 2H2b 'Alcoholic Beverages' included into the BUR1 and NC4 of the RM under the UNFCCC, kt

	1990	1991	1992	1993	1994	1995	1996	1997	1998
BUR1	1.0413	1.0254	0.8446	1.3841	2.3360	3.5282	2.7795	2.1125	1.5661
NC4	1.2109	1.1934	1.0524	1.8074	3.0881	4.6380	3.5746	2.7530	2.1389
Difference, %	16.3	16.4	24.6	30.6	32.2	31.5	28.6	30.3	36.6
	1999	2000	2001	2002	2003	2004	2005	2006	2007
BUR1	0.8739	0.6937	0.8837	1.0485	1.6503	2.3245	2.6381	1.8979	1.6919
NC4	1.1396	0.8406	1.0877	1.3334	2.2069	3.1694	3.5807	2.3918	2.0699
Difference, %	30.4	21.2	23.1	27.2	33.7	36.3	35.7	26.0	22.3
	2008	2009	2010	2011	2012	2013	2014	2015	%
BUR1	1.4565	1.1797	1.3764	1.5970	1.9597	2.4051			
NC4	1.7245	1.3825	1.5763	1.8592	2.2435	2.6539	2.4336	2.0963	73.1
Difference, %	18.4	17.2	14.5	16.4	14.5	10.3			

Abbreviations: BUR1 – First Biennial Update Report and NC4 – Fourth National Communication.

4.8.6. Planned Improvements

Possible improvements under the 2H2 'Food and Beverages Industry' source category aim at updating/précising the activity data used to estimate NMVOC emissions within this category for 1990-2004 time periods (until 2004, Republic of Moldova used a classifier of the industrial production specific to the USSR, while the 'PRODMOLD-A' classifier was introduced only since 2004, respectively it offers detailed information on the industrial production collected through the Statistical Reports PRODMOLD-A 'Total production, as a natural expression, in the Republic, by product type' covering the 2005-2015 time series).

5. AGRICULTURE SECTOR

Agriculture sector plays a significant role in the national economy of the Republic of Moldova, contributing with 13.1 per cent to its GDP (NBS, 2016). In 2015, under the agriculture sector the plant production accounted for a relatively large share – 66.5 per cent, animal breeding – for 31.6 per cent, while the services – for circa 1.9 per cent (NBS, 2016). More than 31.7 per cent of active population is employed in this sector (NBS, 2016). The overwhelming majority of agricultural workers represent small and medium agricultural production enterprises.

On January 1, 2016 the total area of the country represented 3384.6 thousand ha, including 2499.6 thousand ha (73.9 per cent) – agricultural lands; of which 1822.9 thousand ha (53.9 per cent) – arable lands; 288.9 thousand ha (8.5 per cent) – perennial plantations; 347.1 thousand ha (10.3 per cent) – hayfields and pastures; 40.6 thousand ha (1.2 per cent) – fallow lands; 465.2 thousand ha (13.7 per cent) – forests and lands covered with forest vegetation; 96.7 thousand ha (2.9 per cent) – rivers, lakes, water basins and bogs, and 323.1 thousand ha (9.5 per cent) – other lands (NBS, 2016).

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 'Agriculture' sector in the Republic of Moldova include methane emissions from animal breeding, in particular from 3A 'Enteric Fermentation', 3B 'Manure Management', nitrous oxide emissions from 3B 'Manure Management' and 3D 'Agricultural Soils' as well as carbon dioxide emissions from 3H 'Urea Application' in managed soils.

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' were reported under 'Land Use, Land-Use Change and Forestry' sector (i.e., under the 4B 'Cropland').

A brief overview, methodological issues and data sources, key categories, uncertainties and times-series consistency, QA and QC procedures, recalculations made and planned improvements are described for each source category in this sector.

5.1.1. Summary of Emission Trends

In 2015, 'Agriculture' sector accounted for circa 15.2 per cent of total national direct GHG emissions (without LULUCF), being the second major source of GHG emissions after the 'Energy' sector. To be noted that 'Agriculture' sector was a major source of CH_4 and N_2O emissions, accounting for circa 25.3 per cent and respectively 91.4 per cent of total emissions reported at national level.

Between 1990 and 2015, the total GHG emissions originated from the 'Agriculture' sector tended to lower values, decreasing by 59.4 per cent, from 5.2106 to 2.1147 Mt (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 'Agriculture' Sector in the Republic of Moldova within 1990-2015 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	2 685.5119	2 445.5377	2 367.5139	2 149.4445	2 089.3133	1 825.3852	1 677.8577	1 436.6865	1 374.5289
N_2O	2 524.4565	2 410.8373	2 029.7671	2 073.1365	1 662.3048	1 765.1411	1 722.9511	1 743.2337	1 571.9426
Total	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
	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	1 265.6370	1 170.2811	1 190.6828	1 218.1391	1 114.4621	1 043.3273	1 012.5368	984.4359	786.9180
N_2O	1 423.5440	1 329.4855	1 481.9718	1 524.2668	1 309.8618	1 548.3781	1 563.8059	1 478.4928	897.4717
Total	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
	2008	2009	2010	2011	2012	2013	2014	2015	%
CO_2	0.8505	0.5864	1.7443	3.6752	5.5908	4.1840	10.2058	5.8323	902.2
CH_4	751.9315	787.5366	789.0144	743.6065	702.9324	711.3840	753.7058	724.9634	-73.0
N_2O	1 485.6434	1 282.1672	1 458.9670	1 456.7476	1 067.2790	1 533.4545	1 723.9607	1 383.8981	-45.2
Total	2 238.4254	2 070.2902	2 249.7258	2 204.0293	1 775.8023	2 249.0224	2 487.8723	2 114.6937	-59.4

To be noted that in 1990, CO_2, CH_4 and N_2O emissions accounted for 0.01 per cent, 51.54 per cent and respectively 48.45 per cent of total direct GHG emissions originated from the 'Agriculture' sector. By 2015, the share of CO_2 emissions increased up to 0.28 per cent, CH_4 emissions decreased to 34.28 per cent, while that of N_2O emissions increased up to 65.44 per cent.

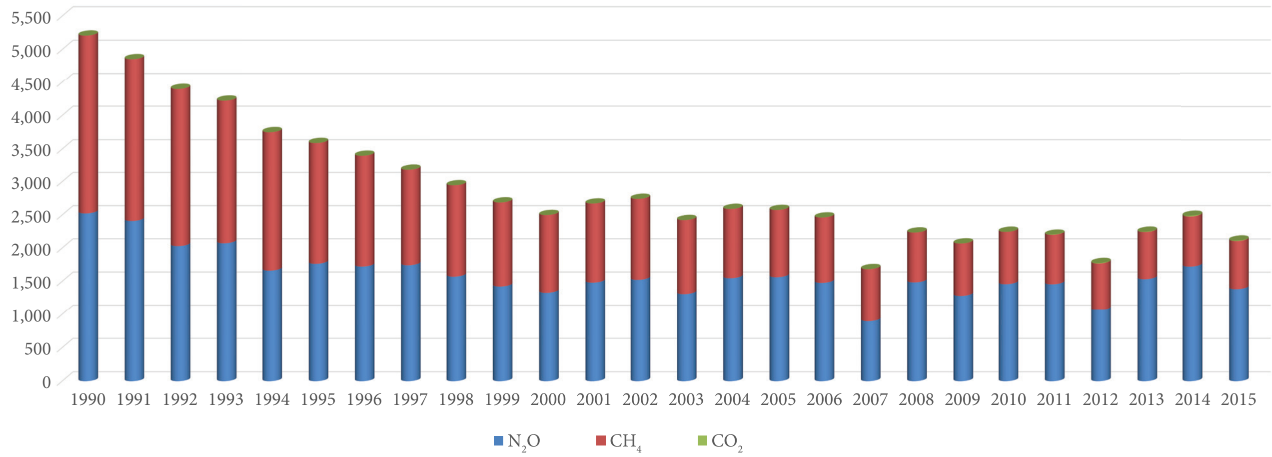


Figure 5-1: Direct GHG Emissions from 'Agriculture' sector in the Republic of Moldova within 1990-2015 periods, kt CO_2 equivalent.

Over the period under review, total direct GHG emissions from the 'Agriculture' sector decreased by 59.4 per cent, while CH_4 and N_2O emissions decreased respectively, by 73.0 per cent and 45.2 per cent (Figure 5-1, Table 5-2). At the same time, between 1990 and 2015, CO_2 emissions from urea application increased by circa 10 times.

Table 5-2: Total Direct GHG Emissions from 'Agriculture' sector by Category, within 1990-2015 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 Agriculture Sector	**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	73.0171	64.8267	59.6473	51.4038	49.9020
3B Manure Management	19.7927	16.5955	14.9221	10.9646	10.5554	8.1887	7.4670	6.0636	5.0792
Total CH_4 Emissions from Agriculture Sector	**107.4205**	**97.8215**	**94.7006**	**85.9778**	**83.5725**	**73.0154**	**67.1143**	**57.4675**	**54.9812**
3B Manure Management	3.7470	3.4991	3.1392	2.7155	2.6254	2.4251	2.5789	1.9891	1.9212
3D Agricultural Soils	4.7243	4.5909	3.6721	4.2413	2.9528	3.4982	3.2028	3.8607	3.3538
Total N_2O Emissions from Agriculture Sector	**8.4713**	**8.0901**	**6.8113**	**6.9568**	**5.5782**	**5.9233**	**5.7817**	**5.8498**	**5.2750**
	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 Agriculture Sector	**0.0034**	**0.4397**	**0.1496**	**0.0470**	**0.2381**	**0.3669**	**0.1739**	**0.1460**	**0.2631**
3A Enteric Fermentation	46.1688	43.4275	44.2135	45.1458	41.2451	38.4913	37.0747	35.8795	28.9885
3B Manure Management	4.4567	3.3837	3.4138	3.5798	3.3334	3.2418	3.4267	3.4979	2.4883
Total CH_4 Emissions from Agriculture Sector	**50.6255**	**46.8112**	**47.6273**	**48.7256**	**44.5785**	**41.7331**	**40.5015**	**39.3774**	**31.4767**
3B Manure Management	1.7380	1.5597	1.5863	1.6001	1.5214	1.4730	1.5707	1.6153	1.2329
3D Agricultural Soils	3.0390	2.9017	3.3868	3.5149	2.8741	3.7229	3.6770	3.3461	1.7788
Total N_2O Emissions from Agriculture Sector	**4.7770**	**4.4614**	**4.9731**	**5.1150**	**4.3955**	**5.1959**	**5.2477**	**4.9614**	**3.0116**

	2008	2009	2010	2011	2012	2013	2014	2015	%
3H Urea Application	0.8505	0.5864	1.7443	3.6752	5.5908	4.1840	10.2058	5.8323	902.2
Total CO_2 Emissions from Agriculture Sector	**0.8505**	**0.5864**	**1.7443**	**3.6752**	**5.5908**	**4.1840**	**10.2058**	**5.8323**	**902.2**
3A Enteric Fermentation	27.6304	28.7094	28.5047	26.8550	25.3728	25.7538	27.2645	26.1841	-70.1
3B Manure Management	2.4469	2.7921	3.0558	2.8892	2.7445	2.7015	2.8838	2.8145	-85.8
Total CH_4 Emissions from Agriculture Sector	**30.0773**	**31.5015**	**31.5606**	**29.7443**	**28.1173**	**28.4554**	**30.1482**	**28.9985**	**-73.0**
3B Manure Management	1.2103	1.3661	1.4165	1.2930	1.1839	1.1095	1.2202	1.1814	-68.5
3D Agricultural Soils	3.7751	2.9365	3.4794	3.5954	2.3976	4.0363	4.5649	3.4625	-26.7
Total N_2O Emissions from Agriculture Sector	**4.9854**	**4.3026**	**4.8959**	**4.8884**	**3.5815**	**5.1458**	**5.7851**	**4.6440**	**-45.2**

Table 5-3 allow to assert that 3D 'Agricultural Soils' was the largest source of total direct GHG emissions from the 'Agriculture' sector in the Republic of Moldova (with a share varying from a minimum of 23.5 per cent in 1994 to a maximum of 54.7 per cent in 2014), followed by 3A 'Enteric Fermentation' (with a share between a minimum of 27.4 per cent in 2014 to a maximum of 48.7 per cent in 1994), respectively the 3B 'Manure Management' (with a share between a minimum of 17.5 per cent in 2014 to a maximum of 30.9 per cent in 1990). The share of 3H 'Urea Application' in managed soils within the period under review was insignificant.

Table 5-3: Breakdown of the Republic of Moldova's 'Agriculture' Sector Total Direct GHG Emissions within 1990-2015 periods, % of the total

	1990	1991	1992	1993	1994	1995	1996	1997	1998
3A Enteric Fermentation	42.04	41.81	45.35	44.41	48.66	45.14	43.85	40.40	42.34
3B Manure Management	30.93	30.01	29.76	25.65	27.89	25.83	28.09	23.40	23.74
3D Agricultural Soils	27.02	28.17	24.88	29.93	23.45	29.03	28.06	36.17	33.92
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	42.92	43.42	41.35	41.15	42.53	37.12	35.97	36.42	43.02
3B Manure Management	23.40	21.97	20.88	20.65	22.14	20.06	21.49	23.09	25.50
3D Agricultural Soils	33.68	34.59	37.76	38.19	35.33	42.80	42.53	40.48	31.47
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	%
3A Enteric Fermentation	30.86	34.67	31.68	30.46	35.72	28.63	27.40	30.95	-26.4
3B Manure Management	18.85	23.04	22.16	20.76	23.73	17.70	17.51	19.98	-35.4
3D Agricultural Soils	50.26	42.27	46.09	48.61	40.23	53.48	54.68	48.79	80.6
3H Urea Application	0.04	0.03	0.08	0.17	0.31	0.19	0.41	0.28	2369.4

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 'Agriculture' sector.

Table 5-4: Key Categories Identified under the 'Agriculture' Sector

IPCC Category	GHG	Source Category	Key Categories
3A	CH_4	CH_4 emissions from enteric fermentation	Yes (L)
3B	CH_4	CH_4 emissions from manure management	No
3B	N_2O	Direct N_2O emissions from manure management	Yes (L)
3B	N_2O	Indirect N_2O emissions from manure management	No
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' 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 'Agriculture' Sector

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 'Agriculture' sector (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 ±22.75 per cent. The uncertainties introduced in trend in sectoral emissions were estimated at ±6.05 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 'Agriculture' sector, following a Tier 1 methodological approach. 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 'Agriculture' sector are due to the availability of an updated set of activity data (the Statistical Yearbooks of the Republic of Moldova and those of the ATULBD, other relevant publications in the field), due to précising/updating country specific EFs, as well as due to estimating for the first time within this sector CO_2 emissions from 3H 'Urea Application' category. Also, in order to convert direct GHG emissions in CO_2 equivalent, in the current inventory cycle, the 100-year Global Warming Potential (GWP_{100}) values available in the Fourth IPCC Assessment Report (AR4), in the detriment of GWP_{100} values in the Second IPCC Assessment Report (SAR).

In comparison with the results included into the BUR1 of the RM under the UNFCCC (2016), the performed recalculations resulted in increased values of direct GHG emissions within 1990-2013 periods, varying from a minimum of 2.9 per cent in 1990, up to a maximum of 11.9 per cent in 1996 (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 'Agriculture' Sector for 1990-2013, included in the BUR1 of the RM under the UNFCCC, kt CO_2 equivalent

	1990	1991	1992	1993	1994	1995	1996	1997	1998
BUR1	5 063.8990	4 690.5918	4 089.8981	3 926.8322	3 362.6793	3 284.4190	3 040.2554	2 985.2517	2 751.4456
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
Difference, %	2.9	3.5	7.5	7.5	11.6	9.3	11.9	6.6	7.1
	1999	2000	2001	2002	2003	2004	2005	2006	2007
BUR1	2 519.2156	2 289.8545	2 454.9353	2 508.5153	2 195.6150	2 379.0408	2 358.7994	2 265.5620	1 512.4009
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
Difference, %	6.7	9.2	8.9	9.3	10.4	9.0	9.2	8.7	11.4
	2008	2009	2010	2011	2012	2013	2014	2015	%
BUR1	2 100.5711	1 918.0542	2 100.6548	2 086.4947	1 639.9873	2 126.7254			
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	-59.4
Difference, %	6.6	7.9	7.1	5.6	8.3	5.8			

Abbreviations: NC4 – Fourth National Communication; BUR1 – First 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 there are no savannas and rice is not cultivated, 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 LULUCF Sector, 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 'Agriculture' Sector

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.

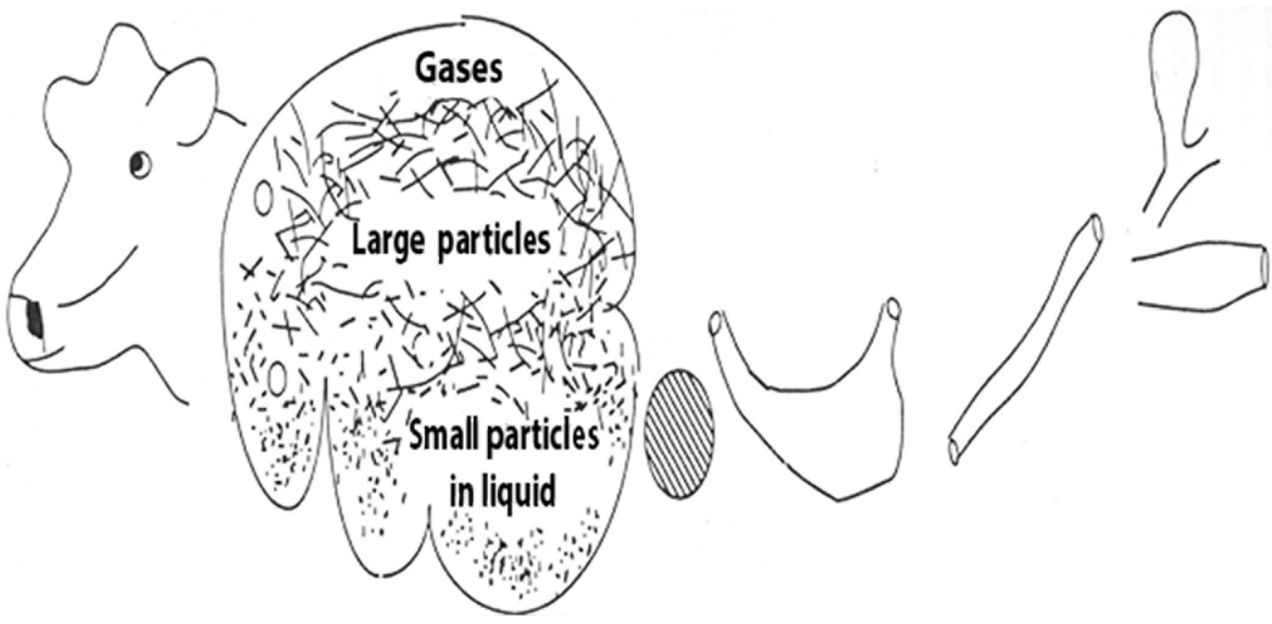
5.1.8. Planned Improvements

Planned improvements at the source categories level within the Agriculture sector 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 (Figure 5-1), which converts feedstock into high quality food products, creating daily a protein mass of up to 2.5 kg. Also in the process, due to the fermentation of nutrients, significant quantities of gases are generated, containing up to 30-40% CH_4 and 60-70% CO_2[61].



[61] „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.Hydrocloric 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 5-1: 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 5-2). 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.

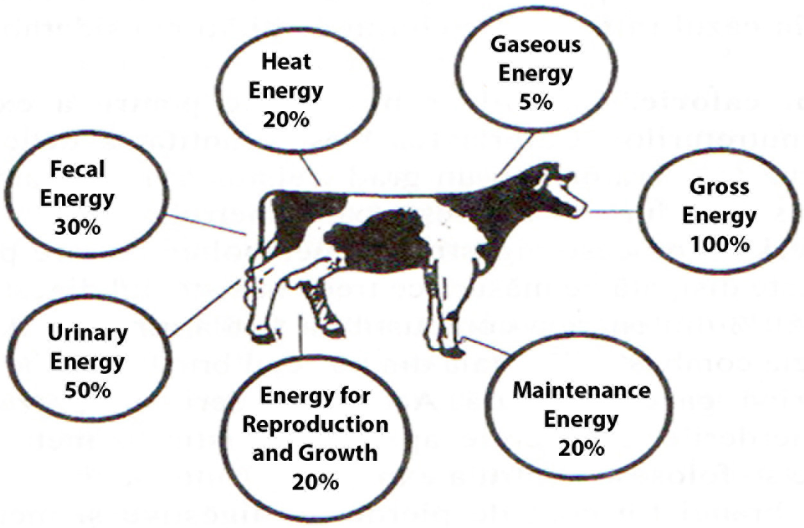


Figure 5-2: Intake Energy for Dairy Cows[62].

To be noted that ruminant livestock (cattle, sheep and goats) are major sources of methane emissions, with moderate amounts produced from non-ruminant livestock (pigs, horses and asses and mules). 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 quality and quantity of the feed intake, etc.

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:

[62] Pârvu Gh, Costea Mihaela, Pârvu M., Nicolae B. „Tratat de nutriția animalelor", București, 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	EF, kg CH_4/head/year		Comments
	WE	EE	
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 1990-2015, 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	1 362.5	1 410.4	1 328.2	1 273.7	1 139.3	1 050.5
Goats	37.1	49.5	62.9	74.7	91.5	94.7	98.7	95.9	96.7
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	1 014.6	950.1	797.5	928.0
Poultry total, including:	24 625.0	23 715.0	17 128.0	12 809.2	13 448.3	13 744.9	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	10 199.5	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	1 487.2	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	1 293.1	1 166.6	1 169.5	1 264.8
...Turkeys	889.3	871.3	820.2	714.8	749.0	765.1	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	453.6	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	180.8
...Other Cattle	175.5	146.9	153.5	149.9	131.5	110.5	106.7	104.9	72.9
Sheep and Goats total, including:	1 055.5	962.1	971.7	978.4	958.4	959.8	954.3	962.5	866.4
Sheep	953.2	850.7	857.0	849.1	834.8	838.1	832.8	848.7	765.5
Goats	102.4	111.4	114.6	129.2	123.6	121.7	121.5	113.8	100.9
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	489.2	550.1	476.4	422.3	493.0	568.3	320.8
Poultry total, including:	13 730.1	13 624.9	14 730.4	15 525.5	16 194.2	17 881.6	22 771.6	23 014.6	17 500.6
...Chickens	9 992.5	9 952.9	10 947.5	11 474.7	12 182.9	13 556.7	17 193.3	17 318.1	14 118.4
...Geese	1 581.6	1 550.6	1 589.2	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	1 367.5	1 423.3	1 461.9	1 592.6	2 394.1	2 551.0	1 435.5
...Turkeys	806.6	796.2	826.2	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	%
Cattle total, including:	238.4	243.0	236.4	224.4	210.6	208.0	210.7	204.5	-80.7
...Dairy Cows	171.8	173.2	166.1	156.0	145.5	141.6	141.4	138.2	-65.0
...Other Cattle	66.6	69.8	70.3	68.4	65.1	66.4	69.3	66.3	-90.0
Sheep and Goats total, including:	879.6	929.7	920.6	846.2	836.9	862.0	887.0	880.8	-31.3
Sheep	774.0	816.7	801.2	722.0	706.4	725.0	740.6	728.7	-41.5
Goats	105.6	112.9	119.4	124.2	130.4	137.1	146.4	152.1	310.2
Horses	57.4	56.1	53.6	50.9	47.5	46.0	42.8	40.2	-15.0
Asses and Mules	3.2	2.9	2.8	2.5	2.4	2.1	2.2	2.0	16.0
Swine	302.9	403.6	511.7	471.7	438.4	444.8	504.7	484.5	-73.8
Poultry total, including:	18 652.1	22 880.2	23 671.7	19 669.2	15 766.3	11 932.9	12 472.0	12 429.2	-49.5
...Chickens	15 285.5	18 729.6	19 338.4	16 096.5	13 121.2	10 081.3	10 390.5	10 494.2	-48.1
...Geese	1 277.2	1 497.4	1 600.2	1 351.6	1 028.5	718.7	768.0	734.0	-45.0
...Ducks	1 501.7	1 981.8	2 013.6	1 622.1	1 166.9	822.4	986.1	894.5	-58.7
...Turkeys	587.8	671.4	719.5	599.0	449.6	310.6	327.4	306.5	-65.5
Rabbits	248.5	274.5	277.0	277.4	267.0	296.2	326.1	350.2	23.7

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 1990-2015); Statistical Yearbooks of ATULBD for 1998 (page 224), 2002 (page 118), 2006 (page 109), 2010 (page 110), 2014 (page 104), 2016 (page 113).

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 1990-2015 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	%
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	7.1
Dairy Cows	405	409	420	421	427	430	450	463	-2.7
Breeding Males	480	478	480	467	474	431	591	595	2.6
Swine from all sub-categories, including:	56	56	55	57	59	54	57	54	-62.8
Female sows	141	137	141	155	167	176	170	172	-9.0
Sheep and Goats	33	35	35	35	36	38	43	41	-4.7
Horses, including:	308	302	307	304	320	326	318	316	-16.0
Female horses older than 3 years and Stallions	342	346	345	343	342	343	338	375	-13.4
Poultry of all species and ages	1.26	1.28	1.28	1.28	1.23	1.31	1.16	2.00	14.9
Average weight per head sold to population, kg:									
Cattles, including	170	209	176	137	169	200	163	285	251.9
Dairy Cows	364	423	410	394	356	408	385	387	-18.5
Swine	22	19	27	45	32	56	38	58	480.0
Sheep and Goats	30	26	29	25	26	16	25	22	10.0
Horses	290	303	269	311	257	339	333	409	154.0
Poultry of all species and ages	0.39	0.34	0.30	0.37	0.45	0.69	0.35	0.65	333.3
Average weight per head bought from population, kg:									
Cattles, including	268	265	275	280	294	307	381	319	-20.8
Dairy Cows	375	390	417	427	426	440	433	479	-9.0
Swine	38	33	34	38	33	31	32	45	-69.2
Sheep and Goats	32	32	30	30	43	45	46	45	4.4
Horses	310	265	298	312	381	347	327	400	2.3
Poultry of all species and ages	0.15	0.16	0.17	0.18	0.26	0.21	0.20	0.20	-87.6
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 1990-2015).

As for cattle[63], 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.

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 Republic of Moldova 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 Republic of Moldova is provided in Annex 3-3.

Average daily weight gain per day (WG)[64]*, g/day.* The information on daily actual weight gain reported in Republic of Moldova within 1990-2015 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 1990-2015 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**	**%**
Daily weight gain, g	Cattle	325.0	378.0	345.0	366.0	379.0	355.0	383.0	342.0	-33.6
	Swine	268.0	311.0	317.0	339.0	398.0	402.0	451.0	448.0	47.4

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 1990-2015).

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: Average Annual Milk Production per one Cow in the Republic of Moldova within1990-2015 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**	**%**
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	-1.8
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	-12.8
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	25.0

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 1990-2015).

[63] 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).
[64] 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).

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 Republic of Moldova 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). 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 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 Republic of Moldova within 1990-2015 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**	**%**
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	-1.8
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	-12.8
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	25.0

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 1990-2015).

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[65]), 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 2003-2015 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 provide 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 2015.

Table 5-15: Average Milk Production per Sheep and Goats at the Individual Farms in the Republic of Moldova within 1990-2015 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 sheet	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 sheet	20.0	20.0	20.0	24.0	26.0	21.0	32.0	30.0	33.0

[65] NBS, on-line database: < http://statbank.statistica.md/pxweb/Database/RO/16%20AGR/AGR03/AGR03.asp>.

	2008	2009	2010	2011	2012	2013	2014	2015	%
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	187.1
Total national average annual milk production per one sheet	35.0	36.0	36.0	34.6	32.7	37.1	39.0	37.0	132.7

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 1990-2015).

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 2015 between 1.5 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 1990-2015 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	%
Average annual amount of wool sheared per sheep	1.70	1.80	1.76	1.66	1.25	1.64	1.93	1.51	-34.3

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 1990-2015).

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 1990-2015 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	%
North	8.9	9.1	9.3	9.4	9.7	9.4	9.3	10.5	+10.5
Centre	10.6	10.5	11.2	11.1	11.3	11.1	10.9	12.0	+6.2
South	11.2	10.6	11.7	11.5	11.8	11.5	11.3	12.1	+6.1

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).

Percentage of females that give birth in a year (%)[66]. 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 2015.

Table 5-18: Live Products Produced by 100 Females at Publicly Owned Agricultural Enterprises in the Republic of Moldova within 1990-2015 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	%
Calves from cows	62	67	63	71	63	56	93	71	-17.4
Pigs from sows	1015	1222	1040	1136	1106	1173	1646	1399	-4.6
Lambs from sheep giving birth	81	83	73	82	89	89	126	84	-7.7

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 1990-2015).

[66] 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.*

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 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)[67]. 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 good 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 2015, 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, which is 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[68], 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.

[67] Default values available in *2006 IPCC Guidelines*, Vol. 4, Ch. 10, Table 10.2, Page 10.14.
[68] Default values available in *2006 IPCC Guidelines*, Volume 4, Chapter 10, Table 10.4, Page 10.16

$$NE_a = C_a \bullet NE_m$$

Where:

NE_a – net energy for animal (cattle) activity, MJ/day;

C_a – coefficient corresponding to animal's feeding situation[69], 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 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 1992-2015;

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[70], 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 5000 meters 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[71];

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[72].

[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, Table 10.5, Page 10.17.
[71] Default values available in *2006 IPCC Guidelines*, Volume 4, Chapter 10, Equation 10.6, Page 10.17.
[72] Default values available in *2006 IPCC Guidelines*, Volume 4, Chapter 10, Table 10.6, Page 10.18.

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;
- *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 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[73]; this inventory cycle used 2 hours of work per day regarding the 1990-1991 time period and 3 hours of work per day for 1992-2015.

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[74] 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, the NE_p requirement is similarly estimated for the 144-154-days gestation period, although the percentage varies with the number of lambs born[75].

$$NE_p = C_{pregnancy} \bullet NE_m$$

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.

[73] Default value available in *2006 IPCC Guidelines*, Volume 4, Chapter 10, Table 10A-2, Page 10.73.
[74] Default value available in *2006 IPCC Guidelines*, Volume 4, Chapter 10, Table 10A-7, Page 10.20.
[75] $C_{pregnancy}$ 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.

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.

$$REG = [1.164 – (5.160 \bullet 10^{-3} \bullet DE\%) + (1.308 \bullet 10^{-5} \bullet (DE\%)^2) – (37.4/DE\%)]$$

Where:

REG – ratio of net energy available for growth in a diet to digestible energy consumed;

DE – digestible energy expressed as a percentage of gross energy.

Gross Energy (GE). Gross energy (GE) was calculated in 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	14.2	14.7	14.7
…Mature females ≥ 1 year	15.9	15.3	15.0	15.5	15.4	15.5	15.6	16.3	16.1
…Breeding males	14.8	16.2	16.2	16.9	16.0	16.7	15.3	15.1	14.8
…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	%
Dairy cows	231.0	232.2	237.6	238.8	239.3	242.3	255.8	254.8	3.7
Other cattle (average)	121.7	120.7	121.8	123.7	124.3	122.0	124.3	120.4	1.7
…Calves and heifers up to 1 year	87.2	90.5	87.1	89.3	90.7	88.1	91.0	86.8	-13.4
…Heifers between 12 and 18 months	119.4	114.9	120.5	122.9	123.7	121.3	123.7	119.4	-8.8
…Heifers between 18 and 24 months	142.1	143.3	144.6	146.6	147.6	145.1	147.6	144.6	-7.7
…Heifers between 24 months and more	151.9	150.3	153.6	154.6	155.1	154.1	156.6	153.6	-8.2
…Breeding males	182.4	180.6	180.6	180.6	180.6	180.6	184.6	180.6	-13.1
…Work bullocks	186.6	185.2	185.2	185.2	185.2	185.2	194.1	185.6	1.7
Sheep (average)	15.5	16.2	16.2	16.0	15.8	17.1	18.2	17.3	2.6
…Mature ewes and Ewe lambs ≥ 1 year	16.2	16.9	16.8	16.7	16.7	18.3	19.5	18.6	6.5
…Breeding rams	20.7	21.3	21.2	21.2	21.2	21.2	21.2	21.2	-14.5
…Growing lambs up to 1 year	10.2	10.9	11.5	10.5	10.9	10.9	12.3	12.0	-9.5
Goats (average)	14.6	15.3	15.5	15.1	14.8	15.6	15.5	15.0	-2.9
…Mature females ≥ 1 year	16.0	16.8	17.2	16.8	16.6	18.0	17.5	17.2	3.6
…Breeding males	14.8	15.5	15.8	15.8	13.8	14.1	15.4	14.6	-11.8
…Growing kids up to 1 year	8.1	8.3	8.4	8.4	7.5	7.5	8.3	7.8	-17.9

For animal categories "other cattle"[76], "sheep" and "goats"[77] 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 Republic of Moldova within 1990-2015 periods, %

	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

[76] 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).
[77] 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%*.

	2008	2009	2010	2011	2012	2013	2014	2015	%
Other cattle, including:	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	0.0
…Calves and heifers up to 1 year	37.0	35.9	35.5	34.6	36.2	35.7	36.9	36.8	-41.0
…Heifers between 12 and 18 months	17.2	19.6	19.1	21.2	20.2	22.0	21.0	20.6	19.0
…Heifers between 18 and 24 months	25.9	25.5	26.9	26.4	25.4	24.5	24.2	25.1	186.9
…Heifers between 24 months and more	17.6	17.0	16.7	16.3	15.7	15.2	15.4	15.4	34.7
…Breeding males	1.6	1.4	1.4	0.4	0.4	0.5	0.4	0.3	48.1
…Work bullocks	0.7	0.4	0.3	1.2	2.1	2.2	2.1	1.9	6164.9
Sheep, including:	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	0.0
…Mature ewes and Ewe lambs ≥ 1 year	82.5	82.1	82.7	83.0	79.7	79.2	78.0	77.2	-2.5
…Breeding rams	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	0.0
…Growing lambs up to 1 year	14.5	14.9	14.3	14.0	17.3	17.8	19.0	19.8	11.2
Goats, including:	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	0.0
…Mature females ≥ 1 year	79.8	79.8	77.5	77.9	77.3	75.2	75.7	73.8	-7.7
…Breeding males	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	0.0
…Growing kids up to 1 year	17.2	17.2	19.5	19.1	19.7	21.8	21.3	23.2	36.4

Source: NBS, Statistical Annual Report No. 24-agr 'Animal Breeding Sector', the Number of Livestock and Poultry in all Households Categories as of 1st January (Annual Reports for 1990-2015).

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[78]: 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[79]: 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

[78] 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;
[79] Default values used for sheep and goats available in *2006 IPCC Guidelines*, Volume 4, Chapter 10, Table 10.13, Page 10.31.

	2008	2009	2010	2011	2012	2013	2014	2015	%
Dairy cows	**98.5**	**99.0**	**101.3**	**101.8**	**102.0**	**103.3**	**109.0**	**108.6**	**3.7**
Other cattle (average)	**51.9**	**51.4**	**51.9**	**52.7**	**53.0**	**52.0**	**53.0**	**51.3**	**1.7**
…Calves and heifers up to 1 year	37.2	38.6	37.1	38.1	38.7	37.6	38.8	37.0	-13.4
…Heifers between 12 and 18 months	50.9	49.0	51.4	52.4	52.8	51.7	52.8	50.9	-8.8
…Heifers between 18 and 24 months	60.6	61.1	61.7	62.5	62.9	61.9	62.9	61.7	-7.7
…Heifers between 24 months and more	64.8	64.1	65.5	65.9	66.1	65.7	66.8	65.5	-8.2
…Breeding males	77.8	77.0	77.0	77.0	77.0	77.0	78.7	77.0	-13.1
…Work bullocks	79.6	79.0	79.0	79.0	79.0	79.0	82.7	79.1	1.7

Table 5-23 features country specific emission factors calculated for sheep and goats in the Republic of Moldova. The obtained results are intermediary to default values characteristic for developing countries (5 kg CH_4/head/year for sheep and goats), and developed countries (8 kg CH_4/head/year for sheep and 5 kg CH_4/ head/year for goats) (2006 IPCC Guidelines).

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
	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**	**5.9**	**6.0**	**6.1**
…Mature females ≥ 1 year	6.8	6.5	6.4	6.6	6.6	6.6	6.7	6.9	6.9
…Breeding males	6.3	6.9	6.9	7.2	6.8	7.1	6.5	6.5	6.3
…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	%
Sheep (average), including:	**6.4**	**6.7**	**6.7**	**6.6**	**6.5**	**7.0**	**7.4**	**7.1**	**2.6**
…Mature ewes and Ewe lambs ≥ 1 year	6.9	7.2	7.2	7.1	7.1	7.8	8.3	7.9	6.5
…Breeding rams	8.8	9.1	9.1	9.1	9.1	9.1	9.1	9.1	-14.5
…Growing lambs up to 1 year	3.0	3.2	3.4	3.1	3.2	3.2	3.6	3.5	-9.5
Goats (average), including:	**6.0**	**6.3**	**6.4**	**6.2**	**6.1**	**6.4**	**6.4**	**6.1**	**-3.4**
…Mature females ≥ 1 year	6.8	7.2	7.3	7.1	7.1	7.7	7.5	7.4	3.6
…Breeding males	6.3	6.6	6.7	6.7	5.9	6.0	6.5	6.2	-11.8
…Growing kids up to 1 year	2.4	2.5	2.5	2.5	2.2	2.2	2.4	2.3	-17.9

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 1990 through 2013 time series, in particular 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); also, in order to convert methane emissions in CO_2 equivalent, in the current inventory cycle, the 100-year Global Warming Potential (GWP_{100}) values available in the Fourth IPCC Assessment Report (AR4), in the detriment of GWP_{100} values in the Second IPCC Assessment Report (SAR) (Table 5-25).

In comparison with emissions estimates included into the BUR1, the changes performed resulted in insignificant variations of methane emissions over the period 1990 through 2013 (Table 5-24).

Table 5-24: Comparative Results of CH_4 Emissions from 3A 'Enteric Fermentation' included into the BUR1 and NC4 of the Republic of Moldova under the UNFCCC, kt

	1990	1991	1992	1993	1994	1995	1996	1997	1998
BUR1	87.6290	81.2261	79.7791	75.0063	73.0080	64.8174	59.6366	51.3958	49.8940
NC4	87.6278	81.2260	79.7785	75.0132	73.0171	64.8267	59.6473	51.4038	49.9020
Difference, %	0.00	0.00	0.00	0.01	0.01	0.01	0.02	0.02	0.02
	1999	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**
BUR1	46.1613	43.4216	44.2080	45.1402	41.2406	38.4878	37.0710	35.8772	28.9864
NC4	46.1688	43.4275	44.2135	45.1458	41.2451	38.4913	37.0747	35.8795	28.9885
Difference, %	0.02	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
	2008	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**%**
BUR1	27.5975	28.7081	28.5037	26.8515	25.3644	25.7746			
NC4	27.6304	28.7094	28.5047	26.8550	25.3728	25.7538	27.2645	26.1841	-70.1
Difference, %	0.12	0.00	0.00	0.01	0.03	-0.08			

Abbreviations: NC4 – Fourth National Communication; BUR1 – First Biennial Update Report.

At the same time, at the conversion of methane emissions in CO_2 equivalent by using the 100-year Global Warming Potential (GWP_{100}= 25) values available in the Fourth IPCC Assessment Report (AR4), in the detriment of GWP_{100} values (GWP_{100}= 21) in the Second IPCC Assessment Report (SAR), resulted in an increase of the respective emissions by circa 19 per cent within 1990-2013 periods (Table 5-25).

Table 5-25: Comparative Results of CH_4 Emissions from 3A 'Enteric Fermentation' included into the BUR1 and NC4 of the Republic of Moldova under the UNFCCC, kt CO_2 equivalent

	1990	1991	1992	1993	1994	1995	1996	1997	1998
BUR1	1840.2088	1705.7475	1675.3620	1575.1314	1533.1687	1361.1650	1252.3693	1079.3113	1047.7741
NC4	2190.6944	2030.6501	1994.4621	1875.3305	1825.4271	1620.6669	1491.1824	1285.0958	1247.5501
Difference, %	19.0	19.0	19.0	19.1	19.1	19.1	19.1	19.1	19.1
	1999	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**
BUR1	969.3880	911.8544	928.3688	947.9450	866.0533	808.2438	778.4903	753.4211	608.7135
NC4	1154.2198	1085.6884	1105.3365	1128.6451	1031.1265	962.2832	926.8686	896.9885	724.7117
Difference, %	19.1	19.1	19.1	19.1	19.1	19.1	19.1	19.1	19.1
	2008	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**%**
BUR1	579.5471	602.8698	598.5781	563.8807	532.6520	541.2669			
NC4	690.7592	717.7349	712.6183	671.3756	634.3201	643.8453	681.6116	654.6016	-70.1
Difference, %	19.2	19.1	19.1	19.1	19.1	19.0			

Abbreviations: NC4 – Fourth National Communication; BUR1 – First Biennial Update Report.

For the period 2014-2015, methane emissions resulting from enteric fermentation were estimated for the first time. The results allow assert that within the 1990-2015 time series methane emissions from

3A 'Enteric Fermentation' decreased by 70.1 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 2015, 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 1990-2015 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	13.9	13.1
Goats	0.3	0.4	0.5	0.6	0.8	0.9	1.0	1.1	1.1
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	2.3	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	62.6	63.0	63.0	62.7	61.6	60.3	61.2
Other cattle	20.0	18.6	18.4	18.0	17.2	16.1	15.9	16.2	13.7
Sheep	12.9	12.2	12.2	11.8	12.4	13.7	14.6	15.0	16.9
Goats	1.3	1.5	1.5	1.7	1.7	1.9	1.9	1.9	2.1
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	%
Dairy cows	61.2	59.7	59.0	59.2	58.5	56.8	56.5	57.3	21.3
Other cattle	12.5	12.5	12.8	13.4	13.6	13.4	13.5	13.0	-66.1
Sheep	17.9	19.0	18.8	17.8	18.1	19.8	20.2	19.7	101.1
Goats	2.3	2.5	2.7	2.9	3.1	3.4	3.4	3.6	1225.4
Horses	3.7	3.5	3.4	3.4	3.4	3.2	2.8	2.8	184.4
Asses and mules	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	288.3
Swine	1.6	2.1	2.7	2.6	2.6	2.6	2.8	2.8	-12.4
Rabbits	0.5	0.6	0.6	0.6	0.6	0.7	0.7	0.8	314.1

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 5.6 per cent in 2014 and a maximum of 18.5 per cent in 1999 (Table 5-27).

Table 5-27: Comparative Results of CH_4 Emissions from 3A 'Enteric Fermentation', 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	88.4704	86.1089	78.3136	71.5573	62.8607	61.1013
Tier 2, kt	87.6278	81.2260	79.7785	75.0132	73.0171	64.8267	59.6473	51.4038	49.9020
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	56.6145	52.9031	53.6467	54.1066	49.6222	44.9235	42.8624	41.6409	33.6936
Tier 2, kt	46.1688	43.4275	44.2135	45.1458	41.2451	38.4913	37.0747	35.8795	28.9885
Difference, %	-18.5	-17.9	-17.6	-16.6	-16.9	-14.3	-13.5	-13.8	-14.0
	2008	2009	2010	2011	2012	2013	2014	2015	%
Tier 1, kt	32.2825	33.1470	32.3666	30.3626	28.7282	28.5304	28.8885	28.2118	-71.2
Tier 2, kt	27.6304	28.7094	28.5047	26.8550	25.3728	25.7538	27.2645	26.1841	-70.1
Difference, %	-14.4	-13.4	-11.9	-11.6	-11.7	-9.7	-5.6	-7.2	

5.2.6. Planned Improvements

Planned improvements could include précising 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'.

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 great 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. On the national level, manure production depends on the number of livestock and poultry, and, in particular, on average amount of waste produced per animal, per year. The share of manure that decomposes anaerobically depends on how the manure is managed – collected, stored and used. 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 less CH_4 is produced.

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 source 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 1990-2015 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	1.98	2.00	2.01	2.23	2.35	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	2.26
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**	**%**
Dairy cows	4.01	4.03	4.13	4.15	4.15	4.21	4.44	4.42	6.6
Other cattle	2.10	2.08	2.10	2.13	2.14	2.10	2.14	2.08	4.8
Market swine	0.41	0.40	0.41	0.45	0.48	0.51	0.49	0.50	-9.0
Fattening swine	0.26	0.25	0.26	0.28	0.30	0.32	0.31	0.31	-9.0

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 [80] (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 1990-2014 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).

[80] 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).

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
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 Methane Conversion Factor 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	< 1 month	3
	> 1 month	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
Dairy cows	3	0	42	24.7	24.7	5.7
Other cattle	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 CH4 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 CH4 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 1989-2015 periods

Animal categories (T) and Management systems (S)	1989 / 1990	1991 / 1992	1993 / 1994	1995 / 1997	1998 / 1999	2000 / 2001	2002 / 2003	2004 / 2005	2006 / 2007	2008 / 2009	2010 / 2011	2012 / 2013	2014 /2015
	$MS_{(T,S)}$ 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**	**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	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	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	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**	**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	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	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	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**	**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	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	63.0

Animal categories (T) and Management systems (S)	1989 / 1990	1991 / 1992	1993 / 1994	1995 / 1997	1998 / 1999	2000 / 2001	2002 / 2003	2004 / 2005	2006 / 2007	2008 / 2009	2010 / 2011	2012 / 2013	2014 /2015
	$MS_{(T,S)}$ values												
Sheep and Goats	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**
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	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	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**	**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	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	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**	**100.0**
Solid Storage	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Poultry	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**
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	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	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 1990-2015 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 1990-2015 periods, % of the total

	1990	1991	1992	1993	1994	1995	1996	1997	1998
	Agricultural enterprises								
Cattles	81.8	77.2	71.3	69.7	59.8	43.8	37.0	26.8	20.9
Cows	74.9	69.5	62.0	57.3	46.9	33.0	26.6	18.6	14.3
Other Cattles	85.9	82.3	78.0	80.4	72.1	56.0	50.2	39.2	31.1
Swine	81.0	77.5	71.0	70.8	61.3	55.2	52.1	40.2	36.9
Sheep and Goats	35.9	31.3	27.3	21.7	17.7	14.6	11.7	9.4	8.1
Sheep	36.9	32.6	28.7	21.5	17.6	15.6	12.6	10.2	8.9
Goats	1.4	1.0	0.8	0.7	0.6	0.5	0.5	0.5	0.5
Horses	85.1	77.1	66.7	53.8	46.4	42.1	35.6	27.9	21.9
Poultry	53.5	51.9	36.4	21.9	20.5	19.4	16.9	14.9	12.9
	Individual farms								
Cattles	18.1	22.9	28.8	41.1	49.3	56.4	63.0	73.4	79.1
Cows	25.1	30.5	38.0	50.1	59.9	66.7	73.4	81.4	85.7
Other Cattles	14.0	17.9	22.2	33.3	39.1	44.7	49.8	61.3	68.9
Swine	19.0	22.5	29.0	39.9	46.1	44.9	47.9	59.8	63.3
Sheep and Goats	64.1	68.7	72.6	79.6	83.4	85.4	88.3	90.5	91.8
Sheep	63.1	67.5	71.3	78.5	82.4	84.4	87.4	89.8	91.1
Goats	98.6	99.0	99.2	99.3	99.4	99.5	99.5	99.5	99.5
Horses	14.9	25.0	35.3	48.1	55.4	57.9	64.4	70.5	78.1
Poultry	46.5	48.1	63.6	92.6	93.5	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	6.5
Cows	8.4	5.6	5.1	4.3	3.9	3.5	3.7	3.4	3.6
Other Cattles	21.6	17.6	13.5	15.3	12.8	12.0	12.8	13.0	14.3
Swine	19.6	9.2	11.1	14.6	9.2	8.5	10.0	12.6	20.7
Sheep and Goats	5.9	4.9	5.0	5.0	4.6	4.0	4.1	3.8	3.6
Sheep	6.6	5.7	5.5	5.7	5.1	4.6	4.5	4.3	4.1
Goats	0.5	0.5	0.4	0.4	0.4	0.4	0.4	0.4	0.5
Horses	11.9	8.5	6.5	6.4	5.1	4.1	4.3	3.0	3.4
Poultry	9.8	9.6	12.6	10.9	9.5	11.3	11.7	11.3	13.0
	Individual farms								
Cattles	87.0	90.6	92.1	92.2	93.3	94.0	93.2	93.6	93.1
Cows	91.6	94.4	94.9	95.7	96.5	96.5	96.3	96.6	96.4
Other Cattles	78.4	82.4	86.5	84.7	86.3	88.0	86.2	87.0	84.1
Swine	80.4	90.8	88.9	85.4	90.8	91.5	90.0	87.4	79.3
Sheep and Goats	94.0	94.9	95.1	94.9	95.5	95.9	96.0	96.1	96.3
Sheep	93.4	94.3	94.5	94.2	94.9	95.4	95.5	95.7	95.9
Goats	99.5	99.5	99.6	99.6	99.6	99.6	99.6	99.6	99.5
Horses	88.1	91.5	93.5	93.6	94.9	95.9	95.7	97.0	96.6
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	%
	Agricultural enterprises								
Cattles	6.0	5.9	5.6	5.9	5.8	6.9	7.3	8.1	-90.1
Cows	3.1	3.1	2.9	3.1	3.4	4.6	4.6	4.7	-93.7
Other Cattles	13.8	13.1	12.3	12.7	11.4	12.1	13.1	15.5	-81.9
Swine	23.2	24.9	29.0	27.6	34.4	37.9	41.6	41.1	-49.3
Sheep and Goats	2.9	2.4	2.2	2.4	2.2	2.4	2.7	3.1	-91.3
Sheep	3.3	2.7	2.5	2.8	2.4	2.7	3.2	3.6	-90.2
Goats	0.5	0.5	0.4	0.4	0.4	0.4	0.3	0.3	-75.5
Horses	3.6	1.9	1.9	2.0	2.2	2.2	2.4	1.3	-98.5
Poultry	17.4	14.9	13.8	14.7	22.4	30.3	29.6	33.4	-37.5
	Individual farms								
Cattles	93.6	93.7	94.4	94.1	94.2	93.1	93.2	91.9	408.0
Cows	97.0	96.9	97.7	97.2	97.0	95.4	96.2	95.3	280.3
Other Cattles	84.1	85.2	86.5	86.7	87.7	87.9	86.9	84.5	505.0
Swine	76.8	75.1	70.8	72.4	65.4	62.1	58.4	58.9	209.8
Sheep and Goats	97.0	97.3	97.7	97.6	97.8	97.6	97.3	96.8	51.1
Sheep	96.7	97.0	97.5	97.2	97.6	97.4	96.8	96.2	52.6
Goats	99.5	99.5	99.6	99.6	99.6	99.6	99.7	99.7	1.0
Horses	96.4	98.1	98.1	98.0	97.8	97.8	97.6	98.7	562.8
Poultry	83.0	85.4	86.2	85.3	77.6	69.7	70.4	66.6	43.0

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 Methane EFs 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	4.8	4.9	4.2	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	%
Dairy cows	4.7	4.7	4.8	4.8	4.8	4.9	5.2	5.1	-61.9
Other cattle (average)	2.3	2.3	2.3	2.4	2.4	2.3	2.4	2.3	-60.2
Swine (average)	2.2	2.1	2.2	2.4	2.7	2.8	2.7	2.8	-46.1
Market swine	3.2	3.2	3.2	3.6	4.0	4.2	4.1	4.1	-46.9
Fattening piglets	2.0	2.0	2.0	2.2	2.5	2.7	2.6	2.6	-46.9

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 1990-2015 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	%
Swine, total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	0.0
…Market swine	13.0	12.9	12.1	12.2	11.0	10.6	10.8	11.4	35.7
…Piglets over 4 months	60.7	65.8	64.9	64.5	65.0	57.6	62.1	54.1	630.5
...Other swine	26.2	21.3	23.0	23.2	23.9	31.8	27.1	34.5	-59.0

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 1990-2015).

5.3.1.3. Uncertainties Assessment and Time-Series Consistency

Uncertainties related to estimation of methane emissions from 3B 'Manure Management' source 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' were recalculated for the 1990 through 2013 time series, in particular due to use of an updated set of values for gross energy (GE) received daily (MJ/day), the most significant changes regard the swine category (it was taken into consideration the dynamic of certain productivity indicators such as the average weight per head at the end of the year and the average daily weight gain per day. Also, the respective emissions were recalculated due to updating the daily ratio of volatile solid excretion on a dry-organic matter basis (kg dm/day); Recalculations were also done due to updating the share of manure management systems for the entire period under review (1990-2015) as a result of 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; 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 (in total, manure management systems from 179 farms were inspected, of which 96 cattle farms, 66 pig farms and 17 poultry farms). As a consequence of the above, the EFs calculated for cattle and swine according to a Tier 2 methodology were updated for 1990-2015 time series.

In comparison with emissions estimates included into the BUR1, the changes performed resulted in increased CH_4 emissions from 3B 'Manure Management' over the 1990-1997 and 2004-2013 periods, with a variation from a minimum increase of 3.4 per cent in 2012 to a maximum of 34.6 per cent in 1990; at the same time, between 1998 and 2003, was recorded a decrease within the respective category, varying from a minimum decrease of 0.6 per cent in 2002-2003 up to a maximum decrease of 6.8 per cent in 2001 (Table 5-39).

Table 5-39: Comparative Results of CH_4 Emissions from 3B 'Manure Management' included into the BUR1 and the NC4 of the Republic of Moldova under the UNFCCC, kt

	1990	1991	1992	1993	1994	1995	1996	1997	1998
BUR1	14.7018	13.0828	11.8291	9.3011	9.0365	7.1870	6.5425	5.3695	5.1130
NC4	19.7927	16.5955	14.9221	10.9646	10.5554	8.1887	7.4670	6.0636	5.0792
Difference, %	34.6	26.8	26.1	17.9	16.8	13.9	14.1	12.9	-0.7
	1999	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**
BUR1	4.5368	3.6273	3.6623	3.6021	3.3528	3.0717	3.2388	3.2826	2.3788
NC4	4.4567	3.3837	3.4138	3.5798	3.3334	3.2418	3.4267	3.4979	2.4883
Difference, %	-1.8	-6.7	-6.8	-0.6	-0.6	5.5	5.80	6.6	4.6
	2008	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**%**
BUR1	2.3492	2.6620	2.8774	2.7032	2.6531	2.5936			
NC4	2.4469	2.7921	3.0558	2.8892	2.7445	2.7015	2.8838	2.8145	-85.8
Difference, %	4.2	4.9	6.2	6.9	3.4	4.2			

Abbreviations: NC4 – Fourth National Communication; BUR1 – First Biennial Update Report.

At the same time, at the conversion of methane emissions in CO_2 equivalent by using the 100-year Global Warming Potential (GWP_{100}= 25) values available in the Fourth IPCC Assessment Report (AR4), in the detriment of GWP_{100} values (GWP_{100}= 21) in the Second IPCC Assessment Report (SAR), resulted in an increase of the respective emissions within 1990-2013 periods, varying from a minimum increase by circa 11.0 per cent in 2001 to a maximum increase of 60.3 per cent in 1990 (Table 5-40).

Table 5-40: Comparative Results of CH_4 Emissions from 3B 'Manure Management' included into the BUR1 and the NC4 of the Republic of Moldova under the UNFCCC, kt CO_2 equivalent

	1990	1991	1992	1993	1994	1995	1996	1997	1998
BUR1	308.7371	274.7391	248.4104	195.3236	189.7661	150.9266	137.3921	112.7600	107.3734
NC4	494.8175	414.8876	373.0518	274.1139	263.8862	204.7183	186.6754	151.5907	126.9789
Difference, %	60.3	51.0	50.2	40.3	39.1	35.6	35.9	34.4	18.3
	1999	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**
BUR1	95.2729	76.1730	76.9080	75.6448	70.4090	64.5052	68.0152	68.9346	49.9546
NC4	111.4172	84.5927	85.3462	89.4941	83.3355	81.0440	85.6682	87.4474	62.2063
Difference, %	16.9	11.1	11.0	18.3	18.4	25.6	26.0	26.9	24.5
	2008	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**%**
BUR1	49.3327	55.9030	60.4258	56.7680	55.7152	54.4662			
NC4	61.1723	69.8017	76.3961	72.2309	68.6123	67.5387	72.0942	70.3618	-85.8
Difference, %	24.0	24.9	26.4	27.2	23.1	24.0			

Abbreviations: NC4 – Fourth National Communication; BUR1 – First Biennial Update Report.

For the 2014-2015 time periods, methane emissions resulting from manure management were estimated for the first time. The obtained results allow assert that within the 1990-2015 time series methane emissions from 3B 'Manure Management' category decreased by 85.8 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). To be noted that over the period under review the share of different animals in the structure of methane emissions from the 3B 'Manure Management' category has changed significantly. By 2015, the share of such livestock categories as 'cattle' and 'swine' decreased in comparison to 1990, while the share of categories like 'sheep', 'goats', 'horses', 'asses and mules', 'rabbits' and 'poultry') increased considerably (Table 5-41).

Table 5-41: Breakdown of the Methane Emissions from 3B 'Manure Management' by Livestock and Poultry Category within 1990-2015 periods, %

	1990	1991	1992	1993	1994	1995	1996	1997	1998
Cattle	46.5	45.0	49.2	50.2	51.6	44.8	44.8	46.4	41.2
Sheep	1.2	1.4	1.6	2.4	2.5	3.1	3.2	3.6	3.9
Goats	0.0	0.0	0.1	0.1	0.1	0.2	0.2	0.2	0.2
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	48.0	48.6	44.8	43.0	41.2	45.9	45.4	41.9	44.7
Poultry	3.8	4.4	3.6	3.4	3.5	4.6	4.8	6.0	7.5
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	43.8	48.8	49.2	47.9	46.5	46.3	41.5	37.8	42.1
Sheep	4.1	4.8	4.8	4.5	4.8	4.9	4.6	4.6	5.8
Goats	0.3	0.4	0.4	0.5	0.5	0.5	0.5	0.4	0.5
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	40.1	29.9	28.4	30.0	29.2	27.1	29.4	33.5	25.9
Poultry	8.9	12.1	13.0	13.0	14.6	16.8	20.0	19.7	21.0
Rabbits	0.3	0.4	0.4	0.4	0.5	0.6	0.7	0.7	0.8
	2008	2009	2010	2011	2012	2013	2014	2015	%
Cattle	39.1	34.9	31.4	31.7	31.3	31.4	31.0	30.7	-34.0
Sheep	6.0	5.6	5.0	4.7	4.9	5.1	4.9	4.9	311.7
Goats	0.6	0.5	0.5	0.6	0.6	0.7	0.7	0.7	2784.4
Horses	3.7	3.1	2.7	2.7	2.7	2.7	2.3	2.2	497.6
Asses and mules	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	715.9
Swine	27.2	30.9	36.6	39.3	42.8	46.4	47.7	47.7	-0.7
Poultry	22.5	24.2	22.9	20.2	16.8	12.8	12.4	12.8	233.5
Rabbits	0.8	0.8	0.7	0.8	0.8	0.9	0.9	1.0	770.2

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 1993-2015 periods, varying between a minimum of 3.0 per cent in 1993 to a maximum of 47.1 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.

Table 5-42: Comparative Results of CH_4 Emissions from 3B ‘Manure Management’, 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	11.2987	10.9066	10.0799	9.2352	8.0218	8.2861
Tier 2, kt	19.7927	16.5955	14.9221	10.9646	10.5554	8.1887	7.4670	6.0636	5.0792
Difference, %	32.1	15.9	13.1	-3.0	-3.2	-18.8	-19.1	-24.4	-38.7
	1999	2000	2001	2002	2003	2004	2005	2006	2007
Tier 1, kt	7.4022	6.3633	6.4559	6.6944	6.0798	5.5297	5.6799	5.7801	4.1864
Tier 2, kt	4.4567	3.3837	3.4138	3.5798	3.3334	3.2418	3.4267	3.4979	2.4883
Difference, %	-39.8	-46.8	-47.1	-46.5	-45.2	-41.4	-39.7	-39.5	-40.6
	2008	2009	2010	2011	2012	2013	2014	2015	%
Tier 1, kt	4.0223	4.4918	4.7591	4.3811	4.0166	3.8893	4.0972	3.9805	-73.4
Tier 2, kt	2.4469	2.7921	3.0558	2.8892	2.7445	2.7015	2.8838	2.8145	-85.8
Difference, %	-39.2	-37.8	-35.8	-34.1	-31.7	-30.5	-29.6	-29.3	-191.3

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.

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’, 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 précising the values for the main parameters used to develop CS EFs for respective animal categories following a Tier 2 method; and also there are planned activities focused on regular updating (every 3-5 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[81] 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 (2006 IPCC Guidelines, Volume 4, Chapter 10, Equation 10.25):

$$N_2O_{D(mm)} = [\sum_{(S)} [\sum_{(T)} (N_{(T)} \bullet Nex_{(T)} \bullet MS_{(T,S)})] \bullet FE_{3(S)}] \bullet 44/28$$

[81] Leaching – the loss of mineral and organic solutes due to water or other liquids percolation from soil.

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*);

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, draft power 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).

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).

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.

Applying the above methodological approach, the implicitly used values for the N excretion rate characteristic to EE, 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 1990-2015 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	%
Dairy cows	55.5	55.8	56.9	57.0	57.8	57.9	60.0	61.3	-2.1
Other cattle	42.1	42.3	42.6	46.3	45.9	44.8	48.9	49.3	-9.3
Sheep	10.8	11.3	11.3	11.3	11.7	12.2	13.7	13.1	-4.3
Goats	12.8	13.6	13.6	13.6	14.1	14.9	17.0	16.1	-5.0
Horses	45.5	44.8	45.3	45.0	46.7	47.2	46.4	46.2	-14.2
Asses and mules	17.6	17.3	17.5	17.7	17.9	18.1	17.7	17.5	-9.5
Swine	12.6	12.6	12.4	12.8	13.2	12.2	12.8	12.2	-40.6
Rabbits	6.2	6.2	6.3	6.2	6.0	6.0	6.2	6.2	-1.7
Chicken	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	-5.0
Geese	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	-3.0
Ducks	0.7	0.7	0.7	0.7	0.6	0.6	0.7	0.7	-3.2
Turkeys	1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.4	-1.6

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.

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.

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.

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

Manure Management System		EF$_3$, kg N_2O-N / kg N excreted	Uncertainty ranges of EF$_3$	Source of reference
Aerobic treatment: The biological oxidation of manure collected as a liquid with either forced or natural aeration. Natural aeration is limited to aerobic and facultative ponds and wetland systems and is due primarily to photosynthesis. Hence, these systems typically become anoxic during periods without sunlight. Nitrification-denitrification is used widely for the removal of nitrogen in the biological treatment of municipal and industrial wastewaters with negligible N_2O emissions. Limited oxidation may increase emissions compared to forced aeration systems.	Natural aeration systems	0.010	Factor of 2	2006 IPCC Guidelines, Table 10.21
	Forced aeration systems	0.005	Factor of 2	

A significant share of the total amount of nitrogen excreted by livestock in different manure management systems (except pasture, range and paddock), is lost before being applied to 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.

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.

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.

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 (-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' source category were recalculated for 1990-2013 time series, in particular due to updating the share of manure management systems for the entire period under review (1990-2015) as a result of 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.

In comparison with emission estimates included into the BUR1, the changes performed resulted in decreased N_2O emissions from 3B 'Manure Management' between 1990 and 2013, with a variation from a minimum decrease of 3.0 per cent in 2001, up to a maximum decrease by 15.9 per cent in 1990 (Table 5-49).

Table 5-49: Comparative Results of $N_2O_{TOTAL(mm)}$ Emissions from 3B 'Manure Management' included into the BUR1 and the NC4 of the RM under the UNFCCC, kt

	1990	1991	1992	1993	1994	1995	1996	1997	1998
BUR1	4.4577	4.0464	3.5193	2.9555	2.8481	2.7252	2.6624	2.2291	2.0630
NC4	3.7470	3.4991	3.1392	2.7155	2.6254	2.4251	2.5789	1.9891	1.9212
Difference, %	-15.9	-13.5	-10.8	-8.1	-7.8	-11.0	-3.1	-10.8	-6.9
	1999	2000	2001	2002	2003	2004	2005	2006	2007
BUR1	1.8491	1.6121	1.6352	1.6709	1.5941	1.5693	1.7119	1.7802	1.3455
NC4	1.7380	1.5597	1.5863	1.6001	1.5214	1.4730	1.5707	1.6153	1.2329
Difference, %	-6.0	-3.3	-3.0	-4.2	-4.6	-6.1	-8.2	-9.3	-8.4
	2008	2009	2010	2011	2012	2013	2014	2015	%
BUR1	1.3457	1.5352	1.6089	1.5356	1.3743	1.2761			
NC4	1.2103	1.3661	1.4165	1.2930	1.1839	1.1095	1.2202	1.1814	-68.5
Difference, %	-10.1	-11.0	-12.0	-15.8	-13.9	-13.1			

Abbreviations: NC4 – Fourth National Communication; BUR1 – First Biennial Update Report.

At the same time, at the conversion of N_2O emissions in CO_2 equivalent by using the 100-year Global Warming Potential (GWP_{100}= 298) values available in the Fourth IPCC Assessment Report (AR4), in the detriment of GWP_{100} values (GWP_{100}= 310) in the Second IPCC Assessment Report (SAR), resulted in a decrease of the respective emissions within 1990-2013 periods, varying from a minimum decrease by circa 6.7 per cent in 2001 to a maximum decrease of 19.2 per cent in 1990 (Table 5-50).

For the 2014-2015 time periods, total N_2O emissions resulting from manure management were estimated for the first time. The obtained results allow assert that within the 1990-2015 time series total N_2O emissions from 3B 'Manure Management' source category decreased by 68.5 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).

Table 5-50: Comparative Results of $N_2O_{TOTAL(mm)}$ Emissions from 3B 'Manure Management' included into the BUR1 and the NC4 of the RM under the UNFCCC, kt CO_2 equivalent

	1990	1991	1992	1993	1994	1995	1996	1997	1998
BUR1	1 381.8884	1 254.3833	1 090.9915	916.2133	882.9197	844.8044	825.3394	691.0307	639.5275
NC4	1 116.6179	1 042.7426	935.4783	809.2207	782.3676	722.6727	768.5050	592.7501	572.5096
Difference, %	-19.2	-16.9	-14.3	-11.7	-11.4	-14.5	-6.9	-14.2	-10.5
	1999	2000	2001	2002	2003	2004	2005	2006	2007
BUR1	573.2198	499.7511	506.9151	517.9941	494.1718	486.4806	530.6779	551.8690	417.1151
NC4	517.9332	464.7815	472.7172	476.8327	453.3829	438.9507	468.0568	481.3605	367.3939
Difference, %	-9.6	-7.0	-6.7	-7.9	-8.3	-9.8	-11.8	-12.8	-11.9
	2008	2009	2010	2011	2012	2013	2014	2015	%
BUR1	417.1664	475.9122	498.7540	476.0285	426.0403	395.6009			
NC4	360.6617	407.0993	422.1117	385.3168	352.8017	330.6386	363.6188	352.0708	-68.5
Difference, %	-13.5	-14.5	-15.4	-19.1	-17.2	-16.4			

Abbreviations: NC4 – Fourth National Communication; BUR1 – First Biennial Update Report.

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 BUR1. For the period 2014-2015, direct $N_2O_{D(mm)}$ and indirect $N_2O_{IND(mm)}$ emissions resulting from manure management were estimated for the first time. The obtained results allow assert that within the 1990-2015 time series direct $N_2O_{D(mm)}$ emissions decreased by 66.5 per cent, while indirect $N_2O_{IND(mm)}$ emissions decreased by 75.5 per cent.

Table 5-51: Comparative Results of Direct $N_2O_{D(mm)}$ Emissions from 3B 'Manure Management' included into the BUR1 and the NC4 of the RM under the UNFCCC, kt

	1990	1991	1992	1993	1994	1995	1996	1997	1998
BUR1	3.6011	3.2827	2.8659	2.4284	2.3436	2.2452	2.1906	1.8360	1.7051
NC4	2.9259	2.7696	2.5012	2.2016	2.1339	1.9768	2.1080	1.6217	1.5828
Difference, %	-18.8	-15.6	-12.7	-9.3	-8.9	-12.0	-3.8	-11.7	-7.2
	1999	2000	2001	2002	2003	2004	2005	2006	2007
BUR1	1.5302	1.3404	1.3589	1.3900	1.3258	1.3047	1.4184	1.4747	1.1170
NC4	1.4359	1.2988	1.3208	1.3313	1.2659	1.2239	1.3011	1.3367	1.0241
Difference, %	-6.2	-3.1	-2.8	-4.2	-4.5	-6.2	-8.3	-9.4	-8.3
	2008	2009	2010	2011	2012	2013	2014	2015	%
BUR1	1.1156	1.2703	1.3292	1.2685	1.1371	1.0602			
NC4	1.0038	1.1301	1.1688	1.0676	0.9786	0.9202	1.0114	0.9799	-66.5
Difference, %	-10.0	-11.0	-12.1	-15.8	-13.9	-13.2			

Abbreviations: NC4 – Fourth National Communication; BUR1 – First Biennial Update Report.

Table 5-52: Comparative Results of Indirect $N_2O_{IND(mm)}$ Emissions from 3B 'Manure Management' included into the BUR1 and the NC4 of the RM under the UNFCCC, kt

	1990	1991	1992	1993	1994	1995	1996	1997	1998
BUR1	0.8566	0.7637	0.6535	0.5271	0.5045	0.4800	0.4718	0.3931	0.3579
NC4	0.8212	0.7295	0.6380	0.5139	0.4915	0.4483	0.4709	0.3674	0.3384
Difference, %	-4.1	-4.5	-2.4	-2.5	-2.6	-6.6	-0.2	-6.5	-5.5
	1999	2000	2001	2002	2003	2004	2005	2006	2007
BUR1	0.3189	0.2717	0.2763	0.2809	0.2683	0.2646	0.2934	0.3055	0.2286
NC4	0.3021	0.2609	0.2655	0.2688	0.2555	0.2491	0.2696	0.2786	0.2088
Difference, %	-5.3	-4.0	-3.9	-4.3	-4.8	-5.9	-8.1	-8.8	-8.7
	2008	2009	2010	2011	2012	2013	2014	2015	%
BUR1	0.2301	0.2649	0.2797	0.2671	0.2372	0.2160			
NC4	0.2065	0.2360	0.2477	0.2254	0.2053	0.1893	0.2088	0.2015	-75.5
Difference, %	-10.3	-10.9	-11.4	-15.6	-13.5	-12.3			

Abbreviations: NC4 – Fourth National Communication; BUR1 – First Biennial Update Report.

To be noted that indirect $N_2O_{G(mm)}$ emissions from volatilization of ammonia (NH_3) and nitrogen oxides (NO_x) decreased by 77.1%, within this period, while $N_2O_{L(mm)}$ emissions from leaching and runoff of nitrogen have decreased by 62.5% (Table 5-53). This evolution was possible due to the 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 5-53: Indirect N_2O Emissions from Volatilization of Ammonia and Nitrogen Oxides, as well as from Leaching and Runoff of Nitrogen, under 3B 'Manure Management' within 1990-2015 periods, kt

	1990	1991	1992	1993	1994	1995	1996	1997	1998
Indirect $N_2O_{(G)}$	0.7311	0.6427	0.5581	0.4409	0.4203	0.3827	0.4008	0.3135	0.2853
Indirect $N_2O_{(L)}$	0.0901	0.0868	0.0798	0.0730	0.0712	0.0656	0.0700	0.0539	0.0531
$N_2O_{IND(mm)}$	0.8212	0.7295	0.6380	0.5139	0.4915	0.4483	0.4709	0.3674	0.3384
	1999	2000	2001	2002	2003	2004	2005	2006	2007
Indirect $N_2O_{(G)}$	0.2531	0.2152	0.2188	0.2220	0.2108	0.2058	0.2237	0.2319	0.1723
Indirect $N_2O_{(L)}$	0.0491	0.0457	0.0466	0.0468	0.0447	0.0433	0.0459	0.0467	0.0365
$N_2O_{IND(mm)}$	0.3021	0.2609	0.2655	0.2688	0.2555	0.2491	0.2696	0.2786	0.2088
	2008	2009	2010	2011	2012	2013	2014	2015	%
Indirect $N_2O_{(G)}$	0.1708	0.1962	0.2071	0.1884	0.1715	0.1575	0.1741	0.1677	-77.1
Indirect $N_2O_{(L)}$	0.0357	0.0398	0.0407	0.0370	0.0338	0.0318	0.0347	0.0338	-62.5
$N_2O_{IND(mm)}$	0.2065	0.2360	0.2477	0.2254	0.2053	0.1893	0.2088	0.2015	-75.5

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 1990-2015 periods, kt N

	1990	1991	1992	1993	1994	1995	1996	1997	1998
$Nex_{(T)}$	135.1713	123.4886	110.3797	94.7337	91.5005	84.2100	87.8787	68.8439	65.2723
N_{MMS_Avb}	85.3474	77.5640	70.2188	59.5936	57.6414	52.3527	54.4732	42.8698	40.4850
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
$Nex_{(T)}$	58.8393	52.3181	53.0375	53.9053	51.0447	49.3468	51.8619	53.1905	40.7678
N_{MMS_Avb}	36.7656	32.8623	33.4889	33.8113	32.0689	30.8717	32.4474	33.2352	25.5899
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	%
$Nex_{(T)}$	40.3745	45.2749	46.8083	42.9383	39.7586	37.7096	41.5046	40.1145	-70.3
N_{MMS_Avb}	25.0246	27.9603	28.8040	26.4227	24.3596	23.1646	25.1942	24.4880	-71.3
Share, % from $Nex_{(T)}$	62.0	61.8	61.5	61.5	61.3	61.4	60.7	61.0	-3.3

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 3-5 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'. 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 1990-2015 time series, direct N_2O emissions from 3D 'Agriculture Soils' decreased by 24.0 per cent, from 3.5880 kt in 1990 to 2.7279 kt in 2015 (Figure 5-2).

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} and N_2O_{CR} emissions decreased by 44.8 per cent, 62.3 per cent and, respectively 28.2 per cent, while the share of N_2O_{PRP} and N_2O_{SOM} emissions increased by 20.0 per cent and 241.8 per cent (Table 5-55).

Table 5-55: Breakdown of Direct N_2O Emissions from 3D 'Agriculture Soils' by Source within 1990-2015 periods, % of the total

	1990	1991	1992	1993	1994	1995	1996	1997	1998
N_2O_{SN}	40.3	37.1	34.8	12.5	9.7	6.0	8.3	5.9	6.0
N_2O_{ON}	24.3	22.6	25.7	18.3	25.8	19.5	22.3	14.3	15.6
N_2O_{PRP}	5.0	6.8	8.1	8.6	12.2	10.8	11.0	8.0	10.2
N_2O_{CR}	15.2	17.6	14.8	14.9	13.6	12.4	11.4	10.8	10.6
N_2O_{SOM}	15.1	15.9	16.7	45.6	38.7	51.3	47.0	61.1	57.6
	1999	2000	2001	2002	2003	2004	2005	2006	2007
N_2O_{SN}	3.9	7.0	7.4	10.1	10.1	8.5	8.7	8.2	21.5
N_2O_{ON}	15.6	14.6	12.7	12.4	14.4	10.7	11.3	12.8	19.0
N_2O_{PRP}	10.4	10.6	9.2	9.2	10.5	7.6	7.6	8.3	12.7
N_2O_{CR}	11.4	11.0	10.1	9.9	11.3	10.6	10.8	11.6	9.4
N_2O_{SOM}	58.7	56.8	60.6	58.3	53.7	62.6	61.6	59.1	37.5
	2008	2009	2010	2011	2012	2013	2014	2015	%
N_2O_{SN}	11.5	11.5	11.7	13.8	28.7	20.7	26.7	22.3	-44.8
N_2O_{ON}	8.5	12.3	10.7	9.5	13.3	7.4	7.2	9.2	-62.3
N_2O_{PRP}	5.8	8.1	6.8	6.1	8.7	4.9	4.7	6.0	20.0
N_2O_{CR}	11.0	10.6	12.1	11.7	10.2	11.4	11.3	10.9	-28.2
N_2O_{SOM}	63.2	57.5	58.7	58.9	39.0	55.6	50.1	51.6	241.8

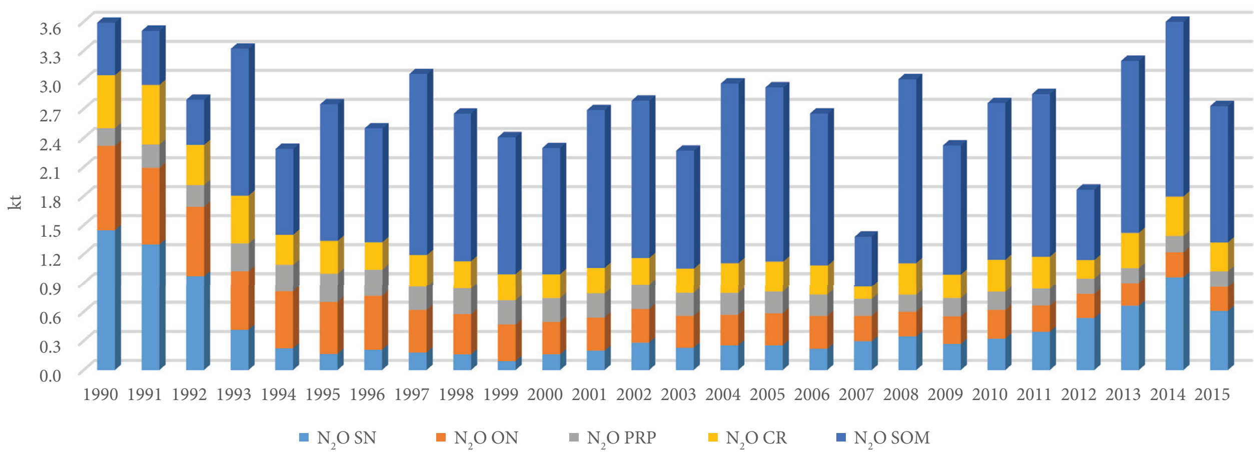


Figure 5-2: Direct N_2O emissions from the 3D 'Agricultural Soils' within 1990-2015 periods, kt

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.

$$N_2O_{\text{INDIRECT}} = N_2O_{\text{ATD}} + N_2O_{\text{L}}$$

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 1990-2015 time series, indirect N_2O emissions from the 3D 'Agricultural Soils' decreased by circa 35.4 per cent, from 1.1363 kt in 1990 to 0.7346 kt in 2015 (Figure 5-3).

The contribution of emission sources in the structure of total indirect N_2O emissions has changed within the reference period. Thus, the share of N_2O_{ATD} emissions has decreased by 40.0 per cent, while the share of N_2O_{L} emissions has increased by 17.3 per cent (Table 5-56).

Table 5-56: Breakdown of Indirect N_2O Emissions from 3D 'Agriculture Soils' by Source within 1990-2015 periods, %

	1990	1991	1992	1993	1994	1995	1996	1997	1998
N_2O_{ATD}	30.2	29.3	30.6	21.6	26.3	21.3	23.6	16.9	18.7
N_2O_{L}	69.8	70.7	69.4	78.4	73.7	78.7	76.4	83.1	81.3
	1999	2000	2001	2002	2003	2004	2005	2006	2007
N_2O_{ATD}	18.1	18.6	16.9	17.5	19.4	15.2	15.7	16.8	26.0
N_2O_{L}	81.9	81.4	83.1	82.5	80.6	84.8	84.3	83.2	74.0
	2008	2009	2010	2011	2012	2013	2014	2015	%
N_2O_{ATD}	14.0	17.6	16.0	15.6	23.4	16.0	17.6	18.1	-40.0
N_2O_{L}	86.0	82.4	84.0	84.4	76.6	84.0	82.4	81.9	17.3

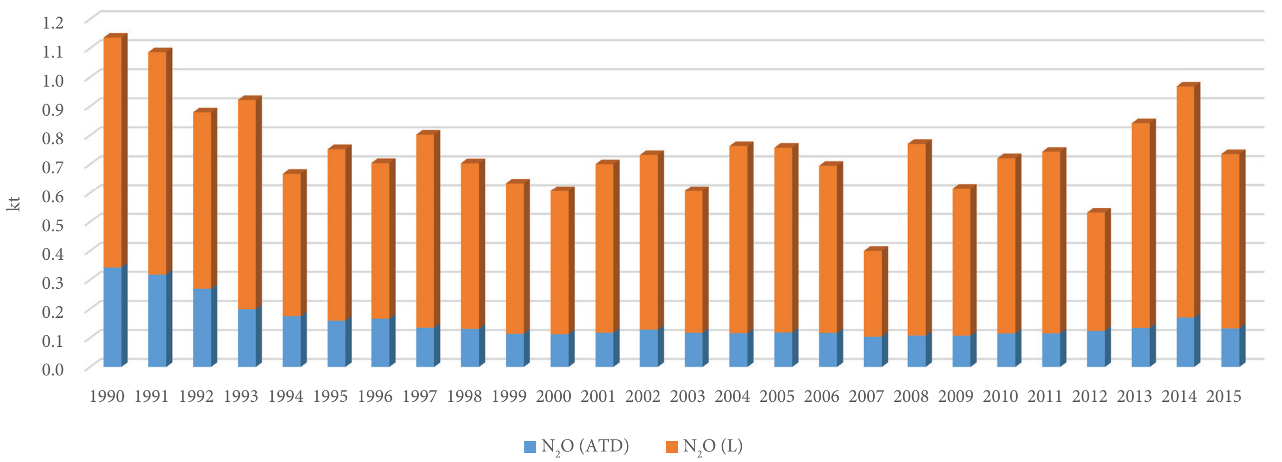


Figure 5-3: Indirect N_2O emissions from the 3D 'Agricultural Soils' within 1990-2015 periods, kt

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 (nitrophoska)	Complex formula	N: P: K 13-19 each	Pellets of different colors	Efficient on all soils and used for all crops.
Diammophos (diammophoska)	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 2015, there was a significant decrease by 4.4 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 4.3 times, from 134 kg a.s./ha in 1990, to 31 kg a.s./ha in 2015.

Table 5-58: Applied Inorganic N Fertilizers within 1990-2015 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	3.7	6.1	7.5	10.6	9.7	10.4	11.1	10.7	14.4
	2008	2009	2010	2011	2012	2013	2014	2015	%
Applied Inorganic N Fertilizer, F_{SN}	21.9	17.0	20.6	25.0	34.1	42.1	61.1	38.7	-58.0
Total Applied Inorganic Fertilizer	24.7	19.9	25.5	30.9	44.0	54.8	84.5	52.4	-77.5
kg applied for 1 sown ha	15.9	13.1	15.8	19.2	26.8	32.7	50.2	31.2	-76.7

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 2016 (page 461). Statistical Yearbooks of the ATULBD for 1998 (page 230), 2000 (page 107), 2002 (page 111), 2006 (page 108), 2009 (page 107), 2012 (page 114), 2014 (page 103), 2016 (page 106).

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

Direct N_2O_{SN} emissions from applied inorganic N fertilizers were recalculated for 2009-2013 time series, in particular due to updating the AD for the left bank of the Dniester River, though the impact of these recalculations were insignificant (Table 5-59). For the 2014-2015 time periods, 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 obtained results allow assert that within the 1990-2015 time series the respective emissions decreased by circa 58 per cent.

Table 5-59: Direct N_2O_{SN} Emissions from Applied Inorganic N Fertilizers included into the BUR1 and NC4 of the RM under the UNFCCC, kt

	1990	1991	1992	1993	1994	1995	1996	1997	1998
BUR1	1.4473	1.2996	0.9711	0.4145	0.2217	0.1652	0.2077	0.1795	0.1600
NC4	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
BUR1	0.0929	0.1609	0.1994	0.2823	0.2298	0.2524	0.2530	0.2168	0.2959
NC4	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	0.1	0.0
	2008	2009	2010	2011	2012	2013	2014	2015	%
BUR1	0.3446	0.2674	0.3241	0.3927	0.5351	0.6617			
NC4	0.3446	0.2670	0.3234	0.3928	0.5355	0.6617	0.9603	0.6078	-58.0
Difference, %	0.0	-0.1	-0.2	0.0	0.1	0.0			

Abbreviations: NC4 – Fourth National Communication; BUR1 – First Biennial Update Report.

At the same time, at the conversion of N_2O emissions in CO_2 equivalent by using the 100-year Global Warming Potential (GWP_{100}= 298) values available in the Fourth IPCC Assessment Report (AR4), in the detriment of GWP_{100} values (GWP_{100}= 310) in the Second IPCC Assessment Report (SAR), the impact on the evolution of direct N_2O_{SN} emissions resulting from applied inorganic N fertilizers on managed lands in the Republic of Moldova represented a decrease by 4 per cent within 1990-2013 periods (Table 5-60).

Table 5-60: Comparative Results of Direct N_2O_{SN} Emissions from Applied Inorganic N Fertilizers included into the BUR1 and the NC4 of the RM under the UNFCCC, kt CO_2 equivalent

	1990	1991	1992	1993	1994	1995	1996	1997	1998
BUR1	448.6586	402.8671	301.0543	128.4937	68.7310	51.2036	64.3905	55.6415	49.6058
NC4	431.2911	387.2723	289.4006	123.5197	66.0704	49.2215	61.8980	53.4876	47.6855
Difference, %	-3.9	-3.9	-3.9	-3.9	-3.9	-3.9	-3.9	-3.9	-3.9
	1999	2000	2001	2002	2003	2004	2005	2006	2007
BUR1	28.7999	49.8883	61.8038	87.5055	71.2252	78.2449	78.4397	67.2111	91.7241
NC4	27.6851	47.9571	59.4114	84.1182	68.4681	75.2161	75.4034	64.6623	88.1735
Difference, %	-3.9	-3.9	-3.9	-3.9	-3.9	-3.9	-3.9	-3.8	-3.9
	2008	2009	2010	2011	2012	2013	2014	2015	%
BUR1	106.8353	82.8825	100.4781	121.7419	165.8868	205.1115			
NC4	102.6997	79.5613	96.3774	117.0677	159.5721	197.1895	286.1680	181.1301	-58.0
Difference, %	-3.9	-4.0	-4.1	-3.8	-3.8	-3.9			

Abbreviations: NC4 – Fourth National Communication; BUR1 – First 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[82]) applied on managed lands are available in the Statistical Yearbooks of the RM and those of the ATULBD (Table 5-61).

Table 5-61: Applied Organic Fertilizers in the Republic of Moldova within 1990-2015 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
tones/sown 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
tones/sown ha	0.10	0.03	0.10	0.02	0.06	0.04	0.04	0.01	0.01

[82] 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	%
Applied organic N fertilizers, kt	8.0	6.9	17.7	31.5	22.9	42.6	33.8	61.2	-99.4
tones/sown ha	0.01	0.01	0.02	0.04	0.03	0.05	0.03	0.07	-98.8

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 2016 (page 461). Statistical Yearbooks of the ATULBD for 1998 (page 230), 2000 (page 107), 2002 (page 111), 2006 (page 108), 2009 (page 107), 2012 (page 114), 2014 (page 103) and 2016 (page 106).

As the table indicates, from 1990 through 2015, according to the NBS and the State Statistical Service of the ATULBD, there was a significant reduction, by circa 80 times, of the amounts of organic N fertilizers applied per hectare of sown fields, from circa 5.6 t/ha in 1990, to circa 70 kg/ha in 2015.

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 1990-2015 periods, in comparison 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	10641.7	10293.1	9348.7	9727.4	7655.3	7229.5
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	39.5	15.7	19.0	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	7229.5	6565.3	5868.3	5980.2	6037.7	5726.6	5512.8	5794.2	5934.9
Applied organic fertilizers (statistical data), kt	227.3	122.1	83.3	98.2	54.2	47.3	42.2	44.2	10.5
Applied organic fertilizers (statistical data), % of the amount of the organic fertilizers available to be applied to soils	3.1	1.9	1.4	1.6	0.9	0.8	0.8	0.8	0.2
	2008	2009	2010	2011	2012	2013	2014	2015	%
Organic fertilizers available to be applied to soils (estimated AD), kt	4468.7	4992.9	5143.6	4718.3	4349.9	4136.5	4499.0	4372.8	-71.3
Applied organic fertilizers (statistical data), kt	8.0	6.9	17.7	31.5	22.9	42.6	33.8	61.2	-99.4
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	0.8	1.4	-97.8

The scientific literature[83] 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 1990-2015 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	10641.7	10293.1	9348.7	9727.4	7655.3	7229.5
Applied organic fertilizers (65 per cent of the available amounts), kt	9906.4	9003.0	8150.4	6917.1	6690.5	6076.6	6322.8	4976.0	4699.1
Applied organic fertilizers (F_{ON}), kt of a.s. (N)	55.4758	50.4166	45.6422	38.7358	37.4669	34.0292	35.4076	27.8654	26.3152
	1999	2000	2001	2002	2003	2004	2005	2006	2007
Organic fertilizers available to be applied to soils (estimated AD), kt	6565.3	5868.3	5980.2	6037.7	5726.6	5512.8	5794.2	5934.9	4569.6
Applied organic fertilizers (65 per cent of the available amounts), kt	4267.4	3814.4	3887.1	3924.5	3722.3	3583.3	3766.2	3857.7	2970.3
Applied organic fertilizers (F_{ON}), kt of a.s. (N)	23.8977	21.3605	21.7678	21.9774	20.8448	20.0666	21.0908	21.6029	16.6334
	2008	2009	2010	2011	2012	2013	2014	2015	%
Organic fertilizers available to be applied to soils (estimated AD), kt	4468.7	4992.9	5143.6	4718.3	4349.9	4136.5	4499.0	4372.8	-71.3
Applied organic fertilizers (65 per cent of the available amounts), kt	2904.6	3245.4	3343.3	3066.9	2827.5	2688.8	2924.3	2842.4	-71.3
Applied organic fertilizers (F_{ON}), kt of a.s. (N)	16.2660	18.1742	18.7226	17.1748	15.8338	15.0570	16.3762	15.9172	-71.3

[83] 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 1990-2013 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 BUR1, the changes performed resulted in increased N_2O_{ON} emissions from applied organic nitrogen fertilizers between 1990 and 2013, with a variation from a minimum increase of 1.7 per cent in 1990, up to a maximum increase by 46934.6 per cent in 2009 (Table 5-64).

Table 5-64: Comparative Results of Direct N_2O_{ON} Emissions from Applied Organic N Fertilizers included into the BUR1 and the NC4 of the RM under the UNFCCC, kt

	1990	1991	1992	1993	1994	1995	1996	1997	1998
BUR1	0.8571	0.7568	0.4664	0.3696	0.1426	0.1566	0.0797	0.0311	0.0200
NC4	0.8718	0.7923	0.7172	0.6087	0.5888	0.5347	0.5564	0.4379	0.4135
Difference, %	1.7	4.7	53.8	64.7	313.0	241.5	598.1	1310.0	1967.4

	1999	2000	2001	2002	2003	2004	2005	2006	2007
BUR1	0.0107	0.0073	0.0086	0.0048	0.0042	0.0037	0.0039	0.0009	0.0007
NC4	0.3755	0.3357	0.3421	0.3454	0.3276	0.3153	0.3314	0.3395	0.2614
Difference, %	3395.0	4479.1	3858.4	7140.8	7769.5	8391.3	8420.8	36639.6	37498.2
	2008	2009	2010	2011	2012	2013	2014	2015	%
BUR1	0.0007	0.0006	0.0016	0.0028	0.0020	0.0037			
NC4	0.2556	0.2856	0.2942	0.2699	0.2488	0.2366	0.2573	0.2501	-71.3
Difference, %	36208.0	46934.6	18788.8	9636.3	12247.0	6211.6			

Abbreviations: NC4 – Fourth National Communication; BUR1 – First Biennial Update Report.

At the same time, at the conversion of N_2O emissions in CO_2 equivalent by using the 100-year Global Warming Potential (GWP_{100}= 298) values available in the Fourth IPCC Assessment Report (AR4), in the detriment of GWP_{100} values (GWP_{100}= 310) in the Second IPCC Assessment Report (SAR), resulted in an increase of N_2O_{ON} emissions within 1990-2013 periods, varying from a minimum increase by circa 0.6 per cent in 1991 to a maximum increase by 45113.9 per cent in 2009, with the exception of 1990, when a decrease by circa 2.2 per cent was recorded (Table 5-65).

Table 5-65: Comparative Results of Direct N_2O_{ON} Emissions from Applied Organic N Fertilizers included into the BUR1 and the NC4 of the RM under the UNFCCC, kt CO_2 equivalent

	1990	1991	1992	1993	1994	1995	1996	1997	1998
BUR1	265.7072	234.6080	144.5840	114.5760	44.1936	48.5366	24.7075	9.6271	6.2007
NC4	259.7852	236.0938	213.7359	181.3944	175.4523	159.3540	165.8088	130.4897	123.2305
Difference, %	-2.2	0.6	47.8	58.3	297.0	228.3	571.1	1255.4	1887.4
	1999	2000	2001	2002	2003	2004	2005	2006	2007
BUR1	3.3309	2.2724	2.6789	1.4786	1.2903	1.1512	1.2058	0.2864	0.2155
NC4	111.9093	100.0280	101.9355	102.9168	97.6131	93.9690	98.7651	101.1631	77.8920
Difference, %	3259.7	4301.8	3705.1	6860.5	7464.9	8062.6	8091.0	35217.4	36042.8
	2008	2009	2010	2011	2012	2013	2014	2015	%
BUR1	0.2182	0.1882	0.4829	0.8593	0.6247	1.1621			
NC4	76.1714	85.1070	87.6753	80.4270	74.1473	70.5099	76.6876	74.5378	-71.3
Difference, %	34802.6	45113.9	18057.7	9259.4	11769.0	5967.3			

Abbreviations: NC4 – Fourth National Communication; BUR1 – First Biennial Update Report.

For the 2014-2015 time periods, total direct N_2O_{ON} emissions resulting from 3D.a.2 'Applied Organic Nitrogen Fertilizers' category were estimated for the first time. The obtained results allow assert that within the 1990-2015 time series, the respective emissions decreased by 71.3 per cent, in particular due to reduced animal population.

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 2016, hayfields and pastures occupied circa 347.1 thousand ha (10.3 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).

Table 5-66: Land Fund by Land Use in the Republic of Moldova within 1992-2016, thousand ha

	1992	1995	2000	2005	2010	2011	2012	2013	2014	2015	2016
Total lands:	**3376.0**	**3385.1**	**3384.4**	**3384.6**	**3384.4**	**3384.4**	**3384.6**	**3384.6**	**3384.6**	**3384.6**	**3384.6**
Agricultural lands, including:	2565.9	2556.7	2550.3	2521.6	2501.1	2498.3	2498.0	2497.8	2500.1	2499.7	2499.6
Arable land	1736.3	1758.7	1813.8	1840.2	1816.7	1812.7	1810.5	1814.1	1816.1	1817.4	1822.9
Perennial plantations:	474.8	430.7	352.3	297.8	301.0	298.8	298.7	295.3	295.3	291.7	288.9
Orchards	224.5	208.3	170.8	131.9	132.5	133.3	134.5	135.1	135.8	134.5	132.5
Vineyards	215.8	202.6	168.9	155.5	153.5	149.6	147.3	142.6	141.2	137.5	132.5
Pastures	350.5	365.2	373.9	370.8	352.1	350.4	350.3	348.9	348.0	346.4	345.0
Hayfields	4.3	2.1	2.5	2.7	2.2	2.2	2.0	2.1	2.0	2.2	2.1
Fallow lands	0.0	0.0	7.8	10.1	29.1	34.2	36.5	37.4	38.7	42.0	40.6
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
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
Other lands	299.7	310.5	315.9	326.7	324.3	323.6	324.4	323.4	322.4	323.6	323.1

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.

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 1990-2015 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 1990-2015 periods, kt

	1990	1991	1992	1993	1994	1995	1996	1997	1998
F_{PRP}	7.5735	9.4632	9.0904	11.3547	11.3040	11.5872	10.8148	9.5014	10.3790
	1999	2000	2001	2002	2003	2004	2005	2006	2007
F_{PRP}	9.6337	9.3579	9.4300	9.8717	9.2689	8.8402	8.7511	8.7218	7.0336
	2008	2009	2010	2011	2012	2013	2014	2015	%
F_{PRP}	7.1984	7.7428	7.7136	7.1434	6.7881	6.6963	7.2865	7.0506	-6.9

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 1990-2013 time series, in particular due to updating the share of manure management systems for the entire period under review (1990-2015) as a result of 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. In comparison with emission estimates included into the BUR1, the changes performed resulted in decreased N_2O_{PRP} emissions from urine and dung deposited by grazing animals between 1990 and 1999, with a variation from a minimum decrease of 3.4 per cent in 1996, up to a maximum decrease by 39.1 per cent in 1990; respectively increased emissions between 2000 and 2013, varying from a minimum increase by 9.8 per cent in 2000, up to a maximum increase by 27.2 per cent in 2009 (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 BUR1 and the NC4 of the RM under the UNFCCC, kt

	1990	1991	1992	1993	1994	1995	1996	1997	1998
BUR1	0.2965	0.3058	0.2919	0.3179	0.3098	0.3079	0.2846	0.2534	0.2902
NC4	0.1807	0.2395	0.2251	0.2856	0.2786	0.2974	0.2750	0.2444	0.2696
Difference, %	-39.1	-21.7	-22.9	-10.1	-10.1	-3.4	-3.4	-3.5	-7.1
	1999	2000	2001	2002	2003	2004	2005	2006	2007
BUR1	0.2684	0.2222	0.2237	0.2273	0.2097	0.1957	0.1915	0.1852	0.1456
NC4	0.2498	0.2438	0.2471	0.2559	0.2378	0.2254	0.2232	0.2203	0.1748
Difference, %	-6.9	9.8	10.5	12.6	13.4	15.2	16.5	19.0	20.0
	2008	2009	2010	2011	2012	2013	2014	2015	%
BUR1	0.1389	0.1484	0.1511	0.1433	0.1345	0.1316			
NC4	0.1757	0.1887	0.1885	0.1746	0.1629	0.1569	0.1691	0.1648	-8.8
Difference, %	26.5	27.2	24.7	21.8	21.1	19.2			

Abbreviations: NC4 – Fourth National Communication; BUR1 – First Biennial Update Report.

At the same time, at the conversion of N_2O emissions in CO_2 equivalent by using the 100-year Global Warming Potential (GWP_{100}= 298) values available in the Fourth IPCC Assessment Report (AR4), in the detriment of GWP_{100} values (GWP_{100}= 310) in the Second IPCC Assessment Report (SAR), resulted a decrease of N_2O_{PRP} emissions within 1990-1999 periods, varying from a minimum decrease by circa 7.1 per cent in 1996 to a maximum decrease by 41.4 per cent in 1990; respectively increased emissions between 2000 and 2013, varying from a minimum increase by 5.5 per cent in 2000, up to a maximum increase by 22.3 per cent in 2009 (Table 5-69). For the period 2014-2015, direct N_2O_{PRP} emissions from urine and dung deposited by grazing animals in the Republic of Moldova were estimated for the first time. The results allow assert that within the 1990-2015 time series, the respective emissions decreased by circa 8.8 per cent. The decrease in emissions is 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).

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 BUR1 and the NC4 of the RM under the UNFCCC, kt CO_2 equivalent

	1990	1991	1992	1993	1994	1995	1996	1997	1998
BUR1	91.9302	94.8018	90.5021	98.5441	96.0244	95.4526	88.2107	78.5418	89.9701
NC4	53.8411	71.3567	67.0890	85.1172	83.0132	88.6241	81.9443	72.8406	80.3398
Difference, %	-41.4	-24.7	-25.9	-13.6	-13.5	-7.2	-7.1	-7.3	-10.7
	1999	2000	2001	2002	2003	2004	2005	2006	2007
BUR1	83.2044	68.8710	69.3560	70.4519	64.9920	60.6695	59.3763	57.4095	45.1513
NC4	74.4272	72.6644	73.6421	76.2645	70.8785	67.1650	66.5032	65.6641	52.1020
Difference, %	-10.5	5.5	6.2	8.3	9.1	10.7	12.0	14.4	15.4
	2008	2009	2010	2011	2012	2013	2014	2015	%
BUR1	43.0638	46.0028	46.8536	44.4245	41.6961	40.7834			
NC4	52.3667	56.2440	56.1822	52.0290	48.5507	46.7450	50.3897	49.1035	-8.8
Difference, %	21.6	22.3	19.9	17.1	16.4	14.6			

Abbreviations: NC4 – Fourth National Communication; BUR1 – First 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' 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)[84].

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[85] (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[86] (see Table 5-70);

[84] Banaru, Anatol (2000), *Methodology to Calculate CO_2 Emissions from Agricultural Soils,* In the collection of papers "Climate Change: Research, Studies, Solutions", Ministry of Environment / UNDP Moldova. „Bons Offices" S.R.L. Chişinău, 2000, pp. 115-123
[85] *2006, IPCC Guidelines*, Volume 4, Chapter 11, Table 11.2, Page 11.17.
[86] 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.

$R_{BG\ (T)}$ – ratio of below-ground residues to harvested yield for crop T, t.d.m$_{BG}$/t dm[87] (see Table 5-70);

$Frac_{Remove\ (T)}$ – fraction of above-ground residues of crop T removed and used for other purposes[88] (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)[89] (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.

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).

[87] *2006 IPCC Guidelines*, Volume 4, Chapter 11, Table 11.2, Page 11.17.
[88] Expert opinion, Prof. Valerian Cerbari, Institute of Pedology, Agrochemistry and Soil Protection „Nicolae Dimo"
[89] 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 5-72: Areas Sown with Crops within 1990-2015 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
...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
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	%
Sown Areas – total	**1 552.0**	**1 593.0**	**1 628.2**	**1 597.3**	**1 624.1**	**1 686.3**	**1 694.3**	**1 693.8**	**-2.3**
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**	**42.9**
...Wheat (Winter and Spring)	429.6	395.8	380.8	353.2	374.2	432.7	415.0	416.9	45.4
...Winter rye	1.0	1.9	1.6	0.6	1.3	2.0	0.5	0.4	-51.0
...Barley (Winter and Spring)	139.4	184.7	164.9	128.4	114.1	126.9	120.9	104.8	-13.0
...Oat	2.8	2.4	3.0	2.2	2.3	2.6	2.1	1.7	-21.1
...Millet	0.3	0.3	0.5	0.2	0.2	0.0	0.1	0.1	-10.0
...Buckwheat	0.8	1.0	0.2	0.6	0.9	0.3	0.3	0.3	-92.9
...Leguminous crops	28.3	36.1	39.5	30.2	25.2	23.5	22.5	24.9	-65.8
...Grain maize	429.5	407.3	425.7	473.8	516.9	488.9	490.3	515.1	99.6
...Grain sorghum	0.2	0.2	0.2	0.1	0.1	0.1	0.1	0.1	-91.7
...Other cereal crops	2.8	3.8	3.5	2.3	1.6	2.0	2.8	0.9	810.0
Industrial crops – total	**355.9**	**401.0**	**440.5**	**477.2**	**462.7**	**463.3**	**501.9**	**499.0**	**69.0**
...Sugar beet	24.7	23.4	26.5	25.4	31.2	28.7	28.0	21.9	-73.1
...Sun flower	239.1	249.5	288.1	320.9	348.4	348.3	371.0	380.6	183.8
...Soybeans	30.5	48.8	59.0	58.9	62.5	42.8	56.5	69.7	163.2
...Tobacco	2.7	2.5	4.4	3.8	2.4	1.5	0.9	0.8	-97.5
...Grain rapeseed	53.5	67.4	48.9	53.8	8.2	36.0	38.2	13.3	NA
...Other industrial crops	4.9	7.2	10.4	12.2	9.8	5.8	6.9	9.4	-55.4
Potatoes, vegetables and melons & gourds – total	**83.2**	**78.7**	**80.5**	**76.4**	**68.4**	**69.9**	**67.1**	**59.6**	**-54.8**
...Potatoes	31.3	28.5	28.0	29.7	25.1	24.1	23.1	22.4	-45.7
...Vegetables	41.7	37.0	40.6	37.4	34.9	37.0	35.5	29.4	-58.7
...Melons and gourds	8.8	11.9	10.6	8.2	7.3	7.8	7.3	6.7	-27.6
...Other	1.4	1.3	1.4	1.1	1.1	1.0	1.2	1.2	-88.3
Forage crops – total	**78.1**	**79.5**	**86.8**	**79.7**	**85.1**	**73.2**	**70.0**	**69.9**	**-87.5**
...Forage roots	1.9	1.5	1.7	1.2	1.4	1.2	1.3	1.3	-95.1
...Maize for silo and green fodder	10.3	11.3	10.1	10.4	22.4	8.8	9.3	11.2	-96.2
...Perennial grasses for green fodder, silage and fodder	60.2	61.5	66.9	61.8	56.7	57.7	54.6	51.6	-75.0
...Annual grasses for green fodder	4.6	3.5	6.5	4.8	3.9	4.4	3.9	4.4	-86.0
...Other	1.1	1.7	1.6	1.4	0.7	1.1	0.9	1.4	-64.1

Source: NBS on-line database, Section 'Sown Area, crops average yield and harvest within 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 97), 2011 (page 100), 2014 (page 94), 2016 (page 107).

Table 5-73: Gross Harvest of Agricultural Crops in the Republic of Moldova within 1990-2015, 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

	1999	2000	2001	2002	2003	2004	2005	2006	2007
...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	%
Cereals and leguminous crops – total	**3261.6**	**2375.5**	**2674.3**	**2794.6**	**1359.0**	**3130.4**	**3341.0**	**2587.0**	**1.9**
...Wheat (Winter and Spring)	1286.5	738.9	749.5	797.1	496.9	1009.6	1102.6	927.4	-17.9
...Winter rye	2.0	3.4	2.4	1.0	2.6	5.7	1.4	1.0	-47.7
...Barley (Winter and Spring)	362.3	290.5	240.7	218.9	139.3	241.6	244.7	199.1	-52.4
...Oat	3.9	1.6	3.1	3.6	2.0	3.8	2.9	1.7	-56.4
...Millet	0.5	0.7	0.3	0.1	0.1	0.1	0.1	0.1	0.0
...Buckwheat	0.5	0.6	0.5	0.5	0.3	0.5	0.4	0.2	-88.4
...Leguminous crops	38.0	32.0	40.1	33.1	17.3	24.1	32.9	25.1	-74.2
...Grain maize	1484.1	1159.6	1462.1	1547.2	587.2	1546.8	1642.1	1133.6	28.0
...Grain sorghum	0.1	0.2	0.2	0.1	0.1	0.4	0.3	0.2	-85.4
...Other cereal crops	8.1	5.3	7.7	4.8	2.1	5.5	8.3	2.7	808.3
Industrial crops – total									
...Sugar beet	960.7	337.4	837.6	588.6	587.0	1009.0	1356.2	537.5	-77.4
...Sun flower	387.2	310.2	440.2	497.4	339.1	602.2	627.1	562.3	123.0
...Soybeans	58.8	50.1	113.0	80.6	48.9	67.6	111.4	49.2	106.5
...Tobacco	3.9	4.4	7.6	5.4	2.9	2.2	1.4	1.2	-98.2
...Grain rapeseed	100.1	81.6	51.0	67.7	8.1	58.8	90.2	25.6	NA
Potatoes, vegetables and melons & gourds – total									
...Potatoes	273.7	264.8	286.7	362.9	191.5	244.0	275.7	163.8	-44.5
...Vegetables	389.4	322.8	365.8	396.0	251.9	319.1	352.3	266.9	-77.3
...Melons and gourds	69.9	102.4	104.9	85.2	52.6	56.6	48.3	56.7	64.8
Forage crops – total									
...Forage roots	26.4	20.0	31.7	23.2	10.6	22.2	26.1	14.6	-98.8
...Maize for silo and green fodder	113.0	106.4	143.8	125.2	110.8	168.2	135.7	91.8	-98.0
...Perennial grasses for green fodder, silage and fodder	364.2	213.4	323.9	238.5	97.6	198.6	275.0	118.5	-97.3
...Annual grasses for green fodder	15.3	7.9	10.9	11.3	6.3	9.6	13.4	8.8	-97.0

Source: NBS on-line database, Section 'Sown Area, crops average yield and harvest within 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 98), 2011 (page 101), 2014 (page 95), 2016 (page 108).

Table 5-74: Average Yield per Hectare of Agricultural Crops in within 1990-2015 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	161.2	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	%
Cereals and leguminous crops – total	**3.2**	**2.3**	**2.6**	**2.8**	**1.3**	**2.9**	**3.2**	**2.4**	**-28.7**
...Wheat (Winter and Spring)	3.0	1.9	2.0	2.3	1.3	2.3	2.7	2.2	-43.5
...Winter rye	1.9	1.8	1.5	1.8	2.0	2.8	2.8	2.3	6.7
...Barley (Winter and Spring)	2.6	1.6	1.5	1.7	1.2	1.9	2.0	1.9	-45.3
...Oat	1.4	0.7	1.0	1.6	0.9	1.5	1.4	1.0	-44.7
...Millet	1.7	2.5	0.5	0.7	0.6	1.1	1.5	1.1	11.1
...Buckwheat	0.6	0.6	3.2	0.8	0.3	1.6	1.5	0.8	63.1
...Leguminous crops	1.3	0.9	1.0	1.1	0.7	1.0	1.5	1.0	-24.6
...Grain maize	3.5	2.8	3.4	3.3	1.1	3.2	3.3	2.2	-35.9
...Grain sorghum	0.5	0.8	0.9	0.7	0.5	3.0	2.8	1.8	75.0
...Other cereal crops	2.1	1.7	1.8	1.9	1.9	2.0	2.1	2.2	-26.3
Industrial crops – total									
...Sugar beet	38.9	14.4	31.6	23.2	18.8	35.2	48.4	24.5	-15.8
...Sun flower	1.6	1.2	1.5	1.6	1.0	1.7	1.7	1.5	-21.4
...Soybeans	1.9	1.0	1.9	1.4	0.8	1.6	2.0	0.7	-21.5
...Tobacco	1.4	1.8	1.7	1.4	1.2	1.5	1.6	1.5	-27.3
...Grain rapeseed	1.9	1.2	1.0	1.3	1.0	1.6	2.4	1.9	-3.5
Potatoes, vegetables and melons & gourds – total									
...Potatoes	8.7	9.3	10.2	12.2	7.6	10.1	11.9	7.3	2.1
...Vegetables	9.3	8.7	9.0	10.6	7.2	8.6	9.9	9.1	-45.1
...Melons and gourds	7.9	8.6	9.9	10.4	7.2	7.3	6.6	8.5	127.7
Forage crops – total									
...Forage roots	14.1	13.7	18.5	19.0	7.4	18.5	20.1	11.2	-74.7
...Maize for silo and green fodder	11.0	9.4	14.2	12.0	5.0	19.2	14.5	8.2	-46.8
...Perennial grasses for green fodder, silage and fodder	6.0	3.5	4.8	3.9	1.7	3.4	5.0	2.3	-89.4
...Annual grasses for green fodder	3.3	2.2	1.7	2.3	1.6	2.2	3.4	2.0	-78.2

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), 2016 (page 110).

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 to 1990 through 2015, the total amount of nitrogen in crop residues returned to soils decreased by 45.4 per cent (Table 5-75).

Table 5-75: Amount of N in Crop Residues Returned to Soils within 1990-2015 periods, kt

	1990	1991	1992	1993	1994	1995	1996	1997	1998
$F_{(CR)}$	34.8062	39.1826	26.3044	31.5513	19.8322	21.6405	18.0979	20.9412	17.9215
	1999	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**
$F_{(CR)}$	17.4528	16.0264	17.2165	17.5917	16.2383	19.9839	20.0496	19.4949	8.2302
	2008	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**%**
$F_{(CR)}$	21.0310	15.6403	21.2771	21.2544	12.1128	23.1551	25.9598	18.9932	-45.4

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 5-4) 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.

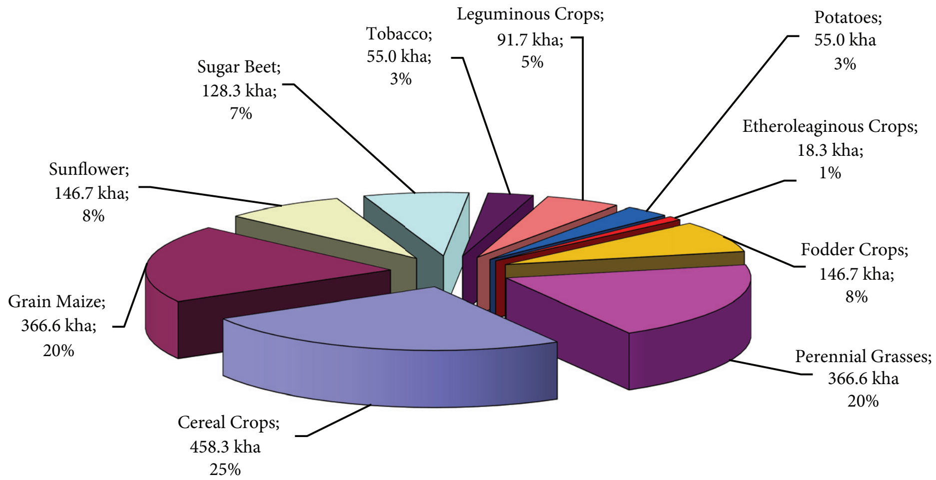


Figure 5-4: Recommended Crops Structure on Agricultural Lands in the RM [90]

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 1995-2003, 2005 and 2010-2013 time series, in particular due to use of an updated set of activity data on sown areas with crops, gross harvest of agricultural crops, average yield per hectare of agricultural crops (available in the NBS on-line database[91] as well as into the Statistical Yearbooks of the ATULBD[92]). In comparison with the last inventory cycle, the changes performed resulted in decreased N_2O_{CR} emissions from crop residues returned to soil between 1995 and 2003, with a variation from a minimum decrease of 1.4 per cent in 1995, up to a maximum decrease by 34.3 per cent in 1999; respectively increased emissions between 2005 and 2010-2013, varying from a minimum increase by 0.7 per cent in 2010, up to a maximum increase by 2.6 per cent in 2005 (Table 5-76).

[90] 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
[91] NBS on-line database, Section "Sown Area, crops average yield and harvest within 1980-2013: <http://statbank.statistica.md/pxweb/Database/RO/16%20AGR/AGR02/AGR02.asp>.
[92] <http://www.mepmr.org/gosudarstvennaya-statistika/informacziya>, <http://www.mepmr.org/pechatnye-izdaniya/statisticheskij-ezhegodnik-pmr>.

Table 5-76: Comparative Results of Direct N_2O_{CR} Emissions from Crop Residues Returned to Soils, included into the BUR1 and NC4 of the Republic of Moldova under the UNFCCC, kt

	1990	1991	1992	1993	1994	1995	1996	1997	1998
BUR1	0.5470	0.6158	0.4134	0.4958	0.3116	0.3449	0.3103	0.4480	0.4008
NC4	0.5470	0.6157	0.4134	0.4958	0.3116	0.3401	0.2844	0.3291	0.2816
Difference, %	0.0	0.0	0.0	0.0	0.0	-1.4	-8.3	-26.5	-29.7
	1999	2000	2001	2002	2003	2004	2005	2006	2007
BUR1	0.4174	0.3300	0.3419	0.3230	0.2793	0.3140	0.3071	0.3063	0.1293
NC4	0.2743	0.2518	0.2705	0.2764	0.2552	0.3140	0.3151	0.3063	0.1293
Difference, %	-34.3	-23.7	-20.9	-14.4	-8.6	0.0	2.6	0.0	0.0
	2008	2009	2010	2011	2012	2013	2014	2015	%
BUR1	0.3305	0.2458	0.3319	0.3311	0.1889	0.3598			
NC4	0.3305	0.2458	0.3344	0.3340	0.1903	0.3639	0.4079	0.2985	-45.4
Difference, %	0.0	0.0	0.7	0.9	0.8	1.1			

Abbreviations: NC4 – Fourth National Communication; BUR1 – First Biennial Update Report.

At the same time, at the conversion of N_2O emissions in CO_2 equivalent by using the 100-year Global Warming Potential (GWP_{100}= 298) values available in the Fourth IPCC Assessment Report (AR4), in the detriment of GWP_{100} values (GWP_{100}= 310) in the Second IPCC Assessment Report (SAR), resulted a decrease of N_2O_{CR} emissions within 1990-2013 periods, varying from a minimum decrease by 1.4 per cent in 2005 to a maximum decrease by 36.8 per cent in 1999 (Table 5-77).

Table 5-77: Comparative Results of Direct N_2O_{CR} Emissions from Crop Residues Returned to Soils, included into the BUR1 and NC4 of the RM under the UNFCCC, kt CO_2 equivalent

	1990	1991	1992	1993	1994	1995	1996	1997	1998
BUR1	169.5561	190.8900	128.1527	153.7098	96.6109	106.9303	96.1835	138.8882	124.2591
NC4	162.9926	183.4866	123.1798	147.7503	92.8712	101.3393	84.7501	98.0646	83.9239
Difference, %	-3.9	-3.9	-3.9	-3.9	-3.9	-5.2	-11.9	-29.4	-32.5
	1999	2000	2001	2002	2003	2004	2005	2006	2007
BUR1	129.4078	102.3102	105.9910	100.1236	86.5695	97.3501	95.1909	94.9681	40.0930
NC4	81.7291	75.0494	80.6222	82.3792	76.0416	93.5817	93.8892	91.2919	38.5410
Difference, %	-36.8	-26.6	-23.9	-17.7	-12.2	-3.9	-1.4	-3.9	-3.9
	2008	2009	2010	2011	2012	2013	2014	2015	%
BUR1	102.4509	76.1904	102.8837	102.6340	58.5598	111.5439			
NC4	98.4850	73.2411	99.6376	99.5312	56.7227	108.4321	121.5659	88.9425	-45.4
Difference, %	-3.9	-3.9	-3.2	-3.0	-3.1	-2.8			

Abbreviations: NC4 – Fourth National Communication; BUR1 – First Biennial Update Report.

For the 2014-2015 time series, the respective emissions were estimated for the first time. The results allow assert that within the 1990-2015 period, direct N_2O emissions from this source category decreased by circa 45.4 per cent.

The decrease in emissions is due to both less area being sown with crops over the period under review (for example, from 1990 through 2015 areas sown with tobacco decreased by 97.5 per cent, with fodder plants – by 87.5 per cent, with sugar beets – by 73.1 per cent, with leguminous crops – by 65.8 per cent, with vegetables – by 58.7 per cent, with potatoes – by 45.7 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 89.4 per cent, for annual grasses for green fodder – by 78.2 per cent, for forage roots – by 74.7 per cent, for barley – by 45.3 per cent, for vegetables – by 45.1 per cent, oat – by 44.7 per cent, for winter wheat – by 43.5 per cent, grain maize – by 35.9 per cent, for tobacco – by 27.3 per cent, leguminous crops – by 24.6 per cent, sunflower – by 21.4 per cent, sugar beet – by 15.8 per cent, etc.).

Despite the fact that over the 1990-2013 time periods the areas sown with some crops increased: sun flower – by 183.8 per cent, soybeans – by 163.2 per cent, grain maize – by 99.6 per cent and winter wheat – by 45.4 per cent; and there was also recorded an increase in yield per hectare in other crops, such as melons and gourds – by 127.7 per cent, grain sorghum - by 75.0 per cent, buckwheat - by 63.1 per cent, millet – by 11.1 per cent, winter rye – by 6.7 per cent and potatoes - by 2.1 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; Banaru, 2002), 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)[93].

Table 5-78: Annual Loss of Soil Carbon in the RM within 1990-2015 periods, kt C

	1990	1991	1992	1993	1994	1995	1996	1997	1998
$\Delta C_{mineral}$	368.5805	379.6968	317.4342	1031.5860	602.6555	959.3810	799.9436	1271.6988	1038.6510
	1999	2000	2001	2002	2003	2004	2005	2006	2007
$\Delta C_{mineral}$	961.9813	886.7331	1108.1526	1105.1509	828.5128	1261.7733	1223.9117	1067.7472	352.4175
	2008	2009	2010	2011	2012	2013	2014	2015	%
$\Delta C_{mineral}$	1292.6606	908.3715	1101.6680	1144.3976	495.8551	1208.9830	1227.4827	957.8486	228.0

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 1990-2015 periods, kt

	1990	1991	1992	1993	1994	1995	1996	1997	1998
F_{SOM}	34.4468	35.4857	29.6667	96.4099	56.3229	89.6618	74.7611	118.8504	97.0702
	1999	2000	2001	2002	2003	2004	2005	2006	2007
F_{SOM}	89.9048	82.8723	103.5657	103.2851	77.4311	117.9227	114.3843	99.7895	32.9362
	2008	2009	2010	2011	2012	2013	2014	2015	%
F_{SOM}	120.8094	84.8945	102.9596	106.9530	46.3416	112.9891	114.7180	89.5186	228.0

[93] Banaru, Anatol (2000), *Methodology to Calculate CO_2 Emissions from Agricultural Soils,* In the collection of papers „Climate Change: Research, Studies, Solutions, Ministry of Environment / UNDP Moldova. „Bons Offices" S.R.L. Chisinau, 2000. P. 115-123.

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 2013 time series, in particular due to use of an updated set of activity data on sown areas with crops, gross harvest of agricultural crops, average yield per hectare of agricultural crops (available in the NBS Database[94] as well as into the Statistical Yearbooks of the ATULBD[95]). In comparison with the last inventory cycle, the changes performed resulted in decreased 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 and 2012, with a variation from a minimum decrease of 0.3 per cent in 2005, up to a maximum decrease by 12.7 per cent in 1990; with the exception of 2013 when an insignificant increase (by 0.2 per cent) of direct N_2O emissions was recorded (Table 5-80). For the 2014-2015 time series, the respective emissions were estimated for the first time. The results allow assert that within the 1990-2015 time series, direct N_2O_{SOM} emissions from this source category increased by 2.6 times.

Table 5-80: Comparative Results of Direct N_2O_{SOM} Emissions from Nitrogen Mineralization Associated with Loss of Soil Organic Matter, included into the BUR1 and NC4 of the Republic of Moldova under the UNFCCC, kt

	1990	1991	1992	1993	1994	1995	1996	1997	1998
BUR1	0.6198	0.6145	0.5209	1.5624	0.9533	1.4185	1.2505	1.9626	1.6197
NC4	0.5413	0.5576	0.4662	1.5150	0.8851	1.4090	1.1748	1.8676	1.5254
Difference, %	-12.7	-9.3	-10.5	-3.0	-7.2	-0.7	-6.1	-4.8	-5.8
	1999	2000	2001	2002	2003	2004	2005	2006	2007
BUR1	1.5106	1.3716	1.6858	1.6796	1.2666	1.8928	1.8025	1.6141	0.5487
NC4	1.4128	1.3023	1.6275	1.6231	1.2168	1.8531	1.7975	1.5681	0.5176
Difference, %	-6.5	-5.1	-3.5	-3.4	-3.9	-2.1	-0.3	-2.8	-5.7
	2008	2009	2010	2011	2012	2013	2014	2015	%
BUR1	1.9285	1.3728	1.6416	1.6987	0.7372	1.7723			
NC4	1.8984	1.3341	1.6179	1.6807	0.7282	1.7755	1.8027	1.4067	159.9
Difference, %	-1.6	-2.8	-1.4	-1.1	-1.2	0.2			

Abbreviations: NC4 – Fourth National Communication; BUR1 – First Biennial Update Report.

At the same time, at the conversion of N_2O emissions in CO_2 equivalent by using the 100-year Global Warming Potential (GWP_{100}= 298) values available in the Fourth IPCC Assessment Report (AR4), in the detriment of GWP_{100} values (GWP_{100}= 310) in the Second IPCC Assessment Report (SAR), resulted a decrease of N_2O_{SOM} emissions within 1990-2013 periods, varying from a minimum decrease by circa 3.7 per cent in 2013 to a maximum decrease by 16.0 per cent in 1990 (Table 5-81).

[94] NBS on-line database, Section "Sown Area, crops average yield and harvest: 1980-2013": <http://statbank.statistica.md/pxweb/Database/RO/16%20AGR/AGR02/AGR02.asp>.
[95] <http://www.mepmr.org/gosudarstvennaya-statistika/informacziya>, <http://www.mepmr.org/pechatnye-izdaniya/statisticheskij-ezhegodnik-pmr>.

Table 5-81: Comparative Results of Direct N_2O_{SOM} Emissions from Nitrogen Mineralization Associated with Loss of Soil Organic Matter, included into the BUR1 and NC4 of the Republic of Moldova under the UNFCCC, kt CO_2 equivalent

	1990	1991	1992	1993	1994	1995	1996	1997	1998
BUR1	192.1384	190.5044	161.4725	484.3407	295.5335	439.7391	387.6697	608.3969	502.1212
NC4	161.3093	166.1744	138.9251	451.4738	263.7523	419.8733	350.0955	556.5592	454.5658
Difference, %	-16.0	-12.8	-14.0	-6.8	-10.8	-4.5	-9.7	-8.5	-9.5
	1999	2000	2001	2002	2003	2004	2005	2006	2007
BUR1	468.2885	425.1903	522.5840	520.6814	392.6515	586.7725	558.7764	500.3608	170.0832
NC4	421.0113	388.0789	484.9832	483.6695	362.5988	552.2154	535.6452	467.2998	154.2356
Difference, %	-10.1	-8.7	-7.2	-7.1	-7.7	-5.9	-4.1	-6.6	-9.3
	2008	2009	2010	2011	2012	2013	2014	2015	%
BUR1	597.8282	425.5663	508.9076	526.6002	228.5238	549.4030			
NC4	565.7332	397.5490	482.1452	500.8458	217.0111	529.1117	537.2081	419.2026	159.9
Difference, %	-5.4	-6.6	-5.3	-4.9	-5.0	-3.7			

Abbreviations: NC4 – Fourth National Communication; BUR1 – First 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 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 1990-2013 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"), as well as due to updating the share of manure management systems for the entire period under review as a result of 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. In comparison with the last inventory cycle, the changes performed resulted in increased N_2O_{ATD} emissions from atmospheric deposition of nitrogen oxides (NO_x) and ammonia (NH_4) between 1992 and 2013, with a variation from a minimum increase of 17.9 per cent in 1992, up to a maximum increase by 160.5 per cent in 2006; with the exception of 1990 and 1991 when a decrease was recorded (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 BUR1 and NC4 of the RM under the UNFCCC, kt

	1990	1991	1992	1993	1994	1995	1996	1997	1998
BUR1	0.3540	0.3202	0.2282	0.1556	0.0907	0.0864	0.0727	0.0556	0.0578
NC4	0.3429	0.3182	0.2691	0.1989	0.1755	0.1599	0.1660	0.1354	0.1313
Difference, %	-3.1	-0.6	17.9	27.8	93.4	85.1	128.4	143.3	127.1
	1999	2000	2001	2002	2003	2004	2005	2006	2007
BUR1	0.0464	0.0444	0.0485	0.0564	0.0492	0.0499	0.0496	0.0449	0.0482
NC4	0.1147	0.1126	0.1180	0.1283	0.1176	0.1161	0.1191	0.1170	0.1040
Difference, %	147.0	153.7	143.3	127.5	139.0	132.5	140.2	160.5	115.8
	2008	2009	2010	2011	2012	2013	2014	2015	%
BUR1	0.0524	0.0460	0.0521	0.0581	0.0714	0.0844			
NC4	0.1082	0.1082	0.1154	0.1157	0.1246	0.1345	0.1704	0.1330	-61.2
Difference, %	106.3	135.0	121.5	99.1	74.6	59.4			

Abbreviations: NC4 – Fourth National Communication; BUR1 – First Biennial Update Report.

At the same time, at the conversion of indirect N_2O emissions in CO_2 equivalent by using the 100-year Global Warming Potential (GWP_{100}= 298) values available in the Fourth IPCC Assessment Report (AR4), in the detriment of GWP_{100} values (GWP_{100}= 310) in the Second IPCC Assessment Report (SAR), resulted an increase of N_2O_{ATD} emissions within 1992-2013 periods, varying from a minimum increase by circa 13.4 per cent in 1992 to a maximum increase by 150.4 per cent in 2006, with the exception of 1990 and 1991 when a decrease was recorded (Table 5-83).

For the 2014-2015 time series, the respective emissions were estimated for the first time.

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 BUR1 and NC4 of the RM under the UNFCCC, kt CO_2 equivalent

	1990	1991	1992	1993	1994	1995	1996	1997	1998
BUR1	109.7501	99.2537	70.7455	48.2272	28.1255	26.7764	22.5326	17.2496	17.9282
NC4	102.1793	94.8090	80.2010	59.2654	52.2845	47.6452	49.4804	40.3455	39.1353
Difference, %	-6.9	-4.5	13.4	22.9	85.9	77.9	119.6	133.9	118.3
	1999	2000	2001	2002	2003	2004	2005	2006	2007
BUR1	14.3915	13.7618	15.0341	17.4893	15.2541	15.4790	15.3693	13.9252	14.9374
NC4	34.1730	33.5657	35.1601	38.2408	35.0504	34.5949	35.4894	34.8675	30.9833
Difference, %	137.5	143.9	133.9	118.7	129.8	123.5	130.9	150.4	107.4
	2008	2009	2010	2011	2012	2013	2014	2015	%
BUR1	16.2573	14.2679	16.1573	18.0160	22.1330	26.1645			
NC4	32.2461	32.2293	34.3971	34.4824	37.1442	40.0925	50.7786	39.6240	-61.2
Difference, %	98.3	125.9	112.9	91.4	67.8	53.2			

Abbreviations: NC4 – Fourth National Communication; BUR1 – First Biennial Update Report.

The results allow assert that, between 1990 and 2015, indirect N_2O_{ATD} emissions from atmospheric deposition of nitrogen oxides (NO_x) and ammonia (NH_4) decreased by circa 61.2 percent. This significant decrease can be explained by a drastic drop in the amounts of synthetic nitrogen and organic fertilizer applied to soils, and due to a significant reduction of the total livestock population over the period under review.

Planned Improvements

No activities for improving the estimation process regarding the indirect N_2O 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, crop residues, mineralization of nitrogen associated with loss of soil carbon in mineral soils through land-use change or management practices, also through urine and dung deposition from grazing animals, 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 1990-2013 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 updating the share of manure management systems for the entire period under review as a result of 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; as well as due to updating AD on areas sown with crops, gross harvest of agricultural crops, average yield per hectare of agricultural crops (available in the NBS on-line database, and the revised versions of the Statistical Yearbooks of the ATULBD). 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 1992 and 2013, with a variation from a minimum increase of 4.5 per cent in 1999, up to a maximum increase by 23.2 per cent in 2007; with the exception of 1990 and 1991 when a decrease was recorded (Table 5-84).

Table 5-84: Comparative Results of Indirect $N_2O_{(L)}$ Emissions from Soil Nitrogen Leaching and Runoff, included into the BUR1 and NC4 of the Republic of Moldova under the UNFCCC, kt

	1990	1991	1992	1993	1994	1995	1996	1997	1998
BUR1	0.8236	0.7832	0.5762	0.6847	0.4116	0.5125	0.4563	0.6252	0.5377
NC4	0.7934	0.7681	0.6099	0.7228	0.4916	0.5920	0.5385	0.6668	0.5723
Difference, %	-3.7	-1.9	5.9	5.6	19.4	15.5	18.0	6.7	6.4
	1999	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**
BUR1	0.4965	0.4509	0.5332	0.5458	0.4290	0.5811	0.5589	0.5070	0.2400
NC4	0.5190	0.4945	0.5822	0.6035	0.4894	0.6466	0.6378	0.5778	0.2958
Difference, %	4.5	9.7	9.2	10.6	14.1	11.3	14.1	14.0	23.2
	2008	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**%**
BUR1	0.6060	0.4460	0.5391	0.5663	0.3489	0.6491			
NC4	0.6620	0.5072	0.6055	0.6277	0.4071	0.7072	0.7971	0.6016	-24.2
Difference, %	9.2	13.7	12.3	10.8	16.7	8.9			

Abbreviations: NC4 – Fourth National Communication; BUR1 – First Biennial Update Report.

At the same time, at the conversion of indirect N_2O emissions in CO_2 equivalent by using the 100-year Global Warming Potential (GWP_{100}= 298) values available in the Fourth IPCC Assessment Report (AR4), in the detriment of GWP_{100} values (GWP_{100}= 310) in the Second IPCC Assessment Report (SAR), resulted an increase of N_2O_L emissions within 1992-2013 periods, varying from a minimum increase by circa 0.5 per cent in 1999 to a maximum increase by 18.5 per cent in 2007, with the exception of 1990 and 1991 when a decrease was recorded (Table 5-85). For the 2014-2015 time series, the respective emissions were estimated for the first time.

Table 5-85: Comparative Results of Indirect $N_2O_{(L)}$ Emissions from Soil Nitrogen Leaching and Run-off, included into the BUR1 and NC4 of the RM under the UNFCCC, kt CO_2 equivalent

	1990	1991	1992	1993	1994	1995	1996	1997	1998
BUR1	255.3242	242.7968	178.6230	212.2725	127.6059	158.8844	141.4601	193.8046	166.6855
NC4	236.4399	228.9020	181.7573	215.3949	146.4933	176.4111	160.4692	198.6964	170.5521
Difference, %	-7.4	-5.7	1.8	1.5	14.8	11.0	13.4	2.5	2.3
	1999	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**
BUR1	153.9120	139.7821	165.2956	169.2010	132.9984	180.1440	173.2576	157.1761	74.4131
NC4	154.6758	147.3604	173.5001	179.8451	145.8284	192.6854	190.0537	172.1836	88.1504
Difference, %	0.5	5.4	5.0	6.3	9.6	7.0	9.7	9.5	18.5
	2008	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**%**
BUR1	187.8712	138.2709	167.1338	175.5417	108.1557	201.2231			
NC4	197.2796	151.1363	180.4404	187.0477	121.3292	210.7352	237.5440	179.2867	-24.2
Difference, %	5.0	9.3	8.0	6.6	12.2	4.7			

Abbreviations: NC4 – Fourth National Communication; BUR1 – First Biennial Update Report.

The results allow assert that, between 1990 and 2015, indirect N_2O_L emissions from soil nitrogen leaching and run-off decreased by circa 24.2 percent. This decrease can be explained by a drastic drop in the amounts of inorganic nitrogen fertilizers and organic fertilizers applied to soils, and due to a significant reduction of the total livestock population over the period under review, due to changes in the share of manure management systems usage in the RM; 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, tonnes C/tonnes 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).

Table 5-86: Urea Consumption in the RM within 1990-2015 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	%
Imports, t	1 159.8	799.6	2 385.5	5 022.2	7 634.2	5 705.4	13 917.0	7 953.1	902.2
Exports, t	0.0	0.0	6.9	10.6	10.4	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	7 953.1	902.2

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.

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.

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

No recalculations of CO_2 emissions from 3H 'Urea Application' source category were performed, since these were estimated for the first time in the Republic of Moldova (Table 5-87). The obtained results allow assert that within 1990-2015 periods, the respective emissions increased by 10 times.

Table 5-87: CO_2 Emissions from Urea Application in the RM within 1990-2015 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**	**%**
3H. CO_2 emissions from urea application	0.8505	0.5864	1.7443	3.6752	5.5908	4.1840	10.2058	5.8323	902.2

5.5.6. Planned Improvements

Potential improvements could include updating and précising 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 Land Use, Land-Use Change and Forestry Sector 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 2015 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 parcelling as result of land reform, a sharp decrease in agricultural production etc.).

Following the implementation of land reforms in the 90's of the last 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 Cadastre, by 01.01.2016, forest lands accounted for 386.4 thousand ha or 11.4 per cent of the country's territory.

6.1.1. Summary of CO_2 Removals Trends

Over the period from 1990 through 2015, CO_2 removals from LULUCF Sector tended to decrease significantly (Figure 6-1), with the exception of 1991-2001 time series, when an increase was recorded. In comparison with the reference year, CO_2 removals from LULUCF Sector decreased by 2015 by circa 50.6 per cent (Table 6-1).

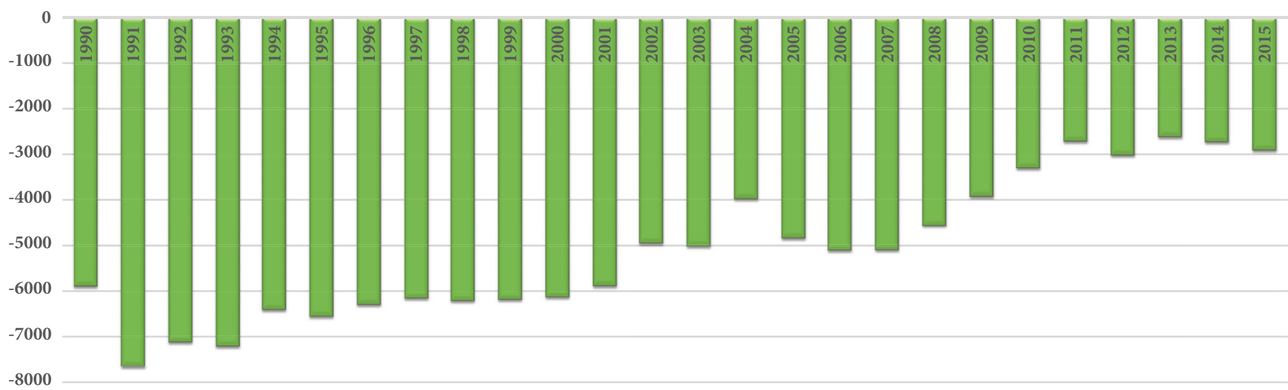


Figure 6-1: CO_2 removals within the LULUCF Sector in the Republic of Moldova within 1990-2015 periods, kt

The main sources of decrease are forest lands, grasslands and lands with wood vegetation from croplands, in particular such categories as: 4A1 "Forest land remaining forest land", 4C2 "Land converted to grassland" and 4B1 "Cropland remaining 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: 4B2 "Land converted to cropland", 4E2 "Land converted to settlements" and 4F2 "Land converted to other land".

Table 6-1: CO_2 Emissions/Removals within the LULUCF Sector in the Republic of Moldova, by Source and Sink Categories within 1990-2015 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	-1591.23	-952.51	-1583.72	1005.60	0.00	-2850.29	0.00	-17.44	0.00	84.75	0.00	152.48	-130.05	-5882.43	100.0
1991	-1364.85	-958.78	-3076.40	978.97	0.00	-3317.42	0.00	-17.44	0.00	88.71	0.00	152.48	-124.59	-7639.32	129.9
1992	-1302.73	-861.94	-3088.16	856.49	0.00	-3383.35	0.00	-17.44	0.00	386.62	0.00	418.89	-115.96	-7107.58	120.8
1993	-1379.80	-794.19	-2967.23	888.60	0.00	-3109.79	0.00	-17.44	0.00	114.62	0.00	164.13	-96.60	-7197.71	122.4
1994	-1367.67	-720.94	-2733.99	912.75	0.00	-3104.19	0.00	0.00	0.00	130.49	0.00	541.07	-65.70	-6408.18	108.9
1995	-1362.78	-662.98	-2935.65	1015.70	0.00	-3088.47	0.00	0.00	0.00	106.92	0.00	392.74	-16.84	-6551.38	111.4
1996	-1571.69	-599.49	-2618.72	1083.13	0.00	-2903.69	0.00	0.00	0.00	101.59	0.00	208.94	3.83	-6296.09	107.0
1997	-1652.15	-560.90	-2463.29	1012.02	0.00	-2771.97	0.00	0.00	0.00	100.80	0.00	179.85	-0.32	-6155.96	104.7
1998	-1744.97	-524.26	-2385.93	1037.72	0.00	-2848.06	0.00	0.00	0.00	99.04	0.00	176.62	-21.29	-6211.13	105.6
1999	-1853.66	-464.04	-2537.63	1124.34	0.00	-2972.09	0.00	0.00	0.00	111.83	0.00	416.77	-11.13	-6185.62	105.2

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		
2000	-1894.25	-394.08	-2484.92	1200.23	0.00	-2844.34	0.00	0.00	0.00	100.18	0.00	170.14	16.59	-6130.46	104.2
2001	-1886.37	-368.24	-2403.66	1297.25	0.00	-2756.00	0.00	0.00	0.00	67.09	0.00	170.14	3.90	-5875.89	99.9
2002	-1926.38	-322.13	-2102.11	1405.83	0.00	-2512.27	0.00	0.00	0.00	67.09	0.00	447.86	-8.13	-4950.25	84.2
2003	-1876.57	-374.35	-2090.97	1444.96	0.00	-2277.65	0.00	0.00	0.00	67.86	0.00	152.12	-58.51	-5013.10	85.2
2004	-1917.04	-398.54	-954.29	1478.81	0.00	-2316.50	0.00	0.00	0.00	53.67	0.00	150.83	-66.90	-3969.96	67.5
2005	-1978.75	-411.62	-1780.45	1291.21	0.00	-2240.76	0.00	0.00	0.00	53.67	0.00	281.65	-55.22	-4840.26	82.3
2006	-1895.58	-451.68	-1710.72	1102.41	0.00	-2227.54	0.00	0.00	0.00	53.67	0.00	70.28	-42.81	-5101.98	86.7
2007	-1973.39	-471.77	-1717.85	1156.56	0.00	-2164.39	0.00	0.00	0.00	49.27	0.00	70.28	-42.25	-5093.53	86.6
2008	-1970.55	-477.38	-1656.16	1138.23	0.00	-1883.47	0.00	0.00	0.00	49.27	0.00	291.00	-46.22	-4555.27	77.4
2009	-1994.27	-517.10	-1514.01	1140.79	0.00	-1123.96	0.00	0.00	0.00	45.57	0.00	79.94	-37.20	-3920.24	66.6
2010	-1969.55	-520.06	-1554.11	1154.84	0.00	-555.75	0.00	0.00	0.00	45.59	0.00	131.68	-30.02	-3297.39	56.1
2011	-1871.29	-502.04	-1566.88	1166.46	0.00	-442.67	0.00	0.00	0.00	61.55	0.00	466.10	-24.32	-2713.10	46.1
2012	-1702.13	-505.94	-1680.36	1203.93	0.00	-426.14	0.00	0.00	0.00	11.83	0.00	87.34	-5.86	-3017.34	51.3
2013	-1531.74	-523.38	-1633.26	1174.66	0.00	-277.47	0.00	0.00	0.00	11.83	0.00	87.34	75.40	-2616.63	44.5
2014	-1499.63	-519.68	-1644.55	1062.11	0.00	-271.16	0.00	0.00	0.00	18.71	0.00	70.48	60.47	-2723.25	46.3
2015	-1511.56	-515.73	-1711.35	983.93	0.00	-306.23	0.00	0.00	0.00	38.89	0.00	60.84	56.64	-2904.57	49.4

This trend is due, first of all, to changes in forest management and forest land use (Category 4B "Cropland"), which contributed to the significant decrease of organic carbon stocks in croplands[96], 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 land use (Category 4A "Forest Land"), such as increasing authorized harvesting of wood mass, significant increase of illegal logging, increased conversion of forest land to agricultural lands, etc.

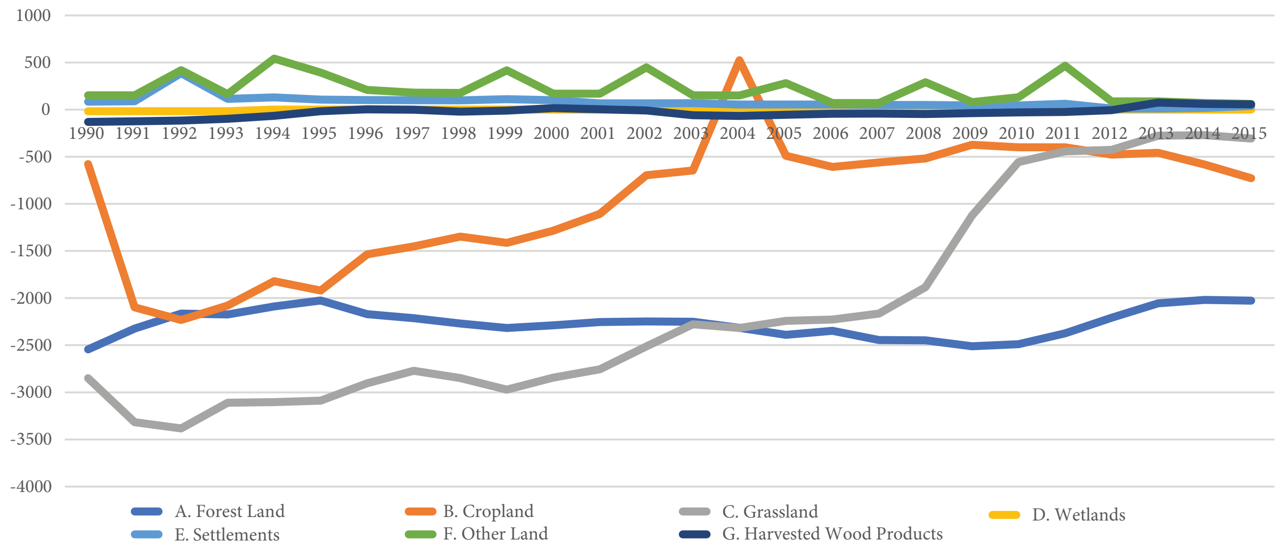


Figure 6-2: CO_2 Emissions/Removals within the LULUCF Sector in the Republic of Moldova, kt

Table 6-2 shows net CO_2 emissions/removals within the LULUCF Sector in the Republic of Moldova within 1990-2015 periods.

Table 6-2: Net CO_2 Emissions/Removals within the LULUCF Sector in the Republic of Moldova within 1990-2015 periods, kt CO_2 equivalent

GHGs	1990	1991	1992	1993	1994	1995	1996	1997	1998
CO_2	-5 882.4287	-7 639.3179	-7 107.5776	-7 197.7136	-6 408.1835	-6 551.3841	-6 296.0942	-6 155.9621	-6 211.1275
CH_4	2.6698	2.4026	2.2003	2.9469	1.6601	2.2399	1.5426	2.6885	2.4766
N_2O	60.1081	59.5672	53.9513	58.1205	60.9789	67.0894	68.3186	64.6443	67.2812
Total	-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
GHGs	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**
CO_2	-6 185.6213	-6 130.4573	-5 875.8873	-4 950.2508	-5 013.0963	-3 969.9582	-4 840.2625	-5 101.9787	-5 093.5290
CH_4	2.3923	0.9124	1.2780	0.2701	0.0658	0.2129	0.2494	0.2629	1.6261
N_2O	71.1684	72.5239	81.7760	83.0170	85.6987	85.0970	75.6478	66.2198	67.6975
Total	-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

[96] 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).

GHGs	2008	2009	2010	2011	2012	2013	2014	2015	%
CO_2	-4 555.2731	-3 920.2377	-3 297.3873	-2 713.1019	-3 017.3416	-2 616.6284	-2 723.2521	-2 904.5678	-50.6
CH_4	0.7777	0.3329	0.1454	0.1688	1.2596	0.9357	0.1221	0.7081	-73.5
N_2O	66.9445	67.7735	67.1303	68.9153	70.9352	68.6457	62.0853	58.4603	-2.7
Total	-4 487.5510	-3 852.1313	-3 230.1116	-2 644.0178	-2 945.1468	-2 547.0470	-2 661.0447	-2 845.3994	-51.1

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 LULUCF Sector.

Table 6-3: Key Source Categories under the LULUCF Sector

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)
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	No
4E1	CO_2	Settlements Remaining Settlements	No
4E2	CO_2	Land Converted to Settlements	No
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., average annual net increment in volume suitable for industrial processing; 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 LULUCF Sector.

At the same time, in order to estimate the decrease of emissions 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.

Table 6-4: Summary of Methods Used to Estimate CO_2 Emissions/Removals from the LULUCF Sector

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 fellings 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)

IPCC Categories	Subcategories	Methodology Used	EF	Notes
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	4G. 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.

The main sources of reference for the activity data used under the LULUCF Sector 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 Cadastres: 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 fellings from the forestry resources managed by the Agency, as well as from forests and forest vegetation managed by other owners; Reports of the State Ecological Inspectorate: illegal fellings 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.

6.1.4. Uncertainties Assessment and Time-Series Consistency

The uncertainty analysis of the CO_2 emissions/removals from the LULUCF Sector (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 ±13.43 per cent. The uncertainties introduced in trend in total sectoral emissions/removals were estimated at ±10.69 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 LULUCF Sector, following a Tier 1 approach (IPCC, 2006). The AD and methods used for estimating CO_2 emissions/removals under the LULUCF Sector 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 LULUCF Sector 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 1970-2015 time series.

6.1.6. Recalculations

CO_2 emissions/removals under the LULUCF sector were recalculated due to use of updated AD and country specific EFs for estimating CO_2 emissions/removals from 4A "Forest Land", 4B "Cropland" and 4C "Grassland". At the same time, for the first time CO_2 emissions/removals from certain categories were estimated separately: 4D "Wetlands", 4E "Settlements", 4F "Other Land" and 4G "Harvested Wood Products". In comparison to the results included into the BUR1 of the RM under the UNFCCC (2016), the performed recalculation resulted in an increase of total net CO_2 removals between 1990 and 2015 (with the exception of 1990), varying from a minimum of +19.2 per cent in 2012, up to a maximum of +7440.4 per cent in 2008 (Table 6-5).

Table 6-5: Recalculated CO_2 Emissions/Removals included into the BUR1 and NC4 of the Republic of Moldova under the UNFCCC within the LULUCF Sector, kt CO_2 equivalent

	1990	1991	1992	1993	1994	1995	1996	1997	1998
BUR1	-5 886.5942	-5 324.9648	-4 384.3888	-1 500.8004	-2 164.0704	-1 029.4289	-1 166.6439	-136.9165	-722.6280
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
Difference, %	-1.1	42.3	60.8	375.5	193.2	529.7	433.7	4347.0	749.9
	1999	2000	2001	2002	2003	2004	2005	2006	2007
BUR1	-1 134.8889	-1 392.2082	-749.9882	-532.6596	-1 554.6866	-103.2311	-375.4117	-639.0807	-3 065.9950
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
Difference, %	438.6	335.1	672.4	813.7	216.9	3663.1	1169.1	687.9	63.9
	2008	2009	2010	2011	2012	2013	2014	2015	%
BUR1	-59.5134	-1 284.9156	-657.0905	-429.1348	-2 470.3546	-97.6148			
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	-51.1
Difference, %	7440.4	199.8	391.6	516.1	19.2	2509.3			

Abbreviations: NC4 – Fourth National Communication; BUR1 – First Biennial Update Report.

The significant differences identified in the current inventory cycle carried out within NC4 of the RM under the UNFCCC (2017), compared to the previous inventory within BUR1 of the RM under the UNFCCC (2016), is due, on one hand, to the full transition to the estimation methodologies available in the 2006 IPCC Guidelines, updating EFs, as well as including in the inventory the estimates related to the process of land conversion and, on the other hand, due to the development and use of the Land Use and Land Use-Change Matrix for 1970-2015 time series. The results of recalculations performed at the category level are presented in sub-chapters 6.2-6.8 of the NIR.

6.1.7. Assessment of Completeness

The current inventory covers CO_2 emissions/removals from 13 source categories (Table 6-6).

Table 6-6: Assessment of Completeness under the LULUCF Sector 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	NE	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	X	X	X	X
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 were estimated under the 4A1 "Forest Land Remaining 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 for category 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 cadastre evidence system in the estimation process of sectoral emissions' decrease. Data on land areas and use categories are provided by land cadastral reports issued by the Agency of Land Relations and Cadastre (ALRC), subsequently approved by Government decisions. Additionally, information on forest land is available at "Moldsilva" Agency.

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 cadastre (aggregated in 11 categories)
1. Forest land (4A)	**(1) forests** (land covered with forests, forest land in a regeneration process (parks, grooves, forest stands affected by fires, degraded stands, forest plantations planted 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) still 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
I. Forest land (4A), total	371.40	369.80	372.30	392.82	411.07	414.10
1.1. Forests (including land covered with forests, forest land in a regeneration process etc.)	368.57	369.24	371.95	388.45	410.63	413.48
1.2. Forested land (conversions)	2.83	0.56	0.35	4.38	0.44	0.62
II. Cropland (4B), total	2258.40	2241.80	2212.50	2198.52	2197.76	2203.59
2.1. Forest vegetation	47.00	55.20	50.50	50.47	52.03	51.15
2.2. Vineyards	218.80	195.90	162.20	157.34	149.58	136.17
2.3. Orchards	251.80	216.70	172.70	141.68	149.21	152.73
2.4. Cropland	1740.80	1774.00	1827.10	1849.03	1846.95	1863.53
III. Grassland (4C), total	390.70	400.60	412.80	399.14	380.92	373.87
IV. Wetlands (4D), total	89.40	92.40	96.60	96.08	99.64	96.66
V. Settlements (4E), total	218.43	234.10	236.10	235.78	233.64	236.48
VI. Other land (4F), total	56.30	45.93	54.33	62.28	61.60	59.93
Total	3384.63	3384.63	3384.63	3384.63	3384.63	3384.63

Source: Land Cadastres of the Republic of Moldova within 1990-2015 periods.

6.1.8. Planned Improvements

Planned improvements at the source and sink category level within the LULUCF Sector 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[97], recovering to 386.4 thousand ha in 2015 or circa 11.4 per cent of the country's territory (Figure 6-3).

[97] 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.

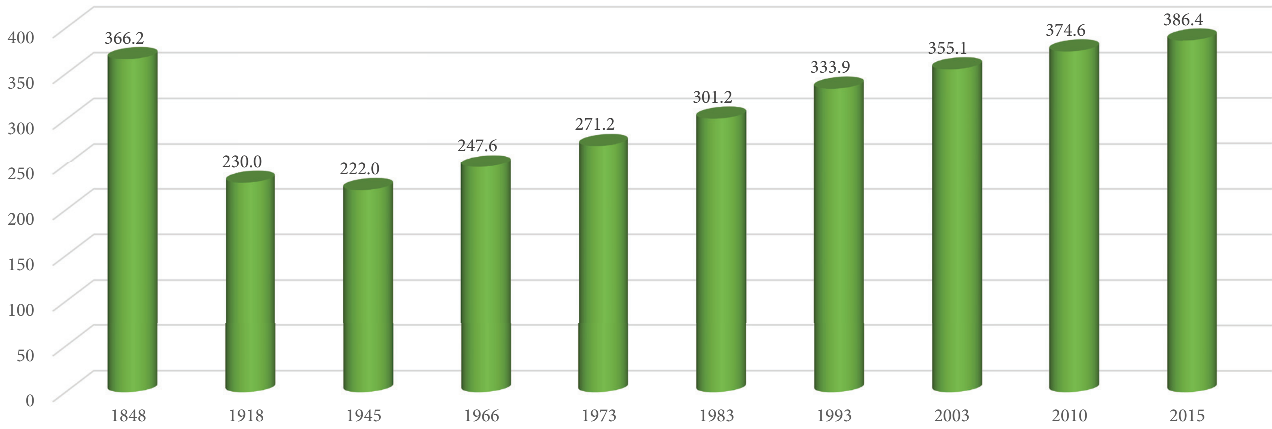


Figure 6-3: Evolution of Areas Covered with Forests in the RM, 1848-2015, thousand ha

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 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.

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 1,468.3 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 growing in the forests of the Republic of Moldova) as well as from losses from authorized and illegal harvesting of fuel 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:

$$\Delta C_G = \sum (A \bullet G_{total} \bullet CF)$$

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.[98]/yr/ha), calculated using the following equation:

$$G_{total} = \sum \{Iv \bullet BCEF_I \bullet (1 + R)\}$$

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:

[98] Constant mass.

$$BCEF_I = BEF_I \cdot D$$

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 fellings and illegal logging, and disturbances (diseases and pests, natural calamities, mass droughts), estimated by the following formula:

$$\Delta CL = L_{fellings} + L_{fuelwood} + L_{perturbations}$$

Where:

ΔCL – annual biomass loss due to wood removals (fellings and other losses), t C/yr;

$L_{fellings}$ – annual carbon loss due to commercial fellings, 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:

$$L_{fellings} = \{H \cdot BCEF_R \cdot (1+R)\} \cdot CF$$

Where:

H – wood removal, 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:

$$BCEF_R = D \cdot BEF_R$$

Where:

D – basic wood density (t MC/m^3 volume for standing wood);

BEF_R – biomass expansion factor for extracted round wood;

$$L_{fuelwood} = [\{FG_{trees} \cdot BCEF_R \cdot (1+R)\} + FG_{parts\ of\ trees} \cdot D] \cdot CF$$

Where:

FG_{trees} – fuelwood removal as trees, m^3;

$FG_{parts\ of\ trees}$ – 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:

$$BCEF_R = D \cdot BEF_R$$

Where:

D – basic wood density (t d.m/m^3 volume for standing wood);

BEF_R – biomass expansion factor for fuel wood gathering;

$$L_{perturbations} = \{A_{perturbations} \cdot BW \cdot (1 + R) \cdot CF \cdot fd\}$$

Where:

$A_{perturbations}$ – areas affected by disturbances (diseases and pests, natural calamities, mass droughts etc.), ha/yr;

BW – 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 $L_{fellings}$ and $L_{fuelwood}$, as the forests in the Republic of Moldova are intensively managed, being regularly draw in cleaning cuttings (including selective sanitation treatments), forestry thinning (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 harvested etc.). The total wood mass harvested includes both wood mass harvested as authorized and planned fellings, as well as illegal logging revealed by forestry and environment protection authorities. 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, Sour cherry tree magaleb, Apricot tree, sycamore, Weeping willow, Hazel tree, Corneal tree, Hawthorn, Sweet briar, Female cornel, 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 2015, available into the National Report on Forestry Resources of the Republic of Moldova (2011), Report on Forest Land and activity results of "Moldsilva" Agency within 1990-2015 periods and General Land Cadasters of the Republic of Moldova (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 1990-2015 periods, thousand ha

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

Source: National Report on Forestry Resources of the Republic of Moldova (2011), General Land Cadastres for 1990-2015 periods; Statistical Records and Reports of "Moldsilva" Agency on afforestation over the 1998-2015 periods.

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 2015. 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 1990-2015 periods, kha

Species	1990	1991	1992	1993	1994	1995	1996	1997	1998
QU	98.38	99.94	104.34	108.15	111.26	113.97	117.15	119.18	121.17
CA	6.58	6.65	6.91	7.20	7.67	8.13	8.63	9.06	9.50
FR	11.61	11.81	12.34	12.81	13.40	13.96	14.58	15.07	15.56
AC	2.03	2.05	2.20	2.27	2.33	2.38	2.44	2.48	2.51
UL	2.17	2.21	2.28	2.35	2.41	2.46	2.52	2.56	2.60
TI	2.03	2.05	2.13	2.20	2.26	2.30	2.36	2.40	2.43
SA	1.33	1.41	1.54	1.67	1.75	1.82	1.90	1.97	2.03
PI	4.83	4.88	5.07	5.23	5.37	5.48	5.62	5.70	5.78
PO	3.99	4.17	4.41	4.62	4.79	4.94	5.12	5.24	5.36
RB	86.76	88.91	93.61	97.84	101.07	103.97	107.30	109.61	111.88
OS	7.98	8.06	8.38	8.72	8.48	8.26	7.98	7.69	7.29
Grooves[4]	32.19	32.30	30.71	30.16	27.79	26.13	25.68	26.00	26.91
Total	259.86	264.46	273.92	283.22	288.57	293.81	301.29	306.95	313.02
Species	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**
QU	123.99	127.38	128.91	128.69	128.94	131.14	132.40	131.17	130.82
CA	10.00	10.57	11.00	11.28	10.95	10.72	10.43	10.31	10.01
FR	16.17	16.86	17.31	17.54	17.46	17.46	17.50	17.47	17.56
AC	2.57	2.63	2.65	2.64	2.78	2.94	3.19	3.41	3.48
UL	2.65	2.72	2.74	2.73	2.78	2.94	3.28	3.24	3.31
TI	2.48	2.54	2.57	2.56	2.69	2.77	2.93	2.90	2.97
SA	2.11	2.20	2.27	2.30	2.17	2.07	2.07	2.05	2.04
PI	5.90	6.05	6.11	6.08	6.00	5.96	6.03	5.97	5.94
PO	5.53	5.71	5.82	5.85	5.82	5.88	5.95	5.97	5.94
RB	114.95	118.56	120.45	120.77	119.82	119.97	120.38	120.94	122.51
OS	6.93	6.66	6.19	5.64	6.78	7.26	8.45	8.52	8.48
Grooves[4]	24.76	24.44	24.60	25.09	27.90	27.93	25.97	28.83	30.29
Total	318.03	326.32	330.62	331.18	334.09	337.04	338.56	340.76	343.35
Species	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**%**
QU	131.06	131.25	132.87	133.67	133.80	132.33	143.76	146.44	48.9
CA	10.08	10.24	10.35	10.41	10.41	10.30	14.06	14.33	117.8
FR	17.62	17.69	17.96	18.05	18.07	17.87	18.71	19.06	64.2
AC	3.47	3.47	3.51	3.52	3.53	3.49	4.92	5.01	146.8
UL	3.30	3.30	3.33	3.35	3.36	3.34	3.56	3.63	67.3
TI	2.97	2.96	2.99	3.01	3.01	2.98	4.90	5.00	146.3
SA	2.03	2.03	2.05	2.06	2.06	2.05	3.36	3.42	157.1
PI	5.85	5.84	5.90	5.93	5.93	5.82	5.43	5.53	14.5
PO	6.01	6.01	6.07	6.10	6.11	6.08	6.47	6.59	65.2
RB	124.28	124.31	126.54	127.25	127.36	125.97	108.06	110.08	26.9
OS	8.47	8.46	8.64	8.69	8.69	8.59	13.15	13.25	66.0
Grooves[4]	30.25	34.55	33.46	30.89	31.73	36.15	29.23	23.83	-26.0
Total	345.40	350.10	353.66	352.93	354.07	354.97	355.62	356.17	37.1

Source: General Land Cadastres for 1990-2015 periods; Land Use and Land Use-Change Matrix for 1970-2015 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 fellings 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 State Ecological Inspectorate, on authorized fellings 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 1990-2015 periods, thousand m³

Sort categories	1990	1991	1992	1993	1994	1995	1996	1997	1998
Commercial fellings	39.42	27.00	27.39	31.50	39.80	68.49	51.69	52.70	38.00
Fuel wood gathering	184.80	376.50	490.29	489.18	538.70	531.42	450.43	423.85	398.55
Sort categories	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**
Commercial fellings	38.79	39.68	37.28	50.41	46.99	43.47	39.01	46.51	44.44
Fuel wood gathering	368.62	393.34	432.47	381.98	420.20	415.37	394.79	430.10	390.92
Sort categories	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**%**
Commercial fellings	42.79	37.34	40.63	33.91	31.69	29.92	25.60	28.00	-29.0
Fuel wood gathering	401.84	396.82	429.89	485.45	541.47	587.20	624.33	607.32	228.6

Source: Statistical Records/Reports of "Moldsilva" Agency and of the State Ecological Inspectorate for the 1990-2015 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 (2000-2016); 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, durmust, 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 1990-2015 time series.

Table 6-13: Trends in Commercial Fellings Harvest in the RM within 1990-2015, 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**	**%**
Quercus spp.	7.17	5.84	7.16	5.68	4.77	6.28	6.05	6.62	-7.5
Carpinus spp.	1.13	0.77	0.87	0.74	0.49	0.52	0.33	0.36	-65.7
Fraxinus spp.	6.02	5.70	5.83	4.03	4.52	4.76	4.26	4.66	27.7
Acer spp.	0.25	0.15	0.20	0.14	0.11	0.15	0.06	0.06	-80.6
Ulmus spp.	0.20	0.17	0.19	0.24	0.12	0.17	0.06	0.06	-64.7
Tilia spp.	3.84	3.24	3.42	3.17	2.67	2.21	2.00	2.19	-42.1
Salix spp.	0.38	0.38	0.14	0.19	0.24	0.25	0.07	0.08	-69.2
Pinus spp.	0.60	0.89	1.19	1.95	1.35	0.73	0.62	0.68	142.9
Populus spp.	6.09	4.87	6.32	5.61	5.26	5.06	4.69	5.13	5.3
Robinia spp.	16.01	14.34	14.41	11.47	11.69	9.43	7.09	7.76	-53.6
Other species	1.10	0.98	0.89	0.69	0.47	0.36	0.37	0.40	-65.2
Total	42.79	37.34	40.63	33.91	31.69	29.92	25.60	28.00	-29.0

Source: Statistical Records/Reports of "Moldsilva" Agency and of the State Ecological Inspectorate for the 1990-2015 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. Taking into account 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 1990-2015 periods, thousand m³

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**	**%**
Quercus spp.	59.84	59.35	65.69	79.64	83.02	98.39	106.84	100.82	235.0
Carpinus spp.	27.73	26.27	30.17	34.86	40.26	43.26	45.93	44.15	253.2
Fraxinus spp.	49.05	52.75	62.33	51.55	63.35	71.66	76.71	74.44	371.1
Acer spp.	23.48	23.33	23.79	22.06	12.98	21.90	17.27	31.63	263.6
Ulmus spp.	8.55	9.90	12.74	20.56	21.48	20.25	19.15	15.12	332.0
Tilia spp.	25.19	22.43	22.98	22.18	28.72	29.86	30.30	31.28	195.1
Salix spp.	7.85	4.75	5.42	7.79	9.24	10.71	10.90	12.82	277.1
Pinus spp.	2.74	3.91	4.78	10.27	8.92	10.87	17.02	5.59	1297.5
Populus spp.	25.04	23.82	26.00	30.91	33.72	39.37	42.69	40.88	246.4
Robinia spp.	153.64	148.00	156.80	182.12	200.93	208.77	208.91	222.77	190.1
Other species	18.74	22.32	19.20	23.51	38.85	32.16	48.61	27.82	148.4
Total	401.84	396.83	429.89	485.45	541.47	587.20	624.33	607.32	228.6

Source: Statistical Records/Reports of "Moldsilva" Agency and of the State Ecological Inspectorate for the 1990-2015 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 2000-2016.

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 in the RM, 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, m³/ha	Basic wood density, t.d.m./m³ fresh volume	Biomass expansion factor for current increments, BEF_1	Biomass expansion factor for Commercial Fellings 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 the following general equation 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 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 the following formula:

$$\Delta C_{Conversion} = \Sigma \{(B_{After} - B_{Before}) \bullet \Delta A_{B\_over}\} \bullet CF$$

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;

ΔA_{B_over} – 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 took into account 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 1970-2015 periods (Table 6-17).

Table 6-17: Annual Successful Afforestation Included in Forest Land in Cadastral Records within 1970-2015 periods, ha

Land Categories	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981
Degraded arable lands	288.0	296.8	307.8	335.3	366.3	399.9	417.2	433.1	464.3	543.2	633.9	244.3
Orchards	146.6	151.1	156.7	170.7	186.5	203.6	212.4	220.5	236.3	276.5	322.7	124.3
Vineyards	4.3	4.5	4.6	5.0	5.5	6.0	6.3	6.5	7.0	8.2	9.5	3.7
Grassland	3327.9	3428.8	3555.9	3874.4	4232.6	4620.6	4820.8	5004.4	5364.2	6276.1	7324.6	2822.2
Total	3766.9	3881.1	4024.9	4385.4	4790.9	5230.0	5456.7	5664.5	6071.7	7104.0	8290.7	3194.5
Land Categories	**1982**	**1983**	**1984**	**1985**	**1986**	**1987**	**1988**	**1989**	**1990**	**1991**	**1992**	**1993**
Degraded 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	115.7	113.2	114.8	115.9	85.7	100.6	152.1	142.5	110.0	41.2	44.6	21.9
Vineyards	3.4	3.3	3.4	3.4	2.5	3.0	4.5	4.2	3.2	1.2	1.3	0.6
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
Total	2971.3	2909.0	2948.0	2977.0	2202.0	2585.0	3909.0	3661.0	2826.0	1057.0	1145.0	562.0

Land Categories	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
Degraded 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	25.2	21.6	12.7	15.0	16.8	15.4	13.8	12.0	175.3	176.8	171.4	170.4
Vineyards	0.7	0.6	0.4	0.4	0.5	0.5	0.4	0.4	5.2	5.2	5.1	5.0
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
Total	648.0	556.0	326.0	387.0	433.0	396.0	354.0	308.0	4503.0	4543.0	4405.0	4377.0
Land Categories	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**%**
Degraded arable lands	352.4	355.7	372.3	221.7	33.3	23.4	19.4	19.6	22.0	47.2	NA	-83.6
Orchards	179.4	181.1	189.5	112.9	17.0	11.9	9.9	10.0	11.2	24.0	NA	-83.6
Vineyards	5.3	5.3	5.6	3.3	0.5	0.4	0.3	0.3	0.3	0.7	NA	-83.7
Grassland	4071.4	4110.1	4302.0	2561.9	384.8	270.3	223.7	226.3	253.7	544.9	NA	-83.6
Total	4608.0	4652.0	4869.0	2900.0	436.0	306.0	253.0	256.0	287.0	617.0	NA	-83.6

Source: General Land Cadastres for 1970-2015 periods; Land Use and Land Use-Change Matrix for 1970-2015 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 2002-2011 periods, ha

Afforestation Area	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	Total
MSC Project	5 197.3	4 971.9	4 477.6	4 152.1	985.6	60.5	329.9	99.0	16.0	0.0	20 289.9
MCFD Project	0.0	0.0	0.0	0.0	2 001.8	2 976.7	2 223.0	1 245.4	10.0	12.0	8 468.8
Total CDM Projects	5 197.3	4 971.9	4 477.6	4 152.1	2 987.4	3 037.2	2 552.9	1 344.4	26.0	12.0	28 758.7

Source: PDD for MSCP and MCFDP; Annual Reports from “Moldsilva” Agency to the World Bank for 2004-2015 time series.

In addition to harvested forest products, the net decrease of CO_2 emissions 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 Development Institute (FRDI), 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;
- C_f – combustion factor, the default value used is 0.45 (2006 IPCC Guidelines, Volume 4, Chapter 2, Table 2.6, Page 2.48);
- $M_B \bullet C_f$ – the amount of fuel actually burnt, its value, according to MSCP and MCFDP estimates is 32.22 t 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 Republic of Moldova and those of the ATULBD (Table 6-21).

Table 6-21: Forest Land Areas Affected by Fires in the RM within1990-2015 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	N/A	N/A	N/A	N/A	N/A	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	%
Right bank of Dniester river	31.00	126.00	20.00	25.90	636.60	460.00	9.50	338.20	181.6
Left bank of Dniester river	24.00	8.20	26.90	36.90	35.80	7.10	28.90	18.00	N/A
Total in the RM	55.00	134.20	46.90	62.80	672.40	467.10	38.40	356.20	196.6

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); 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).

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 2015, the level of precision of activity data related to the production processes reached circa ±15 per cent. Uncertainties related to removals factors in both cases are of circa ±5 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 State Ecological Inspectorate (SEI) only, as an institution that authorizes fellings 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.

Combined uncertainties for 4A1 "Forest Land Remaining Forest Land" sink category represent circa ±15.81 per cent, while, the uncertainties introduced in trend in total sectoral direct GHG emissions/ removals were estimated at ±33.57 per cent.

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 reach to ±15.81 per cent, while, the uncertainties introduced in trend in total sectoral direct GHG emissions/ removals were estimated at ±3.53 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 CH_4 and ±50.99 per cent for N_2O), while combined uncertainties as a percentage of total direct sectoral emissions/removals are of circa ±0.0006 per cent for CH_4 and of circa ±14.92 per cent for 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 Cadastre 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 LULUCF Sector, of a Land Use and Land Use-Change Matrix for 1970-2015 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 revealed by the State Ecological Inspectorate and "Modsilva" Agency annual reports and were provided by the study "*Illegal logging of forest vegetation in the Republic of Moldova*"[99].

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 1990-2013 time series, recalculations were performed for CO_2 removals within the 4A1 "Forest Land Remaining Forest Land" sink category. It should be noted that 4A2 "Land Converted to Forest Land" sink category was considered for the first time in the inventory. The comparative analysis for net CO_2 removals for 4A1 "Forest Land Remaining Forest Land" within 1990-2013 periods is presented in Table 6-22.

Table 6-22: Comparative Evolution for net CO_2 Removals for 4A1 "Forest Land Remaining Forest Land", included into the BUR1 and NC4 of the Republic of Moldova under the UNFCCC, kt

	1990	1991	1992	1993	1994	1995	1996	1997	1998
BUR1	-2197.5790	-1924.1010	-1766.5038	-1491.3852	-1743.7096	-1620.7949	-1705.1295	-2132.2121	-2027.8925
NC4	-1591.2275	-1364.8477	-1302.7299	-1379.8005	-1367.6689	-1362.7847	-1571.6869	-1652.1452	-1744.9666
Difference, %	-27.6	-29.1	-26.3	-7.5	-21.6	-15.9	-7.8	-22.5	-14.0
	1999	2000	2001	2002	2003	2004	2005	2006	2007
BUR1	-2111.2238	-2140.3185	-2195.4199	-2134.8652	-2135.8765	-2183.7322	-2246.2332	-2087.8823	-2192.3574
NC4	-1853.6589	-1894.2503	-1886.3663	-1926.3824	-1876.5708	-1917.0446	-1978.7520	-1895.5814	-1973.3929
Difference, %	-12.2	-11.5	-14.1	-9.8	-12.1	-12.2	-11.9	-9.2	-10.0
	2008	2009	2010	2011	2012	2013	2014	2015	%
BUR1	-2223.0019	-2251.7423	-2193.2612	-2082.9771	-2007.9512	-1887.6165	N/A	N/A	N/A
NC4	-1970.5529	-1994.2669	-1969.5519	-1871.2941	-1702.1310	-1531.7430	-1499.6258	-1511.5589	-5.0
Difference, %	-11.4	-11.4	-10.2	-10.2	-15.2	-18.9	N/A	N/A	N/A

Abbreviations: NC4 – Fourth National Communication; BUR1 – First Biennial Update Report.

As data in the table above reveal, net CO_2 removals from 4A1 sink category constantly decreased (with up to 29.1 per cent per year). This is due to new methodologies used, as well as to enhancement of AD quality used to estimate CO_2 removals.

[99] 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.

Between 1990 and 2015, CO_2 removals from 4A "Forest Land" category decreased (Figure 6-4). Thus, compared to the reference year, in 2015 there was a decrease by 20.3 per cent or a difference by circa 516.5 kt (Table 6-23). This is due to an increase in the volume of wood officially harvested from national forests.

Table 6-23: Net CO_2 Removals from 4A "Forest Land" in the RM within 1990-2015 periods, kt

	1990	1991	1992	1993	1994	1995	1996	1997	1998
CO_2 Removals within 4A1	-1591.2275	-1364.8477	-1302.7299	-1379.8005	-1367.6689	-1362.7847	-1571.6869	-1652.1452	-1744.9666
CO_2 Removals within 4A2	-952.5127	-958.7836	-861.9363	-794.1905	-720.9410	-662.9847	-599.4909	-560.8987	-524.2643
Total CO_2 Removals within 4A	-2543.7403	-2323.6314	-2164.6662	-2173.9910	-2088.6098	-2025.7694	-2171.1779	-2213.0439	-2269.2309
	1999	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**
CO_2 Removals within 4A1	-1853.6589	-1894.2503	-1886.3663	-1926.3824	-1876.5708	-1917.0446	-1978.7520	-1895.5814	-1973.3929
CO_2 Removals within 4A2	-464.0373	-394.0803	-368.2418	-322.1317	-374.3474	-398.5398	-411.6163	-451.6773	-471.7680
Total CO_2 Removals within 4A	-2317.6962	-2288.3306	-2254.6081	-2248.5141	-2250.9181	-2315.5844	-2390.3683	-2347.2587	-2445.1609
	2008	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**%**
CO_2 Removals within 4A1	-1970.5529	-1994.2669	-1969.5519	-1871.2941	-1702.1310	-1531.7430	-1499.6258	-1511.5589	-5.0
CO_2 Removals within 4A2	-477.3833	-517.1006	-520.0570	-502.0372	-505.9393	-523.3781	-519.6830	-515.7307	-45.9
Total CO_2 Removals within 4A	-2447.9362	-2511.3674	-2489.6089	-2373.3313	-2208.0703	-2055.1211	-2019.3088	-2027.2895	-20.3

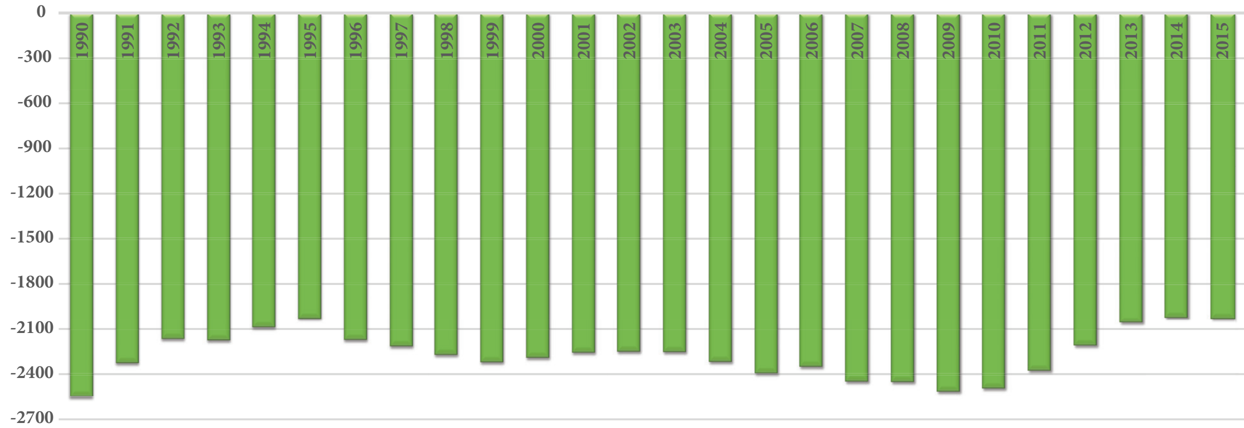


Figure 6-4: Net CO_2 Removals from 4A "Forest Land" in the RM within 1990-2015 periods, kt

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 62.6 per cent in 1990, respectively circa 74.6 per cent in 2015 (Figure 6-5).

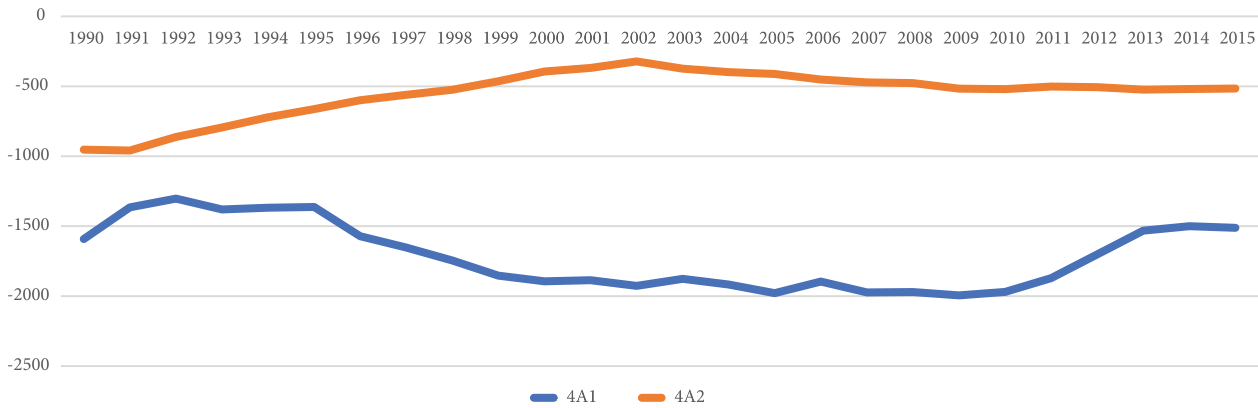


Figure 6-5: Evolution of CO_2 Removal by Each Subcategory in the RM within 1990-2015, kt

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 a 7 times increase compared to the reference year (1990) level. At the same time, in comparison to the reference year, by 2015 the non-CO_2 emissions from forest areas affected annually by fires within the category 4A "Forest Land" increased by circa 3.9 times (Table 6-24).

Table 6-24: Non-CO_2 Emissions from Forest Areas Annually Affected by Fires in the Republic of Moldova within 1990-2015 periods

GHGs	1990	1991	1992	1993	1994	1995	1996	1997	1998
CH_4, kt	0.0089	0.0015	0.0016	0.0001	0.0025	0.0001	0.0008	0.0003	0.0025
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	0.3711	0.0621	0.0680	0.0046	0.1035	0.0060	0.0346	0.0105	0.1041
GHGs	1999	2000	2001	2002	2003	2004	2005	2006	2007
CH_4, kt	0.0019	0.0001	0.0042	0.0023	0.0025	0.0066	0.0006	0.0068	0.0589
N_2O, kt	0.0001	0.0000	0.0002	0.0001	0.0001	0.0004	0.0000	0.0004	0.0033
Total, kt CO_2 equivalent	0.0779	0.0028	0.1761	0.0946	0.1035	0.2719	0.0260	0.2806	2.4453
GHGs	2008	2009	2010	2011	2012	2013	2014	2015	%
CH_4, kt	0.0041	0.0100	0.0035	0.0047	0.0501	0.0348	0.0029	0.0265	196.6
N_2O, kt	0.0002	0.0006	0.0002	0.0003	0.0028	0.0019	0.0002	0.0015	196.6
Total, kt CO_2 equivalent	0.1700	0.4147	0.1449	0.1941	2.0779	1.4435	0.1187	1.1007	196.6

In the context of the attributed competencies, the "Moldsilva" Agency produces regular reports on CO_2 emissions decrease 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 test areas and international certification etc. Thus, according to these reports, between 2004 and 2015, a decrease by circa 2.2 Mt of CO_2 equivalent within the MSCP and MCFDP projects was recorded (Table 6-25).

Table 6-25: CO_2 Losses in the RM within the CDM Projects (MSCP and MCFDP) within 2004-2015 periods, kt

	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Net Removals in "PCSM"	-31.39	-37.36	-86.53	-93.32	-123.30	-138.40	-151.06	-190.60	-191.85	-216.49	-214.77	-221.90
Net Removals in "PDSFCM"	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-328.81	-58.15	-39.00	-36.00
Total CDM Project	-31.39	-37.36	-86.53	-93.32	-123.30	-138.40	-151.06	-190.60	-520.66	-274.64	-253.78	-257.90

Source: "Moldsilva" Agency Reports on MSCP and MCFDP monitoring from 2012, 2013 and 2016; Annual Reports from "Moldsilva" Agency to the World Bank for 2004-2015 time series.

6.2.6. Planned Improvements

For the next inventory cycles it will be considered to improve accounting of distribution of forest land by species, actual consumption of fuel wood from the managed forest land of the Republic of Moldova, 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 unfavourable 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 etc.,); other forest vegetation, including forest stripes for protection 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 two subcategories: 4B1.1 "Cropland Covered with Woody Vegetation" and 4B1.2 "Annual Change in Carbon Stocks in Mineral Soils".

4B1.1. Cropland Covered with Woody Vegetation

The 4B1.1 "Cropland Covered with Woody Vegetation" sink category comprises CO_2 removals from cropland covered with woody vegetation, including above-ground and below-ground biomass in protection forest strips, woody crops 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.

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 woody crops and shrubs plantations along the communication ways;
- water protection forest strips;
- 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 LULUCF sector, as according the General Land Cadastre of the Republic of Moldova (standing as of 01.01.2016), this source includes arable lands with a share of over 55.1 per cent of the total, which occupy 1,863.53 thousand ha). It should be mentioned that over the period from 1990 through 2015, 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[100]. 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 etc.) 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

"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 persist in the Republic of Moldova. Crop residues are burnt in fields to clear the stubble fields from the straw left after reaping (in the Republic of Moldova, 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 etc.) or lacked vegetation (settlements, wetlands etc.).

[100] 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.

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 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 annual 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 calculations 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:

$$\Delta CL = L_{fellings} + L_{fuelwood} + L_{perturbations}$$

Where:

ΔCL – annual decrease in carbon stocks due to biomass loss (harvesting/fellings and other types of removals), t C/yr;
$L_{fellings}$ – 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 SEI 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 mii 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 6-26).

Table 6-26: Estimated Wood Harvested from Other Types of Woody Vegetation in the RM

Categories	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 SEI 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 6-27).

Table 6-27: Evolution of Wood Harvested from Other Types of Woody Vegetation in the RM within 1990-2015 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	%
Wood harvested volume	2.36	2.48	5.20	2.10	2.91	3.49	8.57	9.51	NA

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 Cadastre of the RM on areas occupied by such crops over the period from 1990 through 2015 (Table 6-28).

Table 6-28: Areas of Land Covered with Woody Vegetation from 4B1 "Cropland Remaining Cropland" within 1990-2015 periods, ha

Land Category	1990	1991	1992	1993	1994	1995	1996	1997	1998
Perennial plantations	288963.7	299625.7	290825.7	275601.8	276552.7	264162.7	275381.3	262081.3	246981.3
Other forest vegetation	47000.0	47000.0	47800.0	47000.0	47000.0	54100.0	54600.0	51500.0	49400.0
Total woody vegetation	335963.7	346625.7	338625.7	322601.8	323552.7	318262.7	329981.3	313581.3	296381.3
Land Category	1999	2000	2001	2002	2003	2004	2005	2006	2007
Perennial plantations	228581.3	222913.5	193749.6	200656.6	207902.9	216626.0	216450.7	216266.0	216079.6
Other forest vegetation	49400.0	50500.0	50084.0	50084.0	49030.0	49030.0	49314.0	50466.0	51141.0
Total woody vegetation	277981.3	273413.5	243833.6	250740.6	256932.9	265656.0	265764.7	266732.0	267220.6
Land Category	2008	2009	2010	2011	2012	2013	2014	2015	%
Perennial plantations	224940.6	222903.2	287399.0	289307.4	285978.7	285926.6	282353.6	279548.4	-3.3
Other forest vegetation	51464.5	49081.6	52028.4	49081.2	51945.7	50119.1	49153.2	49153.1	4.6
Total woody vegetation	276405.1	271984.8	339427.3	338388.7	337924.4	336045.7	331506.8	328701.5	-2.2

Source: General Land Cadastre for 1970-2015; Land Use and Land Use-Change Matrix for 1970-2015 periods.

According to recorded data, between 1990 and 2015 the area of other types of woody vegetation had a positive trend, increasing by 4.6%. Within the same periods, perennial plantations constantly decreased (Table 6-8), the total area decreasing by 38.6%: the area of orchards decreased by 39.3 per cent while vineyards – by 37.8%. 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 6-29).

Table 6-29: Evolution of Lands Subject to Internal Conversion from 4B1.1 "Cropland Covered with Woody Vegetation" Category within 1970-2015 periods, ha

Land Category	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981
Perennial plantations to cropland	0.0	0.0	19923.5	0.0	0.0	0.0	0.0	8831.6	5948.0	3255.2	0.0	1347.6
Forest vegetation to cropland	0.0	72.0	72.0	72.0	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	2529.7	18118.8	5607.2	24273.7	0.0	0.0	0.0	11521.0	0.0
Total	0.0	10583.8	19995.5	2601.7	18190.8	5788.2	24418.7	8867.6	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	128.0	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	0.0	63352.0	4165.8	0.0	0.0
Total	11715.3	9934.5	8885.6	26707.9	20499.1	2234.2	9291.2	1649.5	63822.0	4454.8	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	1415.1
Total	19728.7	18150.4	13461.3	14167.1	15571.1	18596.0	17217.6	28777.5	4905.1	3279.9	121.2	1832.1
Land Category	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**%**
Perennial plantations to cropland	0.0	0.0	0.0	1886.7	0.0	2279.6	3258.8	41.1	3497.4	2730.5	NA	NA
Forest vegetation to cropland	0.0	0.0	0.0	1085.6	0.0	0.0	8.7	661.1	349.5	0.0	NA	NA
Cropland to forest vegetation	244.2	116.9	223.0	0.0	0.0	1045.0	0.0	0.0	0.0	724.0	NA	NA
Cropland to perennial plantations	2929.0	807.0	453.6	0.0	15.0	0.0	0.0	0.0	0.0	0.0	NA	NA
Total	3173.2	923.9	676.6	2972.2	15.0	3324.6	3267.5	702.2	3846.9	3454.5	NA	NA

Source: General Land Cadastre for 1970-2015; Land Use and Land Use-Change Matrix for 1970-2015 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 6-30).

Table 6-30: 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 6-31).

Table 6-31: Emission/Removal Factors used for Internal Conversion under the 4B1.1 "Cropland Covered with Woody Vegetation" Category[101]

Internal Conversion	Indicators	Period, years	Units	Indicators Value[1]
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 (DOM)	year 1	Mg C/ha/yr	-1.15
	Annual average increments in soil organic carbon (SOC)	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 (DOM)	years 1-20	Mg C/ha/yr	0.41
	Annual average increments in soil organic carbon (SOC)	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 (DOM)	years 1-20	Mg C/ha/yr	0.00
	Annual average increments in soil organic carbon (SOC)	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).

[101] 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 taken into account:

- 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 2015 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 longest 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 1990-2015 periods.

In order to estimate CO_2 emissions within the category 5B1.2 "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 6-32).

Table 6-32: Areas of Cropland Remaining Cropland in the RM within 1990-2015 periods, kha

Land Category	1990	1991	1992	1993	1994	1995	1996	1997	1998
Cropland Remaining Cropland, kha	1 342.6	1 325.5	1 346.1	1 342.2	1 342.5	1 342.5	1 347.0	1 373.0	1 388.5
Land Category	1999	2000	2001	2002	2003	2004	2005	2006	2007
Cropland Remaining Cropland, kha	1 389.3	1 379.5	1 376.2	1 374.3	1 373.5	1 371.9	1 409.3	1 443.7	1 442.4
Land Category	2008	2009	2010	2011	2012	2013	2014	2015	%
Cropland Remaining Cropland, kha	1 441.6	1 442.4	1 442.7	1 439.5	1 413.0	1 440.1	1 459.8	1 488.5	10.9

Source: General Land Cadastre for 1970-2015; Land Use and Land Use-Change Matrix for 1970-2015 periods.

Based on the respective AD, annual changes in carbon stocks from mineral soils were estimated (Table 6-33).

Table 6-33: Annual Carbon Losses in Mineral Soils in the RM within 1990-2015 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	%
$\Delta C_{mineral}$, 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	10.9

The results show certain changes between 1990 and 2015 accounting for circa 354.9 kg C/ha/yr. This value is close to the previous results of various authors in the RM in long-term experiments (Zagorcea, 1990; Ungureanu et al., 1997; Andries, 1999; Banaru, 2001; Cerbari, 2010, 2012).

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 6-34).

Table 6-34: 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 6-35.

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).

Table 6-35: Stubble Fields Burning in the Republic of Moldova within1990-2015 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	%
Burnt stubble fields, thousand ha	4.465	0.892	0.627	0.475	0.106	0.575	0.400	0.346	-97.2
Burnt stubble fields, % from total	0.78	0.15	0.11	0.10	0.02	0.10	0.07	0.08	-97.3

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.

The activity data on the amount of crop residues available to be combusted on field (Table 6-36) 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 6-36: Amount of Crop Residues Available for Combustion on Field in the Republic of Moldova within 1990-2015 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	%
Winter wheat	2.6653	1.6617	1.7518	2.0397	1.2033	2.0765	2.3645	2.3758	-32.2
Barley	2.3134	1.3993	1.2991	1.5569	1.0984	1.6944	1.8011	1.8832	-39.0
Average	2.4893	1.5305	1.5254	1.7983	1.1508	1.8855	2.0828	2.1295	-35.4

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.

AD on areas subject to conversion to this category are available in the General Land Cadastre of the RM, and are included in the Land Use and Land Use-Change Matrix for 1970-2015 periods. The main types of land converted to cropland are grassland and settlements (Table 6-37).

Table 6-37: Areas of Land Converted to Cropland in the RM within 1970-2015 periods, ha

Conversion	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981
Grassland to cropland	0.0	1271.0	15102.0	0.0	11172.0	2979.0	6479.0	19829.0	8800.0	3797.0	64.0	766.0
Grassland to perennial plantations	0.0	192.7	0.0	46.4	332.1	102.8	444.9	0.0	0.0	0.0	211.2	0.0
Settlements to cropland	0.0	100.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total	0.0	1563.7	15102.0	46.4	11504.1	3081.8	6923.9	19829.0	8800.0	3797.0	275.2	766.0
Conversion	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993
Grassland to cropland	191.0	0.0	1395.0	20871.0	22129.2	0.0	702.0	1085.0	0.0	511.0	447.0	8943.0
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
Settlements to cropland	600.0	0.0	0.0	2100.0	1800.0	0.0	500.0	0.0	300.0	0.0	0.0	200.0
Total	1003.7	182.1	1555.5	22971.0	23929.2	0.0	1365.0	1085.0	1461.2	587.4	447.0	9143.0

Conversion	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
Grassland to cropland	18780.9	16044.0	10425.0	11430.0	14531.0	12687.2	5527.0	20885.0	3774.3	6682.0	523.0	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
Settlements to cropland	0.0	700.0	200.0	0.0	400.0	0.0	0.0	71.0	43.0	0.0	289.0	421.0
Total	18780.9	16744.0	10625.0	11430.0	14931.0	12687.2	5527.0	20956.0	3817.3	6682.0	812.0	1181.9
Conversion	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**%**
Grassland to cropland	1799.4	206.1	835.0	3331.0	33.0	4246.0	5975.0	4551.0	6019.0	7200.0	NA	NA
Grassland to perennial plantations	53.7	1423.0	8.3	0.0	2.0	0.0	0.0	0.0	0.0	0.0	NA	NA
Settlements to cropland	1244.0	347.0	139.3	385.0	1.0	0.0	37.0	0.0	0.0	0.0	NA	NA
Total	3097.1	1976.1	982.6	3716.0	36.0	4246.0	6012.0	4551.0	6019.0	7200.0	NA	NA

Source: General Land Cadastre for 1970-2015; Land Use and Land Use-Change Matrix for 1970-2015 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, 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 6-38).

Table 6-38: 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 (DOM)	year 1	Mg C/ha/yr	0.00
	Annual average increments in soil organic carbon (SOC)	years 1-20	Mg C/ha/yr	-2.2650
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 (DOM)	years 1-20	Mg C/ha/yr	0.00
	Annual average increments in soil organic carbon (SOC)	years 1-20	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 (DOM)	year 1	Mg C/ha/yr	0.00
	Annual average increments in soil organic carbon (SOC)	years 1-20	Mg C/ha/yr	0.2168

Source: 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; "Soil Quality Monitoring in the Republic of Moldova (database, conclusions, forecasts, recommendations)" , 2010.

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 LULUCF Sector. 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 SEI data. As a consequence, for this category, was included wood harvest authorized by SEI annually from the forestry fund and forest vegetation owned by local authorities and other public institutions (except for "Moldsilva" Agency)

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 ±10 per cent. Thus, combined uncertainties related to CO_2 emissions from the "Annual Change in Carbon Stocks in Mineral Soils" represent ±14.14 per cent, while uncertainties introduced in trend in total sectoral emissions/removals were estimated at circa ±17.29 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), while the combined uncertainties as a percentage of total annual direct sectoral emissions represent ±37.40 per cent for CH_4 and ±0.024 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 2015) may be considered relatively low, being estimated at circa ±10 per cent. 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 while the uncertainties introduced in trend in sectoral emissions/removals were estimated at ±5.72 per cent (see 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[102]. At the same time, the quality of estimates increased due to the development of the Land Use and Land Use-Change Matrix for 1970-2015 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 (Statistical Yearbooks of the Republic of Moldova and those of the ATULBD; General Land Cadastres of the Republic of Moldova, 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

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.

[102] 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.

6.3.5. Recalculations

4B1. Cropland Remaining Cropland

4B1.1. Cropland Covered with Woody Vegetation

The CO_2 removals/emissions from the category 4B1.1 "Cropland Covered with Woody Vegetation" were recalculated for the 1990 through 2013 time series, in particular due to the transition to new assessment methods available in the IPCC 2006 Guidelines. The obtained results are presented in Table 6-39. In comparison with the results reported in the BUR1, the changes performed within the current inventory cycle resulted in a significant increase, from a minimum of +359.3 per cent in 1990 to a maximum of +726.2 per cent in 2001.

Table 6-39: Results of Recalculations for CO_2 Removals/Emissions from 4B1.1 "Cropland Covered with Woody Vegetation" Category included into the BUR1 and the NC4 of the Republic of Moldova under the UNFCCC, kt

	1990	1991	1992	1993	1994	1995	1996	1997	1998
BUR1	-725.2315	-613.0622	-613.9635	-611.8682	-590.3010	-598.6205	-551.0146	-573.4484	-550.9832
NC4	-3331.0003	-4801.4045	-4840.0166	-4714.0567	-4481.1975	-4682.7670	-4371.7019	-4250.1710	-4192.9686
Difference, %	359.3	683.2	688.3	670.4	659.1	682.3	693.4	641.2	661.0
	1999	2000	2001	2002	2003	2004	2005	2006	2007
BUR1	-533.4373	-523.3924	-507.7310	-477.5706	-473.9941	-466.3503	-465.3288	-472.0698	-477.0847
NC4	-4345.7620	-4280.1837	-4194.7085	-3890.6260	-3878.4909	-2739.7479	-3614.6135	-3589.5789	-3595.0674
Difference, %	714.7	717.8	726.2	714.7	718.3	487.5	676.8	660.4	653.5
	2008	2009	2010	2011	2012	2013	2014	2015	%
BUR1	-479.9904	-483.5731	-470.5183	-483.1691	-484.2581	-483.4705			
NC4	-3532.2814	-3391.1851	-3431.7251	-3440.3478	-3519.3132	-3507.4181	-3544.4010	-3648.5358	9.5
Difference, %	635.9	601.3	629.3	612.0	626.7	625.5			

Abbreviations: NC4 – Fourth National Communication; BUR1 – First Biennial Update Report.

Since the development of the Land Use and Land Use-Change Matrix for 1970-2015 periods, within this category was included the influence on carbon stocks from internal conversions (see Table 6-29). The evolution of CO_2 removals from 4B1.1 "Cropland Covered with Woody Vegetation" between 1990 and 2015 is presented in Table 6-40.

Table 6-40: CO_2 Removals from "Cropland Covered with Woody Vegetation" in the Republic of Moldova within 1990-2015 periods, kt

	1990	1991	1992	1993	1994	1995	1996	1997	1998
Perennial plantations	-3069.4603	-4527.9650	-4574.7736	-4527.3143	-4239.9701	-4359.4906	-4054.9759	-4004.4400	-3933.1728
Forest vegetation	-261.5400	-273.4395	-265.2429	-186.7424	-241.2273	-323.2764	-316.7260	-245.7310	-259.7958
Total	-3331.0003	-4801.4045	-4840.0166	-4714.0567	-4481.1975	-4682.7670	-4371.7019	-4250.1710	-4192.9686
	1999	2000	2001	2002	2003	2004	2005	2006	2007
Perennial plantations	-4028.8491	-3960.2415	-3880.9904	-3565.7533	-3618.2027	-2421.8011	-3325.8975	-3302.8303	-3294.6994
Forest vegetation	-316.9129	-319.9422	-313.7181	-324.8727	-260.2881	-317.9468	-288.7160	-286.7486	-300.3680
Total	-4345.7620	-4280.1837	-4194.7085	-3890.6260	-3878.4909	-2739.7479	-3614.6135	-3589.5789	-3595.0674
	2008	2009	2010	2011	2012	2013	2014	2015	%
Perennial plantations	-3234.4672	-3215.4633	-3138.6245	-3171.1241	-3220.1603	-3281.0778	-3324.4443	-3406.7886	11.0
Forest vegetation	-297.8142	-175.7217	-293.1007	-269.2237	-299.1529	-226.3404	-219.9566	-241.7472	-7.6
Total	-3532.2814	-3391.1851	-3431.7251	-3440.3478	-3519.3132	-3507.4181	-3544.4010	-3648.5358	9.5

Within the reference period, CO_2 removals from the respective category were relatively constant, with significant fluctuations in certain years due to internal conversions. Towards the end of the period, an increase by circa 9.5 per cent of total CO_2 removals was recorded, compared to 1990. 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.

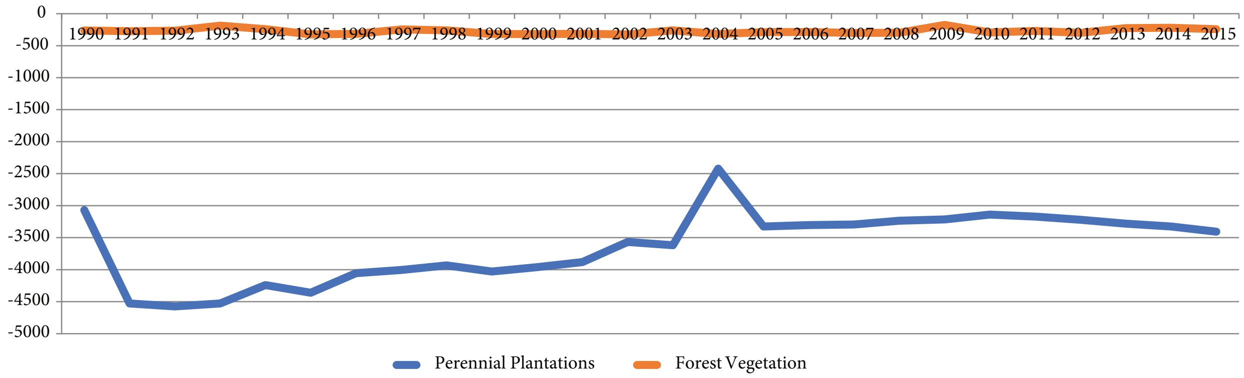


Figure 6-6: CO_2 Removals from "Cropland Covered with Woody Vegetation" in the Republic of Moldova within 1990-2015 periods, kt

4B1.2. Annual Change in Carbon Stocks in Mineral Soils

CO_2 removals/emissions recalculations under the 4B1.2 "Annual Change in Carbon Stocks in Mineral Soils" category were performed for the 1990-2013 time periods, in particular due to the transition to a new assessment method – Tier 2 (2006 IPCC Guidelines) and use of country specific factors regarding the changes of carbon stocks in mineral soils in the RM, in the detriment of a country specific assessment methodology[103] (presented in detail in Annex 3-4.2), used in the previous inventory cycle (currently it is being working on this methodology for improvement and international validation). In comparison with the results recorded in the previous inventory cycle, the changes performed within the current greenhouse gas inventory resulted in decreased CO_2 emissions from 4B1.2 "Annual Change in Carbon Stocks in Mineral Soils" category in 1993, 1995-2006, 2008-2011 and 2013, varying from a minimum decrease of 1.9 per cent in 1993, to a maximum decrease of 56.6 per cent in 2004. The following years represent exceptions: 1990-1993, 1994, 2007 and 2013, when an increasing trend was recorded (Table 6-41).

Table 6-41: Results of Recalculations for CO_2 Removals/Emissions from 4B1.2 "Annual Change in Carbon Stocks in Mineral Soils" Category included into the BUR1 and the NC4 of the Republic of Moldova under the UNFCCC, kt

	1990	1991	1992	1993	1994	1995	1996	1997	1998
BUR1	-1490.8146	-1440.6633	-728.7402	1780.9854	1471.6489	2517.1205	2381.3224	4013.0993	3280.1637
NC4	1747.2754	1725.0092	1751.8566	1746.8240	1747.2071	1747.1140	1752.9849	1786.8799	1807.0429
Difference, %	+217.2	+219.7	+340.4	-1.9	+18.7	-30.6	-26.4	-55.5	-44.9
	1999	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**
BUR1	3025.1199	2827.3964	3545.3117	3573.3887	2681.0372	4110.5280	3883.3090	3450.6090	1113.5737
NC4	1808.1277	1795.2647	1791.0468	1788.5129	1787.5228	1785.4564	1834.1640	1878.8552	1877.2201
Difference, %	-40.2	-36.5	-49.5	-49.9	-33.3	-56.6	-52.8	-45.6	+68.6
	2008	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**%**
BUR1	4137.7822	2931.2323	3458.1723	3597.8304	1481.5276	3728.9563			
NC4	1876.1181	1877.1759	1877.6128	1873.4630	1838.9486	1874.1545	1899.8555	1937.1842	10.9
Difference, %	-54.7	-36.0	-45.7	-47.9	+24.1	-49.7			

Abbreviations: NC4 – Fourth National Communication; BUR1 – First Biennial Update Report.

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. As it can be noted, by 2015 an amount of CO_2 emissions larger by 10.9 per cent to 1990 year level was emitted in the atmosphere.

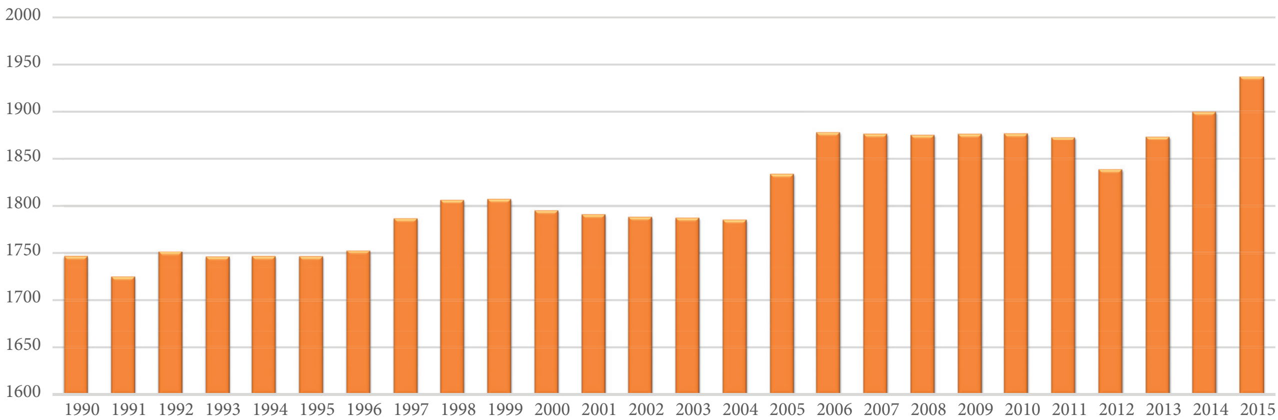


Figure 6-7: CO_2 Emissions from "Annual Change in Carbon Stocks in Mineral Soils" category in the Republic of Moldova within 1990-2015 periods, kt

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.

[103] Banaru, Anatol (2000), *Methodology to calculate CO_2 Emissions from Agriculture Soils* (in Romanian). Collection of articles 'Climate change: Researches, studies, solutions', Ministry of the Environment / UNDP Moldova. "Bons Offices", Chisinau, 2000. p. 115-123.

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" category between 1990 and 2015 is presented in Table 6-42. At the same time, from year to year, the volume fluctuates significantly due to adverse weather conditions and anthropogenic factors.

Table 6-42: Non-CO_2 Emissions from Stubble Fields Burning in the Republic of Moldova within 1990-2015

GHGs	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
GHGs	**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
GHGs	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**%**
CH_4, kt	0.0270	0.0033	0.0023	0.0021	0.0003	0.0026	0.0020	0.0018	-98.2
N_2O, kt	0.0007	0.0001	0.0001	0.0001	0.0000	0.0001	0.0001	0.0000	-98.2
Total, kt CO_2 equivalent	0.8839	0.1086	0.0761	0.0679	0.0097	0.0862	0.0663	0.0586	-98.2

4B2. Land Converted to Cropland

CO_2 emissions from 4B2 "Land Converted to Cropland" category were estimated for the first time. Between 1990-2015 time series, the respective emissions fluctuated (Table 6-43), being influenced by the conversion process of different types of land to cropland, including before 1990 (see Table 6-37).

Table 6-43: CO_2 Emissions from 4B2 "Land Converted to Cropland" Category, 1990-2015, kt

	1990	1991	1992	1993	1994	1995	1996	1997	1998
CO_2 Emissions	1005.5978	978.9688	856.4881	888.5966	912.7487	1015.6958	1083.1337	1012.0184	1037.7153
	1999	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**
CO_2 Emissions	1124.3353	1200.2264	1297.2536	1405.8276	1444.9642	1478.8082	1291.2109	1102.4055	1156.5592
	2008	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**%**
CO_2 Emissions	1138.2331	1140.7945	1154.8436	1166.4621	1203.9295	1174.6617	1062.1085	983.9336	-2.2

The graphical illustration of CO_2 emissions evolution within the source category 4B2 "Land Converted to Cropland" is provided in Figure 6-8.

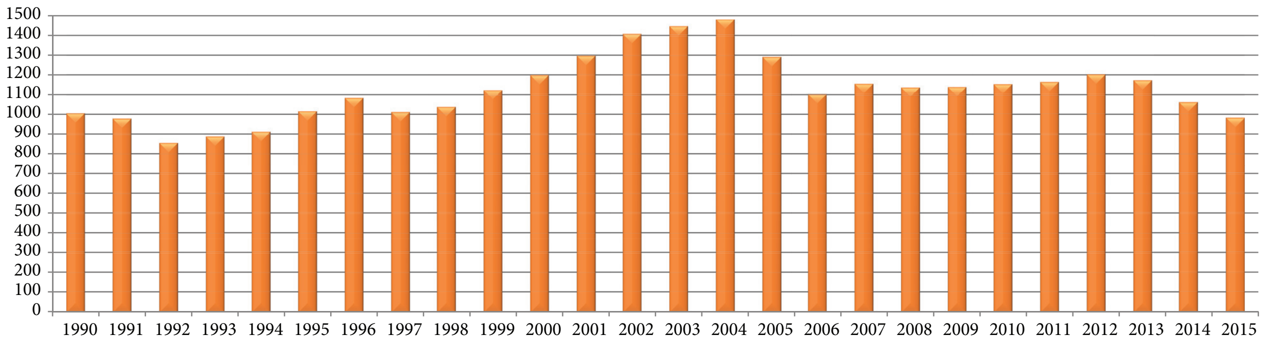


Figure 6-8: CO_2 Emissions from 4B2 "Land Converted to Cropland" category in the Republic of Moldova within 1990-2015 periods, kt

Net CO_2 removals/emissions aggregated at the category level are presented in Figure 6-9 and Table 6-44.

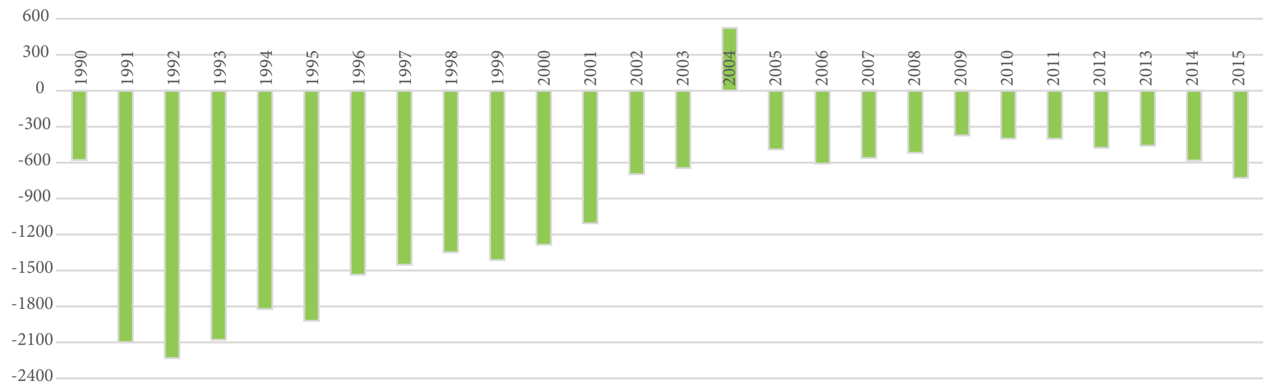


Figure 6-9: CO_2 Removals/Emissions from 4B "Cropland" Category in the Republic of Moldova within 1990-2015 periods, kt

Table 6-44: CO_2 Removals/Emissions from 4B "Cropland" Category in the Republic of Moldova within 1990-2015 periods, kt

	1990	1991	1992	1993	1994	1995	1996	1997	1998
4B1	-1 583.7249	-3 076.3953	-3 088.1600	-2 967.2327	-2 733.9904	-2 935.6531	-2 618.7171	-2 463.2911	-2 385.9258
4B2	1 005.5978	978.9688	856.4881	888.5966	912.7487	1 015.6958	1 083.1337	1 012.0184	1 037.7153
4B	-578.1271	-2 097.4265	-2 231.6719	-2 078.6361	-1 821.2418	-1 919.9573	-1 535.5834	-1 451.2728	-1 348.2104
	1999	2000	2001	2002	2003	2004	2005	2006	2007
4B1	-2 537.6344	-2 484.9190	-2 403.6617	-2 102.1131	-2 090.9681	-954.2915	-1 780.4495	-1 710.7237	-1 717.8473
4B2	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
4B	-1 413.2991	-1 284.6926	-1 106.4081	-696.2856	-646.0039	524.5167	-489.2386	-608.3183	-561.2881
	2008	2009	2010	2011	2012	2013	2014	2015	%
4B1	-1 656.1633	-1 514.0092	-1 554.1124	-1 566.8848	-1 680.3646	-1 633.2636	-1 644.5455	-1 711.3517	8.1
4B2	1 138.2331	1 140.7945	1 154.8436	1 166.4621	1 203.9295	1 174.6617	1 062.1085	983.9336	-2.2
4B	-517.9302	-373.2147	-399.2688	-400.4227	-476.4351	-458.6019	-582.4370	-727.4181	25.8

According to the results obtained, it is observed that during 2004 only, the 4B category represented a source of CO_2 emissions, while during the rest of the period only net removals were recorded. The level of emissions recorded between 2005 and 2015 is relatively constant, with a slight increasing trend between 2009 and 2015.

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 etc.)

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 GHG 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 48.5 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 Cadastre 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 (in particular in the time period from 1991 through 1996). Over 80 per cent of such vegetation is *Robinia pseudoacacia* rammels. In most cases (90 per cent of the total), the wood mass harvested on these lands is used as fuel used for heating and food processing. 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 lowest 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 2015 are available in the General Land Cadasters of the Republic of Moldova, as well as in the Reports of the "Moldsilva" Agency and the State Ecological Inspectorate (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 Cadastre of the RM for the reporting period. The evolution of areas included in this category between 1990 and 2015 is presented in Table 6-45.

Table 6-45: Grassland Area in the Republic of Moldova within 1990-2015 periods, thousand ha

Land Category	1990	1991	1992	1993	1994	1995	1996	1997	1998
Pastures and hayfields	157.37	165.53	161.96	177.06	173.62	165.80	174.79	163.85	152.13
Land under improvement	2.53	2.38	2.26	1.75	1.84	1.70	1.79	1.62	1.50
Landslides	13.49	13.20	12.35	12.38	12.81	12.15	12.50	11.74	9.75
Total	173.39	181.12	176.57	191.20	188.27	179.65	189.08	177.21	163.38
Land Category	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**
Pastures and hayfields	139.65	148.03	144.44	169.66	176.26	181.36	187.42	184.50	189.28
Land under improvement	1.26	1.44	1.35	1.42	1.62	1.99	2.22	2.03	2.24
Landslides	9.13	10.67	11.08	13.24	12.50	12.29	12.43	12.94	13.37
Total	150.04	160.13	156.88	184.32	190.38	195.64	202.07	199.46	204.89
Land Category	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**%**
Pastures and hayfields	217.43	276.53	361.23	358.71	354.28	332.11	315.95	304.81	93.7
Land under improvement	2.47	3.11	4.14	4.11	3.63	3.02	2.89	2.29	-9.5
Landslides	14.97	18.88	24.93	24.96	25.05	23.26	22.04	21.16	56.9
Total	234.86	298.51	390.30	387.79	382.97	358.39	340.88	328.27	89.3

Source: General Land Cadastre for 1970-2015; Land Use and Land Use-Change Matrix for 1970-2015 periods.

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 taking into account the distribution of grasslands by categories and productivity (meadows, grasslands on slopes with high, medium or low productivity), respectively data from scientific literature in the Republic of Moldova (Table 6-46).

Table 6-46: 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 linked 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 arboreal 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, settlements converted to grasslands in the last 46 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 Cadastre of the RM, as well as the Reports of the "Moldsilva" Agency and the Reports of the State Ecological Inspectorate, 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 6-47).

Table 6-47: Area of Lands Converted to Grassland in the RM within 1970-2015 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	9281.0	493.2	24967.0	18040.0	7919.0	20538.0	225.9	1481.0	1892.7	17291.0	17902.7
arable lands	0.0	9153.0	0.0	24839.0	17912.0	7600.0	20283.0	0.0	0.0	1833.0	17291.0	17878.0
forest vegetation	0.0	128.0	128.0	128.0	128.0	319.0	255.0	64.0	1372.0	0.0	0.0	0.0
vineyards and orchards	0.0	0.0	365.2	0.0	0.0	0.0	0.0	161.9	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	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	9281.0	493.2	24967.0	18840.0	7919.0	20538.0	225.9	1481.0	1892.7	17291.0	17902.7
Category of Use	**1982**	**1983**	**1984**	**1985**	**1986**	**1987**	**1988**	**1989**	**1990**	**1991**	**1992**	**1993**
I. Cropland converted to grassland, total	36098.0	16348.0	10147.0	11059.9	3497.2	11247.8	35154.0	69574.0	92010.0	13853.0	1868.6	5173.2
arable lands	36098.0	16348.0	10075.0	10630.0	3146.0	9186.0	35154.0	69555.0	91180.0	13853.0	1711.0	3896.0
forest vegetation	0.0	0.0	72.0	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	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	36098.0	16848.0	10147.0	11059.9	3497.2	11247.8	35154.0	69574.0	92210.0	14553.0	1868.6	5173.2
Category of Use	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**
I. Cropland converted to grassland, total	7686.5	3116.4	2713.7	4758.4	1611.6	1280.9	9281.2	5355.2	2029.2	1177.3	2671.3	1086.0
arable lands	7372.0	2791.0	2088.0	2541.0	0.0	950.0	8713.0	4565.0	1944.0	0.0	2671.0	1086.0
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	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total	7686.5	3416.4	2713.7	4758.4	1611.6	1280.9	9281.2	5398.2	2029.2	2298.3	2671.3	1817.0
Category of Use	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**%**
I. Cropland converted to grassland, total	2862.6	2211.0	297.9	1949.0	385.0	41.8	75.0	1166.7	680.6	50.1	NA	NA
arable lands	2862.6	2211.0	297.9	0.0	385.0	0.0	0.0	0.0	0.0	0.0	NA	NA
forest vegetation	0.0	0.0	0.0	1914.5	0.0	0.0	15.3	1165.9	616.5	0.0	NA	NA
vineyards and orchards	0.0	0.0	0.0	34.6	0.0	41.8	59.7	0.8	64.1	50.1	NA	NA
II. Wetlands converted to grassland	0.0	0.0	0.0	0.0	0.0	0.0	280.0	2373.0	79.0	131.0	NA	NA
III. Settlements converted to grassland	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	NA	NA
Total	2862.6	2211.0	297.9	1949.0	385.0	41.8	355.0	3539.7	759.6	181.1	NA	NA

Source: General Land Cadastres of the Republic of Moldova for 1990-2015, 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 1990-2015; Land Use and Land Use-Change Matrix for 1970-2015 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 the following equation:

$$\Delta C_B = \Delta C_G + \Delta C_{Conversion} - \Delta C_L$$

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 forest land, 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 the following formula:

$$\Delta C_{Conversion} = \Sigma \{(B_{After} - B_{Before}) \bullet \Delta A_{B\_over}\} \bullet CF$$

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;
ΔA_{B_over} – 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 6-48.

Table 6-48: 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/an	-1.22
	Annual average carbon increments in dead organic matter (DOM)	year1	Mg C/ha/an	0.00
	Annual average increments in soil organic carbon (SOC)	years 1-20	Mg C/ha/an	2.2650
Forest Land Converted to Grassland	Annual average carbon increments in biomass	year 1	Mg C/ha/an	-26.02
	Annual average carbon increments in dead organic matter (DOM)	year1	Mg C/ha/an	-1.15
	Annual average increments in soil organic carbon (SOC)	years 1-20	Mg C/ha/an	1.0662
Perennial Plantations Converted to Grassland	Annual average carbon increments in biomass	year 1	Mg C/ha/an	-0.65
	Annual average carbon increments in dead organic matter (DOM)	year1	Mg C/ha/an	0.00
	Annual average increments in soil organic carbon (SOC)	years 1-20	Mg C/ha/an	2.2650
Wetlands Converted to Grassland	Annual average carbon increments in biomass	year 1	Mg C/ha/an	0.00
	Annual average carbon increments in dead organic matter (DOM)	year1	Mg C/ha/an	0.00
	Annual average increments in soil organic carbon (SOC)	years 1-20	Mg C/ha/an	0.00
Settlements Converted to Grassland	Annual average carbon increments in biomass	year 1	Mg C/ha/an	3.78
	Annual average carbon increments in dead organic matter (DOM)	year1	Mg C/ha/an	0.00
	Annual average increments in soil organic carbon (SOC)	years 1-20	Mg C/ha/an	2.4818

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 2015. 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 (2015), 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 Cadastres 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 (±18.03 per cent), while the uncertainties introduced in trend in total sectoral emissions/removals were estimated at circa ±1.25 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 Cadastres 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". 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 1970-2015 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 Cadastres of the Republic of Moldova and Statistical Yearbooks of the Republic of Moldova).

6.4.5. Recalculations

4C1. Grassland Remaining Grassland

In the current inventory cycle, it was taken into consideration that the Tier 1 approach from the 2006 IPCC Guidelines (Volume 4 "AFOLU") considers the biomass stock within this category in balance, respectively the stock does not change and CO_2 emissions/removals were not estimated (Table 6-49).

Table 6-49: CO_2 Emissions/Removals from 4C1 "Grassland Remaining Grassland" included into the BUR1 and the NC4 of the RM under the UNFCCC, kt

	1990	1991	1992	1993	1994	1995	1996	1997	1998
BUR1	-1469.86	-1475.58	-1479.90	-1481.77	-1502.12	-1518.22	-1528.85	-1536.96	-1546.45
NC4	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Difference, %	-100.00	-100.00	-100.00	-100.00	-100.00	-100.00	-100.00	-100.00	-100.00
	1999	2000	2001	2002	2003	2004	2005	2006	2007
BUR1	-1548.98	-1559.51	-1589.50	-1494.72	-1598.52	-1566.29	-1549.72	-1537.87	-1515.51
NC4	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Difference, %	-100.00	-100.00	-100.00	-100.00	-100.00	-100.00	-100.00	-100.00	-100.00
	2008	2009	2010	2011	2012	2013	2014	2015	%
BUR1	-1498.20	-1485.22	-1473.56	-1466.26	-1466.56	-1461.39	N/A	N/A	N/A
NC4	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	N/A
Difference, %	-100.00	-100.00	-100.00	-100.00	-100.00	-100.00	N/A	N/A	N/A

Abbreviations: NC4 – Fourth National Communication; BUR1 – First Biennial Update Report.

4C2. Land Converted to Grassland

In the current inventory cycle, recalculations were performed for CO_2 removals within the 4C2 "Land Converted to Grassland" for the period 1990-2013. In comparison to the previous inventory, CO_2 emissions/removals are quite significant at sectoral level, due to including emissions/removals from initial land converted to grassland, as well as due to introducing the conversion period of 20 years (Table 6-50).

Table 6-50: CO_2 Removals from 4C2 "Land Converted to Grassland" category, included into the BUR1 and the NC4 of the RM under the UNFCCC, kt

	1990	1991	1992	1993	1994	1995	1996	1997	1998
BUR1	-6.3800	125.6200	202.1360	299.8160	198.4400	188.5180	235.2240	89.4740	119.6140
NC4	-2850.2941	-3317.4207	-3383.3454	-3109.7949	-3104.1950	-3088.4744	-2903.6947	-2771.9741	-2848.0605
Difference, %	44575.5	-2740.8	-1773.8	-1137.2	-1664.3	-1738.3	-1334.4	-3198.1	-2481.0
	1999	2000	2001	2002	2003	2004	2005	2006	2007
BUR1	30.8220	2.5520	-4.2240	0.7480	-27.4560	2.2440	2.2440	7.7000	2.3900
NC4	-2972.0904	-2844.3351	-2755.9956	-2512.2749	-2277.6455	-2316.5028	-2240.7618	-2227.5442	-2164.3852
Difference, %	-9742.8	-111555.1	65146.1	-335965.6	8195.6	-103331.0	-99955.7	-29012.6	-90523.9
	2008	2009	2010	2011	2012	2013	2014	2015	%
BUR1	2.9200	3.8100	21.8400	5.1600	4.4900	4.1700	N/A	N/A	N/A
NC4	-1883.4658	-1123.9641	-555.7508	-442.6724	-426.1414	-277.4696	-271.1606	-306.2291	-89.3
Difference, %	-64664.2	-29563.3	-2644.5	-8676.9	-9595.1	-6759.7	N/A	N/A	N/A

Abbreviations: NC4 – Fourth National Communication; BUR1 – First Biennial Update Report.

The graphical illustration of CO_2 removals evolution within the source category 4C2 "Land Converted to Grassland" is provided in Figure 6-10. According to the obtained data, it is noted that CO_2 removals evolution within this source category was in a continuing decline, in 2015 representing only circa 10.7 per cent of the reference year level (1990).

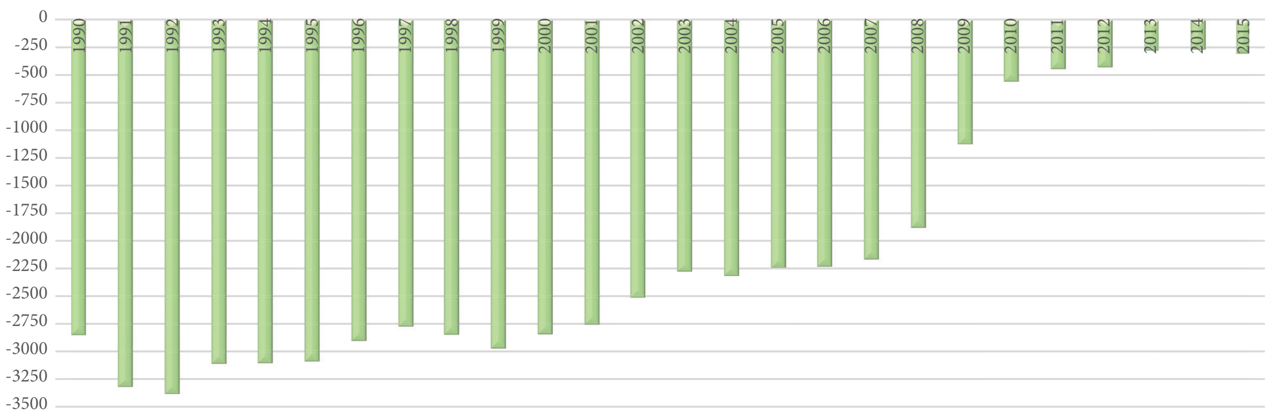


Figure 6-10: CO_2 removals from 4C2 "Land Converted to Grassland" category in the RM within 1990-2015 periods, kt

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 part of the year, 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 Cadastre of the RM and are also included in the Land Use and Land Use-Change Matrix for 1970-2015 periods. 4D1 "Wetlands Remaining Wetlands" also includes lands subject to internal conversion, not generating essential changes in carbon stocks, maintaining a steady balance (Table 6-51).

Table 6-51: Area of Land Included in 4D1 "Wetlands Remaining Wetlands" Category in the RM within 1990-2015 periods, ha

Land Category	1990	1991	1992	1993	1994	1995	1996	1997	1998
Wetlands with vegetation (marshes)	8800.0	8800.0	9100.0	9600.0	9600.0	9500.0	9800.0	9800.0	9800.0
Wetlands saturated by water	54700.0	55500.0	55600.0	56400.0	59500.0	61600.0	63200.0	64200.0	64200.0
Wetlands with vegetation (marshes) converted to wetlands saturated by water	4600.0	4100.0	4000.0	4100.0	3100.0	2300.0	2300.0	2000.0	2000.0
Wetlands saturated by water converted to wetlands with vegetation (marshes)	100.0	200.0	200.0	200.0	200.0	200.0	200.0	200.0	200.0
Total	68200.0	68600.0	68900.0	70300.0	72400.0	73600.0	75500.0	76200.0	76200.0
Land Category	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**
Wetlands with vegetation (marshes)	10000.0	10000.0	11400.0	12000.0	10511.0	11511.0	11217.0	11617.0	11433.0
Wetlands saturated by water	67000.0	67700.0	67525.0	69425.0	69425.0	70025.0	70588.0	70788.0	70788.0
Wetlands with vegetation (marshes) converted to wetlands saturated by water	2000.0	1600.0	1600.0	1600.0	1968.0	1968.0	1568.0	1568.0	1952.0
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	79200.0	79500.0	81057.0	83557.0	82436.0	84036.0	83905.0	84505.0	84605.0
Land Category	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**%**
Wetlands with vegetation (marshes)	12433.0	12726.0	12726.0	12673.0	13227.0	13227.0	14118.0	13967.0	58.7
Wetlands saturated by water	72888.0	72988.0	74088.0	74088.0	74054.0	72649.0	73849.0	73849.0	35.0
Wetlands with vegetation (marshes) converted to wetlands saturated by water	1952.0	1959.0	859.0	1012.0	1012.0	912.0	942.0	962.0	-79.1
Wetlands saturated by water converted to wetlands with vegetation (marshes)	432.0	432.0	432.0	332.0	332.0	364.0	364.0	364.0	264.0
Total	87705.0	88105.0	88105.0	88105.0	88625.0	87152.0	89273.0	89142.0	30.7

Source: General Land Cadastre for 1970-2015; Land Use and Land Use-Change Matrix for 1970-2015 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.). AD on areas subject to conversion within this category are available in the General Land Cadastre of the RM and are also included in the Land Use and Land Use-Change Matrix for 1970-2015 periods. The main land categories converted to wetlands are croplands and grasslands (Table 6-52).

Table 6-52: Area of Lands Converted to Wetlands within 1970-2015 periods, ha

Conversion	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981
Cropland to Wetlands	0.0	0.0	0.0	0.0	2100.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Grassland to Wetlands	0.0	1100.0	300.0	1400.0	0.0	1400.0	1900.0	700.0	0.0	3000.0	300.0	1600.0
Total	0.0	1100.0	300.0	1400.0	2100.0	1400.0	1900.0	700.0	0.0	3000.0	300.0	1600.0

Conversion	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993
Cropland 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
Grassland to Wetlands	2500.0	0.0	1600.0	600.0	600.0	100.0	3100.0	400.0	0.0	0.0	800	900
Total	2500.0	0.0	1600.0	600.0	600.0	100.0	3100.0	400.0	0.0	0.0	800.0	900.0
Conversion	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**
Cropland 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
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
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**	**%**
Cropland to Wetlands	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	NA	NA
Grassland to Wetlands	178.0	80.0	40.5	28.0	0.0	3119.0	0.0	0.0	0.0	0.0	NA	NA
Total	178.0	80.0	40.5	28.0	0.0	3119.0	0.0	0.0	0.0	0.0	NA	NA

Source: General Land Cadastre for 1970-2015; Land Use and Land Use-Change Matrix for 1970-2015 periods.

Country specific emission factors were developed in order to estimate annual biomass increments / losses on land converted to wetlands as presented in Table 6-53.

Table 6-53: EFs Used to Estimate CO_2 Emissions/Removals from the 4D2 "Land Converted to Wetlands" Category

Conversion	Indicators	Period, years	Units	Indicators Value
Cropland to Wetlands	Annual average carbon increments in biomass (crops)	year 1	Mg C/ha/yr	-0.8
	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	2.265
Grassland to Wetlands[104]	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

6.5.3. 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 2015) 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, while the uncertainties introduced in trend in total sectoral emissions/removals were estimated at circa ±0.003 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 Cadastres 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 matrix of land use and land use-change in the RM for 1970-2015 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

CO_2 emissions/removals for category 4D "Wetlands" were estimated for the first time. Between 1990 and 2015, CO_2 emissions / removals from 4D "Wetlands" were influenced by the impermanence of the conversion of different land categories to wetlands (Table 6-54).

[104] Indicators value equals zero, as wetlands (marshes) are associated with grasslands, thus, after the conversion no essential changes occur in carbon stocks.

Table 6-54: CO_2 Emissions/Removals from 4D "Wetlands" in the Republic of Moldova within 1990-2015 periods, kt

	1990	1991	1992	1993	1994	1995	1996	1997	1998
4D1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4D2	-17.4	-17.4	-17.4	-17.4	0.0	0.0	0.0	0.0	0.0
4D	-17.4	-17.4	-17.4	-17.4	0.0	0.0	0.0	0.0	0.0
	1999	2000	2001	2002	2003	2004	2005	2006	2007
4D1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4D2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4D	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	%
4D1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4D2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-100.0
4D	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-100.0

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 include 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) and 4C "Grassland" 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); 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 Cadastre of the RM and are also included in the Land Use and Land Use-Change Matrix for 1970-2015 periods (Table 6-55).

Table 6-55: Area of Land Included in 4E1 "Settlements Remaining Settlements" Category in the RM within 1990-2015 periods, ha

	1990	1991	1992	1993	1994	1995	1996	1997	1998
Settlements	181826.0	181826.0	181826.0	184126.0	187325.9	187925.9	190025.8	191225.8	190825.8
	1999	2000	2001	2002	2003	2004	2005	2006	2007
Settlements	194725.7	203425.5	207054.5	207011.5	211011.4	213022.3	212601.3	211357.3	212910.3
	2008	2009	2010	2011	2012	2013	2014	2015	%
Settlements	212771.0	213986.0	213985.0	214185.0	229347.7	229347.7	230521.7	230521.7	26.8

Source: General Land Cadastre for 1970-2015; Land Use and Land Use-Change Matrix for 1970-2015 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 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 1970-2015 periods. The main land categories converted to settlements are croplands and grasslands (Table 6-56).

Table 6-56: Area of Lands Converted to Settlements within 1970-2015 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
Total	0.0	0.0	0.0	2500.0	3199.9	1300.0	2300.0	1200.0	0.0	3899.9	8699.8	3699.9
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
Total	0.0	3999.9	2300.0	0.0	0.0	1900.0	0.0	1600.0	0.0	200.0	15199.7	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
Total	1174.0	0.0	0.0	100.0	0.0	1100.0	1400.0	0.0	0.0	506.0	0.0	0.0
Conversion	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**%**
Cropland to Settlements	0.0	0.0	0.0	0.0	1.0	677.2	0.0	0.0	395.4	1180.4	NA	NA
Grassland to Settlements	0.0	0.0	0.0	0.0	0.0	151.8	0.0	0.0	88.6	264.6	NA	NA
Total	0.0	0.0	0.0	0.0	1.0	829.0	0.0	0.0	484.0	1445.0	NA	NA

Source: General Land Cadastre for 1970-2015; Land Use and Land Use-Change Matrix for 1970-2015 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 6-57.

Table 6-57: 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

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 2015) 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, while the uncertainties introduced in trend in total sectoral emissions/removals were estimated at circa ±0.003 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 Cadastres 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 1970-2015 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

No recalculations were performed for category 4E 'Settlements' as CO_2 emissions/removals were estimated for the first time. Between 1990 and 2015, CO_2 emissions/removals from 4E 'Settlements' were influenced in particular, by the impermanence of the conversion of different land categories to wetlands (Table 6-58).

Table 6-58: CO_2 Emissions from 4E "Settlements" in the RM within 1990-2015 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**	**%**
4E1	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	NA
4E2	49.2742	45.5694	45.5885	61.5457	11.8308	11.8308	18.7098	38.8867	-54.1
4E	49.2742	45.5694	45.5885	61.5457	11.8308	11.8308	18.7098	38.8867	-54.1

The graphical illustration of CO_2 emissions evolution within the source category 4E "Settlements" is provided in Figure 6-11. Within 1990-2015, 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).

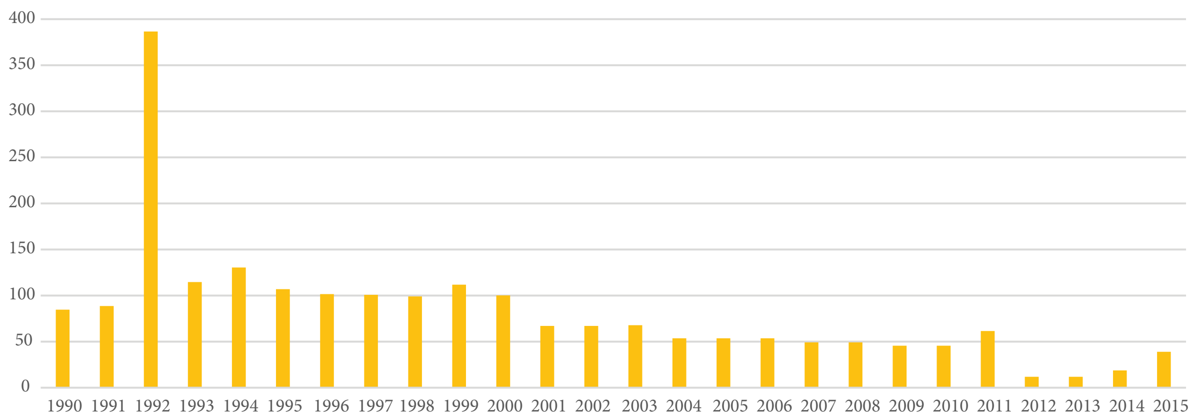


Figure 6-11: CO_2 Emissions from 4E "Settlements" in the RM within 1990-2015 periods, kt

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. 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 Cadastre of the RM and are also included in the Land Use and Land Use-Change Matrix for 1970-2015 periods (Table 6-59).

Table 6-59: Area of Land Included in 4F1 "Other Land Remaining Other Land" Category in the RM within 1990-2015 periods, ha

	1990	1991	1992	1993	1994	1995	1996	1997	1998
Other Land, ha	35426.0	34483.0	34483.0	34145.0	44833.0	44833.0	44833.0	44384.0	43339.0
	1999	2000	2001	2002	2003	2004	2005	2006	2007
Other Land, ha	44993.0	46538.0	45471.0	47042.0	47157.0	46409.0	54586.0	61004.4	60781.4
	2008	2009	2010	2011	2012	2013	2014	2015	%
Other Land, ha	60781.4	57704.4	57704.4	57704.4	58708.4	56135.4	59383.4	61215.4	72.8

Source: General Land Cadastre for 1970-2015; Land Use and Land Use-Change Matrix for 1970-2015 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 Cadastre of the RM and are also included in the Land Use and Land Use-Change Matrix for 1970-2015 periods. The main land categories converted to wetlands are forest lands and croplands –arable soils (Table 6-60).

Table 6-60: Area of Lands Converted to Other Land within 1970-2015 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	664	622	1654	1691	0
Cropland to Other Land	0	0	0	0	10688	0	0	0	0	0	0	0
Total	0	0	0	0	10688	0	0	664	622	1654	1691	0
Conversion	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993
Forest Land to Other Land	1571	4309	248	8177	8802	0	0	0	0	0	2245	0
Cropland to Other Land	0	0	0	0	0	0	0	0	0	0	0	0
Total	1571	4309	248	8177	8802	0	0	0	0	0	2245	0
Conversion	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
Forest Land to Other Land	3248	1856	226	0	0	2096	0	0	2409	0	0	1460
Cropland to Other Land	0	0	0	0	0	0	0	0	0	0	0	0
Total	3248	1856	226	0	0	2096	0	0	2409	0	0	1460
Conversion	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	%
Forest Land to Other Land	0	0	1860	0	436	3235	0	0	0	0	0	NA
Cropland to Other Land	0	0	0	0	0	0	0	0	0	0	0	NA
Total	0	0	1860	0	436	3235	0	0	0	0	0	NA

Source: General Land Cadastre for 1970-2015; Land Use and Land Use-Change Matrix for 1970-2015 periods.

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 6-61.

Table 6-61: 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

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 2015) 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, while the uncertainties introduced in trend in total sectoral emissions/removals were estimated at circa ±0.03 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 Cadastres of the Republic of Moldova). 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 1970-2015 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 4F “Other Land” were estimated for the first time. Between 1990 and 2015, CO_2 emissions from 4F “Other Land” were influenced in particular, by the impermanence of the conversion of different land categories to other land. The largest volumes registered in 1994 – (281.6 kt CO_2), while the lowest – in 1990-1991 and 1993 (8.6 kt CO_2) (Table 6-62).

Table 6-62: CO_2 Emissions from 4F “Other Land” Category within 1990-2015 periods, kt

	1990	1991	1992	1993	1994	1995	1996	1997	1998
4F1 CO_2 Emissions	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
4F2 CO_2 Emissions	8.6217	8.6217	203.2923	8.6217	281.6438	160.9393	19.5971	0.0000	0.0000
4F Total CO_2 Emissions	8.6217	8.6217	203.2923	8.6217	281.6438	160.9393	19.5971	0.0000	0.0000
	1999	2000	2001	2002	2003	2004	2005	2006	2007
4F1 CO_2 Emissions	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
4F2 CO_2 Emissions	181.7504	0.0000	0.0000	208.8916	0.0000	0.0000	126.6010	0.0000	0.0000
4F Total CO_2 Emissions	181.7504	0.0000	0.0000	208.8916	0.0000	0.0000	126.6010	0.0000	0.0000
	2008	2009	2010	2011	2012	2013	2014	2015	%
4F1 CO_2 Emissions	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	N/A
4F2 CO_2 Emissions	161.2836	0.0000	37.8069	280.5166	0.0000	0.0000	0.0000	0.0000	-100.0
4F Total CO_2 Emissions	161.2836	0.0000	37.8069	280.5166	0.0000	0.0000	0.0000	0.0000	-100.0

At the same time, no emissions were recorded within this category for 13 years (1997-1998, 2000-2001, 2003-2004, 2006-2007, 2009 and 2012-2015) (Figure 6-12).

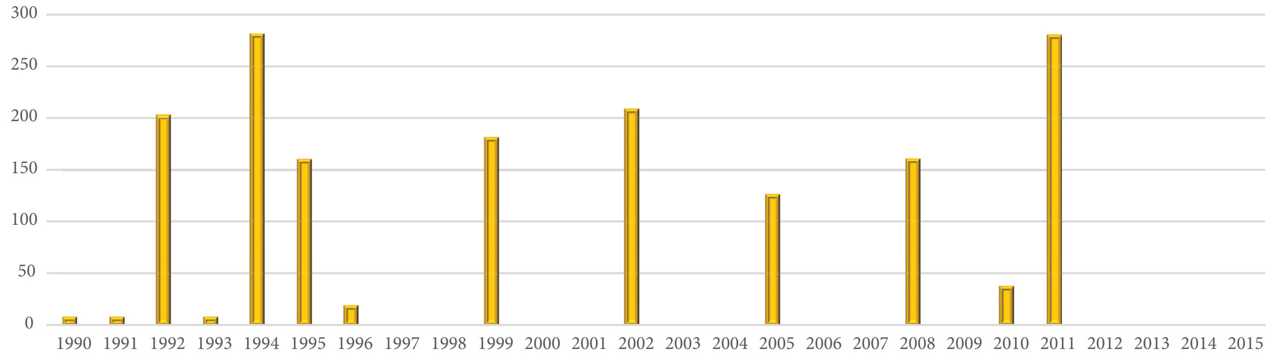


Figure 6-12: CO_2 Emissions from 4F “Other Land” Category within 1990-2015 periods, kt

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 Republic of Moldova.

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 cutting secondary products (cleansing, cleaning, shortening, hygiene cuts), cutting the main products (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 Ministry of Agriculture, Regional Development and Environment 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 2015, 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). At the same time, from the fuelwood certain types are selected (3-5% of the total volume of fuelwood) for primary processing under the technical name of "Technological wood".

6.8.2. Methodological Issues, Emission Factors and Data Sources

For 4G "Harvested Wood Products" 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 1961-2015 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 1994-2015 time series AD from FAOSTAT database were used. The evolution of wood products volume included in source category 4G "Harvested Wood Products" within 1961-2015 periods is presented in Table 6-63.

Table 6-63: Evolution of Wood Products Volume Included in Source Category 4G "Harvested Wood Products" within 1961-2015 periods

Wood Products by Category	Source	1961	1962	1963	1964	1965	1966	1967	1968	1969	1970	1971
Rough round wood, m^3	Produced	26960	26960	26960	26960	26960	24920	22880	20840	18800	16750	15100
	Imported	73040	73040	73040	73040	73040	71480	69920	68360	66800	65240	63680
	Exported	5620	5850	6080	6310	6540	6770	7000	7230	7460	7690	7920
Other types of round wood, m^3	Produced	32300	32300	32300	32300	32300	29860	27420	24980	22540	20100	18110
	Imported	67700	67700	67700	67700	67700	66730	65760	64790	63820	62850	61880
	Exported	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
	Imported	37270	38760	40250	41740	43230	44720	46210	47700	49190	50680	52170
	Exported	0	0	0	0	0	0	0	0	0	0	90
Saw logs and veneer, m^3	Produced	18720	18720	18720	18720	18720	17300	15900	14450	11610	10470	10470
	Imported	39860	39860	39860	39860	39860	38790	37720	36650	35580	34510	33440
	Exported	0	0	0	0	0	0	0	0	0	0	0
Timber, m^3	Produced	23650	37000	50350	63700	77050	90400	103750	117100	130450	143600	143600
	Imported	19380	20220	21060	21900	22740	23580	24420	25260	26100	26940	27780
	Exported	1930	1990	2050	2110	2170	2230	2290	2350	2410	2470	2530
Wood panels, m^3	Produced	660	1320	1980	2640	3300	4540	5780	7020	8260	9500	18540
	Imported	2580	2690	2800	2910	3020	3130	3240	3350	3460	3570	3680
	Exported	2580	2690	2800	2910	3020	3130	3240	3350	3460	3570	3680

Wood Products by Category	Source	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982
Rough round wood, m^3	Produced	13450	11800	10150	8480	8620	8760	8900	9040	9200	11750	8160
	Imported	62120	60560	59000	57440	55880	54320	52760	51200	49640	48080	46520
	Exported	8150	8380	8610	8840	9070	9300	9530	9760	9990	10220	10450
Other types of round wood, m^3	Produced	16120	14130	12140	10160	10340	10520	10700	10880	11050	14080	9780
	Imported	60910	59940	58970	58000	57030	56060	55090	54120	53150	52180	51210
	Exported	0	0	0	0	0	0	0	0	0	0	0

Wood Products by Category	Source	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982
Paper and cardboard, t	Produced	67080	68390	69700	71010	72320	73630	74940	76250	77560	78870	80180
	Imported	53660	55150	56640	58130	59620	61110	62600	64090	65580	67070	68560
	Exported	130	170	210	250	290	330	370	410	450	490	530
Saw logs and veneer, m^3	Produced	9320	8180	7030	5900	6000	6100	6220	6330	6430	8180	5680
	Imported	32370	31300	30230	29160	28090	27020	25950	24880	23810	22740	21670
	Exported	0	0	0	0	0	0	0	0	0	0	0
Timber, m^3	Produced	143600	143600	143700	143800	130260	116720	103180	89640	76100	72000	73700
	Imported	28620	29460	30300	31140	31980	32820	33660	34500	35340	36180	37020
	Exported	2590	2650	2710	2770	2830	2890	2950	3010	3070	3130	3190
Wood panels, m^3	Produced	27580	36620	45660	54700	56260	57820	59380	60940	62500	64800	67100
	Imported	3790	3900	4010	4120	4230	4340	4450	4560	4670	4780	4890
	Exported	3790	3900	4010	4120	4230	4340	4450	4560	4670	4780	4890

Wood Products by Category	Source	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993
Rough round wood, m^3	Produced	21080	26170	31260	36350	41440	46530	51620	56710	61800	66890	71980
	Imported	44960	43400	41840	40280	38720	37160	35600	34040	32480	30920	29360
	Exported	10680	10910	11140	11370	11600	11830	12060	12290	12520	12824	6910
Other types of round wood, m^3	Produced	25260	27160	29060	30960	32860	34760	36660	38560	40460	42360	44260
	Imported	50240	49270	48300	47330	46360	45390	44420	43450	42480	41510	40540
	Exported	0	0	0	0	0	0	0	0	0	0	0
Paper and cardboard, t	Produced	81490	84000	82690	81380	80070	78760	77450	74140	68830	54470	40110
	Imported	70050	71560	71560	71560	71560	71560	71560	71560	71560	5005	10114
	Exported	570	610	650	690	730	770	810	850	890	993	993
Saw logs and veneer, m^3	Produced	14640	15810	18360	20220	22080	23840	25790	27650	29500	31360	33220
	Imported	20600	19530	18460	17390	16320	15250	14180	13110	12040	10970	9900
	Exported	0	0	0	0	0	0	0	0	0	0	0
Timber, m^3	Produced	71800	71800	67720	63640	59560	55480	51400	47320	43240	39160	35080
	Imported	37860	38700	39540	40380	41220	42060	42900	43740	44580	45000	50100
	Exported	3250	3310	3370	3430	3490	3550	3610	3670	3730	3821	2711
Wood panels, m^3	Produced	71600	86000	81670	77340	73010	68680	64350	60020	55690	51360	47000
	Imported	5000	5110	5220	5330	5440	5550	5660	5770	5880	44	6400
	Exported	5000	5110	5220	5330	5440	5550	5660	5770	5880	44	6400

Wood Products by Category	Source	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
Rough round wood, m^3	Produced	77070	82200	71800	82600	67400	74500	80800	71000	92500	94000	86600
	Imported	26200	28300	28300	28300	28300	28300	28300	28300	28300	28300	28300
	Exported	1000	200	200	200	800	900	300	300	300	300	300
Other types of round wood, m^3	Produced	46160	48100	41700	46900	37600	41300	47100	39200	49400	53800	49500
	Imported	39570	38600	37630	36660	35690	34720	33750	32780	31810	30840	29870
	Exported	0	0	0	0	0	0	0	0	0	0	0
Paper and cardboard, t	Produced	25750	11360	11010	13640	12220	5930	12220	14460	19220	31040	30530
	Imported	20000	18400	18400	18400	27106	27106	27106	27106	27106	27106	27106
	Exported	6900	5200	5200	5200	9970	9970	9970	9970	9970	9970	9970
Saw logs and veneer, m^3	Produced	32480	34100	30100	35700	29800	33200	33700	31800	43100	40200	37100
	Imported	7860	8490	8490	8490	8490	8490	8490	8490	8490	8490	8490
	Exported	0	0	0	0	0	0	0	0	0	0	0
Timber, m^3	Produced	31000	25000	29200	29600	29900	5800	5400	15000	31000	31000	31000
	Imported	66400	59700	57300	47600	109700	109700	109700	109700	109700	109700	109700
	Exported	5600	900	600	300	300	0	16	16	16	16	16
Wood panels, m^3	Produced	14000	10000	10000	10000	10000	10000	10000	10000	10000	10000	10000
	Imported	10600	37400	37400	37400	25962	25962	25962	25962	25962	25962	25962
	Exported	10600	37400	37400	37400	25962	25962	25962	25962	25962	25962	25962

Wood Products by Category	Source	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Rough round wood, m^3	Produced	83800	45000	43000	43000	43000	43000	43000	32600	29900	25600	25600
	Imported	28300	43400	39000	39000	39000	39000	45448	49980	36252	29100	29100
	Exported	300	370	2548	2548	2548	2548	134	150	56	56	56
Other types of round wood, m^3	Produced	49500	17900	17000	17000	17000	17000	17000	12800	8600	8800	8800
	Imported	28900	27930	26960	25990	25020	24050	23080	22110	21140	20170	18900
	Exported	0	0	0	0	0	0	0	0	0	0	0
Paper and cardboard, t	Produced	26530	84200	97500	97500	97500	97500	97500	4410	14100	11800	11700
	Imported	27106	48682	80001	80001	80001	80001	40066	35840	34929	36066	36066
	Exported	9970	27880	6100	6100	6100	6100	19898	17860	16406	14833	14833
Saw logs and veneer, m^3	Produced	34300	27100	26000	26000	26000	26000	26000	32600	21300	16800	16800
	Imported	8490	13020	11700	11700	11700	11700	13630	14990	10880	8730	8730
	Exported	0	0	0	0	0	0	0	0	0	0	0
Timber, m^3	Produced	31000	30940	34480	34480	34480	34480	34480	18234	16280	14900	16517
	Imported	109700	134000	143400	143400	143400	143400	137483	117300	126715	141787	141787
	Exported	16	3900	4000	4000	4000	4000	1678	1980	1378	2081	2081
Wood panels, m^3	Produced	10000	18000	2800	2800	2800	2800	2800	15055	15270	15000	15000
	Imported	25962	91	122	122	122	122	161514	167030	169818	212560	212560
	Exported	25962	91	122	122	122	122	161514	167030	169818	212560	212560

Source: Statistical Yearbooks of the RM for 1961-2015; FAOSTAT database for 1994-2015.

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 6-64.

Table 6-64: 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/m^3	0.5
	Wood panels	t C/m^3	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.

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 for 1961-2015; FAOSTAT database for 1994-2015). 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, taking into account 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 emissions/removals from category 4G "Harvested Wood Products" were estimated for the first time. Between 1990 and 2015, CO_2 emissions/removals from 4G "Harvested Wood Products" fluctuated (Figure 6-13) and were influenced in particular, by the impermanence of the wood harvesting/producing process.

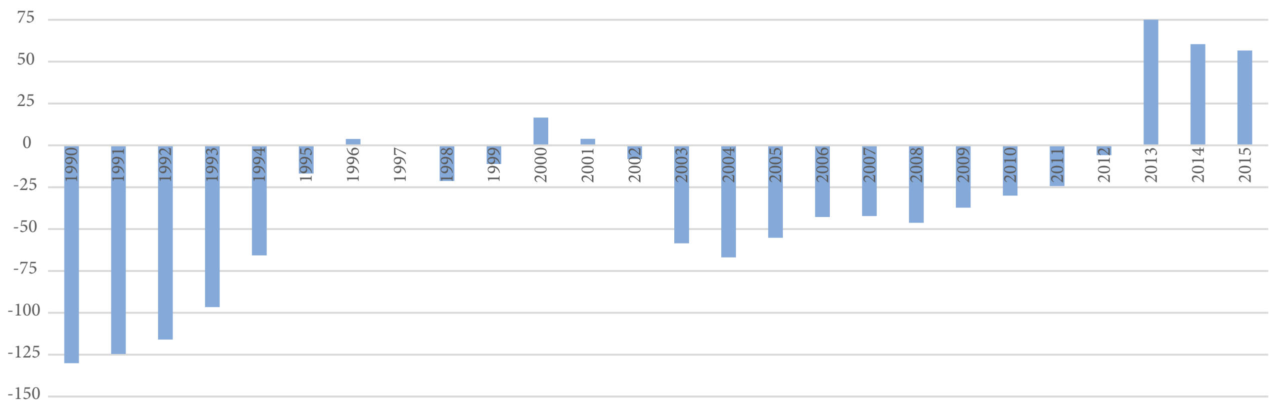


Figure 6-13: CO_2 Emissions/Removals from 4G "Harvested Wood Products" Category in the Republic of Moldova within 1990-2015 periods, kt

The largest volumes registered in 1990 (130.1 kt), while the lowest in 1997 (0.3 kt) (Table 6-65). At the same time, CO_2 emissions were recorded during 6 years (1996, 2000-2001, 2013-2015) – a minimum of 3.8 kt in 1996 and a maximum of 75.4 kt in 2013.

Table 6-65: CO_2 Emissions/Removals from 4G "Harvested Wood Products" Category in the Republic of Moldova within 1990-2015 periods, kt

	1990	1991	1992	1993	1994	1995	1996	1997	1998
4G. CO_2 Emissions/Removals	-130.0504	-124.5885	-115.9639	-96.5980	-65.6972	-16.8419	3.8273	-0.3171	-21.2914
	1999	2000	2001	2002	2003	2004	2005	2006	2007
4G. CO_2 Emissions/Removals	-11.1310	16.5854	3.8960	-8.1271	-58.5123	-66.8962	-55.2171	-42.8125	-42.2503
	2008	2009	2010	2011	2012	2013	2014	2015	%
4G. CO_2 Emissions/Removals	-46.2195	-37.1965	-30.0233	-24.3184	-5.8631	75.3959	60.4660	56.6377	-143.6

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.

7. WASTE SECTOR

7.1. Overview

Within Waste Sector 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 2015, Waste Sector accounted for circa 11.0 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 Energy and Agriculture Sectors. To be noted that Waste Sector represents a major source of CH_4 emissions, accounting for circa 50.6 per cent of total methane emissions reported at the national level.

Between 1990 and 2015, the total GHG emissions originated from the Waste Sector tended to lower values, decreasing from 1977.71 kt CO_2 equivalent in 1990 to circa 1538.66 kt CO_2 equivalent in 2015 (Table 7-1), in particular due to economic decline in the Republic of Moldova during the transition to a market economy.

Table 7-1: Direct GHG Emissions from Waste Sector, by Gas, within 1990-2015 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	1 870.2346	90.3656	1 977.7062	0.9	94.6	4.6
1991	17.1256	1 847.1960	83.5877	1 947.9094	0.9	94.8	4.3
1992	17.1291	1 709.0961	76.7929	1 803.0181	1.0	94.8	4.3
1993	17.1013	1 760.4488	72.1797	1 849.7299	0.9	95.2	3.9
1994	17.1330	1 659.7837	70.1371	1 747.0538	1.0	95.0	4.0
1995	17.1216	1 632.1003	70.9760	1 720.1979	1.0	94.9	4.1
1996	17.1083	1 622.7757	69.9393	1 709.8232	1.0	94.9	4.1
1997	17.0610	1 630.8662	71.1680	1 719.0952	1.0	94.9	4.1
1998	17.0087	1 562.5719	71.8641	1 651.4447	1.0	94.6	4.4
1999	16.9778	1 527.1028	70.3449	1 614.4255	1.1	94.6	4.4
2000	16.9434	1 511.7913	71.9564	1 600.6911	1.1	94.4	4.5
2001	16.9961	1 501.1177	72.9594	1 591.0731	1.1	94.3	4.6
2002	16.9406	1 458.5282	74.7844	1 550.2532	1.1	94.1	4.8
2003	16.8724	1 446.4765	72.2847	1 535.6336	1.1	94.2	4.7
2004	16.5930	1 435.3399	74.2453	1 526.1783	1.1	94.0	4.9
2005	16.5476	1 463.2092	77.5447	1 557.3015	1.1	94.0	5.0
2006	16.4929	1 444.3781	76.0743	1 536.9452	1.1	94.0	4.9
2007	16.4239	1 438.9086	72.9150	1 528.2475	1.1	94.2	4.8
2008	16.3761	1 462.6126	73.2076	1 552.1963	1.1	94.2	4.7
2009	16.3396	1 456.2019	69.1323	1 541.6738	1.1	94.5	4.5
2010	16.3159	1 491.3304	72.4799	1 580.1262	1.0	94.4	4.6
2011	16.3820	1 516.3363	71.7061	1 604.4245	1.0	94.5	4.5
2012	16.3598	1 514.3706	71.0975	1 601.8279	1.0	94.5	4.4
2013	16.3335	1 478.0421	71.7473	1 566.1229	1.0	94.4	4.6
2014	16.2752	1 473.1291	72.5331	1 561.9373	1.0	94.3	4.6
2015	16.1442	1 449.5799	72.9370	1 538.6611	1.0	94.2	4.7
1990-2015, %	-5.6	-22.7	-19.3	-22.4	21.3	-0.4	3.7

To be noted, however, that the economic growth recorded in the last 15 years resulted in a higher level of welfare, an increase consumption and a greater capacity for waste generation. All these changes have contributed to an increasing trend of direct GHG emissions within the Waste Sector, in particular following 2005 year.

In 1990, CO_2, CH_4 and N_2O emissions accounted for circa 0.9 per cent, 94.6 per cent and 4.6 per cent of the total GHG emissions from the Waste Sector. By 2015, the share of pollutants have not changed significantly, representing about circa 1.0 per cent, 94.2 per cent and 4.7 per cent of the total sectoral emissions.

At the same time, between the 1990-2015 time series, the total direct GHG emissions originated from the Waste Sector decreased by circa 22.4 per cent, CO_2 emissions by 5.6 per cent, CH_4 and N_2O emissions decreased respectively, by 22.7 per cent and 19.3 per cent (Figure 7-1).

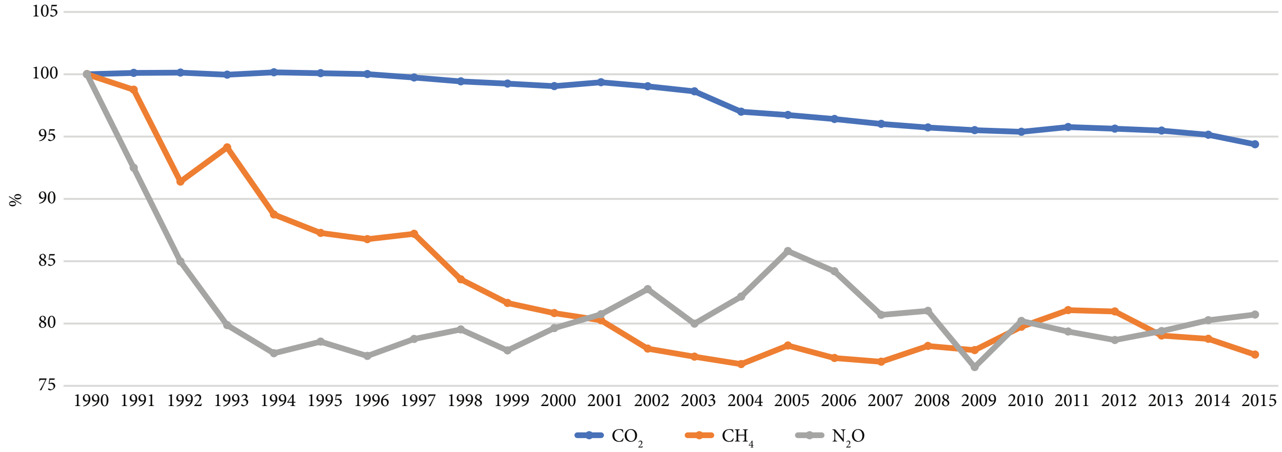


Figure 7-1: Direct GHG Emissions from Waste Sector by Gas in the Republic of Moldova within 1990-2015 time periods, where 1990 represent 100 per cent

The 5A "Solid Waste Disposal" was the largest source of direct GHG emissions in the time period from 1990 through 2015, with a share varying between a minimum of 52.9 per cent of the total in 1990 and a maximum of 74.0 per cent of the total in 1999; followed by the 5D "Wastewater Treatment and Discharge" with a share varying between a minimum of 24.2 per cent of the total in 1999 and a maximum of 45.6 per cent of the total in 1990; respectively by the 5C "Incineration and Open Burning of Waste", with a share varying between 1.4 and 1.8 per cent of the total sectoral emissions within 1990-2015 periods.

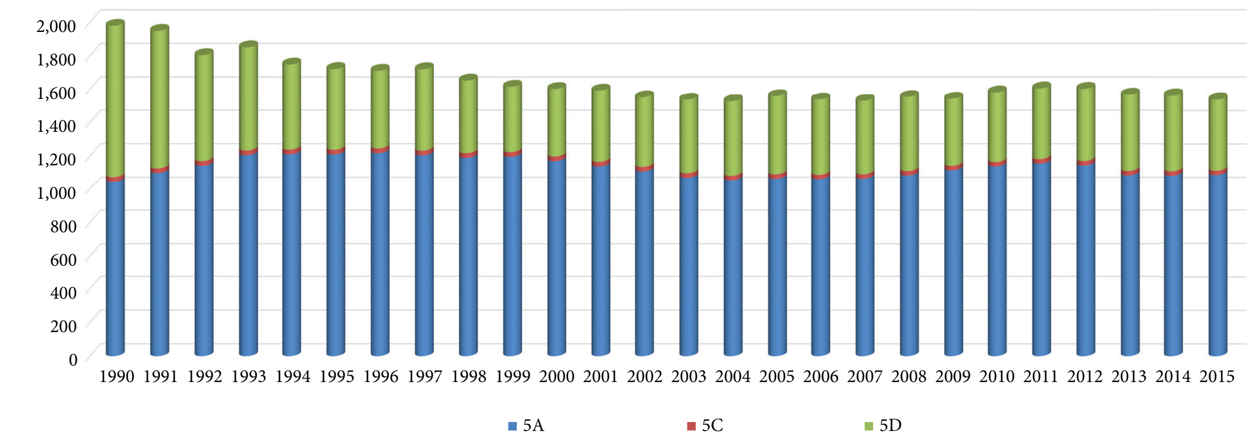


Figure 7-2: Breakdown of Direct GHG Emissions by Category under the Waste Sector within 1990-2015 periods, kt CO_2 equivalent

Within the reference period, direct GHG emissions from the 5A "Solid Waste Disposal" category increased by circa 3.9 per cent, from 5C "Incineration and Open Burning of Waste" category decreased by circa 5.8 per cent, while emissions from the 5D "Wastewater Treatment and Discharge" category decreased by circa 54.4 per cent (Figure 7-2, Table 7-2).

Table 7-2: Breakdown of Direct GHG Emissions by Category and their Share in the Total Sectoral Emissions in the Republic of Moldova within 1990-2015 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	28.3035	902.6749	1 977.7062	52.9	1.4	45.6
1991	1 098.6185	28.3351	820.9558	1 947.9094	56.4	1.5	42.1
1992	1 141.9561	28.3399	632.7221	1 803.0181	63.3	1.6	35.1
1993	1 204.7053	28.2929	616.7317	1 849.7299	65.1	1.5	33.3
1994	1 209.7998	28.3443	508.9097	1 747.0538	69.2	1.6	29.1
1995	1 209.1845	28.3243	482.6890	1 720.1979	70.3	1.6	28.1

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
1996	1 216.7840	28.3012	464.7381	1 709.8232	71.2	1.7	27.2
1997	1 203.7861	28.2217	487.0875	1 719.0952	70.0	1.6	28.3
1998	1 189.3434	28.1338	433.9675	1 651.4447	72.0	1.7	26.3
1999	1 195.2115	28.0813	391.1327	1 614.4255	74.0	1.7	24.2
2000	1 169.5079	28.0229	403.1602	1 600.6911	73.1	1.8	25.2
2001	1 137.4601	28.1086	425.5045	1 591.0731	71.5	1.8	26.7
2002	1 108.0536	28.0151	414.1844	1 550.2532	71.5	1.8	26.7
2003	1 070.2266	27.9006	437.5064	1 535.6336	69.7	1.8	28.5
2004	1 055.1542	27.4363	443.5877	1 526.1783	69.1	1.8	29.1
2005	1 064.2940	27.3593	465.6482	1 557.3015	68.3	1.8	29.9
2006	1 061.8223	27.2667	447.8563	1 536.9452	69.1	1.8	29.1
2007	1 064.8166	27.1505	436.2804	1 528.2475	69.7	1.8	28.5
2008	1 084.2157	27.0691	440.9115	1 552.1963	69.9	1.7	28.4
2009	1 115.0733	27.0065	399.5940	1 541.6738	72.3	1.8	25.9
2010	1 137.8702	26.9649	415.2911	1 580.1262	72.0	1.7	26.3
2011	1 155.0902	27.0530	422.2813	1 604.4245	72.0	1.7	26.3
2012	1 143.6432	27.0156	431.1691	1 601.8279	71.4	1.7	26.9
2013	1 084.7888	26.9722	454.3619	1 566.1229	69.3	1.7	29.0
2014	1 083.0811	26.8791	451.9772	1 561.9373	69.3	1.7	28.9
2015	1 087.1519	26.6656	424.8436	1 538.6611	70.7	1.7	27.6
1990-2015, %	3.9	-5.8	-54.4	-22.4	33.5	21.1	-39.5

The table below presents direct GHG emissions from Waste Sector by sources and gas (Table 7-3).

Table 7-3: Direct GHG Emissions from Waste Sector, by Source and Gas, in the Republic of Moldova within 1990-2015 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	2.4157	814.7250	87.9499	1 977.7062
1991	1 098.6185	17.1256	8.7912	2.4183	739.7863	81.1694	1 947.9094
1992	1 141.9561	17.1291	8.7923	2.4186	558.3477	74.3744	1 803.0181
1993	1 204.7053	17.1013	8.7772	2.4144	546.9664	69.7653	1 849.7299
1994	1 209.7998	17.1330	8.7926	2.4187	441.1912	67.7185	1 747.0538
1995	1 209.1845	17.1216	8.7859	2.4168	414.1298	68.5592	1 720.1979
1996	1 216.7840	17.1083	8.7782	2.4147	397.2135	67.5246	1 709.8232
1997	1 203.7861	17.0610	8.7529	2.4077	418.3272	68.7603	1 719.0952
1998	1 189.3434	17.0087	8.7250	2.4001	364.5035	69.4640	1 651.4447
1999	1 195.2115	16.9778	8.7081	2.3954	323.1832	67.9495	1 614.4255
2000	1 169.5079	16.9434	8.6893	2.3902	333.5941	69.5662	1 600.6911
2001	1 137.4601	16.9961	8.7152	2.3973	354.9424	70.5620	1 591.0731
2002	1 108.0536	16.9406	8.6854	2.3892	341.7891	72.3953	1 550.2532
2003	1 070.2266	16.8724	8.6490	2.3792	367.6009	69.9055	1 535.6336
2004	1 055.1542	16.5930	8.5040	2.3393	371.6817	71.9060	1 526.1783
2005	1 064.2940	16.5476	8.4792	2.3324	390.4359	75.2123	1 557.3015
2006	1 061.8223	16.4929	8.4496	2.3243	374.1062	73.7500	1 536.9452
2007	1 064.8166	16.4239	8.4125	2.3141	365.6796	70.6009	1 528.2475
2008	1 084.2157	16.3761	8.3862	2.3069	370.0107	70.9008	1 552.1963
2009	1 115.0733	16.3396	8.3657	2.3012	332.7629	66.8311	1 541.6738
2010	1 137.8702	16.3159	8.3517	2.2974	345.1085	70.1826	1 580.1262
2011	1 155.0902	16.3820	8.3688	2.3021	352.8773	69.4041	1 604.4245
2012	1 143.6432	16.3598	8.3570	2.2988	362.3704	68.7987	1 601.8279
2013	1 084.7888	16.3335	8.3436	2.2951	384.9097	69.4522	1 566.1229
2014	1 083.0811	16.2752	8.3163	2.2876	381.7317	70.2455	1 561.9373
2015	1 087.1519	16.1442	8.2516	2.2698	354.1764	70.6672	1 538.6611
1990-2015, %	3.9	-5.6	-6.0	-6.0	-58.3	-19.7	-22.4

Within the current inventory cycle, indirect GHG emissions, ozone and aerosol precursors (NO_x, CO, NMVOC and SO_2), from Waste Sector 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 Waste Sector in the RM within 1990-2015 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	0.1699
CO	3.0070	3.0097	3.0095	3.0038	3.0084	3.0055	3.0021	2.9927	2.9824
NMVOC	3.0981	2.9195	2.8132	1.7663	1.6023	1.4716	1.4378	1.3445	1.3380
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	0.1695	0.1691	0.1695	0.1689	0.1681	0.1652	0.1647	0.1640	0.1632
CO	2.9758	2.9684	2.9764	2.9653	2.9518	2.9009	2.8913	2.8800	2.8660
NMVOC	1.2118	1.2083	1.0953	1.1538	1.3068	1.3936	1.5512	1.6796	2.1020
SO_2	0.0059	0.0058	0.0059	0.0058	0.0058	0.0057	0.0057	0.0057	0.0056
	2008	2009	2010	2011	2012	2013	2014	2015	%
NOx	0.1627	0.1622	0.1618	0.1614	0.1612	0.1609	0.1605	0.1594	-7.0
CO	2.8557	2.8473	2.8411	2.8342	2.8299	2.8254	2.8181	2.7978	-7.0
NMVOC	2.3968	2.1806	2.0094	2.0376	2.0137	2.1787	2.3046	2.3072	-25.5
SO_2	0.0056	0.0056	0.0056	0.0056	0.0056	0.0056	0.0056	0.0055	-7.0

7.1.2. Key Categories

The results of key category analysis under the Waste Sector (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 Waste Sector

IPCC Category	GHG	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)	No

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 methodological 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 Waste Sector

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 Waste Sector (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 ±37.26 per cent. The uncertainties introduced in trend in total direct sectoral emissions were estimated at circa ±25.81 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 Waste Sector, following a Tier 1 approach. To be noted that AD and methods used for estimating GHG emissions under the Waste Sector 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 quality control procedures were applied. Following the recommendations included into the 2006 IPCC Guidelines, GHG emissions from the Waste Sector were estimated based on AD and EFs from official sources of reference.

7.1.6. Recalculations

GHG emission recalculations under the Waste Sector are due to use of new methodological approach according to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories, thus replacing the Good Practice Guidance (IPCC, 2000) and the Revised 1996 IPCC Guidelines (IPCC, 1997), 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 1991 and 1998, varying from a minimum of 1.0 per cent in 1998 and a maximum of 12.6 per cent in 1992; respectively an increasing trend of direct GHG emissions between 1990 and 1999-2013, varying from a minimum increase of 0.02 per cent in 2013 and a maximum increase of 20.0 per cent in 2005 (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 Waste Sector within 1990-2013 periods, included into the BUR1 and NC4 of the RM under UNFCCC, kt CO_2 equivalent

	1990	1991	1992	1993	1994	1995	1996	1997	1998
BUR1	1865.4695	1978.1829	2062.1353	2022.0918	1958.7348	1904.3921	1820.9086	1748.3108	1668.6450
NC4	1977.7062	1947.9094	1803.0181	1849.7299	1747.0538	1720.1979	1709.8232	1719.0952	1651.4447
Difference, %	6.0	-1.5	-12.6	-8.5	-10.8	-9.7	-6.1	-1.7	-1.0
	1999	2000	2001	2002	2003	2004	2005	2006	2007
BUR1	1555.5198	1469.0376	1392.6778	1324.6927	1291.9826	1279.4676	1297.8417	1310.9119	1363.9567
NC4	1614.4255	1600.6911	1591.0731	1550.2532	1535.6336	1526.1783	1557.3015	1536.9452	1528.2475
Difference, %	3.8	9.0	14.2	17.0	18.9	19.3	20.0	17.2	12.0
	2008	2009	2010	2011	2012	2013	2014	2015	%
BUR1	1458.9040	1514.5091	1570.6934	1559.7290	1556.6850	1565.7972			
NC4	1552.1963	1541.6738	1580.1262	1604.4245	1601.8279	1566.1229	1561.9373	1538.6611	-22.2
Difference, %	6.4	1.8	0.6	2.9	2.9	0.02			

Abbreviations: NC4 – Fourth National Communication; BUR1 – First Biennial Update Report.

7.1.7. Assessment of Completeness

The current inventory covers direct GHG emissions from three source categories under the Waste Sector (Table 7-8). Though the RM does not own waste incinerators, GHG emissions from 5C “Incineration and Open Burning of Waste” source category were estimated for the first time.

Table 7-8: Assessment of Completeness under the Waste Sector 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 Waste Sector 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[105].

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. According to the studies and analyses on the waste structure carried out by GIZ/GOPA in December 2015, FICHTNER in April 2016 and COWI/GOPA in July 2016, during the development of feasibility studies in waste management regions, the following values were proposed: for rural areas – 0.4 kg/per capita/day, for urban areas with a population up to 15 thousand inhabitants – 0.5 kg/per capita/day; for urban areas with a population between 15 and 40 thousand inhabitants – 0.7 kg/per capita/day, urban areas with more than 40 thousand inhabitants – 0.9 kg/per capita/day, while for Balti and Chisinau municipalities – respectively 0.9 kg/per capita/day and 1.3 kg/per capita/day.

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 2015 – Environment Protection in the Republic of Moldova", the total area of SWDS in urban areas represent circa 1,229.74 ha. In 2015 the area of authorized SWDS represented only 170.7 ha (NBS, 2016), therefore circa 1,059 ha were occupied by the so called "dump sites" (unauthorized landfills) situated especially in the rural areas of the Republic of Moldova. From the existing 1,158 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 2015 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 2000-2015 time periods, through urban sanitation services, about 1,144 and 2,921 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 (Tintareni and Orhei). 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 Tintareni village, Anenii Noi district that served until recently Chisinau municipality

[105] <http://lex.justice.md/index.php?action=view&view=doc&lang=1&id=347341>.

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 it's use stopped, only 19 million m^3 of solid waste were stored, which is less than half the capacity of the landfill. In fact, this landfill could still be used, but this is not possible due to repeated actions of blocking the access to the landfill by the residents of the nearby villages as a result of public opinion manipulation and the politicization of environment protection issues. Road blocking to the Tintareni landfill is considered by the specialists as a populist action, without any relevant supporting arguments for stopping its use.

Meanwhile, since 2011 to 2017, Chisinau municipality has storied its waste near the waste transhipment 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 Tintareni landfill.

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 2015, the methane emissions from the 5A "Solid Waste Disposal" source category increased by circa 3.9 per cent, from circa 41.87 kt in 1990, up to circa 43.49 kt in 2015 (Figure 7-3).

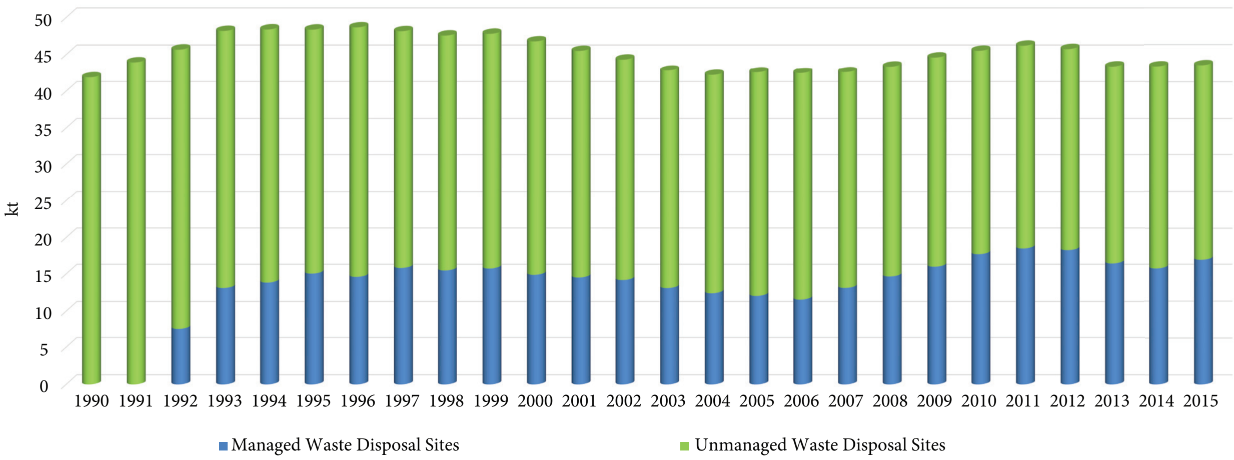


Figure 7-3: Methane Emissions from 5A "Solid Waste Disposal" within 1990-2015, kt

7.2.2. 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 some default emission factors but require good quality country-specific activity data on current and historical waste disposal at SWDS (historical waste disposal data for 10 years or more should be based on country-specific statistics, surveys or other similar sources); 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):

$$Emissions\ CH_4 = [\Sigma_x CH_4\ generated_{x,T} - R_T] \bullet (1\text{-}OX_T)$$

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):

$$DOC = \Sigma_i (DOC_i \bullet W_i)$$

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) accounts for the fact that unmanaged SWDS produce less CH_4 from a given amount of waste than anaerobic managed SWDS. In unmanaged SWDS, 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.

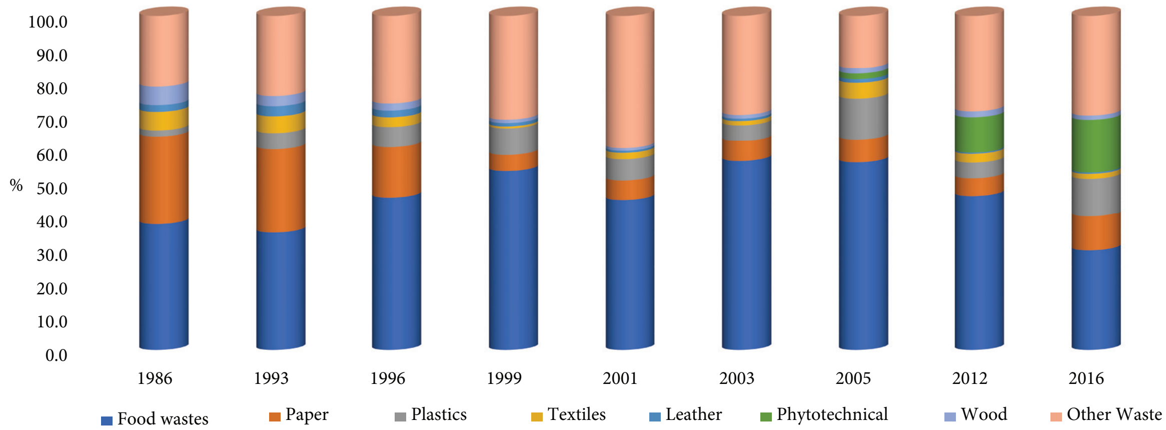


Figure 7-4: Biodegradable Waste in the Major Waste Streams in the Republic of Moldova within 1986-2016 periods, %

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 Ministry of Agriculture, Regional Development and Environment have determined 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	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 (Figure 7-5 and Table 7-12), using AD on the waste morphologic composition, which also served as basis to estimate *DOC* and DOC_f values

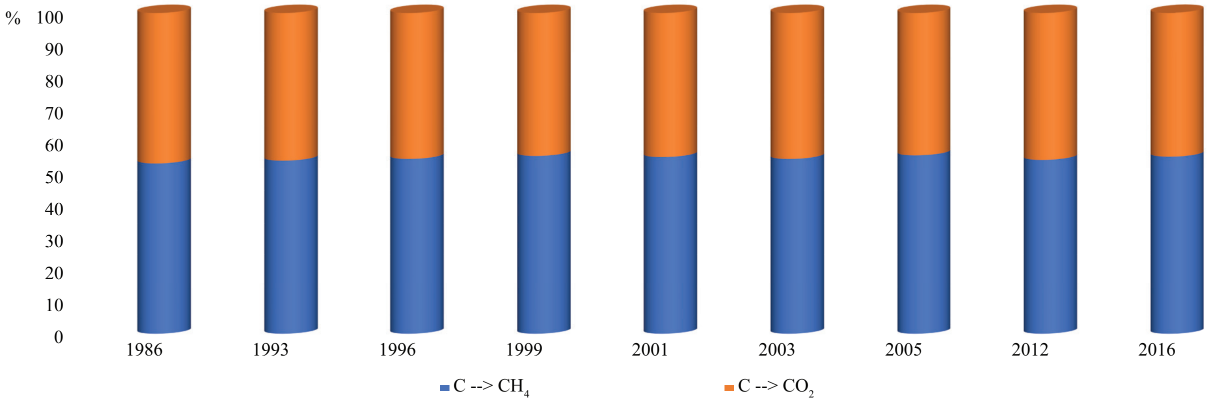


Figure 7-5: Based on Extended Buswell Equation, 1986-2016

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

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 Tintareni, 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 Tintareni, %	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 and 3.1665 kt biogas in 2015) 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[106] (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).

[106] <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. Studies show that 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.

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 1959-2015

	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
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

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 Tintareni village, Anenii Noi district 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.

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. In 1990 year just 20 per cent of the waste was generated in Chisinau city, while in the last four or five years the share of Chisinau city represents 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 Republic of Moldova, information on the amount of recycled waste is not always subjected to a strict statistical evidence. Given the Republic of Moldova's intention to align to EU standards, the waste sector will be essentially restructured. In this context, the majority of SWDS are to be recover 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 1990 through 2013 time series, in particular due to the transition to new assessment methods available in the 2006 IPCC Guidelines to the detriment of those used in the GPG (IPCC, 2000) and due to updated AD and country-specific EF based on new studies, including research on the morphological analysis of solid waste. In comparison with the results reported in the BUR1, the changes performed within the current inventory cycle resulted in a decrease of CH_4 emissions originated from the 5A "Solid Waste Disposal" between 1990-2013, varying from a minimum decrease of 18.4 per cent in 2005, to a maximum decrease of 47.2 per cent in 1992 (Table 7-16).

Table 7-16: Comparative Results of CH_4 Emissions from 5A "Solid Waste Disposal" Category included into the BUR1 and the NC4 of the RM under the UNFCCC, kt

	1990	1991	1992	1993	1994	1995	1996	1997	1998
BUR1	73.5356	80.3777	86.5813	85.1670	83.1035	80.7237	77.2264	73.8246	70.8531
NC4	41.8691	43.9447	45.6782	48.1882	48.3920	48.3674	48.6714	48.1514	47.5737
Difference, %	-43.1	-45.3	-47.2	-43.4	-41.8	-40.1	-37.0	-34.8	-32.9
	1999	2000	2001	2002	2003	2004	2005	2006	2007
BUR1	66.3843	62.3499	58.2796	55.0141	53.1641	51.8747	52.1660	52.9793	55.9154
NC4	47.8085	46.7803	45.4984	44.3221	42.8091	42.2062	42.5718	42.4729	42.5927
Difference, %	-28.0	-25.0	-21.9	-19.4	-19.5	-18.6	-18.4	-19.8	-23.8
	2008	2009	2010	2011	2012	2013	2014	2015	%
BUR1	60.1438	63.2337	65.3038	64.4465	63.8783	63.9950			
NC4	43.3686	44.6029	45.5148	46.2036	45.7457	43.3916	43.3232	43.4861	3.9
Difference, %	-27.9	-29.5	-30.3	-28.3	-28.4	-32.2			

Abbreviations: NC4 – Fourth National Communication; BUR1 – First Biennial Update Report.

At the same time, the impact of the conversion of methane emissions in CO_2 equivalent using the global warming potential value available in the IPCC AR4 ($GWP_{100} = 25$) in the detriment of the value used in the IPCC AR2 ($GWP_{100} = 21$) revealed an increasing trend regarding the methane emissions from 5A "Solid Waste Disposal" category within the 1990-2013 periods, by circa 19 per cent. In comparison with the results reported in the BUR1, the changes performed within the current inventory cycle resulted in a decrease of CH_4 emissions originated from the 5A "Solid Waste Disposal" between 1990-2013, varying from a minimum decrease of 2.8 per cent in 2005, to a maximum decrease of 37.2 per cent in 1992 (Table 7-17).

Table 7-17: Comparative Results of CH_4 Emissions from 5A "Solid Waste Disposal" Category included into the BUR1 and the NC4 of the RM under the UNFCCC, kt CO_2 equivalent

	1990	1991	1992	1993	1994	1995	1996	1997	1998
BUR1	1544.2480	1687.9308	1818.2070	1788.5075	1745.1730	1695.1973	1621.7539	1550.3166	1487.9148
NC4	1046.7277	1098.6185	1141.9561	1204.7053	1209.7998	1209.1845	1216.7840	1203.7861	1189.3434
Difference, %	-32.2	-34.9	-37.2	-32.6	-30.7	-28.7	-25.0	-22.4	-20.1
	1999	2000	2001	2002	2003	2004	2005	2006	2007
BUR1	1394.0708	1309.3479	1223.8706	1155.2957	1116.4467	1089.3693	1095.4870	1112.5653	1174.2231
NC4	1195.2115	1169.5079	1137.4601	1108.0536	1070.2266	1055.1542	1064.2940	1061.8223	1064.8166
Difference, %	-14.3	-10.7	-7.1	-4.1	-4.1	-3.1	-2.8	-4.6	-9.3
	2008	2009	2010	2011	2012	2013	2014	2015	%
BUR1	1263.0198	1327.9083	1371.3804	1353.3765	1341.4442	1343.8942			
NC4	1084.2157	1115.0733	1137.8702	1155.0902	1143.6432	1084.7888	1083.0811	1087.1519	3.9
Difference, %	-14.2	-16.0	-17.0	-14.7	-14.7	-19.3			

Abbreviations: NC4 – Fourth National Communication; BUR1 – First Biennial Update Report.

For 2014-2015 the respective emissions were estimated for the first time. The results allow assert that within 1990-2015 periods CH_4 emissions from this category increased by circa 3.9 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.

Between 1990 and 2015, NMVOC emissions from the 5A "Solid Waste Disposal" category were estimated for the first time. The results allow assert that within the period of reference the respective emissions decreased by circa 25.3 per cent (Table 7-18).

Table 7-18: NMVOC Emissions from 5A "Solid Waste Disposal" Category included into the NC4 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	%
NMVOC	2.3236	2.1076	1.9364	1.9649	1.9411	2.1063	2.2326	2.2355	-25.3

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 Republic of Moldova 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 Waste Sector, while those from waste incineration with energy recovery are included in the Energy Sector. The methodology described in this chapter applies for both categories. Co-firing of specific waste fractions with other fuels is reported only within the Energy Sector (for example, emissions from the incineration of tyres in the kilns from cement plants will be reported only within the Energy Sector). At the same time, emissions from agricultural residue burning are considered in the Agriculture Sector or in the LULUCF Sector.

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 1990-2015 periods, million people

	1990	1991	1992	1993	1994	1995	1996	1997	1998
Left bank of Dniester River	0.7307	0.7303	0.7296	0.7025	0.7017	0.6916	0.6791	0.6708	0.6657
Right bank of Dniester River	3.6309	3.6360	3.6295	3.6453	3.6510	3.6563	3.6553	3.6492	3.6390
Republic of Moldova, total	4.3616	4.3663	4.3591	4.3478	4.3527	4.3479	4.3344	4.3200	4.3047
	1999	2000	2001	2002	2003	2004	2005	2006	2007
Left bank of Dniester River	0.6600	0.6513	0.6425	0.6336	0.6238	0.5544	0.5475	0.5406	0.5335
Right bank of Dniester River	3.6330	3.6303	3.6351	3.6278	3.6183	3.6074	3.6004	3.5899	3.5811
Republic of Moldova, total	4.2930	4.2815	4.2776	4.2614	4.2421	4.1618	4.1479	4.1305	4.1146
	2008	2009	2010	2011	2012	2013	2014	2015	%
Left bank of Dniester River	0.5275	0.5225	0.5180	0.5134	0.5094	0.5052	0.5007	0.4751	-35.0
Right bank of Dniester River	3.5727	3.5675	3.5637	3.5604	3.5595	3.5595	3.5576	3.5552	-2.1
Republic of Moldova, total	4.1002	4.0900	4.0817	4.0738	4.0690	4.0647	4.0583	4.0303	-7.6

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 a developed country, 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 1990-2015 periods between 44.5 and 47.5 per cent, while the rural population, respectively, between 52.5 and 55.5 per cent (Table 7-20).

Table 7-20: Urban and Rural Population of the RM within 1990-2015 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	1.9873
Rural population	2.2923	2.2927	2.3069	2.3086	2.3161	2.3149	2.3303	2.3247	2.3174
Share of urban population, %	47.4	47.5	47.1	46.9	46.8	46.8	46.2	46.2	46.2
Share of rural population, %	52.6	52.5	52.9	53.1	53.2	53.2	53.8	53.8	53.8
	1999	2000	2001	2002	2003	2004	2005	2006	2007
Urban population	1.9763	1.9685	1.9263	1.9186	1.9104	1.8550	1.8485	1.8378	1.8415
Rural population	2.3167	2.3130	2.3513	2.3428	2.3318	2.3068	2.2994	2.2927	2.2731
Share of urban population, %	46.0	46.0	45.0	45.0	45.0	44.6	44.6	44.5	44.8
Share of rural population, %	54.0	54.0	55.0	55.0	55.0	55.4	55.4	55.5	55.2
	2008	2009	2010	2011	2012	2013	2014	2015	%
Urban population	1.8361	1.8364	1.8341	1.8361	1.8377	1.8414	1.8495	1.8399	-11.1
Rural population	2.2641	2.2536	2.2475	2.2377	2.2313	2.2233	2.2088	2.1904	-4.4
Share of urban population, %	44.8	44.9	44.9	45.1	45.2	45.3	45.6	45.7	-3.8
Share of rural population, %	55.2	55.1	55.1	54.9	54.8	54.7	54.4	54.3	3.4

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 60-80 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[107].

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, Labour and Social Protection of the Republic of Moldova[108] 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 2010-2015 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;

[107] 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.
[108] 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.

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: $\sum WF_j = 1$,
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. This is only the case 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

	NOx, 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"

Year	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 urban 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	20.3930	33.4676	53.8605	0.1815
1991	2 073.6	2 292.7	0.9	0.5	20.4353	33.4734	53.9087	0.1911
1992	2 052.2	2 306.9	0.9	0.5	20.2244	33.6807	53.9052	0.2011
1993	2 039.2	2 308.6	0.9	0.5	20.0963	33.7056	53.8019	0.2117
1994	2 036.6	2 316.1	0.9	0.5	20.0707	33.8151	53.8858	0.2228
1995	2 033.0	2 314.9	0.9	0.5	20.0352	33.7975	53.8328	0.2346
1996	2 004.1	2 330.3	0.9	0.5	19.7504	34.0224	53.7728	0.2469
1997	1 995.3	2 324.7	0.9	0.5	19.6637	33.9406	53.6043	0.2599
1998	1 987.3	2 317.4	0.9	0.5	19.5848	33.8340	53.4189	0.2736
1999	1 976.3	2 316.7	0.9	0.5	19.4764	33.8238	53.3003	0.2880
2000	1 968.5	2 313.0	0.9	0.5	19.3996	33.7698	53.1694	0.3031
2001	1 926.3	2 351.3	0.9	0.5	18.9837	34.3290	53.3127	0.3191
2002	1 918.6	2 342.8	0.9	0.5	18.9078	34.2049	53.1127	0.3359
2003	1 910.4	2 331.8	0.9	0.5	18.8270	34.0443	52.8713	0.3536
2004	1 855.0	2 306.8	0.9	0.5	18.2810	33.6793	51.9603	0.3722
2005	1 848.5	2 299.4	0.9	0.5	18.2170	33.5712	51.7882	0.3918
2006	1 837.8	2 292.7	0.9	0.5	18.1115	33.4734	51.5849	0.4124
2007	1 841.5	2 273.1	0.9	0.5	18.1480	33.1873	51.3352	0.4341
2008	1 836.1	2 264.1	0.9	0.5	18.0948	33.0559	51.1506	0.4569
2009	1 836.4	2 253.6	0.9	0.5	18.0977	32.9026	51.0003	0.4810
2010	1 834.1	2 247.5	0.9	0.5	18.0749	32.8137	50.8886	0.5063
2011	1 836.1	2 237.7	0.9	0.5	18.0946	32.6711	50.7657	0.7348
2012	1 837.7	2 231.3	0.9	0.5	18.1105	32.5767	50.6872	0.7403
2013	1 841.4	2 223.3	0.9	0.5	18.1469	32.4596	50.6065	0.7387
2014	1 849.5	2 208.8	0.9	0.5	18.2268	32.2488	50.4756	0.7017
2015	1 839.9	2 190.4	0.9	0.5	18.1319	31.9803	50.1122	0.6666
%	-11.1	-4.4			-11.1	-4.4	-7.0	267.3

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.

7.3.5. Recalculations

Direct and indirect GHG emissions from incineration and open burning of household and clinical waste were estimated for the first time within the current inventory cycle. The results are presented below in Table 7-23.

Table 7-23: Direct and Indirect GHG Emissions from Source Category 5C "Incineration and open burning of waste" in the RM within 1990-2015 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	17.0087
CH_4	0.3513	0.3516	0.3517	0.3511	0.3517	0.3514	0.3511	0.3501	0.3490
N_2O	0.0081	0.0081	0.0081	0.0081	0.0081	0.0081	0.0081	0.0081	0.0081
NOx	0.1717	0.1719	0.1719	0.1716	0.1719	0.1717	0.1716	0.1711	0.1705
CO	3.0071	3.0098	3.0096	3.0038	3.0085	3.0055	3.0022	2.9928	2.9824
NMVOC	0.0664	0.0664	0.0664	0.0663	0.0664	0.0664	0.0663	0.0661	0.0659
SO_2	0.0060	0.0060	0.0060	0.0060	0.0060	0.0060	0.0060	0.0060	0.0060
	1999	2000	2001	2002	2003	2004	2005	2006	2007
CO_2	16.9778	16.9434	16.9961	16.9406	16.8724	16.5930	16.5476	16.4929	16.4239
CH_4	0.3483	0.3476	0.3486	0.3474	0.3460	0.3402	0.3392	0.3380	0.3365
N_2O	0.0080	0.0080	0.0080	0.0080	0.0080	0.0078	0.0078	0.0078	0.0078
NOx	0.1702	0.1698	0.1703	0.1697	0.1689	0.1661	0.1656	0.1650	0.1642
CO	2.9758	2.9685	2.9765	2.9653	2.9519	2.9010	2.8914	2.8801	2.8661
NMVOC	0.0658	0.0656	0.0658	0.0656	0.0653	0.0642	0.0640	0.0637	0.0634
SO_2	0.0060	0.0060	0.0060	0.0060	0.0060	0.0059	0.0059	0.0059	0.0059
	2008	2009	2010	2011	2012	2013	2014	2015	%
CO_2	16.3761	16.3396	16.3159	16.3820	16.3598	16.3335	16.2752	16.1442	-5.6
CH_4	0.3354	0.3346	0.3341	0.3348	0.3343	0.3337	0.3327	0.3301	-6.0
N_2O	0.0077	0.0077	0.0077	0.0077	0.0077	0.0077	0.0077	0.0076	-6.0
NOx	0.1637	0.1633	0.1630	0.1631	0.1629	0.1626	0.1621	0.1609	-6.3
CO	2.8558	2.8474	2.8412	2.8344	2.8300	2.8255	2.8182	2.7979	-7.0
NMVOC	0.0632	0.0631	0.0629	0.0630	0.0629	0.0628	0.0626	0.0621	-6.4
SO_2	0.0059	0.0059	0.0059	0.0060	0.0060	0.0060	0.0059	0.0059	-2.5

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)

Untreated or insufficiently treated wastewater from sewage plants directly into the natural water receivers have a big influence on the quality of natural waters. The largest volumes of untreated wastewater come from the domestic sewage systems. In recent decades one can notice a quantitative decrease in wastewater discharges. Thus, the volume of wastewater discharged into surface water basins between 1990 and 2015 decreased by approximately 75.4 per cent, from circa 2,731 million m^3 in 1990 to circa 672 million m^3 in 2015.

However, 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 92.1 per cent, from 89 million m^3 in 1990, to 7 million m^3 in 2015 (Table 7-24). 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.

Table 7-24: Wastewater Discharged into Surface Water Basins within 1990-2015, million m^3

	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	696	685	688	690	695	687
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	89	88
	2008	2009	2010	2011	2012	2013	2014	2015	%
Discharged wastewater – total	686	685	689	686	682	679	664	672	-75.4
Conventional pure water (untreated)	550	552	555	555	553	551	545	546	-77.5
Polluted wastewater	14	10	8	8	9	9	10	8	-91.1
..untreated	0.8	0.8	0.9	1.0	1.5	1.0	1.4	1.4	40.0
..insufficiently treated	13.3	9.5	7.5	7.2	7.4	7.9	8.7	7.0	-92.1
Treated water according to normative requirements	115	116	119	115	113	113	109	112	-48.1
Treated water according to normative, in % compared to the total volume of wastewater needing treatment	85	87	89	88	87	88	87	89	27.1

Source: NBS, Statistical Yearbooks of the RM for 1994 (page 41), 1999 (page 23), 2006 (page 27), 2011 (page 24) 2014 (page 24), 2016 (page 32).

Wastewater treatment plants hold one of the most important places in water resources protection systems. 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[109]. In 2002, 106 WBTP[110] operated, while in 2003 only 104 treatment plants existed (they used only a third of capacity, about 198 thousand m^3/day being treated, at a total capacity of circa 614 thousand m^3/day)[111]. In 2004, 252 WBTP existed, most of them presenting a high attrition rate regarding

[109] 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).
[110] 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).
[111] 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).

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)[112]. 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[113]. 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[114]. In 2006, 131 WBTP existed, but functioned only 78 and just one was according to normative requirements; another 53 WBTP were closed[115]. 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[116]. 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 according to normative requirements[117]. 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[118]. Between 2010-2011, 79 wastewater treatment plants had project documentation, 17 units operated according to normative requirements, 112 units performed insufficient treatment while 69 did not functioned[119]. In 2012, 73 wastewater treatment plants had project documentation, 30 units operated according to normative requirements, 116 units – performed insufficient treatment[120]. 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[121]. In 2014, 81 wastewater treatment plants had project documentation, 24 units operated according to normative requirements, 138 units performed insufficient treatment [122]. 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

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[112] 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).
[113] State of the Environment in the Republic of Moldova in 2006: (National Report) – Ch.: S.n., 2007, - 103 pages (see page 50).
[114] 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).
[115] Environment Protection in the Republic of Moldova: (National Report for the Ministerial Conference in Belgrade, Serbia) – Chisinau, 2008, - 64 pages (see page 32).
[116] SEI Yearbook „Quality of the Environment and the State Ecological Inspectorate Activity – 2007" – Chisinau, 2008 – 202 pages (see page 8).
[117] 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).
[118] 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).
[119] 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).
[120] 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).
[121] 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).
[122] 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).

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[123]. 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.[124] 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.

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.

According to the Republic of Moldova's Strategy for Water Supply and Sanitation (2014–2028)[125] approved by Government Decision No. 199 dated 20.03.2014, in 2012 only about 1032 localities across the country possessed centralized sewage systems, including 3 municipalities and 52 towns. 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.

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.

7.4.1. Source Category Description

The 5D "Wastewater treatment and discharge" category deals with direct (CH_4 and N_2O) and indirect GHG emissions from two sub-categories: 5D1 "Domestic wastewater" and 5D2 "Industrial wastewater".

5D1 "Domestic Wastewater"

[123] 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).
[124] 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).
[125] <http://lex.justice.md/index.php?action=view&view=doc&lang=1&id=352311>.

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.

The amount of 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. Under these circumstances, it was not deemed necessary to estimate methane emissions resulting from sludge treatment, in particular keeping in mind that the deposited sludge undergoes fermentation in aerobic conditions. 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.

Step I: Estimating total organically degradable carbon in wastewater

Estimating total organically degradable carbon in wastewater. 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):

$$TOW = P \bullet BOD \bullet 0.001 \bullet I \bullet D$$

Where:

TOW – total organics in wastewater in inventory year, kg BOD/yr;

P – country population in inventory year (person);

BOD – country-specific per capita BOD in inventory year, g/person/day, the default value used for the European countries represents 60 g BOD_5/person/day (2006 IPCC Guidelines, Volume 5, Chapter 6, Table 6.4, page 6.14); in the Republic of Moldova the country-specific value is 75 g BOD/person/day (SNIP 2.04.03.85);

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).

Since industrial wastewater is discharged together with domestic wastewater, the amount of organic matter load from the industrial sector will be substituted by the equivalent number of population connected to the centralized sewage systems. 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 7-25), as well as the amount of annual output for each industry branch (Table 7-26).

Table 7-25: EFs Used to Estimate CH_4 Emissions from the 5D2 "Industrial Wastewater"

Industry Production by Type	D_{ind} – industrial degradable organic component, kg CCO/m^3	W_{ind} – amount of wastewater generated per industrial production output unit, m^3/t
Canned meat	4.1	13.0
Canned vegetables and 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 7-26: 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
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	%
Canned meat	1.555	1.195	1.598	1.433	1.654	0.969	0.825	0.769	-94.9
Canned vegetables and fruit	102.669	60.237	75.977	71.009	81.109	100.844	104.250	70.864	-85.8
Fruit and vegetable juices	39.042	28.163	31.852	34.758	55.428	60.119	58.835	46.860	-82.9
Canned vegetables	41.939	26.505	29.890	26.336	24.291	25.114	30.395	15.674	-89.5
Processed and canned fruit	17.781	3.738	7.985	6.758	0.436	10.741	7.598	7.895	-89.6
Beer	86.659	78.174	95.260	106.812	111.844	102.927	98.475	99.454	30.9
Grapes wine	155.297	126.305	128.550	126.057	142.202	155.166	140.946	135.653	-16.8
Sparkling wine	5.720	4.997	5.561	6.864	6.539	5.955	5.140	5.023	-37.5
Cognac	10.373	6.978	7.465	9.118	10.940	11.797	9.395	7.016	-49.7
Brandy and liqueurs	12.911	11.080	12.711	14.021	16.586	19.614	18.338	16.234	190.4
Meat	12.809	16.260	24.699	28.509	31.597	35.495	44.072	45.735	-82.3
Sausages	22.466	17.057	16.697	17.963	19.633	21.265	20.824	20.915	-58.2
Butter	4.697	4.222	4.586	4.258	4.392	5.811	5.008	5.062	-81.3
Margarine	1.940	1.657	1.274	1.119	0.484	0.706	0.000	0.000	
Cheese and cottage cheese	2.609	1.463	1.828	2.153	2.250	2.525	2.481	2.500	-79.5
Curd, curd cream, yogurt, kefir, sour cream	32.373	32.961	32.999	35.412	39.283	41.212	40.890	41.840	-69.7
Ice cream	7.679	7.010	8.490	8.313	9.436	10.173	10.477	10.706	-7.1
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	-82.4
Milk and whipped cream in solid form	2.693	1.821	1.217	0.625	0.536	0.439	1.042	1.357	-91.2
Crude oil, not chemically modified	79.307	83.881	80.705	89.787	96.828	65.502	113.223	109.534	-12.8
Granulated sugar	133.966	38.373	103.209	88.436	83.440	140.297	177.695	84.519	-80.6
Fish and fish products	4.600	3.700	1.300	7.578	7.732	8.490	8.774	9.241	-2.7
Mineral and aerated water	130.358	117.804	122.668	114.370	114.375	100.470	115.695	126.312	143.3
Other non-alcoholic drinks	87.526	67.617	73.043	80.746	79.734	70.545	70.700	70.413	-46.4
Paper and corrugated cardboard	1.140	0.870	1.290	2.520	1.324	2.467	0.000	0.000	-100.0
Synthetic resins	0.961	0.777	1.516	1.657	1.774	1.842	1.739	0.929	-94.7
Paint and Varnishes	11.557	11.822	12.864	18.011	17.907	12.345	17.685	26.858	129.6
Soap	0.399	0.380	0.538	0.523	0.570	0.637	0.786	0.993	-91.5
Washing and cleaning products	0.451	0.482	0.618	0.727	0.798	1.892	1.416	1.760	-88.3
Rough leather goods	0.000	0.000	0.000	0.000	0.000	0.007	0.000	0.000	-100.0
Leather boxing clothes	0.000	0.000	0.000	0.000	0.000	0.035	0.000	0.000	-100.0
Cotton yarn	20.635	14.867	16.155	13.078	14.290	14.886	13.193	10.445	-66.9
Fabrics	26.787	18.129	21.777	17.544	19.628	24.239	18.287	13.980	-58.3
Polymer film	3.384	2.973	3.498	3.708	3.175	2.528	1.671	1.640	-68.5

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).

The amount of total organic wastewater (TOW_{ind}) was estimated using the following equations.

$$TOW_{ind\ (wastewater)} = O \bullet W_{ind} \bullet D_{ind} \bullet (1-DS) \ \ and \ \ TOS_{ind\ (sludge)} = O \bullet W_{ind} \bullet D_{ind} \bullet DS$$

Where:

TOW_{ind} – total industrial organic wastewater, kg COD_5/year[126];
TOS_{ind} – total industrial organic sludge, kg COD_5/year;
O – total annual industrial output, t[127]/year;
W_{ind} – amount of wastewater consumed, m^3/t of industrial output;
D_{ind} – industrial degradable organic component, kg COD_5/m^3;
DS – fraction of organic component removed as sludge.

The obtained value for total industrial organic wastewater (TOW_{ind}) (Table 7-27) was converted in "Population Equivalent Number" (P_{EQ}).

$$P_{EQ} = TOW_{ind} / B / D$$

Where:

TOW_{ind} – total industrial organic wastewater, kg COD_5/year;
B – organic load in chemical oxygen demand per person, g COD/person/day, overall default in European countries - 60 g BOD_5/person/day or 18 250 kg BOD_5/thousand people/year (2006 IPCC Guidelines, Volume 5, Chapter 6, Table 6.4, page 6.14); in the Republic of Moldova the country-specific value is 75 g BOD/person/day or 27 375 kg BOD_5/thousand people/year (SNIP 2.04.03.85);

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).

[126] COD – Chemical Oxygen Demand;
[127] The following conversion factors were used: 1 jar equivalent = 0.5 kg; 1 m^2 fabric = 0.2 kg; 1m^2 of soft man made leather = 0.7 kg; 1 m^2 of corrugated cardboard = 0.3 kg; 1 dal of alcoholic drinks (wine, sparkling wine, brandy, brandies and liqueurs, beer) = 10 kg.

Table 7-27: Total Industrial Organic Wastewater (TOW_{ind}) and the Estimated Population Equivalent Number (P_{EQ}) in the Republic of Moldova within 1990-2015 periods

	1990	1991	1992	1993	1994	1995	1996	1997	1998
TOW_{ind}, kt BOD/yr	171.6784	149.4848	95.1084	97.0926	65.9984	59.3797	52.8898	62.6507	46.6608
P_{EQ}, million people	6.2714	5.4606	3.4648	3.5468	2.4109	2.1691	1.9268	2.2886	1.7045
	1999	2000	2001	2002	2003	2004	2005	2006	2007
TOW_{ind}, kt BOD/yr	32.7019	32.8868	41.0832	36.8221	46.0028	49.0863	55.9908	50.7420	47.8500
P_{EQ}, million people	1.1946	1.1981	1.5008	1.3451	1.6805	1.7882	2.0453	1.8536	1.7479
	2008	2009	2010	2011	2012	2013	2014	2015	%
TOW_{ind}, kt BOD/yr	49.5387	33.9618	41.4518	44.1921	46.7863	54.6617	52.8269	43.9474	-74.4
P_{EQ}, million people	1.8047	1.2406	1.5142	1.6143	1.7044	1.9968	1.9297	1.6054	-74.4

The calculated population equivalent values (P_{EQ}) are added to the number of urban and rural population in the country, thus estimating the fictitious number of population connected to sewage systems (Table 7-28).

Table 7-28: Fictitious Number of Population Connected to Sewage System in the Republic of Moldova within 1990-2015 periods, million inhabitants

	1990	1991	1992	1993	1994	1995	1996	1997	1998
P_{EQ}	6.2714	5.4606	3.4648	3.5468	2.4109	2.1691	1.9268	2.2886	1.7045
P_{URBAN}	2.0693	2.0736	2.0522	2.0392	2.0366	2.0330	2.0041	1.9953	1.9873
P_{RURAL}	2.2923	2.2927	2.3069	2.3086	2.3161	2.3149	2.3303	2.3247	2.3174
$P_{FICTITIOUS}$	10.6330	9.8269	7.8239	7.8946	6.7636	6.5170	6.2612	6.6086	6.0092
	1999	2000	2001	2002	2003	2004	2005	2006	2007
P_{EQ}	1.1946	1.1981	1.5008	1.3451	1.6805	1.7882	2.0453	1.8536	1.7479
P_{URBAN}	1.9763	1.9685	1.9263	1.9186	1.9104	1.8550	1.8485	1.8378	1.8415
P_{RURAL}	2.3167	2.3130	2.3513	2.3428	2.3318	2.3068	2.2994	2.2927	2.2731
$P_{FICTITIOUS}$	5.4876	5.4796	5.7784	5.6065	5.9227	5.9500	6.1932	5.9841	5.8625
	2008	2009	2010	2011	2012	2013	2014	2015	%
P_{EQ}	1.8047	1.2406	1.5142	1.6143	1.7044	1.9968	1.9297	1.6054	-74.4
P_{URBAN}	1.8361	1.8364	1.8341	1.8361	1.8377	1.8414	1.8495	1.8399	-11.1
P_{RURAL}	2.2641	2.2536	2.2475	2.2377	2.2313	2.2233	2.2088	2.1904	-4.4
$P_{FICTITIOUS}$	5.9049	5.3306	5.5958	5.6882	5.7734	6.0614	5.9881	5.6357	-47.0

The next step was to estimate the total amount of organic matter in the wastewater in the inventory year (TOW) (Table 7-29).

Table 7-29: AD Used to Estimate CH_4 Emissions from the 5D1 "Domestic Wastewater" and 5D2 "Industrial Wastewater" in the Republic of Moldova within 1990-2015 periods

	1990	1991	1992	1993	1994	1995	1996	1997	1998
TOW_{rural}, kt BOD_5/yr	62.7517	62.7627	63.3244	63.1979	63.4032	63.3704	63.9667	63.6387	63.4388
TOW_{urban}, kt BOD_5/yr	56.6471	56.7648	56.3329	55.8231	55.7519	55.6534	55.0125	54.6213	54.4023
TOW_{EQ}, kt BOD_5/yr	171.6784	149.4848	95.1084	97.0926	65.9984	59.3797	52.8898	62.6507	46.6608
TOW_{total}, kt BOD_5/yr	291.0772	269.0122	214.7656	216.1137	185.1535	178.4035	171.8691	180.9107	164.5020
	1999	2000	2001	2002	2003	2004	2005	2006	2007
TOW_{rural}, kt BOD_5/yr	63.4197	63.4919	64.3668	64.1342	63.8330	63.3217	62.9461	62.7627	62.2261
TOW_{urban}, kt BOD_5/yr	54.1012	54.0353	52.7325	52.5217	52.2972	50.9198	50.6027	50.3098	50.4111
TOW_{EQ}, kt BOD_5/yr	32.7019	32.8868	41.0832	36.8221	46.0028	49.0863	55.9908	50.7420	47.8500
TOW_{total}, kt BOD_5/yr	150.2227	150.4140	158.1825	153.4779	162.1330	163.3277	169.5395	163.8144	160.4871
	2008	2009	2010	2011	2012	2013	2014	2015	%
TOW_{rural}, kt BOD_5/yr	62.1495	61.6923	61.5257	61.2583	61.2487	60.8617	60.4666	59.9630	-4.4
TOW_{urban}, kt BOD_5/yr	50.4009	50.2715	50.2080	50.2629	50.4448	50.4081	50.6300	50.3664	-11.1
TOW_{EQ}, kt BOD_5/yr	49.5387	33.9618	41.4518	44.1921	46.7863	54.6617	52.8269	43.9474	-74.4
TOW_{total}, kt BOD_5/yr	162.0892	145.9256	153.1855	155.7132	158.4798	165.9315	163.9234	154.2768	-47.0

The TOW value is influenced, in particular, by the fictitious number of population connected to sewage systems (rural and urban population plus the equivalent, representing the industrial sector), respectively, by the degradable organic component in wastewater; as mentioned above, the overall default in European countries is 60 g BOD_5/person/day or 18 250 kg BOD_5/thousand people/year (2006 IPCC Guidelines, Volume 5, Chapter 6, Table 6.4, page 6.14); while in the RM the country-specific value is 75 g BOD/person/day or 27 375 kg BOD_5/thousand people/year (SNIP 2.04.03.85).

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 or COD) 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 7-30).

Table 7-30: EFs Used to Estimate CH_4 Emissions from the 5D1 "Domestic Wastewater" and 5D2 "Industrial 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	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	0.06
	Centralized, aerobic treatment plant, not well managed	0.6	0.3	0.18
	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	0.5	0.30
	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 5D "Wastewater treatment and discharge" 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):

$$CH_4\ Emissions = \left[\sum_{ij}(Ui \bullet Tij \bullet EFj)\right] \bullet (TOW - S) - R$$

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, 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 7-31), of which depends the access to wastewater collection and treatment systems, as well as the efficiency of these systems.

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 7-31); 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 7-31: Population Divided in Groups, Depending on Income and Urbanization Rate, within 1990-2015 periods, thousand inhabitants

	1990	1991	1992	1993	1994	1995	1996	1997	1998
P_{rural}	2 292.3	2 292.7	2 306.9	2 308.6	2 316.1	2 314.9	2 330.3	2 324.7	2 317.4
P_{urban}	2 069.3	2 073.6	2 052.2	2 039.2	2 036.6	2 033.0	2 004.1	1 995.3	1 987.3
P_{EQ}	6 271.4	5 460.6	3 464.8	3 546.8	2 410.9	2 169.1	1 926.8	2 288.6	1 704.5
$P_{total, fictitious\ population}$	10 633.0	9 826.9	7 823.9	7 894.6	6 763.6	6 517.0	6 261.2	6 608.6	6 009.2
$P_{urban} + P_{EQ}$	8 340.7	7 534.2	5 517.0	5 586.0	4 447.5	4 202.1	3 930.9	4 283.9	3 691.8
$P_{urban, high\ income}$	1 259.3	1 264.7	1 252.6	1 241.3	1 238.8	1 233.0	1 222.5	1 219.6	1 212.8
$P_{urban, low\ income}$	7 081.4	6 269.5	4 264.4	4 344.7	3 208.7	2 969.1	2 708.4	3 064.3	2 479.0
	1999	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**
P_{rural}	2 316.7	2 313.0	2 351.3	2 342.8	2 331.8	2 306.8	2 299.4	2 292.7	2 273.1
P_{urban}	1 976.3	1 968.5	1 926.3	1 918.6	1 910.4	1 855.0	1 848.5	1 837.8	1 841.5
P_{EQ}	1 194.6	1 198.1	1 500.8	1 345.1	1 680.5	1 788.2	2 045.3	1 853.6	1 747.9
$P_{total, fictitious\ population}$	5 487.6	5 479.6	5 778.4	5 606.5	5 922.7	5 950.0	6 193.2	5 984.1	5 862.5
$P_{urban} + P_{EQ}$	3 170.9	3 166.6	3 427.1	3 263.7	3 590.9	3 643.2	3 893.8	3 691.4	3 589.4
$P_{urban, high\ income}$	1 208.5	1 202.1	1 189.0	1 183.4	1 175.8	1 141.9	1 126.9	1 131.7	1 124.2
$P_{urban, low\ income}$	1 962.4	1 964.5	2 238.1	2 080.3	2 415.1	2 501.3	2 766.9	2 559.7	2 465.2
	2008	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**%**
P_{rural}	2 264.1	2 253.6	2 247.5	2 237.7	2 231.3	2 223.3	2 208.8	2 190.4	-4.4
P_{urban}	1 836.1	1 836.4	1 834.1	1 836.1	1 837.7	1 841.4	1 849.5	1 839.9	-11.1
P_{EQ}	1 804.7	1 240.6	1 514.2	1 614.3	1 704.4	1 996.8	1 929.7	1 605.4	-74.4
$P_{total, fictitious\ population}$	5 904.9	5 330.6	5 595.8	5 688.2	5 773.4	6 061.4	5 988.1	5 635.7	-47.0
$P_{urban} + P_{EQ}$	3 640.8	3 077.0	3 348.3	3 450.4	3 542.1	3 838.2	3 779.2	3 445.3	-58.7
$P_{urban, high\ income}$	1 127.5	1 127.5	1 125.6	1 125.9	1 127.4	1 130.0	1 130.5	1 122.1	-58.7
$P_{urban, low\ income}$	2 513.3	1 949.5	2 222.7	2 324.5	2 414.7	2 708.2	2 648.7	2 323.2	-58.7

Table 7-32: Population of the Republic of Moldova with High Urbanization Rate and High Income, within 1990-2015 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	%
Chisinau	663.1	663.2	663.4	664.7	667.6	671.8	674.5	678.2	0.4
Balti	143.2	143.2	143.3	144.0	144.3	144.8	144.9	145.3	-10.1
Bender	94.1	93.8	93.3	93.0	92.4	91.9	91.0	84.7	-35.9
Tiraspol	137.3	137.8	136.8	135.7	134.8	133.8	132.9	128.9	-29.8
Ribnita	50.8	50.1	49.4	48.8	48.5	47.9	47.6	45.4	-27.0
Cahul	39.0	39.4	39.4	39.7	39.8	39.8	39.6	39.6	-10.0
Total, $P_{urban,\ high\ income}$	1127.5	1127.5	1125.6	1125.9	1127.4	1130.0	1130.5	1122.1	-10.9

Source: http://statbank.statistica.md/pxweb/pxweb/ro/20%20Populatia%20si%20procesele%20demografice/?rxid=b2ff27d7-0b96-43c9-934b-42e1a2a9a774; Statistical Yearbooks of the ATULBD for 1998-2016.

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 equivalent population (P_{EQ}) determined above, respectively the total amount of organic matter in the wastewater of industrial origin (TOW_{EQ}), was allocated 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. The share of different population groups in the total fictitious population over the reference period is shown below (Table 7-33).

Table 7-33: The Share (U_i Fraction, where 100 per cent = 1.0) of Different Groups in the Total Fictitious Population of the RM within 1990-2015 periods

	1990	1991	1992	1993	1994	1995	1996	1997	1998
U_{rural}	0.216	0.233	0.295	0.292	0.342	0.355	0.372	0.352	0.386
$P_{urban,\ high\ income}$	0.118	0.129	0.160	0.157	0.183	0.189	0.195	0.185	0.202
$P_{urban,\ low\ income}$	0.666	0.638	0.545	0.550	0.474	0.456	0.433	0.464	0.413
	1999	2000	2001	2002	2003	2004	2005	2006	2007
U_{rural}	0.422	0.422	0.407	0.418	0.394	0.388	0.371	0.383	0.388
$P_{urban,\ high\ income}$	0.220	0.219	0.206	0.211	0.199	0.192	0.182	0.189	0.192
$P_{urban,\ low\ income}$	0.358	0.359	0.387	0.371	0.408	0.420	0.447	0.428	0.421
	2008	2009	2010	2011	2012	2013	2014	2015	%
U_{rural}	0.383	0.423	0.402	0.393	0.386	0.367	0.369	0.389	80.3
$P_{urban,\ high\ income}$	0.191	0.212	0.201	0.198	0.195	0.186	0.189	0.199	68.1
$P_{urban,\ low\ income}$	0.426	0.366	0.397	0.409	0.418	0.447	0.442	0.412	-38.1

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 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 (1990-2015) (Table 7-34).

Table 7-34: Country-specific Factors used to Estimate CH_4 Emissions from 5D "Wastewater Treatment and Discharge" Category within 1990-2015 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, small family (3-5 persons)	U_i	Centralized, aerobic treatment plant, not well managed	Latrine, ground water table lower than latrine, small family (3-5 persons)	U_i	Centralized, aerobic treatment plant, not well managed	Latrine, ground water table lower than latrine, small family (3-5 persons)
1990	0.118	0.60	0.10	0.30	0.666	0.60	0.40	0.216	0.10	0.90
1991	0.129	0.60	0.10	0.30	0.638	0.60	0.40	0.233	0.09	0.91
1992	0.160	0.60	0.10	0.30	0.545	0.60	0.40	0.295	0.08	0.92
1993	0.157	0.60	0.10	0.30	0.550	0.56	0.44	0.292	0.07	0.93
1994	0.183	0.60	0.10	0.30	0.474	0.54	0.46	0.342	0.06	0.94
1995	0.189	0.60	0.10	0.30	0.456	0.52	0.48	0.355	0.05	0.95
1996	0.195	0.60	0.20	0.20	0.433	0.50	0.50	0.372	0.04	0.96
1997	0.185	0.60	0.20	0.20	0.464	0.48	0.52	0.352	0.03	0.97
1998	0.202	0.60	0.20	0.20	0.413	0.46	0.54	0.386	0.02	0.98
1999	0.220	0.60	0.20	0.20	0.358	0.46	0.54	0.422	0.02	0.98

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, small family (3-5 persons)	U_i	Centralized, aerobic treatment plant, not well managed	Latrine, ground water table lower than latrine, small family (3-5 persons)	U_i	Centralized, aerobic treatment plant, not well managed	Latrine, ground water table lower than latrine, small family (3-5 persons)		
2000	0.219	0.60	0.30	0.10	0.359	0.46	0.54	0.422	0.02	0.98		
2001	0.206	0.60	0.30	0.10	0.387	0.46	0.54	0.407	0.02	0.98		
2002	0.211	0.60	0.30	0.10	0.371	0.46	0.54	0.418	0.02	0.98		
2003	0.199	0.60	0.30	0.10	0.408	0.46	0.54	0.394	0.02	0.98		
2004	0.192	0.60	0.30	0.10	0.420	0.46	0.54	0.388	0.02	0.98		
2005	0.182	0.60	0.30	0.10	0.447	0.46	0.54	0.371	0.02	0.98		
2006	0.189	0.60	0.30	0.10	0.428	0.46	0.54	0.383	0.02	0.98		
2007	0.192	0.60	0.30	0.10	0.421	0.46	0.54	0.388	0.02	0.98		
2008	0.191	0.60	0.30	0.10	0.426	0.46	0.54	0.383	0.02	0.98		
2009	0.236	0.60	0.30	0.10	0.366	0.46	0.54	0.423	0.02	0.98		
2010	0.201	0.60	0.30	0.10	0.397	0.46	0.54	0.402	0.02	0.98		
2011	0.198	0.60	0.30	0.10	0.409	0.46	0.54	0.393	0.02	0.98		
2012	0.195	0.60	0.30	0.10	0.418	0.47	0.53	0.386	0.02	0.98		
2013	0.186	0.60	0.30	0.10	0.447	0.47	0.53	0.367	0.02	0.98		
2014	0.189	0.60	0.30	0.10	0.442	0.48	0.52	0.369	0.02	0.98		
2015	0.199	0.60	0.30	0.10	0.412	0.48	0.52	0.389	0.02	0.98		

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):

$$N_2O\ Emissions = N_{EFFLUENT} \bullet EF_{EFFLUENT} \bullet 44/28$$

Where:

N_2O Emissions – N_2O emissions in inventory year, kg N_2O/yr;
$N_{EFFLUENT}$ – total nitrogen in the effluent discharged to aquatic environments, kg N/yr;
$EF_{EFFLUENT}$ – emission factor for N_2O emissions from discharged 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 $U_{urban,\ high\ income}$) (Table 7-33);

$F_{IND-COM}$ – 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 7-35). 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 7-35: 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	4 304 700
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]	4 293 000	4 281 500	4 277 600	4 261 400	4 242 100	4 161 800	4 147 900	4 130 500	4 114 600
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	%
P, inhabitants[1]	4 100 200	4 090 000	4 081 695	4 073 832	4 068 980	4 064 650	4 058 320	4 030 300	-7.6
Proteins, g/per capita/day	72.07	68.29	71.86	71.20	70.47	71.41	72.34	73.28	-13.0
Proteins, kg/per capita/day	26.38	24.93	26.23	25.99	25.79	26.06	26.40	26.75	-13.0

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 2017, <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 7-24);

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 ±58.31 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 1990-2013 time series, in particular as a result of the transition to the calculation methodologies available in the 2006 IPCC Guidelines, to the detriment of those available in the 1996 Revised IPCC Guidelines (IPCC, 1997) and the Good Practice Guidelines (IPCC, 2000) and due to use of an updated set of activity data and country specific EFs.

In comparison with the previously obtained results included in the BUR1, the above mentioned changes resulted in a significant increase of CH_4 emissions from 5D "Wastewater treatment and discharge" category within 1990-2013 periods, with a variation from a minimum increase of 133.8 per cent in 2012, to a maximum increase of 264.0 per cent in 2000 (Table 7-36).

Table 7-36: Comparative Results of CH_4 Emissions from 5D "Wastewater Treatment and Discharge" Category included into the BUR1 and the NC4 of the RM under the UNFCCC, kt

	1990	1991	1992	1993	1994	1995	1996	1997	1998
BUR1	10.2667	9.2598	7.4042	7.1720	6.3338	6.0783	5.6587	5.5341	4.6722
NC4	32.5890	29.5915	22.3339	21.8787	17.6476	16.5652	15.8885	16.7331	14.5801
Difference, %	217.4	219.6	201.6	205.1	178.6	172.5	180.8	202.4	212.1
	1999	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**
BUR1	3.8403	3.6656	4.0422	3.9660	4.4010	4.9829	5.3754	5.2657	5.0606
NC4	12.9273	13.3438	14.1977	13.6716	14.7040	14.8673	15.6174	14.9642	14.6272
Difference, %	236.6	264.0	251.2	244.7	234.1	198.4	190.5	184.2	189.0
	2008	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**%**
BUR1	5.3242	5.0028	5.4352	5.8467	6.1992	6.4993			
NC4	14.8004	13.3105	13.8043	14.1151	14.4948	15.3964	15.2693	14.1671	-56.5
Difference, %	178.0	166.1	154.0	141.4	133.8	136.9			

Abbreviations: NC4 – Fourth National Communication; BUR1 – First Biennial Update Report.

At the same time, at the conversion of methane emissions to CO_2 equivalent by using the 100-year global warming potential available in the IPCC 4th Assessment Report ($GWP_{100} = 25$), to the detriment of the IPCC Second Assessment Report ($GWP_{100} = 21$), the impact of this conversion on the evolution trend of methane emissions within 1990-2013 periods shows an increase by circa 19 per cent. In comparison with the results reported in the BUR1, the changes performed in this inventory cycle resulted in an increase of methane emissions from the 5D "Wastewater treatment and discharge" over the reference period, varying from a minimum increase of 178.4 per cent in 2012, up to a maximum increase of 333.4 per cent in 2000 (Table 7-37).

Table 7-37: Comparative Results of CH_4 Emissions from 5D "Wastewater Treatment and Discharge" Category included into the BUR1 and the NC4 of the RM under the UNFCCC, kt CO_2 equivalent

	1990	1991	1992	1993	1994	1995	1996	1997	1998
BUR1	215.6014	194.4556	155.4889	150.6122	133.0100	127.6433	118.8331	116.2163	98.1153
NC4	814.7250	739.7863	558.3477	546.9664	441.1912	414.1298	397.2135	418.3272	364.5035
Difference, %	277.9	280.4	259.1	263.2	231.7	224.4	234.3	260.0	271.5
	1999	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**
BUR1	80.6464	76.9773	84.8869	83.2851	92.4207	104.6407	112.8840	110.5789	106.2720
NC4	323.1832	333.5941	354.9424	341.7891	367.6009	371.6817	390.4359	374.1062	365.6796
Difference, %	300.7	333.4	318.1	310.4	297.7	255.2	245.9	238.3	244.1
	2008	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**%**
BUR1	111.8084	105.0578	114.1384	122.7799	130.1822	136.4857			
NC4	370.0107	332.7629	345.1085	352.8773	362.3704	384.9097	381.7317	354.1764	-56.5
Difference, %	230.9	216.7	202.4	187.4	178.4	182.0			

Abbreviations: NC4 – Fourth National Communication; BUR1 – First Biennial Update Report.

For 2014-2015 CH_4 emissions from 5D "Wastewater treatment and discharge" were estimated for the first time. The results allow assert that within the 1990-2015 time series CH_4 emissions from the respective source category decreased by circa 56.5 per cent.

N_2O emissions from the 5D "Wastewater treatment and discharge" were recalculated for the 1990 through 2013 time series, in particular due to the transition to a calculation methodology available in the 2006 IPCC Guidelines, to the detriment of that available in the 1996 Revised IPCC Guidelines (IPCC, 1997), and also due to use of an updated set of activity data and country-specific values. In comparison with the results reported in the BUR1, the changes performed in this inventory cycle resulted in a decrease of N_2O emissions from the 5D "Wastewater treatment and discharge" within 1990-2013 periods, varying from a minimum decrease of 11.9 per cent in 1991, to a maximum decrease of 15.9 per cent in 2012 (Table 7-36).

Table 7-38: Comparative Results of N_2O Emissions from 5D "Wastewater Treatment and Discharge" Category included into the BUR1 and the NC4 of the RM under the UNFCCC, kt

	1990	1991	1992	1993	1994	1995	1996	1997	1998
BUR1	0.3407	0.3090	0.2853	0.2677	0.2598	0.2631	0.2591	0.2638	0.2665
NC4	0.2951	0.2724	0.2496	0.2341	0.2272	0.2301	0.2266	0.2307	0.2331
Difference, %	-13.4	-11.9	-12.5	-12.5	-12.5	-12.5	-12.5	-12.5	-12.5
	1999	2000	2001	2002	2003	2004	2005	2006	2007
BUR1	0.2607	0.2668	0.2707	0.2778	0.2681	0.2757	0.2886	0.2831	0.2692
NC4	0.2280	0.2334	0.2368	0.2429	0.2346	0.2413	0.2524	0.2475	0.2369
Difference, %	-12.5	-12.5	-12.5	-12.5	-12.5	-12.5	-12.6	-12.6	-12.0
	2008	2009	2010	2011	2012	2013	2014	2015	%
BUR1	0.2712	0.2630	0.2748	0.2696	0.2744	0.2755			
NC4	0.2379	0.2243	0.2355	0.2329	0.2309	0.2331	0.2357	0.2371	-19.7
Difference, %	-12.3	-14.7	-14.3	-13.6	-15.9	-15.4			

Abbreviations: NC4 – Fourth National Communication; BUR1 – First Biennial Update Report.

At the same time, at the conversion N_2O emissions to CO_2 equivalent by using the 100-year GWP value available in the IPCC AR4 (GWP_{100} = 298), to the detriment of the IPCC SAR (GWP_{100} = 310), the impact of this conversion on the evolution trend of N_2O emissions within 1990-2013 periods shows a decrease by circa 3.9 per cent. In comparison with the results reported in the BUR1, the changes performed in this inventory cycle resulted in a decrease of nitrous oxide emissions from the 5D "Wastewater treatment and discharge" over the reference period, varying from a minimum decrease of 15.3 per cent in 1991, up to a maximum decrease of 19.1 per cent in 2012 (Table 7-39). For 2014-2015 N_2O emissions from 5D "Wastewater treatment and discharge" were estimated for the first time. The results allow assert that within the 1990-2015 time series N_2O emissions from the respective source category decreased by circa 19.7 per cent.

Table 7-39: Comparative Results of N_2O Emissions from 5D "Wastewater Treatment and Discharge" Category included into the BUR1 and the NC4 of the RM under the UNFCCC, kt CO_2 equivalent

	1990	1991	1992	1993	1994	1995	1996	1997	1998
BUR1	105.6201	95.7965	88.4394	82.9720	80.5518	81.5515	80.3216	81.7779	82.6149
NC4	87.9499	81.1694	74.3744	69.7653	67.7185	68.5592	67.5246	68.7603	69.4640
Difference, %	-16.7	-15.3	-15.9	-15.9	-15.9	-15.9	-15.9	-15.9	-15.9
	1999	2000	2001	2002	2003	2004	2005	2006	2007
BUR1	80.8026	82.7123	83.9202	86.1119	83.1151	85.4576	89.4708	87.7676	83.4615
NC4	67.9495	69.5662	70.5620	72.3953	69.9055	71.9060	75.2123	73.7500	70.6009
Difference, %	-15.9	-15.9	-15.9	-15.9	-15.9	-15.9	-15.9	-16.0	-15.4
	2008	2009	2010	2011	2012	2013	2014	2015	%
BUR1	84.0757	81.5430	85.1747	83.5727	85.0586	85.4174			
NC4	70.9008	66.8311	70.1826	69.4041	68.7987	69.4522	70.2455	70.6672	-19.7
Difference, %	-15.7	-18.0	-17.6	-17.0	-19.1	-18.7			

Abbreviations: NC4 – Fourth National Communication; BUR1 – First Biennial Update Report.

For 1990-2015, NMVOC emissions from 5D "Wastewater treatment and discharge" were estimated for the first time. The results allow assert that within this time period, NMVOC emissions from the respective source category decreased by circa 75.4 per cent (Table 7-40).

Table 7-40: NMVOC Emissions from 5D "Wastewater Treatment and Discharge" Category included into the NC4 of the Republic of Moldova under the UNFCCC, kt

	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	0.0104	0.0104	0.0103
	2008	2009	2010	2011	2012	2013	2014	2015	%
NMVOC Emissions, kt	0.0103	0.0103	0.0103	0.0103	0.0102	0.0102	0.0100	0.0101	-75.4

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[128]. 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 Republic of Moldova, contributing to the improvement of health, dignity and quality of life as well as to the economic development of the country. The National Program for the Implementation of the Protocol on Water and Health in the Republic of Moldova for 2016-2025 has been approved through the Government Decision No. 1063 as of 16.09.2016 and includes the following goals regarding the water and sanitation sector: 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. At the same time, the program 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. In order to achieve the goals, the program also includes a plan with specific implementation measures, but with no certain financial coverage, their realization being difficult. 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. It is expected that this regulation will produce a positive effect on the quality of the AD and respectively, a decrease of emissions at the sectoral level. 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 aims to regulate the conditions for wastewater collection, treatment and discharge in the sewage system and/or in water basins. Thus, 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 this sector.

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, Law No. 303 as of 13.12.2013 on *Public Service for Water and Sanitation Supply,* the set of secondary legislation to these Laws, 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

[128] <http://lex.justice.md/index.php?action=view&view=doc&lang=1&id=352311>.

maintenance of systems, for expanding the services to new users. Currently, the regionalization process includes 6 water companies from Hincesti, Soroca, Floresti, Ceadir-Lunga and Orhei districts. These reforms will change the wastewater management system; leading thus, to decreased GHG emissions within this sector. Another institutional reform planned for implementation within this sector refers to creating regulatory authorities by extending the responsibilities of the National Agency for Energy Regulation, which will exercise a major impact in regulating the functioning of the sector. These institutional instruments will determine the sustainability of sector management.

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". 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 is planned also to use updated values for BOD_5 in water waste (recently it was approved a new national norm – NCM G.03.02-2015, which replaces the previous one - SNIP 2.04.03.85); it will be assessed also 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" source category.

8. RECALCULATIONS AND PLANNED IMPROVEMENTS

This chapter summarizes the explanations and justification for GHG emissions recalculations performed to the Republic of Moldova's GHG Inventory for the 1990-2013 time series, included in the First Biennial Update Report under the UNFCCC (2016), as well as planned improvements for the future inventory cycles. Specific information on the level of source categories associated with respective recalculations and planned improvements can also be found in Chapters 3-7 of the NIR: 1990-2015.

8.1. Explanations and Justifications for Recalculations

The national inventory team revised and recalculated GHG emissions and CO_2 removals for each calendar year covered by the inventory for the period from 1990 through 2013, a component part of the BUR1 of the Republic of Moldova under the UNFCCC (2016). These activities were carried out during the on-going process of improving the quality of the National GHG Inventory (including, by taking into account the updated activity data, new methodological approaches available in the 2006 IPCC Guidelines [the complete transition to this Guidelines has been achieved in the current inventory cycle], emission factors used, and identified errors correcting actions).

Under the current inventory cycle, improvements were made in all sectors (move to higher tier methodologies, revision of previously used methodological approaches and emission factors, activity data etc.), entailing the need to make recalculations of national GHG emissions for the time period from 1990 through 2013, reflected in the First Biennial Update Report of the Republic of Moldova under the UNFCCC (Chapter 2 "National GHG Inventory").

In comparison with the results reported under the BUR1, the changes made during the development of the current inventory, resulted in insignificant increased values of total direct GHG emissions in 1991 and 1994-2012, respectively revealed a decreasing trend in 1990, 1992-1993 and 2013 (Table 8-1).

Table 8-1: Recalculations of Total Direct GHG Emissions included into the BUR1 of the Republic of Moldova under the UNFCCC, Mt CO_2 equivalent

	1990	1991	1992	1993	1994	1995	1996	1997
BUR1	43.4188	38.7474	28.7545	23.2180	20.9914	17.4240	17.2640	16.0256
NC4	43.4000	38.9878	28.3850	22.9386	21.2027	17.6498	17.7123	16.3028
Difference, %	-0.04	0.6	-1.3	-1.2	1.0	1.3	2.6	1.7
	1998	1999	2000	2001	2002	2003	2004	2005
BUR1	14.0442	11.7718	10.7307	11.4210	11.1419	11.6173	12.3044	12.7530
NC4	14.4061	12.1228	11.2078	11.9762	11.8020	12.2221	12.9717	13.4141
Difference, %	2.6	3.0	4.4	4.9	5.9	5.2	5.4	5.2
	2006	2007	2008	2009	2010	2011	2012	2013
BUR1	11.9433	11.6586	13.0587	13.1368	13.9394	14.1417	13.3642	12.8363
NC4	12.5625	12.2087	13.4685	13.4743	14.2635	14.5031	13.7486	11.4349
Difference, %	5.2	4.7	3.1	2.6	2.3	2.6	2.9	-10.9

Abbreviations: NC4 – Fourth National Communication; BUR1 – First Biennial Update Report.

With reference to the net direct GHG emissions included into the BUR1 of the RM under the UNFCCC, changes made in the development of the current inventory, resulted in decreased emissions between 1991 and 2013, varying from a minimum of 0.8 per cent in 2012 to a maximum of 44.8 per cent in 2008; with the exception of 1990, when an insignificant increase of net direct GHG emissions was recorded (by 0.1 per cent) (Table 8-2).

Table 8-2: Recalculations of the Total Net Direct GHG Emissions included into the BUR of the Republic of Moldova under the UNFCCC, Mt CO_2 equivalent

	1990	1991	1992	1993	1994	1995	1996	1997
BUR1	37.5322	33.4510	24.3701	21.7173	18.8274	16.3946	16.0973	15.8886
NC4	37.5804	31.4104	21.3336	15.8020	14.8571	11.1677	11.4861	10.2141
Difference, %	0.1	-6.1	-12.5	-27.2	-21.1	-31.9	-28.6	-35.7
	1998	1999	2000	2001	2002	2003	2004	2005
BUR1	13.3216	10.6370	9.3385	10.6710	10.6092	10.0626	12.2012	12.3776
NC4	8.2647	6.0108	5.1507	6.1833	6.9351	7.2948	9.0870	8.6497
Difference, %	-38.0	-43.5	-44.8	-42.1	-34.6	-27.5	-25.5	-30.1

	2006	2007	2008	2009	2010	2011	2012	2013
BUR1	11.3042	8.5926	12.9992	11.8519	13.2823	13.7120	10.8939	12.7387
NC4	7.5270	7.1845	8.9809	9.6222	11.0334	11.8591	10.8034	8.8878
Difference, %	-33.4	-16.4	-30.9	-18.8	-16.9	-13.5	-0.8	-30.2

Abbreviations: NC4 – Fourth National Communication; BUR1 – First Biennial Update Report.

8.1.1. Energy Sector

Recalculations of direct GHG emissions from the Energy Sector were performed based on the following considerations:

- in order to estimate GHG emissions were used AD expressed in energy units (TJ) and not in natural units (kt or thousand m^3);
- with reference to 1A1a category, GHG emissions were estimated for 3 sub-categories: 1A1ai Electricity Production; 1A1aii Combined Electricity and Heat Production; 1A1aiii Heat Production; while for the 1A5 category, GHG emissions were estimated for 2 sub-categories: 1A5a Stationary and 1A5b Mobile;
- GHG emissions from oil and lubricants consumption, previously included in source categories 1A2, 1A3, 1A4 and 1A5, were transferred to 2D1 within the current inventory cycle;
- Regarding source categories 1A3 and 1A4, GHG emissions were estimated for one additional sub-category;
- For each category, the AD were updated and specified, for the subcategories included for the first time, activity data were identified based on the existing reference sources;
- new fuels have been identified and recorded for the first time; in some cases, previously the consumption of certain fuel types were considered insignificant without being accounted for in the national inventory;
- for 1A2, 1A3b and 1A3c categories, AD on diesel and gasoline consumption on the left bank of Dniester River were considered for the first time (identified indirectly based on the specific per capita consumption);
- the distribution formula of diesel consumption for agriculture sector was revised: for national roads and off-road, the following distribution was applied: for 1990 – 30 per cent and 70 per cent, for 1991 – 20 per cent and 80 per cent, for 1992 – 15 per cent and 85 per cent; while for 1993-2015 time series it was kept the respective formula: 10 per cent and 90 per cent;
- GHG emissions from coal and residual fuel oil consumption, previously included in 1A3c, in the current inventory cycle were reallocated to 1A4a;
- for the first time GHG emissions from the following sources were estimated separately (1B2a Oil, 1B2b Natural Gas, 1B2c Venting, 1B2d Other), within 1B2 "Fugitive Emissions from Oil and Natural Gas" category;
- in order to convert direct GHG emissions in CO_2 equivalent, in the current inventory cycle, the 100-year Global Warming Potential (GWP_{100}) values available in the Fourth IPCC Assessment Report (AR4), were used in the detriment of GWP_{100} values in the Second IPCC Assessment Report (SAR).

Overall, the performed recalculations showed slight differences compared to the results obtained in the previous inventory cycle. In comparison with the results included into the BUR1 of the RM under the UNFCCC (2016), these recalculations resulted in a small increase of direct GHG emissions within 1990-2013 periods (with the exception of 1992 and 1993), varying from a minimum of 0.3 per cent in 1990, up to a maximum of 3.6 per cent in 2007 (Table 8-3).

Table 8-3: Recalculations of Total Direct GHG Emissions within the Energy Sector included into the BUR of the RM under the UNFCCC, Mt CO_2 equivalent

	1990	1991	1992	1993	1994	1995	1996	1997
BUR1	34.5213	30.2217	21.3789	16.4721	15.0185	11.7222	11.9472	10.7884
NC4	34.6308	30.7803	21.3699	16.1330	15.1511	11.8855	12.1887	10.9476
Difference, %	0.3	1.8	0.0	-2.1	0.9	1.4	2.0	1.5

	1998	1999	2000	2001	2002	2003	2004	2005
BUR1	9.2725	7.3733	6.6728	7.2688	6.9519	7.7253	8.1841	8.4684
NC4	9.4270	7.4725	6.7878	7.3880	7.1323	7.8500	8.3637	8.6817
Difference, %	1.7	1.3	1.7	1.6	2.6	1.6	2.2	2.5
	2006	2007	2008	2009	2010	2011	2012	2013
BUR1	7.6334	7.7455	8.3514	9.0709	9.6473	9.8255	9.4690	8.4046
NC4	7.8533	8.0245	8.6140	9.3023	9.8287	9.9961	9.6545	8.5633
Difference, %	2.9	3.6	3.1	2.6	1.9	1.7	2.0	1.9

Abbreviations: NC4 – Fourth National Communication; BUR1 – First 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: 1990-2015.

8.1.2. Industrial Processes and Product Use Sector

Recalculations of total direct GHG emissions from the 'Industrial Processes and Product Use' Sector were performed based on the following considerations:

- 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 2005-2015;
- due to use of new methodological approach and new default EFs available into the 2006 IPCC Guidelines, as well as in the EMEP/EEA Air Pollutant Emission Inventory Guidebook (2016), thus replacing methodological approaches and EFs available in the Revised 1996 IPCC Guidelines, in the Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories, as well as in the EMEP/EEA Air Pollutant Emission Inventory Guidebook (2009, 2013);
- CO_2 emissions from the lime production were recalculated as result of taking into consideration, for the first time, the lime production from other local producers (sugar mils). (category 1A2 "Lime Production");
- updating the AD regarding the amount of bricks produced (category 2A4 "Other Process Uses of Carbonates"), data provided by NBS with the Statistical Reports PRODMOLD-A "Total production, as a natural expression, in the Republic, by product type", respectively due to use of conversion factors (the weight in kg of conventional brick, as well as the amount of clay used in brick production);
- CO_2 emissions from certain categories were estimated for the first time: CO_2 emissions from ceramics production (category 2A4 "Other Process Uses of Carbonates"), CO_2 from 2D1 "Lubricant Use", 2D2 "Paraffin Wax Use"; 2D4 "Other" (the use of urea catalysts);
- eliminating from the calculation of the CO_2 emissions from amount of soda ash used in glass production from category 2A4 "Other Process Uses of Carbonates" (CO_2 emissions from the glass production are included within 2A3 "Glass Production"), respectively the use of a revised value of the default EF (during the previous inventory cycle it was used the rounded EF value of 415 kg CO_2 per tonne of soda ash used, while the current inventory cycle it was used the value of 414.92 kg CO_2 per tonne of soda ash, which is according to the 2006 IPCC Guidelines);
- due to updating the AD on steel and rolling mills production provided by the Statistical Reports PRODMOLD-A "Total production, as a natural expression, in the Republic, by product type";
- due to use of an updated set of activity data regarding category 2D3 "Solvent Use" 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", respectively due to the change of assessment method and default EF as well as considering new sources of emissions (preservation of wood, underseal treatment and conservation of vehicles); if previously emissions from domestic solvent use, paints application, degreasing, dry cleaning, chemical products, printing, other solvent and product use, such as seed oil extraction, use of glues and other adhesives and vehicles dewaxing were reported under Sector 3 "Solvents and Other Product Use", while emissions from road paving with asphalt and asphalt roofing – under category 2A "Mineral Industry", being estimated according to the EMEP/CORINAIR

Atmospheric Emissions Inventory Guidebook (2009), within the current inventory cycle, the respective emissions were estimated according to the EMEP/EEA Atmospheric Emissions Inventory Guidebook (2016); to be noted also, that within the current inventory cycle, the carbon fraction value in NMVOC emissions used to estimate indirect CO_2 emissions was considered following the 2006 IPCC Guidelines (Volume 3, Chapter 5.5, page 5.17), while in the previous inventory cycle there were used values from the National Inventory Reports of Hungary;

- in order to transfer direct GHG emissions into CO_2 equivalent, within the current inventory cycle were used the GWP_{100} values available in the IPCC (AR4), thus replacing the GWP_{100} values from the IPCC (SAR).

In comparison with the results obtained in the BUR1 of the Republic of Moldova under UNFCCC (2016), the recalculations performed in the current inventory cycle resulted in a decrease of direct GHG emissions within 1990-1997 periods, with a variation from a minimum of 0.8 per cent in 1993 up to a maximum of 29.0 per cent in 1992, respectively in an increase of direct GHG emissions within 1998-2013 time series, varying from a minimum of 3.5 per cent in 2007 to a maximum 23.8 per cent in 2001 (Table 8-4).

Table 8-4: Recalculations of Total Direct GHG Emissions within the Industrial Processes and Product Use Sector included into the BUR1 of the RM under the UNFCCC, Mt CO_2 equivalent

	1990	1991	1992	1993	1994	1995	1996	1997
BUR1	1.8420	1.7560	1.1472	0.7394	0.6077	0.4784	0.4256	0.4778
NC4	1.5810	1.4026	0.8144	0.7332	0.5529	0.4535	0.4129	0.4550
Difference, %	-14.2	-20.1	-29.0	-0.8	-9.0	-5.2	-3.0	-4.8
	1998	1999	2000	2001	2002	2003	2004	2005
BUR1	0.3321	0.2971	0.2702	0.2620	0.3204	0.3715	0.4201	0.5605
NC4	0.3809	0.3452	0.3190	0.3243	0.3770	0.4119	0.4897	0.5986
Difference, %	14.7	16.2	18.1	23.8	17.7	10.9	16.6	6.8
	2006	2007	2008	2009	2010	2011	2012	2013
BUR1	0.6563	0.9385	1.0150	0.5137	0.5594	0.6011	0.6227	0.6726
NC4	0.7092	0.9713	1.0639	0.5601	0.6050	0.6985	0.7164	0.7703
Difference, %	8.1	3.5	4.8	9.0	8.1	16.2	15.1	14.5

Abbreviations: NC4 – Fourth National Communication; BUR1 – First Biennial Update Report.

The results of recalculations performed by categories are presented also in the sub-chapters 4.2-4.8 of the NIR: 1990-2015.

8.1.3. Agriculture Sector

Recalculations of total direct GHG emissions from the 'Agriculture' Sector were performed based on the following considerations:

- due to the availability of an updated set of activity data (the Statistical Yearbooks of the Republic of Moldova and those of the ATULBD, other relevant publications in the field), used to estimate GHG emissions from Sector 3 "Agriculture";
- use of an updated set values for gross energy (GE), respectively updating country specific EFs for estimating CH_4 emissions from 3A "Enteric Fermentation" for cattle, sheep and goats according to the Tier 2 approach;
- use of an updated set of values for gross energy (GE) received daily (MJ/day) for estimating CH_4 and N_2O emissions from 3B "Manure Management", the most significant changes regard the swine category (it was taken into consideration the dynamic of certain productivity indicators such as the average weight per head at the end of the year and the average daily weight gain per day; also, the respective emissions were recalculated due to updating the daily ratio of volatile solid excretion on a dry-organic matter basis (kg dm/day); recalculations were also done due to updating the share of manure management systems for the entire period under review (1990-2015) as a result of 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; 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 (in total, manure management systems from 179 farms were inspected, of which 96 cattle farms, 66 pig farms and 17 poultry farms); as a consequence of the above, the EFs calculated for cattle and swine according to a Tier 2 methodology were updated for 1990-2015 time series;

- updating the AD for the left bank of the Dniester River on applied inorganic N fertilizers in order to estimate direct N_2O_{SN} emissions (category 3D.a.1);
- 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 order to estimate direct N_2O_{ON} emissions from the 3D.a.2 "Applied Organic Nitrogen Fertilizers" source category;
- direct N_2O_{CR} emissions from crop residues returned to soil as well as direct N_2O emissions from nitrogen mineralization associated with loss of soil carbon as a result of land-use or management change were recalculated in particular due to use of an updated set of activity data on sown areas with crops, gross harvest of agricultural crops, average yield per hectare of agricultural crops (available in the NBS on-line database as well as into the Statistical Yearbooks of the ATULBD) (categories 3D.a.4 and 3D.a.5);
- 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"), as well as due to updating the share of manure management systems for the entire period under review as a result of 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, used to estimate Indirect N_2O_{ATD} emissions from the 3D.b.1 "Atmospheric Deposition of Nitrogen Oxides (NO_x) and Ammonia (NH_4)" source category as well as indirect N_2O_L emissions from the 3D.b.2 "Nitrogen Leaching and Run-off" source category;
- CO_2 emissions from 3H "Urea Application" source category were estimated for the first time;
- in order to convert direct GHG emissions in CO_2 equivalent, in the current inventory cycle, the 100-year Global Warming Potential (GWP_{100}) values available in the Fourth IPCC Assessment Report (AR4), in the detriment of GWP_{100} values in the Second IPCC Assessment Report (SAR).

Compared with the results recorded in the BUR1, changes performed in the current inventory cycle revealed an increasing trend of direct GHG emissions between 1990 and 2013, with a variation from a minimum of 2.9 per cent in 1990 to a maximum of 11.9 per cent in 1996 (Table 8-5).

Table 8-5: Recalculations of Direct GHG Emissions within the Agriculture Sector included into the BUR1 of the RM under the UNFCCC, Mt CO_2 equivalent

	1990	1991	1992	1993	1994	1995	1996	1997
BUR1	5.0639	4.6906	4.0899	3.9268	3.3627	3.2844	3.0403	2.9853
NC4	5.2106	4.8569	4.3977	4.2227	3.7517	3.5906	3.4009	3.1810
Difference, %	2.9	3.5	7.5	7.5	11.6	9.3	11.9	6.6
	1998	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**
BUR1	2.7514	2.5192	2.2899	2.4549	2.5085	2.1956	2.3790	2.3588
NC4	2.9467	2.6892	2.5002	2.6728	2.7425	2.4246	2.5921	2.5765
Difference, %	7.1	6.7	9.2	8.9	9.3	10.4	9.0	9.2
	2006	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**
BUR1	2.2656	1.5124	2.1006	1.9181	2.1007	2.0865	1.6400	2.1267
NC4	2.4631	1.6847	2.2384	2.0703	2.2497	2.2040	1.7758	2.2490
Difference, %	8.7	11.4	6.6	7.9	7.1	5.6	8.3	5.8

Abbreviations: NC4 – Fourth National Communication; BUR1 – First Biennial Update Report.

The results of recalculations performed by categories are presented also in the sub-chapters 5.2-5.5 of the NIR: 1990-2015.

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

Recalculations of total net GHG emissions from the LULUCF Sector were performed based on the following considerations:

- the full transition to the estimation methodologies available in the 2006 IPCC Guidelines;
- the development and use of the Land Use and Land Use-Change Matrix for 1970-2015 time series;
- including in the inventory the estimates related to the process of land conversion (for the first time in the current inventory were included the following sub-categories: 4A2 "Land Converted to Forest Land" and 4B2 "Land Converted to Cropland");
- updating activity data and country specific emission factors in order to estimate CO_2 emissions/removals within the 4A "Forest Land", 4B "Cropland" and 4C "Grassland";
- transition to a new assessment method – Tier 2 (2006 IPCC Guidelines) and use of country specific factors regarding the changes of carbon stocks in mineral soils in the RM, in the detriment of a country specific assessment methodology, used in the previous inventory cycle (currently it is being working on this methodology for improvement and international validation) in order to estimate CO_2 removals/emissions recalculations under the 4B1.2 "Annual Change in Carbon Stocks in Mineral Soils" category;
- taking into consideration that the Tier 1 approach from the 2006 IPCC Guidelines (Volume 4 "AFOLU") considers the biomass stock within this category in balance, respectively the stock does not change, the CO_2 emissions/removals could not be estimated in the current inventory cycle;
- including in the inventory emissions/removals from initial land converted to grassland, as well as introducing the conversion period of 20 years, in order to estimate CO_2 emissions/removals within the 4C2 "Land Converted to Grassland" category;
- also, for the first time CO_2 emissions/removals from certain categories were estimated separately: 4D "Wetlands", 4E "Settlements", 4F "Other Land" and 4G "Harvested Wood Products".

Compared with the results recorded in the BUR1, changes performed in the current inventory cycle resulted in an increasing of total net CO_2 removals in 1990-2015 time series (except for 1990), with a variation from a minimum of +19.2 per cent in 2012 to a maximum of +7440.4 per cent in 2008 (Table 8-6).

Table 8-6: Recalculations of Net CO_2 Removals within the Land Use, Land-Use Change and Forestry Sector included into the BUR1 of the RM under the UNFCCC, Mt CO_2

	1990	1991	1992	1993	1994	1995	1996	1997
BUR1	-5.8866	-5.3250	-4.3844	-1.5008	-2.1641	-1.0294	-1.1666	-0.1369
NC4	-5.8197	-7.5773	-7.0514	-7.1366	-6.3455	-6.4821	-6.2262	-6.0886
Difference, %	-1.1	42.3	60.8	375.5	193.2	529.7	433.7	4347.0
	1998	1999	2000	2001	2002	2003	2004	2005
BUR1	-0.7226	-1.1349	-1.3922	-0.7500	-0.5327	-1.5547	-0.1032	-0.3754
NC4	-6.1414	-6.1121	-6.0570	-5.7928	-4.8670	-4.9273	-3.8846	-4.7644
Difference, %	749.9	438.6	335.1	672.4	813.7	216.9	3663.1	1169.1
	2006	2007	2008	2009	2010	2011	2012	2013
BUR1	-0.6391	-3.0660	-0.0595	-1.2849	-0.6571	-0.4291	-2.4704	-0.0976
NC4	-5.0355	-5.0242	-4.4876	-3.8521	-3.2301	-2.6440	-2.9451	-2.5470
Difference, %	687.9	63.9	7440.4	199.8	391.6	516.1	19.2	2509.3

Abbreviations: NC4 – Fourth National Communication; BUR1 – First Biennial Update Report.

The results of recalculations performed by categories are presented also in the sub-chapters 6.2-6.8 of the NIR: 1990-2015.

8.1.5. Waste Sector

Recalculations of total direct GHG emissions from the Waste Sector were performed based on the following considerations:

- transition to new methodological approach according to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories, thus replacing the Good Practice Guidance (IPCC, 2000) and the Revised 1996 IPCC Guidelines (IPCC, 1997);
- the use of an updated set of AD and country specific EFs values based on new studies, including research on the morphological analysis of solid waste;
- direct and indirect GHG emissions from incineration and open burning of household and clinical waste were estimated for the first time:
- in order to convert direct GHG emissions in CO_2 equivalent, in the current inventory cycle, the 100-year Global Warming Potential (GWP_{100}) values available in the Fourth IPCC Assessment Report (AR4), were used in the detriment of GWP_{100} values in the Second IPCC Assessment Report (SAR).

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 1991 and 1998, with a variation from a minimum of 1.0 per cent in 1998 and a maximum of 12.6 per cent in 1992; respectively an increasing trend of direct GHG emissions in 1990 and 1999-2013, varying from a minimum increase by 0.02 per cent in 2013 to a maximum of 20.0 per cent in 2005 (Table 8-7).

Table 8-7: Recalculations of Direct GHG Emissions within the Waste Sector included into the BUR1 of the RM under the UNFCCC, Mt CO_2 equivalent

	1990	1991	1992	1993	1994	1995	1996	1997
BUR1	1.8655	1.9782	2.0621	2.0221	1.9587	1.9044	1.8209	1.7483
NC4	1.9777	1.9479	1.8030	1.8497	1.7471	1.7202	1.7098	1.7191
Difference, %	6.0	-1.5	-12.6	-8.5	-10.8	-9.7	-6.1	-1.7
	1998	1999	2000	2001	2002	2003	2004	2005
BUR1	1.6686	1.5555	1.4690	1.3927	1.3247	1.2920	1.2795	1.2978
NC4	1.6514	1.6144	1.6007	1.5911	1.5503	1.5356	1.5262	1.5573
Difference, %	-1.0	3.8	9.0	14.2	17.0	18.9	19.3	20.0
	2006	2007	2008	2009	2010	2011	2012	2013
BUR1	1.3109	1.3640	1.4589	1.5145	1.5707	1.5597	1.5567	1.5658
NC4	1.5369	1.5282	1.5522	1.5417	1.5801	1.6044	1.6018	1.5661
Difference, %	17.2	12.0	6.4	1.8	0.6	2.9	2.9	0.0

Abbreviations: NC4 – Fourth National Communication; BUR1 – First Biennial Update Report.

The results of recalculations performed by categories are presented also in the sub-chapters 7.2-7.4 of the NIR: 1990-2015.

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 carbon dioxide 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;
- Reinforcing the main elements of the National Reporting Systems under the UNFCCC (NRS-UNFCCC) by using the US EPA Template Workbook "Developing a National Greenhouse Gas Inventory System" (<www.epa.gov/climatechange/emissions/ghginventorycapacitybuilding>), in order to prepare by the end of the next inventory cycle (in the context of the complete transition to the assessment methodologies available in the 2006 IPCC Guidelines) a "*Report on the National GHG Inventory System of the Republic of Moldova*" which would contain information according to six templates: (1) a description of institutional arrangements for National Inventory Systems; (2) methods and data documentation; (3) a description of quality

assurance and quality control procedures; (4) a description of archiving system; (5) a description of key category analysis; and (6) a description of the National Inventory Improvement Plan;

- 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 data management system used in each inventory cycle, as well as the periodic archiving of the inventory and the documentation on which the inventory was drawn up, in order to comply with the principle of transparency;
- Enhancing the professional capacities of national experts involved in the inventory process, as well as transitioning from default EFs and Tier 1 methodologies to country specific emission factors and Tier 2 and 3 methodologies, particularly focusing on key categories.

8.2.2. Planned Improvements

Energy Sector

Potential improvements within the Energy Sector could be achieved once:

- new AD regarding the fuel consumption for electricity and heat generation (category 1A1 "Energy Industry") in the ATULBD are available (filling the gaps for certain years); another possible improvement could be using real reported caloric values for natural gas imported annually in the Republic of Moldova, based on the information provided by J.S.C. "Moldovagaz";
- updated AD regarding the fuel consumption with energy purposes in industries (category 1A2 "Manufacturing Industries and Construction") for ATULBD are available (filling the gaps for certain years). Another possible improvement could be using real reported caloric values for natural gas imported annually in the Republic of Moldova, based on the information provided by J.S.C. "Moldovagaz";
- updating the available AD on fuel consumption in ATULBD (category 1A3 „Transport") as well as applying a higher level calculation methodology (for example, the COPERT model); since for the Left Bank of Dniester River, there are no complete information for the entire time period. It would be possible to carry out a study focused on indirect generation of AD associated with fuel consumption in the transport sector based on the existing information on the structure of vehicle fleet, respectively on the specific fuel consumption within this sector on the Right Bank of Dniester River, applying the methods available in the 2006 IPCC Guidelines for obtaining AD for the missing year series;
- updating the available AD on fuel consumption in commercial/institutional, residential and agriculture/forestry/fishing sectors (category 1A4 "Other Sectors") on the territory of ATULBD for the entire period under review (for example, by applying techniques for data recovery for the missing years; updating AD on fuel consumption within this sector for 1991 and 1992, when the Energy Balances of the RM were not generated, through reallocations from other source categories based on expert opinion or through the application of certain methods of data recovery according to the recommendations and the good practices presented in the 2006 IPCC Guidelines; by obtaining and using annual AD associated with real caloric values for natural gas imported and consumed each year in the RM within the 1A4 source category (according to the information provided by J.S.C. "Moldovagaz");
- potential improvements in 1A5 "Other" category could be performed if new AD on fuel consumption for other works and needs would be available for the ATULBD;
- 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, etc.) (category 1B2 "Fugitive Emissions from Oil and Natural Gas"), 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 Left Bank of Dniester River for the entire period under review;

- within the "International Bunkers: Aviation", 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;
- potential improvements within the "CO_2 emissions from biomass" (Memo Items) could be achieved by collecting more accurate AD for the Right Bank of Dniester River (AD on biomass consumption were recently revised by the NBS using a new methodology, though it did not covered the entire historical period, revealing thus the time-series inconsistency related to inventory results for CO_2 emissions from biomass); respectively, by collecting AD on biomass consumption in the ATULBD for a longer period of time.

Industrial Processes and Product Use Sector

Monitoring the GHG emissions from the Industrial Processes and Product Use Sector is planned to be improved along with:

- updating/précising the activity data used to estimate GHG emissions within category 2A "Mineral Industry", 2B "Chemical Industry", 2H "Other" for 1990-2004 time periods (until 2004, Republic of Moldova used a classifier of the industrial production specific to the USSR, while the 'PRODMOLD-A' classifier was introduced only since 2004, respectively it offers detailed information on the industrial production collected through the Statistical Reports PRODMOLD-A "Total production, as a natural expression, in the Republic, by product type" covering the 2005-2015 time series);
- updating/précising the activity data regarding the consumption of raw materials per tonne of production, as well as the specific consumption of electrodes per tonne of steel produced by the national enterprises. If new country specific data will be available, the uncertainties associated with GHG emissions from category 2C1 "Iron and Steel Production" could be decreased with the next inventory cycles;
- updating/précising the activity data used to estimate GHG emissions within source category 2D "Non-energy Products from Fuels and Solvent Use" for the 1990-2015 periods;
- 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 of the Ministry of Agriculture, Regional Development and Environment 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;
- updating/précising the activity data used to estimate GHG emissions within category 2G "Other Product Manufacture and Use" for the 1990-2015 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).

Agriculture Sector

Monitoring the GHG emissions from the Agriculture Sector is planned to be improved along with:

- updating the activity data set and the productivity indicators, used to estimate GHG emissions from 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 the activity data set and the productivity indicators, used to estimate GHG 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 précising the values for the main parameters used to develop CS

EFs for respective animal categories following a Tier 2 method; and also there are planned activities focused on regular updating (every 3-5 years) the AD regarding the share of manure management systems in the livestock breeding sector;

- updating country specific N excreted rates for different categories (kg N/head/year) used to estimate N_2O emissions from source category 3B "Manure Management";
- updating activity data and country specific coefficients and parameters used to estimate direct N_2O emissions from crop residues returned to soils in the RM;
- 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 under the 3D "Agriculture Soils" category;
- updating and précising AD used to estimate CO_2 emissions from urea application in the Republic of Moldova.

Land Use, Land-Use Change and Forestry Sector

Monitoring the CO_2 emissions/removals from the Land Use, Land-Use Change and Forestry Sector is planned to be improved along with:

- improving accounting of distribution of forest land by species, actual consumption of fuel wood from the managed forest land of the Republic of Moldova, as well as updating national emission/removal factors (basic wood density, biomass expansion factors, emission factors from forest fires etc.), for 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 etc.), for sub-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 "Annual Change in Carbon Stocks in Mineral Soils";
- improving the cadastral records (as the main reference sources for AD) pertaining to specification of land use categories to which converted lands are transferred to, for category 4C "Grassland";
- improving 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 - category 4D "Wetlands";
- improving 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 - category 4E "Settlements";
- improving 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 - category 4F "Other Land";
- improving the statistical records (as the main reference sources for AD) pertaining to wood products production/export/import from 4G "Harvested Wood Products" category.

Waste Sector

Monitoring the direct GHG emissions from the Waste Sector is planned to be improved along with:

- 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;
- promoting statistical accounting of the generated waste and an essential restructuring of the waste management in the Republic of Moldova taking into account the international practice

in municipal solid waste management and political declarations on the intended aligning to EU standards;

- 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.); also, 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 in two of the largest municipalities in the country (Chisinau and Balti);
- 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;
- improve the population's access to quality water supply and sanitation services, in the context of fully implementing the Government Decision No. 199 as of 20.03.2014 the Strategy on water supply and sanitation (2014-2028), which will ensure 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, Law No. 303 as of 13.12.2013 on Public Service for Water and Sanitation Supply, the set of secondary legislation to these Laws, 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, the regionalization process includes 6 water companies from Hincesti, Soroca, Floresti, Ceadir-Lunga and Orhei districts; these reforms will change the wastewater management system; leading thus, to decreased GHG emissions within this sector; another institutional reform planned for implementation within this sector refers to creating regulatory authorities by extending the responsibilities of the National Agency for Energy Regulation, which will exercise a major impact in regulating the functioning of the sector; these institutional instruments will determine the sustainability of sector management.
    - *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 it is planned also to use updated values for BOD_5 in water waste (recently it was approved a new national norm – NCM G.03.02-2015, which replaced the previous one - SNIP 2.04.03.85); it will be assessed also 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" source 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 1990-2015 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:

$$T_{x,t} = |E_{x,0}| / \Sigma |E_{y,0}| \bullet |[(E_{x,t} - E_{x,0})/E_{x,0}] - [(\Sigma E_{y,t} - \Sigma E_{y,0}) / |\Sigma E_{y,0}|]|$$

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:

$$LU_{x,t} = (L_{x,t} \bullet U_{x,t}) / \Sigma [(L_{y,t} \bullet U_{y,t})]$$

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:

$$TU_{x,t} = (T_{x,t} \bullet U_{x,t})$$

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)[129].

[129] <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

Key Categories from Tier 1 Base Year Level Assessment

Key Categories from Tier 1 Base Year Level Assessment - 1990	GHG Emissions in 1990 (Gg CO_2 eq.)	Level Assessment	Cumulative Sum (%)
1A1 – Fuel Combustion Activities – Energy Industries – CO_2	19 338.02	0.4431	44.3%
1A4 – Fuel Combustion Activities – Other Sectors – CO_2	7 291.57	0.1671	61.0%
1A3b – Fuel Combustion Activities – Transport – Road Transportation – CO_2	3 826.36	0.0877	69.8%
1A2 – Fuel Combustion Activities – Manufacturing Industries and Construction – CO_2	2 206.28	0.0506	74.8%
3A – Enteric Fermentation – CH_4	2 190.69	0.0502	79.9%
3Da – Direct N_2O Emissions from Managed Soils – N_2O	1 069.22	0.0245	82.3%
5A – Solid Waste Disposal – CH_4	1 046.73	0.0240	84.7%
2A1 – Mineral Industry – Cement Production – CO_2	971.70	0.0223	86.9%
3B1-4 – Manure Management – N_2O	871.91	0.0200	88.9%
5D – Wastewater Treatment and Discharge – CH_4	814.73	0.0187	90.8%
1B2b – Fugitive Emissions from Fuels – Oil and Natural Gas – CH_4	812.24	0.0186	92.7%
3B – Manure Management – CH_4	494.82	0.0113	93.8%
1A3c – Fuel Combustion Activities – Transport – Railways – CO_2	403.48	0.0092	94.7%
3Db – Indirect N_2O Emissions from Managed Soils – N_2O	338.62	0.0078	95.5%

Key Categories from Tier 1 Current Year Level Assessment - 2015

Key Categories from Tier 1 Current Year Level Assessment - 2015	GHG Emissions in 2015 (Gg CO_2 eq.)	Level Assessment	Cumulative Sum (%)
1A1 – – Fuel Combustion Activities – Energy Industries – CO_2	4 141.22	0.2955	29.5%
1A3b – Fuel Combustion Activities – Transport – Road Transportation – CO_2	2 119.36	0.1512	44.7%
1A4 – Fuel Combustion Activities – Other Sectors – CO_2	1 790.21	0.1277	57.4%
5A – Solid Waste Disposal - CH_4	1 087.15	0.0776	65.2%
3Da – Direct N_2O Emissions from Managed Soils – N_2O	812.92	0.0580	71.0%
1A2 – Fuel Combustion Activities – Manufacturing Industries and Construction – CO_2	665.62	0.0475	75.8%
3A – Enteric Fermentation – CH_4	654.60	0.0467	80.4%
1B2b- Fugitive Emissions from Fuels – Oil and Natural Gas – CH_4	566.60	0.0404	84.5%
2A1 – Mineral Industry – Cement Production – CO_2	443.24	0.0316	87.6%
5D – Wastewater Treatment and Discharge – CH_4	354.18	0.0253	90.2%
3B1-4 – Manure Management – N_2O	292.02	0.0208	92.2%
3Db – Indirect N_2O Emissions from Managed Soils – N_2O	218.91	0.0156	93.8%
1A4 – Fuel Combustion Activities – Other Sectors – CH4	108.92	0.0078	94.6%
2F2 – Product Use as Substitutes for Ozone Depleting Substances – Foam Blowing Agents – HFCs	101.88	0.0073	95.3%

Key Categories from Tier 1 Trend Assessment

Key Categories from Tier 1 Trend Assessment	GHG Emissions in 2015 (Gg CO_2 eq.)	Trend Assessment	Cumulative Sum (%)
1A1 – – Fuel Combustion Activities – Energy Industries – CO_2	4 141.22	0.0474	33.5%
1A3b – Fuel Combustion Activities – Transport – Road Transportation – CO_2	2 119.36	0.0204	47.9%
5A – Solid Waste Disposal – CH_4	1 087.15	0.0172	60.0%
1A4 – Fuel Combustion Activities – Other Sectors – CO_2	1 790.21	0.0126	68.9%
3Da – Direct N_2O Emissions from Managed Soils – N_2O	812.92	0.0108	76.5%
1B2b- Fugitive Emissions from Fuels – Oil and Natural Gas – CH_4	566.60	0.0070	81.5%
2A1 – Mineral Industry – Cement Production – CO_2	443.24	0.0030	83.6%
3Db – Indirect N_2O Emissions from Managed Soils – N_2O	218.91	0.0025	85.4%
1A3c – Fuel Combustion Activities – Transport – Railways – CO_2	21.67	0.0025	87.1%
2F2 – Product Use as Substitutes for Ozone Depleting Substances – Foam Blowing Agents – HFCs	101.88	0.0023	88.8%
5D – Wastewater Treatment and Discharge – CH_4	354.18	0.0021	90.3%
3B – Manure Management – CH_4	70.36	0.0020	91.7%
2F1 – Product Use as Substitutes for Ozone Depleting Substances – Refrigeration and Air Conditioning – HFCs	77.36	0.0018	93.0%
2A2 – Mineral Industry – Lime Production – CO_2	21.75	0.0012	93.8%
3A – Enteric Fermentation – CH_4	654.60	0.0011	94.6%
1A2 – Fuel Combustion Activities – Manufacturing Industries and Construction – CO_2	665.62	0.0010	95.3%

Key Categories from Tier 2 Base Year Level Assessment - 1990

Key Categories from Tier 2 Base Year Level Assessment - 1990	GHG Emissions in 1990 (Gg CO_2 eq.)	Relative level of assessment with uncertainty	Cumulative Sum (%)
1A1 – Fuel Combustion Activities – Energy Industries – CO_2	19 338.02	0.2001	20.0%
3B1-4 – Manure Management – N_2O	871.91	0.1332	33.3%
3Db – Indirect N_2O Emissions from Managed Soils – N_2O	338.62	0.0831	41.6%
5A – Solid Waste Disposal – CH_4	1 046.73	0.0766	49.3%
1A4 – Fuel Combustion Activities – Other Sectors – CO_2	7 291.57	0.0754	56.8%
3A – Enteric Fermentation – CH_4	2 190.69	0.0717	64.0%
5D – Wastewater Treatment and Discharge – CH_4	814.73	0.0596	70.0%
3B5 – Indirect N_2O Emissions from Manure Management – N_2O	244.71	0.0548	75.4%
1B2b – Fugitive Emissions from Fuels – Oil and Natural Gas – CH_4	812.24	0.0420	79.6%
3Da – Direct N_2O Emissions from Managed Soils – N_2O	1 069.22	0.0399	83.6%
1A3b – Fuel Combustion Activities – Transport – Road Transportation – CO_2	3 826.36	0.0396	87.6%
3B – Manure Management – CH_4	494.82	0.0229	89.9%
1A2 – Fuel Combustion Activities – Manufacturing Industries and Construction – CO_2	2 206.28	0.0228	92.2%

Key Categories from Tier 2 Current Year Level Assessment - 2015

Key Categories from Tier 2 Current Year Level Assessment - 2015	GHG Emissions in 2015 (Gg CO_2 eq.)	Relative level of assessment with uncertainty	Cumulative Sum (%)
5A - Solid Waste Disposal – CH_4	1 087.15	0.1828	18.3%
3Db – Indirect N_2O Emissions from Managed Soils – N_2O	218.91	0.1235	30.6%
3B1-4 – Manure Management – N_2O	292.02	0.1025	40.9%
1A1 – Fuel Combustion Activities – Energy Industries – CO_2	4 141.22	0.0985	50.7%
3Da – Direct N_2O Emissions from Managed Soils – N_2O	812.92	0.0697	57.7%
1B2b – Fugitive Emissions from Fuels – Oil and Natural Gas – CH_4	566.60	0.0674	64.4%
5D – Wastewater Treatment and Discharge – CH_4	354.18	0.0596	70.4%
1A3b – Fuel Combustion Activities – Transport – Road Transportation – CO_2	2 119.36	0.0504	75.4%
3A – Enteric Fermentation – CH_4	654.60	0.0492	80.4%
1A4 – Fuel Combustion Activities – Other Sectors – CO_2	1 790.21	0.0426	84.6%
3B5 – Indirect N_2O Emissions from Manure Management – N_2O	60.05	0.0309	87.7%
1A4 – Fuel Combustion Activities – Other Sectors – CO_2	108.92	0.0184	89.5%
1A2 – Fuel Combustion Activities – Manufacturing Industries and Construction – CO_2	665.62	0.0158	91.1%

Key Categories from Tier 2 Trend Assessment

Key Categories from Tier 2 Trend Assessment	GHG Emissions in 2015 (Gg CO_2 eq.)	Relative level of assessment with uncertainty	Cumulative Sum (%)
5A – Solid Waste Disposal – CH_4	1 087.15	0.2779	27.8%
3Db – Indirect N_2O Emissions from Managed Soils – N_2O	218.91	0.1368	41.5%
1A1 – Fuel Combustion Activities – Energy Industries – CO_2	4 141.22	0.1082	52.3%
3Da – Direct N_2O Emissions from Managed Soils – N_2O	812.92	0.0886	61.2%
1B2b – Fugitive Emissions from Fuels – Oil and Natural Gas – CH_4	566.60	0.0800	69.2%
1A3b – Fuel Combustion Activities – Transport – Road Transportation – CO_2	2 119.36	0.0466	73.8%
5D – Wastewater Treatment and Discharge – CH_4	354.18	0.0343	77.2%
2F2 – Product Use as Substitutes for Ozone Depleting Substances – Foam Blowing Agents – HFCs	101.88	0.0320	80.4%
2F1 – Product Use as Substitutes for Ozone Depleting Substances – Refrigeration and Air Conditioning – HFCs	77.36	0.0308	83.5%
1A4 – Fuel Combustion Activities – Other Sectors – CO_2	1 790.21	0.0288	86.4%
3B5 – Indirect N_2O Emissions from Manure Management – N_2O	60.05	0.0210	88.5%
3B – Manure Management – CH_4	70.36	0.0207	90.6%

Annex 1-3: The Results of Key Category Analysis, following the Tier 1 and Tier 2 methodologic approach, with LULUCF

Key Category Tier 1 Analysis, Level Assessment - 1990

Key Category Tier 1 Analysis, Level Assessment - 1990	GHG Emissions in 1990 (Gg CO_2 eq.)	Level Assessment	Cumulative Sum (%)
1A1 – Fuel Combustion Activities – Energy Industries – CO_2	19 338.02	0.3731	37.3%
1A4 – Fuel Combustion Activities – Other Sectors – CO_2	7 291.57	0.1407	51.4%
1A3b – Fuel Combustion Activities – Transport – Road Transportation – CO_2	3 826.36	0.0738	58.8%
4C2 – Land Converted to Grassland – CO_2	-2 850.29	0.0550	64.3%
1A2 – Fuel Combustion Activities – Manufacturing Industries and Construction – CO_2	2 206.28	0.0426	68.5%
3A – Enteric Fermentation – CH_4	2 190.69	0.0423	72.7%
4A1 – Forest Land Remaining Forest Land – CO_2	-1 591.23	0.0307	75.8%
4B1 – Cropland Remaining Cropland – CO_2	-1 583.72	0.0306	78.9%
3Da – Direct N_2O Emissions from Managed Soils – N_2O	1 069.22	0.0206	80.9%
5A – Solid Waste Disposal – CH_4	1 046.73	0.0202	83.0%
4B2 – Land Converted to Cropland – CO_2	1 005.60	0.0194	84.9%
2A1 – Mineral Industry – Cement Production – CO_2	971.70	0.0187	86.8%
4A2 – Land Converted to Forest Land – CO_2	-952.51	0.0184	88.6%
3B1-4 – Manure Management – N_2O	871.91	0.0168	90.3%
5D – Wastewater Treatment and Discharge – CH_4	814.73	0.0157	91.9%
1B2b – Fugitive Emissions from Fuels – Oil and Natural Gas – CH_4	812.24	0.0157	93.4%
3B – Manure Management – CH_4	494.82	0.0095	94.4%
1A3c – Fuel Combustion Activities – Transport – Railways – CO_2	403.48	0.0078	95.2%

Key Category Tier 1 Analysis, Level Assessment 2015

Key Category Tier 1 Analysis, Level Assessment 2015	GHG Emissions in 2015 (Gg CO_2 eq.)	Level Assessment	Cumulative Sum (%)
1A1 – Fuel Combustion Activities – Energy Industries – CO_2	4 141.22	0.2157	21.6%
1A3b – Fuel Combustion Activities – Transport – Road Transportation – CO_2	2 119.36	0.1104	32.6%
1A4 – Fuel Combustion Activities – Other Sectors – CO_2	1 790.21	0.0932	41.9%
4B1 – Cropland Remaining Cropland – CO_2	-1 711.35	0.0891	50.8%
4A1 – Forest Land Remaining Forest Land – CO_2	-1 511.56	0.0787	58.7%
5A – Solid Waste Disposal – CH_4	1 087.15	0.0566	64.4%
4B2 – Land Converted to Cropland – CO_2	983.93	0.0512	69.5%
3Da – Direct N_2O Emissions from Managed Soils – N_2O	812.92	0.0423	73.7%
1A2 – Fuel Combustion Activities – Manufacturing Industries and Construction – CO_2	665.62	0.0347	77.2%
3A – Enteric Fermentation – CH_4	654.60	0.0341	80.6%
1B2b – Fugitive Emissions from Fuels – Oil and Natural Gas – CH_4	566.60	0.0295	83.6%
4A2 – Land Converted to Forest Land – CO_2	-515.73	0.0269	86.3%
2A1 Mineral Industry – Cement Production – CO_2	443.24	0.0231	88.6%
5D – Wastewater Treatment and Discharge – CH_4	354.18	0.0184	90.4%
4C2 – Land Converted to Grassland – CO_2	-306.23	0.0160	92.0%
3B1-4 – Manure Management – N_2O	292.02	0.0152	93.5%
3Db – Indirect N_2O Emissions from Managed Soils – N_2O	218.91	0.0114	94.7%
1A4 – Fuel Combustion Activities – Other Sectors – CH_4	108.92	0.0057	95.2%

Key Categories Tier 1 Analysis, Trend Assessment

Key Categories Tier 1 Analysis, Trend Assessment	GHG Emissions in 2015 (Gg CO_2 eq.)	Trend Assessment	Cumulative Sum (%)
4C2 – Land Converted to Grassland – CO_2	-306.23	0.0878	31.3%
1A1 – Fuel Combustion Activities – Energy Industries – CO_2	4 141.22	0.0304	42.1%
4A1 – Forest Land Remaining Forest Land – CO_2	-1 511.56	0.0232	50.4%
4A2 – Land Converted to Forest Land – CO_2	-515.73	0.0214	58.0%
1A3b – Fuel Combustion Activities – Transport – Road Transportation – CO_2	2 119.36	0.0191	64.8%
4B1 – Cropland Remaining Cropland – CO_2	-1 711.35	0.0191	71.6%
5A – Solid Waste Disposal – CH_4	1 087.15	0.0150	76.9%
4B2 – Land Converted to Cropland – CO_2	983.93	0.0132	81.6%
3Da – Direct N_2O Emissions from Managed Soils – N_2O	812.92	0.0096	85.0%
1A4 – Fuel Combustion Activities – Other Sectors – CO_2	1 790.21	0.0070	87.6%
1B2b – Fugitive Emissions from Fuels – Oil and Natural Gas – CH_4	566.60	0.0063	89.8%
4G – Harvested Wood Products – CO_2	57.00	0.0054	91.7%
2A1 – Mineral Industry – Cement Production – CO_2	443.24	0.0030	92.8%
3Db – Indirect N_2O Emissions from Managed Soils – N_2O	218.91	0.0023	93.6%
5D – Wastewater Treatment and Discharge – CH_4	354.18	0.0022	94.4%
2F2 – Product Use as Substitutes for Ozone Depleting Substances – Foam Blowing Agents – HFCs	101.88	0.0020	95.1%

Key Category Tier 2 Analysis, Level Assessment - 1990

Key Category Tier 2 Analysis, Level Assessment - 1990	GHG Emissions in 1990 (Gg CO_2 eq.)	Relative level of assessment with uncertainty	Cumulative Sum (%)
1A1 – Fuel Combustion Activities – Energy Industries – CO_2	19 338.02	0.1675	16.8%
3B1-4 – Manure Management – N_2O	871.91	0.1115	27.9%
3Db – Indirect N_2O Emissions from Managed Soils – N_2O	338.62	0.0696	34.9%
5A – Solid Waste Disposal – CH_4	1 046.73	0.0641	41.3%
1A4 – Fuel Combustion Activities – Other Sectors – CO_2	7 291.57	0.0632	47.6%
4C2 – Land Converted to Grassland – CO_2	-2 850.29	0.0629	53.9%
3A – Enteric Fermentation – CH_4	2 190.69	0.0600	59.9%
5D – Wastewater Treatment and Discharge – CH_4	814.73	0.0499	64.9%
3B5 – Indirect N_2O Emissions from Manure Management – N_2O	244.71	0.0459	69.5%
1B2b – Fugitive Emissions from Fuels – Oil and Natural Gas – CH_4	812.24	0.0352	73.0%
3Da – Direct N_2O Emissions from Managed Soils – N_2O	1 069.22	0.0334	76.3%
1A3b – Fuel Combustion Activities – Transport – Road Transportation – CO_2	3 826.36	0.0331	79.6%
4A1 – Forest Land Remaining Forest Land – CO_2	-1 591.23	0.0308	82.7%
4B1 – Cropland Remaining Cropland – CO_2	-1 583.72	0.0274	85.5%
3B – Manure Management – CH_4	494.82	0.0192	87.4%
1A2 – Fuel Combustion Activities – Manufacturing Industries and Construction - CO_2	2 206.28	0.0191	89.3%
4A2 – Land Converted to Forest Land – CO_2	-952.51	0.0185	91.1%

Key Category Tier 2 Analysis, Level Assessment - 2015

Key Category Tier 2 Analysis, Level Assessment - 2015	GHG Emissions in 2015 (Gg CO_2 eq.)	Relative level of assessment with uncertainty	Cumulative Sum (%)
5A – Solid Waste Disposal – CH_4	1 087.15	0.1433	14.3%
3Db – Indirect N_2O Emissions from Managed Soils – N_2O	218.91	0.0968	24.0%
3B1-4 – Manure Management – N_2O	292.02	0.0804	32.0%
1A1 – Fuel Combustion Activities – Energy Industries – CO_2	4 141.22	0.0772	39.8%
4B1 – Cropland Remaining Cropland – CO_2	-1 711.35	0.0638	46.1%
4A1 – Forest Land Remaining Forest Land – CO_2	-1 511.56	0.0630	52.4%
3Da – Direct N_2O Emissions from Managed Soils – N_2O	812.92	0.0546	57.9%
1B2b – Fugitive Emissions from Fuels – Oil and Natural Gas – CH_4	566.60	0.0528	63.2%
5D – Wastewater Treatment and Discharge – CH_4	354.18	0.0467	67.9%
1A3b – Fuel Combustion Activities – Transport – Road Transportation – CO_2	2 119.36	0.0395	71.8%
3A – Enteric Fermentation – CH_4	654.60	0.0386	75.7%
4B2 – Land Converted to Cropland – CO_2	983.93	0.0367	79.3%
1A4 – Fuel Combustion Activities – Other Sectors – CO_2	1 790.21	0.0334	82.7%
3B5 – Indirect N_2O Emissions from Manure Management – N_2O	60.05	0.0242	85.1%
4A2 – Land Converted to Forest Land – CO_2	-515.73	0.0215	87.2%
4C2 – Land Converted to Grassland – CO_2	-306.23	0.0146	88.7%
1A4 – Fuel Combustion Activities – Other Sectors – CH_4	108.92	0.0144	90.1%

Key Categories Tier 2 Analysis, Trend Assessment

Key Categories Tier 2 Analysis Trend Assessment	GHG Emissions in 2015 (Gg CO_2 eq.)	Relative level of assessment with uncertainty	Cumulative Sum (%)
4C2 – Land Converted to Grassland – CO_2	-306.23	0.2822	28.2%
5A – Solid Waste Disposal – CH_4	1 087.15	0.1338	41.6%
3Db – Indirect N_2O Emissions from Managed Soils – N_2O	218.91	0.0685	48.5%
4A1 – Forest Land Remaining Forest Land – CO_2	-1 511.56	0.0653	55.0%
4A2 – Land Converted to Forest Land– CO_2	-515.73	0.0602	61.0%
4B1 – Cropland Remaining Cropland – CO_2	-1 711.35	0.0481	65.8%
3Da – Direct N_2O Emissions from Managed Soils – N_2O	812.92	0.0436	70.2%
1B2b – Fugitive Emissions from Fuels – Oil and Natural Gas – CH_4	566.60	0.0397	74.1%
1A1 – Fuel Combustion Activities – Energy Industries – CO_2	4 141.22	0.0383	78.0%
4B2 – Land Converted to Cropland– CO_2	983.93	0.0334	81.3%
4G – Harvested Wood Products – CO_2	57.00	0.0303	84.3%
1A3b – Fuel Combustion Activities – Transport – Road Transportation – CO_2	2 119.36	0.0240	86.7%
5D – Wastewater Treatment and Discharge – CH_4	354.18	0.0195	88.7%
2F2 – Product Use as Substitutes for Ozone Depleting Substances – Foam Blowing Agents – HFCs	101.88	0.0149	90.2%

Annex 2. Energy Balances of the Republic of Moldova for 2015 (without ATULBD)

SUPPLY AND CONSUMPTION	Coal, including														Peat and peat products, t	Shale, t	Natural gas, thousand m³ stand.**
	Anthracite, t	Coke coal, t	Other bituminous coal, t	Semibituminous coal, t	Lignite, t	Coke t	Coke gas, t	Coke dust, t	Semicoke t	Solid fuel briquettes, t	Brown coal briquettes, t	Coal tar, t	Coal gas, water gas, gas from generator and similar gas, except for the gas from wells, and other gaseous hidrocarbons, thousandm³	Other coal products, t			
	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	95		71	0		0		0						0	7		1008
Export															0		
Stock variation	5		-10	0		0		0							0		-2
Stock at the start of the year	53		31	0		0		0							0		17
Stock at the end of the year	58		21	0		0		0							0		15
Gross domestic consumption calculated	**90**		**81**	**0**		**0**		**0**						**0**	7		**1010**
Real gross domestic consumption	**90**		**81**	**0**		**0**		**0**						**0**	7		**1010**
TRANSFORMATION, INPUTS	**3**		**0**														**452**
Power Plants																	0
Combined Heat Plants – Public energy producers	0																345
Combined Heat Plants - Autoproducers																	17
Heat Plants - Public energy producers																	49
Heat Plants – Autoproducers	3		0														41
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																	

SUPPLY AND CONSUMPTION	Coal, including														Peat and peat products, t	Shale, t	Natural gas, thousand m^3 stand.**
	Anthracite, t	Coke coal, t	Other bituminous coal, t	Semibituminous coal, t	Lignite, t	Coke t	Coke gas, t	Coke dust, t	Semicoke t	Solid fuel briquettes, t	Brown coal briquettes, t	Coal tar, t	Coal gas, water gas, gas from generator and similar gas, except for the gas from wells, and other gaseous hidrocarbons, thousandm^3	Other coal products, t			
	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
Energy used for other purposes																	**0**
Oil Refineries																	
Petrochemical Plants																	
Power, Heat and Electrical Plants																	
Pumping Storage Plants																	
Unspecified elsewhere																	0
Losses	**0**		**0**												**0**		**72**
FINAL CONSUMPTION	**87**		**81**	**0**		**0**		**0**						**0**	**7**		**486**
FINAL ENERGY CONSUMPTION	**87**		**81**	**0**		**0**		**0**							**1**		**486**
INDUSTRY	**2**		**70**			**0**		**0**									**74**
Mining																	
Food Processing, Beverages and Tobacco	2					0											26
Textiles and leather industry	0																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)																	1
Non-metallic minerals	0		70														43
Iron and steel	0																
Car engineering industry	0					0		0									0
Production of trailers, semitrailers and other transport means																	
Other industries n.c.a.	0																0
For construction																	1
TRANSPORT																	**12**
Railways																	
Terrestrial passenger and cargo transport by autovehicles																	4
Pipeline transportation																	8
Navigation																	
Aviation																	
Other supplementary activities for transport																	
Other	**85**		**11**	**0**				**0**							**1**		**400**
Agriculture/Forestry /Fishing	1																3
Commercial/Institutional	1																11
For communal services	24		4	0											0		94

SUPPLY AND CONSUMPTION	Coal, including														Peat and peat products, t	Shale, t	Natural gas, thousand m³ stand.**
	Anthracite, t	Coke coal, t	Other bituminous coal, t	Semibituminous coal, t	Lignite, t	Coke t	Coke gas, t	Coke dust, t	Semicoke t	Solid fuel briquettes, t	Brown coal briquettes, t	Coal tar, t	Coal gas, water gas, gas from generator and similar gas, except for the gas from wells, and other gaseous hidrocarbons, thousandm³	Other coal products, t			
	110	**121**	**129**	**210**	**220**	**311**	**312**	**313**	**314**	**320**	**330**	**340**	**350**	**390**	**1110**	**2000**	**3000**
A	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**
Residential	59		7	0				0							1		292
Not specified elsewhere	0																0
CONSUMED FOR NON-ENERGY PURPOSES	**0**													**0**	**6**		**0**
Statistical differences	0		0	0		0		0						0	0		0

SUPPLY AND CONSUMPTION	Oil Products, including																					
	Oil, t	Other gaseous hidrocarbons (ethylene, propylene, butylene, butadiene and other), thousand m3 stand.**	Raw materials for refineries, t	Additives and oxygenated compounds, t	Other hidrocarbons, t	Gas from wells, thousand m3	Ethane, thousand m3	Liquefied (petroleum) gases, t	Naphta, t	Aviation gasoline , t	Gasoline, t	Gasoline for jet engines, t	Kerosene for jet engines , t	Other kerosene gas, t	Diesel oil, t	Residual fuel oil, t	White-spirit Petroleum, t	Oils and greases (lubricants , t	Paraffins, t	Petroleum coke, t	Petroleum bitumen, t	Other petroleum products, t
	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	7																					
Inputs from other sources																						
Import	0				0			74	0	0	164		22		522	6	0	8	0	9	26	0
Export								0			0		6		9	5		0				
Stock variation	0				0			-2	0	0	1		-2	0	15	-1	0	0	0	9	-3	0
Stock at the start of the year	1							9		0	17		4	0	40	29	0	3	0		5	0
Stock at the end of the year	1				0			7	0	0	18		2		54	28	0	3	0	9	2	0
Gross domestic consumption calculated	**7**				**0**			**76**	**0**	**0**	**163**		**18**	**0**	**498**	**2**	**0**	**8**	**0**	**0**	**29**	**0**
Real gross domestic consumption	**7**							**76**	**0**	**0**	**163**		**18**	**0**	**498**	**2**	**0**	**8**	**0**	**0**	**29**	**0**
TRANSFORMATION, INPUTS	**7**										**0**				**4**	**12**						**0**
Power Plants											0				0							
Combined Heat Plants – Public energy producers																						
Combined Heat Plants - Autoproducers																7						
Heat Plants - Public energy producers																						

SUPPLY AND CONSUMPTION	Oil Products, including																					
	Oil, t	Other gaseous hidrocarbons (ethylene, propylene, butylene, butadiene and other), thousand m3 stand.**	Raw materials for refineries, t	Additives and oxygenated compounds, t	Other hidrocarbons, t	Gas from wells, thousand m3	Ethane, thousand m3	Liquefied (petroleum) gases, t	Naphta, t	Aviation gasoline , t	Gasoline, t	Gasoline for jet engines, t	Kerosene for jet engines , t	Other kerosene gas, t	Diesel oil, t	Residual fuel oil, t	White-spirit Petroleum, t	Oils and greases (lubricants , t	Paraffins, t	Petroleum coke, t	Petroleum bitumen, t	Other petroleum products, t
	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
Heat Plants – Autoproduceres															0	0						0
Oil Refineries																						
Petrochemical plants	7										0				4	5						0
Liquefaction plants																						
Charcoal production plants																		0				
Other transformation installations																						
TRANSFORMATION, OUTPUT											**0**					**11**						**0**
Power Plants																						
Combined Heat Plants – Public energy producers																						
Combined Heat Plants - Autoproducers																						
Heat Plants - Public energy producers																						
Heat Plants – Autoproducers																						
Oil Refineries															0							
Petrochemical plants											0					11						0
Liquefaction plants																						
Charcoal production plants																						
Other transformation installations																						
Energy used for other purposes								**0**							**0**	**0**						**0**
Oil Refineries																						
Petrochemical Plants															0	0						0
Power, Heat and Electrical Plants																						0
Pumping Storage Plants																						
Unspecified elsewhere								0														
Losses								**1**			**1**		**0**		**1**			**0**				
FINAL CONSUMPTION								**75**	**0**	**0**	**162**		**18**	**0**	**493**	**1**	**0**	**8**	**0**	**0**	**29**	**0**
FINAL ENERGY CONSUMPTION								**75**			**162**		**18**		**492**	**1**				**0**		**0**
INDUSTRY								**0**			**0**		**0**		**5**	**1**				**0**		**0**
Mining								0			0				1							
Food Processing, Beverages and Tobacco								0			0				0	1						
Textiles and leather industry								0			0				0							
Wood Processing, manufacture of wood and cork products, except furniture; manufacture of straw products and from other vegetal plaiting materials											0				0							

SUPPLY AND CONSUMPTION	Oil Products, including																					
	Oil, t	Other gaseous hidrocarbons (ethylene, propylene, butylene, butadiene and other), thousand m3 stand.**	Raw materials for refineries, t	Additives and oxygenated compounds, t	Other hidrocarbons, t	Gas from wells, thousand m3	Ethane, thousand m3	Liquefied (petroleum) gases, t	Naphta, t	Aviation gasoline , t	Gasoline, t	Gasoline for jet engines, t	Kerosene for jet engines , t	Other kerosene gas, t	Diesel oil, t	Residual fuel oil, t	White-spirit Petroleum, t	Oils and greases (lubricants , t	Paraffins, t	Petroleum coke, t	Petroleum bitumen, t	Other petroleum products, t
	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**
Printing and reproduction of recorded media											0											
Chemical and petrochemical industry (including the pharmaceutical industry)								0														0
Non-metallic minerals								0			0				0	0				0		
Iron and steel								0														
Car engineering industry								0			0				0							
Production of trailers, semitrailers and other transport means															0							
Other industries n.c.a.								0			0		0		0							0
For construction								0			0				3	0						
TRANSPORT								**14**			**162**		**18**		**421**							
Railways													0		6							
Terrestrial passenger and cargo transport by autovehicles								14			162				413							
Pipeline transportation																						
Navigation															1							
Aviation													18									
Other supplementary activities for transport								0			0		0		1							
Other								**61**			**0**		**0**		**66**	**0**		**0**		**0**		**0**
Agriculture/Forestry /Fishing								0			0				62							0
Commercial/Institutional								0							1							0
For communal services								1					0		3	0						0
Residential								60			0				0			0		0		0
Not specified elsewhere								0								0						
CONSUMED FOR NON-ENERGY PURPOSES								**0**	**0**	**0**	**0**			**0**	**1**		**0**	**8**	**0**		**29**	**0**
Statistical differences	0				0			0	0	0	0		0	0	0	0	0	0	0	0	0	0

SUPPLY AND CONSUMPTION	Biofuels and waste, including															Waste, including		Electricity, MWh	Heat, Gcal.	Other types of fuel, t
	Briquettes and wood peletts and other vegetal waste, t	Fuel wood m³ comp.***	Wood waste, t	Animal waste, t	Black wood, t	Agricultural fuel residues, t	Charcoal, t	Biogasoline t	Biodiesel oil, t	Biodiesel oil for jet engines, t	Other types of liquid fuel, t CC	Gas from organic waste, thousand m³	Gas from sewage sludge thousand m3	Other types of biogas from anaerobic fermentation, thousand m³	Biogas from heating processes thousand m3	Industrial waste, t	Urban waste,t			
	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	20	1471	9	11		43						8						53		
Inputs from other sources																		3297		
Import	0	2	1				0											18		
Export	5	0	0			0		0										0		
Stock variation	0	-39	0			0	0	0												
Stock at the start of the year	4	104	2			2	0	0												
Stock at the end of the year	5	65	2			2	0	0												
Gross domestic consumption calculated	**15**	**1512**	**10**	**11**		**43**	**0**	**0**				**8**						**3368**		
Real gross domestic consumption	**15**	**1512**	**10**	**11**		**43**	**0**					**8**						**3368**		
TRANSFORMATION, INPUTS	**2**	**11**	**1**			**22**						**8**						**53**		
Power Plants												0						53		
Combined and Heat Plants – Public energy producers																				
Combined and Heat Plants - Autoproduceres												8								
Heat Plants - Public energy producers																				
Heat Plants – Autoproduceres	2	1	1			22														
Oil Refineries																				
Petrochemical plants																				
Liquefaction plants																				
Charcoal production plants		10																		
Other transformation installations																				
TRANSFORMATION, OUTPUT							**1**											**939**	**2397**	
Power Plants																		55		
Combined and Heat Plants – Public energy producers																		845	1430	
Combined and Heat Plants - Autoproduceres																		39	155	
Heat Plants - Public energy producers																			431	
Heat Plants – Autoproduceres																			381	
Oil Refineries																				
Petrochemical plants																				
Liquefaction plants																				

SUPPLY AND CONSUMPTION	Biofuels and waste, including															Waste, including		Electricity, MWh	Heat, Gcal.	Other types of fuel, t
	Briquettes and wood peletts and other vegetal waste, t	Fuel wood m^3 comp.***	Wood waste, t	Animal waste, t	Black wood, t	Agricultural fuel residues, t	Charcoal, t	Biogasoline t	Biodiesel oil, t	Biodiesel oil for jet engines, t	Other types of liquid fuel, t CC	Gas from organic waste, thousand m^3	Gas from sewage sludge thousand m3	Other types of biogas from anaerobic fermentation, thousand m^3	Biogas from heating processes thousand m3	Industrial waste, t	Urban waste,t			
	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**
Charcoal production plants							1													
Other transformation installations																				
Energy used for other purposes																		**176**	**17**	
Oil Refineries																				
Petrochemical Plants																		0	2	
Power, Heat and Electrical Plants																		135	9	
Pumping Storage Plants																				
Unspecified elsewhere																		41	6	
Losses	**0**	**0**				**0**												**393**	**358**	
FINAL CONSUMPTION	**13**	**1501**	**9**	**11**		**21**	**1**											**3685**	**2022**	
FINAL ENERGY CONSUMPTION	**13**	**1501**	**8**			**13**	**1**											**3685**	**2022**	
INDUSTRY	**2**	**3**	**0**			**0**												**772**	**403**	
Mining																		16		
Food Processing, Beverages and Tobacco	2	2	0			0												396	377	
Textiles and leather industry	0																	36	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																		4	1	
Chemical and petrochemical industry (including the pharmaceutical industry)						0												45	4	
Non-metallic minerals																		158	0	
Iron and steel		0																2		
Car engineering industry		0																47	0	
Production of trailers, semitrailers and other transport means	0																	0		
Other industries n.c.a.	0	0	0															17	0	
For construction																		6	0	
TRANSPORT																		**49**		
Railways																				
Terrestrial passenger and cargo transport by autovehicles																		43		
Pipeline transportation																		6		

SUPPLY AND CONSUMPTION	Biofuels and waste, including															Waste, including		Electricity, MWh	Heat, Gcal.	Other types of fuel, t
	Briquettes and wood peletts and other vegetal waste, t	Fuel wood m³ comp.***	Wood waste, t	Animal waste, t	Black wood, t	Agricultural fuel residues, t	Charcoal, t	Biogasoline t	Biodiesel oil, t	Biodiesel oil for jet engines, t	Other types of liquid fuel, t CC	Gas from organic waste, thousand m³	Gas from sewage sludge thousand m3	Other types of biogas from anaerobic fermentation, thousand m³	Biogas from heating processes thousand m3	Industrial waste, t	Urban waste,t			
	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**
Navigation																				
Aviation																				
Other supplementary activities for transport																				
Other	**11**	**1498**	**8**			**13**	**1**											**2864**	**1619**	
Agriculture/Forestry /Fishing	0	3	0			0												46	0	
Commercial/Institutional	0	2	0															243	31	
For communal services	5	26	2			3	1											905	410	
Residential	6	1467	6			10	0											1670	1178	
Not specified elsewhere		0																0	0	
CONSUMED FOR NON-ENERGY PURPOSES		**0**	**1**	**11**		**8**	**0**													
Statistical differences	0	0	0	0		0	0	0				0						0	0	

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 Energy Sector

Annex 3-1.1: Assessment Method Used to Estimate SO_2 Emissions within the Energy Sector

SO_2 emissions from 1A 'Fuel Combustion' were estimated following a Tier 1 method. The basic equations used to estimate SO_2 emissions are described as follows:

$$Emissions\ SO_2 (Gg) = \Sigma\ [Activity_{ab} (TJ) \bullet EF_{ab} (kg/TJ)]$$

$$Emission\ Factor = 2 \bullet (s/100) \bullet (1/ Q) \bullet 10^6 \bullet (100\text{-}r)/100 \bullet ((100\text{-}n) /100,$$

Where:

Activity – Energy Input (TJ);
EF – Emission Factor (kg/TJ);
a – fuel type;
b – sector or activity;
2 – SO_2/S (kg/kg);
S – sulphur content in fuel (per cent);
r – retention of sulphur in ash (per cent);
Q – net calorific value (TJ/kt);
10^6 – conversion factor;
n – efficiency of abatement technology and/or reduction efficiency (per cent).

Default emission factors available in the Revised 1996 Guidelines (IPCC, 1997) and 2006 IPCC Guidelines were used to estimate SO_2 emissions (Table A3-1.1.1), except for the coefficient of sulphur fraction in fuels imported in the Republic of Moldova (these values were provided by the Customs Service of the Republic of Moldova).

Table A3-1.1.1: Emission Factors Used to Estimate SO_2 Emissions in the RM

Fuel Type	Sulphur Fraction in Fuel, %	Retention of Sulphur in Ash, %	Net Calorific Value, TJ/kg
Anthracite	1.5	5	25.70
Other Bituminous Coals	1.5	5	26.41
Lignite	1.5	30	11.68
Residual Fuel Oil	3	0	40.20
Diesel Oil	0.3	0	42.54
Gasoline	0.1	0	43.72
Natural Gas	0.3	0	33.86
Kerosene	0.05	0	43.13
Fire Wood	0.2	0	12.32

Source: Revised 1996 Guidelines, Vol. 3, Tab. 1-12, page1.44; National Bureau of Statistics of the RM and Customs Service of the RM

Annex 3-1.2: Additional Data Sources Used to Estimate GHG Emissions within the Energy Sector for the ATULBD

Table A3-1.2.1: Fuel Consumption for Heat and Power Generation (Source Category 1A1 'Energy Industries') in the ATULBD within 1994-2015

	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
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
MTPP Dnestrovsk	1030.00	1098.40	1231.80	1113.30	856.60	841.30	768.40	937.40	719.30	756.20	838.70
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
	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Natural Gas, million m^3, including:	972.10	611.10	885.70	995.20	1448.30	1549.90	1428.8	1458.8	958.4	1350.7	1539.0
MTPP Dnestrovsk	805.40	429.40	719.00	766.20	1267.20	1339.40	1220.0	1255.8	754.3	1162.6	1348.0
Other plants in energy sector	166.70	181.70	166.70	189.00	181.10	210.10	208.3	203.1	204.1	188.1	191.0
Residual Fuel Oil, kt				7.6057	19.7749	19.5171	16.2301	13.8776	12.268	14.0393	14.9647
Other bituminous coal, kt				115.4448	230.8896	201.1057	160.6408	159.9969	180.8061	178.3061	176.0424

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; 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 A3-1.2.2: Fuel Consumption within the Source Category 1A2 'Manufacturing Industries and Construction' for the ATULBD within 1994-2015

	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
Natural Gas, million m³	275.10	71.72	52.11	151.50	146.50	136.10	143.90	174.50	73.20	79.00	71.90
	2005	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**
Natural Gas, million m³	102.50	133.90	232.60	250.50	121.90	113.50	123.00	134.90	110.80	129.70	108.00
Residual Fuel Oil, kt				0.8715	0.5705	0.3208	0.3098	0.2581	0.3713	0.3713	0.3713
Other bituminous coal, kt				0.0737	0.1473	0.1108	0.1102	0.0840	0.0324	0.0772	0.0641

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; 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 A3-1.2.3: Fuel Consumption within the Source Category 1A3b 'Road Transportation' for the ATULBD within 1995-2015

	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
Diesel Oil, kt	2.9748	2.3819	3.1773	2.4552	2.2670	1.6176	1.5949	1.2404	0.8601	0.7708	0.5394
	2006	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**%**
Diesel Oil, kt	0.4471	0.3259	0.2945	0.3893	0.8235	0.9326	1.0272	1.1664	1.1385	1.079	-63.7
Compressed Natural Gas, million m³				4.1	6.9	1.8	2.2	5.2	4.8	5	NA

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 113), 2014 (page 102); 2015 (page 95). 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.

Table A3-1.2.4: Fuel Consumption within the Source Category 1A4a 'Commercial/Institutional Sector' for the ATULBD within 1999-2015

	1999	2000	2001	2002	2003	2004	2005	2006	2007
Natural Gas, million m³	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**	**%**
Natural Gas, million m³	19.8	16.1	37.7	209.2	202.3	99.9	105.1	27.0	297.1
Other bituminous coal, kt	0.0620	0.0626	0.01270	0.0412	0.0087	0.0356	0.0127	0.0050	
Residual Fuel Oil, kt	0.0868	0.1369	0.1063	0.0399	0.0400	0.0430	0.0620	0.0283	
LPG, kt				0.0026	0.0011	0.0012	0.0011	0.0012	

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; 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 A3-1.2.5: Fuel Consumption within the Source Category 1A4b 'Residential Sector' for the ATULBD within 1995-2015

	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 m³ *	216.6	163.4	354.8	321.6	293.2	NA	196.4	175.4	176.6	162.8	164.8
Natural Gas, million m³ **					294.2	217.9	196.4	163.5	176.6	132.0	144.2
	2006	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**%**
LPG, kt *	0.5000	0.4486	0.4962	0.3869	0.5798	0.6060	0.4770	0.3836	0.3525	0.2753	-89.0
Natural Gas, million m³ *	161.2	150.8	150.0	156.0	174.3	184.5	184.1	180.6	180.1	175.0	-19.2
Natural Gas, million m³ **	157.0	149.2	148.7	154.7	173.0	184.5	184.1	180.6	180.1	175.4	
Fire Wood, thousand m³ ***				10.1793	10.8175	9.2527	5.5379	4.8690	7.6844	10.9011	

Source: * Statistical Yearbooks of the ATULBD for 2000 (page 22), 2006 (page 22), 2009 (page 23), 2010 (page 23), 2011 (page 23), 2012 (page 23); 2013 (page 23); Press-Release «The state of housing and communal services of the Republic for 2011-2015»; ** 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; *** 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 A3-1.2.6: Fuel Consumption within the Source Category 1A4c 'Agriculture/ Forestry/ Fishing Sectors' for the ATULBD within 1995-2015

	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
Diesel Oil, kt *	26.7732	21.4371	28.5957	22.0698	20.4030	14.5584	14.3541	11.1636	7.7409	6.9372	4.8546
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.m³ **									0.9	0.7	0.4

	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	%
Diesel Oil, kt *	4.0239	2.9331	2.6505	3.5037	7.4195	8.3934	9.2448	10,5	10,2465	9,717	-93,4
Gasoline, kt *	0.5740	0.3980	0.3340	0.4230	0.6460	0.582	0.613	0,849	0,721	0,6431	-63,8
Natural Gas, mln.m³ **	0.1	0.0	0.1	0.0	0.1	0,1	0,2	0	0	0	
Residual Fuel Oil, kt ***			0.0032	0.0032	0.0032	0.193	0.0032	0,0032	0	0	
Coal, kt ***			0.0153	0.0115	0.0090	0.031	0.024	0,024	0,024	0,022	

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); ** 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; *** 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 A3-1.7: Fuel Consumption within the Source Category 1A5 'Other' (Other Works and Needs) for the ATULBD within 1995-2015

	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	%
Lubricants, kt *	0.1480	0.1530	0.0790	0.1070	0.1944	0.1930	0.2010	0.2042	0.2132	0.1997	-81.2
Bituminous coal, kt **			2.0299	1.1388	1.1101	0.9823	0.6502	0.6441	0.3769	0.4485	
Residual Fuel Oil, kt **			0.048	0.036							

Sursa: * 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); ** State Statistical Service of the Transnistrian Moldovan Republic (2016), *Socio-economic development of the TMR for 2015.* Tiraspol, 2016, 81 p.; State Statistical Service of the Transnistrian Moldovan Republic (2015), *Socio-economic development of the TMR for 2014.* Tiraspol, 2015.81 p.; State Statistical Service of the Transnistrian Moldovan Republic (2013), *Socio-economic development of the TMR for 2012.* Tiraspol, 2013.85 p.; State Statistical Service of the Transnistrian Moldovan Republic (2012), *Socio-economic development of the TMR, 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 Industrial Processes and Product Use Sector

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 1990-2015 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
2011-2015	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 Agriculture Sector

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, Rodionov, 1997; Bucataru, Radionov, Urzica, 2002; Bivol, Ciubotaru, 2005) (Table A3-3.1). 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*[130] has been crossbred as a result of crossbreeding of *Steppe Red* and *Simmental* with the improved races *Spotted Black* and *Holstein*.

[130] 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

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

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). 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).

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

Sheep

The sheep bred in the Republic of Moldova are represented by races *Karakul, Tsigaie, Turcana* and *Frisian* (Table A3-3.3). The most typical colours 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).

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

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), colour 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,

fattening has a daily weight gain of 1200 g, slaughtering efficiency being of 55%.

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[131] 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 fur	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).

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).

[131] 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 demandi g in terms of feeding and maintenance conditions, has a greater working power than a horse, but is sterile.

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 LULUCF Sector

Annex 3-4.1: Additional Information Associated with 4A "Forest Land"

Annex 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	386395.4	57152.1	46289.2	7240.8	5071.2	4707.1	6859.1	30290.6	13666.8
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	1457791	241111	178467	6875	28262	30540	16046	134292	87863
Average volume per standing wood, m^3/ha	118	184	234	119	174	106	90	195	238
Forest fund per standing wood, m^3	45407785	10536945	10843035	863755	881432	498840	615719	5909773	3256044
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	386395.4	20576.9	6261.9	11762.7	127902.7	6033.0	3886.9	38257.4	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	1457791	102138	17927	32332	414757	28455	18012	119572	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	45407785	3131245	386897	403949	3841412	534891	450882	3222509	30457
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)[132] 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).

[132] 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.

In 2010, the methodology was updated[133], 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.

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

[133] 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.

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:

$$B_C \pm = (V_I - C_O) \bullet Area_{(T)}$$

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:

$$V = V_1 + V_2$$

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:

$$V_1 = [(Crop_{(T)} \bullet R_{AG\,(T)} \bullet (1-Frac_{Remove\,(T)}) + Crop_{(T)} \bullet R_{BG\,(T)}) \bullet k_1] / 1.724$$ [134]

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;
DRY – dry matter fraction of harvested crop *T*, kg d.m./t of yield[135];
$R_{AG\,(T)}$ – ratio of above-ground residues dry matter to harvested yield for crop *T* (Crop(*T*)), $t.d.m_{AG}/t.d.m$[136];
$R_{BG\,(T)}$ – ratio of below-ground residues to harvested yield for crop *T*, $t.d.m_{BG}/t\ dm$[137];
$Frac_{Remove\,(T)}$ – fraction of above-ground residues of crop *T* removed and used for other purposes[138]
k_1 – coefficient reflecting the humificatin of crop residues[139];
1.724 – coefficient reflecting the conversion from humus to carbon[140].

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

[134] Arinushkina E.V. *Guidelines for Chemical Analysis of Soils* (in Russian). Moscow, Moscow State University Press, 1961. p.136.
[135] *2006, IPCC Guidelines*, Volume 4, Chapter 11, Table 11.2, Page 11.17.
[136] 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.
[137] *2006 IPCC Guidelines*, Volume 4, Chapter 11, Table 11.2, Page 11.17.
[138] Expert opinion, Prof. Valerian Cerbari, Institute of Pedology, Agrochemistry and Soil Protection „Nicolae Dimo"
[139] Rusu M., Mărghitaş M., Oroian I., Mihăilescu T., Dumitraş A. (2005), *Agrochemistry Treaty* (in Romanian). Bucuresti, Publishing House Ceres, 2005. 672 p.
[140] Arinushkina E.V. *Guidelines for Chemical Analysis of Soils* (in Russian). Moscow, Moscow State University Press, 1961. p 136.

Crop	DRY	$R_{AG(T)}$	$R_{BG(T)}$	$Frac_{Remove(T)}$	k_1
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);

$$F_{ON} = F_{AM} + F_{SEW} + F_{COMP} + F_{OOA}$$

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)[141];
1.724 – coefficient reflecting the transition from humus to carbon[142].

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:

$$E_{r\,(T)} = (\text{Yield Fresh}_{(T)} \bullet k_{3\,(T)}) / 10^3$$

Where:

[141] 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.
[142] Arinushkina E.V. *Guidelines for Chemical Analysis of Soils* (in Russian). Moscow, Moscow State University Press, 1961. p 136.

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)[143].

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
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:

$$E_O = F_{ON} \bullet k_5$$

[143] 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.

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:

$$F_{CR} = (Crop_{(T)} \bullet R_{AG(T)} \bullet (1-Frac_{Remove(T)}) + Crop_{(T)} \bullet R_{BG(T)}) \bullet (P_{CR}/10^2) \bullet (k_6/10^2)$$

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*)), $t.d.m_{AG}/t.d.m.$[144];
$R_{BG(T)}$ – ratio of below-ground residues to harvested yield for crop *T*, $t.d.m_{BG}/t\ d.m.$[145];
$Frac_{Remove(T)}$ – fraction of above-ground residues of crop *T* removed and used for other purposes[146];
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)

[144] 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
[145] *2006 IPCC Guidelines*, Volume 4, Chapter 11, Table 11.2, Page 11.17.
[146] 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	Amount of used N from crop residues represents 25 per cent from the total
Winter rye	1.05	
Winter barley	0.80	
Oat	0.60	
Millet	1.25	
Buckwheat	0.60	
Leguminous crops	2.08	
Grain maize	1.08	
Grain sorghum	1.00	
Other cereal crops	0.60	
Sugar beet	1.65	
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	
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:

$$E_{S(T)} = \text{Yield Fresh}_{(T)} \bullet (k_{7\,(T)} / 10^3) \bullet (k_{8\,(T)} / 10^2)$$

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[147] (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[148] (Table 3-4.2.10).

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

[147] 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.
[148] Idem.

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 or 2013), caused in particular by favourable 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 2015 of carbon returned to soil with manure (by 50.6 per cent), respectively with above- and below-ground crop residues (by 67.5 per cent), led to a shift from a positive carbon balance (+0.32 t/ha in 1990, the period before the agrarian reform in the country) to a deep negative balance (maximum -0.62 t/ha in 2008) (Table 3-4.2.11).

Table 3-4.2.11: Carbon Balance in Cropland Remaining Cropland in the RM within 1990-2015

Indicators	1990	1991	1992	1993	1994	1995	1996	1997	1998
Carbon introduced in soil with organic fertilizers, kt	288.3	319.1	224.7	259.5	120.8	142.6	112.6	141.4	121.7
Carbon introduced in soil with above- and below-ground residues, kt	445.8	390.6	370.1	268.8	262.0	249.1	263.8	209.0	201.4
Carbon losses from soil due to humus mineralization, kt	-310.9	-308.1	-265.1	-700.8	-416.0	-755.0	-631.2	-1 014.4	-844.1
Carbon balance in cropland remaining cropland, kt	423.2	401.5	329.7	-172.5	-33.1	-363.3	-254.8	-664.0	-521.0
Carbon balance in cropland remaining cropland, t/ha	0.32	0.30	0.24	-0.13	-0.02	-0.27	-0.19	-0.48	-0.38
Indicators	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**
Carbon introduced in soil with organic fertilizers, kt	119.3	104.4	118.5	117.9	103.0	135.2	140.9	147.0	64.9
Carbon introduced in soil with above- and below-ground residues, kt	188.5	164.4	167.1	167.1	173.8	159.7	179.0	197.7	151.9
Carbon losses from soil due to humus mineralization, kt	-807.6	-721.6	-884.2	-878.9	-714.7	-1 032.7	-1 013.8	-997.6	-330.2
Carbon balance in cropland remaining cropland, kt	-499.9	-452.8	-598.7	-593.9	-437.9	-737.8	-693.8	-652.8	-113.5
Carbon balance in cropland remaining cropland, t/ha	-0.36	-0.33	-0.44	-0.43	-0.32	-0.54	-0.49	-0.45	-0.08
Indicators	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**%**
Carbon introduced in soil with organic fertilizers, kt	171.8	122.9	155.8	157.2	86.1	166.2	190.6	142.4	-50.6
Carbon introduced in soil with above- and below-ground residues, kt	148.6	162.5	166.9	152.8	138.9	131.3	145.7	144.8	-67.5
Carbon losses from soil due to humus mineralization, kt	-1 207.1	-828.8	-982.2	-1 023.7	-434.3	-1 059.6	-1 090.5	-875.1	181.5
Carbon balance in cropland remaining cropland, kt	-886.7	-543.5	-659.4	-713.7	-209.3	-762.1	-754.2	-588.0	-238.9
Carbon balance in cropland remaining cropland, t/ha	-0.62	-0.38	-0.46	-0.50	-0.14	-0.46	-0.50	-0.38	-221.2

To be noted that if the carbon balance in the arable land represented in average -0.29 t/ha per year between 1990 and 2002, for the 2003-2015 time series it already reached an average of circa -0.41 t/ha per year.

In comparison, Table 3-4.2.12 presents the results obtained using the respective assessment method if considering the entire area of arable lands in the country between 1990 and 2015.

Table 3-4.2.12: Carbon Balance in Cropland (total area of arable lands) in the Republic of Moldova within 1990-2015 periods

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	162.2	182.2	143.1	177.5	150.0
Carbon introduced in soil with above- and below-ground residues, kt	563.7	512.3	463.8	373.0	355.3	318.1	334.4	261.6	248.0
Carbon losses from soil due to humus mineralization, kt	-368.6	-379.7	-317.4	-1 031.6	-602.7	-959.4	-799.9	-1 271.7	-1 038.7
Carbon balance in cropland (total area of arable lands), kt	559.7	542.0	427.8	-295.4	-85.1	-459.1	-322.5	-832.7	-640.7
Carbon balance in cropland (total area of arable lands), t/ha	0.33	0.32	0.25	-0.16	-0.05	-0.27	-0.19	-0.48	-0.37

Indicators	1999	2000	2001	2002	2003	2004	2005	2006	2007
Carbon introduced in soil with organic fertilizers, kt	142.3	128.4	148.5	148.3	119.4	165.3	169.4	157.3	69.4
Carbon introduced in soil with above- and below-ground residues, kt	224.4	201.8	206.8	210.0	201.0	195.1	205.4	210.8	162.4
Carbon losses from soil due to humus mineralization, kt	-962.0	-886.7	-1 108.2	-1 105.2	-828.5	-1 261.8	-1 223.9	-1 067.7	-352.4
Carbon balance in cropland (total area of arable lands), kt	-595.3	-556.6	-752.9	-746.8	-508.1	-901.4	-849.1	-699.6	-120.6
Carbon balance in cropland (total area of arable lands), t/ha	-0.36	-0.33	-0.44	-0.43	-0.32	-0.54	-0.53	-0.45	-0.08
Indicators	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**%**
Carbon introduced in soil with organic fertilizers, kt	184.2	134.9	174.8	175.0	97.3	189.2	213.5	155.6	-57.3
Carbon introduced in soil with above- and below-ground residues, kt	159.1	178.0	183.4	167.6	154.5	146.9	159.7	155.4	-72.4
Carbon losses from soil due to humus mineralization, kt	-1 292.7	-908.4	-1 101.7	-1 144.4	-495.9	-1 209.0	-1 227.5	-957.8	159.9
Carbon balance in cropland (total area of arable lands), kt	-949.4	-595.5	-743.4	-801.8	-244.1	-872.9	-854.3	-646.9	-215.6
Carbon balance in cropland (total area of arable lands), t/ha	-0.61	-0.38	-0.47	-0.51	-0.15	-0.53	-0.52	-0.39	-218.8

Tables 3-4.2.13 and 3-4.2.14, present other relevant information in the calculation process, including the areas of croplands remaining croplands, respectively total area of cropland, as well as data on crop yields recorded within 1990-2015 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.

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: 1990-2015. Greenhouse Gas Sources and Sinks in the Republic of Moldova)

Document: National Inventory Report: 1990-2015. Greenhouse Gas Sources and Sinks in the Republic of Moldova

Stage of Report Preparation: final draft report

Highlight all categories subject to verification verificării: 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 addresss: 156A Mitropolit Dosoftei Str., Office No. 37, MD 2004, Chisinauu, 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 responsability for the processs of inventory quality assurance and control at the sectoral level (separate chapter of the National Inventory Report for 1990-2015). 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: 1990-2015. 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: 1990-2015. Greenhouse Gas Sources and Sinks in the Republic of Moldova.

Chapter: ____________________

No.	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 - adresses should not include hiperlinks, 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 identing 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: 1990-2015

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), asigurând realizarea controlului/ verificărilor efectuate, precum și a acțiunilor de corecție luate. Formularul se completează electronic. Odată completat, formularul urmează a fi expediat liderului echipei de inventariere a emisiilor de gaze cu efect de seră pe adresa electronică: <clima@clima.md>, împreună cu copiile pe hârtie, semnate și prezentate personal la adresa: str. Mitropolit Dosoftei nr. 156A, biroul nr. 37, MD 2004, Chișinău, Republica 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 responsability for the processs of inventory quality assurance and control at the sectoral level (separate chapter of the National Inventory Report for 1990-2015). 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)	Date	Individual (first name, last name)	Date	
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						

Verification and Quality Control Form for Individual Source Categories

Source Category: ____________________

Quality Control Activities/ Verifications and Quality Control Procedures		Date	Check Completed		Corrective Action		Supporting documents (provide reference)
			Individual (first name, last name)	Date	Individual (first name, last name)	Date	
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							

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)	Date	Individual (first name, last name)	Date	
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: 1990-2015

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), asigurând realizarea controlului/ verificărilor efectuate, precum și a acțiunilor de corecție luate. Formularul se completează electronic. Odată completat, formularul urmează a fi expediat liderului echipei de inventariere a emisiilor de gaze cu efect de seră pe adresa electronică: <clima@clima.md>, împreună cu copiile pe hârtie, semnate și prezentate personal la adresa: str. Mitropolit Dosoftei nr. 156A, biroul nr. 37, MD 2004, Chișinău, Republica 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 responsability for the processs of inventory quality assurance and control at the sectoral level (separate chapter of the National Inventory Report for 1990-2015). 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	Date	Check Completed		Corrective Action		Supporting documents (provide reference)
			Individual (first name, last name)	Date	Individual (first name, last name)	Date	
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						

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)	Date	Individual (first name, last name)	Date	
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 2015

Category	Pollutant	Base Year Emissions (1990)	Year t Emissions (2015)	Activity Data Uncertainty (1)	Emission Factor Uncertainty (1)	Combined Uncertainty	Contribution to variability by category in 2015	Type A Sensibility	Type B Sensibility	Uncertainty Introduced in Trend in Sectoral Emissions Introduced by EF Uncertainty (2)	Uncertainty Introduced in Trend in Sectoral Emissions Introduced by AD Uncertainty (3)	Uncertainty Introduced in Trend in Sectoral 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	$\left\|\frac{D}{\sum C}\right\|$	I*F Note C	J*E*sqrt(2) Note D	K^2 + L^2
1A1. Energy Industries	CO_2	19338.0195	4141.2201	5	5	7.0711	6.9496	0.0002	0.1102	0.0009	0.7792	0.6072
1A1. Energy Industries	CH_4	11.0724	1.7930	5	50	50.2494	0.0001	0.0020	0.0000	0.1010	0.0003	0.0102
1A1. Energy Industries	N_2O	49.2565	4.0598	3	50	50.0899	0.0003	0.0009	0.0001	0.0456	0.0005	0.0021
1A2. Manufacturing Industries and Construction	CO_2	2206.2753	665.6173	5	5	7.0711	0.1795	0.0003	0.0177	0.0016	0.1252	0.0157
1A2. Manufacturing Industries and Construction	CH_4	2.4544	1.0172	5	50	50.2494	0.0000	0.0014	0.0000	0.0714	0.0002	0.0051
1A2. Manufacturing Industries and Construction	N_2O	5.0856	1.6577	3	50	50.0899	0.0001	0.0001	0.0000	0.0030	0.0002	0.0000
1A3. Transport	CO_2	4346.0289	2158.1164	5	5	7.0711	1.8873	0.0009	0.0574	0.0044	0.4061	0.1649
1A3. Transport	CH_4	32.6324	9.8514	5	40	40.3113	0.0013	0.0011	0.0003	0.0434	0.0019	0.0019
1A3. Transport	N_2O	103.1032	35.0077	5	50	50.2494	0.0251	0.0099	0.0009	0.4943	0.0066	0.2444
1A4. Other Sectors	CO_2	7291.5661	1790.2120	5	5	7.0711	1.2987	0.0003	0.0476	0.0013	0.3368	0.1135
1A4. Other Sectors	CH_4	289.1794	108.9172	5	50	50.2494	0.2428	0.0029	0.0029	0.1455	0.0205	0.0216
1A4. Other Sectors	N_2O	27.6563	16.9359	3	50	50.0899	0.0058	0.0002	0.0005	0.0075	0.0019	0.0001
1A5. Other	CO_2	113.9722	2.2468	5	5	7.0711	0.0000	0.0000	0.0001	0.0000	0.0004	0.0000
1A5. Other	CH_4	0.2726	0.0059	5	50	50.2494	0.0000	0.0153	0.0000	0.7634	0.0000	0.5828
1A5. Other	N_2O	1.3253	0.0215	3	50	50.0899	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
1B2. Fugitive Emissions from Oil and Natural Gas	CO_2	0.6377	1.6581	25	25	35.3553	0.0000	0.0000	0.0000	0.0000	0.0016	0.0000
1B2. Fugitive Emissions from Oil and Natural Gas	CH_4	812.2415	566.6016	25	25	35.3553	3.2524	0.0000	0.0151	0.0000	0.5331	0.2841
1B2. Fugitive Emissions from Oil and Natural Gas	N_2O	0.0002	0.0027	25	25	35.3553	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
2A1. Cement Production	CO_2	971.6967	443.2441	2	3	3.6056	0.0207	0.0000	0.0118	0.0000	0.0334	0.0011
2A2. Lime Production	CO_2	232.4996	21.7547	10	2	10.1980	0.0004	0.0000	0.0006	0.0000	0.0082	0.0001
2A3. Glass Production	CO_2	25.2212	27.9127	10	10	14.1421	0.0013	0.0000	0.0007	0.0000	0.0105	0.0001
2A4. Other Process Uses of Carbonates	CO_2	86.6865	16.7826	10	5	11.1803	0.0003	0.0000	0.0004	0.0000	0.0063	0.0000
2C1. Iron and Steel Production	CO_2	28.5023	17.2258	5	10	11.1803	0.0003	0.0000	0.0005	0.0000	0.0032	0.0000
2D1. Lubricant Use	CO_2	23.4455	4.8162	5	50	50.2494	0.0005	0.0000	0.0001	0.0000	0.0009	0.0000
2D2. Paraffin Wax Use	CO_2	0.2787	0.0587	20	100	101.9804	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
2D3. Solvent Use	CO_2	204.1460	79.2460	20	35	40.3113	0.0827	0.0000	0.0021	0.0000	0.0596	0.0036
2D4. Other – Urea-Based Catalysts	CO_2	5.3387	2.6910	20	2	20.0998	0.0000	0.0000	0.0001	0.0000	0.0020	0.0000
2F1. Refrigeration and Air Conditioning	HFCs		77.3604	20	50	53.8516	0.1407	0.0000	0.0021	0.0000	0.0582	0.0034
2F2. Foam Blowing Agents	HFCs		101.8751	30	30	42.4264	0.1514	0.0000	0.0027	0.0000	0.1150	0.0132
2F4. Aerosols	HFCs		0.2020	5	5	7.0711	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
2G1. Electrical Equipment	SF_6		1.0575	5	20	20.6155	0.0000	0.0000	0.0000	0.0000	0.0002	0.0000
2G1. Electrical Equipment	PFC		0.0403	5	20	20.6155	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
2G3. N_2O from Product Use (medical application)	N_2O	0.0197		5	3	5.8310	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
2G4. Other (Tobacco Combustion and Use of Shoes)	CO_2	3.1787	0.7840	5	50	50.2494	0.0000	0.0000	0.0000	0.0000	0.0001	0.0000
3A. Enteric Fermentation	CH_4	2190.6944	654.6016	10	20	22.3607	1.7364	0.0000	0.0174	0.0000	0.2463	0.0607
3B. Manure Management	CH_4	494.8175	70.3618	10	30	31.6228	0.0401	0.0000	0.0019	0.0000	0.0265	0.0007
3Ba. Direct N_2O from Manure Management	N_2O	871.9076	292.0217	30	100	104.4031	7.5334	0.0000	0.0078	0.0000	0.3297	0.1087
3Bb. Indirect N_2O from Manure Management	N_2O	244.7103	60.0491	30	150	152.9706	0.6838	0.0000	0.0016	0.0000	0.0678	0.0046

Category	Pollutant	Base Year Emissions (1990)	Year t Emissions (2015)	Activity Data Uncertainty (1)	Emission Factor Uncertainty (1)	Combined Uncertainty	Contribution to variability by category in 2015	Type A Sensibility	Type B Sensibility	Uncertainty Introduced in Trend in Sectoral Emissions Introduced by EF Uncertainty (2)	Uncertainty Introduced in Trend in Sectoral Emissions Introduced by AD Uncertainty (3)	Uncertainty Introduced in Trend in Sectoral 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
3D.a.1. Inorganic N Fertilizers	N_2O	431.2911	181.1301	5	6	7.8102	0.0162	0.0000	0.0048	0.0000	0.0341	0.0012
3D.a.2. Organic N Fertilizers	N_2O	259.7852	74.5378	30	6	30.5941	0.0421	0.0000	0.0020	0.0000	0.0841	0.0071
3D.1.3. Urine and Dung Deposited by Grazing Animals	N_2O	53.8411	49.1035	30	50	58.3095	0.0664	0.0000	0.0013	0.0000	0.0554	0.0031
3D.a.4. Crop Residues	N_2O	162.9926	88.9425	5	25	25.4951	0.0417	0.0000	0.0024	0.0000	0.0167	0.0003
3D.a.5. Mineralization/immobilization associated with loss/gain of soil organic matter	N_2O	161.3093	419.2026	5	25	25.4951	0.9257	0.0000	0.0112	0.0000	0.0789	0.0062
3D.b.1. Atmospheric Deposition of NO_x and NH_4	N_2O	102.1793	39.6240	70	150	165.5295	0.3487	0.0000	0.0011	0.0000	0.1044	0.0109
3D.b.2. Nitrogen Leaching and Run-off	N_2O	236.4399	179.2867	75	150	167.7051	7.3269	0.0000	0.0048	0.0000	0.5060	0.2561
3H. Urea Application	CO_2	0.5820	5.8323	30	50	58.3095	0.0009	0.0000	0.0002	0.0000	0.0066	0.0000
4A.1. Forest Land Remaining Forest Land	CO_2	-1591.2275	-1511.5589	15	5	15.8114	4.6294	0.0000	0.0402	0.0000	0.8532	0.7280
4A.2. Land Converted to Forest Land	CO_2	-952.5127	-515.7307	15	5	15.8114	0.5389	0.0000	0.0137	0.0000	0.2911	0.0847
4A.2. Land Converted to Forest Land (Non-CO_2 emissions from forest vegetation fires)	CH_4	0.2237	0.6633	10	30	31.6228	0.0000	0.0000	0.0000	0.0000	0.0002	0.0000
4A.2. Land Converted to Forest Land (Non-CO_2 emissions from forest vegetation fires)	N_2O	0.1475	0.4374	10	50	50.9902	0.0000	0.0000	0.0000	0.0000	0.0002	0.0000
4B.1 Cropland Remaining Cropland	CO_2	-1583.7249	-1711.3517	10	10	14.1421	4.7472	0.0000	0.0455	0.0000	0.6440	0.4147
4B.1. Cropland Remaining Cropland (Non-CO_2 emissions from stubble fields burning)	CH_4	2.4461	0.0448	10	30	31.6228	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
4B.1. Cropland Remaining Cropland (Non-CO_2 emissions from stubble fields burning)	N_2O	56.8256	57.5206	10	50	50.9902	0.0697	0.0000	0.0015	0.0000	0.0216	0.0005
4B.2. Land Converted to Cropland	CO_2	1005.5978	983.9336	10	10	14.1421	1.5693	0.0000	0.0262	0.0000	0.3703	0.1371
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
4C.2. Land Converted to Grassland	CO_2	-2850.2941	-306.2291	15	10	18.0278	0.2470	0.0000	0.0081	0.0000	0.1729	0.0299
4D.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
4D.2. Land Converted to Wetlands	CO_2	-17.4403	0.0000	10	10	14.1421	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
4E.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
4E.2. Land Converted to Settlements	CO_2	84.7480	38.8867	10	10	14.1421	0.0025	0.0000	0.0010	0.0000	0.0146	0.0002
4E.2. Land Converted to Settlements (non-CO2 emissions)	N_2O	3.1350	0.5023	10	50	50.9902	0.0000	0.0000	0.0000	0.0000	0.0002	0.0000
4F.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
4F.2. . Land Converted to Other Land	CO_2	152.4756	60.8445	10	10	14.1421	0.0060	0.0000	0.0016	0.0000	0.0229	0.0005
4H. Harvested Wood Products	CO_2	-130.0504	56.6377	30	10	31.6228	0.0260	0.0000	0.0015	0.0000	0.0639	0.0041
5A. Solid Waste Disposal	CH_4	1046.7277	1087.1519	30	40	50.0000	23.9471	0.0000	0.0289	0.0000	1.2273	1.5064
5C. Incineration and Open Burning of Waste	CO_2	17.1060	16.1442	40	25	47.1699	0.0047	0.0000	0.0004	0.0000	0.0243	0.0006
5C. Incineration and Open Burning of Waste	CH_4	8.7818	8.2516	40	50	64.0312	0.0023	0.0000	0.0002	0.0000	0.0124	0.0002
5C. Incineration and Open Burning of Waste	N_2O	2.4157	2.2698	40	100	107.7033	0.0005	0.0000	0.0001	0.0000	0.0034	0.0000
5D. Wastewater Treatment and Discharge	CH_4	814.7250	354.1764	30	40	50.0000	2.5416	0.0000	0.0094	0.0000	0.3998	0.1599
5D. Wastewater Treatment and Discharge	N_2O	87.9499	70.6672	30	50	58.3095	0.1376	0.0000	0.0019	0.0000	0.0798	0.0064
End												
Total		**37580.3987**	**11107.9488**				**71.4735**					**5.6076**
Total Uncertainties						**Total Sectoral Uncertainties %:**	**8.4542**				**Uncertainties by trend %:**	**2.3680**

Annex 5-2: Summary of Direct Greenhouse Gas Uncertainties

Annex 5-2.1: Carbon Dioxide Uncertainties (CO_2)

Category	Pollutant	Base Year Emissions (1990)	Year t Emissions (2015)	Activity Data Uncertainty (1)	Emission Factor Uncertainty (1)	Combined Uncertainty	Contribution to variability by category in 2015	Type A Sensibility	Type B Sensibility	Uncertainty Introduced in Trend in Sectoral Emissions Introduced by EF Uncertainty (2)	Uncertainty Introduced in Trend in Sectoral Emissions Introduced by AD Uncertainty (3)	Uncertainty Introduced in Trend in Sectoral 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
1A1. Energy Industries	CO_2	19338.0195	4141.2201	5	5	7.0711	20.3519	0.0057	0.1427	0.0283	1.0093	1.0195
1A2. Manufacturing Industries and Construction	CO_2	2206.2753	665.6173	5	5	7.0711	0.5258	0.0002	0.0229	0.0009	0.1622	0.0263
1A3. Transport	CO_2	4346.0289	2158.1164	5	5	7.0711	5.5271	0.0013	0.0744	0.0064	0.5260	0.2767
1A4. Other sectors	CO_2	7291.5661	1790.2120	5	5	7.0711	3.8033	0.0006	0.0617	0.0029	0.4363	0.1904
1A5. Other	CO_2	113.9722	2.2468	5	5	7.0711	0.0000	0.0000	0.0001	0.0000	0.0005	0.0000
1B2. Fugitive Emissions from Oil and Natural Gas	CO_2	0.6377	1.6581	25	25	35.3553	0.0001	0.0000	0.0001	0.0000	0.0020	0.0000
2A1. Cement Production	CO_2	971.6967	443.2441	2	3	3.6056	0.0606	0.0000	0.0153	0.0000	0.0432	0.0019
2A2. Lime Production	CO_2	232.4996	21.7547	10	2	10.1980	0.0012	0.0000	0.0007	0.0000	0.0106	0.0001
2A3. Glass Production	CO_2	25.2212	27.9127	10	10	14.1421	0.0037	0.0000	0.0010	0.0000	0.0136	0.0002
2A4. Other Purposes for Carbonates	CO_2	86.6865	16.7826	10	5	11.1803	0.0008	0.0000	0.0006	0.0000	0.0082	0.0001
2C1. Iron and Steel Production	CO_2	28.5023	17.2258	5	10	11.1803	0.0009	0.0000	0.0006	0.0000	0.0042	0.0000
2D1. Lubricant Use	CO_2	23.4455	4.8162	5	50	50.2494	0.0014	0.0000	0.0002	0.0000	0.0012	0.0000
2D2. Paraffin Wax Use	CO_2	0.2787	0.0587	20	100	101.9804	0.0000	0.0000	0.0000	0.0000	0.0001	0.0000
2D3. Solvent Use	CO_2	204.1460	79.2460	20	35	40.3113	0.2422	0.0000	0.0027	0.0000	0.0773	0.0060
2D4. Other – Urea Based Catalysts	CO_2	5.3387	2.6910	20	2	20.0998	0.0001	0.0000	0.0001	0.0000	0.0026	0.0000
2G4. Other Product Manufacture and Use (tobacco combustion and use of shoes)	CO_2	3.1787	0.7840	5	50	50.2494	0.0000	0.0000	0.0000	0.0000	0.0002	0.0000
3H. Urea Application	CO_2	0.5820	5.8323	30	50	58.3095	0.0027	0.0000	0.0002	0.0000	0.0085	0.0001
4A.1. Forest Land Remaining Forest Land	CO_2	-1591.2275	-1511.5589	15	5	15.8114	13.5571	0.0000	0.0521	0.0000	1.1052	1.2215
4A.2. Land Converted to Forest Land	CO_2	-952.5127	-515.7307	15	5	15.8114	1.5782	0.0000	0.0178	0.0000	0.3771	0.1422
4B.1. Cropland Remaining Cropland	CO_2	-1583.7249	-1711.3517	10	10	14.1421	13.9023	0.0000	0.0590	0.0000	0.8342	0.6959
4B.2. Land Converted to Cropland	CO_2	1005.5978	983.9336	10	10	14.1421	4.5956	0.0000	0.0339	0.0000	0.4796	0.2300
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
4C.2. Land Converted to Grassland	CO_2	-2850.2941	-306.2291	15	10	18.0278	0.7234	0.0000	0.0106	0.0000	0.2239	0.0501
4D.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
4D.2. Land Converted to Wetlands	CO_2	-17.4403	0.0000	10	10	14.1421	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
4E.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
4E.2. Land Converted to Settlements	CO_2	84.7480	38.8867	10	10	14.1421	0.0072	0.0000	0.0013	0.0000	0.0190	0.0004
4F.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
4F.2. . Land Converted to Other Land	CO_2	152.4756	60.8445	10	10	14.1421	0.0176	0.0000	0.0021	0.0000	0.0297	0.0009
4H. Harvested Wood Products	CO_2	-130.0504	56.6377	30	10	31.6228	0.0761	0.0000	0.0020	0.0000	0.0828	0.0069
5C. Incineration and Open Burning of Waste	CO_2	17.1060	16.1442	40	25	47.1699	0.0138	0.0000	0.0006	0.0000	0.0315	0.0010
END												
Total		**29012.7530**	**6490.9952**				**64.9929**					**3.8700**
Total Uncertainties						**Total Sectoral Uncertainties %:**	**8.0618**				**Uncertainties by trend %:**	**1.9672**

Annex 5-2.2: Methane Uncertainties (CH_4)

Category	Pollutant	Base Year Emissions (1990)	Year t Emissions (2015)	Activity Data Uncertainty (1)	Emission Factor Uncertainty (1)	Combined Uncertainty	Contribution to variability by category in 2015	Type A Sensibility	Type B Sensibility	Uncertainty Introduced in Trend in Sectoral Emissions Introduced by EF Uncertainty (2)	Uncertainty Introduced in Trend in Sectoral Emissions Introduced by AD Uncertainty (3)	Uncertainty Introduced in Trend in Sectoral 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
1A1. Energy Industries	CH_4	11.0724	1.7930	5	50	50.2494	0.0010	0.0312	0.0003	1.5578	0.0022	2.4268
1A2. Manufacturing Industries and Construction	CH_4	2.4544	1.0172	5	50	50.2494	0.0003	0.0062	0.0002	0.3090	0.0013	0.0955
1A3. Transport	CH_4	32.6324	9.8514	5	40	40.3113	0.0192	0.0013	0.0017	0.0501	0.0122	0.0027
1A4. Other sectors	CH_4	289.1794	108.9172	5	50	50.2494	3.6532	0.0106	0.0191	0.5311	0.1350	0.3003
1A5. Other	CH_4	0.2726	0.0059	5	50	50.2494	0.0000	0.0868	0.0000	4.3414	0.0000	18.8479
1B2. Fugitive Emissions from Oil and Natural Gas	CH_4	812.2415	566.6016	25	25	35.3553	48.9430	0.0000	0.0993	0.0000	3.5106	12.3243
3A. Enteric Fermentation	CH_4	2190.6944	654.6016	10	20	22.3607	26.1306	0.0000	0.1147	0.0000	1.6223	2.6320
3B. Manure Management	CH_4	494.8175	70.3618	10	30	31.6228	0.6038	0.0000	0.0123	0.0000	0.1744	0.0304
4A.2. Land Converted to Forest Land (Non-CO_2 emissions from forest vegetation fires)	CH_4	0.2237	0.6633	10	30	31.6228	0.0001	0.0000	0.0001	0.0000	0.0016	0.0000
4B.1. Cropland Remaining Cropland (Non-CO_2 emissions from stubble fields burning)	CH_4	2.4461	0.0448	10	30	31.6228	0.0000	0.0000	0.0000	0.0000	0.0001	0.0000
5A. Solid Waste Disposal	CH_4	1046.7277	1087.1519	30	40	50.0000	360.3670	0.0000	0.1905	0.0000	8.0830	65.3354
5C. Incineration and Open Burning of Waste	CH_4	8.7818	8.2516	40	50	64.0312	0.0340	0.0000	0.0014	0.0000	0.0818	0.0067
5D. Wastewater Treatment and Discharge	CH_4	814.7250	354.1764	30	40	50.0000	38.2476	0.0000	0.0621	0.0000	2.6333	6.9344
END												
Total		**5706.2689**	**2863.4377**				**477.9998**					**108.9362**
Total Uncertainties						**Total Sectoral Uncertainties %:**	**21.8632**				**Uncertainties by trend %:**	**10.4373**

Annex 5-2.3: Nitrous Oxide Uncertainties (N_2O)

Category	Pollutant	Base Year Emissions (1990)	Year t Emissions (2015)	Activity Data Uncertainty (1)	Emission Factor Uncertainty (1)	Combined Uncertainty	Contribution to variability by category in 2015	Type A Sensibility	Type B Sensibility	Uncertainty Introduced in Trend in Sectoral Emissions Introduced by EF Uncertainty (2)	Uncertainty Introduced in Trend in Sectoral Emissions Introduced by AD Uncertainty (3)	Uncertainty Introduced in Trend in Sectoral 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
1A1. Energy Industries	N_2O	49.2565	4.0598	3	50	50.0899	0.0167	0.0653	0.0014	3.2628	0.0060	10.6459
1A2. Manufacturing Industries and Construction	N_2O	5.0856	1.6577	3	50	50.0899	0.0028	0.0238	0.0006	1.1919	0.0025	1.4207
1A3. Transport	N_2O	103.1032	35.0077	5	50	50.2494	1.2507	0.1154	0.0122	5.7724	0.0865	33.3281
1A4. Other sectors	N_2O	27.6563	16.9359	3	50	50.0899	0.2909	0.0019	0.0059	0.0963	0.0251	0.0099
1A5. Other	N_2O	1.3253	0.0215	3	50	50.0899	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
1B2. Fugitive Emissions from Oil and Natural Gas	N_2O	0.0002	0.0027	25	25	35.3553	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
2G3. N_2O from Product Uses (medical application)	N_2O	0.0197		5	3	5.8310	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
3Ba. Direct N_2O from Manure Management	N_2O	871.9076	292.0217	30	100	104.4031	375.6731	0.0000	0.1021	0.0000	4.3299	18.7479
3Bb. Indirect N_2O from Manure Management	N_2O	244.7103	60.0491	30	150	152.9706	34.1021	0.0000	0.0210	0.0000	0.8904	0.7927
3D.a.1. Inorganic N Fertilizers	N_2O	431.2911	181.1301	5	6	7.8102	0.8088	0.0000	0.0633	0.0000	0.4476	0.2004
3D.a.2. Organic N Fertilizers	N_2O	259.7852	74.5378	30	6	30.5941	2.1018	0.0000	0.0260	0.0000	1.1052	1.2215
3D.1.3. Urine and Dung Deposited by Grazing Animals	N_2O	53.8411	49.1035	30	50	58.3095	3.3133	0.0000	0.0172	0.0000	0.7281	0.5301
3D.a.4. Crop Residues	N_2O	162.9926	88.9425	5	25	25.4951	2.0782	0.0000	0.0311	0.0000	0.2198	0.0483
3D.a.5. Mineralization/immobilization associated with loss/gain of soil organic matter	N_2O	161.3093	419.2026	5	25	25.4951	46.1652	0.0000	0.1465	0.0000	1.0359	1.0732
3D.b.1. Atmospheric Deposition of NO_x and NH_4	N_2O	102.1793	39.6240	70	150	165.5295	17.3868	0.0000	0.0138	0.0000	1.3709	1.8793
3D.b.2. Nitrogen Leaching and Run-off	N_2O	236.4399	179.2867	75	150	167.7051	365.3778	0.0000	0.0627	0.0000	6.6458	44.1671
4A.2. Land Converted to Forest Land (Non-CO_2 emissions from forest vegetation fires)	N_2O	0.1475	0.4374	10	50	50.9902	0.0002	0.0000	0.0002	0.0000	0.0022	0.0000
4B.1. Cropland Remaining Cropland (Non-CO_2 emissions from stubble fields burning)	N_2O	56.8256	57.5206	10	50	50.9902	3.4768	0.0000	0.0201	0.0000	0.2843	0.0808
4E.2. Land Converted to Settlements (Non-CO_2Emissions)	N_2O	3.1350	0.5023	10	50	50.9902	0.0003	0.0000	0.0002	0.0000	0.0025	0.0000
5C. Incineration and Open Burning of Waste	N_2O	2.4157	2.2698	40	100	107.7033	0.0242	0.0000	0.0008	0.0000	0.0449	0.0020
5D. Wastewater Treatment and Discharge	N_2O	87.9499	70.6672	30	50	58.3095	6.8623	0.0000	0.0247	0.0000	1.0478	1.0979
END												
Total		**2861.3769**	**1572.9806**				**858.9317**					**115.2457**
Total Uncertainties						**Total Sectoral Uncertainties %:**	**29.3075**				**Uncertainties by trend %:**	**10.7353**

Annex 5-3: Overall Inventory Uncertainty

Annex 5-3.1: Overall Inventory Uncertainty for Sector 1 „Energy"

	Category	Pollutant	Base Year Emissions (1990)	Year t Emissions (2015)	Activity Data Uncertainty (1)	Emission Factor Uncertainty (1)	Combined Uncertainty	Contribution to variability by category in 2015	Type A Sensibility	Type B Sensibility	Uncertainty Introduced in Trend in Sectoral Emissions Introduced by EF Uncertainty (2)	Uncertainty Introduced in Trend in Sectoral Emissions Introduced by AD Uncertainty (3)	Uncertainty Introduced in Trend in Sectoral Emissions
			kt CO_2 equivalent	kt CO_2 equivalent	%	%	%		%	%	%	%	%
			input data	input data	input data Note A	input data Note A	$\sqrt{E^2+F^2}$	$\frac{(G \bullet D)^2}{(\Sigma D)^2}$	Note B	$\left\lvert\frac{D}{\Sigma C}\right\rvert$	I*F Note C	J*E*sqrt(2) Note D	K^2 + L^2
1.A.1.	Energy Industries	CO_2	19 338.0195	4 141.2201	5	5	7.0711	6.8783	0.0571	0.1181	0.2855	0.8348	0.7784
1.A.1.	Energy Industries	CH_4	11.0724	1.7930	5	50	50.2494	0.0001	0.0000	0.0001	0.0025	0.0004	0.0000
1.A.1.	Energy Industries	N_2O	49.2565	4.0598	3	50	50.0899	0.0003	0.0003	0.0001	0.0166	0.0005	0.0003
1.A.2.	Manufacturing industries and construction	CO_2	2 206.2753	665.6173	5	5	7.0711	0.1777	0.0010	0.0190	0.0052	0.1342	0.0180
1.A.2.	Manufacturing industries and constructio	CH_4	2.4544	1.0172	5	50	50.2494	0.0000	0.0000	0.0000	0.0003	0.0002	0.0000
1.A.2.	Manufacturing industries and construction	N_2O	5.0856	1.6577	3	50	50.0899	0.0001	0.0000	0.0000	0.0001	0.0002	0.0000
1.A.3.	Transport	CO_2	4 346.0289	2 158.1164	5	5	7.0711	1.8680	0.0221	0.0615	0.1103	0.4350	0.2014
1.A.3.	Transport	CH_4	32.6324	9.8514	5	40	40.3113	0.0013	0.0000	0.0003	0.0006	0.0020	0.0000
1.A.3.	Transport	N_2O	103.1032	35.0077	5	50	50.2494	0.0248	0.0001	0.0010	0.0031	0.0071	0.0001
1.A.4.	Other Sectors	CO_2	7 291.5661	1 790.2120	5	5	7.0711	1.2854	0.0151	0.0510	0.0755	0.3609	0.1359
1.A.4.	Other Sectors	CH_4	289.1794	108.9172	5	50	50.2494	0.2403	0.0005	0.0031	0.0240	0.0220	0.0011
1.A.4.	Other Sectors	N_2O	27.6563	16.9359	3	50	50.0899	0.0058	0.0002	0.0005	0.0116	0.0020	0.0001
1.A.5.	Other	CO_2	113.9722	2.2468	5	5	7.0711	0.0000	0.0010	0.0001	0.0049	0.0005	0.0000
1.A.5.	Other	CH_4	0.2726	0.0059	5	50	50.2494	0.0000	0.0000	0.0000	0.0001	0.0000	0.0000
1.A.5.	Other	N_2O	1.3253	0.0215	3	50	50.0899	0.0000	0.0000	0.0000	0.0006	0.0000	0.0000
1.B.2.	Fugitive Emissions from Oil and Natural Gas	CO_2	0.6377	1.6581	25	25	35.3553	0.0000	0.0000	0.0000	0.0010	0.0017	0.0000
1.B.2.	Fugitive Emissions from Oil and Natural Gas	CH_4	812.2415	566.6016	25	25	35.3553	3.2190	0.0088	0.0162	0.2195	0.5711	0.3743
1.B.2.	Fugitive Emissions from Oil and Natural Gas	N_2O	0.0002	0.0027	25	25	35.3553	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Memo Items	International Aviation	CO_2	217.3668	218.4093	5	5	7.0711	0.0191	0.0043	0.0062	0.0213	0.0440	0.0024
Memo Items	International Aviation	CH_4	0.0430	0.1451	5	10	11.1803	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Memo Items	International Aviation	N_2O	0.0070	2.0736	5	100	100.1249	0.0003	0.0001	0.0001	0.0059	0.0004	0.0000
Memo Items	CO_2 Emissions from Biomass	CO_2	229.3072	1 439.8048	20	80	82.4621	113.0758	0.0390	0.0410	3.1170	1.1610	11.0638
	END												
	Total (without Memo Items)		**34 630.7793**	**9 504.9423**				**13.7010**					**1.5097**
	TOTAL (with Memo Items)		**35 077.5033**	**11 165.3751**				**126.7962**					**12.5759**
	Total Uncertainties (without Memo Items)						**Total Sectoral Uncertainties %:**	**3.7015**				**Uncertainties by trend %:**	**1.2287**
	Total Uncertainties (with Memo Items)							**11.2604**					**3.5463**

Annex 5-3.2: Overall Inventory Uncertainty for Sector 2 „Industrial Processes and Product Use"

	Category	Pollutant	Base Year Emissions (1990)	Year t Emissions (2015)	Activity Data Uncertainty (1)	Emission Factor Uncertainty (1)	Combined Uncertainty	Contribution to variability by category in 2015	Type A Sensibility	Type B Sensibility	Uncertainty Introduced in Trend in Sectoral Emissions Introduced by EF Uncertainty (2)	Uncertainty Introduced in Trend in Sectoral Emissions Introduced by AD Uncertainty (3)	Uncertainty Introduced in Trend in Sectoral 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	$\left\|\frac{D}{\sum C}\right\|$	I*F Note C	J*E*sqrt(2) Note D	K^2 + L^2
2.A.1	Cement Production	CO_2	971.6967	443.2441	2	3	3.6056	4.0294	0.0290	0.2804	0.0869	0.7930	0.6363
2.A.2	Lime Production	CO_2	232.4996	21.7547	10	2	10.1980	0.0777	0.0602	0.0138	0.1204	0.1946	0.0524
2.A.3	Glass Production	CO_2	25.2212	27.9127	10	10	14.1421	0.2458	0.0096	0.0177	0.0962	0.2497	0.0716
2.A.4	Other Processes Use of Carbonates	CO_2	86.6865	16.7826	10	5	11.1803	0.0555	0.0170	0.0106	0.0849	0.1501	0.0297
2.C.1	Steel Production	CO_2	28.5023	17.2258	5	10	11.1803	0.0585	0.0018	0.0109	0.0182	0.0770	0.0063
2.D.1	Lubricant Use	CO_2	23.4455	4.8162	5	50	50.2494	0.0924	0.0044	0.0030	0.2210	0.0215	0.0493
2.D.2	Paraffine Wax Use	CO_2	0.2787	0.0587	20	100	101.9804	0.0001	0.0001	0.0000	0.0052	0.0010	0.0000
2.D.3	Solvent Use	CO_2	204.1460	79.2460	20	35	40.3113	16.0998	0.0149	0.0501	0.5208	1.4177	2.2810
2.D.4	Use of Urea Catalysts	CO_2	5.3387	2.6910	20	2	20.0998	0.0046	0.0000	0.0017	0.0000	0.0481	0.0023
2.F.1	Refrigeration and Air Conditioning	HFC		77.3604	20	50	53.8516	27.3808	0.0489	0.0489	2.4465	1.3840	7.9008
2.F.2	Foam Blowing Agents	HFC		101.8751	30	30	42.4264	29.4727	0.0644	0.0644	1.9331	2.7338	11.2103
2.F.4	Aerosols	HFC		0.2020	5	5	7.0711	0.0000	0.0001	0.0001	0.0006	0.0009	0.0000
2.G.1	Electrical Equipment	SF_6		1.0575	5	20	20.6155	0.0007	0.0007	0.0007	0.0134	0.0047	0.0002
2.G.1	Electrical Equipment	PFC		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 (Tobacco Combustion, Use of Shoes)	CO_2	3.1983	1.8818	5	50	50.2494	0.0141	0.0002	0.0012	0.0086	0.0084	0.0001
	END												
	Total		**1581.0334**	**796.1489**				**77.5322**					**22.2404**
	Total Uncertainties						**Total Sectoral Uncertainties %:**	**8.8052**				**Uncertainties by trend %:**	**4.7160**

Annex 5-3.3: Overall Inventory Uncertainty for Sector 3 „Agriculture"

	IPCC Source Categories	Pollutant	Base Year Emissions (1990)	Year t Emissions (2015)	Activity Data Uncertainty	Emission Factor Uncertainty	Combined Uncertainty	Combined Uncertainty as % of Total Sectoral Emissions in the Year t (2015)	Type A Sensibility	Type B Sensibility	Uncertainty Introduced in Trend in Sectoral Emissions Introduced by EF Uncertainty	Uncertainty Introduced in Trend in Sectoral Emissions Introduced by AD Uncertainty	Uncertainty Introduced in Trend in Sectoral Emissions
			kt CO_2 equivalent	kt CO_2 equivalent	%	%	%		%	%	%	%	%
			Entry data	Entry data	Entry data	Entry data	$\sqrt{E^2+F^2}$	$\frac{(G \bullet D)^2}{(\sum D)^2}$		$\left\lvert\frac{D}{\sum C}\right\rvert$	I*F	J*E*sqrt(2)	K^2 + L^2
3.A.	Enteric fermentation	CH_4	2190.6944	654.6016	10	20	22.3607	47.9103	0.0448	0.1256	0.8963	1.7767	3.9599
3.B.	Manure management	CH_4	494.8175	70.3618	10	30	31.6228	1.1071	0.0250	0.0135	0.7504	0.1910	0.5996
3.B.a.	Direct N_2O emissions from manure management	N_2O	871.9076	292.0217	30	100	104.4031	207.8557	0.0118	0.0560	1.1849	2.3778	7.0576
3.B.b	Indirect N_2O emissions from manure management	N_2O	244.7103	60.0491	30	150	152.9706	18.8683	0.0075	0.0115	1.1299	0.4889	1.5156
3.D.a.1.	Inorganic nitrogen fertilizers	N_2O	431.2911	181.1301	5	6	7.8102	0.4475	0.0012	0.0348	0.0070	0.2458	0.0605
3.D.a.2.	Organic nitrogen fertilizers	N_2O	259.7852	74.5378	30	6	30.5941	1.1629	0.0059	0.0143	0.0356	0.6069	0.3696
3.D.a.3.	Urine and dung N deposited by grazing animals	N_2O	53.8411	49.1035	30	50	58.3095	1.8332	0.0052	0.0094	0.2615	0.3998	0.2282
3.D.a.4.	Crop Residues	N_2O	162.9926	88.9425	5	25	25.4951	1.1498	0.0044	0.0171	0.1093	0.1207	0.0265
3.D.a.5.	Mineralization Associated with Loss of Soil Organic Matter	N_2O	161.3093	419.2026	5	25	25.4951	25.5427	0.0679	0.0805	1.6967	0.5689	3.2024
3.D.b.1.	Atmospheric deposition	N_2O	102.1793	39.6240	70	150	165.5295	9.6199	0.0004	0.0076	0.0531	0.7528	0.5695
3.D.b.2.	Nitrogen leaching/run-off	N_2O	236.4399	179.2867	75	150	167.7051	202.1594	0.0160	0.0344	2.3977	3.6496	19.0685
3.H.	Urea application	CO_2	0.5820	5.8323	30	50	58.3095	0.0259	0.0011	0.0011	0.0537	0.0475	0.0051
	END												
	Total		**5210.5504**	**2114.6937**				**517.6827**					**36.6631**
	Total Uncertainty						**Total sectoral uncertainty %:**	**22.7526**				**Trend uncertainty %:**	**6.0550**

Annex 5-3.4: Overall Inventory Uncertainty for Sector 4 "LULUCF"

	IPCC Category	Pollutant	Base Year Emissions (1990)	Year t Emissions (2015)	Activity Data Uncertainty	Emission Factor Uncertainty	Combined Uncertainty	Combined Uncertainty as % of Total Sectoral Emissions in the Year t (2015)	Type A Sensibility	Type B Sensibility	Uncertainty Introduced in Trend in Sectoral Emissions Introduced by EF Uncertainty	Uncertainty Introduced in Trend in Sectoral Emissions Introduced by AD Uncertainty	Uncertainty Introduced in Trend in Sectoral 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	-1591.2275	-1511.5589	15	5	15.8114	70.5511	0.3583	0.2597	1.7917	5.5098	33.5678
4.A.2.	Land Converted to Forest Land	CO_2	-952.5127	-515.7307	15	5	15.8114	8.2130	0.0003	0.0886	0.0017	1.8799	3.5340
4.A.2.	Land Converted to Forest Land (non-CO_2 emissions from vegetation fires)	CH_4	0.2237	0.6633	10	30	31.6228	0.0001	0.0008	0.0001	0.0253	0.0016	0.0006
4.A.2.	Land Converted to Forest Land (non-CO_2 emissions from vegetation fires)	N_2O	0.1475	0.4374	10	50	50.9902	0.0001	0.0773	0.0001	3.8631	0.0011	14.9238
4.B.1.	Cropland Remaining Cropland	CO_2	-1 583.7249	-1 711.3517	10	10	14.1421	72.3473	0.0001	0.2941	0.0012	4.1587	17.2948
4.B.1.	Cropland Remaining Cropland (non-CO_2 emissions from stubble fields burning)	CH_4	2.4461	0.0448	10	30	31.6228	0.0000	0.2039	0.0000	6.1159	0.0001	37.4045
4.B.1.	Cropland Remaining Cropland (non-CO_2 emissions from stubble fields burning)	N_2O	56.8256	57.5206	10	50	50.9902	1.0625	0.0013	0.0099	0.0669	0.1398	0.0240
4.B.2	Land Converted to Cropland	CO_2	1005.5978	983.9336	10	10	14.1421	23.9153	0.0059	0.1691	0.0590	2.3910	5.7205
4.C.1.	Grassland Remaining Grassland	CO_2	0.0000	0.0000	15	10	18.0278	0.0000	0.0406	0.0000	0.4064	0.0000	0.1652
4C.2.	Land Converted to Grassland	CO_2	-2850.2941	-306.2291	15	10	18.0278	3.7643	0.0005	0.0526	0.0047	1.1162	1.2460
4.D.1.	Wetlands Remaining Wetlands	CO_2	0.0000	0.0000	10	10	14.1421	0.0000	0.0001	0.0000	0.0010	0.0000	0.0000
4.D.2.	Land Converted to Wetlands	CO_2	-17.4403	0.0000	10	10	14.1421	0.0000	0.0051	0.0000	0.0509	0.0000	0.0026
4.E.1.	Settlements Remaining Settlements	CO_2	0.0000	0.0000	10	10	14.1421	0.0000	0.0000	0.0000	0.0002	0.0000	0.0000
4.E.2.	Land Converted to Settlements	CO_2	84.7480	38.8867	10	10	14.1421	0.0374	0.0136	0.0067	0.1355	0.0945	0.0273
4.E.2.	Land Converted to Settlements (non-CO_2 emissions)	N_2O	3.1350	0.5023	10	50	50.9902	0.0001	0.0064	0.0001	0.3206	0.0012	0.1028
4.F.1.	Other Land Remaining Other Land	CO_2	0.0000	0.0000	10	10	14.1421	0.0000	0.0064	0.0000	0.0641	0.0000	0.0041
4.F.2.	Land Converted to Other Land	CO_2	152.4756	60.8445	10	10	14.1421	0.0915	0.0080	0.0105	0.0804	0.1479	0.0283
4.G.	Harvested Wood Products	CO_2	-130.0504	56.6377	30	10	31.6228	0.3962	0.0132	0.0097	0.1325	0.4129	0.1880
	END												
	Total		**-5819.6508**	**-2845.3994**				**180.3786**					**114.2343**
	Total Uncertainty						**Total Sectoral Uncertainty %:**	**13.4305**				**Uncertainty in Trend %:**	**10.6880**

Annex 5-3.5: Overall Inventory Uncertainty for Sector 5 "Waste Sector"

	Category	Pollutant	Base Year Emissions (1990)	Year t Emissions (2015)	Activity Data Uncertainty (1)	Emission Factor Uncertainty (1)	Combined Uncertainty	Contribution to variability by category in 2015	Type A Sensibility	Type B Sensibility	Uncertainty Introduced in Trend in Sectoral Emissions Introduced by EF Uncertainty (2)	Uncertainty Introduced in Trend in Sectoral Emissions Introduced by AD Uncertainty (3)	Uncertainty Introduced in Trend in Sectoral 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
5A	Solid Waste Disposal	CH_4	1046.7277	1087.1519	30	40	50.0000	1248.0574	0.1372	0.5497	5.4883	23.3219	574.0350
5C	Incineration and open burning of waste	CO_2	17.1060	16.1442	40	25	47.1699	0.2449	0.0014	0.0082	0.0358	0.4618	0.2145
5C	Incineration and open burning of waste	CH_4	8.7818	8.2516	40	50	64.0312	0.1179	0.0007	0.0042	0.0359	0.2360	0.0570
5C	Incineration and open burning of waste	N_2O	2.4157	2.2698	40	100	107.7033	0.0252	0.0002	0.0011	0.0197	0.0649	0.0046
5D	Wastewater treatment and discharge	CH_4	814.7250	354.1764	30	40	50.0000	132.4626	0.1408	0.1791	5.6335	7.5979	89.4644
5D	Wastewater treatment and discharge	N_2O	87.9499	70.6672	30	50	58.3095	7.1718	0.0011	0.0357	0.0567	1.5160	2.3014
	END												
	Total		**1977.7062**	**1538.6611**				**1388.0799**					**666.0769**
	Total Uncertainties						**Total Sectoral Uncertainties %:**	**37.2569**				**Uncertainties by trend %:**	**25.8085**

Annex 6. Sectoral and Summary Reports on GHG Emissions in the Republic of Moldova within 1990-2015

Annex 6-1: Sectoral Report for Energy Sector within 1990-2015

1990

Greenhouse Gas Source Categories	CO_2	CH_4	N_2O	NO_X	CO	NMVOC	SO_2
	(kt)						
Total Energy	**33 296.4997**	**45.9141**	**0.6256**	**133.3639**	**430.6217**	**73.2953**	**292.9100**
A. Fuel combustion activities (sectoral approach)	**33 295.8620**	**13.4244**	**0.6256**	**133.3639**	**430.6217**	**72.7136**	**292.9100**
1. Energy industries	**19 338.0195**	**0.4429**	**0.1653**	**54.3056**	**4.9308**	**1.3291**	**203.2479**
a. Public electricity and heat production	**19 338.0195**	**0.4429**	**0.1653**	**54.3056**	**4.9308**	**1.3291**	**203.2479**
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	**2 206.2753**	**0.0982**	**0.0171**	**5.9159**	**1.4020**	**0.2003**	**24.1751**
a. Iron and steel	IE	IE	IE	IE	IE	IE	IE
b. Non-ferrous metals	IE	IE	IE	IE	IE	IE	IE
c. Chemicals	IE	IE	IE	IE	IE	IE	IE
d. Pulp, paper and print	IE	IE	IE	IE	IE	IE	IE
e. Food processing, beverages and tobacco	IE	IE	IE	IE	IE	IE	IE
f. Non-metallic minerals	IE	IE	IE	IE	IE	IE	IE
g. Other	IE	IE	IE	IE	IE	IE	IE
3. Transport	**4 346.0289**	**1.3053**	**0.3460**	**43.3474**	**299.7054**	**56.4524**	**5.1060**
a. Domestic aviation	6.0915	0.0000	0.0002	0.0264	0.0088	0.0044	0.0040
b. Road transportation	3 826.3625	1.2792	0.1894	36.1602	293.9637	55.2998	4.2980
c. Railways	403.4834	0.0226	0.1557	6.5341	5.4451	1.0890	0.7680
d. Domestic navigation	18.9133	0.0018	0.0005	0.3829	0.2552	0.0510	0.0360
e. Other transportation	91.1782	0.0016	0.0002	0.2438	0.0325	0.0081	0.0000
4. Other sectors	**7 291.5661**	**11.5672**	**0.0928**	**28.9129**	**122.3226**	**14.3034**	**59.7859**
a. Commercial/institutional	1 415.1097	0.2473	0.0205	1.5218	25.4024	2.5806	14.7102
b. Residential	4 410.0721	10.9567	0.0600	4.7958	76.8970	7.8405	41.4559
c. Agriculture/forestry/fishing	1 466.3843	0.3632	0.0124	22.5953	20.0232	3.8823	3.6198
5. Other	**113.9722**	**0.0109**	**0.0044**	**0.8821**	**2.2609**	**0.4285**	**0.5951**
a. Stationary	41.9609	0.0020	0.0007	0.1306	0.0536	0.0046	0.4571
b. Mobile	72.0113	0.0089	0.0037	0.7515	2.2073	0.4240	0.1380
B. Fugitive emissions from fuels	**0.6377**	**32.4897**	**0.0000**	**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	**0.6377**	**32.4897**	**0.0000**	**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	**217.3668**	**0.0430**	**0.0070**	**0.7949**	**0.8733**	**0.5202**	**0.0689**
Aviation	217.3668	0.0430	0.0070	0.7949	0.8733	0.5202	0.0689
Navigation	NO	NO	NO	NO	NO	NO	NO
Multilateral operations	NO	NO	NO	NO	NO	NO	NO
CO_2 emissions from biomass	**229.3072**						
CO_2 captured	NO						
For domestic storage	NO						
For storage in other countries	NO						

1991

Greenhouse Gas Source Categories	CO_2	CH_4	N_2O	NO_X	CO	NMVOC	SO_2
	(kt)						
Total Energy	**29 615.6682**	**39.7815**	**0.5709**	**120.7994**	**363.5195**	**64.3990**	**242.9820**
A. Fuel combustion activities (sectoral approach)	**29 615.0542**	**9.2890**	**0.5709**	**120.7994**	**363.5195**	**63.8552**	**242.9820**
1. Energy industries	**17 363.5768**	**0.3826**	**0.1457**	**48.8473**	**4.4530**	**1.2021**	**172.1415**
a. Public electricity and heat production	**17 363.5768**	**0.3826**	**0.1457**	**48.8473**	**4.4530**	**1.2021**	**172.1415**
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	**1 751.5621**	**0.0771**	**0.0133**	**4.6859**	**0.7688**	**0.1609**	**19.2292**
a. Iron and steel	IE	IE	IE	IE	IE	IE	IE

Greenhouse Gas Source Categories	CO_2	CH_4	N_2O	NO_x	CO	NMVOC	SO_2
	(kt)						
b. Non-ferrous metals	IE	IE	IE	IE	IE	IE	IE
c. Chemicals	IE	IE	IE	IE	IE	IE	IE
d. Pulp, paper and print	IE	IE	IE	IE	IE	IE	IE
e. Food processing, beverages and tobacco	IE	IE	IE	IE	IE	IE	IE
f. Non-metallic minerals	IE	IE	IE	IE	IE	IE	IE
g. Other	IE	IE	IE	IE	IE	IE	IE
3. Transport	**4 435.3173**	**1.1863**	**0.3444**	**44.7084**	**282.8296**	**53.3770**	**5.6146**
a. Domestic aviation	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
b. Road transportation	3 972.8520	1.1633	0.1952	38.2454	277.5868	52.3271	4.8789
c. Railways	386.2439	0.0216	0.1491	6.2550	5.2125	1.0425	0.7352
d. Domestic navigation	0.2396	0.0000	0.0000	0.0048	0.0032	0.0006	0.0005
e. Other transportation	75.9818	0.0014	0.0001	0.2032	0.0271	0.0068	0.0000
4. Other sectors	**5 984.1624**	**7.6360**	**0.0643**	**21.9131**	**73.9506**	**8.8220**	**45.4314**
a. Commercial/institutional	819.7683	0.0887	0.0100	0.8867	11.2492	1.1327	8.3445
b. Residential	3 261.7707	6.1741	0.0370	3.5006	40.8852	4.1175	28.7327
c. Agriculture/forestry/fishing	1 902.6234	1.3733	0.0173	17.5257	21.8163	3.5718	8.3543
5. Other	**80.4355**	**0.0070**	**0.0031**	**0.6447**	**1.5175**	**0.2932**	**0.5653**
a. Stationary	25.5778	0.0009	0.0002	0.0687	0.0050	0.0016	0.4603
b. Mobile	54.8577	0.0061	0.0028	0.5761	1.5125	0.2916	0.1050
B. Fugitive emissions from fuels	**0.6140**	**30.4926**	**0.0000**	**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	**0.6140**	**30.4926**	**0.0000**	**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	**232.8115**	**0.0487**	**0.0074**	**0.8447**	**0.9641**	**0.5792**	**0.0738**
Aviation	232.8115	0.0487	0.0074	0.8447	0.9641	0.5792	0.0738
Navigation	NO	NO	NO	NO	NO	NO	NO
Multilateral operations	NO	NO	NO	NO	NO	NO	NO
CO_2 emissions from biomass	**427.7268**						
CO_2 captured	NO						
For domestic storage	NO						
For storage in other countries	NO						

1992

Greenhouse Gas Source Categories	CO_2	CH_4	N_2O	NO_x	CO	NMVOC	SO_2
	(kt)						
Total Energy	**20 487.2378**	**31.2304**	**0.3421**	**76.3110**	**166.9663**	**30.7516**	**169.0953**
A. Fuel combustion activities (sectoral approach)	**20 486.7203**	**3.6261**	**0.3421**	**76.3110**	**166.9663**	**30.2584**	**169.0953**
1. Energy industries	**13 010.9387**	**0.2828**	**0.1102**	**36.6784**	**3.3396**	**0.8992**	**128.3280**
a. Public electricity and heat production	**13 010.9387**	**0.2828**	**0.1102**	**36.6784**	**3.3396**	**0.8992**	**128.3280**
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	**1 013.7705**	**0.0412**	**0.0071**	**2.6879**	**0.4219**	**0.0896**	**10.9365**
a. Iron and steel	IE	IE	IE	IE	IE	IE	IE
b. Non-ferrous metals	IE	IE	IE	IE	IE	IE	IE
c. Chemicals	IE	IE	IE	IE	IE	IE	IE
d. Pulp, paper and print	IE	IE	IE	IE	IE	IE	IE
e. Food processing, beverages and tobacco	IE	IE	IE	IE	IE	IE	IE
f. Non-metallic minerals	IE	IE	IE	IE	IE	IE	IE
g. Other	IE	IE	IE	IE	IE	IE	IE
3. Transport	**2 142.4037**	**0.5682**	**0.1929**	**21.9215**	**134.4383**	**25.3717**	**2.7015**
a. Domestic aviation	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
b. Road transportation	1 816.4231	0.5521	0.0890	17.4121	130.7879	24.6406	2.1894
c. Railways	268.7893	0.0151	0.1037	4.3529	3.6274	0.7255	0.5116
d. Domestic navigation	0.2049	0.0000	0.0000	0.0041	0.0028	0.0006	0.0004
e. Other transportation	56.9864	0.0010	0.0001	0.1524	0.0203	0.0051	0.0000
4. Other sectors	**4 257.3797**	**2.7295**	**0.0299**	**14.5814**	**27.9162**	**3.7324**	**26.5401**

Greenhouse Gas Source Categories	CO_2	CH_4	N_2O	NO_x	CO	NMVOC	SO_2
	(kt)						
a. Commercial/institutional	378.1095	0.0438	0.0030	0.4376	1.7487	0.1830	3.4542
b. Residential	2 405.6534	1.3946	0.0134	2.5022	9.2974	0.9571	16.1423
c. Agriculture/forestry/fishing	1 473.6168	1.2912	0.0135	11.6416	16.8701	2.5922	6.9437
5. Other	**62.2278**	**0.0044**	**0.0020**	**0.4417**	**0.8504**	**0.1655**	**0.5892**
a. Staţionary	27.0699	0.0010	0.0002	0.0699	0.0052	0.0017	0.5220
b. Mobile	35.1579	0.0034	0.0018	0.3718	0.8451	0.1638	0.0672
B. Fugitive emissions from fuels	**0.5175**	**27.6043**	**0.0000**	**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	**0.5175**	**27.6043**	**0.0000**	**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	**96.2635**	**0.0189**	**0.0031**	**0.3512**	**0.3847**	**0.2288**	**0.0305**
Aviation	96.2635	0.0189	0.0031	0.3512	0.3847	0.2288	0.0305
Navigation	NO	NO	NO	NO	NO	NO	NO
Multilateral operations	NO	NO	NO	NO	NO	NO	NO
CO_2 emissions from biomass	**531.1505**						
CO_2 captured	NO						
For domestic storage	NO						
For storage in other countries	NO						

1993

Greenhouse Gas Source Categories	CO_2	CH_4	N_2O	NO_x	CO	NMVOC	SO_2
	(kt)						
Total Energy	**15 345.5359**	**27.3820**	**0.3454**	**60.7032**	**139.7971**	**25.0832**	**136.5303**
A. Fuel combustion activities (sectoral approach)	**15 345.0977**	**2.5793**	**0.3454**	**60.7032**	**139.7971**	**24.6395**	**136.5303**
1. Energy industries	**10 737.0218**	**0.2447**	**0.0928**	**30.1864**	**2.7480**	**0.7361**	**114.6896**
a. Public electricity and heat production	**10 737.0218**	**0.2447**	**0.0928**	**30.1864**	**2.7480**	**0.7361**	**114.6896**
b. Petroleum refining	NO	NO	NO	NO	NO	NO	NO
c. Manufacture of solid fuels and other energy industries	NO	NO	NO	NO	NO	NO	NO
2. Manufacturing industries and construction	**563.0714**	**0.0273**	**0.0045**	**1.5266**	**0.5219**	**0.0587**	**5.1076**
a. Iron and steel	IE	IE	IE	IE	IE	IE	IE
b. Non-ferrous metals	IE	IE	IE	IE	IE	IE	IE
c. Chemicals	IE	IE	IE	IE	IE	IE	IE
d. Pulp, paper and print	IE	IE	IE	IE	IE	IE	IE
e. Food processing, beverages and tobacco	IE	IE	IE	IE	IE	IE	IE
f. Non-metallic minerals	IE	IE	IE	IE	IE	IE	IE
g. Other	IE	IE	IE	IE	IE	IE	IE
3. Transport	**1 699.7939**	**0.4614**	**0.2209**	**16.5386**	**103.2541**	**19.4675**	**2.1961**
a. Domestic aviation	0.8316	0.0000	0.0000	0.0036	0.0012	0.0006	0.0005
b. Road transportation	1 408.0668	0.4458	0.1158	12.0750	99.5719	18.7304	1.6773
c. Railways	272.0339	0.0152	0.1050	4.4054	3.6712	0.7342	0.5178
d. Domestic navigation	0.2364	0.0000	0.0000	0.0048	0.0032	0.0006	0.0005
e. Other transportation	18.6252	0.0003	0.0000	0.0498	0.0066	0.0017	0.0000
4. Other sectors	**2 253.3852**	**1.8406**	**0.0248**	**11.9354**	**32.2832**	**4.1894**	**13.8256**
a. Commercial/institutional	589.8426	0.0968	0.0081	0.6364	9.7981	0.9946	6.7667
b. Residential	978.2205	1.5726	0.0109	1.0791	13.3500	1.4304	5.2514
c. Agriculture/forestry/fishing	685.3221	0.1712	0.0059	10.2199	9.1352	1.7643	1.8075
5. Other	**91.8254**	**0.0054**	**0.0023**	**0.5163**	**0.9899**	**0.1879**	**0.7113**
a. Staţionary	59.9669	0.0015	0.0007	0.1833	0.0385	0.0050	0.6503
b. Mobile	31.8585	0.0038	0.0016	0.3330	0.9514	0.1829	0.0610
B. Fugitive emissions from fuels	**0.4382**	**24.8026**	**0.0000**	**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	**0.4382**	**24.8026**	**0.0000**	**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**						

Greenhouse Gas Source Categories	CO_2	CH_4	N_2O	NO_x	CO	NMVOC	SO_2
	(kt)						
1. Transport of CO_2	NO						
2. Injection and storage	NO						
3. Other	NO						
Memo items:							
International bunkers	**62.0927**	**0.0099**	**0.0020**	**0.2331**	**0.2215**	**0.1293**	**0.0197**
Aviation	62.0927	0.0099	0.0020	0.2331	0.2215	0.1293	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 Categories	CO_2	CH_4	N_2O	NO_x	CO	NMVOC	SO_2
	(kt)						
Total Energy	**14 410.2040**	**26.9855**	**0.2222**	**56.8378**	**135.3988**	**24.0078**	**99.8703**
A. Fuel combustion activities (sectoral approach)	**14 409.7955**	**3.1141**	**0.2222**	**56.8378**	**135.3988**	**23.5809**	**99.8703**
1. Energy industries	**9 935.3786**	**0.1885**	**0.0868**	**28.4710**	**2.8047**	**0.7002**	**82.3832**
a. Public electricity and heat production	**9 935.3786**	**0.1885**	**0.0868**	**28.4710**	**2.8047**	**0.7002**	**82.3832**
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	**828.8950**	**0.0229**	**0.0031**	**2.2333**	**0.5059**	**0.0787**	**1.6222**
a. Iron and steel	IE	IE	IE	IE	IE	IE	IE
b. Non-ferrous metals	IE	IE	IE	IE	IE	IE	IE
c. Chemicals	IE	IE	IE	IE	IE	IE	IE
d. Pulp, paper and print	IE	IE	IE	IE	IE	IE	IE
e. Food processing, beverages and tobacco	IE	IE	IE	IE	IE	IE	IE
f. Non-metallic minerals	IE	IE	IE	IE	IE	IE	IE
g. Other	IE	IE	IE	IE	IE	IE	IE
3. Transport	**1 485.6786**	**0.4168**	**0.1052**	**14.3065**	**96.5881**	**18.2035**	**1.7173**
a. Domestic aviation	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
b. Road transportation	1 289.4203	0.4092	0.0630	12.3069	95.0857	17.9014	1.5098
c. Railways	108.8368	0.0061	0.0420	1.7625	1.4688	0.2938	0.2072
d. Domestic navigation	0.1860	0.0000	0.0000	0.0038	0.0025	0.0005	0.0004
e. Other transportation	87.2355	0.0016	0.0002	0.2333	0.0311	0.0078	0.0000
4. Other sectors	**2 086.3753**	**2.4789**	**0.0257**	**11.4859**	**34.3147**	**4.3774**	**13.5587**
a. Commercial/institutional	386.9544	0.0757	0.0058	0.4180	7.2546	0.7385	4.5211
b. Residential	1 062.6784	2.2578	0.0145	1.1633	18.2460	1.9291	7.5615
c. Agriculture/forestry/fishing	636.7425	0.1453	0.0055	9.9046	8.8140	1.7099	1.4761
5. Other	**73.4680**	**0.0070**	**0.0015**	**0.3411**	**1.1855**	**0.2211**	**0.5889**
a. Staționary	54.4786	0.0023	0.0005	0.1547	0.0441	0.0053	0.5520
b. Mobile	18.9894	0.0047	0.0009	0.1864	1.1413	0.2157	0.0368
B. Fugitive emissions from fuels	**0.4085**	**23.8714**	**0.0000**	**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	**0.4085**	**23.8714**	**0.0000**	**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	**37.8235**	**0.0058**	**0.0012**	**0.1433**	**0.1323**	**0.0766**	**0.0120**
Aviation	37.8235	0.0058	0.0012	0.1433	0.1323	0.0766	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 Categories	CO_2	CH_4	N_2O	NO_X	CO	NMVOC	SO_2
	(kt)						
Total Energy	**11 122.6101**	**28.3907**	**0.1782**	**48.0824**	**134.3789**	**24.3552**	**59.0498**
A. Fuel combustion activities (sectoral approach)	**11 122.1908**	**1.9351**	**0.1782**	**48.0824**	**134.3789**	**23.8791**	**59.0498**
1. Energy industries	**6 886.3081**	**0.1319**	**0.0496**	**19.4094**	**2.0544**	**0.5132**	**45.8616**
a. Public electricity and heat production	**6 886.3081**	**0.1319**	**0.0496**	**19.4094**	**2.0544**	**0.5132**	**45.8616**
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	**463.9562**	**0.0155**	**0.0022**	**1.2541**	**0.3118**	**0.0458**	**1.1823**
a. Iron and steel	IE	IE	IE	IE	IE	IE	IE
b. Non-ferrous metals	IE	IE	IE	IE	IE	IE	IE
c. Chemicals	IE	IE	IE	IE	IE	IE	IE
d. Pulp, paper and print	IE	IE	IE	IE	IE	IE	IE
e. Food processing, beverages and tobacco	IE	IE	IE	IE	IE	IE	IE
f. Non-metallic minerals	IE	IE	IE	IE	IE	IE	IE
g. Other	IE	IE	IE	IE	IE	IE	IE
3. Transport	**1 482.0856**	**0.4276**	**0.1012**	**14.1154**	**100.4237**	**18.9204**	**1.6675**
a. Domestic aviation	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
b. Road transportation	1 302.2861	0.4207	0.0642	12.3376	99.0999	18.6542	1.4850
c. Railways	95.6942	0.0054	0.0369	1.5497	1.2914	0.2583	0.1821
d. Domestic navigation	0.1797	0.0000	0.0000	0.0036	0.0024	0.0005	0.0003
e. Other transportation	83.9256	0.0015	0.0001	0.2244	0.0299	0.0075	0.0000
4. Other sectors	**2 172.1646**	**1.3501**	**0.0230**	**12.8308**	**30.2159**	**4.1462**	**8.7335**
a. Commercial/institutional	395.4161	0.0766	0.0059	0.4299	7.4883	0.7619	4.6204
b. Residential	1 068.7561	1.1441	0.0112	1.1777	13.0643	1.4815	2.6868
c. Agriculture/forestry/fishing	707.9924	0.1295	0.0059	11.2233	9.6634	1.9028	1.4263
5. Other	**117.6762**	**0.0100**	**0.0021**	**0.4726**	**1.3732**	**0.2535**	**1.6050**
a. Staţionary	96.6955	0.0047	0.0011	0.2673	0.0801	0.0092	1.5643
b. Mobile	20.9807	0.0053	0.0010	0.2053	1.2931	0.2443	0.0407
B. Fugitive emissions from fuels	**0.4194**	**26.4555**	**0.0000**	**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	**0.4194**	**26.4555**	**0.0000**	**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	**230.0502**						
CO_2 captured	NO						
For domestic storage	NO						
For storage in other countries	NO						

1996

Greenhouse Gas Source Categories	CO_2	CH_4	N_2O	NO_X	CO	NMVOC	SO_2
	(kt)						
Total Energy	**11 342.9211**	**31.7196**	**0.1771**	**45.9385**	**135.5848**	**23.9485**	**58.0004**
A. Fuel combustion activities (sectoral approach)	**11 342.4485**	**2.9641**	**0.1771**	**45.9385**	**135.5848**	**23.4325**	**58.0004**
1. Energy industries	**7 155.3361**	**0.1358**	**0.0477**	**20.0704**	**2.1843**	**0.5442**	**42.6638**
a. Public electricity and heat production	**7 155.3361**	**0.1358**	**0.0477**	**20.0704**	**2.1843**	**0.5442**	**42.6638**
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	**377.6208**	**0.0138**	**0.0020**	**1.0218**	**0.2688**	**0.0383**	**1.2844**
a. Iron and steel	IE	IE	IE	IE	IE	IE	IE
b. Non-ferrous metals	IE	IE	IE	IE	IE	IE	IE
c. Chemicals	IE	IE	IE	IE	IE	IE	IE

Greenhouse Gas Source Categories	CO_2	CH_4	N_2O	NO_X	CO	NMVOC	SO_2
	(kt)						
d. Pulp, paper and print	IE	IE	IE	IE	IE	IE	IE
e. Food processing, beverages and tobacco	IE	IE	IE	IE	IE	IE	IE
f. Non-metallic minerals	IE	IE	IE	IE	IE	IE	IE
g. Other	IE	IE	IE	IE	IE	IE	IE
3. Transport	**1 451.6525**	**0.4125**	**0.0972**	**13.5802**	**95.3461**	**17.9605**	**1.5915**
a. Domestic aviation	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
b. Road transportation	1 240.1866	0.4052	0.0612	11.7568	94.0490	17.6990	1.4145
c. Railways	92.7872	0.0052	0.0358	1.5026	1.2522	0.2504	0.1766
d. Domestic navigation	0.1954	0.0000	0.0000	0.0040	0.0026	0.0005	0.0004
e. Other transportation	118.4832	0.0021	0.0002	0.3168	0.0422	0.0106	0.0000
4. Other sectors	**2 274.8811**	**2.3910**	**0.0279**	**10.8341**	**36.2020**	**4.6049**	**11.4920**
a. Commercial/institutional	362.4420	0.0905	0.0056	0.3975	7.0263	0.7214	4.0969
b. Residential	1 347.6630	2.1818	0.0175	1.5268	21.2955	2.3492	6.2369
c. Agriculture/forestry/fishing	564.7761	0.1187	0.0048	8.9098	7.8802	1.5344	1.1582
5. Other	**82.9580**	**0.0110**	**0.0023**	**0.4319**	**1.5836**	**0.2846**	**0.9687**
a. Staționary	56.4752	0.0051	0.0010	0.1690	0.1306	0.0095	0.9175
b. Mobile	26.4828	0.0059	0.0013	0.2629	1.4530	0.2751	0.0512
B. Fugitive emissions from fuels	**0.4726**	**28.7555**	**0.0000**	**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	**0.4726**	**28.7555**	**0.0000**	**0.0000**	**0.0000**	**0.5160**	**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	**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	**295.4440**						
CO_2 captured	NO						
For domestic storage	NO						
For storage in other countries	NO						

1997

Greenhouse Gas Source Categories	CO_2	CH_4	N_2O	NO_X	CO	NMVOC	SO_2
	(kt)						
Total Energy	**10 252.1997**	**26.0228**	**0.1506**	**42.2769**	**143.7241**	**25.6799**	**33.1004**
A. Fuel combustion activities (sectoral approach)	**10 251.7346**	**2.3800**	**0.1506**	**42.2769**	**143.7241**	**25.2623**	**33.1004**
1. Energy industries	**5 615.5061**	**0.1108**	**0.0244**	**15.3208**	**1.8464**	**0.4607**	**21.3361**
a. Public electricity and heat production	**5 615.5061**	**0.1108**	**0.0244**	**15.3208**	**1.8464**	**0.4607**	**21.3361**
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	**597.7916**	**0.0202**	**0.0027**	**1.6209**	**0.8510**	**0.0631**	**1.0385**
a. Iron and steel	IE	IE	IE	IE	IE	IE	IE
b. Non-ferrous metals	IE	IE	IE	IE	IE	IE	IE
c. Chemicals	IE	IE	IE	IE	IE	IE	IE
d. Pulp, paper and print	IE	IE	IE	IE	IE	IE	IE
e. Food processing, beverages and tobacco	IE	IE	IE	IE	IE	IE	IE
f. Non-metallic minerals	IE	IE	IE	IE	IE	IE	IE
g. Other	IE	IE	IE	IE	IE	IE	IE
3. Transport	**1 469.7744**	**0.4563**	**0.0966**	**14.0262**	**108.1520**	**20.3626**	**1.6281**
a. Domestic aviation	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
b. Road transportation	1 340.3690	0.4509	0.0657	12.5972	107.0543	20.1422	1.4758
c. Railways	79.8262	0.0045	0.0308	1.2927	1.0773	0.2155	0.1519
d. Domestic navigation	0.2112	0.0000	0.0000	0.0043	0.0029	0.0006	0.0004
e. Other transportation	49.3680	0.0009	0.0001	0.1320	0.0176	0.0044	0.0000
4. Other sectors	**2 496.0098**	**1.7851**	**0.0249**	**10.9306**	**31.6363**	**4.1483**	**8.3265**
a. Commercial/institutional	307.2393	0.0668	0.0046	0.3301	5.9072	0.6030	3.3143

Greenhouse Gas Source Categories	CO_2	CH_4	N_2O	NO_X	CO	NMVOC	SO_2
	(kt)						
b. Residential	1 621.9510	1.5902	0.0153	1.7440	17.5742	1.9803	3.8611
c. Agriculture/forestry/fishing	566.8195	0.1280	0.0051	8.8565	8.1549	1.5651	1.1511
5. Other	**72.6527**	**0.0077**	**0.0019**	**0.3784**	**1.2383**	**0.2275**	**0.7711**
a. Staționary	49.2792	0.0029	0.0007	0.1440	0.0709	0.0061	0.7260
b. Mobile	23.3735	0.0048	0.0012	0.2345	1.1675	0.2214	0.0451
B. Fugitive emissions from fuels	**0.4651**	**23.6428**	**0.0000**	**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	**0.4651**	**23.6428**	**0.0000**	**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
Navigation	NO	NO	NO	NO	NO	NO	NO
Multilateral operations	NO	NO	NO	NO	NO	NO	NO
CO_2 emissions from biomass	**291.0280**						
CO_2 captured	NO						
For domestic storage	NO						
For storage in other countries	NO						

1998

Greenhouse Gas Source Categories	CO_2	CH_4	N_2O	NO_X	CO	NMVOC	SO_2
	(kt)						
Total Energy	**8 794.4337**	**23.8261**	**0.1238**	**35.3240**	**120.7329**	**21.6983**	**25.9626**
A. Fuel combustion activities (sectoral approach)	**8 794.0063**	**1.7011**	**0.1238**	**35.3240**	**120.7329**	**21.3067**	**25.9626**
1. Energy industries	**4 848.6438**	**0.0963**	**0.0192**	**13.1565**	**1.5895**	**0.4013**	**17.1551**
a. Public electricity and heat production	**4 848.6438**	**0.0963**	**0.0192**	**13.1565**	**1.5895**	**0.4013**	**17.1551**
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	**559.0312**	**0.0160**	**0.0021**	**1.5075**	**0.5420**	**0.0551**	**0.9557**
a. Iron and steel	IE	IE	IE	IE	IE	IE	IE
b. Non-ferrous metals	IE	IE	IE	IE	IE	IE	IE
c. Chemicals	IE	IE	IE	IE	IE	IE	IE
d. Pulp, paper and print	IE	IE	IE	IE	IE	IE	IE
e. Food processing, beverages and tobacco	IE	IE	IE	IE	IE	IE	IE
f. Non-metallic minerals	IE	IE	IE	IE	IE	IE	IE
g. Other	IE	IE	IE	IE	IE	IE	IE
3. Transport	**1 273.6172**	**0.3898**	**0.0803**	**12.0909**	**92.0086**	**17.3252**	**1.4198**
a. Domestic aviation	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
b. Road transportation	1 166.5762	0.3856	0.0574	11.0023	91.1913	17.1609	1.3069
c. Railways	59.1674	0.0033	0.0228	0.9582	0.7985	0.1597	0.1126
d. Domestic navigation	0.1324	0.0000	0.0000	0.0027	0.0018	0.0004	0.0003
e. Other transportation	47.7411	0.0009	0.0001	0.1277	0.0170	0.0043	0.0000
4. Other sectors	**2 056.9647**	**1.1913**	**0.0204**	**8.2332**	**25.3604**	**3.3031**	**6.0518**
a. Commercial/institutional	305.5365	0.0669	0.0047	0.3300	6.0173	0.6140	3.3209
b. Residential	1 337.6459	1.0521	0.0123	1.4660	13.7780	1.5950	1.9376
c. Agriculture/forestry/fishing	413.7823	0.0723	0.0034	6.4373	5.5650	1.0941	0.7933
5. Other	**55.7495**	**0.0077**	**0.0018**	**0.3359**	**1.2324**	**0.2221**	**0.3803**
a. Staționary	33.1070	0.0031	0.0007	0.1089	0.0955	0.0065	0.3365
b. Mobile	22.6425	0.0046	0.0011	0.2270	1.1369	0.2156	0.0437
B. Fugitive emissions from fuels	**0.4274**	**22.1250**	**0.0000**	**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	**0.4274**	**22.1250**	**0.0000**	**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

Greenhouse Gas Source Categories	CO_2	CH_4	N_2O	NO_X	CO	NMVOC	SO_2
	(kt)						
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						

1999

Greenhouse Gas Source Categories	CO_2	CH_4	N_2O	NO_X	CO	NMVOC	SO_2
	(kt)						
Total Energy	**6 849.6505**	**23.9519**	**0.0807**	**25.6213**	**79.8417**	**14.1048**	**13.0512**
A. Fuel combustion activities (sectoral approach)	**6 849.2574**	**1.5474**	**0.0807**	**25.6213**	**79.8417**	**13.7041**	**13.0512**
1. Energy industries	**3 660.4440**	**0.0727**	**0.0088**	**9.7716**	**1.2800**	**0.3193**	**6.1391**
a. Public electricity and heat production	**3 660.4440**	**0.0727**	**0.0088**	**9.7716**	**1.2800**	**0.3193**	**6.1391**
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	**491.5201**	**0.0132**	**0.0016**	**1.3246**	**0.5065**	**0.0485**	**0.4945**
a. Iron and steel	IE	IE	IE	IE	IE	IE	IE
b. Non-ferrous metals	IE	IE	IE	IE	IE	IE	IE
c. Chemicals	IE	IE	IE	IE	IE	IE	IE
d. Pulp, paper and print	IE	IE	IE	IE	IE	IE	IE
e. Food processing, beverages and tobacco	IE	IE	IE	IE	IE	IE	IE
f. Non-metallic minerals	IE	IE	IE	IE	IE	IE	IE
g. Other	IE	IE	IE	IE	IE	IE	IE
3. Transport	**854.3647**	**0.2341**	**0.0506**	**8.0351**	**54.8341**	**10.3380**	**1.0022**
a. Domestic aviation	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
b. Road transportation	770.6445	0.2314	0.0386	7.3906	54.3964	10.2495	0.9431
c. Railways	30.8217	0.0017	0.0119	0.4991	0.4159	0.0832	0.0587
d. Domestic navigation	0.2207	0.0000	0.0000	0.0045	0.0030	0.0006	0.0004
e. Other transportation	52.6779	0.0009	0.0001	0.1409	0.0188	0.0047	0.0000
4. Other sectors	**1 798.5838**	**1.2211**	**0.0182**	**6.2210**	**22.3344**	**2.8415**	**5.0117**
a. Commercial/institutional	228.3903	0.0500	0.0033	0.2447	4.1754	0.4268	2.2146
b. Residential	1 281.0643	1.1324	0.0126	1.4302	14.3691	1.6576	2.2645
c. Agriculture/forestry/fishing	289.1292	0.0387	0.0023	4.5462	3.7900	0.7571	0.5326
5. Other	**44.3448**	**0.0063**	**0.0015**	**0.2691**	**0.8867**	**0.1568**	**0.4037**
a. Staţionary	26.2608	0.0031	0.0006	0.0854	0.0939	0.0060	0.3689
b. Mobile	18.0840	0.0032	0.0009	0.1837	0.7928	0.1508	0.0348
B. Fugitive emissions from fuels	**0.3931**	**22.4045**	**0.0000**	**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	**0.3931**	**22.4045**	**0.0000**	**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 Categories	CO_2	CH_4	N_2O	NO_X	CO	NMVOC	SO_2
	(kt)						
Total Energy	**6 124.4101**	**25.5546**	**0.0823**	**23.9680**	**78.6297**	**14.0072**	**9.0536**
A. Fuel combustion activities (sectoral approach)	**6 124.0342**	**1.5292**	**0.0823**	**23.9680**	**78.6297**	**13.5732**	**9.0536**
1. Energy industries	**3 155.7517**	**0.0610**	**0.0069**	**8.4378**	**1.1590**	**0.2803**	**2.7544**
a. Public electricity and heat production	**3 155.7517**	**0.0610**	**0.0069**	**8.4378**	**1.1590**	**0.2803**	**2.7544**
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	**537.2463**	**0.0123**	**0.0015**	**1.4419**	**0.2952**	**0.0496**	**0.4796**
a. Iron and steel	IE	IE	IE	IE	IE	IE	IE
b. Non-ferrous metals	IE	IE	IE	IE	IE	IE	IE
c. Chemicals	IE	IE	IE	IE	IE	IE	IE
d. Pulp, paper and print	IE	IE	IE	IE	IE	IE	IE
e. Food processing, beverages and tobacco	IE	IE	IE	IE	IE	IE	IE
f. Non-metallic minerals	IE	IE	IE	IE	IE	IE	IE
g. Other	IE	IE	IE	IE	IE	IE	IE
3. Transport	**926.2051**	**0.2370**	**0.0561**	**8.9744**	**55.6587**	**10.5079**	**1.1795**
a. Domestic aviation	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
b. Road transportation	857.5798	0.2345	0.0432	8.3390	55.1955	10.4146	1.1160
c. Railways	33.2968	0.0019	0.0129	0.5392	0.4493	0.0899	0.0634
d. Domestic navigation	0.0977	0.0000	0.0000	0.0020	0.0013	0.0003	0.0002
e. Other transportation	35.2308	0.0006	0.0001	0.0942	0.0126	0.0031	0.0000
4. Other sectors	**1 478.8536**	**1.2154**	**0.0171**	**4.9689**	**20.8854**	**2.6198**	**4.4697**
a. Commercial/institutional	205.2273	0.0475	0.0027	0.2197	3.3643	0.3459	1.7445
b. Residential	1 048.1482	1.1379	0.0126	1.2407	14.5958	1.6897	2.3142
c. Agriculture/forestry/fishing	225.4781	0.0300	0.0018	3.5086	2.9253	0.5842	0.4110
5. Other	**25.9774**	**0.0036**	**0.0008**	**0.1449**	**0.6314**	**0.1156**	**0.1704**
a. Staționary	16.1734	0.0011	0.0003	0.0489	0.0330	0.0025	0.1514
b. Mobile	9.8040	0.0025	0.0005	0.0961	0.5984	0.1131	0.0190
B. Fugitive emissions from fuels	**0.3759**	**24.0254**	**0.0000**	**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	**0.3759**	**24.0254**	**0.0000**	**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 Categories	CO_2	CH_4	N_2O	NO_X	CO	NMVOC	SO_2
	(kt)						
Total Energy	**6 731.0024**	**25.2265**	**0.0885**	**26.2808**	**81.6619**	**14.6544**	**8.7167**
A. Fuel combustion activities (sectoral approach)	**6 730.5931**	**1.4057**	**0.0885**	**26.2808**	**81.6619**	**14.2266**	**8.7167**
1. Energy industries	**3 677.7189**	**0.0726**	**0.0080**	**9.8425**	**1.4358**	**0.3317**	**2.5279**
a. Public electricity and heat production	**3 677.7189**	**0.0726**	**0.0080**	**9.8425**	**1.4358**	**0.3317**	**2.5279**
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	**618.7855**	**0.0150**	**0.0020**	**1.6750**	**0.3269**	**0.0567**	**0.6265**
a. Iron and steel	IE	IE	IE	IE	IE	IE	IE
b. Non-ferrous metals	IE	IE	IE	IE	IE	IE	IE

Greenhouse Gas Source Categories	CO_2	CH_4	N_2O	NO_X	CO	NMVOC	SO_2
	(kt)						
c. Chemicals	IE	IE	IE	IE	IE	IE	IE
d. Pulp, paper and print	IE	IE	IE	IE	IE	IE	IE
e. Food processing, beverages and tobacco	IE	IE	IE	IE	IE	IE	IE
f. Non-metallic minerals	IE	IE	IE	IE	IE	IE	IE
g. Other	IE	IE	IE	IE	IE	IE	IE
3. Transport	**989.3629**	**0.2515**	**0.0611**	**9.7695**	**59.3163**	**11.2030**	**1.2904**
a. Domestic aviation	0.0960	0.0000	0.0000	0.0004	0.0001	0.0001	0.0001
b. Road transportation	938.5285	0.2493	0.0472	9.1467	58.8258	11.1046	1.2219
c. Railways	35.7682	0.0020	0.0138	0.5792	0.4827	0.0965	0.0681
d. Domestic navigation	0.1765	0.0000	0.0000	0.0036	0.0024	0.0005	0.0003
e. Other transportation	14.7936	0.0003	0.0000	0.0396	0.0053	0.0013	0.0000
4. Other sectors	**1 416.7615**	**1.0618**	**0.0163**	**4.8004**	**19.8497**	**2.5041**	**4.0549**
a. Commercial/institutional	236.4333	0.0681	0.0032	0.2591	3.8481	0.4004	1.9172
b. Residential	964.8546	0.9562	0.0113	1.1414	13.0248	1.5205	1.7301
c. Agriculture/forestry/fishing	215.4736	0.0375	0.0018	3.3999	2.9768	0.5832	0.4076
5. Other	**27.9644**	**0.0047**	**0.0012**	**0.1934**	**0.7332**	**0.1312**	**0.2170**
a. Staționary	13.3407	0.0019	0.0004	0.0455	0.0619	0.0037	0.1888
b. Mobile	14.6237	0.0027	0.0007	0.1479	0.6713	0.1275	0.0282
B. Fugitive emissions from fuels	**0.4092**	**23.8208**	**0.0000**	**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	**0.4092**	**23.8208**	**0.0000**	**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 Categories	CO_2	CH_4	N_2O	NO_X	CO	NMVOC	SO_2
	(kt)						
Total Energy	**6 405.6634**	**27.6567**	**0.1182**	**27.4453**	**102.8280**	**18.3764**	**9.7717**
A. Fuel combustion activities (sectoral approach)	**6 405.2733**	**1.7743**	**0.1182**	**27.4453**	**102.8280**	**17.9066**	**9.7717**
1. Energy industries	**2 933.2101**	**0.0614**	**0.0069**	**7.8618**	**1.2633**	**0.2704**	**1.9697**
a. Public electricity and heat production	**2 933.2101**	**0.0614**	**0.0069**	**7.8618**	**1.2633**	**0.2704**	**1.9697**
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	**431.7808**	**0.0103**	**0.0013**	**1.1589**	**0.2403**	**0.0403**	**0.4309**
a. Iron and steel	IE	IE	IE	IE	IE	IE	IE
b. Non-ferrous metals	IE	IE	IE	IE	IE	IE	IE
c. Chemicals	IE	IE	IE	IE	IE	IE	IE
d. Pulp, paper and print	IE	IE	IE	IE	IE	IE	IE
e. Food processing, beverages and tobacco	IE	IE	IE	IE	IE	IE	IE
f. Non-metallic minerals	IE	IE	IE	IE	IE	IE	IE
g. Other	IE	IE	IE	IE	IE	IE	IE
3. Transport	**1 261.6952**	**0.3243**	**0.0892**	**12.5249**	**76.6112**	**14.4651**	**1.6186**
a. Domestic aviation	0.0831	0.0000	0.0000	0.0004	0.0001	0.0001	0.0001
b. Road transportation	1 147.4178	0.3191	0.0577	11.1104	75.4946	14.2412	1.4627
c. Railways	81.4710	0.0046	0.0314	1.3194	1.0995	0.2199	0.1551
d. Domestic navigation	0.4098	0.0000	0.0000	0.0083	0.0055	0.0011	0.0008
e. Other transportation	32.3136	0.0006	0.0001	0.0864	0.0115	0.0029	0.0000
4. Other sectors	**1 743.4526**	**1.3701**	**0.0193**	**5.6854**	**23.6946**	**2.9582**	**5.4030**
a. Commercial/institutional	426.8063	0.0852	0.0039	0.4261	4.7052	0.4856	2.2206

Greenhouse Gas Source Categories	CO_2	CH_4	N_2O	NO_X	CO	NMVOC	SO_2
	(kt)						
b. Residential	1 065.7157	1.2513	0.0134	1.2920	15.6823	1.8118	2.7170
c. Agriculture/forestry/fishing	250.9306	0.0336	0.0020	3.9674	3.3071	0.6608	0.4654
5. Other	**35.1345**	**0.0081**	**0.0015**	**0.2143**	**1.0185**	**0.1726**	**0.3494**
a. Staționary	21.0485	0.0046	0.0009	0.0765	0.1497	0.0084	0.3221
b. Mobile	14.0860	0.0036	0.0007	0.1378	0.8688	0.1642	0.0273
B. Fugitive emissions from fuels	**0.3901**	**25.8825**	**0.0000**	**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	**0.3901**	**25.8825**	**0.0000**	**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	**324.9000**						
CO_2 captured	NO						
For domestic storage	NO						
For storage in other countries	NO						

2003

Greenhouse Gas Source Categories	CO_2	CH_4	N_2O	NO_X	CO	NMVOC	SO_2
	(kt)						
Total Energy	**7 080.9417**	**29.3214**	**0.1209**	**29.7886**	**123.0619**	**21.7330**	**11.7861**
A. Fuel combustion activities (sectoral approach)	**7 079.8825**	**2.2629**	**0.1209**	**29.7886**	**123.0619**	**21.1947**	**11.7861**
1. Energy industries	**3 036.7432**	**0.0626**	**0.0069**	**8.1426**	**1.3033**	**0.2802**	**1.4374**
a. Public electricity and heat production	**3 036.7432**	**0.0626**	**0.0069**	**8.1426**	**1.3033**	**0.2802**	**1.4374**
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	**456.6402**	**0.0103**	**0.0013**	**1.2246**	**0.2474**	**0.0418**	**0.4519**
a. Iron and steel	IE	IE	IE	IE	IE	IE	IE
b. Non-ferrous metals	IE	IE	IE	IE	IE	IE	IE
c. Chemicals	IE	IE	IE	IE	IE	IE	IE
d. Pulp, paper and print	IE	IE	IE	IE	IE	IE	IE
e. Food processing, beverages and tobacco	IE	IE	IE	IE	IE	IE	IE
f. Non-metallic minerals	IE	IE	IE	IE	IE	IE	IE
g. Other	IE	IE	IE	IE	IE	IE	IE
3. Transport	**1 477.1916**	**0.3811**	**0.0873**	**14.4970**	**90.8456**	**17.1547**	**1.9169**
a. Domestic aviation	0.6414	0.0000	0.0000	0.0028	0.0009	0.0005	0.0004
b. Road transportation	1 409.9136	0.3782	0.0705	13.7246	90.2476	17.0344	1.8335
c. Railways	43.2637	0.0024	0.0167	0.7006	0.5839	0.1168	0.0823
d. Domestic navigation	0.3720	0.0000	0.0000	0.0075	0.0050	0.0010	0.0007
e. Other transportation	23.0010	0.0004	0.0000	0.0615	0.0082	0.0021	0.0000
4. Other sectors	**2 082.5048**	**1.8054**	**0.0246**	**5.7822**	**30.2158**	**3.6405**	**7.7279**
a. Commercial/institutional	580.5169	0.2144	0.0072	0.6168	8.8661	0.9398	3.6219
b. Residential	1 266.4167	1.5509	0.0154	1.4957	18.1475	2.0727	3.6669
c. Agriculture/forestry/fishing	235.5712	0.0401	0.0020	3.6697	3.2022	0.6279	0.4391
5. Other	**26.8027**	**0.0036**	**0.0008**	**0.1422**	**0.4499**	**0.0775**	**0.2519**
a. Staționary	18.7910	0.0020	0.0004	0.0615	0.0634	0.0041	0.2365
b. Mobile	8.0117	0.0016	0.0004	0.0807	0.3865	0.0734	0.0155
B. Fugitive emissions from fuels	**1.0592**	**27.0585**	**0.0000**	**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	**1.0592**	**27.0585**	**0.0000**	**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

Greenhouse Gas Source 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	**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 Categories	CO_2	CH_4	N_2O	NO_x	CO	NMVOC	SO_2
	(kt)						
Total Energy	**7 540.7092**	**31.3414**	**0.1324**	**31.7397**	**125.1157**	**22.8140**	**10.5951**
A. Fuel combustion activities (sectoral approach)	**7 539.6047**	**1.9716**	**0.1324**	**31.7397**	**125.1157**	**21.9447**	**10.5951**
1. Energy industries	**3 107.0816**	**0.0639**	**0.0071**	**8.3336**	**1.3408**	**0.2872**	**1.2771**
a. Public electricity and heat production	**3 107.0816**	**0.0639**	**0.0071**	**8.3336**	**1.3408**	**0.2872**	**1.2771**
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	**471.0767**	**0.0127**	**0.0016**	**1.2718**	**0.3512**	**0.0458**	**0.6201**
a. Iron and steel	IE	IE	IE	IE	IE	IE	IE
b. Non-ferrous metals	IE	IE	IE	IE	IE	IE	IE
c. Chemicals	IE	IE	IE	IE	IE	IE	IE
d. Pulp, paper and print	IE	IE	IE	IE	IE	IE	IE
e. Food processing, beverages and tobacco	IE	IE	IE	IE	IE	IE	IE
f. Non-metallic minerals	IE	IE	IE	IE	IE	IE	IE
g. Other	IE	IE	IE	IE	IE	IE	IE
3. Transport	**1 668.7316**	**0.4094**	**0.1017**	**16.4341**	**97.7586**	**18.4736**	**2.1947**
a. Domestic aviation	0.4041	0.0000	0.0000	0.0017	0.0006	0.0003	0.0003
b. Road transportation	1 571.7682	0.4054	0.0788	15.3700	96.9437	18.3097	2.0814
c. Railways	58.9867	0.0033	0.0228	0.9553	0.7960	0.1592	0.1123
d. Domestic navigation	0.3783	0.0000	0.0000	0.0077	0.0051	0.0010	0.0007
e. Other transportation	37.1943	0.0007	0.0001	0.0995	0.0133	0.0033	0.0000
4. Other sectors	**2 258.9904**	**1.4822**	**0.0210**	**5.4797**	**25.1063**	**3.0344**	**6.3768**
a. Commercial/institutional	822.7869	0.1775	0.0062	0.8077	7.2426	0.7583	3.0185
b. Residential	1 220.2545	1.2703	0.0130	1.4153	15.0797	1.7266	2.9609
c. Agriculture/forestry/fishing	215.9490	0.0344	0.0017	3.2568	2.7840	0.5495	0.3974
5. Other	**33.7244**	**0.0034**	**0.0011**	**0.2205**	**0.5588**	**0.1037**	**0.1264**
a. Stationary	17.4853	0.0013	0.0002	0.0516	0.0315	0.0026	0.0953
b. Mobile	16.2391	0.0021	0.0008	0.1689	0.5273	0.1011	0.0311
B. Fugitive emissions from fuels	**1.1045**	**29.3699**	**0.0000**	**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	**1.1045**	**29.3699**	**0.0000**	**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
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 Categories	CO_2	CH_4	N_2O	NO_x	CO	NMVOC	SO_2
	(kt)						
Total Energy	**7 811.9510**	**33.0891**	**0.1428**	**32.7063**	**127.2978**	**23.1601**	**10.2432**
A. Fuel combustion activities (sectoral approach)	**7 810.8291**	**2.0717**	**0.1428**	**32.7063**	**127.2978**	**22.3811**	**10.2432**
1. Energy industries	**3 229.4503**	**0.0660**	**0.0072**	**8.6604**	**1.3853**	**0.2983**	**1.1727**
a. Public electricity and heat production	**3 229.4503**	**0.0660**	**0.0072**	**8.6604**	**1.3853**	**0.2983**	**1.1727**
b. Petroleum refining	NE	NE	NE	NE	NE	NE	NE
c. Manufacture of solid fuels and other energy industries	NO	NO	NO	NO	NO	NO	NO
2. Manufacturing industries and construction	**603.9661**	**0.0145**	**0.0018**	**1.6266**	**0.3974**	**0.0569**	**0.5378**
a. Iron and steel	IE	IE	IE	IE	IE	IE	IE
b. Non-ferrous metals	IE	IE	IE	IE	IE	IE	IE
c. Chemicals	IE	IE	IE	IE	IE	IE	IE
d. Pulp, paper and print	IE	IE	IE	IE	IE	IE	IE
e. Food processing, beverages and tobacco	IE	IE	IE	IE	IE	IE	IE
f. Non-metallic minerals	IE	IE	IE	IE	IE	IE	IE
g. Other	IE	IE	IE	IE	IE	IE	IE
3. Transport	**1 723.9901**	**0.4222**	**0.1122**	**17.1134**	**100.5947**	**19.0104**	**2.2795**
a. Domestic aviation	0.1103	0.0000	0.0000	0.0005	0.0002	0.0001	0.0001
b. Road transportation	1 607.7107	0.4170	0.0810	15.7059	99.4889	18.7886	2.1253
c. Railways	80.6729	0.0045	0.0311	1.3064	1.0887	0.2177	0.1536
d. Domestic navigation	0.3215	0.0000	0.0000	0.0065	0.0043	0.0009	0.0006
e. Other transportation	35.1747	0.0006	0.0001	0.0941	0.0125	0.0031	0.0000
4. Other sectors	**2 218.7801**	**1.5662**	**0.0206**	**5.0944**	**24.5675**	**2.9510**	**6.1272**
a. Commercial/institutional	702.3918	0.1394	0.0050	0.6847	5.8510	0.6102	2.4525
b. Residential	1 331.6290	1.3938	0.0140	1.5268	16.1941	1.8470	3.3182
c. Agriculture/forestry/fishing	184.7593	0.0330	0.0015	2.8829	2.5224	0.4939	0.3565
5. Other	**34.6426**	**0.0028**	**0.0010**	**0.2115**	**0.3529**	**0.0646**	**0.1261**
a. Staționary	20.3994	0.0015	0.0003	0.0603	0.0361	0.0030	0.0989
b. Mobile	14.2432	0.0013	0.0007	0.1512	0.3168	0.0616	0.0272
B. Fugitive emissions from fuels	**1.1219**	**31.0174**	**0.0000**	**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	**1.1219**	**31.0174**	**0.0000**	**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
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 Categories	CO_2	CH_4	N_2O	NO_x	CO	NMVOC	SO_2
	(kt)						
Total Energy	**7 069.0187**	**29.5995**	**0.1486**	**30.6692**	**122.9391**	**22.0307**	**10.5018**
A. Fuel combustion activities (sectoral approach)	**7 067.7927**	**2.2692**	**0.1486**	**30.6692**	**122.9391**	**21.3514**	**10.5018**
1. Energy industries	**2 492.9310**	**0.0517**	**0.0057**	**6.6886**	**1.0976**	**0.2317**	**0.8876**
a. Public electricity and heat production	**2 492.9310**	**0.0517**	**0.0057**	**6.6886**	**1.0976**	**0.2317**	**0.8876**
b. Petroleum refining	NE	NE	NE	NE	NE	NE	NE
c. Manufacture of solid fuels and other energy industries	NO	NO	NO	NO	NO	NO	NO
2. Manufacturing industries and construction	**668.5271**	**0.0148**	**0.0018**	**1.7956**	**0.3704**	**0.0609**	**0.5672**
a. Iron and steel	IE	IE	IE	IE	IE	IE	IE
b. Non-ferrous metals	IE	IE	IE	IE	IE	IE	IE
c. Chemicals	IE	IE	IE	IE	IE	IE	IE
d. Pulp, paper and print	IE	IE	IE	IE	IE	IE	IE
e. Food processing, beverages and tobacco	IE	IE	IE	IE	IE	IE	IE
f. Non-metallic minerals	IE	IE	IE	IE	IE	IE	IE

Greenhouse Gas Source Categories	CO_2	CH_4	N_2O	NO_X	CO	NMVOC	SO_2
	(kt)						
g. Other	IE	IE	IE	IE	IE	IE	IE
3. Transport	**1 651.9002**	**0.3897**	**0.1168**	**16.8128**	**93.4424**	**17.6745**	**2.2771**
a. Domestic aviation	0.1929	0.0000	0.0000	0.0008	0.0003	0.0001	0.0001
b. Road transportation	1 544.2673	0.3839	0.0779	15.1596	92.0784	17.4015	2.0850
c. Railways	100.6052	0.0056	0.0388	1.6292	1.3577	0.2715	0.1915
d. Domestic navigation	0.2711	0.0000	0.0000	0.0055	0.0037	0.0007	0.0005
e. Other transportation	6.5637	0.0001	0.0000	0.0176	0.0023	0.0006	0.0000
4. Other sectors	**2 203.5166**	**1.8096**	**0.0229**	**5.0878**	**27.5881**	**3.3028**	**6.4610**
a. Commercial/institutional	644.5057	0.1450	0.0050	0.6334	5.7988	0.6083	2.3346
b. Residential	1 380.1564	1.6302	0.0164	1.6182	19.2683	2.2036	3.7763
c. Agriculture/forestry/fishing	178.8545	0.0344	0.0015	2.8362	2.5210	0.4909	0.3501
5. Other	**50.9179**	**0.0034**	**0.0014**	**0.2844**	**0.4406**	**0.0815**	**0.3090**
a. Staţionary	33.3608	0.0018	0.0005	0.0983	0.0408	0.0038	0.2755
b. Mobile	17.5571	0.0016	0.0009	0.1861	0.3998	0.0777	0.0335
B. Fugitive emissions from fuels	**1.2260**	**27.3303**	**0.0000**	**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	**1.2260**	**27.3303**	**0.0000**	**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 Categories	CO_2	CH_4	N_2O	NO_X	CO	NMVOC	SO_2
	(kt)						
Total Energy	**7 208.6350**	**30.8524**	**0.1495**	**32.5239**	**120.7018**	**22.2713**	**8.3615**
A. Fuel combustion activities (sectoral approach)	**7 207.3774**	**1.7986**	**0.1495**	**32.5239**	**120.7018**	**21.4002**	**8.3615**
1. Energy industries	**2 890.4481**	**0.0592**	**0.0063**	**7.7534**	**1.2656**	**0.2688**	**0.5638**
a. Public electricity and heat production	**2 890.4481**	**0.0592**	**0.0063**	**7.7534**	**1.2656**	**0.2688**	**0.5638**
b. Petroleum refining	NE	NE	NE	NE	NE	NE	NE
c. Manufacture of solid fuels and other energy industries	NO	NO	NO	NO	NO	NO	NO
2. Manufacturing industries and construction	**831.1775**	**0.0169**	**0.0019**	**2.2278**	**0.4592**	**0.0748**	**0.3809**
a. Iron and steel	IE	IE	IE	IE	IE	IE	IE
b. Non-ferrous metals	IE	IE	IE	IE	IE	IE	IE
c. Chemicals	IE	IE	IE	IE	IE	IE	IE
d. Pulp, paper and print	IE	IE	IE	IE	IE	IE	IE
e. Food processing, beverages and tobacco	IE	IE	IE	IE	IE	IE	IE
f. Non-metallic minerals	IE	IE	IE	IE	IE	IE	IE
g. Other	IE	IE	IE	IE	IE	IE	IE
3. Transport	**1 757.8033**	**0.4066**	**0.1216**	**17.9824**	**96.8558**	**18.3272**	**2.4643**
a. Domestic aviation	0.1229	0.0000	0.0000	0.0005	0.0002	0.0001	0.0001
b. Road transportation	1 653.3638	0.4008	0.0826	16.3323	95.4876	18.0534	2.2714
c. Railways	100.9750	0.0057	0.0390	1.6352	1.3627	0.2725	0.1922
d. Domestic navigation	0.3121	0.0000	0.0000	0.0063	0.0042	0.0008	0.0006
e. Other transportation	3.0294	0.0001	0.0000	0.0081	0.0011	0.0003	0.0000
4. Other sectors	**1 666.7458**	**1.3113**	**0.0178**	**4.1758**	**21.4422**	**2.6024**	**4.7091**
a. Commercial/institutional	361.9216	0.1193	0.0039	0.3773	4.7658	0.5052	1.8839
b. Residential	1 152.4286	1.1664	0.0126	1.3548	14.5622	1.6809	2.5314
c. Agriculture/forestry/fishing	152.3956	0.0256	0.0013	2.4437	2.1142	0.4163	0.2937
5. Other	**61.2028**	**0.0046**	**0.0019**	**0.3845**	**0.6790**	**0.1271**	**0.2434**
a. Staţionary	34.4911	0.0021	0.0005	0.1019	0.0449	0.0041	0.1924
b. Mobile	26.7117	0.0025	0.0014	0.2826	0.6342	0.1230	0.0511

Greenhouse Gas Source Categories	CO_2	CH_4	N_2O	NO_x	CO	NMVOC	SO_2
	(kt)						
B. Fugitive emissions from fuels	**1.2577**	**29.0538**	**0.0000**	**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	**1.2577**	**29.0538**	**0.0000**	**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 Categories	CO_2	CH_4	N_2O	NO_x	CO	NMVOC	SO_2
	(kt)						
Total Energy	**7 797.1121**	**30.7646**	**0.1602**	**34.8468**	**126.1410**	**23.5029**	**14.7669**
A. Fuel combustion activities (sectoral approach)	**7 795.8374**	**1.8660**	**0.1602**	**34.8468**	**126.1410**	**22.3546**	**14.7669**
1. Energy industries	**3 292.3392**	**0.0691**	**0.0118**	**8.9779**	**1.4975**	**0.3003**	**4.5794**
a. Public electricity and heat production	**3 292.3392**	**0.0691**	**0.0118**	**8.9779**	**1.4975**	**0.3003**	**4.5794**
b. Petroleum refining	NE	NE	NE	NE	NE	NE	NE
c. Manufacture of solid fuels and other energy industries	NO	NO	NO	NO	NO	NO	NO
2. Manufacturing industries and construction	**914.5002**	**0.0349**	**0.0047**	**2.5416**	**0.7142**	**0.1050**	**2.6179**
a. Iron and steel	IE	IE	IE	IE	IE	IE	IE
b. Non-ferrous metals	IE	IE	IE	IE	IE	IE	IE
c. Chemicals	IE	IE	IE	IE	IE	IE	IE
d. Pulp, paper and print	IE	IE	IE	IE	IE	IE	IE
e. Food processing, beverages and tobacco	IE	IE	IE	IE	IE	IE	IE
f. Non-metallic minerals	IE	IE	IE	IE	IE	IE	IE
g. Other	IE	IE	IE	IE	IE	IE	IE
3. Transport	**1 848.7566**	**0.4221**	**0.1233**	**18.8620**	**101.0306**	**19.1218**	**2.6186**
a. Domestic aviation	0.1482	0.0000	0.0000	0.0006	0.0002	0.0001	0.0001
b. Road transportation	1 751.6164	0.4168	0.0876	17.3439	99.7746	18.8704	2.4416
c. Railways	92.6093	0.0052	0.0357	1.4997	1.2498	0.2500	0.1763
d. Domestic navigation	0.3436	0.0000	0.0000	0.0070	0.0046	0.0009	0.0007
e. Other transportation	4.0392	0.0001	0.0000	0.0108	0.0014	0.0004	0.0000
4. Other sectors	**1 677.3708**	**1.3356**	**0.0186**	**4.1047**	**22.2423**	**2.7039**	**4.5404**
a. Commercial/institutional	370.7184	0.1296	0.0040	0.3901	4.7134	0.5033	1.9113
b. Residential	1 156.8420	1.1821	0.0135	1.3801	15.5241	1.8050	2.3462
c. Agriculture/forestry/fishing	149.8105	0.0239	0.0012	2.3345	2.0048	0.3956	0.2829
5. Other	**62.8705**	**0.0042**	**0.0017**	**0.3607**	**0.6564**	**0.1236**	**0.4105**
a. Staționary	39.6045	0.0017	0.0005	0.1159	0.0358	0.0038	0.3660
b. Mobile	23.2659	0.0025	0.0012	0.2448	0.6205	0.1198	0.0445
B. Fugitive emissions from fuels	**1.2748**	**28.8986**	**0.0000**	**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	**1.2748**	**28.8986**	**0.0000**	**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**						

Greenhouse Gas Source Categories	CO_2	CH_4	N_2O	NO_X	CO	NMVOC	SO_2
	(kt)						
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 Categories	CO_2	CH_4	N_2O	NO_X	CO	NMVOC	SO_2
	(kt)						
Total Energy	**8 606.6397**	**25.9034**	**0.1613**	**36.1288**	**125.9630**	**23.3804**	**18.9374**
A. Fuel combustion activities (sectoral approach)	**8 605.3665**	**1.9861**	**0.1613**	**36.1288**	**125.9630**	**22.2479**	**18.9374**
1. Energy industries	**4 452.7046**	**0.0914**	**0.0185**	**12.2184**	**1.9199**	**0.3947**	**9.5045**
a. Public electricity and heat production	**4 452.7046**	**0.0914**	**0.0185**	**12.2184**	**1.9199**	**0.3947**	**9.5045**
b. Petroleum refining	NE	NE	NE	NE	NE	NE	NE
c. Manufacture of solid fuels and other energy industries	NO	NO	NO	NO	NO	NO	NO
2. Manufacturing industries and construction	**507.6894**	**0.0221**	**0.0031**	**1.4245**	**0.4309**	**0.0619**	**1.7887**
a. Iron and steel	IE	IE	IE	IE	IE	IE	IE
b. Non-ferrous metals	IE	IE	IE	IE	IE	IE	IE
c. Chemicals	IE	IE	IE	IE	IE	IE	IE
d. Pulp, paper and print	IE	IE	IE	IE	IE	IE	IE
e. Food processing, beverages and tobacco	IE	IE	IE	IE	IE	IE	IE
f. Non-metallic minerals	IE	IE	IE	IE	IE	IE	IE
g. Other	IE	IE	IE	IE	IE	IE	IE
3. Transport	**1 807.3330**	**0.4302**	**0.1199**	**18.3053**	**100.3654**	**18.9797**	**2.5152**
a. Domestic aviation	0.0743	0.0000	0.0000	0.0003	0.0001	0.0001	0.0000
b. Road transportation	1 710.7699	0.4251	0.0864	16.8695	99.1877	18.7439	2.3496
c. Railways	86.7368	0.0049	0.0335	1.4046	1.1705	0.2341	0.1651
d. Domestic navigation	0.2711	0.0000	0.0000	0.0055	0.0037	0.0007	0.0005
e. Other transportation	9.4809	0.0002	0.0000	0.0254	0.0034	0.0008	0.0000
4. Other sectors	**1 824.7201**	**1.4415**	**0.0195**	**4.1212**	**23.0987**	**2.7846**	**5.0117**
a. Commercial/institutional	476.5648	0.2179	0.0053	0.5274	6.1622	0.6758	2.1805
b. Residential	1 209.0564	1.1981	0.0130	1.4055	15.0047	1.7317	2.5639
c. Agriculture/forestry/fishing	139.0989	0.0255	0.0012	2.1884	1.9318	0.3771	0.2674
5. Other	**12.9193**	**0.0010**	**0.0003**	**0.0593**	**0.1482**	**0.0271**	**0.1172**
a. Staționary	9.9033	0.0004	0.0001	0.0288	0.0115	0.0011	0.1114
b. Mobile	3.0161	0.0006	0.0002	0.0305	0.1367	0.0260	0.0058
B. Fugitive emissions from fuels	**1.2732**	**23.9173**	**0.0000**	**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	**1.2732**	**23.9173**	**0.0000**	**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 Categories	CO_2	CH_4	N_2O	NO_x	CO	NMVOC	SO_2
	(kt)						
Total Energy	**9 148.1087**	**25.3241**	**0.1594**	**39.0509**	**125.3956**	**23.0859**	**18.4660**
A. Fuel combustion activities (sectoral approach)	**9 146.8340**	**2.1313**	**0.1594**	**39.0509**	**125.3956**	**22.2089**	**18.4660**
1. Energy industries	**4 589.7895**	**0.0965**	**0.0180**	**12.5571**	**2.0615**	**0.4139**	**8.4258**
a. Public electricity and heat production	**4 589.7895**	**0.0965**	**0.0180**	**12.5571**	**2.0615**	**0.4139**	**8.4258**
b. Petroleum refining	NE	NE	NE	NE	NE	NE	NE
c. Manufacture of solid fuels and other energy industries	NO	NO	NO	NO	NO	NO	NO
2. Manufacturing industries and construction	**539.5862**	**0.0228**	**0.0032**	**1.5074**	**0.4630**	**0.0644**	**1.7348**
a. Iron and steel	IE	IE	IE	IE	IE	IE	IE
b. Non-ferrous metals	IE	IE	IE	IE	IE	IE	IE
c. Chemicals	IE	IE	IE	IE	IE	IE	IE
d. Pulp, paper and print	IE	IE	IE	IE	IE	IE	IE
e. Food processing, beverages and tobacco	IE	IE	IE	IE	IE	IE	IE
f. Non-metallic minerals	IE	IE	IE	IE	IE	IE	IE
g. Other	IE	IE	IE	IE	IE	IE	IE
3. Transport	**2 007.4377**	**0.4354**	**0.1187**	**20.4225**	**100.2581**	**18.9936**	**2.9510**
a. Domestic aviation	0.1144	0.0000	0.0000	0.0005	0.0002	0.0001	0.0001
b. Road transportation	1 953.6146	0.4325	0.0988	19.5801	99.5612	18.8541	2.8528
c. Railways	51.3468	0.0029	0.0198	0.8315	0.6929	0.1386	0.0977
d. Domestic navigation	0.2301	0.0000	0.0000	0.0047	0.0031	0.0006	0.0004
e. Other transportation	2.1318	0.0000	0.0000	0.0057	0.0008	0.0002	0.0000
4. Other sectors	**1 985.9921**	**1.5743**	**0.0190**	**4.4650**	**22.4025**	**2.7027**	**5.0653**
a. Commercial/institutional	477.2015	0.1304	0.0035	0.4887	3.8871	0.4189	1.4066
b. Residential	1 353.0451	1.4132	0.0141	1.5357	16.3240	1.8588	3.3607
c. Agriculture/forestry/fishing	155.7455	0.0307	0.0013	2.4406	2.1914	0.4249	0.2981
5. Other	**24.0285**	**0.0022**	**0.0006**	**0.0989**	**0.2105**	**0.0343**	**0.2890**
a. Staționary	20.5266	0.0016	0.0004	0.0635	0.0478	0.0034	0.2822
b. Mobile	3.5018	0.0007	0.0002	0.0354	0.1627	0.0309	0.0068
B. Fugitive emissions from fuels	**1.2747**	**23.1928**	**0.0000**	**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	**1.2747**	**23.1928**	**0.0000**	**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	**343.3412**						
CO_2 captured	NO						
For domestic storage	NO						
For storage in other countries	NO						

2011

Greenhouse Gas Source Categories	CO_2	CH_4	N_2O	NO_x	CO	NMVOC	SO_2
	(kt)						
Total Energy	**9 230.5492**	**28.6717**	**0.1637**	**39.4830**	**131.6881**	**24.2590**	**17.2073**
A. Fuel combustion activities (sectoral approach)	**9 229.2351**	**2.2555**	**0.1637**	**39.4830**	**131.6881**	**23.2423**	**17.2073**
1. Energy industries	**4 181.2774**	**0.0859**	**0.0152**	**11.4061**	**1.8179**	**0.3760**	**6.6957**
a. Public electricity and heat production	**4 181.2774**	**0.0859**	**0.0152**	**11.4061**	**1.8179**	**0.3760**	**6.6957**
b. Petroleum refining	NE	NE	NE	NE	NE	NE	NE
c. Manufacture of solid fuels and other energy industries	NO	NO	NO	NO	NO	NO	NO
2. Manufacturing industries and construction	**599.6756**	**0.0273**	**0.0038**	**1.6749**	**0.5802**	**0.0746**	**2.1379**
a. Iron and steel	IE	IE	IE	IE	IE	IE	IE
b. Non-ferrous metals	IE	IE	IE	IE	IE	IE	IE
c. Chemicals	IE	IE	IE	IE	IE	IE	IE

Greenhouse Gas Source Categories	CO_2	CH_4	N_2O	NO_x	CO	NMVOC	SO_2
	(kt)						
d. Pulp, paper and print	IE	IE	IE	IE	IE	IE	IE
e. Food processing, beverages and tobacco	IE	IE	IE	IE	IE	IE	IE
f. Non-metallic minerals	IE	IE	IE	IE	IE	IE	IE
g. Other	IE	IE	IE	IE	IE	IE	IE
3. Transport	**2 116.7005**	**0.4384**	**0.1228**	**21.5408**	**104.1850**	**19.7559**	**3.1333**
a. Domestic aviation	0.1181	0.0000	0.0000	0.0005	0.0002	0.0001	0.0001
b. Road transportation	2 069.1207	0.4357	0.1046	20.7708	103.5443	19.6277	3.0429
c. Railways	47.2252	0.0026	0.0182	0.7648	0.6373	0.1275	0.0899
d. Domestic navigation	0.2364	0.0000	0.0000	0.0048	0.0032	0.0006	0.0005
e. Other transportation	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
4. Other sectors	**2 309.8144**	**1.7026**	**0.0214**	**4.7683**	**24.9419**	**3.0066**	**5.0153**
a. Commercial/institutional	806.0042	0.1538	0.0040	0.7682	4.1189	0.4393	1.3462
b. Residential	1 351.7459	1.5223	0.0161	1.6184	18.7527	2.1609	3.3772
c. Agriculture/forestry/fishing	152.0644	0.0264	0.0013	2.3817	2.0703	0.4065	0.2919
5. Other	**21.7672**	**0.0013**	**0.0005**	**0.0928**	**0.1631**	**0.0292**	**0.2251**
a. Staționary	17.9050	0.0007	0.0003	0.0535	0.0203	0.0019	0.2178
b. Mobile	3.8622	0.0006	0.0002	0.0393	0.1428	0.0273	0.0073
B. Fugitive emissions from fuels	**1.3141**	**26.4162**	**0.0000**	**0.0000**	**0.0000**	**1.0167**	**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	**1.3141**	**26.4162**	**0.0000**	**0.0000**	**0.0000**	**1.0167**	**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	**386.2234**						
CO_2 captured	NO						
For domestic storage	NO						
For storage in other countries	NO						

2012

Greenhouse Gas Source Categories	CO_2	CH_4	N_2O	NO_x	CO	NMVOC	SO_2
	(kt)						
Total Energy	**8 897.8193**	**28.4484**	**0.1527**	**36.7628**	**117.4788**	**21.3257**	**16.3476**
A. Fuel combustion activities (sectoral approach)	**8 896.5089**	**2.4119**	**0.1527**	**36.7628**	**117.4788**	**20.3960**	**16.3476**
1. Energy industries	**4 190.8271**	**0.0806**	**0.0144**	**11.4154**	**1.6530**	**0.3687**	**6.3171**
a. Public electricity and heat production	**4 190.8271**	**0.0806**	**0.0144**	**11.4154**	**1.6530**	**0.3687**	**6.3171**
b. Petroleum refining	NE	NE	NE	NE	NE	NE	NE
c. Manufacture of solid fuels and other energy industries	NO	NO	NO	NO	NO	NO	NO
2. Manufacturing industries and construction	**563.6377**	**0.0232**	**0.0032**	**1.5729**	**0.5298**	**0.0671**	**1.5965**
a. Iron and steel	IE	IE	IE	IE	IE	IE	IE
b. Non-ferrous metals	IE	IE	IE	IE	IE	IE	IE
c. Chemicals	IE	IE	IE	IE	IE	IE	IE
d. Pulp, paper and print	IE	IE	IE	IE	IE	IE	IE
e. Food processing, beverages and tobacco	IE	IE	IE	IE	IE	IE	IE
f. Non-metallic minerals	IE	IE	IE	IE	IE	IE	IE
g. Other	IE	IE	IE	IE	IE	IE	IE
3. Transport	**1 862.8628**	**0.3734**	**0.1120**	**19.0501**	**87.9904**	**16.6961**	**2.8130**
a. Domestic aviation	0.2021	0.0000	0.0000	0.0009	0.0003	0.0001	0.0001
b. Road transportation	1 808.3423	0.3705	0.0924	18.2133	87.3005	16.5579	2.7158
c. Railways	50.7384	0.0028	0.0196	0.8217	0.6847	0.1369	0.0966
d. Domestic navigation	0.2701	0.0000	0.0000	0.0055	0.0036	0.0007	0.0005
e. Other transportation	3.3099	0.0001	0.0000	0.0089	0.0012	0.0003	0.0000
4. Other sectors	**2 271.4679**	**1.9341**	**0.0229**	**4.6777**	**27.1805**	**3.2403**	**5.5744**
a. Commercial/institutional	777.0093	0.1756	0.0041	0.7468	4.3631	0.4718	1.2626

Greenhouse Gas Source Categories	CO_2	CH_4	N_2O	NO_X	CO	NMVOC	SO_2
	(kt)						
b. Residential	1 345.5955	1.7270	0.0175	1.6419	20.7339	2.3670	4.0261
c. Agriculture/forestry/fishing	148.8631	0.0315	0.0013	2.2890	2.0835	0.4015	0.2858
5. Other	**7.7134**	**0.0006**	**0.0002**	**0.0466**	**0.1251**	**0.0239**	**0.0466**
a. Staţionary	4.3648	0.0001	0.0000	0.0125	0.0022	0.0003	0.0402
b. Mobile	3.3486	0.0005	0.0002	0.0341	0.1230	0.0235	0.0064
B. Fugitive emissions from fuels	**1.3104**	**26.0365**	**0.0000**	**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	**1.3104**	**26.0365**	**0.0000**	**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
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	**404.3122**						
CO_2 captured	NO						
For domestic storage	NO						
For storage in other countries	NO						

2013

Greenhouse Gas Source Categories	CO_2	CH_4	N_2O	NO_X	CO	NMVOC	SO_2
	(kt)						
Total Energy	**7 835.9759**	**27.2620**	**0.1535**	**35.5789**	**116.6533**	**21.0355**	**19.1181**
A. Fuel combustion activities (sectoral approach)	**7 834.3318**	**2.4637**	**0.1535**	**35.5789**	**116.6533**	**20.1562**	**19.1181**
1. Energy industries	**3 310.5699**	**0.0656**	**0.0141**	**9.1042**	**1.4032**	**0.2912**	**7.2180**
a. Public electricity and heat production	**3 310.5699**	**0.0656**	**0.0141**	**9.1042**	**1.4032**	**0.2912**	**7.2180**
b. Petroleum refining	NE	NE	NE	NE	NE	NE	NE
c. Manufacture of solid fuels and other energy industries	NO	NO	NO	NO	NO	NO	NO
2. Manufacturing industries and construction	**599.5639**	**0.0310**	**0.0044**	**1.6913**	**0.6181**	**0.0799**	**2.6151**
a. Iron and steel	IE	IE	IE	IE	IE	IE	IE
b. Non-ferrous metals	IE	IE	IE	IE	IE	IE	IE
c. Chemicals	IE	IE	IE	IE	IE	IE	IE
d. Pulp, paper and print	IE	IE	IE	IE	IE	IE	IE
e. Food processing, beverages and tobacco	IE	IE	IE	IE	IE	IE	IE
f. Non-metallic minerals	IE	IE	IE	IE	IE	IE	IE
g. Other	IE	IE	IE	IE	IE	IE	IE
3. Transport	**1 972.4617**	**0.3736**	**0.1114**	**20.1215**	**86.1610**	**16.3683**	**3.0321**
a. Domestic aviation	0.1922	0.0000	0.0000	0.0008	0.0003	0.0001	0.0001
b. Road transportation	1 926.9672	0.3715	0.0989	19.5566	85.7152	16.2788	2.9697
c. Railways	32.4079	0.0018	0.0125	0.5248	0.4374	0.0875	0.0617
d. Domestic navigation	0.2719	0.0000	0.0000	0.0055	0.0037	0.0007	0.0005
e. Other transportation	12.6225	0.0002	0.0000	0.0338	0.0045	0.0011	0.0000
4. Other sectors	**1 947.9381**	**1.9933**	**0.0235**	**4.6348**	**28.4029**	**3.4037**	**6.2194**
a. Commercial/institutional	471.0134	0.1303	0.0035	0.4690	3.9791	0.4253	1.6757
b. Residential	1 311.5084	1.8255	0.0186	1.6408	22.1217	2.5356	4.2108
c. Agriculture/forestry/fishing	165.4163	0.0375	0.0014	2.5251	2.3021	0.4428	0.3329
5. Other	**3.7983**	**0.0003**	**0.0001**	**0.0271**	**0.0682**	**0.0131**	**0.0335**
a. Staţionary	1.6550	0.0000	0.0000	0.0049	0.0003	0.0001	0.0295
b. Mobile	2.1433	0.0003	0.0001	0.0221	0.0678	0.0130	0.0041
B. Fugitive emissions from fuels	**1.6441**	**24.7983**	**0.0000**	**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	**1.6441**	**24.7983**	**0.0000**	**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

Greenhouse Gas Source Categories	CO_2	CH_4	N_2O	NO_X	CO	NMVOC	SO_2
	(kt)						
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
Multilateral operations	NO	NO	NO	NO	NO	NO	NO
CO_2 emissions from biomass	**431.4636**						
CO_2 captured	NO						
For domestic storage	NO						
For storage in other countries	NO						

2014

Greenhouse Gas Source Categories	CO_2	CH_4	N_2O	NO_X	CO	NMVOC	SO_2
	(kt)						
Total Energy	**8 581.9429**	**28.3945**	**0.1776**	**39.4038**	**155.1296**	**25.7186**	**21.9002**
A. Fuel combustion activities (sectoral approach)	**8 580.2708**	**4.5816**	**0.1776**	**39.4038**	**155.1296**	**24.9414**	**21.9002**
1. Energy industries	**4 014.9274**	**0.0810**	**0.0153**	**10.9980**	**1.8876**	**0.3667**	**6.8685**
a. Public electricity and heat production	**4 014.9274**	**0.0810**	**0.0153**	**10.9980**	**1.8876**	**0.3667**	**6.8685**
b. Petroleum refining	NE	NE	NE	NE	NE	NE	NE
c. Manufacture of solid fuels and other energy industries	NO	NO	NO	NO	NO	NO	NO
2. Manufacturing industries and construction	**585.7254**	**0.0274**	**0.0038**	**1.6513**	**0.5392**	**0.0740**	**2.2402**
a. Iron and steel	IE	IE	IE	IE	IE	IE	IE
b. Non-ferrous metals	IE	IE	IE	IE	IE	IE	IE
c. Chemicals	IE	IE	IE	IE	IE	IE	IE
d. Pulp, paper and print	IE	IE	IE	IE	IE	IE	IE
e. Food processing, beverages and tobacco	IE	IE	IE	IE	IE	IE	IE
f. Non-metallic minerals	IE	IE	IE	IE	IE	IE	IE
g. Other	IE	IE	IE	IE	IE	IE	IE
3. Transport	**2 049.6073**	**0.3748**	**0.1051**	**20.7783**	**86.9611**	**16.5327**	**3.1761**
a. Domestic aviation	0.1166	0.0000	0.0000	0.0005	0.0002	0.0001	0.0001
b. Road transportation	2 030.0041	0.3743	0.1040	20.6831	86.9139	16.5230	3.1702
c. Railways	2.7049	0.0002	0.0010	0.0438	0.0365	0.0073	0.0051
d. Domestic navigation	0.3444	0.0000	0.0000	0.0070	0.0046	0.0009	0.0007
e. Other transportation	16.4373	0.0003	0.0000	0.0440	0.0059	0.0015	0.0000
4. Other sectors	**1 927.7357**	**4.0980**	**0.0533**	**5.9605**	**65.6711**	**7.9546**	**9.5958**
a. Commercial/institutional	482.9781	0.1892	0.0038	0.4986	4.4207	0.4771	3.3959
b. Residential	1 246.5418	3.8638	0.0477	2.3301	58.3881	6.9268	5.7985
c. Agriculture/forestry/fishing	198.2158	0.0451	0.0018	3.1318	2.8624	0.5508	0.4014
5. Other	**2.2750**	**0.0003**	**0.0001**	**0.0156**	**0.0705**	**0.0134**	**0.0196**
a. Stationary	0.9603	0.0000	0.0000	0.0029	0.0002	0.0000	0.0171
b. Mobile	1.3147	0.0003	0.0001	0.0128	0.0703	0.0133	0.0025
B. Fugitive emissions from fuels	**1.6721**	**23.8129**	**0.0000**	**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	**1.6721**	**23.8129**	**0.0000**	**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	**154.5065**	**0.0034**	**0.0049**	**0.6256**	**0.3250**	**0.1444**	**0.0490**
Aviation	154.5065	0.0034	0.0049	0.6256	0.3250	0.1444	0.0490
Navigation	NO	NO	NO	NO	NO	NO	NO
Multilateral operations	NO	NO	NO	NO	NO	NO	NO
CO_2 emissions from biomass	**1 317.1650**						
CO_2 captured	NO						
For domestic storage	NO						
For storage in other countries	NO						

Greenhouse Gas Source Categories	CO_2	CH_4	N_2O	NO_X	CO	NMVOC	SO_2
	(kt)						
Total Energy	**8 759.0707**	**27.5275**	**0.1936**	**41.4066**	**164.0111**	**26.8381**	**21.2059**
A. Fuel combustion activities (sectoral approach)	**8 757.4126**	**4.8634**	**0.1936**	**41.4066**	**164.0111**	**26.1223**	**21.2059**
1. Energy industries	**4 141.2201**	**0.0717**	**0.0136**	**11.2794**	**1.4073**	**0.3526**	**5.9151**
a. Public electricity and heat production	**4 141.2201**	**0.0717**	**0.0136**	**11.2794**	**1.4073**	**0.3526**	**5.9151**
b. Petroleum refining	NE	NE	NE	NE	NE	NE	NE
c. Manufacture of solid fuels and other energy industries	NO	NO	NO	NO	NO	NO	NO
2. Manufacturing industries and construction	**665.6173**	**0.0407**	**0.0056**	**1.9040**	**2.2239**	**0.1007**	**2.5810**
a. Iron and steel	IE	IE	IE	IE	IE	IE	IE
b. Non-ferrous metals	IE	IE	IE	IE	IE	IE	IE
c. Chemicals	IE	IE	IE	IE	IE	IE	IE
d. Pulp, paper and print	IE	IE	IE	IE	IE	IE	IE
e. Food processing, beverages and tobacco	IE	IE	IE	IE	IE	IE	IE
f. Non-metallic minerals	IE	IE	IE	IE	IE	IE	IE
g. Other	IE	IE	IE	IE	IE	IE	IE
3. Transport	**2 158.1164**	**0.3941**	**0.1175**	**21.9992**	**90.0932**	**17.1297**	**3.3575**
a. Domestic aviation	0.3044	0.0000	0.0000	0.0013	0.0004	0.0002	0.0002
b. Road transportation	2 119.3613	0.3925	0.1091	21.6000	89.7928	17.0692	3.3158
c. Railways	21.6726	0.0012	0.0084	0.3510	0.2925	0.0585	0.0413
d. Domestic navigation	0.1163	0.0000	0.0000	0.0024	0.0016	0.0003	0.0002
e. Other transportation	16.6617	0.0003	0.0000	0.0446	0.0059	0.0015	0.0000
4. Other sectors	**1 790.2120**	**4.3567**	**0.0568**	**6.2097**	**70.2315**	**8.5288**	**9.3297**
a. Commercial/institutional	340.0285	0.1451	0.0032	0.3595	3.6728	0.3951	2.7760
b. Residential	1 231.3854	4.1654	0.0518	2.4227	63.5073	7.5410	6.1102
c. Agriculture/forestry/fishing	218.7982	0.0462	0.0019	3.4275	3.0514	0.5927	0.4435
5. Other	**2.2468**	**0.0002**	**0.0001**	**0.0144**	**0.0551**	**0.0105**	**0.0226**
a. Staționary	1.1524	0.0000	0.0000	0.0034	0.0002	0.0001	0.0205
b. Mobile	1.0944	0.0002	0.0001	0.0110	0.0549	0.0104	0.0021
B. Fugitive emissions from fuels	**1.6581**	**22.6641**	**0.0000**	**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	**1.6581**	**22.6641**	**0.0000**	**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	**218.4093**	**0.0058**	**0.0070**	**0.9142**	**0.4451**	**0.2206**	**0.0693**
Aviation	218.4093	0.0058	0.0070	0.9142	0.4451	0.2206	0.0693
Navigation	NO	NO	NO	NO	NO	NO	NO
Multilateral operations	NO	NO	NO	NO	NO	NO	NO
CO_2 emissions from biomass	**1 439.8048**						
CO_2 captured	NO						
For domestic storage	NO						
For storage in other countries	NO						

Annex 6-2: Sectoral Report for Industrial Processes and Product Use Sector, 1990-2015

1990

Greenhouse Gas Source and Sink Categories	CO_2	CH_4	N_2O	HFC	PFC	Unspecified mix of HFC and PFC	SF_6	NF_3	NO_x	CO	NMVOC	SO_2
	(kt)			CO_2 equivalent (kt)					(kt)			
2. Industrial Processes and Product Use	**1 580.9940**	**NO**	**0.0001**	**NO, NE**	**NO, NE**	**NO, NE**	**NO, NE**	**NO, NE**	**3.6575**	**5.4300**	**106.6288**	**1.3330**
A. Mineral Industry	**1 316.1041**								**3.5018**	**3.3740**	**0.0339**	**1.2687**
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	86.6865								0.1415	0.1454		0.0305
B. Chemical Industry	**NO**	**NO**	**NO**						**NO**	**NO**	**0.0650**	**NO**
1. Ammonia Production	NO	NO	NO						NO	NO	NO	NO
2. Nitric Acid Production			NO						NO			
3. Adipic Acid Production	NO		NO						NO	NO	NO	
4. Caprolactam, Glyoxal and Glyoxylic Acid Production	NO		NO								NO	NO
5. Carbide Production	NO	NO							NO	NO	NO	NO
6. Titanium Dioxide Production	NO											
7. Soda Ash Production	NO											
8. Petrochemical and Carbon Black Production	NO	NO							NO	NO	NO	NO
9. Fluorochemical Production				NO	NO	NO	NO	NO				
10. Other	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0.0650	NO
C. Metal Industry	**28.5023**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**0.0925**	**1.2102**	**0.0370**	**0.0427**
1. Iron and Steel Production	28.5023	NO							0.0925	1.2102	0.0370	0.0427
2. Ferroalloys Production	NO	NO							NO	NO	NO	NO
3. Aluminium Production	NO				NO		NO		NO	NO	NO	NO
4. Magnesium Production	NO			NO	NO	NO	NO		NO	NO	NO	NO
5. Lead Production	NO								NO	NO	NO	NO
6. Zinc Production	NO								NO	NO	NO	NO
7. Other	NO	NO	NO						NO	NO	NO	NO
D. Non-energy Products from Fuels and Solvent Use	**233.2089**	**NO**	**NO**						**0.0434**	**0.2441**	**92.7937**	**0.0216**
1. Lubricant Use	23.4455	NO	NO						NO	NO	NO	NO
2. Paraffin Wax Use	0.2787	NO	NO						NO	NO	NO	NO
3. Solvent Use	204.1460	NO	NO						0.0434	0.2441	92.7937	0.0216
4. Other	5.3387	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, NE	NO, NE	NO, NE	NO, NE	NO, NE				
1. Refrigeration and Air Conditioning				NO, NE	NO, NE	NO, NE	NO, NE	NO, NE				
2. Foam Blowing Agents				NO, NE	NO, NE	NO, NE	NO, NE	NO, NE				
3. Fire Protection				NO, NE	NO, NE	NO, NE	NO, NE	NO, NE				
4. Aerosols				NO, NE	NO, NE	NO, NE	NO, NE	NO, NE				
5. Solvents				NO, NE	NO, NE	NO, NE	NO, NE	NO, NE				
6. Other Applications				NO, NE	NO, NE	NO, NE	NO, NE	NO, NE				
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 Use			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

1991

Greenhouse Gas Source and Sink Categories	CO_2	CH_4	N_2O	HFC	PFC	Unspecified mix of HFC and PFC	SF_6	NF_3	NO_x	CO	NMVOC	SO_2
	(kt)			CO_2 equivalent (kt)					(kt)			
2. Industrial Processes and Product Use	**1 402.6293**	**NO**	**0.0001**	**NO, NE**	**NO, NE**	**NO, NE**	**NO, NE**	**NO, NE**	**3.3691**	**4.8820**	**87.9714**	**1.2554**
A. Mineral Industry	**1 182.6733**								**3.2328**	**3.0205**	**0.0315**	**1.2004**
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	80.3098								0.1307	0.1343		0.0281
B. Chemical Industry	**NO**	**NO**	**NO**						**NO**	**NO**	**0.0544**	**NO**
1. Ammonia Production	NO	NO	NO						NO	NO	NO	NO
2. Nitric Acid Production			NO						NO			
3. Adipic Acid Production	NO		NO						NO	NO	NO	
4. Caprolactam, Glyoxal and Glyoxylic Acid Production	NO		NO								NO	NO
5. Carbide Production	NO	NO							NO	NO	NO	NO
6. Titanium Dioxide Production	NO											
7. Soda Ash Production	NO											
8. Petrochemical and Carbon Black Production	NO	NO							NO	NO	NO	NO
9. Fluorochemical Production				NO	NO	NO	NO	NO				
10. Other	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0.0544	NO
C. Metal Industry	**24.7297**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**0.0803**	**1.0502**	**0.0323**	**0.0371**
1. Iron and Steel Production	24.7297	NO							0.0803	1.0502	0.0323	0.0371
2. Ferroalloys Production	NO	NO							NO	NO	NO	NO
3. Aluminium Production	NO				NO		NO		NO	NO	NO	NO
4. Magnesium Production	NO			NO	NO	NO	NO		NO	NO	NO	NO
5. Lead Production	NO								NO	NO	NO	NO
6. Zinc Production	NO								NO	NO	NO	NO
7. Other	NO	NO	NO						NO	NO	NO	NO
D. Non-energy Products from Fuels and Solvent Use	**192.3631**	**NO**	**NO**						**0.0361**	**0.2030**	**76.2635**	**0.0180**
1. Lubricant Use	19.6288	NO	NO						NO	NO	NO	NO
2. Paraffin Wax Use	0.2347	NO	NO						NO	NO	NO	NO
3. Solvent Use	167.7797	NO	NO						0.0361	0.2030	76.2635	0.0180
4. Other	4.7200	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, NE	NO, NE	NO, NE	NO, NE	NO, NE				
1. Refrigeration and Air Conditioning				NO, NE	NO, NE	NO, NE	NO, NE	NO, NE				
2. Foam Blowing Agents				NO, NE	NO, NE	NO, NE	NO, NE	NO, NE				
3. Fire Protection				NO, NE	NO, NE	NO, NE	NO, NE	NO, NE				
4. Aerosols				NO, NE	NO, NE	NO, NE	NO, NE	NO, NE				
5. Solvents				NO, NE	NO, NE	NO, NE	NO, NE	NO, NE				
6. Other Applications				NO, NE	NO, NE	NO, NE	NO, NE	NO, NE				
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 Use			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

Greenhouse Gas Source and Sink Categories	CO_2	CH_4	N_2O	HFC	PFC	Unspecified mix of HFC and PFC	SF_6	NF_3	NO_x	CO	NMVOC	SO_2
	(kt)			CO_2 equivalent (kt)					(kt)			
2. Industrial Processes and Product Use	**814.3567**	**NO**	**0.0001**	**NO, NE**	**NO, NE**	**NO, NE**	**NO, NE**	**NO, NE**	**1.7974**	**3.3821**	**72.3206**	**0.6514**
A. Mineral Industry	**634.3365**								**1.6705**	**1.6235**	**0.0165**	**0.6003**
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	44.3047								0.0710	0.0730		0.0153
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	**153.7706**	**NO**	**NO**						**0.0304**	**0.1706**	**62.9651**	**0.0151**
1. Lubricant Use	11.4501	NO	NO						NO	NO	NO	NO
2. Paraffin Wax Use	0.1907	NO	NO						NO	NO	NO	NO
3. Solvent Use	138.5232	NO	NO						0.0304	0.1706	62.9651	0.0151
4. Other	3.6067	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, NE	NO, NE	NO, NE	NO, NE	NO, NE				
1. Refrigeration and Air Conditioning				NO, NE	NO, NE	NO, NE	NO, NE	NO, NE				
2. Foam Blowing Agents				NO, NE	NO, NE	NO, NE	NO, NE	NO, NE				
3. Fire Protection				NO, NE	NO, NE	NO, NE	NO, NE	NO, NE				
4. Aerosols				NO, NE	NO, NE	NO, NE	NO, NE	NO, NE				
5. Solvents				NO, NE	NO, NE	NO, NE	NO, NE	NO, NE				
6. Other Applications				NO, NE	NO, NE	NO, NE	NO, NE	NO, NE				
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 Use			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

Greenhouse Gas Source and Sink Categories	CO_2	CH_4	N_2O	HFC	PFC	Unspecified mix of HFC and PFC	SF_6	NF_3	NO_x	CO	NMVOC	SO_2
	(kt)			CO_2 equivalent (kt)					(kt)			
2. Industrial Processes and Product Use	**733.1321**	**NO**	**0.0001**	**NO, NE**	**NO, NE**	**NO, NE**	**NO, NE**	**NO, NE**	**1.7064**	**3.2245**	**60.6455**	**0.6346**
A. Mineral Industry	**583.4616**								**1.5838**	**1.4688**	**0.0143**	**0.5859**
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	66.2737								0.1080	0.1109		0.0232
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	**123.3910**	**NO**	**NO**						**0.0241**	**0.1356**	**50.1008**	**0.0120**
1. Lubricant Use	10.3596	NO	NO						NO	NO	NO	NO
2. Paraffin Wax Use	0.1467	NO	NO						NO	NO	NO	NO
3. Solvent Use	110.2218	NO	NO						0.0241	0.1356	50.1008	0.0120
4. Other	2.6630	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, NE	NO, NE	NO, NE	NO, NE	NO, NE				
1. Refrigeration and Air Conditioning				NO, NE	NO, NE	NO, NE	NO, NE	NO, NE				
2. Foam Blowing Agents				NO, NE	NO, NE	NO, NE	NO, NE	NO, NE				
3. Fire Protection				NO, NE	NO, NE	NO, NE	NO, NE	NO, NE				
4. Aerosols				NO, NE	NO, NE	NO, NE	NO, NE	NO, NE				
5. Solvents				NO, NE	NO, NE	NO, NE	NO, NE	NO, NE				
6. Other Applications				NO, NE	NO, NE	NO, NE	NO, NE	NO, NE				
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					
3. N_2O from Product Use			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

Greenhouse Gas Source and Sink Categories	CO_2	CH_4	N_2O	HFC	PFC	Unspecified mix of HFC and PFC	SF_6	NF_3	NO_x	CO	NMVOC	SO_2
	(kt)			CO_2 equivalent (kt)					(kt)			
2. Industrial Processes and Product Use	**552.8842**	**NO**	**0.0001**	**NO, NE**	**NO, NE**	**NO, NE**	**NO, NE**	**NO, NE**	**1.3435**	**2.8279**	**41.6403**	**0.5041**
A. Mineral Industry	**441.6001**								**1.2292**	**1.1396**	**0.0115**	**0.4588**
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	33.2410								0.0537	0.0551		0.0116
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	**84.6033**	**NO**	**NO**						**0.0146**	**0.0820**	**32.7972**	**0.0073**
1. Lubricant Use	10.1157	NO	NO						NO	NO	NO	NO
2. Paraffin Wax Use	0.1173	NO	NO						NO	NO	NO	NO
3. Solvent Use	72.1539	NO	NO						0.0146	0.0820	32.7972	0.0073
4. Other	2.2163	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, NE	NO, NE	NO, NE	NO, NE	NO, NE				
1. Refrigeration and Air Conditioning				NO, NE	NO, NE	NO, NE	NO, NE	NO, NE				
2. Foam Blowing Agents				NO, NE	NO, NE	NO, NE	NO, NE	NO, NE				
3. Fire Protection				NO, NE	NO, NE	NO, NE	NO, NE	NO, NE				
4. Aerosols				NO, NE	NO, NE	NO, NE	NO, NE	NO, NE				
5. Solvents				NO, NE	NO, NE	NO, NE	NO, NE	NO, NE				
6. Other Applications				NO, NE	NO, NE	NO, NE	NO, NE	NO, NE				
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 Use			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	HFC	PFC	Unspecified mix of HFC and PFC	SF_6	NF_3	NO_x	CO	NMVOC	SO_2
	(kt)			CO_2 equivalent (kt)					(kt)			
2. Industrial Processes and Product Use	**448.9341**	**NO**	**0.0000**	**4.5879**	**NO, NE**	**NO, NE**	**NO, NE**	**NO, NE**	**1.1438**	**2.5468**	**40.2086**	**0.4530**
A. Mineral Industry	**345.1199**								**1.0299**	**0.8868**	**0.0089**	**0.4070**
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	22.5003								0.0356	0.0365		0.0077
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	**76.4826**	**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	0.0880	NO	NO						NO	NO	NO	NO
3. Solvent Use	64.2796	NO	NO						0.0132	0.0740	29.2180	0.0065
4. Other	1.9834	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				**4.5879**	**NO, NE**	**NO, NE**	**NO, NE**	**NO, NE**				
1. Refrigeration and Air Conditioning				4.3115	NO, NE	NO, NE	NO, NE	NO, NE				
2. Foam Blowing Agents				0.2763	NO, NE	NO, NE	NO, NE	NO, NE				
3. Fire Protection				NO, NE	NO, NE	NO, NE	NO, NE	NO, NE				
4. Aerosols				NO, NE	NO, NE	NO, NE	NO, NE	NO, NE				
5. Solvents				NO, NE	NO, NE	NO, NE	NO, NE	NO, NE				
6. Other Applications				NO, NE	NO, NE	NO, NE	NO, NE	NO, NE				
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 Use			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

Greenhouse Gas Source and Sink Categories	CO_2	CH_4	N_2O	HFC	PFC	Unspecified mix of HFC and PFC	SF_6	NF_3	NO_x	CO	NMVOC	SO_2
	(kt)			CO_2 equivalent (kt)					(kt)			
2. Industrial Processes and Product Use	**407.6878**	**NO**	**0.0000**	**5.1847**	**NO, NE**	**NO, NE**	**NO, NE**	**NO, NE**	**0.9967**	**2.6314**	**36.9171**	**0.3831**
A. Mineral Industry	**308.9247**								**0.8768**	**0.7855**	**0.0069**	**0.3371**
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	19.8100								0.0320	0.0328		0.0069
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	
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	**70.9984**	**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	0.0733	NO	NO						NO	NO	NO	NO
3. Solvent Use	59.4607	NO	NO						0.0119	0.0671	27.0276	0.0059
4. Other	1.6968	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				**5.1847**	**NO, NE**	**NO, NE**	**NO, NE**	**NO, NE**				
1. Refrigeration and Air Conditioning				4.4983	NO, NE	NO, NE	NO, NE	NO, NE				
2. Foam Blowing Agents				0.6864	NO, NE	NO, NE	NO, NE	NO, NE				
3. Fire Protection				NO, NE	NO, NE	NO, NE	NO, NE	NO, NE				
4. Aerosols				NO, NE	NO, NE	NO, NE	NO, NE	NO, NE				
5. Solvents				NO, NE	NO, NE	NO, NE	NO, NE	NO, NE				
6. Other Applications				NO, NE	NO, NE	NO, NE	NO, NE	NO, NE				
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 Use			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

Greenhouse Gas Source and Sink Categories	CO_2	CH_4	N_2O	HFC	PFC	Unspecified mix of HFC and PFC	SF_6	NF_3	NO_x	CO	NMVOC	SO_2
	(kt)			CO_2 equivalent (kt)					(kt)			
2. Industrial Processes and Product Use	**449.0073**	**NO**	**0.0000**	**5.9997**	**NO, NE**	**NO, NE**	**NO, NE**	**NO, NE**	**1.2065**	**2.9916**	**22.9531**	**0.4652**
A. Mineral Industry	**373.6804**								**1.0765**	**0.9626**	**0.0096**	**0.4145**
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	23.1676								0.0359	0.0369		0.0077
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
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	**42.0075**	**NO**	**NO**						**0.0040**	**0.0227**	**14.1331**	**0.0020**
1. Lubricant Use	9.2158	NO	NO						NO	NO	NO	NO
2. Paraffin Wax Use	0.0587	NO	NO						NO	NO	NO	NO
3. Solvent Use	31.0928	NO	NO						0.0040	0.0227	14.1331	0.0020
4. Other	1.6402	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				**5.9997**	**NO, NE**	**NO, NE**	**NO, NE**	**NO, NE**				
1. Refrigeration and Air Conditioning				4.7703	NO, NE	NO, NE	NO, NE	NO, NE				
2. Foam Blowing Agents				1.2294	NO, NE	NO, NE	NO, NE	NO, NE				
3. Fire Protection				NO, NE	NO, NE	NO, NE	NO, NE	NO, NE				
4. Aerosols				NO, NE	NO, NE	NO, NE	NO, NE	NO, NE				
5. Solvents				NO, NE	NO, NE	NO, NE	NO, NE	NO, NE				
6. Other Applications				NO, NE	NO, NE	NO, NE	NO, NE	NO, NE				
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 Use			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

Greenhouse Gas Source and Sink Categories	CO_2	CH_4	N_2O	HFC	PFC	Unspecified mix of HFC and PFC	SF_6	NF_3	NO_x	CO	NMVOC	SO_2
	(kt)			CO_2 equivalent (kt)					(kt)			
2. Industrial Processes and Product Use	**373.4402**	**NO**	**0.0000**	**7.4843**	**NO, NE**	**NO, NE**	**NO, NE**	**NO, NE**	**1.0595**	**2.5186**	**20.4827**	**0.4289**
A. Mineral Industry	**306.5335**								**0.9467**	**0.7826**	**0.0078**	**0.3842**
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	21.6739								0.0335	0.0344		0.0072
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	**37.5225**	**NO**	**NO**						**0.0033**	**0.0185**	**13.2383**	**0.0016**
1. Lubricant Use	7.0099	NO	NO						NO	NO	NO	NO
2. Paraffin Wax Use	0.0440	NO	NO						NO	NO	NO	NO
3. Solvent Use	29.1244	NO	NO						0.0033	0.0185	13.2383	0.0016
4. Other	1.3442	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				**7.4843**	**NO, NE**	**NO, NE**	**NO, NE**	**NO, NE**				
1. Refrigeration and Air Conditioning				5.6215	NO, NE	NO, NE	NO, NE	NO, NE				
2. Foam Blowing Agents				1.8628	NO, NE	NO, NE	NO, NE	NO, NE				
3. Fire Protection				NO, NE	NO, NE	NO, NE	NO, NE	NO, NE				
4. Aerosols				NO, NE	NO, NE	NO, NE	NO, NE	NO, NE				
5. Solvents				NO, NE	NO, NE	NO, NE	NO, NE	NO, NE				
6. Other Applications				NO, NE	NO, NE	NO, NE	NO, NE	NO, NE				
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 Use			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

Greenhouse Gas Source and Sink Categories	CO_2	CH_4	N_2O	HFC	PFC	Unspecified mix of HFC and PFC	SF_6	NF_3	NO_x	CO	NMVOC	SO_2
	(kt)			CO_2 equivalent (kt)					(kt)			
2. Industrial Processes and Product Use	**336.6304**	**NO**	**0.0000**	**8.5714**	**NO, NE**	**NO, NE**	**NO, NE**	**NO, NE**	**0.9452**	**2.6426**	**16.1302**	**0.3746**
A. Mineral Industry	**272.6662**								**0.8205**	**0.6987**	**0.0075**	**0.3257**
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	21.8274								0.0341	0.0351		0.0073
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	**31.5638**	**NO**	**NO**						**0.0024**	**0.0132**	**11.5886**	**0.0012**
1. Lubricant Use	4.9993	NO	NO						NO	NO	NO	NO
2. Paraffin Wax Use	0.0440	NO	NO						NO	NO	NO	NO
3. Solvent Use	25.4949	NO	NO						0.0024	0.0132	11.5886	0.0012
4. Other	1.0256	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				**8.5714**	**NO, NE**	**NO, NE**	**NO, NE**	**NO, NE**				
1. Refrigeration and Air Conditioning				5.9668	NO, NE	NO, NE	NO, NE	NO, NE				
2. Foam Blowing Agents				2.6045	NO, NE	NO, NE	NO, NE	NO, NE				
3. Fire Protection				NO, NE	NO, NE	NO, NE	NO, NE	NO, NE				
4. Aerosols				NO, NE	NO, NE	NO, NE	NO, NE	NO, NE				
5. Solvents				NO, NE	NO, NE	NO, NE	NO, NE	NO, NE				
6. Other Applications				NO, NE	NO, NE	NO, NE	NO, NE	NO, NE				
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					
3. N_2O from Product Use			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	HFC	PFC	Unspecified mix of HFC and PFC	SF_6	NF_3	NO_x	CO	NMVOC	SO_2
	(kt)			CO_2 equivalent (kt)					(kt)			
2. Industrial Processes and Product Use	**308.5696**	**NO**	**0.0000**	**10.4630**	**NO, NE**	**NO, NE**	**NO, NE**	**NO, NE**	**1.0686**	**2.7459**	**15.8398**	**0.4912**
A. Mineral Industry	**240.0428**								**0.9286**	**0.5791**	**0.0067**	**0.4358**
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	21.0475								0.0318	0.0327		0.0068
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	**31.3591**	**NO**	**NO**						**0.0019**	**0.0107**	**11.6111**	**0.0009**
1. Lubricant Use	4.7117	NO	NO						NO	NO	NO	NO
2. Paraffin Wax Use	0.0293	NO	NO						NO	NO	NO	NO
3. Solvent Use	25.5444	NO	NO						0.0019	0.0107	11.6111	0.0009
4. Other	1.0736	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				**10.4630**	**NO, NE**	**NO, NE**	**NO, NE**	**NO, NE**				
1. Refrigeration and Air Conditioning				6.2743	NO, NE	NO, NE	NO, NE	NO, NE				
2. Foam Blowing Agents				4.1887	NO, NE	NO, NE	NO, NE	NO, NE				
3. Fire Protection				NO, NE	NO, NE	NO, NE	NO, NE	NO, NE				
4. Aerosols				NO, NE	NO, NE	NO, NE	NO, NE	NO, NE				
5. Solvents				NO, NE	NO, NE	NO, NE	NO, NE	NO, NE				
6. Other Applications				NO, NE	NO, NE	NO, NE	NO, NE	NO, NE				
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 Use			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	HFC	PFC	Unspecified mix of HFC and PFC	SF_6	NF_3	NO_x	CO	NMVOC	SO_2
	(kt)			CO_2 equivalent (kt)					(kt)			
2. Industrial Processes and Product Use	**311.3929**	**NO**	**0.0000**	**12.8513**	**NO, NE**	**NO, NE**	**NO, NE**	**NO, NE**	**1.0294**	**2.8564**	**17.4602**	**0.4640**
A. Mineral Industry	**237.3637**								**0.8809**	**0.5760**	**0.0066**	**0.4048**
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	20.9031								0.0322	0.0330		0.0069
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	**34.6288**	**NO**	**NO**						**0.0024**	**0.0134**	**12.8531**	**0.0012**
1. Lubricant Use	5.1876	NO	NO						NO	NO	NO	NO
2. Paraffin Wax Use	0.0293	NO	NO						NO	NO	NO	NO
3. Solvent Use	28.2768	NO	NO						0.0024	0.0134	12.8531	0.0012
4. Other	1.1350	NO	NO						NO	NO	NO	NO
E. Electronics Industry				NO	NO	NO	NO	NO				
1. Integrated Circuit or Semiconductor				NO	NO	NO	NO	NO				
2. TFT Flat Panel Display				NO	NO	NO	NO	NO				
3. Photovoltaics				NO	NO	NO	NO	NO				
4. Heat Transfer Fluid				NO	NO	NO	NO	NO				
5. Other				NO	NO	NO	NO	NO				
F. Product Uses as Substitutes for ODS				**12.8513**	**NO, NE**	**NO, NE**	**NO, NE**	**NO, NE**				
1. Refrigeration and Air Conditioning				6.8790	NO, NE	NO, NE	NO, NE	NO, NE				
2. Foam Blowing Agents				5.9723	NO, NE	NO, NE	NO, NE	NO, NE				
3. Fire Protection				NO, NE	NO, NE	NO, NE	NO, NE	NO, NE				
4. Aerosols				NO, NE	NO, NE	NO, NE	NO, NE	NO, NE				
5. Solvents				NO, NE	NO, NE	NO, NE	NO, NE	NO, NE				
6. Other Applications				NO, NE	NO, NE	NO, NE	NO, NE	NO, NE				
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 Use			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

Greenhouse Gas Source and Sink Categories	CO_2	CH_4	N_2O	HFC	PFC	Unspecified mix of HFC and PFC	SF_6	NF_3	NO_x	CO	NMVOC	SO_2
	(kt)			CO_2 equivalent (kt)					(kt)			
2. Industrial Processes and Product Use	**360.0955**	**NO**	**0.0000**	**16.8928**	**NO, NE**	**NO, NE**	**NO, NE**	**NO, NE**	**1.1728**	**2.0366**	**19.0027**	**0.5261**
A. Mineral Industry	**302.8397**								**1.0903**	**0.7351**	**0.0083**	**0.4942**
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	25.4017								0.0390	0.0400		0.0084
B. Chemical Industry	**NO**	**NO**	**NO**						**NO**	**NO**	**0.0104**	**NO**
1. Ammonia Production	NO	NO	NO						NO	NO	NO	NO
2. Nitric Acid Production			NO						NO			
3. Adipic Acid Production	NO		NO						NO	NO	NO	
4. Caprolactam, Glyoxal and Glyoxylic Acid Production	NO		NO								NO	NO
5. Carbide Production	NO	NO							NO	NO	NO	NO
6. Titanium Dioxide Production	NO											
7. Soda Ash Production	NO											
8. Petrochemical and Carbon Black Production	NO	NO							NO	NO	NO	NO
9. Fluorochemical Production				NO	NO	NO	NO	NO				
10. Other	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0.0104	NO
C. Metal Industry	**20.5030**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**0.0667**	**0.8725**	**0.0263**	**0.0308**
1. Iron and Steel Production	20.5030	NO							0.0667	0.8725	0.0263	0.0308
2. Ferroalloys Production	NO	NO							NO	NO	NO	NO
3. Aluminium Production	NO				NO		NO		NO	NO	NO	NO
4. Magnesium Production	NO			NO	NO	NO	NO		NO	NO	NO	NO
5. Lead Production	NO								NO	NO	NO	NO
6. Zinc Production	NO								NO	NO	NO	NO
7. Other	NO	NO	NO						NO	NO	NO	NO
D. Non-energy Products from Fuels and Solvent Use	**36.0221**	**NO**	**NO**						**0.0021**	**0.0117**	**13.7991**	**0.0010**
1. Lubricant Use	4.3240	NO	NO						NO	NO	NO	NO
2. Paraffin Wax Use	0.0293	NO	NO						NO	NO	NO	NO
3. Solvent Use	30.3579	NO	NO						0.0021	0.0117	13.7991	0.0010
4. Other	1.3108	NO	NO						NO	NO	NO	NO
E. Electronics Industry				NO	NO	NO	NO	NO				
1. Integrated Circuit or Semiconductor				NO	NO	NO	NO	NO				
2. TFT Flat Panel Display				NO	NO	NO	NO	NO				
3. Photovoltaics				NO	NO	NO	NO	NO				
4. Heat Transfer Fluid				NO	NO	NO	NO	NO				
5. Other				NO	NO	NO	NO	NO				
F. Product Uses as Substitutes for ODS				**16.8928**	**NO, NE**	**NO, NE**	**NO, NE**	**NO, NE**				
1. Refrigeration and Air Conditioning				7.4672	NO, NE	NO, NE	NO, NE	NO, NE				
2. Foam Blowing Agents				9.4256	NO, NE	NO, NE	NO, NE	NO, NE				
3. Fire Protection				NO, NE	NO, NE	NO, NE	NO, NE	NO, NE				
4. Aerosols				NO, NE	NO, NE	NO, NE	NO, NE	NO, NE				
5. Solvents				NO, NE	NO, NE	NO, NE	NO, NE	NO, NE				
6. Other Applications				NO, NE	NO, NE	NO, NE	NO, NE	NO, NE				
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 Use			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

Greenhouse Gas Source and Sink Categories	CO_2	CH_4	N_2O	HFC	PFC	Unspecified mix of HFC and PFC	SF_6	NF_3	NO_x	CO	NMVOC	SO_2
	(kt)			CO_2 equivalent (kt)					(kt)			
2. Industrial Processes and Product Use	**388.2276**	**NO**	**0.0000**	**23.6694**	**NO, NE**	**NO, NE**	**0.0000**	**NO, NE**	**1.2110**	**2.7524**	**20.1475**	**0.5321**
A. Mineral Industry	**311.0548**								**1.0778**	**0.7592**	**0.0091**	**0.4777**
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	26.1452								0.0419	0.0430		0.0090
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	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	**40.8564**	**NO**	**NO**						**0.0026**	**0.0145**	**14.8566**	**0.0013**
1. Lubricant Use	6.5825	NO	NO						NO	NO	NO	NO
2. Paraffin Wax Use	0.0293	NO	NO						NO	NO	NO	NO
3. Solvent Use	32.6846	NO	NO						0.0026	0.0145	14.8566	0.0013
4. Other	1.5601	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				**23.6694**	**NO, NE**	**NO, NE**	**NO, NE**	**NO, NE**				
1. Refrigeration and Air Conditioning				8.5770	NO, NE	NO, NE	NO, NE	NO, NE				
2. Foam Blowing Agents				15.0924	NO, NE	NO, NE	NO, NE	NO, NE				
3. Fire Protection				NO, NE	NO, NE	NO, NE	NO, NE	NO, NE				
4. Aerosols				0.0001	NO, NE	NO, NE	NO, NE	NO, NE				
5. Solvents				NO, NE	NO, NE	NO, NE	NO, NE	NO, NE				
6. Other Applications				NO, NE	NO, NE	NO, NE	NO, NE	NO, NE				
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	NO	NO					
3. N_2O from Product Use			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

Greenhouse Gas Source and Sink Categories	CO_2	CH_4	N_2O	HFC	PFC	Unspecified mix of HFC and PFC	SF_6	NF_3	NO_x	CO	NMVOC	SO_2
	(kt)			CO_2 equivalent (kt)					(kt)			
2. Industrial Processes and Product Use	**458.6192**	**NO**	**0.0001**	**31.0742**	**NO, NE**	**NO, NE**	**0.0000**	**NO, NE**	**1.3599**	**3.1110**	**31.8863**	**0.5901**
A. Mineral Industry	**353.3699**								**1.2047**	**0.8754**	**0.0104**	**0.5252**
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	30.0814								0.0494	0.0507		0.0106
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	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	**63.7753**	**NO**	**NO**						**0.0082**	**0.0459**	**25.2292**	**0.0041**
1. Lubricant Use	6.5215	NO	NO						NO	NO	NO	NO
2. Paraffin Wax Use	0.0440	NO	NO						NO	NO	NO	NO
3. Solvent Use	55.5043	NO	NO						0.0082	0.0459	25.2292	0.0041
4. Other	1.7055	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				**31.0742**	**NO, NE**	**NO, NE**	**NO, NE**	**NO, NE**				
1. Refrigeration and Air Conditioning				9.8973	NO, NE	NO, NE	NO, NE	NO, NE				
2. Foam Blowing Agents				21.1768	NO, NE	NO, NE	NO, NE	NO, NE				
3. Fire Protection				NO, NE	NO, NE	NO, NE	NO, NE	NO, NE				
4. Aerosols				0.0002	NO, NE	NO, NE	NO, NE	NO, NE				
5. Solvents				NO, NE	NO, NE	NO, NE	NO, NE	NO, NE				
6. Other Applications				NO, NE	NO, NE	NO, NE	NO, NE	NO, NE				
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	NO	NO					
3. N_2O from Product Use			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	HFC	PFC	Unspecified mix of HFC and PFC	SF_6	NF_3	NO_x	CO	NMVOC	SO_2
	(kt)			CO_2 equivalent (kt)					(kt)			
2. Industrial Processes and Product Use	**556.3237**	**NO**	**0.0001**	**42.1522**	**NO, NE**	**NO, NE**	**0.0000**	**NO, NE**	**1.6376**	**3.3632**	**34.6011**	**0.6968**
A. Mineral Industry	**444.8424**								**1.4802**	**1.1266**	**0.0133**	**0.6300**
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	27.6907								0.0553	0.0568		0.0119
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	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	**68.4829**	**NO**	**NO**						**0.0077**	**0.0431**	**27.3110**	**0.0038**
1. Lubricant Use	6.5370	NO	NO						NO	NO	NO	NO
2. Paraffin Wax Use	0.0440	NO	NO						NO	NO	NO	NO
3. Solvent Use	60.0843	NO	NO						0.0077	0.0431	27.3110	0.0038
4. Other	1.8177	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				**42.1522**	**NO, NE**	**NO, NE**	**NO, NE**	**NO, NE**				
1. Refrigeration and Air Conditioning				10.9213	NO, NE	NO, NE	NO, NE	NO, NE				
2. Foam Blowing Agents				31.2305	NO, NE	NO, NE	NO, NE	NO, NE				
3. Fire Protection				NO, NE	NO, NE	NO, NE	NO, NE	NO, NE				
4. Aerosols				0.0004	NO, NE	NO, NE	NO, NE	NO, NE				
5. Solvents				NO, NE	NO, NE	NO, NE	NO, NE	NO, NE				
6. Other Applications				NO, NE	NO, NE	NO, NE	NO, NE	NO, NE				
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	NO	NO					
3. N_2O from Product Use			0.0001									
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

Greenhouse Gas Source and Sink Categories	CO_2	CH_4	N_2O	HFC	PFC	Unspecified mix of HFC and PFC	SF_6	NF_3	NO_x	CO	NMVOC	SO_2
	(kt)			CO_2 equivalent (kt)					(kt)			
2. Industrial Processes and Product Use	**654.1156**	**NO**	**0.0001**	**54.7020**	**0.0231**	**NO, NE**	**0.0000**	**NO, NE**	**1.7861**	**2.9378**	**39.4337**	**0.7256**
A. Mineral Industry	**543.7505**								**1.6749**	**1.3863**	**0.0164**	**0.6789**
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	29.8885								0.0553	0.0568		0.0119
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	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	**82.3885**	**NO**	**NO**						**0.0124**	**0.0697**	**33.3990**	**0.0062**
1. Lubricant Use	7.0202	NO	NO						NO	NO	NO	NO
2. Paraffin Wax Use	0.0587	NO	NO						NO	NO	NO	NO
3. Solvent Use	73.4778	NO	NO						0.0124	0.0697	33.3990	0.0062
4. Other	1.8318	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				**54.7020**	**NO, NE**	**NO, NE**	**NO, NE**	**NO, NE**				
1. Refrigeration and Air Conditioning				12.0839	NO, NE	NO, NE	NO, NE	NO, NE				
2. Foam Blowing Agents				42.6149	NO, NE	NO, NE	NO, NE	NO, NE				
3. Fire Protection				NO, NE	NO, NE	NO, NE	NO, NE	NO, NE				
4. Aerosols				0.0032	NO, NE	NO, NE	NO, NE	NO, NE				
5. Solvents				NO, NE	NO, NE	NO, NE	NO, NE	NO, NE				
6. Other Applications				NO, NE	NO, NE	NO, NE	NO, NE	NO, NE				
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	NO	NO					
3. N_2O from Product Use			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

Greenhouse Gas Source and Sink Categories	CO_2	CH_4	N_2O	HFC	PFC	Unspecified mix of HFC and PFC	SF_6	NF_3	NO_x	CO	NMVOC	SO_2
	(kt)			CO_2 equivalent (kt)					(kt)			
2. Industrial Processes and Product Use	**901.0373**	**NO**	**NO**	**69.8086**	**0.0231**	**NO, NE**	**0.0000**	**NO, NE**	**2.3331**	**4.0697**	**39.7471**	**0.8823**
A. Mineral Industry	**776.1316**								**2.1837**	**2.0250**	**0.0244**	**0.8179**
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	29.7100								0.0633	0.0650		0.0136
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	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	**85.3456**	**NO**	**NO**						**0.0130**	**0.0732**	**35.2553**	**0.0065**
1. Lubricant Use	5.7882	NO	NO						NO	NO	NO	NO
2. Paraffin Wax Use	0.0733	NO	NO						NO	NO	NO	NO
3. Solvent Use	77.5617	NO	NO						0.0130	0.0732	35.2553	0.0065
4. Other	1.9224	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				**69.8086**	**NO, NE**	**NO, NE**	**NO, NE**	**NO, NE**				
1. Refrigeration and Air Conditioning				15.1801	NO, NE	NO, NE	NO, NE	NO, NE				
2. Foam Blowing Agents				54.6209	NO, NE	NO, NE	NO, NE	NO, NE				
3. Fire Protection				NO, NE	NO, NE	NO, NE	NO, NE	NO, NE				
4. Aerosols				0.0076	NO, NE	NO, NE	NO, NE	NO, NE				
5. Solvents				NO, NE	NO, NE	NO, NE	NO, NE	NO, NE				
6. Other Applications				NO, NE	NO, NE	NO, NE	NO, NE	NO, NE				
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	NO	NO					
3. N_2O from Product Use			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

Greenhouse Gas Source and Sink Categories	CO_2	CH_4	N_2O	HFC	PFC	Unspecified mix of HFC and PFC	SF_6	NF_3	NO_x	CO	NMVOC	SO_2
	(kt)			CO_2 equivalent (kt)					(kt)			
2. Industrial Processes and Product Use	**978.6462**	**NO**	**NO**	**84.6748**	**0.0288**	**NO, NE**	**0.0000**	**NO, NE**	**2.5297**	**4.1271**	**32.6079**	**0.9287**
A. Mineral Industry	**874.7129**								**2.3984**	**2.3142**	**0.0277**	**0.8718**
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	27.7519								0.0569	0.0585		0.0122
B. Chemical Industry	**NO**	**NO**	**NO**						**NO**	**NO**	**0.0122**	**NO**
1. Ammonia Production	NO	NO	NO						NO	NO	NO	NO
2. Nitric Acid Production			NO						NO			
3. Adipic Acid Production	NO		NO						NO	NO	NO	
4. Caprolactam, Glyoxal and Glyoxylic Acid Production	NO		NO								NO	NO
5. Carbide Production	NO	NO							NO	NO	NO	NO
6. Titanium Dioxide Production	NO											
7. Soda Ash Production	NO											
8. Petrochemical and Carbon Black Production	NO	NO							NO	NO	NO	NO
9. Fluorochemical Production				NO	NO	NO	NO	NO				
10. Other	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0.0122	NO
C. Metal Industry	**35.4118**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**0.1152**	**1.5064**	**0.0465**	**0.0532**
1. Iron and Steel Production	35.4118	NO							0.1152	1.5064	0.0465	0.0532
2. Ferroalloys Production	NO	NO							NO	NO	NO	NO
3. Aluminium Production	NO				NO		NO		NO	NO	NO	NO
4. Magnesium Production	NO			NO	NO	NO	NO		NO	NO	NO	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	**67.5356**	**NO**	**NO**						**0.0075**	**0.0427**	**26.9460**	**0.0037**
1. Lubricant Use	6.1680	NO	NO						NO	NO	NO	NO
2. Paraffin Wax Use	0.0733	NO	NO						NO	NO	NO	NO
3. Solvent Use	59.2811	NO	NO						0.0075	0.0427	26.9460	0.0037
4. Other	2.0131	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				**84.6748**	**NO, NE**	**NO, NE**	**NO, NE**	**NO, NE**				
1. Refrigeration and Air Conditioning				18.9723	NO, NE	NO, NE	NO, NE	NO, NE				
2. Foam Blowing Agents				65.6924	NO, NE	NO, NE	NO, NE	NO, NE				
3. Fire Protection				NO, NE	NO, NE	NO, NE	NO, NE	NO, NE				
4. Aerosols				0.0101	NO, NE	NO, NE	NO, NE	NO, NE				
5. Solvents				NO, NE	NO, NE	NO, NE	NO, NE	NO, NE				
6. Other Applications				NO, NE	NO, NE	NO, NE	NO, NE	NO, NE				
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	NO	NO					
3. N_2O from Product Use			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	HFC	PFC	Unspecified mix of HFC and PFC	SF_6	NF_3	NO_x	CO	NMVOC	SO_2
	(kt)			CO_2 equivalent (kt)					(kt)			
2. Industrial Processes and Product Use	**466.2423**	**NO**	**NO**	**93.2489**	**0.0288**	**NO, NE**	**0.0000**	**NO, NE**	**1.2535**	**2.0770**	**27.2539**	**0.5017**
A. Mineral Industry	**389.8573**								**1.1819**	**0.9974**	**0.0122**	**0.4733**
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	22.3942								0.0357	0.0367		0.0077
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	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	**58.6232**	**NO**	**NO**						**0.0056**	**0.0316**	**23.4326**	**0.0028**
1. Lubricant Use	5.1273	NO	NO						NO	NO	NO	NO
2. Paraffin Wax Use	0.1027	NO	NO						NO	NO	NO	NO
3. Solvent Use	51.5516	NO	NO						0.0056	0.0316	23.4326	0.0028
4. Other	1.8416	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				**93.2489**	**NO, NE**	**NO, NE**	**NO, NE**	**NO, NE**				
1. Refrigeration and Air Conditioning				20.3882	NO, NE	NO, NE	NO, NE	NO, NE				
2. Foam Blowing Agents				72.8440	NO, NE	NO, NE	NO, NE	NO, NE				
3. Fire Protection				NO, NE	NO, NE	NO, NE	NO, NE	NO, NE				
4. Aerosols				0.0167	NO, NE	NO, NE	NO, NE	NO, NE				
5. Solvents				NO, NE	NO, NE	NO, NE	NO, NE	NO, NE				
6. Other Applications				NO, NE	NO, NE	NO, NE	NO, NE	NO, NE				
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	NO	NO					
3. N_2O from Product Use			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

Greenhouse Gas Source and Sink Categories	CO_2	CH_4	N_2O	HFC	PFC	Unspecified mix of HFC and PFC	SF_6	NF_3	NO_x	CO	NMVOC	SO_2
	(kt)			CO_2 equivalent (kt)					(kt)			
2. Industrial Processes and Product Use	**490.8096**	**NO**	**NO**	**113.4282**	**0.0403**	**NO, NE**	**0.0000**	**NO, NE**	**1.3392**	**1.9101**	**31.9434**	**0.5474**
A. Mineral Industry	**412.7424**								**1.2872**	**1.0448**	**0.0126**	**0.5294**
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	21.7348								0.0335	0.0344		0.0072
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	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	**67.4640**	**NO**	**NO**						**0.0069**	**0.0392**	**27.0436**	**0.0034**
1. Lubricant Use	5.5099	NO	NO						NO	NO	NO	NO
2. Paraffin Wax Use	0.1760	NO	NO						NO	NO	NO	NO
3. Solvent Use	59.4960	NO	NO						0.0069	0.0392	27.0436	0.0034
4. Other	2.2821	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				**113.4282**	**NO, NE**	**NO, NE**	**NO, NE**	**NO, NE**				
1. Refrigeration and Air Conditioning				33.6498	NO, NE	NO, NE	NO, NE	NO, NE				
2. Foam Blowing Agents				79.7528	NO, NE	NO, NE	NO, NE	NO, NE				
3. Fire Protection				NO, NE	NO, NE	NO, NE	NO, NE	NO, NE				
4. Aerosols				0.0255	NO, NE	NO, NE	NO, NE	NO, NE				
5. Solvents				NO, NE	NO, NE	NO, NE	NO, NE	NO, NE				
6. Other Applications				NO, NE	NO, NE	NO, NE	NO, NE	NO, NE				
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	NO	NO					
3. N_2O from Product Use			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

Greenhouse Gas Source and Sink Categories	CO_2	CH_4	N_2O	HFC	PFC	Unspecified mix of HFC and PFC	SF_6	NF_3	NO_x	CO	NMVOC	SO_2
	(kt)			CO_2 equivalent (kt)					(kt)			
2. Industrial Processes and Product Use	**578.2196**	**NO**	**NO**	**119.5378**	**0.0403**	**NO, NE**	**0.0000**	**NO, NE**	**1.6013**	**2.2818**	**34.4817**	**0.6513**
A. Mineral Industry	**491.5026**								**1.5377**	**1.2638**	**0.0155**	**0.6282**
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	22.9484								0.4640		0.0010	0.3104
4. Other Process Uses of Carbonates	19.2305								0.0344	0.0353		0.0074
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	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	**72.7635**	**NO**	**NO**						**0.0078**	**0.0443**	**29.2885**	**0.0039**
1. Lubricant Use	5.8338	NO	NO						NO	NO	NO	NO
2. Paraffin Wax Use	0.0733	NO	NO						NO	NO	NO	NO
3. Solvent Use	64.4348	NO	NO						0.0078	0.0443	29.2885	0.0039
4. Other	2.4216	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				**119.5378**	**NO, NE**	**NO, NE**	**NO, NE**	**NO, NE**				
1. Refrigeration and Air Conditioning				34.5607	NO, NE	NO, NE	NO, NE	NO, NE				
2. Foam Blowing Agents				84.9304	NO, NE	NO, NE	NO, NE	NO, NE				
3. Fire Protection				NO, NE	NO, NE	NO, NE	NO, NE	NO, NE				
4. Aerosols				0.0467	NO, NE	NO, NE	NO, NE	NO, NE				
5. Solvents				NO, NE	NO, NE	NO, NE	NO, NE	NO, NE				
6. Other Applications				NO, NE	NO, NE	NO, NE	NO, NE	NO, NE				
G. Other Product Manufacture and Use	**1.0979**	**NO**	**NO**	**NO**	**0.0403**	**NO**	**0.0000**	**NO**	**0.0140**	**0.4272**	**0.4990**	**NO**
1. Electrical Equipment				NO	0.0403	NO	0.0000	NO				
2. SF_6 and PFCs from Other Product Use					NO	NO	NO					
3. N_2O from Product Use			NO									
4. Other	1.0979	NO	NO	NO	NO	NO	NO	NO	0.0140	0.4272	0.4990	NO
H. Other									**NO**	**NO**	**4.6461**	**NO**
1. Pulp and Paper Industry									NO	NO	NO	NO
2. Food and Beverages Industry									NO	NO	4.6461	NO
3. Other									NO	NO	NO	NO

Greenhouse Gas Source and Sink Categories	CO_2	CH_4	N_2O	HFC	PFC	Unspecified mix of HFC and PFC	SF_6	NF_3	NO_x	CO	NMVOC	SO_2
	(kt)			CO_2 equivalent (kt)					(kt)			
2. Industrial Processes and Product Use	**586.7346**	**NO**	**NO**	**128.8468**	**0.0403**	**NO, NE**	**0.0000**	**NO, NE**	**1.5106**	**2.1929**	**36.3735**	**0.5841**
A. Mineral Industry	**496.8003**								**1.4504**	**1.2952**	**0.0157**	**0.5606**
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	17.8264								0.3501		0.0007	0.2342
4. Other Process Uses of Carbonates	16.1560								0.0287	0.0295		0.0062
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	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	**76.1943**	**NO**	**NO**						**0.0088**	**0.0500**	**31.3721**	**0.0044**
1. Lubricant Use	4.9558	NO	NO						NO	NO	NO	NO
2. Paraffin Wax Use	0.0293	NO	NO						NO	NO	NO	NO
3. Solvent Use	69.0187	NO	NO						0.0088	0.0500	31.3721	0.0044
4. Other	2.1904	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				**128.8468**	**NO, NE**	**NO, NE**	**NO, NE**	**NO, NE**				
1. Refrigeration and Air Conditioning				38.7915	NO, NE	NO, NE	NO, NE	NO, NE				
2. Foam Blowing Agents				89.9845	NO, NE	NO, NE	NO, NE	NO, NE				
3. Fire Protection				NO, NE	NO, NE	NO, NE	NO, NE	NO, NE				
4. Aerosols				0.0708	NO, NE	NO, NE	NO, NE	NO, NE				
5. Solvents				NO, NE	NO, NE	NO, NE	NO, NE	NO, NE				
6. Other Applications				NO, NE	NO, NE	NO, NE	NO, NE	NO, NE				
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	NO	NO					
3. N_2O from Product Use			NO									
4. Other	1.0427	NO	NO	NO	NO	NO	NO	NO	0.0101	0.3078	0.4739	NO
H. Other									**NO**	**NO**	**4.4796**	**NO**
1. Pulp and Paper Industry									NO	NO	NO	NO
2. Food and Beverages Industry									NO	NO	4.4796	NO
3. Other									NO	NO	NO	NO

Greenhouse Gas Source and Sink Categories	CO_2	CH_4	N_2O	HFC	PFC	Unspecified mix of HFC and PFC	SF_6	NF_3	NO_x	CO	NMVOC	SO_2
	(kt)			CO_2 equivalent (kt)					(kt)			
2. Industrial Processes and Product Use	**631.7162**	**NO**	**NO**	**137.5611**	**0.0403**	**NO, NE**	**0.0000**	**NO, NE**	**1.7172**	**2.0236**	**35.7659**	**0.6881**
A. Mineral Industry	**551.5523**								**1.6760**	**1.4190**	**0.0171**	**0.6722**
1. Cement Production	476.9104								1.1139	1.3060	0.0162	0.3357
2. Lime Production	30.1662								0.0556	0.0788		0.0128
3. Glass Production	25.7612								0.4732		0.0010	0.3165
4. Other Process Uses of Carbonates	18.7145								0.0332	0.0341		0.0071
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	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	**71.3632**	**NO**	**NO**						**0.0088**	**0.0501**	**29.0945**	**0.0044**
1. Lubricant Use	4.8761	NO	NO						NO	NO	NO	NO
2. Paraffin Wax Use	0.0733	NO	NO						NO	NO	NO	NO
3. Solvent Use	64.0079	NO	NO						0.0088	0.0501	29.0945	0.0044
4. Other	2.4059	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				**137.5611**	**NO, NE**	**NO, NE**	**NO, NE**	**NO, NE**				
1. Refrigeration and Air Conditioning				44.0486	NO, NE	NO, NE	NO, NE	NO, NE				
2. Foam Blowing Agents				93.4254	NO, NE	NO, NE	NO, NE	NO, NE				
3. Fire Protection				NO, NE	NO, NE	NO, NE	NO, NE	NO, NE				
4. Aerosols				0.0870	NO, NE	NO, NE	NO, NE	NO, NE				
5. Solvents				NO, NE	NO, NE	NO, NE	NO, NE	NO, NE				
6. Other Applications				NO, NE	NO, NE	NO, NE	NO, NE	NO, NE				
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	NO	NO					
3. N_2O from Product Use			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

Greenhouse Gas Source and Sink Categories	CO_2	CH_4	N_2O	HFC	PFC	Unspecified mix of HFC and PFC	SF_6	NF_3	NO_x	CO	NMVOC	SO_2
	(kt)			CO_2 equivalent (kt)					(kt)			
2. Industrial Processes and Product Use	**652.4526**	**NO**	**NO**	**151.3701**	**0.0403**	**NO, NE**	**0.0000**	**NO, NE**	**1.7200**	**2.2174**	**44.1349**	**0.6915**
A. Mineral Industry	**548.2551**								**1.6573**	**1.4047**	**0.0167**	**0.6644**
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	26.0660								0.4702		0.0010	0.3145
4. Other Process Uses of Carbonates	18.3906								0.0328	0.0337		0.0071
B. Chemical Industry	**NO**	**NO**	**NO**						**NO**	**NO**	**0.0161**	**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	0.0161	NO
C. Metal Industry	**13.7976**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**0.0449**	**0.5868**	**0.0186**	**0.0207**
1. Iron and Steel Production	13.7976	NO							0.0449	0.5868	0.0186	0.0207
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	**89.3660**	**NO**	**NO**						**0.0128**	**0.0723**	**37.2835**	**0.0064**
1. Lubricant Use	4.7900	NO	NO						NO	NO	NO	NO
2. Paraffin Wax Use	0.0293	NO	NO						NO	NO	NO	NO
3. Solvent Use	82.0236	NO	NO						0.0128	0.0723	37.2835	0.0064
4. Other	2.5230	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				**151.3701**	**NO, NE**	**NO, NE**	**NO, NE**	**NO, NE**				
1. Refrigeration and Air Conditioning				54.3268	NO, NE	NO, NE	NO, NE	NO, NE				
2. Foam Blowing Agents				96.9516	NO, NE	NO, NE	NO, NE	NO, NE				
3. Fire Protection				NO, NE	NO, NE	NO, NE	NO, NE	NO, NE				
4. Aerosols				0.0917	NO, NE	NO, NE	NO, NE	NO, NE				
5. Solvents				NO, NE	NO, NE	NO, NE	NO, NE	NO, NE				
6. Other Applications				NO, NE	NO, NE	NO, NE	NO, NE	NO, NE				
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	NO	NO					
3. N_2O from Product Use			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

Greenhouse Gas Source and Sink Categories	CO$_2$	CH$_4$	N$_2$O	HFC	PFC	Unspecified mix of HFC and PFC	SF$_6$	NF$_3$	NO$_x$	CO	NMVOC	SO$_2$
	(kt)			CO$_2$ equivalent (kt)					(kt)			
2. Industrial Processes and Product Use	**614.5157**	**NO**	**NO**	**179.4375**	**0.0403**	**NO, NE**	**0.0000**	**NO, NE**	**1.6503**	**2.1966**	**41.1605**	**0.6781**
A. Mineral Industry	**509.6941**								**1.5815**	**1.2964**	**0.0160**	**0.6478**
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	27.9127								0.4804		0.0010	0.3214
4. Other Process Uses of Carbonates	16.7826								0.0299	0.0307		0.0064
B. Chemical Industry	**NO**	**NO**	**NO**						**NO**	**NO**	**0.0114**	**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	0.0114	NO
C. Metal Industry	**17.2258**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**0.0560**	**0.7325**	**0.0221**	**0.0259**
1. Iron and Steel Production	17.2258	NO							0.0560	0.7325	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	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	**86.8119**	**NO**	**NO**						**0.0089**	**0.0503**	**36.0209**	**0.0044**
1. Lubricant Use	4.8162	NO	NO						NO	NO	NO	NO
2. Paraffin Wax Use	0.0587	NO	NO						NO	NO	NO	NO
3. Solvent Use	79.2460	NO	NO						0.0089	0.0503	36.0209	0.0044
4. Other	2.6910	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				**179.4375**	**NO, NE**	**NO, NE**	**NO, NE**	**NO, NE**				
1. Refrigeration and Air Conditioning				77.3604	NO, NE	NO, NE	NO, NE	NO, NE				
2. Foam Blowing Agents				101.8751	NO, NE	NO, NE	NO, NE	NO, NE				
3. Fire Protection				NO, NE	NO, NE	NO, NE	NO, NE	NO, NE				
4. Aerosols				0.2020	NO, NE	NO, NE	NO, NE	NO, NE				
5. Solvents				NO, NE	NO, NE	NO, NE	NO, NE	NO, NE				
6. Other Applications				NO, NE	NO, NE	NO, NE	NO, NE	NO, NE				
G. Other Product Manufacture and Use	**0.7840**	**NO**	**NO**	**NO**	**0.0403**	**NO**	**0.0000**	**NO**	**0.0038**	**0.1174**	**0.3564**	**NO**
1. Electrical Equipment				NO	0.0403	NO	0.0000	NO				
2. SF$_6$ and PFCs from Other Product Use					NO	NO	NO					
3. N$_2$O from Product Use			NO									
4. Other	0.7840	NO	NO	NO	NO	NO	NO	NO	0.0038	0.1174	0.3564	NO
H. Other									**NO**	**NO**	**4.7339**	**NO**
1. Pulp and Paper Industry									NO	NO	NO	NO
2. Food and Beverages Industry									NO	NO	4.7339	NO
3. Other									NO	NO	NO	NO

Annex 6-3: Sectoral Report for Agriculture Sector, 1990-2015

1990

Greenhouse Gas Source and Sink Categories	CO_2	CH_4	N_2O	NO_x	CO	NMVOC
	(kt)					
3. Total Agriculture	**0.5820**	**107.4205**	**8.4713**	NO	NO	NO, NE
I. Livestock		**107.4205**	**3.7470**			NO, NE
A. Enteric fermentation		**87.6278**				
1. Cattle		74.9935				
Dairy cows		41.4105				
Other cattle		33.5830				
2. Sheep		8.5887				
3. Swine		2.7751				
4. Other livestock		1.2705				
Goats		0.2361				
Horses		0.8505				
Asses and Mules		0.0169				
Other (Rabbits)		0.1670				
B. Manure Management		**19.7927**	**3.7470**			**NE**
1. Cattle		9.2029	1.3936			NE
Dairy cattle		5.3324	0.5914			NE
Non-dairy cattle		3.8705	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			**4.7243**			
a. Direct N_2O emissions from managed soils			3.5880			
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			0.5413			
6. Cultivation of organic soils			NO			
7. Other			NO			
b. Indirect N_2O emissions from managed soils			1.1363			
1. Atmospheric deposition			0.3429			
2. Nitrogen leaching and run-off			0.7934			
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					
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**	**97.8215**	**8.0901**	**NO**	**NO**	**NO, NE**
I. Livestock		**97.8215**	**3.4991**			**NO, NE**
A. Enteric fermentation		**81.2260**				
1. Cattle		68.6275				
Dairy cows		38.7594				
Other cattle		29.8681				
2. Sheep		8.6126				
3. Swine		2.6295				
4. Other livestock		1.3564				
Goats		0.3186				
Horses		0.8719				
Asses and Mules		0.0179				
Other (Rabbits)		0.1479				
B. Manure Management		**16.5955**	**3.4991**			**NE**
1. Cattle		7.4601	1.2622			NE
Dairy cattle		4.5405	0.5548			NE
Non-dairy cattle		2.9195	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			**4.5909**			
a. Direct N_2O emissions from managed soils			3.5046			
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			0.5576			
6. Cultivation of organic soils			NO			
7. Other			NO			
b. Indirect N_2O emissions from managed soils			1.0863			
1. Atmospheric deposition			0.3182			
2. Nitrogen leaching and run-off			0.7681			
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					
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**	**94.7006**	**6.8113**	**NO**	**NO**	**NO, NE**
I. Livestock		**94.7006**	**3.1392**			**NO, NE**
A. Enteric fermentation		**79.7785**				
1. Cattle		67.3319				
Dairy cows		39.1042				
Other cattle		28.2278				
2. Sheep		8.6947				
3. Swine		2.2311				
4. Other livestock		1.5207				
Goats		0.3987				
Horses		0.9248				
Asses and Mules		0.0211				
Other (Rabbits)		0.1761				
B. Manure Management		**14.9221**	**3.1392**			**NE**
1. Cattle		7.3411	1.1797			NE
Dairy cattle		4.5809	0.5518			NE
Non-dairy cattle		2.7602	0.6279			NE
2. Sheep		0.2459	0.4586			NE
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			**3.6721**			
a. Direct N_2O emissions from managed soils			2.7931			
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			0.4662			
6. Cultivation of organic soils			NO			
7. Other			NO			
b. Indirect N_2O emissions from managed soils			0.8791			
1. Atmospheric deposition			0.2691			
2. Nitrogen leaching and run-off			0.6099			
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					
J. Other	NO	NO	NO	NO	NO	NO

1993

Greenhouse Gas Source and Sink Categories	CO_2	CH_4	N_2O	NO_x	CO	NMVOC
	(kt)					
3. Total Agriculture	**0.1276**	**85.9778**	**6.9568**	NO	NO	NO, NE
I. Livestock		**85.9778**	**2.7155**			NO, NE
A. Enteric fermentation		**75.0132**				
1. Cattle		62.7512				
Dairy cows		37.6503				
Other cattle		25.1009				
2. Sheep		9.0105				
3. Swine		1.6235				
4. Other livestock		1.6280				
Goats		0.4706				
Horses		0.9802				
Asses and Mules		0.0225				
Other (Rabbits)		0.1548				
B. Manure Management		**10.9646**	**2.7155**			**NE**
1. Cattle		5.4991	1.0636			NE
Dairy cattle		3.4585	0.5343			NE
Non-dairy cattle		2.0406	0.5293			NE
2. Sheep		0.2589	0.4698			NE
3. Swine		4.7183	0.3163			NE
4. Other livestock		0.4883	0.3519			NE
Goats		0.0097	0.0319			NE
Horses		0.0849	0.0671			NE
Mules and Asses		0.0017	0.0011			NE
Poultry		0.3709	0.2013			NE
Other (Rabbits)		0.0210	0.0505			NE
5. Indirect N_2O emissions			0.5139			
C. Rice cultivation		NO				NO
D. Agricultural soils			**4.2413**			
a. Direct N_2O emissions from managed soils			3.3196			
1. Inorganic N fertilizers			0.4145			
2. Organic N fertilizers			0.6087			
a. Animal manure applied to soils			0.6087			
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			0.2856			
4. Crop residues			0.4958			
5. Mineralization/immobilization associated with loss/gain of soil organic matter			1.5150			
6. Cultivation of organic soils			NO			
7. Other			NO			
b. Indirect N_2O emissions from managed soils			0.9217			
1. Atmospheric deposition			0.1989			
2. Nitrogen leaching and run-off			0.7228			
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					
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**	**83.5725**	**5.5782**	**NO**	**NO**	**NO, NE**
I. Livestock		**83.5725**	**2.6254**			**NO, NE**
A. Enteric fermentation		**73.0171**				
1. Cattle		60.4337				
Dairy cows		37.3768				
Other cattle		23.0570				
2. Sheep		9.2361				
3. Swine		1.5702				
4. Other livestock		1.7770				
Goats		0.5606				
Horses		1.0473				
Asses and Mules		0.0292				
Other (Rabbits)		0.1399				
B. Manure Management		**10.5554**	**2.6254**			**NE**
1. Cattle		5.4482	0.9913			NE
Dairy cattle		3.5237	0.5334			NE
Non-dairy cattle		1.9245	0.4579			NE
2. Sheep		0.2680	0.4968			NE
3. Swine		4.3463	0.2928			NE
4. Other livestock		0.4929	0.3530			NE
Goats		0.0119	0.0400			NE
Horses		0.0908	0.0755			NE
Mules and Asses		0.0022	0.0014			NE
Poultry		0.3691	0.1901			NE
Other (Rabbits)		0.0190	0.0460			NE
5. Indirect N_2O emissions			0.4915			
C. Rice cultivation		NO				NO
D. Agricultural soils			**2.9528**			
a. Direct N_2O emissions from managed soils			2.2858			
1. Inorganic N fertilizers			0.2217			
2. Organic N fertilizers			0.5888			
a. Animal manure applied to soils			0.5888			
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			0.2786			
4. Crop residues			0.3116			
5. Mineralization/immobilization associated with loss/gain of soil organic matter			0.8851			
6. Cultivation of organic soils			NO			
7. Other			NO			
b. Indirect N_2O emissions from managed soils			0.6670			
1. Atmospheric deposition			0.1755			
2. Nitrogen leaching and run-off			0.4916			
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					
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**	**73.0154**	**5.9233**	**NO**	**NO**	**NO, NE**
I. Livestock		**73.0154**	**2.4251**			**NO, NE**
A. Enteric fermentation		**64.8267**				
1. Cattle		52.9534				
Dairy cows		34.6078				
Other cattle		18.3456				
2. Sheep		8.5093				
3. Swine		1.5219				
4. Other livestock		1.8421				
Goats		0.5777				
Horses		1.1086				
Asses and Mules		0.0323				
Other (Rabbits)		0.1235				
B. Manure Management		**8.1887**	**2.4251**			**NE**
1. Cattle		3.6718	0.8857			NE
Dairy cattle		2.5546	0.5019			NE
Non-dairy cattle		1.1172	0.3838			NE
2. Sheep		0.2524	0.4185			NE
3. Swine		3.7617	0.3315			NE
4. Other livestock		0.5029	0.3412			NE
Goats		0.0123	0.0364			NE
Horses		0.0961	0.0778			NE
Mules and Asses		0.0025	0.0015			NE
Poultry		0.3753	0.1846			NE
Other (Rabbits)		0.0167	0.0408			NE
5. Indirect N_2O emissions			0.4483			
C. Rice cultivation		NO				NO
D. Agricultural soils			**3.4982**			
a. Direct N_2O emissions from managed soils			2.7463			
1. Inorganic N fertilizers			0.1652			
2. Organic N fertilizers			0.5347			
a. Animal manure applied to soils			0.5347			
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			0.2974			
4. Crop residues			0.3401			
5. Mineralization/immobilization associated with loss/gain of soil organic matter			1.4090			
6. Cultivation of organic soils			NO			
7. Other			NO			
b. Indirect N_2O emissions from managed soils			0.7519			
1. Atmospheric deposition			0.1599			
2. Nitrogen leaching and run-off			0.5920			
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					
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**	**67.1143**	**5.7817**	NO	NO	NO, NE
I. Livestock		**67.1143**	**2.5789**			NO, NE
A. Enteric fermentation		**59.6473**				
1. Cattle		48.1637				
Dairy cows		32.1108				
Other cattle		16.0529				
2. Sheep		8.1793				
3. Swine		1.4251				
4. Other livestock		1.8791				
Goats		0.5961				
Horses		1.1403				
Asses and Mules		0.0308				
Other (Rabbits)		0.1120				
B. Manure Management		**7.4670**	**2.5789**			**NE**
1. Cattle		3.3486	0.7978			NE
Dairy cattle		2.3702	0.4686			NE
Non-dairy cattle		0.9783	0.3292			NE
2. Sheep		0.2420	0.4023			NE
3. Swine		3.3886	0.3544			NE
4. Other livestock		0.4879	0.5535			NE
Goats		0.0128	0.0380			NE
Horses		0.0988	0.0776			NE
Mules and Asses		0.0023	0.0014			NE
Poultry		0.3587	0.1821			NE
Other (Rabbits)		0.0152	0.2544			NE
5. Indirect N_2O emissions			0.4709			
C. Rice cultivation		NO				NO
D. Agricultural soils			**3.2028**			
a. Direct N_2O emissions from managed soils			2.4983			
1. Inorganic N fertilizers			0.2077			
2. Organic N fertilizers			0.5564			
a. Animal manure applied to soils			0.5564			
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			0.2750			
4. Crop residues			0.2844			
5. Mineralization/immobilization associated with loss/gain of soil organic matter			1.1748			
6. Cultivation of organic soils			NO			
7. Other			NO			
b. Indirect N_2O emissions from managed soils			0.7045			
1. Atmospheric deposition			0.1660			
2. Nitrogen leaching and run-off			0.5385			
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					
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**	**57.4675**	**5.8498**	**NO**	**NO**	**NO, NE**
I. Livestock		**57.4675**	**1.9891**			**NO, NE**
A. Enteric fermentation		**51.4038**				
1. Cattle		41.1875				
Dairy cows		29.1741				
Other cattle		12.0134				
2. Sheep		7.1330				
3. Swine		1.1963				
4. Other livestock		1.8870				
Goats		0.5757				
Horses		1.1773				
Asses and Mules		0.0297				
Other (Rabbits)		0.1043				
B. Manure Management		**6.0636**	**1.9891**			**NE**
1. Cattle		2.8116	0.7066			NE
Dairy cattle		2.0983	0.4578			NE
Non-dairy cattle		0.7134	0.2488			NE
2. Sheep		0.2165	0.3251			NE
3. Swine		2.5398	0.2661			NE
4. Other livestock		0.4957	0.3239			NE
Goats		0.0125	0.0328			NE
Horses		0.1020	0.0743			NE
Mules and Asses		0.0023	0.0013			NE
Poultry		0.3648	0.1809			NE
Other (Rabbits)		0.0141	0.0346			NE
5. Indirect N_2O emissions			0.3674			
C. Rice cultivation		NO				NO
D. Agricultural soils			**3.8607**			
a. Direct N_2O emissions from managed soils			3.0585			
1. Inorganic N fertilizers			0.1795			
2. Organic N fertilizers			0.4379			
a. Animal manure applied to soils			0.4379			
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			0.2444			
4. Crop residues			0.3291			
5. Mineralization/immobilization associated with loss/gain of soil organic matter			1.8676			
6. Cultivation of organic soils			NO			
7. Other			NO			
b. Indirect N_2O emissions from managed soils			0.8022			
1. Atmospheric deposition			0.1354			
2. Nitrogen leaching and run-off			0.6668			
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					
J. Other	NO	NO	NO	NO	NO	NO

Greenhouse Gas Source and Sink Categories	CO_2	CH_4	N_2O	NO_x	CO	NMVOC
	(kt)					
3. Total Agriculture	**0.2721**	**54.9812**	**5.2750**	NO	NO	NO, NE
I. Livestock		**54.9812**	**1.9212**			NO, NE
A. Enteric fermentation		**49.9020**				
1. Cattle		40.0305				
Dairy cows		28.7829				
Other cattle		11.2475				
2. Sheep		6.5322				
3. Swine		1.3921				
4. Other livestock		1.9473				
Goats		0.5725				
Horses		1.2330				
Asses and Mules		0.0320				
Other (Rabbits)		0.1097				
B. Manure Management		**5.0792**	**1.9212**			**NE**
1. Cattle		2.0925	0.6743			NE
Dairy cattle		1.6125	0.4433			NE
Non-dairy cattle		0.4800	0.2309			NE
2. Sheep		0.1996	0.2922			NE
3. Swine		2.2708	0.2802			NE
4. Other livestock		0.5163	0.3361			NE
Goats		0.0126	0.0323			NE
Horses		0.1069	0.0755			NE
Mules and Asses		0.0024	0.0014			NE
Poultry		0.3796	0.1909			NE
Other (Rabbits)		0.0149	0.0361			NE
5. Indirect N_2O emissions			0.3384			
C. Rice cultivation		NO				NO
D. Agricultural soils			**3.3538**			
a. Direct N_2O emissions from managed soils			2.6502			
1. Inorganic N fertilizers			0.1600			
2. Organic N fertilizers			0.4135			
a. Animal manure applied to soils			0.4135			
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			0.2696			
4. Crop residues			0.2816			
5. Mineralization/immobilization associated with loss/gain of soil organic matter			1.5254			
6. Cultivation of organic soils			NO			
7. Other			NO			
b. Indirect N_2O emissions from managed soils			0.7036			
1. Atmospheric deposition			0.1313			
2. Nitrogen leaching and run-off			0.5723			
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					
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**	**50.6255**	**4.7770**	**NO**	**NO**	**NO, NE**
I. Livestock		**50.6255**	**1.7380**			**NO, NE**
A. Enteric fermentation		**46.1688**				
1. Cattle		37.0494				
Dairy cows		27.7978				
Other cattle		9.2516				
2. Sheep		5.9516				
3. Swine		1.1270				
4. Other livestock		2.0408				
Goats		0.6026				
Horses		1.2964				
Asses and Mules		0.0341				
Other (Rabbits)		0.1077				
B. Manure Management		**4.4567**	**1.7380**			**NE**
1. Cattle		1.9521	0.6113			NE
Dairy cattle		1.5573	0.4244			NE
Non-dairy cattle		0.3948	0.1869			NE
2. Sheep		0.1811	0.2652			NE
3. Swine		1.7854	0.2112			NE
4. Other livestock		0.5380	0.3482			NE
Goats		0.0133	0.0342			NE
Horses		0.1124	0.0752			NE
Mules and Asses		0.0026	0.0014			NE
Poultry		0.3952	0.2024			NE
Other (Rabbits)		0.0146	0.0350			NE
5. Indirect N_2O emissions			0.3021			
C. Rice cultivation		NO				NO
D. Agricultural soils			**3.0390**			
a. Direct N_2O emissions from managed soils			2.4052			
1. Inorganic N fertilizers			0.0929			
2. Organic N fertilizers			0.3755			
a. Animal manure applied to soils			0.3755			
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			0.2498			
4. Crop residues			0.2743			
5. Mineralization/immobilization associated with loss/gain of soil organic matter			1.4128			
6. Cultivation of organic soils			NO			
7. Other			NO			
b. Indirect N_2O emissions from managed soils			0.6337			
1. Atmospheric deposition			0.1147			
2. Nitrogen leaching and run-off			0.5190			
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					
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**	**46.8112**	**4.4614**	NO	NO	NO, NE
I. Livestock		**46.8112**	**1.5597**			NO, NE
A. Enteric fermentation		**43.4275**				
1. Cattle		35.2640				
Dairy cows		27.1900				
Other cattle		8.0740				
2. Sheep		5.2801				
3. Swine		0.7390				
4. Other livestock		2.1445				
Goats		0.6423				
Horses		1.3687				
Asses and Mules		0.0384				
Other (Rabbits)		0.0951				
B. Manure Management		**3.3837**	**1.5597**			**NE**
1. Cattle		1.6524	0.5625			NE
Dairy cattle		1.3106	0.4135			NE
Non-dairy cattle		0.3418	0.1490			NE
2. Sheep		0.1616	0.2372			NE
3. Swine		1.0111	0.1423			NE
4. Other livestock		0.5586	0.3567			NE
Goats		0.0145	0.0373			NE
Horses		0.1186	0.0803			NE
Mules and Asses		0.0029	0.0016			NE
Poultry		0.4097	0.2067			NE
Other (Rabbits)		0.0129	0.0308			NE
5. Indirect N_2O emissions			0.2609			
C. Rice cultivation		NO				NO
D. Agricultural soils			**2.9017**			
a. Direct N_2O emissions from managed soils			2.2946			
1. Inorganic N fertilizers			0.1609			
2. Organic N fertilizers			0.3357			
a. Animal manure applied to soils			0.3357			
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			0.2438			
4. Crop residues			0.2518			
5. Mineralization/immobilization associated with loss/gain of soil organic matter			1.3023			
6. Cultivation of organic soils			NO			
7. Other			NO			
b. Indirect N_2O emissions from managed soils			0.6071			
1. Atmospheric deposition			0.1126			
2. Nitrogen leaching and run-off			0.4945			
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					
J. Other	NO	NO	NO	NO	NO	NO

Greenhouse Gas Source and Sink Categories	CO_2	CH_4	N_2O	NO_x	CO	NMVOC
	(kt)					
3. Total Agriculture	**0.1496**	**47.6273**	**4.9731**	NO	NO	NO, NE
I. Livestock		**47.6273**	**1.5863**			NO, NE
A. Enteric fermentation		**44.2135**				
1. Cattle		35.8179				
Dairy cows		27.6639				
Other cattle		8.1539				
2. Sheep		5.3734				
3. Swine		0.7337				
4. Other livestock		2.2884				
Goats		0.6647				
Horses		1.4680				
Asses and Mules		0.0427				
Other (Rabbits)		0.1129				
B. Manure Management		**3.4138**	**1.5863**			**NE**
1. Cattle		1.6782	0.5708			NE
Dairy cattle		1.3334	0.4142			NE
Non-dairy cattle		0.3448	0.1566			NE
2. Sheep		0.1628	0.2260			NE
3. Swine		0.9691	0.1353			NE
4. Other livestock		0.6036	0.3887			NE
Goats		0.0149	0.0359			NE
Horses		0.1272	0.0856			NE
Mules and Asses		0.0032	0.0017			NE
Poultry		0.4430	0.2282			NE
Other (Rabbits)		0.0153	0.0373			NE
5. Indirect N_2O emissions			0.2655			
C. Rice cultivation		NO				NO
D. Agricultural soils			**3.3868**			
a. Direct N_2O emissions from managed soils			2.6866			
1. Inorganic N fertilizers			0.1994			
2. Organic N fertilizers			0.3421			
a. Animal manure applied to soils			0.3421			
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			0.2471			
4. Crop residues			0.2705			
5. Mineralization/immobilization associated with loss/gain of soil organic matter			1.6275			
6. Cultivation of organic soils			NO			
7. Other			NO			
b. Indirect N_2O emissions from managed soils			0.7002			
1. Atmospheric deposition			0.1180			
2. Nitrogen leaching and run-off			0.5822			
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					
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**	**48.7256**	**5.1150**	**NO**	**NO**	**NO, NE**
I. Livestock		**48.7256**	**1.6001**			**NO, NE**
A. Enteric fermentation		**45.1458**				
1. Cattle		36.5787				
Dairy cows		28.4383				
Other cattle		8.1404				
2. Sheep		5.3414				
3. Swine		0.8252				
4. Other livestock		2.4004				
Goats		0.7606				
Horses		1.4875				
Asses and Mules		0.0397				
Other (Rabbits)		0.1125				
B. Manure Management		**3.5798**	**1.6001**			**NE**
1. Cattle		1.7149	0.5723			NE
Dairy cattle		1.3707	0.4206			NE
Non-dairy cattle		0.3442	0.1517			NE
2. Sheep		0.1613	0.2182			NE
3. Swine		1.0728	0.1459			NE
4. Other livestock		0.6308	0.3950			NE
Goats		0.0168	0.0394			NE
Horses		0.1289	0.0849			NE
Mules and Asses		0.0030	0.0016			NE
Poultry		0.4668	0.2320			NE
Other (Rabbits)		0.0153	0.0370			NE
5. Indirect N_2O emissions			0.2688			
C. Rice cultivation		NO				NO
D. Agricultural soils			**3.5149**			
a. Direct N_2O emissions from managed soils			2.7830			
1. Inorganic N fertilizers			0.2823			
2. Organic N fertilizers			0.3454			
a. Animal manure applied to soils			0.3454			
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			0.2559			
4. Crop residues			0.2764			
5. Mineralization/immobilization associated with loss/gain of soil organic matter			1.6231			
6. Cultivation of organic soils			NO			
7. Other			NO			
b. Indirect N_2O emissions from managed soils			0.7318			
1. Atmospheric deposition			0.1283			
2. Nitrogen leaching and run-off			0.6035			
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					
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**	**44.5785**	**4.3955**	**NO**	**NO**	**NO, NE**
I. Livestock		**44.5785**	**1.5214**			**NO, NE**
A. Enteric fermentation		**41.2451**				
1. Cattle		33.0553				
Dairy cows		25.9741				
Other cattle		7.0812				
2. Sheep		5.1307				
3. Swine		0.7146				
4. Other livestock		2.3445				
Goats		0.7149				
Horses		1.4656				
Asses and Mules		0.0428				
Other (Rabbits)		0.1212				
B. Manure Management		**3.3334**	**1.5214**			**NE**
1. Cattle		1.5513	0.5128			NE
Dairy cattle		1.2520	0.3812			NE
Non-dairy cattle		0.2994	0.1316			NE
2. Sheep		0.1586	0.2145			NE
3. Swine		0.9748	0.1307			NE
4. Other livestock		0.6487	0.4080			NE
Goats		0.0161	0.0377			NE
Horses		0.1270	0.0847			NE
Mules and Asses		0.0033	0.0017			NE
Poultry		0.4859	0.2448			NE
Other (Rabbits)		0.0164	0.0390			NE
5. Indirect N_2O emissions			0.2555			
C. Rice cultivation		NO				NO
D. Agricultural soils			**2.8741**			**NE**
a. Direct N_2O emissions from managed soils			2.2671			
1. Inorganic N fertilizers			0.2298			
2. Organic N fertilizers			0.3276			
a. Animal manure applied to soils			0.3276			
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			0.2378			
4. Crop residues			0.2552			
5. Mineralization/immobilization associated with loss/gain of soil organic matter			1.2168			
6. Cultivation of organic soils			NO			
7. Other			NO			
b. Indirect N_2O emissions from managed soils			0.6070			
1. Atmospheric deposition			0.1176			
2. Nitrogen leaching and run-off			0.4894			
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					
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**	**41.7331**	**5.1959**	**NO**	**NO**	**NO, NE**
I. Livestock		**41.7331**	**1.4730**			**NO, NE**
A. Enteric fermentation		**38.4913**				
1. Cattle		30.3317				
Dairy cows		24.1309				
Other cattle		6.2007				
2. Sheep		5.2647				
3. Swine		0.6335				
4. Other livestock		2.2615				
Goats		0.7158				
Horses		1.3646				
Asses and Mules		0.0400				
Other (Rabbits)		0.1410				
B. Manure Management		**3.2418**	**1.4730**			**NE**
1. Cattle		1.5011	0.4526			NE
Dairy cattle		1.2057	0.3410			NE
Non-dairy cattle		0.2953	0.1116			NE
2. Sheep		0.1592	0.2159			NE
3. Swine		0.8799	0.1177			NE
4. Other livestock		0.7015	0.4377			NE
Goats		0.0158	0.0372			NE
Horses		0.1183	0.0775			NE
Mules and Asses		0.0030	0.0016			NE
Poultry		0.5453	0.2751			NE
Other (Rabbits)		0.0191	0.0463			NE
5. Indirect N_2O emissions			0.2491			
C. Rice cultivation		NO				NO
D. Agricultural soils			**3.7229**			
a. Direct N_2O emissions from managed soils			2.9602			
1. Inorganic N fertilizers			0.2524			
2. Organic N fertilizers			0.3153			
a. Animal manure applied to soils			0.3153			
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			0.2254			
4. Crop residues			0.3140			
5. Mineralization/immobilization associated with loss/gain of soil organic matter			1.8531			
6. Cultivation of organic soils			NO			
7. Other			NO			
b. Indirect N_2O emissions from managed soils			0.7627			
1. Atmospheric deposition			0.1161			
2. Nitrogen leaching and run-off			0.6466			
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					
J. Other	NO	NO	NO	NO	NO	NO

Greenhouse Gas Source and Sink Categories	CO_2	CH_4	N_2O	NO_x	CO	NMVOC
	(kt)					
3. Total Agriculture	**0.1739**	**40.5015**	**5.2477**	**NO**	**NO**	**NO, NE**
I. Livestock		**40.5015**	**1.5707**			**NO, NE**
A. Enteric fermentation		**37.0747**				
1. Cattle		28.7238				
Dairy cows		22.8364				
Other cattle		5.8874				
2. Sheep		5.4013				
3. Swine		0.7395				
4. Other livestock		2.2101				
Goats		0.7121				
Horses		1.2961				
Asses and Mules		0.0374				
Other (Rabbits)		0.1645				
B. Manure Management		**3.4267**	**1.5707**			**NE**
1. Cattle		1.4213	0.4207			NE
Dairy cattle		1.1411	0.3152			NE
Non-dairy cattle		0.2803	0.1055			NE
2. Sheep		0.1582	0.2140			NE
3. Swine		1.0087	0.1349			NE
4. Other livestock		0.8384	0.5316			NE
Goats		0.0158	0.0371			NE
Horses		0.1123	0.0759			NE
Mules and Asses		0.0028	0.0015			NE
Poultry		0.6851	0.3629			NE
Other (Rabbits)		0.0223	0.0541			NE
5. Indirect N_2O emissions			0.2696			
C. Rice cultivation		NO				NO
D. Agricultural soils			**3.6770**			
a. Direct N_2O emissions from managed soils			2.9202			
1. Inorganic N fertilizers			0.2530			
2. Organic N fertilizers			0.3314			
a. Animal manure applied to soils			0.3314			
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			0.2232			
4. Crop residues			0.3151			
5. Mineralization/immobilization associated with loss/gain of soil organic matter			1.7975			
6. Cultivation of organic soils			NO			
7. Other			NO			
b. Indirect N_2O emissions from managed soils			0.7569			
1. Atmospheric deposition			0.1191			
2. Nitrogen leaching and run-off			0.6378			
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					
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**	**39.3774**	**4.9614**	**NO**	**NO**	**NO, NE**
I. Livestock		**39.3774**	**1.6153**			**NO, NE**
A. Enteric fermentation		**35.8795**				
1. Cattle		27.4654				
Dairy cows		21.6435				
Other cattle		5.8220				
2. Sheep		5.3991				
3. Swine		0.8524				
4. Other livestock		2.1626				
Goats		0.6871				
Horses		1.2468				
Asses and Mules		0.0364				
Other (Rabbits)		0.1923				
B. Manure Management		**3.4979**	**1.6153**			**NE**
1. Cattle		1.3228	0.4040			NE
Dairy cattle		1.0530	0.2991			NE
Non-dairy cattle		0.2698	0.1049			NE
2. Sheep		0.1613	0.2240			NE
3. Swine		1.1714	0.1580			NE
4. Other livestock		0.8425	0.5506			NE
Goats		0.0148	0.0359			NE
Horses		0.1081	0.0791			NE
Mules and Asses		0.0028	0.0015			NE
Poultry		0.6908	0.3706			NE
Other (Rabbits)		0.0261	0.0636			NE
5. Indirect N_2O emissions			0.2786			
C. Rice cultivation		NO				NO
D. Agricultural soils			**3.3461**			
a. Direct N_2O emissions from managed soils			2.6513			
1. Inorganic N fertilizers			0.2170			
2. Organic N fertilizers			0.3395			
a. Animal manure applied to soils			0.3395			
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			0.2203			
4. Crop residues			0.3063			
5. Mineralization/immobilization associated with loss/gain of soil organic matter			1.5681			
6. Cultivation of organic soils			NO			
7. Other			NO			
b. Indirect N_2O emissions from managed soils			0.6948			
1. Atmospheric deposition			0.1170			
2. Nitrogen leaching and run-off			0.5778			
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					
J. Other	NO	NO	NO	NO	NO	NO

Greenhouse Gas Source and Sink Categories	CO_2	CH_4	N_2O	NO_x	CO	NMVOC
	(kt)					
3. Total Agriculture	**0.2631**	**31.4767**	**3.0116**	**NO**	**NO**	**NO, NE**
I. Livestock		**31.4767**	**1.2329**			**NO, NE**
A. Enteric fermentation		**28.9885**				
1. Cattle		21.7055				
Dairy cows		17.7373				
Other cattle		3.9683				
2. Sheep		4.9104				
3. Swine		0.4812				
4. Other livestock		1.8914				
Goats		0.6151				
Horses		1.0897				
Asses and Mules		0.0312				
Other (Rabbits)		0.1554				
B. Manure Management		**2.4883**	**1.2329**			**NE**
1. Cattle		1.0469	0.3130			NE
Dairy cattle		0.8630	0.2427			NE
Non-dairy cattle		0.1839	0.0703			NE
2. Sheep		0.1454	0.1967			NE
3. Swine		0.6434	0.0892			NE
4. Other livestock		0.6525	0.4252			NE
Goats		0.0131	0.0308			NE
Horses		0.0944	0.0640			NE
Mules and Asses		0.0024	0.0013			NE
Poultry		0.5215	0.2793			NE
Other (Rabbits)		0.0211	0.0498			NE
5. Indirect N_2O emissions			0.2088			
C. Rice cultivation		NO				NO
D. Agricultural soils			**1.7788**			
a. Direct N_2O emissions from managed soils			1.3790			
1. Inorganic N fertilizers			0.2959			
2. Organic N fertilizers			0.2614			
a. Animal manure applied to soils			0.2614			
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			0.1748			
4. Crop residues			0.1293			
5. Mineralization/immobilization associated with loss/gain of soil organic matter			0.5176			
6. Cultivation of organic soils			NO			
7. Other			NO			
b. Indirect N_2O emissions from managed soils			0.3998			
1. Atmospheric deposition			0.1040			
2. Nitrogen leaching and run-off			0.2958			
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					
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**	**30.0773**	**4.9854**	**NO**	**NO**	**NO, NE**
I. Livestock		**30.0773**	**1.2103**			**NO, NE**
A. Enteric fermentation		**27.6304**				
1. Cattle		20.3763				
Dairy cows		16.9198				
Other cattle		3.4565				
2. Sheep		4.9518				
3. Swine		0.4544				
4. Other livestock		1.8479				
Goats		0.6366				
Horses		1.0329				
Asses and Mules		0.0319				
Other (Rabbits)		0.1466				
B. Manure Management		**2.4469**	**1.2103**			**NE**
1. Cattle		0.9568	0.2876			NE
Dairy cattle		0.8009	0.2229			NE
Non-dairy cattle		0.1558	0.0648			NE
2. Sheep		0.1471	0.1941			NE
3. Swine		0.6661	0.0886			NE
4. Other livestock		0.6770	0.4335			NE
Goats		0.0137	0.0314			NE
Horses		0.0895	0.0607			NE
Mules and Asses		0.0024	0.0013			NE
Poultry		0.5515	0.2917			NE
Other (Rabbits)		0.0199	0.0483			NE
5. Indirect N_2O emissions			0.2065			
C. Rice cultivation		NO				NO
D. Agricultural soils			**3.7751**			
a. Direct N_2O emissions from managed soils			3.0049			
1. Inorganic N fertilizers			0.3446			
2. Organic N fertilizers			0.2556			
a. Animal manure applied to soils			0.2556			
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			0.1757			
4. Crop residues			0.3305			
5. Mineralization/immobilization associated with loss/gain of soil organic matter			1.8984			
6. Cultivation of organic soils			NO			
7. Other			NO			
b. Indirect N_2O emissions from managed soils			0.7702			
1. Atmospheric deposition			0.1082			
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					
J. Other	NO	NO	NO	NO	NO	NO

Greenhouse Gas Source and Sink Categories	CO_2	CH_4	N_2O	NO_x	CO	NMVOC
	(kt)					
3. Total Agriculture	**0.5864**	**31.5015**	**4.3026**	**NO**	**NO**	**NO, NE**
I. Livestock		**31.5015**	**1.3661**			**NO, NE**
A. Enteric fermentation		**28.7094**				
1. Cattle		20.7352				
Dairy cows		17.1448				
Other cattle		3.5904				
2. Sheep		5.4512				
3. Swine		0.6054				
4. Other livestock		1.9175				
Goats		0.7171				
Horses		1.0092				
Asses and Mules		0.0294				
Other (Rabbits)		0.1619				
B. Manure Management		**2.7921**	**1.3661**			**NE**
1. Cattle		0.9735	0.2942			NE
Dairy cattle		0.8116	0.2259			NE
Non-dairy cattle		0.1619	0.0683			NE
2. Sheep		0.1552	0.2156			NE
3. Swine		0.8616	0.1178			NE
4. Other livestock		0.8018	0.5026			NE
Goats		0.0147	0.0358			NE
Horses		0.0875	0.0584			NE
Mules and Asses		0.0022	0.0012			NE
Poultry		0.6755	0.3535			NE
Other (Rabbits)		0.0220	0.0537			NE
5. Indirect N_2O emissions			0.2360			
C. Rice cultivation		NO				NO
D. Agricultural soils			**2.9365**			
a. Direct N_2O emissions from managed soils			2.3211			
1. Inorganic N fertilizers			0.2670			
2. Organic N fertilizers			0.2856			
a. Animal manure applied to soils			0.2856			
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			0.1887			
4. Crop residues			0.2458			
5. Mineralization/immobilization associated with loss/gain of soil organic matter			1.3341			
6. Cultivation of organic soils			NO			
7. Other			NO			
b. Indirect N_2O emissions from managed soils			0.6153			
1. Atmospheric deposition			0.1082			
2. Nitrogen leaching and run-off			0.5072			
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					
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**	**31.5606**	**4.8959**	**NO**	**NO**	**NO, NE**
I. Livestock		**31.5606**	**1.4165**			**NO, NE**
A. Enteric fermentation		**28.5047**				
1. Cattle		20.4684				
Dairy cows		16.8175				
Other cattle		3.6509				
2. Sheep		5.3515				
3. Swine		0.7675				
4. Other livestock		1.9173				
Goats		0.7617				
Horses		0.9646				
Asses and Mules		0.0275				
Other (Rabbits)		0.1635				
B. Manure Management		**3.0558**	**1.4165**			**NE**
1. Cattle		0.9607	0.2901			NE
Dairy cattle		0.7961	0.2209			NE
Non-dairy cattle		0.1646	0.0692			NE
2. Sheep		0.1522	0.2114			NE
3. Swine		1.1196	0.1470			NE
4. Other livestock		0.8234	0.5202			NE
Goats		0.0155	0.0378			NE
Horses		0.0836	0.0564			NE
Mules and Asses		0.0021	0.0011			NE
Poultry		0.7000	0.3703			NE
Other (Rabbits)		0.0222	0.0545			NE
5. Indirect N_2O emissions			0.2477			
C. Rice cultivation		NO				NO
D. Agricultural soils			**3.4794**			
a. Direct N_2O emissions from managed soils			2.7584			
1. Inorganic N fertilizers			0.3234			
2. Organic N fertilizers			0.2942			
a. Animal manure applied to soils			0.2942			
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			0.1885			
4. Crop residues			0.3344			
5. Mineralization/immobilization associated with loss/gain of soil organic matter			1.6179			
6. Cultivation of organic soils			NO			
7. Other			NO			
b. Indirect N_2O emissions from managed soils			0.7209			
1. Atmospheric deposition			0.1154			
2. Nitrogen leaching and run-off			0.6055			
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					
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**	**29.7443**	**4.8884**	**NO**	**NO**	**NO, NE**
I. Livestock		**29.7443**	**1.2930**			**NO, NE**
A. Enteric fermentation		**26.8550**				
1. Cattle		19.4924				
Dairy cows		15.8871				
Other cattle		3.6053				
2. Sheep		4.7753				
3. Swine		0.7076				
4. Other livestock		1.8797				
Goats		0.7750				
Horses		0.9160				
Asses and Mules		0.0251				
Other (Rabbits)		0.1636				
B. Manure Management		**2.8892**	**1.2930**			**NE**
1. Cattle		0.9146	0.2811			NE
Dairy cattle		0.7520	0.2080			NE
Non-dairy cattle		0.1626	0.0731			NE
2. Sheep		0.1372	0.1906			NE
3. Swine		1.1353	0.1397			NE
4. Other livestock		0.7021	0.4563			NE
Goats		0.0161	0.0393			NE
Horses		0.0794	0.0532			NE
Mules and Asses		0.0019	0.0010			NE
Poultry		0.5825	0.3087			NE
Other (Rabbits)		0.0222	0.0541			NE
5. Indirect N_2O emissions			0.2254			
C. Rice cultivation		NO				NO
D. Agricultural soils			**3.5954**			
a. Direct N_2O emissions from managed soils			2.8520			
1. Inorganic N fertilizers			0.3928			
2. Organic N fertilizers			0.2699			
a. Animal manure applied to soils			0.2699			
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			0.1746			
4. Crop residues			0.3340			
5. Mineralization/immobilization associated with loss/gain of soil organic matter			1.6807			
6. Cultivation of organic soils			NO			
7. Other			NO			
b. Indirect N_2O emissions from managed soils			0.7434			
1. Atmospheric deposition			0.1157			
2. Nitrogen leaching and run-off			0.6277			
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					
J. Other	NO	NO	NO	NO	NO	NO

Greenhouse Gas Source and Sink Categories	CO_2	CH_4	N_2O	NO_x	CO	NMVOC
	(kt)					
3. Total Agriculture	**5.5908**	**28.1173**	**3.5815**	**NO**	**NO**	**NO, NE**
I. Livestock		**28.1173**	**1.1839**			**NO, NE**
A. Enteric fermentation		**25.3728**				
1. Cattle		18.2873				
Dairy cows		14.8369				
Other cattle		3.4504				
2. Sheep		4.5963				
3. Swine		0.6576				
4. Other livestock		1.8317				
Goats		0.7954				
Horses		0.8546				
Asses and Mules		0.0242				
Other (Rabbits)		0.1575				
B. Manure Management		**2.7445**	**1.1839**			**NE**
1. Cattle		0.8579	0.2654			NE
Dairy cattle		0.7023	0.1964			NE
Non-dairy cattle		0.1556	0.0690			NE
2. Sheep		0.1342	0.1918			NE
3. Swine		1.1759	0.1313			NE
4. Other livestock		0.5765	0.3902			NE
Goats		0.0170	0.0427			NE
Horses		0.0741	0.0515			NE
Mules and Asses		0.0018	0.0010			NE
Poultry		0.4622	0.2443			NE
Other (Rabbits)		0.0214	0.0506			NE
5. Indirect N_2O emissions			0.2053			
C. Rice cultivation		NO				NO
D. Agricultural soils			**2.3976**			
a. Direct N_2O emissions from managed soils			1.8658			
1. Inorganic N fertilizers			0.5355			
2. Organic N fertilizers			0.2488			
a. Animal manure applied to soils			0.2488			
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			0.1629			
4. Crop residues			0.1903			
5. Mineralization/immobilization associated with loss/gain of soil organic matter			0.7282			
6. Cultivation of organic soils			NO			
7. Other			NO			
b. Indirect N_2O emissions from managed soils			0.5318			
1. Atmospheric deposition			0.1246			
2. Nitrogen leaching and run-off			0.4071			
E. Prescribed burning of savannas		NO	NO			
F. Field burning of agricultural residues		IE	IE			
G. Liming	NO					
H. Urea application	5.5908					
I. Other carbon-containing fertilizers	NO					
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**	**28.4554**	**5.1458**	**NO**	**NO**	**NO, NE**
I. Livestock		**28.4554**	**1.1095**			**NO, NE**
A. Enteric fermentation		**25.7538**				
1. Cattle		18.0834				
Dairy cows		14.6285				
Other cattle		3.4549				
2. Sheep		5.0982				
3. Swine		0.6672				
4. Other livestock		1.9050				
Goats		0.8814				
Horses		0.8275				
Asses and Mules		0.0214				
Other (Rabbits)		0.1748				
B. Manure Management		**2.7015**	**1.1095**			**NE**
1. Cattle		0.8482	0.2606			NE
Dairy cattle		0.6925	0.1918			NE
Non-dairy cattle		0.1558	0.0688			NE
2. Sheep		0.1377	0.2063			NE
3. Swine		1.2548	0.1233			NE
4. Other livestock		0.4608	0.3300			NE
Goats		0.0178	0.0474			NE
Horses		0.0717	0.0505			NE
Mules and Asses		0.0016	0.0009			NE
Poultry		0.3460	0.1755			NE
Other (Rabbits)		0.0237	0.0558			NE
5. Indirect N_2O emissions			0.1893			
C. Rice cultivation		NO				NO
D. Agricultural soils			**4.0363**			
a. Direct N_2O emissions from managed soils			3.1946			
1. Inorganic N fertilizers			0.6617			
2. Organic N fertilizers			0.2366			
a. Animal manure applied to soils			0.2366			
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			0.1569			
4. Crop residues			0.3639			
5. Mineralization/immobilization associated with loss/gain of soil organic matter			1.7755			
6. Cultivation of organic soils			NO			
7. Other			NO			
b. Indirect N_2O emissions from managed soils			0.8417			
1. Atmospheric deposition			0.1345			
2. Nitrogen leaching and run-off			0.7072			
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					
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**	**30.1482**	**5.7851**	**NO**	**NO**	**NO, NE**
I. Livestock		**30.1482**	**1.2202**			**NO, NE**
A. Enteric fermentation		**27.2645**				
1. Cattle		19.0862				
Dairy cows		15.4148				
Other cattle		3.6714				
2. Sheep		5.5041				
3. Swine		0.7571				
4. Other livestock		1.9171				
Goats		0.9329				
Horses		0.7699				
Asses and Mules		0.0220				
Other (Rabbits)		0.1924				
B. Manure Management		**2.8838**	**1.2202**			**NE**
1. Cattle		0.8952	0.2765			NE
Dairy cattle		0.7297	0.1982			NE
Non-dairy cattle		0.1655	0.0782			NE
2. Sheep		0.1407	0.2362			NE
3. Swine		1.3764	0.1464			NE
4. Other livestock		0.4714	0.3523			NE
Goats		0.0190	0.0578			NE
Horses		0.0667	0.0461			NE
Mules and Asses		0.0017	0.0009			NE
Poultry		0.3579	0.1842			NE
Other (Rabbits)		0.0261	0.0633			NE
5. Indirect N_2O emissions			0.2088			
C. Rice cultivation		NO				NO
D. Agricultural soils			**4.5649**			**NE**
a. Direct N_2O emissions from managed soils			3.5974			
1. Inorganic N fertilizers			0.9603			
2. Organic N fertilizers			0.2573			
a. Animal manure applied to soils			0.2573			
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			0.1691			
4. Crop residues			0.4079			
5. Mineralization/immobilization associated with loss/gain of soil organic matter			1.8027			
6. Cultivation of organic soils			NO			
7. Other			NO			
b. Indirect N_2O emissions from managed soils			0.9675			
1. Atmospheric deposition			0.1704			
2. Nitrogen leaching and run-off			0.7971			
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					
J. Other	NO	NO	NO	NO	NO	NO

Greenhouse Gas Source and Sink Categories	CO_2	CH_4	N_2O	NO_x	CO	NMVOC
	(kt)					
3. Total Agriculture	**5.8323**	**28.9985**	**4.6440**	**NO**	**NO**	**NO, NE**
I. Livestock		**28.9985**	**1.1814**			**NO, NE**
A. Enteric fermentation		**26.1841**				
1. Cattle		18.4128				
Dairy cows		15.0077				
Other cattle		3.4052				
2. Sheep		5.1604				
3. Swine		0.7267				
4. Other livestock		1.8841				
Goats		0.9352				
Horses		0.7227				
Asses and Mules		0.0196				
Other (Rabbits)		0.2066				
B. Manure Management		**2.8145**	**1.1814**			**NE**
1. Cattle		0.8639	0.2736			NE
Dairy cattle		0.7104	0.1980			NE
Non-dairy cattle		0.1535	0.0756			NE
2. Sheep		0.1385	0.2224			NE
3. Swine		1.3412	0.1343			NE
4. Other livestock		0.4709	0.3496			NE
Goats		0.0198	0.0571			NE
Horses		0.0626	0.0431			NE
Mules and Asses		0.0015	0.0008			NE
Poultry		0.3590	0.1809			NE
Other (Rabbits)		0.0280	0.0677			NE
5. Indirect N_2O emissions			0.2015			
C. Rice cultivation		NO				NO
D. Agricultural soils			**3.4625**			
a. Direct N_2O emissions from managed soils			2.7279			
1. Inorganic N fertilizers			0.6078			
2. Organic N fertilizers			0.2501			
a. Animal manure applied to soils			0.2501			
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			0.1648			
4. Crop residues			0.2985			
5. Mineralization/immobilization associated with loss/gain of soil organic matter			1.4067			
6. Cultivation of organic soils			NO			
7. Other			NO			
b. Indirect N_2O emissions from managed soils			0.7346			
1. Atmospheric deposition			0.1330			
2. Nitrogen leaching and run-off			0.6016			
E. Prescribed burning of savannas		NO	NO			
F. Field burning of agricultural residues		IE	IE			
G. Liming	NO					
H. Urea application	5.8323					
I. Other carbon-containing fertilizers	NO					
J. Other	NO	NO	NO	NO	NO	NO

Annex 6-4: Sectoral Reports for LULUCF Sector, 1990-2015

1990

Greenhouse Gas Source and Sink Categories	CO_2 Emissions/Removals	CH_4	N_2O	NO_x	CO	NMVOC
	(kt)					
4. Total LULUCF	**-5 882.4287**	**0.1068**	**0.2017**	**0.0963**	**3.5377**	**NE**
A. Forest Land	**-2 543.7403**	**0.0089**	**0.0005**	**0.0057**	**0.2037**	**NE**
1. Forest Land Remaining Forest Land	-1 591.2275	NE	NE	NE	NE	NE
2. Land Converted to Forest Land	-952.5127	0.0089	0.0005	0.0057	0.2037	NE
B. Cropland	**-578.1271**	**0.0978**	**0.1907**	**0.0906**	**3.3340**	**NE**
1. Cropland Remaining Cropland	-1 583.7249	0.0978	0.1907	0.0906	3.3340	NE
2. Land Converted to Cropland	1 005.5978	NE	NE	NE	NE	NE
C. Grassland	**-2 850.2941**	**NE**	**NE**	**NE**	**NE**	**NE**
1. Grassland Remaining Grassland	NO	NE	NE	NE	NE	NE
2. Land Converted to Grassland	-2 850.2941	NE	NE	NE	NE	NE
D. Wetlands	**-17.4403**	**NE**	**NE**	**NE**	**NE**	**NE**
1. Wetlands Remaining Wetlands	NO	NE	NE	NE	NE	NE
2. Land Converted to Wetlands	-17.4403	NE	NE	NE	NE	NE
E. Settlements	**84.7480**	**NE**	**0.0105**	**NE**	**NE**	**NE**
1. Settlements Remaining Settlements	NO	NE	NE	NE	NE	NE
2. Land Converted to Settlements	84.7480	NE	0.0105	NE	NE	NE
F. Other Land	**152.4756**	**NE**	**NE**	**NE**	**NE**	**NE**
1. Other Land Remaining Other Land						
2. Land Converted to Other Land	152.4756	NE	NE	NE	NE	NE
G. Harvested Wood Products	**-130.0504**					
H. Other	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**

1991

Greenhouse Gas Source and Sink Categories	CO_2 Emissions/Removals	CH_4	N_2O	NO_x	CO	NMVOC
	(kt)					
4. Total LULUCF	**-7 639.3179**	**0.0961**	**0.1999**	**0.0886**	**3.2577**	**NE**
A. Forest Land	**-2 323.6314**	**0.0015**	**0.0001**	**0.0010**	**0.0341**	**NE**
1. Forest Land Remaining Forest Land	-1 364.8477	NE	NE	NE	NE	NE
2. Land Converted to Forest Land	-958.7836	0.0015	0.0001	0.0010	0.0341	NE
B. Cropland	**-2 097.4265**	**0.0946**	**0.1892**	**0.0876**	**3.2236**	**NE**
1. Cropland Remaining Cropland	-3 076.3953	0.0946	0.1892	0.0876	3.2236	NE
2. Land Converted to Cropland	978.9688	NE	NE	NE	NE	NE
C. Grassland	**-3 317.4207**	**NE**	**NE**	**NE**	**NE**	**NE**
1. Grassland Remaining Grassland	NO	NE	NE	NE	NE	NE
2. Land Converted to Grassland	-3 317.4207	NE	NE	NE	NE	NE
D. Wetlands	**-17.4403**	**NE**	**NE**	**NE**	**NE**	**NE**
1. Wetlands Remaining Wetlands	NO	NE	NE	NE	NE	NE
2. Land Converted to Wetlands	-17.4403	NE	NE	NE	NE	NE
E. Settlements	**88.7139**	**NE**	**0.0106**	**NE**	**NE**	**NE**
1. Settlements Remaining Settlements	NO	NE	NE	NE	NE	NE
2. Land Converted to Settlements	88.7139	NE	0.0106	NE	NE	NE
F. Other Land	**152.4756**	**NE**	**NE**	**NE**	**NE**	**NE**
1. Other Land Remaining Other Land						
2. Land Converted to Other Land	152.4756	NE	NE	NE	NE	NE
G. Harvested Wood Products	**-124.5885**					
H. Other	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**

1992

Greenhouse Gas Source and Sink Categories	CO_2 Emissions/Removals	CH_4	N_2O	NO_x	CO	NMVOC
	(kt)					
4. Total LULUCF	**-7 107.5776**	**0.0880**	**0.1810**	**0.0810**	**2.9804**	**NE**
A. Forest Land	**-2 164.6662**	**0.0016**	**0.0001**	**0.0010**	**0.0373**	**NE**
1. Forest Land Remaining Forest Land	-1 302.7299	NE	NE	NE	NE	NE
2. Land Converted to Forest Land	-861.9363	0.0016	0.0001	0.0010	0.0373	NE
B. Cropland	**-2 231.6719**	**0.0864**	**0.1660**	**0.0800**	**2.9431**	**NE**
1. Cropland Remaining Cropland	-3 088.1600	0.0864	0.1660	0.0800	2.9431	NE
2. Land Converted to Cropland	856.4881	NE	NE	NE	NE	NE
C. Grassland	**-3 383.3454**	**NE**	**NE**	**NE**	**NE**	**NE**
1. Grassland Remaining Grassland	NO	NE	NE	NE	NE	NE
2. Land Converted to Grassland	-3 383.3454	NE	NE	NE	NE	NE
D. Wetlands	**-17.4403**	**NE**	**NE**	**NE**	**NE**	**NE**
1. Wetlands Remaining Wetlands	NO	NE	NE	NE	NE	NE
2. Land Converted to Wetlands	-17.4403	NE	NE	NE	NE	NE
E. Settlements	**386.6196**	**NE**	**0.0149**	**NE**	**NE**	**NE**
1. Settlements Remaining Settlements	NO	NE	NE	NE	NE	NE
2. Land Converted to Settlements	386.6196	NE	0.0149	NE	NE	NE

Greenhouse Gas Source and Sink Categories	CO_2 Emissions/Removals	CH_4	N_2O	NO_x	CO	NMVOC
	(kt)					
F. Other Land	**418.8904**	**NE**	**NE**	**NE**	**NE**	**NE**
1. Other Land Remaining Other Land						
2. Land Converted to Other Land	418.8904	NE	NE	NE	NE	NE
G. Harvested Wood Products	**-115.9639**					
H. Other	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**

1993

Greenhouse Gas Source and Sink Categories	CO_2 Emissions/Removals	CH_4	N_2O	NO_x	CO	NMVOC
	(kt)					
4. Total LULUCF	**-7 197.7136**	**0.1179**	**0.1950**	**0.1091**	**4.0153**	**NE**
A. Forest Land	**-2 173.9910**	**0.0001**	**0.0000**	**0.0001**	**0.0025**	**NE**
1. Forest Land Remaining Forest Land	-1 379.8005	NE	NE	NE	NE	NE
2. Land Converted to Forest Land	-794.1905	0.0001	0.0000	0.0001	0.0025	NE
B. Cropland	**-2 078.6361**	**0.1178**	**0.1808**	**0.1090**	**4.0127**	**NE**
1. Cropland Remaining Cropland	-2 967.2327	0.1178	0.1808	0.1090	4.0127	NE
2. Land Converted to Cropland	888.5966	NE	NE	NE	NE	NE
C. Grassland	**-3 109.7949**	**NE**	**NE**	**NE**	**NE**	**NE**
1. Grassland Remaining Grassland	NO	NE	NE	NE	NE	NE
2. Land Converted to Grassland	-3 109.7949	NE	NE	NE	NE	NE
D. Wetlands	**-17.4403**	**NE**	**NE**	**NE**	**NE**	**NE**
1. Wetlands Remaining Wetlands	NO	NE	NE	NE	NE	NE
2. Land Converted to Wetlands	-17.4403	NE	NE	NE	NE	NE
E. Settlements	**114.6181**	**NE**	**0.0142**	**NE**	**NE**	**NE**
1. Settlements Remaining Settlements	NO	NE	NE	NE	NE	NE
2. Land Converted to Settlements	114.6181	NE	0.0142	NE	NE	NE
F. Other Land	**164.1286**	**NE**	**NE**	**NE**	**NE**	**NE**
1. Other Land Remaining Other Land						
2. Land Converted to Other Land	164.1286	NE	NE	NE	NE	NE
G. Harvested Wood Products	**-96.5980**					
H. Other	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**

1994

Greenhouse Gas Source and Sink Categories	CO_2 Emissions/Removals	CH_4	N_2O	NO_x	CO	NMVOC
	(kt)					
4. Total LULUCF	**-6 408.1835**	**0.0664**	**0.2046**	**0.0608**	**2.2344**	**NE**
A. Forest Land	**-2 088.6098**	**0.0025**	**0.0001**	**0.0016**	**0.0568**	**NE**
1. Forest Land Remaining Forest Land	-1 367.6689	NE	NE	NE	NE	NE
2. Land Converted to Forest Land	-720.9410	0.0025	0.0001	0.0016	0.0568	NE
B. Cropland	**-1 821.2418**	**0.0639**	**0.1908**	**0.0592**	**2.1776**	**NE**
1. Cropland Remaining Cropland	-2 733.9904	0.0639	0.1908	0.0592	2.1776	NE
2. Land Converted to Cropland	912.7487	NE	NE	NE	NE	NE
C. Grassland	**-3 104.1950**	**NE**	**NE**	**NE**	**NE**	**NE**
1. Grassland Remaining Grassland	NO	NE	NE	NE	NE	NE
2. Land Converted to Grassland	-3 104.1950	NE	NE	NE	NE	NE
D. Wetlands	**NO**	**NE**	**NE**	**NE**	**NE**	**NE**
1. Wetlands Remaining Wetlands	NO	NE	NE	NE	NE	NE
2. Land Converted to Wetlands	NO	NE	NE	NE	NE	NE
E. Settlements	**130.4883**	**NE**	**0.0136**	**NE**	**NE**	**NE**
1. Settlements Remaining Settlements	NO	NE	NE	NE	NE	NE
2. Land Converted to Settlements	130.4883	NE	0.0136	NE	NE	NE
F. Other Land	**541.0720**	**NE**	**NE**	**NE**	**NE**	**NE**
1. Other Land Remaining Other Land						
2. Land Converted to Other Land	541.0720	NE	NE	NE	NE	NE
G. Harvested Wood Products	**-65.6972**					
H. Other	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**

1995

Greenhouse Gas Source and Sink Categories	CO_2 Emissions/Removals	CH_4	N_2O	NO_x	CO	NMVOC
	(kt)					
4. Total LULUCF	**-6 551.3841**	**0.0896**	**0.2251**	**0.0829**	**3.0513**	**NE**
A. Forest Land	**-2 025.7694**	**0.0001**	**0.0000**	**0.0001**	**0.0033**	**E**
1. Forest Land Remaining Forest Land	-1 362.7847	NE	NE	NE	NE	NE
2. Land Converted to Forest Land	-662.9847	0.0001	0.0000	0.0001	0.0033	NE
B. Cropland	**-1 919.9573**	**0.0895**	**0.2119**	**0.0828**	**3.0480**	**NE**
1. Cropland Remaining Cropland	-2 935.6531	0.0895	0.2119	0.0828	3.0480	NE

Greenhouse Gas Source and Sink Categories	CO_2 Emissions/Removals	CH_4	N_2O	NO_x	CO	NMVOC
	(kt)					
2. Land Converted to Cropland	1 015.6958	NE	NE	NE	NE	NE
C. Grassland	**-3 088.4744**	**NE**	**NE**	**NE**	**NE**	**NE**
1. Grassland Remaining Grassland	NO	NE	NE	NE	NE	NE
2. Land Converted to Grassland	-3 088.4744	NE	NE	NE	NE	NE
D. Wetlands	**NO**	**NE**	**NE**	**NE**	**NE**	**NE**
1. Wetlands Remaining Wetlands	NO	NE	NE	NE	NE	NE
2. Land Converted to Wetlands	NO	NE	NE	NE	NE	NE
E. Settlements	**106.9167**	**NE**	**0.0133**	**NE**	**NE**	**NE**
1. Settlements Remaining Settlements	NO	NE	NE	NE	NE	NE
2. Land Converted to Settlements	106.9167	NE	0.0133	NE	NE	NE
F. Other Land	**392.7422**	**NE**	**NE**	**NE**	**NE**	**NE**
1. Other Land Remaining Other Land						
2. Land Converted to Other Land	392.7422	NE	NE	NE	NE	NE
G. Harvested Wood Products	**-16.8419**					
H. Other	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**

1996

Greenhouse Gas Source and Sink Categories	CO_2 Emissions/Removals	CH_4	N_2O	NO_x	CO	NMVOC
	(kt)					
4. Total LULUCF	**-6 296.0942**	**0.0617**	**0.2293**	**0.0569**	**2.0930**	**NE**
A. Forest Land	**-2 171.1779**	**0.0008**	**0.0000**	**0.0005**	**0.0190**	**NE**
1. Forest Land Remaining Forest Land	-1 571.6869	NE	NE	NE	NE	NE
2. Land Converted to Forest Land	-599.4909	0.0008	0.0000	0.0005	0.0190	NE
B. Cropland	**-1 535.5834**	**0.0609**	**0.2166**	**0.0564**	**2.0740**	**NE**
1. Cropland Remaining Cropland	-2 618.7171	0.0609	0.2166	0.0564	2.0740	NE
2. Land Converted to Cropland	1 083.1337	NE	NE	NE	NE	NE
C. Grassland	**-2 903.6947**	**NE**	**NE**	**NE**	**NE**	**NE**
1. Grassland Remaining Grassland	NO	NE	NE	NE	NE	NE
2. Land Converted to Grassland	-2 903.6947	NE	NE	NE	NE	NE
D. Wetlands	**NO**	**NE**	**NE**	**NE**	**NE**	**NE**
1. Wetlands Remaining Wetlands	NO	NE	NE	NE	NE	NE
2. Land Converted to Wetlands	NO	NE	NE	NE	NE	NE
E. Settlements	**101.5910**	**NE**	**0.0126**	**NE**	**NE**	**NE**
1. Settlements Remaining Settlements	NO	NE	NE	NE	NE	NE
2. Land Converted to Settlements	101.5910	NE	0.0126	NE	NE	NE
F. Other Land	**208.9434**	**NE**	**NE**	**NE**	**NE**	**NE**
1. Other Land Remaining Other Land						
2. Land Converted to Other Land	208.9434	NE	NE	NE	NE	NE
G. Harvested Wood Products	**3.8273**					
H. Other	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**

1997

Greenhouse Gas Source and Sink Categories	CO_2 Emissions/Removals	CH_4	N_2O	NO_x	CO	NMVOC
	(kt)					
4. Total LULUCF	**-6 155.9621**	**0.1075**	**0.2169**	**0.0995**	**3.6614**	**NE**
A. Forest Land	**-2 213.0439**	**0.0003**	**0.0000**	**0.0002**	**0.0058**	**NE**
1. Forest Land Remaining Forest Land	-1 652.1452	NE	NE	NE	NE	NE
2. Land Converted to Forest Land	-560.8987	0.0003	0.0000	0.0002	0.0058	NE
B. Cropland	**-1 451.2728**	**0.1073**	**0.2046**	**0.0993**	**3.6556**	**NE**
1. Cropland Remaining Cropland	-2 463.2911	0.1073	0.2046	0.0993	3.6556	NE
2. Land Converted to Cropland	1 012.0184	NE	NE	NE	NE	NE
C. Grassland	**-2 771.9741**	**NE**	**NE**	**NE**	**NE**	**NE**
1. Grassland Remaining Grassland	NO	NE	NE	NE	NE	NE
2. Land Converted to Grassland	-2 771.9741	NE	NE	NE	NE	NE
D. Wetlands	**NO**	**NE**	**NE**	**NE**	**NE**	**NE**
1. Wetlands Remaining Wetlands	NO	NE	NE	NE	NE	NE
2. Land Converted to Wetlands	NO	NE	NE	NE	NE	NE
E. Settlements	**100.7954**	**NE**	**0.0123**	**NE**	**NE**	**NE**
1. Settlements Remaining Settlements	NO	NE	NE	NE	NE	NE
2. Land Converted to Settlements	100.7954	NE	0.0123	NE	NE	NE
F. Other Land	**179.8504**	**NE**	**NE**	**NE**	**NE**	**NE**
1. Other Land Remaining Other Land						
2. Land Converted to Other Land	179.8504	NE	NE	NE	NE	NE
G. Harvested Wood Products	**-0.3171**					
H. Other	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**

1998

Greenhouse Gas Source and Sink Categories	CO_2 Emissions/Removals	CH_4	N_2O	NO_x	CO	NMVOC
	(kt)					
4. Total LULUCF	**-6 211.1275**	**0.0991**	**0.2258**	**0.0910**	**3.3472**	**NE**
A. Forest Land	**-2 269.2309**	**0.0025**	**0.0001**	**0.0016**	**0.0571**	**NE**
1. Forest Land Remaining Forest Land	-1 744.9666	NE	NE	NE	NE	NE
2. Land Converted to Forest Land	-524.2643	0.0025	0.0001	0.0016	0.0571	NE
B. Cropland	**-1 348.2104**	**0.0966**	**0.2133**	**0.0894**	**3.2900**	**NE**
1. Cropland Remaining Cropland	-2 385.9258	0.0966	0.2133	0.0894	3.2900	NE
2. Land Converted to Cropland	1 037.7153	NE	NE	NE	NE	NE
C. Grassland	**-2 848.0605**	**NE**	**NE**	**NE**	**NE**	**NE**
1. Grassland Remaining Grassland	NO	NE	NE	NE	NE	NE
2. Land Converted to Grassland	-2 848.0605	NE	NE	NE	NE	NE
D. Wetlands	**NO**	**NE**	**NE**	**NE**	**NE**	**NE**
1. Wetlands Remaining Wetlands	NO	NE	NE	NE	NE	NE
2. Land Converted to Wetlands	NO	NE	NE	NE	NE	NE
E. Settlements	**99.0440**	**NE**	**0.0123**	**NE**	**NE**	**NE**
1. Settlements Remaining Settlements	NO	NE	NE	NE	NE	NE
2. Land Converted to Settlements	99.0440	NE	0.0123	NE	NE	NE
F. Other Land	**176.6218**	**NE**	**NE**	**NE**	**NE**	**NE**
1. Other Land Remaining Other Land						
2. Land Converted to Other Land	176.6218	NE	NE	NE	NE	NE
G. Harvested Wood Products	**-21.2914**					
H. Other	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**

1999

Greenhouse Gas Source and Sink Categories	CO_2 Emissions/Removals	CH_4	N_2O	NO_x	CO	NMVOC
	(kt)					
4. Total LULUCF	**-6 185.6213**	**0.0957**	**0.2388**	**0.0881**	**3.2394**	**NE**
A. Forest Land	**-2 317.6962**	**0.0019**	**0.0001**	**0.0012**	**0.0427**	**NE**
1. Forest Land Remaining Forest Land	-1 853.6589	NE	NE	NE	NE	NE
2. Land Converted to Forest Land	-464.0373	0.0019	0.0001	0.0012	0.0427	NE
B. Cropland	**-1 413.2991**	**0.0938**	**0.2272**	**0.0869**	**3.1967**	**NE**
1. Cropland Remaining Cropland	-2 537.6344	0.0938	0.2272	0.0869	3.1967	NE
2. Land Converted to Cropland	1 124.3353	NE	NE	NE	NE	NE
C. Grassland	**-2 972.0904**	**NE**	**NE**	**NE**	**NE**	**NE**
1. Grassland Remaining Grassland	NO	NE	NE	NE	NE	NE
2. Land Converted to Grassland	-2 972.0904	NE	NE	NE	NE	NE
D. Wetlands	**NO**	**NE**	**NE**	**NE**	**NE**	**NE**
1. Wetlands Remaining Wetlands	NO	NE	NE	NE	NE	NE
2. Land Converted to Wetlands	NO	NE	NE	NE	NE	NE
E. Settlements	**111.8259**	**NE**	**0.0115**	**NE**	**NE**	**NE**
1. Settlements Remaining Settlements	NO	NE	NE	NE	NE	NE
2. Land Converted to Settlements	111.8259	NE	0.0115	NE	NE	NE
F. Other Land	**416.7695**	**NE**	**NE**	**NE**	**NE**	**NE**
1. Other Land Remaining Other Land						
2. Land Converted to Other Land	416.7695	NE	NE	NE	NE	NE
G. Harvested Wood Products	**-11.1310**					
H. Other	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**

2000

Greenhouse Gas Source and Sink Categories	CO_2 Emissions/Removals	CH_4	N_2O	NO_x	CO	NMVOC
	(kt)					
4. Total LULUCF	**-6 130.4573**	**0.0365**	**0.2434**	**0.0338**	**1.2428**	**NE**
A. Forest Land	**-2 288.3306**	**0.0001**	**0.0000**	**0.0000**	**0.0015**	**NE**
1. Forest Land Remaining Forest Land	-1 894.2503	NE	NE	NE	NE	NE
2. Land Converted to Forest Land	-394.0803	0.0001	0.0000	0.0000	0.0015	NE
B. Cropland	**-1 284.6926**	**0.0364**	**0.2340**	**0.0337**	**1.2413**	**NE**
1. Cropland Remaining Cropland	-2 484.9190	0.0364	0.2340	0.0337	1.2413	NE
2. Land Converted to Cropland	1 200.2264	NE	NE	NE	NE	NE
C. Grassland	**-2 844.3351**	**NE**	**NE**	**NE**	**NE**	**NE**
1. Grassland Remaining Grassland	NO	NE	NE	NE	NE	NE
2. Land Converted to Grassland	-2 844.3351	NE	NE	NE	NE	NE
D. Wetlands	**NO**	**NE**	**NE**	**NE**	**NE**	**NE**
1. Wetlands Remaining Wetlands	NO	NE	NE	NE	NE	NE
2. Land Converted to Wetlands	NO	NE	NE	NE	NE	NE
E. Settlements	**100.1768**	**NE**	**0.0094**	**NE**	**NE**	**NE**
1. Settlements Remaining Settlements	NO	NE	NE	NE	NE	NE
2. Land Converted to Settlements	100.1768	NE	0.0094	NE	NE	NE
F. Other Land	**170.1387**	**NE**	**NE**	**NE**	**NE**	**NE**
1. Other Land Remaining Other Land						
2. Land Converted to Other Land	170.1387	NE	NE	NE	NE	NE
G. Harvested Wood Products	**16.5854**					
H. Other	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**

2001

Greenhouse Gas Source and Sink Categories	CO_2 Emissions/Removals	CH_4	N_2O	NO_x	CO	NMVOC
	(kt)					
4. Total LULUCF	**-5 875.8873**	**0.0511**	**0.2744**	**0.0461**	**1.6939**	**NE**
A. Forest Land	**-2 254.6081**	**0.0042**	**0.0002**	**0.0027**	**0.0967**	**NE**
1. Forest Land Remaining Forest Land	-1 886.3663	NE	NE	NE	NE	NE
2. Land Converted to Forest Land	-368.2418	0.0042	0.0002	0.0027	0.0967	NE
B. Cropland	**-1 106.4081**	**0.0469**	**0.2659**	**0.0434**	**1.5972**	**NE**
1. Cropland Remaining Cropland	-2 403.6617	0.0469	0.2659	0.0434	1.5972	NE
2. Land Converted to Cropland	1 297.2536	NE	NE	NE	NE	NE
C. Grassland	**-2 755.9956**	**NE**	**NE**	**NE**	**NE**	**NE**
1. Grassland Remaining Grassland	NO	NE	NE	NE	NE	NE
2. Land Converted to Grassland	-2 755.9956	NE	NE	NE	NE	NE
D. Wetlands	**NO**	**NE**	**NE**	**NE**	**NE**	**NE**
1. Wetlands Remaining Wetlands	NO	NE	NE	NE	NE	NE
2. Land Converted to Wetlands	NO	NE	NE	NE	NE	NE
E. Settlements	**67.0898**	**NE**	**0.0083**	**NE**	**NE**	**NE**
1. Settlements Remaining Settlements	NO	NE	NE	NE	NE	NE
2. Land Converted to Settlements	67.0898	NE	0.0083	NE	NE	NE
F. Other Land	**170.1387**	**NE**	**NE**	**NE**	**NE**	**NE**
1. Other Land Remaining Other Land						
2. Land Converted to Other Land	170.1387	NE	NE	NE	NE	NE
G. Harvested Wood Products	**3.8960**					
H. Other	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**

2002

Greenhouse Gas Source and Sink Categories	CO_2 Emissions/Removals	CH_4	N_2O	NO_x	CO	NMVOC
	(kt)					
4. Total LULUCF	**-4 950.2508**	**0.0108**	**0.2786**	**0.0093**	**0.3423**	**NE**
A. Forest Land	**-2 248.5141**	**0.0023**	**0.0001**	**0.0015**	**0.0519**	**NE**
1. Forest Land Remaining Forest Land	-1 926.3824	NE	NE	NE	NE	NE
2. Land Converted to Forest Land	-322.1317	0.0023	0.0001	0.0015	0.0519	NE
B. Cropland	**-696.2856**	**0.0085**	**0.2701**	**0.0079**	**0.2904**	**NE**
1. Cropland Remaining Cropland	-2 102.1131	0.0085	0.2701	0.0079	0.2904	NE
2. Land Converted to Cropland	1 405.8276	NE	NE	NE	NE	NE
C. Grassland	**-2 512.2749**	**NE**	**NE**	**NE**	**NE**	**NE**
1. Grassland Remaining Grassland	NO	NE	NE	NE	NE	NE
2. Land Converted to Grassland	-2 512.2749	NE	NE	NE	NE	NE
D. Wetlands	**NO**	**NE**	**NE**	**NE**	**NE**	**NE**
1. Wetlands Remaining Wetlands	NO	NE	NE	NE	NE	NE
2. Land Converted to Wetlands	NO	NE	NE	NE	NE	NE
E. Settlements	**67.0898**	**NE**	**0.0083**	**NE**	**NE**	**NE**
1. Settlements Remaining Settlements	NO	NE	NE	NE	NE	NE
2. Land Converted to Settlements	67.0898	NE	0.0083	NE	NE	NE
F. Other Land	**447.8610**	**NE**	**NE**	**NE**	**NE**	**NE**
1. Other Land Remaining Other Land						
2. Land Converted to Other Land	447.8610	NE	NE	NE	NE	NE
G. Harvested Wood Products	**-8.1271**					
H. Other	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**

2003

Greenhouse Gas Source and Sink Categories	CO_2 Emissions/Removals	CH_4	N_2O	NO_x	CO	NMVOC
	(kt)					
4. Total LULUCF	**-5 013.0963**	**0.0026**	**0.2876**	**0.0017**	**0.0614**	**NE**
A. Forest Land	**-2 250.9181**	**0.0025**	**0.0001**	**0.0016**	**0.0568**	**NE**
1. Forest Land Remaining Forest Land	-1 876.5708	NE	NE	NE	NE	NE
2. Land Converted to Forest Land	-374.3474	0.0025	0.0001	0.0016	0.0568	NE
B. Cropland	**-646.0039**	**0.0001**	**0.2801**	**0.0001**	**0.0046**	**NE**
1. Cropland Remaining Cropland	-2 090.9681	0.0001	0.2801	0.0001	0.0046	NE
2. Land Converted to Cropland	1 444.9642	NE	NE	NE	NE	NE
C. Grassland	**-2 277.6455**	**NE**	**NE**	**NE**	**NE**	**NE**
1. Grassland Remaining Grassland	NO	NE	NE	NE	NE	NE
2. Land Converted to Grassland	-2 277.6455	NE	NE	NE	NE	NE
D. Wetlands	**NO**	**NE**	**NE**	**NE**	**NE**	**NE**
1. Wetlands Remaining Wetlands	NO	NE	NE	NE	NE	NE
2. Land Converted to Wetlands	NO	NE	NE	NE	NE	NE
E. Settlements	**67.8615**	**NE**	**0.0073**	**NE**	**NE**	**NE**
1. Settlements Remaining Settlements	NO	NE	NE	NE	NE	NE
2. Land Converted to Settlements	67.8615	NE	0.0073	NE	NE	NE
F. Other Land	**152.1220**	**NE**	**NE**	**NE**	**NE**	**NE**
1. Other Land Remaining Other Land						
2. Land Converted to Other Land	152.1220	NE	NE	NE	NE	NE
G. Harvested Wood Products	**-58.5123**					
H. Other	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**

2004

Greenhouse Gas Source and Sink Categories	CO_2 Emissions/Removals	CH_4	N_2O	NO_x	CO	NMVOC
	(kt)					
4. Total LULUCF	**-3 969.9582**	**0.0085**	**0.2856**	**0.0060**	**0.2160**	**NE**
A. Forest Land	**-2 315.5844**	**0.0066**	**0.0004**	**0.0042**	**0.1492**	**NE**
1. Forest Land Remaining Forest Land	-1 917.0446	NE	NE	NE	NE	NE
2. Land Converted to Forest Land	-398.5398	0.0066	0.0004	0.0042	0.1492	NE
B. Cropland	**524.5167**	**0.0020**	**0.2785**	**0.0018**	**0.0668**	**NE**
1. Cropland Remaining Cropland	-954.2915	0.0020	0.2785	0.0018	0.0668	NE
2. Land Converted to Cropland	1 478.8082	NE	NE	NE	NE	NE
C. Grassland	**-2 316.5028**	**NE**	**NE**	**NE**	**NE**	**NE**
1. Grassland Remaining Grassland	NO	NE	NE	NE	NE	NE
2. Land Converted to Grassland	-2 316.5028	NE	NE	NE	NE	NE
D. Wetlands	**NO**	**NE**	**NE**	**NE**	**NE**	**NE**
1. Wetlands Remaining Wetlands	NO	NE	NE	NE	NE	NE
2. Land Converted to Wetlands	NO	NE	NE	NE	NE	NE
E. Settlements	**53.6737**	**NE**	**0.0067**	**NE**	**NE**	**NE**
1. Settlements Remaining Settlements	NO	NE	NE	NE	NE	NE
2. Land Converted to Settlements	53.6737	NE	0.0067	NE	NE	NE
F. Other Land	**150.8347**	**NE**	**NE**	**NE**	**NE**	**NE**
1. Other Land Remaining Other Land						
2. Land Converted to Other Land	150.8347	NE	NE	NE	NE	NE
G. Harvested Wood Products	**-66.8962**					
H. Other	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**

2005

Greenhouse Gas Source and Sink Categories	CO_2 Emissions/Removals	CH_4	N_2O	NO_x	CO	NMVOC
	(kt)					
4. Total LULUCF	**-4 840.2625**	**0.0100**	**0.2539**	**0.0091**	**0.3328**	**NE**
A. Forest Land	**-2 390.3683**	**0.0006**	**0.0000**	**0.0004**	**0.0142**	**NE**
1. Forest Land Remaining Forest Land	-1 978.7520	NE	NE	NE	NE	NE
2. Land Converted to Forest Land	-411.6163	0.0006	0.0000	0.0004	0.0142	NE
B. Cropland	**-489.2386**	**0.0093**	**0.2472**	**0.0087**	**0.3185**	**NE**
1. Cropland Remaining Cropland	-1 780.4495	0.0093	0.2472	0.0087	0.3185	NE
2. Land Converted to Cropland	1 291.2109	NE	NE	NE	NE	NE
C. Grassland	**-2 240.7618**	**NE**	**NE**	**NE**	**NE**	**NE**
1. Grassland Remaining Grassland	NO	NE	NE	NE	NE	NE
2. Land Converted to Grassland	-2 240.7618	NE	NE	NE	NE	NE
D. Wetlands	**NO**	**NE**	**NE**	**NE**	**NE**	**NE**
1. Wetlands Remaining Wetlands	NO	NE	NE	NE	NE	NE
2. Land Converted to Wetlands	NO	NE	NE	NE	NE	NE
E. Settlements	**53.6737**	**NE**	**0.0067**	**NE**	**NE**	**NE**
1. Settlements Remaining Settlements	NO	NE	NE	NE	NE	NE
2. Land Converted to Settlements	53.6737	NE	0.0067	NE	NE	NE
F. Other Land	**281.6495**	**NE**	**NE**	**NE**	**NE**	**NE**
1. Other Land Remaining Other Land						
2. Land Converted to Other Land	281.6495	NE	NE	NE	NE	NE
G. Harvested Wood Products	**-55.2171**					
H. Other	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**

2006

Greenhouse Gas Source and Sink Categories	CO_2 Emissions/Removals	CH_4	N_2O	NO_x	CO	NMVOC
	(kt)					
4. Total LULUCF	**-5 101.9787**	**0.0105**	**0.2222**	**0.0078**	**0.2819**	**NE**
A. Forest Land	**-2 347.2587**	**0.0068**	**0.0004**	**0.0043**	**0.1540**	**NE**
1. Forest Land Remaining Forest Land	-1 895.5814	NE	NE	NE	NE	NE
2. Land Converted to Forest Land	-451.6773	0.0068	0.0004	0.0043	0.1540	NE
B. Cropland	**-608.3183**	**0.0038**	**0.2152**	**0.0035**	**0.1279**	**NE**
1. Cropland Remaining Cropland	-1 710.7237	0.0038	0.2152	0.0035	0.1279	NE
2. Land Converted to Cropland	1 102.4055	NE	NE	NE	NE	NE
C. Grassland	**-2 227.5442**	**NE**	**NE**	**NE**	**NE**	**NE**
1. Grassland Remaining Grassland	NO	NE	NE	NE	NE	NE
2. Land Converted to Grassland	-2 227.5442	NE	NE	NE	NE	NE
D. Wetlands	**NO**	**NE**	**NE**	**NE**	**NE**	**NE**
1. Wetlands Remaining Wetlands	NO	NE	NE	NE	NE	NE
2. Land Converted to Wetlands	NO	NE	NE	NE	NE	NE
E. Settlements	**53.6737**	**NE**	**0.0067**	**NE**	**NE**	**NE**
1. Settlements Remaining Settlements	NO	NE	NE	NE	NE	NE
2. Land Converted to Settlements	53.6737	NE	0.0067	NE	NE	NE

Greenhouse Gas Source and Sink Categories	CO_2 Emissions/Removals	CH_4	N_2O	NO_x	CO	NMVOC
	(kt)					
F. Other Land	**70.2812**	**NE**	**NE**	**NE**	**NE**	**NE**
1. Other Land Remaining Other Land						
2. Land Converted to Other Land	70.2812	NE	NE	NE	NE	NE
G. Harvested Wood Products	**-42.8125**					
H. Other	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**

2007

Greenhouse Gas Source and Sink Categories	CO_2 Emissions/Removals	CH_4	N_2O	NO_x	CO	NMVOC
	(kt)					
4. Total LULUCF	**-5 093.5290**	**0.0650**	**0.2272**	**0.0433**	**1.5498**	**NE**
A. Forest Land	**-2 445.1609**	**0.0589**	**0.0033**	**0.0376**	**1.3419**	**NE**
1. Forest Land Remaining Forest Land	-1 973.3929	NE	NE	NE	NE	NE
2. Land Converted to Forest Land	-471.7680	0.0589	0.0033	0.0376	1.3419	NE
B. Cropland	**-561.2881**	**0.0061**	**0.2178**	**0.0056**	**0.2079**	**NE**
1. Cropland Remaining Cropland	-1 717.8473	0.0061	0.2178	0.0056	0.2079	NE
2. Land Converted to Cropland	1 156.5592	NE	NE	NE	NE	NE
C. Grassland	**-2 164.3852**	**NE**	**NE**	**NE**	**NE**	**NE**
1. Grassland Remaining Grassland	NO	NE	NE	NE	NE	NE
2. Land Converted to Grassland	-2 164.3852	NE	NE	NE	NE	NE
D. Wetlands	**NO**	**NE**	**NE**	**NE**	**NE**	**NE**
1. Wetlands Remaining Wetlands	NO	NE	NE	NE	NE	NE
2. Land Converted to Wetlands	NO	NE	NE	NE	NE	NE
E. Settlements	**49.2742**	**NE**	**0.0061**	**NE**	**NE**	**NE**
1. Settlements Remaining Settlements	NO	NE	NE	NE	NE	NE
2. Land Converted to Settlements	49.2742	NE	0.0061	NE	NE	NE
F. Other Land	**70.2812**	**NE**	**NE**	**NE**	**NE**	**NE**
1. Other Land Remaining Other Land						
2. Land Converted to Other Land	70.2812	NE	NE	NE	NE	NE
G. Harvested Wood Products	**-42.2503**					
H. Other	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**

2008

Greenhouse Gas Source and Sink Categories	CO_2 Emissions/Removals	CH_4	N_2O	NO_x	CO	NMVOC
	(kt)					
4. Total LULUCF	**-4 555.2731**	**0.0311**	**0.2246**	**0.0276**	**1.0136**	**NE**
A. Forest Land	**-2 447.9362**	**0.0041**	**0.0002**	**0.0026**	**0.0933**	**NE**
1. Forest Land Remaining Forest Land	-1 970.5529	NE	NE	NE	NE	NE
2. Land Converted to Forest Land	-477.3833	0.0041	0.0002	0.0026	0.0933	NE
B. Cropland	**-517.9302**	**0.0270**	**0.2183**	**0.0250**	**0.9203**	**NE**
1. Cropland Remaining Cropland	-1 656.1633	0.0270	0.2183	0.0250	0.9203	NE
2. Land Converted to Cropland	1 138.2331	NE	NE	NE	NE	NE
C. Grassland	**-1 883.4658**	**NE**	**NE**	**NE**	**NE**	**NE**
1. Grassland Remaining Grassland	NO	NE	NE	NE	NE	NE
2. Land Converted to Grassland	-1 883.4658	NE	NE	NE	NE	NE
D. Wetlands	**NO**	**NE**	**NE**	**NE**	**NE**	**NE**
1. Wetlands Remaining Wetlands	NO	NE	NE	NE	NE	NE
2. Land Converted to Wetlands	NO	NE	NE	NE	NE	NE
E. Settlements	**49.2742**	**NE**	**0.0061**	**NE**	**NE**	**NE**
1. Settlements Remaining Settlements	NO	NE	NE	NE	NE	NE
2. Land Converted to Settlements	49.2742	NE	0.0061	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	**-46.2195**					
H. Other	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**

2009

Greenhouse Gas Source and Sink Categories	CO_2 Emissions/Removals	CH_4	N_2O	NO_x	CO	NMVOC
	(kt)					
4. Total LULUCF	**-3 920.2377**	**0.0133**	**0.2274**	**0.0095**	**0.3406**	**NE**
A. Forest Land	**-2 511.3674**	**0.0100**	**0.0006**	**0.0064**	**0.2276**	**NE**
1. Forest Land Remaining Forest Land	-1 994.2669	NE	NE	NE	NE	NE
2. Land Converted to Forest Land	-517.1006	0.0100	0.0006	0.0064	0.2276	NE
B. Cropland	**-373.2147**	**0.0033**	**0.2212**	**0.0031**	**0.1130**	**NE**

Greenhouse Gas Source and Sink Categories	CO_2 Emissions/Removals	CH_4	N_2O	NO_x	CO	NMVOC
	(kt)					
1. Cropland Remaining Cropland	-1 514.0092	0.0033	0.2212	0.0031	0.1130	NE
2. Land Converted to Cropland	1 140.7945	NE	NE	NE	NE	NE
C. Grassland	**-1 123.9641**	**NE**	**NE**	**NE**	**NE**	**NE**
1. Grassland Remaining Grassland	NO	NE	NE	NE	NE	NE
2. Land Converted to Grassland	-1 123.9641	NE	NE	NE	NE	NE
D. Wetlands	**NO**	**NE**	**NE**	**NE**	**NE**	**NE**
1. Wetlands Remaining Wetlands	NO	NE	NE	NE	NE	NE
2. Land Converted to Wetlands	NO	NE	NE	NE	NE	NE
E. Settlements	**45.5694**	**NE**	**0.0057**	**NE**	**NE**	**NE**
1. Settlements Remaining Settlements	NO	NE	NE	NE	NE	NE
2. Land Converted to Settlements	45.5694	NE	0.0057	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	**-37.1965**					
H. Other	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**

2010

Greenhouse Gas Source and Sink Categories	CO_2 Emissions/Removals	CH_4	N_2O	NO_x	CO	NMVOC
	(kt)					
4. Total LULUCF	**-3 297.3873**	**0.0058**	**0.2253**	**0.0044**	**0.1587**	**NE**
A. Forest Land	**-2 489.6089**	**0.0035**	**0.0002**	**0.0022**	**0.0795**	**NE**
1. Forest Land Remaining Forest Land	-1 969.5519	NE	NE	NE	NE	NE
2. Land Converted to Forest Land	-520.0570	0.0035	0.0002	0.0022	0.0795	NE
B. Cropland	**-399.2688**	**0.0023**	**0.2194**	**0.0022**	**0.0792**	**NE**
1. Cropland Remaining Cropland	-1 554.1124	0.0023	0.2194	0.0022	0.0792	NE
2. Land Converted to Cropland	1 154.8436	NE	NE	NE	NE	NE
C. Grassland	**-555.7508**	**NE**	**NE**	**NE**	**NE**	**NE**
1. Grassland Remaining Grassland	NO	NE	NE	NE	NE	NE
2. Land Converted to Grassland	-555.7508	NE	NE	NE	NE	NE
D. Wetlands	**NO**	**NE**	**NE**	**NE**	**NE**	**NE**
1. Wetlands Remaining Wetlands	NO	NE	NE	NE	NE	NE
2. Land Converted to Wetlands	NO	NE	NE	NE	NE	NE
E. Settlements	**45.5885**	**NE**	**0.0057**	**NE**	**NE**	**NE**
1. Settlements Remaining Settlements	NO	NE	NE	NE	NE	NE
2. Land Converted to Settlements	45.5885	NE	0.0057	NE	NE	NE
F. Other Land	**131.6759**	**NE**	**NE**	**NE**	**NE**	**NE**
1. Other Land Remaining Other Land						
2. Land Converted to Other Land	131.6759	NE	NE	NE	NE	NE
G. Harvested Wood Products	**-30.0233**					
H. Other	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**

2011

Greenhouse Gas Source and Sink Categories	CO_2 Emissions/Removals	CH_4	N_2O	NO_x	CO	NMVOC
	(kt)					
4. Total LULUCF	**-2 713.1019**	**0.0068**	**0.2313**	**0.0049**	**0.1772**	**NE**
A. Forest Land	**-2 373.3313**	**0.0047**	**0.0003**	**0.0030**	**0.1065**	**NE**
1. Forest Land Remaining Forest Land	-1 871.2941	NE	NE	NE	NE	NE
2. Land Converted to Forest Land	-502.0372	0.0047	0.0003	0.0030	0.1065	NE
B. Cropland	**-400.4227**	**0.0021**	**0.2252**	**0.0019**	**0.0707**	**NE**
1. Cropland Remaining Cropland	-1 566.8848	0.0021	0.2252	0.0019	0.0707	NE
2. Land Converted to Cropland	1 166.4621	NE	NE	NE	NE	NE
C. Grassland	**-442.6724**	**NE**	**NE**	**NE**	**NE**	**NE**
1. Grassland Remaining Grassland	NO	NE	NE	NE	NE	NE
2. Land Converted to Grassland	-442.6724	NE	NE	NE	NE	NE
D. Wetlands	**NO**	**NE**	**NE**	**NE**	**NE**	**NE**
1. Wetlands Remaining Wetlands	NO	NE	NE	NE	NE	NE
2. Land Converted to Wetlands	NO	NE	NE	NE	NE	NE
E. Settlements	**61.5457**	**NE**	**0.0058**	**NE**	**NE**	**NE**
1. Settlements Remaining Settlements	NO	NE	NE	NE	NE	NE
2. Land Converted to Settlements	61.5457	NE	0.0058	NE	NE	NE
F. Other Land	**466.0972**	**NE**	**NE**	**NE**	**NE**	**NE**
1. Other Land Remaining Other Land						
2. Land Converted to Other Land	466.0972	NE	NE	NE	NE	NE
G. Harvested Wood Products	**-24.3184**					
H. Other	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**

2012

Greenhouse Gas Source and Sink Categories	CO_2 Emissions/Removals	CH_4	N_2O	NO_x	CO	NMVOC
	(kt)					
4. Total LULUCF	**-3 017.3416**	**0.0504**	**0.2380**	**0.0322**	**1.1504**	**NE**
A. Forest Land	**-2 208.0703**	**0.0501**	**0.0028**	**0.0320**	**1.1403**	**NE**
1. Forest Land Remaining Forest Land	-1 702.1310	NE	NE	NE	NE	NE
2. Land Converted to Forest Land	-505.9393	0.0501	0.0028	0.0320	1.1403	NE
B. Cropland	**-476.4351**	**0.0003**	**0.2338**	**0.0003**	**0.0101**	**NE**
1. Cropland Remaining Cropland	-1 680.3646	0.0003	0.2338	0.0003	0.0101	NE
2. Land Converted to Cropland	1 203.9295	NE	NE	NE	NE	NE
C. Grassland	**-426.1414**	**NE**	**NE**	**NE**	**NE**	**NE**
1. Grassland Remaining Grassland	NO	NE	NE	NE	NE	NE
2. Land Converted to Grassland	-426.1414	NE	NE	NE	NE	NE
D. Wetlands	**NO**	**NE**	**NE**	**NE**	**NE**	**NE**
1. Wetlands Remaining Wetlands	NO	NE	NE	NE	NE	NE
2. Land Converted to Wetlands	NO	NE	NE	NE	NE	NE
E. Settlements	**11.8308**	**NE**	**0.0015**	**NE**	**NE**	**NE**
1. Settlements Remaining Settlements	NO	NE	NE	NE	NE	NE
2. Land Converted to Settlements	11.8308	NE	0.0015	NE	NE	NE
F. Other Land	**87.3375**	**NE**	**NE**	**NE**	**NE**	**NE**
1. Other Land Remaining Other Land						
2. Land Converted to Other Land	87.3375	NE	NE	NE	NE	NE
G. Harvested Wood Products	**-5.8631**					
H. Other	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**

2013

Greenhouse Gas Source and Sink Categories	CO_2 Emissions/Removals	CH_4	N_2O	NO_x	CO	NMVOC
	(kt)					
4. Total LULUCF	**-2 616.6284**	**0.0374**	**0.2304**	**0.0246**	**0.8819**	**NE**
A. Forest Land	**-2 055.1211**	**0.0348**	**0.0019**	**0.0222**	**0.7921**	**NE**
1. Forest Land Remaining Forest Land	-1 531.7430	NE	NE	NE	NE	NE
2. Land Converted to Forest Land	-523.3781	0.0348	0.0019	0.0222	0.7921	NE
B. Cropland	**-458.6019**	**0.0026**	**0.2270**	**0.0024**	**0.0898**	**NE**
1. Cropland Remaining Cropland	-1 633.2636	0.0026	0.2270	0.0024	0.0898	NE
2. Land Converted to Cropland	1 174.6617	NE	NE	NE	NE	NE
C. Grassland	**-277.4696**	**NE**	**NE**	**NE**	**NE**	**NE**
1. Grassland Remaining Grassland	NO	NE	NE	NE	NE	NE
2. Land Converted to Grassland	-277.4696	NE	NE	NE	NE	NE
D. Wetlands	**NO**	**NE**	**NE**	**NE**	**NE**	**NE**
1. Wetlands Remaining Wetlands	NO	NE	NE	NE	NE	NE
2. Land Converted to Wetlands	NO	NE	NE	NE	NE	NE
E. Settlements	**11.8308**	**NE**	**0.0015**	**NE**	**NE**	**NE**
1. Settlements Remaining Settlements	NO	NE	NE	NE	NE	NE
2. Land Converted to Settlements	11.8308	NE	0.0015	NE	NE	NE
F. Other Land	**87.3375**	**NE**	**NE**	**NE**	**NE**	**NE**
1. Other Land Remaining Other Land						
2. Land Converted to Other Land	87.3375	NE	NE	NE	NE	NE
G. Harvested Wood Products	**75.3959**					
H. Other	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**

2014

Greenhouse Gas Source and Sink Categories	CO_2 Emissions/Removals	CH_4	N_2O	NO_x	CO	NMVOC
	(kt)					
4. Total LULUCF	**-2 723.2521**	**0.0049**	**0.2083**	**0.0037**	**0.1341**	**NE**
A. Forest Land	**-2 019.3088**	**0.0029**	**0.0002**	**0.0018**	**0.0651**	**NE**
1. Forest Land Remaining Forest Land	-1 499.6258	NE	NE	NE	NE	NE
2. Land Converted to Forest Land	-519.6830	0.0029	0.0002	0.0018	0.0651	NE
B. Cropland	**-582.4370**	**0.0020**	**0.2069**	**0.0019**	**0.0690**	**NE**
1. Cropland Remaining Cropland	-1 644.5455	0.0020	0.2069	0.0019	0.0690	NE
2. Land Converted to Cropland	1 062.1085	NE	NE	NE	NE	NE
C. Grassland	**-271.1606**	**NE**	**NE**	**NE**	**NE**	**NE**
1. Grassland Remaining Grassland	NO	NE	NE	NE	NE	NE
2. Land Converted to Grassland	-271.1606	NE	NE	NE	NE	NE
D. Wetlands	**NO**	**NE**	**NE**	**NE**	**NE**	**NE**
1. Wetlands Remaining Wetlands	NO	NE	NE	NE	NE	NE
2. Land Converted to Wetlands	NO	NE	NE	NE	NE	NE

Greenhouse Gas Source and Sink Categories	CO_2 Emissions/Removals	CH_4	N_2O	NO_x	CO	NMVOC
	(kt)					
E. Settlements	**18.7098**	**NE**	**0.0013**	**NE**	**NE**	**NE**
1. Settlements Remaining Settlements	NO	NE	NE	NE	NE	NE
2. Land Converted to Settlements	18.7098	NE	0.0013	NE	NE	NE
F. Other Land	**70.4783**	**NE**	**NE**	**NE**	**NE**	**NE**
1. Other Land Remaining Other Land						
2. Land Converted to Other Land	70.4783	NE	NE	NE	NE	NE
G. Harvested Wood Products	**60.4660**					
H. Other	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**

2015

Greenhouse Gas Source and Sink Categories	CO_2 Emissions/Removals	CH_4	N_2O	NO_x	CO	NMVOC
	(kt)					
4. Total LULUCF	**-2 904.5678**	**0.0283**	**0.1962**	**0.0186**	**0.6651**	**NE**
A. Forest Land	**-2 027.2895**	**0.0265**	**0.0015**	**0.0169**	**0.6041**	**NE**
1. Forest Land Remaining Forest Land	-1 511.5589	NE	NE	NE	NE	NE
2. Land Converted to Forest Land	-515.7307	0.0265	0.0015	0.0169	0.6041	NE
B. Cropland	**-727.4181**	**0.0018**	**0.1930**	**0.0017**	**0.0610**	**NE**
1. Cropland Remaining Cropland	-1 711.3517	0.0018	0.1930	0.0017	0.0610	NE
2. Land Converted to Cropland	983.9336	NE	NE	NE	NE	NE
C. Grassland	**-306.2291**	**NE**	**NE**	**NE**	**NE**	**NE**
1. Grassland Remaining Grassland	NO	NE	NE	NE	NE	NE
2. Land Converted to Grassland	-306.2291	NE	NE	NE	NE	NE
D. Wetlands	**NO**	**NE**	**NE**	**NE**	**NE**	**NE**
1. Wetlands Remaining Wetlands	NO	NE	NE	NE	NE	NE
2. Land Converted to Wetlands	NO	NE	NE	NE	NE	NE
E. Settlements	**38.8867**	**NE**	**0.0017**	**NE**	**NE**	**NE**
1. Settlements Remaining Settlements	NO	NE	NE	NE	NE	NE
2. Land Converted to Settlements	38.8867	NE	0.0017	NE	NE	NE
F. Other Land	**60.8445**	**NE**	**NE**	**NE**	**NE**	**NE**
1. Other Land Remaining Other Land						
2. Land Converted to Other Land	60.8445	NE	NE	NE	NE	NE
G. Harvested Wood Products	**56.6377**					
H. Other	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**

Annex 6-5: Sectoral Report for Waste Sector 1990-2015

1990

Greenhouse Gas Source and Sink Categories	CO_2	CH_4	N_2O	NO_x	CO	NMVOC	SO_2
	(kt)						
5. Total Waste	**17.1060**	**74.8094**	**0.3032**	**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**	**0.0081**	**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	0.0081	0.1717	3.0071	0.0664	0.0060
D. Wastewater treatment and discharge		**32.5890**	**0.2951**	**NA, IE**	**NA, IE**	**0.0410**	
1. Domestic wastewater		32.5890	0.2951	NA	NA	0.0410	
2. Industrial wastewater		IE	IE	IE	IE	IE	
3. Other		NA	NA	NA	NA	NA	
E. Other	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**
Memo item:							
Long-term storage of C in waste disposal sites	NE						
Annual change in total long-term C storage	NE						
Annual Change in total long-term C storage in HWP waste	NE						

1991

Greenhouse Gas Source and Sink Categories	CO_2	CH_4	N_2O	NO_x	CO	NMVOC	SO_2
	(kt)						
5. Total Waste	**17.1256**	**73.8878**	**0.2805**	**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**	**0.0081**	**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	0.0081	0.1719	3.0098	0.0664	0.0060
D. Wastewater treatment and discharge		**29.5915**	**0.2724**	**NA, IE**	**NA, IE**	**0.0373**	
1. Domestic wastewater		29.5915	0.2724	NA	NA	0.0373	
2. Industrial wastewater		IE	IE	IE	IE	IE	
3. Other		NA	NA	NA	NA	NA	
E. Other	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**
Memo item:							
Long-term storage of C in waste disposal sites	NE						
Annual change in total long-term C storage	NE						
Annual Change in total long-term C storage in HWP waste	NE						

1992

Greenhouse Gas Source and Sink Categories	CO_2	CH_4	N_2O	NO_x	CO	NMVOC	SO_2
	(kt)						
5. Total Waste	**17.1291**	**68.3638**	**0.2577**	**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**	**0.0081**	**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	0.0081	0.1719	3.0096	0.0664	0.0060
D. Wastewater treatment and discharge		**22.3339**	**0.2496**	**NA, IE**	**NA, IE**	**0.0335**	
1. Domestic wastewater		22.3339	0.2496	NA	NA	0.0335	
2. Industrial wastewater		IE	IE	IE	IE	IE	

Greenhouse Gas Source and Sink Categories	CO_2	CH_4	N_2O	NO_x	CO	NMVOC	SO_2
	(kt)						
3. Other		NA	NA	NA	NA	NA	
E. Other	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**
Memo item:							
Long-term storage of C in waste disposal sites	NE						
Annual change in total long-term C storage	NE						
Annual Change in total long-term C storage in HWP waste	NE						

1993

Greenhouse Gas Source and Sink Categories	CO_2	CH_4	N_2O	NO_x	CO	NMVOC	SO_2
	(kt)						
5. Total Waste	**17.1013**	**70.4180**	**0.2422**	**0.1716**	**3.0038**	**1.7665**	**0.0060**
A. Solid waste disposal	**NA, NO**	**48.1882**		**NA, NO**	**NA, NO**	**1.6703**	
1. Managed waste disposal sites	NA, NO	13.1072		NA, NO	NA	0.4543	
2. Unmanaged waste disposal sites	NA, NO	35.0810		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**	**0.0081**	**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	0.0081	0.1716	3.0038	0.0663	0.0060
D. Wastewater treatment and discharge		**21.8787**	**0.2341**	**NA, IE**	**NA, IE**	**0.0299**	
1. Domestic wastewater		21.8787	0.2341	NA	NA	0.0299	
2. Industrial wastewater		IE	IE	IE	IE	IE	
3. Other		NA	NA	NA	NA	NA	
E. Other	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**
Memo item:							
Long-term storage of C in waste disposal sites	NE						
Annual change in total long-term C storage	NE						
Annual Change in total long-term C storage in HWP waste	NE						

1994

Greenhouse Gas Source and Sink Categories	CO_2	CH_4	N_2O	NO_x	CO	NMVOC	SO_2
	(kt)						
5. Total Waste	**17.1330**	**66.3913**	**0.2354**	**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**	**0.0081**	**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	0.0081	0.1719	3.0085	0.0664	0.0060
D. Wastewater treatment and discharge		**17.6476**	**0.2272**	**NA, IE**	**NA, IE**	**0.0272**	
1. Domestic wastewater		17.6476	0.2272	NA	NA	0.0272	
2. Industrial wastewater		IE	IE	IE	IE	IE	
3. Other		NA	NA	NA	NA	NA	
E. Other	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**
Memo item:							
Long-term storage of C in waste disposal sites	NE						
Annual change in total long-term C storage	NE						
Annual Change in total long-term C storage in HWP waste	NE						

1995

Greenhouse Gas Source and Sink Categories	CO_2	CH_4	N_2O	NO_x	CO	NMVOC	SO_2
	(kt)						
5. Total Waste	**17.1216**	**65.2840**	**0.2382**	**0.1717**	**3.0055**	**1.4718**	**0.0060**
A. Solid waste disposal	**NA, NO**	**48.3674**		**NA, NO**	**NA, NO**	**1.3847**	
1. Managed waste disposal sites	NA, NO	15.0423		NA, NO	NA	0.4306	
2. Unmanaged waste disposal sites	NA, NO	33.3251		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**	

Greenhouse Gas Source and Sink Categories	CO_2	CH_4	N_2O	NO_x	CO	NMVOC	SO_2
	(kt)						
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**	**0.0081**	**0.1717**	**3.0055**	**0.0664**	**0.0060**
1. Waste incineration	NO	NO	NO	NO	NO	NO	NO
2. Open burning of waste	17.1216	0.3514	0.0081	0.1717	3.0055	0.0664	0.0060
D. Wastewater treatment and discharge		**16.5652**	**0.2301**	**NA, IE**	**NA, IE**	**0.0207**	
1. Domestic wastewater		16.5652	0.2301	NA	NA	0.0207	
2. Industrial wastewater		IE	IE	IE	IE	IE	
3. Other		NA	NA	NA	NA	NA	
E. Other	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**
Memo item:							
Long-term storage of C in waste disposal sites	NE						
Annual change in total long-term C storage	NE						
Annual Change in total long-term C storage in HWP waste	NE						

1996

Greenhouse Gas Source and Sink Categories	CO_2	CH_4	N_2O	NO_x	CO	NMVOC	SO_2
	(kt)						
5. Total Waste	**17.1083**	**64.9110**	**0.2347**	**0.1716**	**3.0022**	**1.4379**	**0.0060**
A. Solid waste disposal	**NA, NO**	**48.6714**		**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	34.0700		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**	**0.0081**	**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	0.0081	0.1716	3.0022	0.0663	0.0060
D. Wastewater treatment and discharge		**15.8885**	**0.2266**	**NA, IE**	**NA, IE**	**0.0208**	
1. Domestic wastewater		15.8885	0.2266	NA	NA	0.0208	
2. Industrial wastewater		IE	IE	IE	IE	IE	
3. Other		NA	NA	NA	NA	NA	
E. Other	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**
Memo item:							
Long-term storage of C in waste disposal sites	NE						
Annual change in total long-term C storage	NE						
Annual Change in total long-term C storage in HWP waste	NE						

1997

Greenhouse Gas Source and Sink Categories	CO_2	CH_4	N_2O	NO_x	CO	NMVOC	SO_2
	(kt)						
5. Total Waste	**17.0610**	**65.2346**	**0.2388**	**0.1711**	**2.9928**	**1.3447**	**0.0060**
A. Solid waste disposal	**NA, NO**	**48.1514**		**NA, NO**	**NA, NO**	**1.2600**	
1. Managed waste disposal sites	NA, NO	15.7937		NA, NO	NA	0.4133	
2. Unmanaged waste disposal sites	NA, NO	32.3578		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**	**0.0081**	**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	0.0081	0.1711	2.9928	0.0661	0.0060
D. Wastewater treatment and discharge		**16.7331**	**0.2307**	**NA, IE**	**NA, IE**	**0.0186**	
1. Domestic wastewater		16.7331	0.2307	NA	NA	0.0186	
2. Industrial wastewater		IE	IE	IE	IE	IE	
3. Other		NA	NA	NA	NA	NA	
E. Other	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**
Memo item:							
Long-term storage of C in waste disposal sites	NE						
Annual change in total long-term C storage	NE						
Annual Change in total long-term C storage in HWP waste	NE						

1998

Greenhouse Gas Source and Sink Categories	CO_2	CH_4	N_2O	NO_x	CO	NMVOC	SO_2
	(kt)						
5. Total Waste	**17.0087**	**62.5029**	**0.2412**	**0.1705**	**2.9824**	**1.3381**	**0.0060**
A. Solid waste disposal	**NA, NO**	**47.5737**		**NA, NO**	**NA, NO**	**1.2568**	
1. Managed waste disposal sites	NA, NO	15.4615		NA, NO	NA	0.4085	
2. Unmanaged waste disposal sites	NA, NO	32.1123		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	**17.0087**	**0.3490**	**0.0081**	**0.1705**	**2.9824**	**0.0659**	**0.0060**
1. Waste incineration	NO	NO	NO	NO	NO	NO	NO
2. Open burning of waste	17.0087	0.3490	0.0081	0.1705	2.9824	0.0659	0.0060
D. Wastewater treatment and discharge		**14.5801**	**0.2331**	**NA, IE**	**NA, IE**	**0.0155**	
1. Domestic wastewater		14.5801	0.2331	NA	NA	0.0155	
2. Industrial wastewater		IE	IE	IE	IE	IE	
3. Other		NA	NA	NA	NA	NA	
E. Other	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**
Memo item:							
Long-term storage of C in waste disposal sites	NE						
Annual change in total long-term C storage	NE						
Annual Change in total long-term C storage in HWP waste	NE						

1999

Greenhouse Gas Source and Sink Categories	CO_2	CH_4	N_2O	NO_x	CO	NMVOC	SO_2
	(kt)						
5. Total Waste	**16.9778**	**61.0841**	**0.2411**	**0.1702**	**2.9758**	**1.2120**	**0.0060**
A. Solid waste disposal	**NA, NO**	**47.8085**		**NA, NO**	**NA, NO**	**1.1343**	
1. Managed waste disposal sites	NA, NO	15.7290		NA, NO	NA	0.3732	
2. Unmanaged waste disposal sites	NA, NO	32.0795		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	**16.9778**	**0.3483**	**0.0080**	**0.1702**	**2.9758**	**0.0658**	**0.0060**
1. Waste incineration	NO	NO	NO	NO	NO	NO	NO
2. Open burning of waste	16.9778	0.3483	0.0080	0.1702	2.9758	0.0658	0.0060
D. Wastewater treatment and discharge		**12.9273**	**0.2331**	**NA, IE**	**NA, IE**	**0.0119**	
1. Domestic wastewater		12.9273	0.2331	NA	NA	0.0119	
2. Industrial wastewater		IE	IE	IE	IE	IE	
3. Other		NA	NA	NA	NA	NA	
E. Other	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**
Memo item:							
Long-term storage of C in waste disposal sites	NE						
Annual change in total long-term C storage	NE						
Annual Change in total long-term C storage in HWP waste	NE						

2000

Greenhouse Gas Source and Sink Categories	CO_2	CH_4	N_2O	NO_x	CO	NMVOC	SO_2
	(kt)						
5. Total Waste	**16.9434**	**60.4717**	**0.2415**	**0.1698**	**2.9685**	**1.2085**	**0.0060**
A. Solid waste disposal	**NA, NO**	**46.7803**		**NA, NO**	**NA, NO**	**1.1318**	
1. Managed waste disposal sites	NA, NO	14.8761		NA, NO	NA	0.3599	
2. Unmanaged waste disposal sites	NA, NO	31.9042		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	**16.9434**	**0.3476**	**0.0080**	**0.1698**	**2.9685**	**0.0656**	**0.0060**
1. Waste incineration	NO	NO	NO	NO	NO	NO	NO
2. Open burning of waste	16.9434	0.3476	0.0080	0.1698	2.9685	0.0656	0.0060
D. Wastewater treatment and discharge		**13.3438**	**0.2334**	**NA, IE**	**NA, IE**	**0.0111**	
1. Domestic wastewater		13.3438	0.2334	NA	NA	0.0111	
2. Industrial wastewater		IE	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						

2001

Greenhouse Gas Source and Sink Categories	CO_2	CH_4	N_2O	NO_x	CO	NMVOC	SO_2
	(kt)						
5. Total Waste	**16.9961**	**60.0447**	**0.2448**	**0.1703**	**2.9765**	**1.0955**	**0.0060**
A. Solid waste disposal	**NA, NO**	**45.4984**		**NA, NO**	**NA, NO**	**1.0191**	
1. Managed waste disposal sites	NA, NO	14.5140		NA, NO	NA	0.3251	
2. Unmanaged waste disposal sites	NA, NO	30.9844		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	**16.9961**	**0.3486**	**0.0080**	**0.1703**	**2.9765**	**0.0658**	**0.0060**
1. Waste incineration	NO	NO	NO	NO	NO	NO	NO
2. Open burning of waste	16.9961	0.3486	0.0080	0.1703	2.9765	0.0658	0.0060
D. Wastewater treatment and discharge		**14.1977**	**0.2368**	**NA, IE**	**NA, IE**	**0.0106**	
1. Domestic wastewater		14.1977	0.2368	NA	NA	0.0106	
2. Industrial wastewater		IE	IE	IE	IE	IE	
3. Other		NA	NA	NA	NA	NA	
E. Other	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**
Memo item:							
Long-term storage of C in waste disposal sites	NE						
Annual change in total long-term C storage	NE						
Annual Change in total long-term C storage in HWP waste	NE						

2002

Greenhouse Gas Source and Sink Categories	CO_2	CH_4	N_2O	NO_x	CO	NMVOC	SO_2
	(kt)						
5. Total Waste	**16.9406**	**58.3411**	**0.2510**	**0.1697**	**2.9653**	**1.1541**	**0.0060**
A. Solid waste disposal	**NA, NO**	**44.3221**		**NA, NO**	**NA, NO**	**1.0781**	
1. Managed waste disposal sites	NA, NO	14.1831		NA, NO	NA	0.3450	
2. Unmanaged waste disposal sites	NA, NO	30.1391		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	**16.9406**	**0.3474**	**0.0080**	**0.1697**	**2.9653**	**0.0656**	**0.0060**
1. Waste incineration	NO	NO	NO	NO	NO	NO	NO
2. Open burning of waste	16.9406	0.3474	0.0080	0.1697	2.9653	0.0656	0.0060
D. Wastewater treatment and discharge		**13.6716**	**0.2429**	**NA, IE**	**NA, IE**	**0.0104**	
1. Domestic wastewater		13.6716	0.2429	NA	NA	0.0104	
2. Industrial wastewater		IE	IE	IE	IE	IE	
3. Other		NA	NA	NA	NA	NA	
E. Other	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**
Memo item:							
Long-term storage of C in waste disposal sites							
Annual change in total long-term C storage	NE						
Annual Change in total long-term C storage in HWP waste	NE						

2003

Greenhouse Gas Source and Sink Categories	CO_2	CH_4	N_2O	NO_x	CO	NMVOC	SO_2
	(kt)						
5. Total Waste	**16.8724**	**57.8591**	**0.2426**	**0.1689**	**2.9519**	**1.3071**	**0.0060**
A. Solid waste disposal	**NA, NO**	**42.8091**		**NA, NO**	**NA, NO**	**1.2315**	
1. Managed waste disposal sites	NA, NO	13.0996		NA, NO	NA	0.3769	
2. Unmanaged waste disposal sites	NA, NO	29.7095		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	

Greenhouse Gas Source and Sink Categories	CO_2	CH_4	N_2O	NO_x	CO	NMVOC	SO_2
	(kt)						
2. Anaerobic digestion at biogas facilities		NE	NE	NE	NE	NE	
C. Incineration and open burning of waste	**16.8724**	**0.3460**	**0.0080**	**0.1689**	**2.9519**	**0.0653**	**0.0060**
1. Waste incineration	NO	NO	NO	NO	NO	NO	NO
2. Open burning of waste	16.8724	0.3460	0.0080	0.1689	2.9519	0.0653	0.0060
D. Wastewater treatment and discharge		**14.7040**	**0.2346**	**NA, IE**	**NA, IE**	**0.0103**	
1. Domestic wastewater		14.7040	0.2346	NA	NA	0.0103	
2. Industrial wastewater		IE	IE	IE	IE	IE	
3. Other		NA	NA	NA	NA	NA	
E. Other	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**
Memo item:							
Long-term storage of C in waste disposal sites	NE						
Annual change in total long-term C storage	NE						
Annual Change in total long-term C storage in HWP waste	NE						

2004

Greenhouse Gas Source and Sink Categories	CO_2	CH_4	N_2O	NO_x	CO	NMVOC	SO_2
	(kt)						
5. Total Waste	**16.5930**	**57.4136**	**0.2491**	**0.1661**	**2.9010**	**1.3939**	**0.0059**
A. Solid waste disposal	**NA, NO**	**42.2062**		**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	29.7976		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	**16.5930**	**0.3402**	**0.0078**	**0.1661**	**2.9010**	**0.0642**	**0.0059**
1. Waste incineration	NO	NO	NO	NO	NO	NO	NO
2. Open burning of waste	16.5930	0.3402	0.0078	0.1661	2.9010	0.0642	0.0059
D. Wastewater treatment and discharge		**14.8673**	**0.2413**	**NA, IE**	**NA, IE**	**0.0103**	
1. Domestic wastewater		14.8673	0.2413	NA	NA	0.0103	
2. Industrial wastewater		IE	IE	IE	IE	IE	
3. Other		NA	NA	NA	NA	NA	
E. Other	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**
Memo item:							
Long-term storage of C in waste disposal sites	NE						
Annual change in total long-term C storage	NE						
Annual Change in total long-term C storage in HWP waste	NE						

2005

Greenhouse Gas Source and Sink Categories	CO_2	CH_4	N_2O	NO_x	CO	NMVOC	SO_2
	(kt)						
5. Total Waste	**16.5476**	**58.5284**	**0.2602**	**0.1656**	**2.8914**	**1.5515**	**0.0059**
A. Solid waste disposal	**NA, NO**	**42.5718**		**NA, NO**	**NA, NO**	**1.4772**	
1. Managed waste disposal sites	NA, NO	12.0478		NA, NO	NA	0.4180	
2. Unmanaged waste disposal sites	NA, NO	30.5240		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	**16.5476**	**0.3392**	**0.0078**	**0.1656**	**2.8914**	**0.0640**	**0.0059**
1. Waste incineration	NO	NO	NO	NO	NO	NO	NO
2. Open burning of waste	16.5476	0.3392	0.0078	0.1656	2.8914	0.0640	0.0059
D. Wastewater treatment and discharge		**15.6174**	**0.2524**	**NA, IE**	**NA, IE**	**0.0104**	
1. Domestic wastewater		15.6174	0.2524	NA	NA	0.0104	
2. Industrial wastewater		IE	IE	IE	IE	IE	
3. Other		NA	NA	NA	NA	NA	
E. Other	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**
Memo item:							
Long-term storage of C in waste disposal sites	NE						
Annual change in total long-term C storage	NE						
Annual Change in total long-term C storage in HWP waste	NE						

2006

Greenhouse Gas Source and Sink Categories	CO_2	CH_4	N_2O	NO_x	CO	NMVOC	SO_2
	(kt)						
5. Total Waste	**16.4929**	**57.7751**	**0.2553**	**0.1650**	**2.8801**	**1.6799**	**0.0059**
A. Solid waste disposal	**NA, NO**	**42.4729**		**NA, NO**	**NA, NO**	**1.6057**	
1. Managed waste disposal sites	NA, NO	11.5526		NA, NO	NA	0.4368	
2. Unmanaged waste disposal sites	NA, NO	30.9203		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	**16.4929**	**0.3380**	**0.0078**	**0.1650**	**2.8801**	**0.0637**	**0.0059**
1. Waste incineration	NO	NO	NO	NO	NO	NO	NO
2. Open burning of waste	16.4929	0.3380	0.0078	0.1650	2.8801	0.0637	0.0059
D. Wastewater treatment and discharge		**14.9642**	**0.2475**	**NA, IE**	**NA, IE**	**0.0104**	
1. Domestic wastewater		14.9642	0.2475	NA	NA	0.0104	
2. Industrial wastewater		IE	IE	IE	IE	IE	
3. Other		NA	NA	NA	NA	NA	
E. Other	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**
Memo item:							
Long-term storage of C in waste disposal sites	NE						
Annual change in total long-term C storage	NE						
Annual Change in total long-term C storage in HWP waste	NE						

2007

Greenhouse Gas Source and Sink Categories	CO_2	CH_4	N_2O	NO_x	CO	NMVOC	SO_2
	(kt)						
5. Total Waste	**16.4239**	**57.5563**	**0.2447**	**0.1642**	**2.8661**	**2.1023**	**0.0059**
A. Solid waste disposal	**NA, NO**	**42.5927**		**NA, NO**	**NA, NO**	**2.0285**	
1. Managed waste disposal sites	NA, NO	13.1185		NA, NO	NA	0.6248	
2. Unmanaged waste disposal sites	NA, NO	29.4741		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	**16.4239**	**0.3365**	**0.0078**	**0.1642**	**2.8661**	**0.0634**	**0.0059**
1. Waste incineration	NO	NO	NO	NO	NO	NO	NO
2. Open burning of waste	16.4239	0.3365	0.0078	0.1642	2.8661	0.0634	0.0059
D. Wastewater treatment and discharge		**14.6272**	**0.2369**	**NA, IE**	**NA, IE**	**0.0103**	
1. Domestic wastewater		14.6272	0.2369	NA	NA	0.0103	
2. Industrial wastewater		IE	IE	IE	IE	IE	
3. Other		NA	NA	NA	NA	NA	
E. Other	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**
Memo item:							
Long-term storage of C in waste disposal sites	NE						
Annual change in total long-term C storage	NE						
Annual Change in total long-term C storage in HWP waste	NE						

2008

Greenhouse Gas Source and Sink Categories	CO_2	CH_4	N_2O	NO_x	CO	NMVOC	SO_2
	(kt)						
5. Total Waste	**16.3761**	**58.5045**	**0.2457**	**0.1637**	**2.8558**	**2.3971**	**0.0059**
A. Solid waste disposal	**NA, NO**	**43.3686**		**NA, NO**	**NA, NO**	**2.3236**	
1. Managed waste disposal sites	NA, NO	14.6586		NA, NO	NA	0.7854	
2. Unmanaged waste disposal sites	NA, NO	28.7100		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	**16.3761**	**0.3354**	**0.0077**	**0.1637**	**2.8558**	**0.0632**	**0.0059**
1. Waste incineration	NO	NO	NO	NO	NO	NO	NO
2. Open burning of waste	16.3761	0.3354	0.0077	0.1637	2.8558	0.0632	0.0059
D. Wastewater treatment and discharge		**14.8004**	**0.2379**	**NA, IE**	**NA, IE**	**0.0103**	
1. Domestic wastewater		14.8004	0.2379	NA	NA	0.0103	
2. Industrial wastewater		IE	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						

2009

Greenhouse Gas Source and Sink Categories	CO_2	CH_4	N_2O	NO_x	CO	NMVOC	SO_2
	(kt)						
5. Total Waste	**16.3396**	**58.2481**	**0.2320**	**0.1633**	**2.8474**	**2.1810**	**0.0059**
A. Solid waste disposal	**NA, NO**	**44.6029**		**NA, NO**	**NA, NO**	**2.1076**	
1. Managed waste disposal sites	NA, NO	15.9678		NA, NO	NA	0.7545	
2. Unmanaged waste disposal sites	NA, NO	28.6351		NA, NO	NA	1.3531	
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	**16.3396**	**0.3346**	**0.0077**	**0.1633**	**2.8474**	**0.0631**	**0.0059**
1. Waste incineration	NO	NO	NO	NO	NO	NO	NO
2. Open burning of waste	16.3396	0.3346	0.0077	0.1633	2.8474	0.0631	0.0059
D. Wastewater treatment and discharge		**13.3105**	**0.2243**	**NA, IE**	**NA, IE**	**0.0103**	
1. Domestic wastewater		13.3105	0.2243	NA	NA	0.0103	
2. Industrial wastewater		IE	IE	IE	IE	IE	
3. Other		NA	NA	NA	NA	NA	
E. Other	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**
Memo item:							
Long-term storage of C in waste disposal sites	NE						
Annual change in total long-term C storage	NE						
Annual Change in total long-term C storage in HWP waste	NE						

2010

Greenhouse Gas Source and Sink Categories	CO_2	CH_4	N_2O	NO_x	CO	NMVOC	SO_2
	(kt)						
5. Total Waste	**16.3159**	**59.6532**	**0.2432**	**0.1630**	**2.8412**	**2.0097**	**0.0059**
A. Solid waste disposal	**NA, NO**	**45.5148**		**NA, NO**	**NA, NO**	**1.9364**	
1. Managed waste disposal sites	NA, NO	17.7508		NA, NO	NA	0.7552	
2. Unmanaged waste disposal sites	NA, NO	27.7640		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	**16.3159**	**0.3341**	**0.0077**	**0.1630**	**2.8412**	**0.0629**	**0.0059**
1. Waste incineration	NO	NO	NO	NO	NO	NO	NO
2. Open burning of waste	16.3159	0.3341	0.0077	0.1630	2.8412	0.0629	0.0059
D. Wastewater treatment and discharge		**13.8043**	**0.2355**	**NA, IE**	**NA, IE**	**0.0103**	
1. Domestic wastewater		13.8043	0.2355	NA	NA	0.0103	
2. Industrial wastewater		IE	IE	IE	IE	IE	
3. Other		NA	NA	NA	NA	NA	
E. Other	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**
Memo item:							
Long-term storage of C in waste disposal sites	NE						
Annual change in total long-term C storage	NE						
Annual Change in total long-term C storage in HWP waste	NE						

2011

Greenhouse Gas Source and Sink Categories	CO_2	CH_4	N_2O	NO_x	CO	NMVOC	SO_2
	(kt)						
5. Total Waste	**16.3820**	**60.6535**	**0.2406**	**0.1631**	**2.8344**	**2.0381**	**0.0060**
A. Solid waste disposal	**NA, NO**	**46.2036**		**NA, NO**	**NA, NO**	**1.9649**	
1. Managed waste disposal sites	NA, NO	18.5276		NA, NO	NA	0.7879	
2. Unmanaged waste disposal sites	NA, NO	27.6760		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	

Greenhouse Gas Source and Sink Categories	CO_2	CH_4	N_2O	NO_x	CO	NMVOC	SO_2
	(kt)						
2. Anaerobic digestion at biogas facilities		NE	NE	NE	NE	NE	
C. Incineration and open burning of waste	**16.3820**	**0.3348**	**0.0077**	**0.1631**	**2.8344**	**0.0630**	**0.0060**
1. Waste incineration	NO	NO	NO	NO	NO	NO	NO
2. Open burning of waste	16.3820	0.3348	0.0077	0.1631	2.8344	0.0630	0.0060
D. Wastewater treatment and discharge		**14.1151**	**0.2329**	**NA, IE**	**NA, IE**	**0.0103**	
1. Domestic wastewater		14.1151	0.2329	NA	NA	0.0103	
2. Industrial wastewater		IE	IE	IE	IE	IE	
3. Other		NA	NA	NA	NA	NA	
E. Other	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**
Memo item:							
Long-term storage of C in waste disposal sites	NE						
Annual change in total long-term C storage	NE						
Annual Change in total long-term C storage in HWP waste	NE						

2012

Greenhouse Gas Source and Sink Categories	CO_2	CH_4	N_2O	NO_x	CO	NMVOC	SO_2
	(kt)						
5. Total Waste	**16.3598**	**60.5748**	**0.2386**	**0.1629**	**2.8300**	**2.0142**	**0.0060**
A. Solid waste disposal	**NA, NO**	**45.7457**		**NA, NO**	**NA, NO**	**1.9411**	
1. Managed waste disposal sites	NA, NO	18.2983		NA, NO	NA	0.7764	
2. Unmanaged waste disposal sites	NA, NO	27.4474		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	**16.3598**	**0.3343**	**0.0077**	**0.1629**	**2.8300**	**0.0629**	**0.0060**
1. Waste incineration	NO	NO	NO	NO	NO	NO	NO
2. Open burning of waste	16.3598	0.3343	0.0077	0.1629	2.8300	0.0629	0.0060
D. Wastewater treatment and discharge		**14.4948**	**0.2309**	**NA, IE**	**NA, IE**	**0.0102**	
1. Domestic wastewater		14.4948	0.2309	NA	NA	0.0102	
2. Industrial wastewater		IE	IE	IE	IE	IE	
3. Other		NA	NA	NA	NA	NA	
E. Other	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**
Memo item:							
Long-term storage of C in waste disposal sites	NE						
Annual change in total long-term C storage	NE						
Annual Change in total long-term C storage in HWP waste	NE						

2013

Greenhouse Gas Source and Sink Categories	CO_2	CH_4	N_2O	NO_x	CO	NMVOC	SO_2
	(kt)						
5. Total Waste	**16.3335**	**59.1217**	**0.2408**	**0.1626**	**2.8255**	**2.1793**	**0.0060**
A. Solid waste disposal	**NA, NO**	**43.3916**		**NA, NO**	**NA, NO**	**2.1063**	
1. Managed waste disposal sites	NA, NO	16.4020		NA, NO	NA	0.7962	
2. Unmanaged waste disposal sites	NA, NO	26.9895		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	**16.3335**	**0.3337**	**0.0077**	**0.1626**	**2.8255**	**0.0628**	**0.0060**
1. Waste incineration	NO	NO	NO	NO	NO	NO	NO
2. Open burning of waste	16.3335	0.3337	0.0077	0.1626	2.8255	0.0628	0.0060
D. Wastewater treatment and discharge		**15.3964**	**0.2331**	**NA, IE**	**NA, IE**	**0.0102**	
1. Domestic wastewater		15.3964	0.2331	NA	NA	0.0102	
2. Industrial wastewater		IE	IE	IE	IE	IE	
3. Other		NA	NA	NA	NA	NA	
E. Other	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**
Memo item:							
Long-term storage of C in waste disposal sites	NE						
Annual change in total long-term C storage	NE						
Annual Change in total long-term C storage in HWP waste	NE						

2014

Greenhouse Gas Source and Sink Categories	CO_2	CH_4	N_2O	NO_x	CO	NMVOC	SO_2
	(kt)						
5. Total Waste	**16.2752**	**58.9252**	**0.2434**	**0.1621**	**2.8182**	**2.3051**	**0.0059**
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	**16.2752**	**0.3327**	**0.0077**	**0.1621**	**2.8182**	**0.0626**	**0.0059**
1. Waste incineration	NO	NO	NO	NO	NO	NO	NO
2. Open burning of waste	16.2752	0.3327	0.0077	0.1621	2.8182	0.0626	0.0059
D. Wastewater treatment and discharge		**15.2693**	**0.2357**	**NA, IE**	**NA, IE**	**0.0100**	
1. Domestic wastewater		15.2693	0.2357	NA	NA	0.0100	
2. Industrial wastewater		IE	IE	IE	IE	IE	
3. Other		NA	NA	NA	NA	NA	
E. Other	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**
Memo item:							
Long-term storage of C in waste disposal sites	NE						
Annual change in total long-term C storage	NE						
Annual Change in total long-term C storage in HWP waste	NE						

2015

Greenhouse Gas Source and Sink Categories	CO_2	CH_4	N_2O	NO_x	CO	NMVOC	SO_2
	(kt)						
5. Total Waste	**16.1442**	**57.9832**	**0.2448**	**0.1609**	**2.7979**	**2.3076**	**0.0059**
A. Solid waste disposal	**NA, NO**	**43.4861**		**NA, NO**	**NA, NO**	**2.2355**	
1. Managed waste disposal sites	NA, NO	17.0031		NA, NO	NA	0.8741	
2. Unmanaged waste disposal sites	NA, NO	26.4830		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	**16.1442**	**0.3301**	**0.0076**	**0.1609**	**2.7979**	**0.0621**	**0.0059**
1. Waste incineration	NO	NO	NO	NO	NO	NO	NO
2. Open burning of waste	16.1442	0.3301	0.0076	0.1609	2.7979	0.0621	0.0059
D. Wastewater treatment and discharge		**14.1671**	**0.2371**	**NA, IE**	**NA, IE**	**0.0101**	
1. Domestic wastewater		14.1671	0.2371	NA	NA	0.0101	
2. Industrial wastewater		IE	IE	IE	IE	IE	
3. Other		NA	NA	NA	NA	NA	
E. Other	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**
Memo item:							
Long-term storage of C in waste disposal sites	NE						
Annual change in total long-term C storage	NE						
Annual Change in total long-term C storage in HWP waste	NE						

Annex 6-6: Summary Reports on GHG Emissions in the Republic of Moldova within 1990-2015

1990

SOURCES OF GHG EMISSIONS	Net CO_2 Emissions/ sinks	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 sinks	**29012.7530**	**228.2508**	**9.6019**	**NO**	**NO**	**NO**	**NO**	**NO**	**137.2894**	**442.5964**	**183.0223**	**294.2491**
1. Energy	**33296.4997**	**45.9141**	**0.6256**						**133.3639**	**430.6217**	**73.2953**	**292.9100**
A. Fuel Combustion Reference Approach	33084.0361											
Sectoral Approach	33295.8620	13.4244	0.6256						133.3639	430.6217	72.7136	292.9100
1. Energy Industries	19338.0195	0.4429	0.1653						54.3056	4.9308	1.3291	203.2479
2. Manufacturing Industries and Construction	2206.2753	0.0982	0.0171						5.9159	1.4020	0.2003	24.1751
3. Transport	4346.0289	1.3053	0.3460						43.3474	299.7054	56.4524	5.1060
4. Other Sectors	7291.5661	11.5672	0.0928						28.9129	122.3226	14.3034	59.7859
5. Other	113.9722	0.0109	0.0044						0.8821	2.2609	0.4285	0.5951
B. Fugitive Emissions from Fuels	0.6377	32.4897	0.0000						0.0000	0.0000	0.5817	0.0000
1. Solid Fuels	NO	NO	NO						NO	NO	NO	NO
2. Oil and Natural Gas	0.6377	32.4897	0.0000						0.0000	0.0000	0.5817	0.0000
C. CO_2 Transport and Storage	NO											
2. Industrial Processes and Product Use	**1580.9940**	**NO**	**0.0001**	**NO**	**NO**	**NO**	**NO**	**NO**	**3.6575**	**5.4300**	**106.6288**	**1.3330**
A. Mineral Industry	1316.1041								3.5018	3.3740	0.0339	1.2687
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	233.2089	NO	NO						0.0434	0.2441	92.7937	0.0216
E. Electronic Industry				NO	NO	NO	NO	NO				
F. Product Use 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**	**107.4205**	**8.4713**						**NO**	**NO**	**NE, NO**	
A. Enteric Fermentation		87.6278										
B. Manure Management		19.7927	3.7470								NO	
C. Rice Cultivation		NO										
D. Agricultural Soils			4.7243									
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											
J. Other	NO	NO	NO						**NO**	**NO**	**NO**	
4. LULUCF	**-5882.4287**	**0.1068**	**0.2017**						**0.0963**	**3.5377**	**NE**	
A. Forest Land	-2543.7403	0.0089	0.0005						0.0057	0.2037	NE	
B. Cropland	-578.1271	0.0978	0.1907						0.0906	3.3340	NE	
C. Grassland	-2850.2941	NE	NE						NE	NE	NE	
D. Wetlands	-17.4403	NE	NE						NE	NE	NE	
E. Settlements	84.7480	NE	0.0105						NE	NE	NE	

SOURCES OF GHG EMISSIONS	Net CO_2 Emissions/ sinks	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	152.4756	NE	NE						NE	NE	NE	
G. Harvested Wood Products	-130.0504											
H. Other	NO	NO	NO						NO	NO	NO	
5. Waste	**17.1060**	**74.8094**	**0.3032**						**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	0.0081						0.1717	3.0071	0.0664	0.0060
D. Wastewater Treatment and Discharge		32.5890	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	217.3668	0.0430	0.0070						0.7949	0.8733	0.5202	0.0689
Aviation	217.3668	0.0430	0.0070						0.7949	0.8733	0.5202	0.0689
Navigation	NO	NO	NO						NO	NO	NO	NO
Multilateral Operations	**NO**	**NO**	**NO**						**NO**	**NO**	**NO**	**NO**
CO_2 Emissions from Biomass	229.3072											
CO_2 Captured and Stored	NO											
Long-term Storage of C in waste disposal sites	NO											
Indirect N_2O			**1.9575**									
Indirect CO_2	**207.3247**											

1991

SOURCES OF GHG EMISSIONS	Net CO_2 Emissions/ sinks	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 sinks	**23396.6278**	**211.5870**	**9.1414**	**NO**	**NO**	**NO**	**NO**	**NO**	**124.4290**	**374.6690**	**155.2900**	**244.2434**
1. Energy	**29615.6682**	**39.7815**	**0.5709**						**120.7994**	**363.5195**	**64.3990**	**242.9820**
A. Fuel Combustion Reference Approach	29387.3159											
Sectoral Approach	29615.0542	9.2890	0.5709						120.7994	363.5195	63.8552	242.9820
1. Energy Industries	17363.5768	0.3826	0.1457						48.8473	4.4530	1.2021	172.1415
2. Manufacturing Industries and Construction	1751.5621	0.0771	0.0133						4.6859	0.7688	0.1609	19.2292
3. Transport	4435.3173	1.1863	0.3444						44.7084	282.8296	53.3770	5.6146
4. Other Sectors	5984.1624	7.6360	0.0643						21.9131	73.9506	8.8220	45.4314
5. Other	80.4355	0.0070	0.0031						0.6447	1.5175	0.2932	0.5653
B. Fugitive Emissions from Fuels	0.6140	30.4926	0.0000						0.0000	0.0000	0.5438	0.0000
1. Solid Fuels	NO	NO	NO						NO	NO	NO	NO
2. Oil and Natural Gas	0.6140	30.4926	0.0000						0.0000	0.0000	0.5438	0.0000
C. CO_2 Transport and Storage	NO											
2. Industrial Processes and Product Use	**1402.6293**	**NO**	**0.0001**	**NO**	**NO**	**NO**	**NO**	**NO**	**3.3691**	**4.8820**	**87.9714**	**1.2554**
A. Mineral Industry	1182.6733								3.2328	3.0205	0.0315	1.2004
B. Chemical Industry	NO	NO	NO						NO	NO	0.0544	NO
C. Metal Industry	24.7297	NO	NO	NO	NO	NO	NO	NO	0.0803	1.0502	0.0323	0.0371

SOURCES OF GHG EMISSIONS	Net CO_2 Emissions/ sinks	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	192.3631	NO	NO						0.0361	0.2030	76.2635	0.0180
E. Electronic Industry				NO	NO	NO	NO	NO				
F. Product Use 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**	**97.8215**	**8.0901**						**NO**	**NO**	**NE, NO**	
A. Enteric Fermentation		81.2260										
B. Manure Management		16.5955	3.4991									
C. Rice Cultivation		NO										
D. Agricultural Soils			4.5909									
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											
J. Other	NO	NO	NO						NO	NO	NO	
4. LULUCF	**-7639.3179**	**0.0961**	**0.1999**						**0.0886**	**3.2577**	**NE**	
A. Forest Land	-2323.6314	0.0015	0.0001						0.0010	0.0341	NE	
B. Cropland	-2097.4265	0.0946	0.1892						0.0876	3.2236	NE	
C. Grassland	-3317.4207	NE	NE						NE	NE	NE	
D. Wetlands	-17.4403	NE	NE						NE	NE	NE	
E. Settlements	88.7139	NE	0.0106						NE	NE	NE	
F. Other Land	152.4756	NE	NE						NE	NE	NE	
G. Harvested Wood Products	-124.5885											
H. Other	NO	NO	NO						NO	NO	NO	
5. Waste	**17.1256**	**73.8878**	**0.2805**						**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	0.0081						0.1719	3.0098	0.0664	0.0060
D. Wastewater Treatment and Discharge		29.5915	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	232.8115	0.0487	0.0074						0.8447	0.9641	0.5792	0.0738
Aviation	232.8115	0.0487	0.0074						0.8447	0.9641	0.5792	0.0738
Navigation	NO	NO	NO						NO	NO	NO	NO
Multilateral Operations	**NO**	**NO**	**NO**						**NO**	**NO**	**NO**	**NO**
CO_2 Emissions from Biomass	427.7268											
CO_2 Captured and Stored	NO											
Long-term Storage of C in waste disposal sites	NO											
Indirect N_2O			**1.8158**									
Indirect CO_2	**170.6429**											

1992

SOURCES OF GHG EMISSIONS	Net CO_2 Emissions/ sinks	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 sinks	**14211.5365**	**194.3828**	**7.5922**	**NO**	**NO**	**NO**	**NO**	**NO**	**78.3613**	**176.3384**	**105.8855**	**169.7527**
1. Energy	**20487.2378**	**31.2304**	**0.3421**						**76.3110**	**166.9663**	**30.7516**	**169.0953**
A. Fuel Combustion Reference Approach	20392.5412											
Sectoral Approach	20486.7203	3.6261	0.3421						76.3110	166.9663	30.2584	169.0953
1. Energy Industries	13010.9387	0.2828	0.1102						36.6784	3.3396	0.8992	128.3280
2. Manufacturing Industries and Construction	1013.7705	0.0412	0.0071						2.6879	0.4219	0.0896	10.9365
3. Transport	2142.4037	0.5682	0.1929						21.9215	134.4383	25.3717	2.7015
4. Other Sectors	4257.3797	2.7295	0.0299						14.5814	27.9162	3.7324	26.5401
5. Other	62.2278	0.0044	0.0020						0.4417	0.8504	0.1655	0.5892
B. Fugitive Emissions from Fuels	0.5175	27.6043	0.0000						0.0000	0.0000	0.4931	0.0000
1. Solid Fuels	NO	NO	NO						NO	NO	NO	NO
2. Oil and Natural Gas	0.5175	27.6043	0.0000						0.0000	0.0000	0.4931	0.0000
C. CO_2 Transport and Storage	NO											
2. Industrial Processes and Product Use	**814.3567**	**NO**	**0.0001**	**NO**	**NO**	**NO**	**NO**	**NO**	**1.7974**	**3.3821**	**72.3206**	**0.6514**
A. Mineral Industry	634.3365								1.6705	1.6235	0.0165	0.6003
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	153.7706	NO	NO						0.0304	0.1706	62.9651	0.0151
E. Electronic Industry				NO	NO	NO	NO	NO				
F. Product Use 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**	**94.7006**	**6.8113**						**NO**	**NO**	**NE, NO**	
A. Enteric Fermentation		79.7785										
B. Manure Management		14.9221	3.1392								NO	
C. Rice Cultivation		NO										
D. Agricultural Soils			3.6721									
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											
J. Other	NO	NO	NO						NO	NO	NO	
4. LULUCF	**-7107.5776**	**0.0880**	**0.1810**						**0.0810**	**2.9804**	**NE**	
A. Forest Land	-2164.6662	0.0016	0.0001						0.0010	0.0373	NE	
B. Cropland	-2231.6719	0.0864	0.1660						0.0800	2.9431	NE	
C. Grassland	-3383.3454	NE	NE						NE	NE	NE	
D. Wetlands	-17.4403	NE	NE						NE	NE	NE	
E. Settlements	386.6196	NE	0.0149						NE	NE	NE	
F. Other Land	418.8904	NE	NE						NE	NE	NE	

SOURCES OF GHG EMISSIONS	Net CO_2 Emissions/ sinks	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	-115.9639											
H. Other	NO	NO	NO						NO	NO	NO	
5. Waste	**17.1291**	**68.3638**	**0.2577**						**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	0.0081						0.1719	3.0096	0.0664	0.0060
D. Wastewater Treatment and Discharge		22.3339	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	96.2635	0.0189	0.0031						0.3512	0.3847	0.2288	0.0305
Aviation	96.2635	0.0189	0.0031						0.3512	0.3847	0.2288	0.0305
Navigation	NO	NO	NO						NO	NO	NO	NO
Multilateral Operations	**NO**	**NO**	**NO**						**NO**	**NO**	**NO**	**NO**
CO_2 Emissions from Biomass	531.1505											
CO_2 Captured and Stored	NO											
Long-term Storage of C in waste disposal sites	NO											
Indirect N_2O			**1.5170**									
Indirect CO_2	**140.7804**											

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SOURCES OF GHG EMISSIONS	Net CO_2 Emissions/ sinks	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 sinks	**8898.1834**	**183.8956**	**7.7396**	**NO**	**NO**	**NO**	**NO**	**NO**	**62.6903**	**150.0408**	**87.4951**	**137.1709**
1. Energy	**15345.5359**	**27.3820**	**0.3454**						**60.7032**	**139.7971**	**25.0832**	**136.5303**
A. Fuel Combustion — Reference Approach	15284.3469											
Sectoral Approach	15345.0977	2.5793	0.3454						60.7032	139.7971	24.6395	136.5303
1. Energy Industries	10737.0218	0.2447	0.0928						30.1864	2.7480	0.7361	114.6896
2. Manufacturing Industries and Construction	563.0714	0.0273	0.0045						1.5266	0.5219	0.0587	5.1076
3. Transport	1699.7939	0.4614	0.2209						16.5386	103.2541	19.4675	2.1961
4. Other Sectors	2253.3852	1.8406	0.0248						11.9354	32.2832	4.1894	13.8256
5. Other	91.8254	0.0054	0.0023						0.5163	0.9899	0.1879	0.7113
B. Fugitive Emissions from Fuels	0.4382	24.8026	0.0000						0.0000	0.0000	0.4437	0.0000
1. Solid Fuels	NO	NO	NO						NO	NO	NO	NO
2. Oil and Natural Gas	0.4382	24.8026	0.0000						0.0000	0.0000	0.4437	0.0000
C. CO_2 Transport and Storage	NO											
2. Industrial Processes and Product Use	**733.1321**	**NO**	**0.0001**	**NO**	**NO**	**NO**	**NO**	**NO**	**1.7064**	**3.2245**	**60.6455**	**0.6346**
A. Mineral Industry	583.4616								1.5838	1.4688	0.0143	0.5859
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

SOURCES OF GHG EMISSIONS	Net CO_2 Emissions/ sinks	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	123.3910	NO	NO						0.0241	0.1356	50.1008	0.0120
E. Electronic Industry				NO	NO	NO	NO	NO				
F. Product Use 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**	**85.9778**	**6.9568**						**NO**	**NO**	**NE, NO**	
A. Enteric Fermentation		75.0132										
B. Manure Management		10.9646	2.7155								NO	
C. Rice Cultivation		NO										
D. Agricultural Soils			4.2413									
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											
J. Other	NO	NO	NO						NO	NO	NO	
4. LULUCF	**-7197.7136**	**0.1179**	**0.1950**						**0.1091**	**4.0153**	**NE**	
A. Forest Land	-2173.9910	0.0001	0.0000						0.0001	0.0025	NE	
B. Cropland	-2078.6361	0.1178	0.1808						0.1090	4.0127	NE	
C. Grassland	-3109.7949	NE	NE						NE	NE	NE	
D. Wetlands	-17.4403	NE	NE						NE	NE	NE	
E. Settlements	114.6181	NE	0.0142						NE	NE	NE	
F. Other Land	164.1286	NE	NE						NE	NE	NE	
G. Harvested Wood Products	-96.5980											
H. Other	NO	NO	NO						NO	NO	NO	
5. Waste	**17.1013**	**70.4180**	**0.2422**						**0.1716**	**3.0038**	**1.7665**	**0.0060**
A. Solid Waste Disposal	NA, NO	48.1882							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	0.0081						0.1716	3.0038	0.0663	0.0060
D. Wastewater Treatment and Discharge		21.8787	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	62.0927	0.0099	0.0020						0.2331	0.2215	0.1293	0.0197
Aviation	62.0927	0.0099	0.0020						0.2331	0.2215	0.1293	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 and Stored	NO											
Long-term Storage of C in waste disposal sites	NO											
Indirect N_2O			**1.4356**									
Indirect CO_2	**112.0762**											

SOURCES OF GHG EMISSIONS	Net CO_2 Emissions/ sinks	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 sinks	**8572.0914**	**177.0158**	**6.2405**	**NO**	**NO**	**NO**	**NO**	**NO**	**58.4139**	**143.4696**	**67.2505**	**100.3805**
1. Energy	**14410.2040**	**26.9855**	**0.2222**						**56.8378**	**135.3988**	**24.0078**	**99.8703**
A. Fuel Combustion Reference Approach	14372.7899											
Sectoral Approach	14409.7955	3.1141	0.2222						56.8378	135.3988	23.5809	99.8703
1. Energy Industries	9935.3786	0.1885	0.0868						28.4710	2.8047	0.7002	82.3832
2. Manufacturing Industries and Construction	828.8950	0.0229	0.0031						2.2333	0.5059	0.0787	1.6222
3. Transport	1485.6786	0.4168	0.1052						14.3065	96.5881	18.2035	1.7173
4. Other Sectors	2086.3753	2.4789	0.0257						11.4859	34.3147	4.3774	13.5587
5. Other	73.4680	0.0070	0.0015						0.3411	1.1855	0.2211	0.5889
B. Fugitive Emissions from Fuels	0.4085	23.8714	0.0000						0.0000	0.0000	0.4269	0.0000
1. Solid Fuels	NO	NO	NO						NO	NO	NO	NO
2. Oil and Natural Gas	0.4085	23.8714	0.0000						0.0000	0.0000	0.4269	0.0000
C. CO_2 Transport and Storage	NO											
2. Industrial Processes and Product Use	**552.8842**	**NO**	**0.0001**	**NO**	**NO**	**NO**	**NO**	**NO**	**1.3435**	**2.8279**	**41.6403**	**0.5041**
A. Mineral Industry	441.6001								1.2292	1.1396	0.0115	0.4588
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	84.6033	NO	NO						0.0146	0.0820	32.7972	0.0073
E. Electronic Industry				NO	NO	NO	NO	NO				
F. Product Use 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**	**83.5725**	**5.5782**						**NO**	**NO**	**NE, NO**	
A. Enteric Fermentation		73.0171										
B. Manure Management		10.5554	2.6254								NO	
C. Rice Cultivation		NO										
D. Agricultural Soils			2.9528									
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											
J. Other	NO	NO	NO						NO	NO	NO	
4. LULUCF	**-6408.1835**	**0.0664**	**0.2046**						**0.0608**	**2.2344**	**NE**	
A. Forest Land	-2088.6098	0.0025	0.0001						0.0016	0.0568	NE	
B. Cropland	-1821.2418	0.0639	0.1908						0.0592	2.1776	NE	
C. Grassland	-3104.1950	NE	NE						NE	NE	NE	
D. Wetlands	NO	NE	NE						NE	NE	NE	
E. Settlements	130.4883	NE	0.0136						NE	NE	NE	
F. Other Land	541.0720	NE	NE						NE	NE	NE	

SOURCES OF GHG EMISSIONS	Net CO_2 Emissions/ sinks	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	-65.6972											
H. Other	NO	NO	NO						NO	NO	NO	
5. Waste	**17.1330**	**66.3913**	**0.2354**						**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	0.0081						0.1719	3.0085	0.0664	0.0060
D. Wastewater Treatment and Discharge		17.6476	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	37.8235	0.0058	0.0012						0.1433	0.1323	0.0766	0.0120
Aviation	37.8235	0.0058	0.0012						0.1433	0.1323	0.0766	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 and Stored	NO											
Long-term Storage of C in waste disposal sites	NO											
Indirect N_2O			**1.1585**									
Indirect CO_2	**73.5058**											

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SOURCES OF GHG EMISSIONS	Net CO_2 Emissions/ sinks	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 sinks	**5037.3423**	**166.7797**	**6.5648**	**4.5879**	**NO**	**NO**	**NO**	**NO**	**49.4809**	**142.9825**	**66.0356**	**59.5089**
1. Energy	**11122.6101**	**28.3907**	**0.1782**						**48.0824**	**134.3789**	**24.3552**	**59.0498**
A. Fuel Combustion Reference Approach	11081.1763											
Sectoral Approach	11122.1908	1.9351	0.1782						48.0824	134.3789	23.8791	59.0498
1. Energy Industries	6886.3081	0.1319	0.0496						19.4094	2.0544	0.5132	45.8616
2. Manufacturing Industries and Construction	463.9562	0.0155	0.0022						1.2541	0.3118	0.0458	1.1823
3. Transport	1482.0856	0.4276	0.1012						14.1154	100.4237	18.9204	1.6675
4. Other Sectors	2172.1646	1.3501	0.0230						12.8308	30.2159	4.1462	8.7335
5. Other	117.6762	0.0100	0.0021						0.4726	1.3732	0.2535	1.6050
B. Fugitive Emissions from Fuels	0.4194	26.4555	0.0000						0.0000	0.0000	0.4761	0.0000
1. Solid Fuels	NO	NO	NO						NO	NO	NO	NO
2. Oil and Natural Gas	0.4194	26.4555	0.0000						0.0000	0.0000	0.4761	0.0000
C. CO_2 Transport and Storage	NO											
2. Industrial Processes and Product Use	**448.9341**	**NO**	**0.0000**	**4.5879**	**NO**	**NO**	**NO**	**NO**	**1.1438**	**2.5468**	**40.2086**	**0.4530**
A. Mineral Industry	345.1199								1.0299	0.8868	0.0089	0.4070
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

SOURCES OF GHG EMISSIONS	Net CO_2 Emissions/ sinks	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	76.4826	NO	NO						0.0132	0.0740	29.2180	0.0065
E. Electronic Industry				NO	NO	NO	NO	NO				
F. Product Use as Substitutes for ODS				4.5879	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**	**73.0154**	**5.9233**						**NO**	**NO**	**NE, NO**	
A. Enteric Fermentation		64.8267										
B. Manure Management		8.1887	2.4251								NO	
C. Rice Cultivation		NO										
D. Agricultural Soils			3.4982									
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											
J. Other	NO	NO	NO						NO	NO	NO	
4. LULUCF	**-6551.3841**	**0.0896**	**0.2251**						**0.0829**	**3.0513**	**NE**	
A. Forest Land	-2025.7694	0.0001	0.0000						0.0001	0.0033	NE	
B. Cropland	-1919.9573	0.0895	0.2119						0.0828	3.0480	NE	
C. Grassland	-3088.4744	NE	NE						NE	NE	NE	
D. Wetlands	NO	NE	NE						NE	NE	NE	
E. Settlements	106.9167	NE	0.0133						NE	NE	NE	
F. Other Land	392.7422	NE	NE						NE	NE	NE	
G. Harvested Wood Products	-16.8419											
H. Other	NO	NO	NO						NO	NO	NO	
5. Waste	**17.1216**	**65.2840**	**0.2382**						**0.1717**	**3.0055**	**1.4718**	**0.0060**
A. Solid Waste Disposal	NA, NO	48.3674							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	0.0081						0.1717	3.0055	0.0664	0.0060
D. Wastewater Treatment and Discharge		16.5652	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	230.0502											
CO_2 Captured and Stored	NO											
Long-term Storage of C in waste disposal sites	NO											
Indirect N_2O			**1.2001**									
Indirect CO_2	**65.3743**											

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SOURCES OF GHG EMISSIONS	Net CO_2 Emissions/ sinks	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 sinks	**5471.7141**	**163.8067**	**6.4228**	**5.1847**	**NO**	**NO**	**NO**	**NO**	**47.1636**	**143.3115**	**62.3036**	**58.3896**
1. Energy	**11342.9211**	**31.7196**	**0.1771**						**45.9385**	**135.5848**	**23.9485**	**58.0004**
A. Fuel Combustion Reference Approach	11277.9972											
Sectoral Approach	11342.4485	2.9641	0.1771						45.9385	135.5848	23.4325	58.0004
1. Energy Industries	7155.3361	0.1358	0.0477						20.0704	2.1843	0.5442	42.6638
2. Manufacturing Industries and Construction	377.6208	0.0138	0.0020						1.0218	0.2688	0.0383	1.2844
3. Transport	1451.6525	0.4125	0.0972						13.5802	95.3461	17.9605	1.5915
4. Other Sectors	2274.8811	2.3910	0.0279						10.8341	36.2020	4.6049	11.4920
5. Other	82.9580	0.0110	0.0023						0.4319	1.5836	0.2846	0.9687
B. Fugitive Emissions from Fuels	0.4726	28.7555	0.0000						0.0000	0.0000	0.5160	0.0000
1. Solid Fuels	NO	NO	NO						NO	NO	NO	NO
2. Oil and Natural Gas	0.4726	28.7555	0.0000						0.0000	0.0000	0.5160	0.0000
C. CO_2 Transport and Storage	NO											
2. Industrial Processes and Product Use	**407.6878**	**NO**	**0.0000**	**5.1847**	**NO**	**NO**	**NO**	**NO**	**0.9967**	**2.6314**	**36.9171**	**0.3831**
A. Mineral Industry	308.9247								0.8768	0.7855	0.0069	0.3371
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	70.9984	NO	NO						0.0119	0.0671	27.0276	0.0059
E. Electronic Industry				NO	NO	NO	NO	NO				
F. Product Use as Substitutes for ODS				5.1847	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**	**67.1143**	**5.7817**						**NO**	**NO**	**NE, NO**	
A. Enteric Fermentation		59.6473										
B. Manure Management		7.4670	2.5789								NO	
C. Rice Cultivation		NO										
D. Agricultural Soils			3.2028									
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											
J. Other	NO	NO	NO						NO	NO	NO	
4. LULUCF	**-6296.0942**	**0.0617**	**0.2293**						**0.0569**	**2.0930**	**NE**	
A. Forest Land	-2171.1779	0.0008	0.0000						0.0005	0.0190	NE	
B. Cropland	-1535.5834	0.0609	0.2166						0.0564	2.0740	NE	
C. Grassland	-2903.6947	NE	NE						NE	NE	NE	
D. Wetlands	NO	NE	NE						NE	NE	NE	
E. Settlements	101.5910	NE	0.0126						NE	NE	NE	
F. Other Land	208.9434	NE	NE						NE	NE	NE	

SOURCES OF GHG EMISSIONS	Net CO_2 Emissions/ sinks	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	3.8273											
H. Other	NO	NO	NO						NO	NO	NO	
5. Waste	**17.1083**	**64.9110**	**0.2347**						**0.1716**	**3.0022**	**1.4379**	**0.0060**
A. Solid Waste Disposal	NA, NO	48.6714							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	0.0081						0.1716	3.0022	0.0663	0.0060
D. Wastewater Treatment and Discharge		15.8885	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	295.4440											
CO_2 Captured and Stored	NO											
Long-term Storage of C in waste disposal sites	NO											
Indirect N_2O			**1.1754**									
Indirect CO_2	**60.4993**											

1997

SOURCES OF GHG EMISSIONS	Net CO_2 Emissions/ sinks	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 sinks	**4563.4052**	**148.8324**	**6.4561**	**5.9997**	**NO**	**NO**	**NO**	**NO**	**43.7539**	**153.3698**	**49.5601**	**33.5716**
1. Energy	**10252.1997**	**26.0228**	**0.1506**						**42.2769**	**143.7241**	**25.2623**	**33.1004**
A. Fuel Combustion Reference Approach	10177.7235											
Sectoral Approach	10251.7346	2.3800	0.1506						42.2769	143.7241	25.2623	33.1004
1. Energy Industries	5615.5061	0.1108	0.0244						15.3208	1.8464	0.4607	21.3361
2. Manufacturing Industries and Construction	597.7916	0.0202	0.0027						1.6209	0.8510	0.0631	1.0385
3. Transport	1469.7744	0.4563	0.0966						14.0262	108.1520	20.3626	1.6281
4. Other Sectors	2496.0098	1.7851	0.0249						10.9306	31.6363	4.1483	8.3265
5. Other	72.6527	0.0077	0.0019						0.3784	1.2383	0.2275	0.7711
B. Fugitive Emissions from Fuels	0.4651	23.6428	0.0000						0.0000	0.0000	0.0000	0.0000
1. Solid Fuels	NO	NO	NO						NO	NO	NO	NO
2. Oil and Natural Gas	0.4651	23.6428	0.0000						0.0000	0.0000	0.0000	0.0000
C. CO_2 Transport and Storage	NO											
2. Industrial Processes and Product Use	**449.0073**	**NO**	**0.0000**	**5.9997**	**NO**	**NO**	**NO**	**NO**	**1.2065**	**2.9916**	**22.9531**	**0.4652**
A. Mineral Industry	373.6804								1.0765	0.9626	0.0096	0.4145
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

SOURCES OF GHG EMISSIONS	Net CO_2 Emissions/ sinks	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	42.0075	NO	NO						0.0040	0.0227	14.1331	0.0020
E. Electronic Industry				NO	NO	NO	NO	NO				
F. Product Use as Substitutes for ODS				5.9997	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**	**57.4675**	**5.8498**						**NO**	**NO**	**NE, NO**	
A. Enteric Fermentation		51.4038										
B. Manure Management		6.0636	1.9891								NO	
C. Rice Cultivation		NO										
D. Agricultural Soils			3.8607									
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											
J. Other	NO	NO	NO						NO	NO	NO	
4. LULUCF	**-6155.9621**	**0.1075**	**0.2169**						**0.0995**	**3.6614**	**NE**	
A. Forest Land	-2213.0439	0.0003	0.0000						0.0002	0.0058	NE	
B. Cropland	-1451.2728	0.1073	0.2046						0.0993	3.6556	NE	
C. Grassland	-2771.9741	NE	NE						NE	NE	NE	
D. Wetlands	NO	NE	NE						NE	NE	NE	
E. Settlements	100.7954	NE	0.0123						NE	NE	NE	
F. Other Land	179.8504	NE	NE						NE	NE	NE	
G. Harvested Wood Products	-0.3171											
H. Other	NO	NO	NO						NO	NO	NO	
5. Waste	**17.0610**	**65.2346**	**0.2388**						**0.1711**	**2.9928**	**1.3447**	**0.0060**
A. Solid Waste Disposal	NA, NO	48.1514							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	0.0081						0.1711	2.9928	0.0661	0.0060
D. Wastewater Treatment and Discharge		16.7331	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	291.0280											
CO_2 Captured and Stored	NO											
Long-term Storage of C in waste disposal sites	NO											
Indirect N_2O			**1.1696**									
Indirect CO_2	**32.0316**											

SOURCES OF GHG EMISSIONS	Net CO_2 Emissions/ sinks	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 sinks	**2974.0273**	**141.4092**	**5.8657**	**7.4843**	**NO**	**NO**	**NO**	**NO**	**36.6451**	**129.5811**	**43.5191**	**26.3976**
1. Energy	**8794.4337**	**23.8261**	**0.1238**						**35.3240**	**120.7329**	**21.6983**	**25.9626**
A. Fuel Combustion Reference Approach	8723.0790											
Sectoral Approach	8794.0063	1.7011	0.1238						35.3240	120.7329	21.3067	25.9626
1. Energy Industries	4848.6438	0.0963	0.0192						13.1565	1.5895	0.4013	17.1551
2. Manufacturing Industries and Construction	559.0312	0.0160	0.0021						1.5075	0.5420	0.0551	0.9557
3. Transport	1273.6172	0.3898	0.0803						12.0909	92.0086	17.3252	1.4198
4. Other Sectors	2056.9647	1.1913	0.0204						8.2332	25.3604	3.3031	6.0518
5. Other	55.7495	0.0077	0.0018						0.3359	1.2324	0.2221	0.3803
B. Fugitive Emissions from Fuels	0.4274	22.1250	0.0000						0.0000	0.0000	0.3916	0.0000
1. Solid Fuels	NO	NO	NO						NO	NO	NO	NO
2. Oil and Natural Gas	0.4274	22.1250	0.0000						0.0000	0.0000	0.3916	0.0000
C. CO_2 Transport and Storage	NO											
2. Industrial Processes and Product Use	**373.4402**	**NO**	**0.0000**	**7.4843**	**NO**	**NO**	**NO**	**NO**	**1.0595**	**2.5186**	**20.4827**	**0.4289**
A. Mineral Industry	306.5335								0.9467	0.7826	0.0078	0.3842
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	37.5225	NO	NO						0.0033	0.0185	13.2383	0.0016
E. Electronic Industry				NO	NO	NO	NO	NO				
F. Product Use as Substitutes for ODS				7.4843	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**	**54.9812**	**5.2750**						**NO**	**NO**	**NE, NO**	
A. Enteric Fermentation		49.9020										
B. Manure Management		5.0792	1.9212								NO	
C. Rice Cultivation		NO										
D. Agricultural Soils			3.3538									
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											
J. Other	NO	NO	NO						NO	NO	NO	
4. LULUCF	**-6211.1275**	**0.0991**	**0.2258**						**0.0910**	**3.3472**	**NE**	
A. Forest Land	-2269.2309	0.0025	0.0001						0.0016	0.0571	NE	
B. Cropland	-1348.2104	0.0966	0.2133						0.0894	3.2900	NE	
C. Grassland	-2848.0605	NE	NE						NE	NE	NE	
D. Wetlands	NO	NE	NE						NE	NE	NE	
E. Settlements	99.0440	NE	0.0123						NE	NE	NE	
F. Other Land	176.6218	NE	NE						NE	NE	NE	

SOURCES OF GHG EMISSIONS	Net CO_2 Emissions/ sinks	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	-21.2914											
H. Other	NO	NO	NO						NO	NO	NO	
5. Waste	**17.0087**	**62.5029**	**0.2412**						**0.1705**	**2.9824**	**1.3381**	**0.0060**
A. Solid Waste Disposal	NA, NO	47.5737							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	17.0087	0.3490	0.0081						0.1705	2.9824	0.0659	0.0060
D. Wastewater Treatment and Discharge		14.5801	0.2331						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 and Stored	NO											
Long-term Storage of C in waste disposal sites	NO											
Indirect N_2O			**1.0420**									
Indirect CO_2	**29.8264**											

1999

SOURCES OF GHG EMISSIONS	Net CO_2 Emissions/ sinks	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 sinks	**1017.6408**	**135.7572**	**5.3377**	**8.5714**	**NO**	**NO**	**NO**	**NO**	**26.8247**	**88.6995**	**31.4470**	**13.4319**
1. Energy	**6849.6505**	**23.9519**	**0.0807**						**25.6213**	**79.8417**	**14.1048**	**13.0512**
A. Fuel Combustion Reference Approach	6778.3302											
Sectoral Approach	6849.2574	1.5474	0.0807						25.6213	79.8417	13.7041	13.0512
1. Energy Industries	3660.4440	0.0727	0.0088						9.7716	1.2800	0.3193	6.1391
2. Manufacturing Industries and Construction	491.5201	0.0132	0.0016						1.3246	0.5065	0.0485	0.4945
3. Transport	854.3647	0.2341	0.0506						8.0351	54.8341	10.3380	1.0022
4. Other Sectors	1798.5838	1.2211	0.0182						6.2210	22.3344	2.8415	5.0117
5. Other	44.3448	0.0063	0.0015						0.2691	0.8867	0.1568	0.4037
B. Fugitive Emissions from Fuels	0.3931	22.4045	0.0000						0.0000	0.0000	0.4007	0.0000
1. Solid Fuels	NO	NO	NO						NO	NO	NO	NO
2. Oil and Natural Gas	0.3931	22.4045	0.0000						0.0000	0.0000	0.4007	0.0000
C. CO_2 Transport and Storage	NO											
2. Industrial Processes and Product Use	**336.6304**	**NO**	**0.0000**	**8.5714**	**NO**	**NO**	**NO**	**NO**	**0.9452**	**2.6426**	**16.1302**	**0.3746**
A. Mineral Industry	272.6662								0.8205	0.6987	0.0075	0.3257
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

SOURCES OF GHG EMISSIONS	Net CO_2 Emissions/ sinks	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	31.5638	NO	NO						0.0024	0.0132	11.5886	0.0012
E. Electronic Industry				NO	NO	NO	NO	NO				
F. Product Use as Substitutes for ODS				8.5714	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**	**50.6255**	**4.7770**						**NO**	**NO**	**NE, NO**	
A. Enteric Fermentation		46.1688										
B. Manure Management		4.4567	1.7380								NO	
C. Rice Cultivation		NO										
D. Agricultural Soils			3.0390									
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											
J. Other	NO	NO	NO						NO	NO	NO	
4. LULUCF	**-6185.6213**	**0.0957**	**0.2388**						**0.0881**	**3.2394**	**NE**	
A. Forest Land	-2317.6962	0.0019	0.0001						0.0012	0.0427	NE	
B. Cropland	-1413.2991	0.0938	0.2272						0.0869	3.1967	NE	
C. Grassland	-2972.0904	NE	NE						NE	NE	NE	
D. Wetlands	NO	NE	NE						NE	NE	NE	
E. Settlements	111.8259	NE	0.0115						NE	NE	NE	
F. Other Land	416.7695	NE	NE						NE	NE	NE	
G. Harvested Wood Products	-11.1310											
H. Other	NO	NO	NO						NO	NO	NO	
5. Waste	**16.9778**	**61.0841**	**0.2411**						**0.1702**	**2.9758**	**1.2120**	**0.0060**
A. Solid Waste Disposal	NA, NO	47.8085							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	16.9778	0.3483	0.0080						0.1702	2.9758	0.0658	0.0060
D. Wastewater Treatment and Discharge		12.9273	0.2331						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 and Stored	NO											
Long-term Storage of C in waste disposal sites	NO											
Indirect N_2O			**0.9359**									
Indirect CO_2	**26.1011**											

2000

SOURCES OF GHG EMISSIONS	Net CO_2 Emissions/ sinks	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 sinks	**319.9055**	**132.8740**	**5.0286**	**10.4630**	**NO**	**NO**	**NO**	**NO**	**25.2402**	**85.5869**	**31.0555**	**9.5508**
1. Energy	**6124.4101**	**25.5546**	**0.0823**						**23.9680**	**78.6297**	**14.0072**	**9.0536**
A. Fuel Combustion Reference Approach	6059.2745											
Sectoral Approach	6124.0342	1.5292	0.0823						23.9680	78.6297	13.5732	9.0536
1. Energy Industries	3155.7517	0.0610	0.0069						8.4378	1.1590	0.2803	2.7544
2. Manufacturing Industries and Construction	537.2463	0.0123	0.0015						1.4419	0.2952	0.0496	0.4796
3. Transport	926.2051	0.2370	0.0561						8.9744	55.6587	10.5079	1.1795
4. Other Sectors	1478.8536	1.2154	0.0171						4.9689	20.8854	2.6198	4.4697
5. Other	25.9774	0.0036	0.0008						0.1449	0.6314	0.1156	0.1704
B. Fugitive Emissions from Fuels	0.3759	24.0254	0.0000						0.0000	0.0000	0.4341	0.0000
1. Solid Fuels	NO	NO	NO						NO	NO	NO	NO
2. Oil and Natural Gas	0.3759	24.0254	0.0000						0.0000	0.0000	0.4341	0.0000
C. CO_2 Transport and Storage	NO											
2. Industrial Processes and Product Use	**308.5696**	**NO**	**0.0000**	**10.4630**	**NO**	**NO**	**NO**	**NO**	**1.0686**	**2.7459**	**15.8398**	**0.4912**
A. Mineral Industry	240.0428								0.9286	0.5791	0.0067	0.4358
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	31.3591	NO	NO						0.0019	0.0107	11.6111	0.0009
E. Electronic Industry				NO	NO	NO	NO	NO				
F. Product Use as Substitutes for ODS				10.4630	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**	**46.8112**	**4.4614**						**NO**	**NO**	**NE, NO**	
A. Enteric Fermentation		43.4275										
B. Manure Management		3.3837	1.5597								NO	
C. Rice Cultivation		NO										
D. Agricultural Soils			2.9017									
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											
J. Other	NO	NO	NO						NO	NO	NO	
4. LULUCF	**-6130.4573**	**0.0365**	**0.2434**						**0.0338**	**1.2428**	**NE**	
A. Forest Land	-2288.3306	0.0001	0.0000						0.0000	0.0015	NE	
B. Cropland	-1284.6926	0.0364	0.2340						0.0337	1.2413	NE	
C. Grassland	-2844.3351	NE	NE						NE	NE	NE	
D. Wetlands	NO	NE	NE						NE	NE	NE	
E. Settlements	100.1768	NE	0.0094						NE	NE	NE	
F. Other Land	170.1387	NE	NE						NE	NE	NE	

SOURCES OF GHG EMISSIONS	Net CO_2 Emissions/ sinks	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	16.5854											
H. Other	NO	NO	NO						NO	NO	NO	
5. Waste	**16.9434**	**60.4717**	**0.2415**						**0.1698**	**2.9685**	**1.2085**	**0.0060**
A. Solid Waste Disposal	NA, NO	46.7803							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	16.9434	0.3476	0.0080						0.1698	2.9685	0.0656	0.0060
D. Wastewater Treatment and Discharge		13.3438	0.2334						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 and Stored	NO											
Long-term Storage of C in waste disposal sites	NO											
Indirect N_2O			**0.8680**									
Indirect CO_2	**26.4431**											

2001

SOURCES OF GHG EMISSIONS	Net CO_2 Emissions/ sinks	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 sinks	**1183.6537**	**132.9496**	**5.5809**	**12.8513**	**NO**	**NO**	**NO**	**NO**	**27.5266**	**89.1888**	**33.2102**	**9.1867**
1. Energy	**6731.0024**	**25.2265**	**0.0885**						**26.2808**	**81.6619**	**14.6544**	**8.7167**
A. Fuel Combustion Reference Approach	6670.0891											
Sectoral Approach	6730.5931	1.4057	0.0885						26.2808	81.6619	14.2266	8.7167
1. Energy Industries	3677.7189	0.0726	0.0080						9.8425	1.4358	0.3317	2.5279
2. Manufacturing Industries and Construction	618.7855	0.0150	0.0020						1.6750	0.3269	0.0567	0.6265
3. Transport	989.3629	0.2515	0.0611						9.7695	59.3163	11.2030	1.2904
4. Other Sectors	1416.7615	1.0618	0.0163						4.8004	19.8497	2.5041	4.0549
5. Other	27.9644	0.0047	0.0012						0.1934	0.7332	0.1312	0.2170
B. Fugitive Emissions from Fuels	0.4092	23.8208	0.0000						0.0000	0.0000	0.4278	0.0000
1. Solid Fuels	NO	NO	NO						NO	NO	NO	NO
2. Oil and Natural Gas	0.4092	23.8208	0.0000						0.0000	0.0000	0.4278	0.0000
C. CO_2 Transport and Storage	NO											
2. Industrial Processes and Product Use	**311.3929**	**NO**	**0.0000**	**12.8513**	**NO**	**NO**	**NO**	**NO**	**1.0294**	**2.8564**	**17.4602**	**0.4640**
A. Mineral Industry	237.3637								0.8809	0.5760	0.0066	0.4048
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

SOURCES OF GHG EMISSIONS	Net CO_2 Emissions/ sinks	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	34.6288	NO	NO						0.0024	0.0134	12.8531	0.0012
E. Electronic Industry				NO	NO	NO	NO	NO				
F. Product Use as Substitutes for ODS				12.8513	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**	**47.6273**	**4.9731**						**NO**	**NO**	**NE, NO**	
A. Enteric Fermentation		44.2135										
B. Manure Management		3.4138	1.5863								NO	
C. Rice Cultivation		NO										
D. Agricultural Soils			3.3868									
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											
J. Other	NO	NO	NO						NO	NO	NO	
4. LULUCF	**-5875.8873**	**0.0511**	**0.2744**						**0.0461**	**1.6939**	**NE**	
A. Forest Land	-2254.6081	0.0042	0.0002						0.0027	0.0967	NE	
B. Cropland	-1106.4081	0.0469	0.2659						0.0434	1.5972	NE	
C. Grassland	-2755.9956	NE	NE						NE	NE	NE	
D. Wetlands	NO	NE	NE						NE	NE	NE	
E. Settlements	67.0898	NE	0.0083						NE	NE	NE	
F. Other Land	170.1387	NE	NE						NE	NE	NE	
G. Harvested Wood Products	3.8960											
H. Other	NO	NO	NO						NO	NO	NO	
5. Waste	**16.9961**	**60.0447**	**0.2448**						**0.1703**	**2.9765**	**1.0955**	**0.0060**
A. Solid Waste Disposal	NA, NO	45.4984							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	16.9961	0.3486	0.0080						0.1703	2.9765	0.0658	0.0060
D. Wastewater Treatment and Discharge		14.1977	0.2368						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 and Stored	NO											
Long-term Storage of C in waste disposal sites	NO											
Indirect N_2O			**0.9657**									
Indirect CO_2	**29.0498**											

2002

SOURCES OF GHG EMISSIONS	Net CO_2 Emissions/ sinks	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 sinks	**1832.4957**	**134.7342**	**5.7628**	**16.8928**	**NO**	**NO**	**NO**	**NO**	**28.7971**	**108.1723**	**38.5332**	**10.3037**
1. Energy	**6405.6634**	**27.6567**	**0.1182**						**27.4453**	**102.8280**	**18.3764**	**9.7717**
A. Fuel Combustion Reference Approach	6344.6150											
Sectoral Approach	6405.2733	1.7743	0.1182						27.4453	102.8280	17.9066	9.7717
1. Energy Industries	2933.2101	0.0614	0.0069						7.8618	1.2633	0.2704	1.9697
2. Manufacturing Industries and Construction	431.7808	0.0103	0.0013						1.1589	0.2403	0.0403	0.4309
3. Transport	1261.6952	0.3243	0.0892						12.5249	76.6112	14.4651	1.6186
4. Other Sectors	1743.4526	1.3701	0.0193						5.6854	23.6946	2.9582	5.4030
5. Other	35.1345	0.0081	0.0015						0.2143	1.0185	0.1726	0.3494
B. Fugitive Emissions from Fuels	0.3901	25.8825	0.0000						0.0000	0.0000	0.4697	0.0000
1. Solid Fuels	NO	NO	NO						NO	NO	NO	NO
2. Oil and Natural Gas	0.3901	25.8825	0.0000						0.0000	0.0000	0.4697	0.0000
C. CO_2 Transport and Storage	NO											
2. Industrial Processes and Product Use	**360.0955**	**NO**	**0.0000**	**16.8928**	**NO**	**NO**	**NO**	**NO**	**1.1728**	**2.0366**	**19.0027**	**0.5261**
A. Mineral Industry	302.8397								1.0903	0.7351	0.0083	0.4942
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	36.0221	NO	NO						0.0021	0.0117	13.7991	0.0010
E. Electronic Industry				NO	NO	NO	NO	NO				
F. Product Use as Substitutes for ODS				16.8928	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**	**48.7256**	**5.1150**						**NO**	**NO**	**NE, NO**	
A. Enteric Fermentation		45.1458										
B. Manure Management		3.5798	1.6001								NO	
C. Rice Cultivation		NO										
D. Agricultural Soils			3.5149									
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											
J. Other	NO	NO	NO						NO	NO	NO	
4. LULUCF	**-4950.2508**	**0.0108**	**0.2786**						**0.0093**	**0.3423**	**NE**	
A. Forest Land	-2248.5141	0.0023	0.0001						0.0015	0.0519	NE	
B. Cropland	-696.2856	0.0085	0.2701						0.0079	0.2904	NE	
C. Grassland	-2512.2749	NE	NE						NE	NE	NE	
D. Wetlands	NO	NE	NE						NE	NE	NE	
E. Settlements	67.0898	NE	0.0083						NE	NE	NE	
F. Other Land	447.8610	NE	NE						NE	NE	NE	

SOURCES OF GHG EMISSIONS	Net CO_2 Emissions/ sinks	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	-8.1271											
H. Other	NO	NO	NO						NO	NO	NO	
5. Waste	**16.9406**	**58.3411**	**0.2510**						**0.1697**	**2.9653**	**1.1541**	**0.0060**
A. Solid Waste Disposal	NA, NO	44.3221							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	16.9406	0.3474	0.0080						0.1697	2.9653	0.0656	0.0060
D. Wastewater Treatment and Discharge		13.6716	0.2429						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	324.9000											
CO_2 Captured and Stored	NO											
Long-term Storage of C in waste disposal sites	NO											
Indirect N_2O			**1.0006**									
Indirect CO_2	**31.0887**											

2003

SOURCES OF GHG EMISSIONS	Net CO_2 Emissions/ sinks	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 sinks	**2473.1835**	**131.7616**	**5.0466**	**23.6694**	**NO**	**NO**	**0.0000**	**NO**	**31.1703**	**128.8276**	**43.1876**	**12.3242**
1. Energy	**7080.9417**	**29.3214**	**0.1209**						**29.7886**	**123.0619**	**21.7330**	**11.7861**
A. Fuel Combustion Reference Approach	7011.3606											
Sectoral Approach	7079.8825	2.2629	0.1209						29.7886	123.0619	21.1947	11.7861
1. Energy Industries	3036.7432	0.0626	0.0069						8.1426	1.3033	0.2802	1.4374
2. Manufacturing Industries and Construction	456.6402	0.0103	0.0013						1.2246	0.2474	0.0418	0.4519
3. Transport	1477.1916	0.3811	0.0873						14.4970	90.8456	17.1547	1.9169
4. Other Sectors	2082.5048	1.8054	0.0246						5.7822	30.2158	3.6405	7.7279
5. Other	26.8027	0.0036	0.0008						0.1422	0.4499	0.0775	0.2519
B. Fugitive Emissions from Fuels	1.0592	27.0585	0.0000						0.0000	0.0000	0.5383	0.0000
1. Solid Fuels	NO	NO	NO						NO	NO	NO	NO
2. Oil and Natural Gas	1.0592	27.0585	0.0000						0.0000	0.0000	0.5383	0.0000
C. CO_2 Transport and Storage	NO											
2. Industrial Processes and Product Use	**388.2276**	**NO**	**0.0000**	**23.6694**	**NO**	**NO**	**0.0000**	**NO**	**1.2110**	**2.7524**	**20.1475**	**0.5321**
A. Mineral Industry	311.0548								1.0778	0.7592	0.0091	0.4777
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

SOURCES OF GHG EMISSIONS	Net CO_2 Emissions/ sinks	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	40.8564	NO	NO						0.0026	0.0145	14.8566	0.0013
E. Electronic Industry				NO	NO	NO	NO	NO				
F. Product Use as Substitutes for ODS				23.6694	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**	**44.5785**	**4.3955**						**NO**	**NO**	**NE, NO**	
A. Enteric Fermentation		41.2451										
B. Manure Management		3.3334	1.5214								NO	
C. Rice Cultivation		NO										
D. Agricultural Soils			2.8741									
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											
J. Other	NO	NO	NO						NO	NO	NO	
4. LULUCF	**-5013.0963**	**0.0026**	**0.2876**						**0.0017**	**0.0614**	**NE**	
A. Forest Land	-2250.9181	0.0025	0.0001						0.0016	0.0568	NE	
B. Cropland	-646.0039	0.0001	0.2801						0.0001	0.0046	NE	
C. Grassland	-2277.6455	NE	NE						NE	NE	NE	
D. Wetlands	NO	NE	NE						NE	NE	NE	
E. Settlements	67.8615	NE	0.0073						NE	NE	NE	
F. Other Land	152.1220	NE	NE						NE	NE	NE	
G. Harvested Wood Products	-58.5123											
H. Other	NO	NO	NO						NO	NO	NO	
5. Waste	**16.8724**	**57.8591**	**0.2426**						**0.1689**	**2.9519**	**1.3071**	**0.0060**
A. Solid Waste Disposal	NA, NO	42.8091							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	16.8724	0.3460	0.0080						0.1689	2.9519	0.0653	0.0060
D. Wastewater Treatment and Discharge		14.7040	0.2346						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 and Stored	NO											
Long-term Storage of C in waste disposal sites	NO											
Indirect N_2O			**0.8625**									
Indirect CO_2	**33.5726**											

2004

SOURCES OF GHG EMISSIONS	Net CO_2 Emissions/ sinks	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 sinks	**4046.3301**	**130.4966**	**5.8631**	**31.0742**	**NO**	**NO**	**0.0000**	**NO**	**33.2717**	**131.3437**	**56.0942**	**11.1911**
1. Energy	**7540.7092**	**31.3414**	**0.1324**						**31.7397**	**125.1157**	**22.8140**	**10.5951**
A. Fuel Combustion Reference Approach	7473.8274											
Sectoral Approach	7539.6047	1.9716	0.1324						31.7397	125.1157	21.9447	10.5951
1. Energy Industries	3107.0816	0.0639	0.0071						8.3336	1.3408	0.2872	1.2771
2. Manufacturing Industries and Construction	471.0767	0.0127	0.0016						1.2718	0.3512	0.0458	0.6201
3. Transport	1668.7316	0.4094	0.1017						16.4341	97.7586	18.4736	2.1947
4. Other Sectors	2258.9904	1.4822	0.0210						5.4797	25.1063	3.0344	6.3768
5. Other	33.7244	0.0034	0.0011						0.2205	0.5588	0.1037	0.1264
B. Fugitive Emissions from Fuels	1.1045	29.3699	0.0000						0.0000	0.0000	0.8693	0.0000
1. Solid Fuels	NO	NO	NO						NO	NO	NO	NO
2. Oil and Natural Gas	1.1045	29.3699	0.0000						0.0000	0.0000	0.8693	0.0000
C. CO_2 Transport and Storage	NO											
2. Industrial Processes and Product Use	**458.6192**	**NO**	**0.0001**	**31.0742**	**NO**	**NO**	**0.0000**	**NO**	**1.3599**	**3.1110**	**31.8863**	**0.5901**
A. Mineral Industry	353.3699								1.2047	0.8754	0.0104	0.5252
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	63.7753	NO	NO						0.0082	0.0459	25.2292	0.0041
E. Electronic Industry				NO	NO	NO	NO	NO				
F. Product Use as Substitutes for ODS				31.0742	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**	**41.7331**	**5.1959**						**NO**	**NO**	**NE, NO**	
A. Enteric Fermentation		38.4913										
B. Manure Management		3.2418	1.4730								NO	
C. Rice Cultivation		NO										
D. Agricultural Soils			3.7229									
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											
J. Other	NO	NO	NO						NO	NO	NO	
4. LULUCF	**-3969.9582**	**0.0085**	**0.2856**						**0.0060**	**0.2160**	**NE**	
A. Forest Land	-2315.5844	0.0066	0.0004						0.0042	0.1492	NE	
B. Cropland	524.5167	0.0020	0.2785						0.0018	0.0668	NE	
C. Grassland	-2316.5028	NE	NE						NE	NE	NE	
D. Wetlands	NO	NE	NE						NE	NE	NE	
E. Settlements	53.6737	NE	0.0067						NE	NE	NE	
F. Other Land	150.8347	NE	NE						NE	NE	NE	

SOURCES OF GHG EMISSIONS	Net CO_2 Emissions/ sinks	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	-66.8962											
H. Other	NO	NO	NO						NO	NO	NO	
5. Waste	**16.5930**	**57.4136**	**0.2491**						**0.1661**	**2.9010**	**1.3939**	**0.0059**
A. Solid Waste Disposal	NA, NO	42.2062							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	16.5930	0.3402	0.0078						0.1661	2.9010	0.0642	0.0059
D. Wastewater Treatment and Discharge		14.8673	0.2413						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 and Stored	NO											
Long-term Storage of C in waste disposal sites	NO											
Indirect N_2O			**1.0118**									
Indirect CO_2	**56.4699**											

2005

SOURCES OF GHG EMISSIONS	Net CO_2 Emissions/ sinks	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 sinks	**3544.7338**	**132.1289**	**5.9046**	**42.1522**	**NO**	**NO**	**0.0000**	**NO**	**34.5186**	**133.8851**	**59.3127**	**10.9459**
1. Energy	**7811.9510**	**33.0891**	**0.1428**						**32.7063**	**127.2978**	**23.1601**	**10.2432**
A. Fuel Combustion Reference Approach	7744.7258											
Sectoral Approach	7810.8291	2.0717	0.1428						32.7063	127.2978	22.3811	10.2432
1. Energy Industries	3229.4503	0.0660	0.0072						8.6604	1.3853	0.2983	1.1727
2. Manufacturing Industries and Construction	603.9661	0.0145	0.0018						1.6266	0.3974	0.0569	0.5378
3. Transport	1723.9901	0.4222	0.1122						17.1134	100.5947	19.0104	2.2795
4. Other Sectors	2218.7801	1.5662	0.0206						5.0944	24.5675	2.9510	6.1272
5. Other	34.6426	0.0028	0.0010						0.2115	0.3529	0.0646	0.1261
B. Fugitive Emissions from Fuels	1.1219	31.0174	0.0000						0.0000	0.0000	0.7790	0.0000
1. Solid Fuels	NO	NO	NO						NO	NO	NO	NO
2. Oil and Natural Gas	1.1219	31.0174	0.0000						0.0000	0.0000	0.7790	0.0000
C. CO_2 Transport and Storage	NO											
2. Industrial Processes and Product Use	**556.3237**	**NO**	**0.0001**	**42.1522**	**NO**	**NO**	**0.0000**	**NO**	**1.6376**	**3.3632**	**34.6011**	**0.6968**
A. Mineral Industry	444.8424								1.4802	1.1266	0.0133	0.6300
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

SOURCES OF GHG EMISSIONS	Net CO_2 Emissions/ sinks	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	68.4829	NO	NO						0.0077	0.0431	27.3110	0.0038
E. Electronic Industry				NO	NO	NO	NO	NO				
F. Product Use as Substitutes for ODS				42.1522	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**	**40.5015**	**5.2477**						**NO**	**NO**	**NE, NO**	
A. Enteric Fermentation		37.0747										
B. Manure Management		3.4267	1.5707								NO	
C. Rice Cultivation		NO										
D. Agricultural Soils			3.6770									
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											
J. Other	NO	NO	NO						NO	NO	NO	
4. LULUCF	**-4840.2625**	**0.0100**	**0.2539**						**0.0091**	**0.3328**	**NE**	
A. Forest Land	-2390.3683	0.0006	0.0000						0.0004	0.0142	NE	
B. Cropland	-489.2386	0.0093	0.2472						0.0087	0.3185	NE	
C. Grassland	-2240.7618	NE	NE						NE	NE	NE	
D. Wetlands	NO	NE	NE						NE	NE	NE	
E. Settlements	53.6737	NE	0.0067						NE	NE	NE	
F. Other Land	281.6495	NE	NE						NE	NE	NE	
G. Harvested Wood Products	-55.2171											
H. Other	NO	NO	NO						NO	NO	NO	
5. Waste	**16.5476**	**58.5284**	**0.2602**						**0.1656**	**2.8914**	**1.5515**	**0.0059**
A. Solid Waste Disposal	NA, NO	42.5718							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	16.5476	0.3392	0.0078						0.1656	2.8914	0.0640	0.0059
D. Wastewater Treatment and Discharge		15.6174	0.2524						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	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 and Stored	NO											
Long-term Storage of C in waste disposal sites	NO											
Indirect N_2O			**1.0264**									
Indirect CO_2	**61.1468**											

2006

SOURCES OF GHG EMISSIONS	Net CO_2 Emissions/ sinks	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 sinks	**2637.7945**	**126.7626**	**5.5875**	**54.7020**	**0.0231**	**NO**	**0.0000**	**NO**	**32.6280**	**129.0389**	**63.1443**	**11.2334**
1. Energy	**7069.0187**	**29.5995**	**0.1486**						**30.6692**	**122.9391**	**22.0307**	**10.5018**
A. Fuel Combustion Reference Approach	6993.5519											
Sectoral Approach	7067.7927	2.2692	0.1486						30.6692	122.9391	21.3514	10.5018
1. Energy Industries	2492.9310	0.0517	0.0057						6.6886	1.0976	0.2317	0.8876
2. Manufacturing Industries and Construction	668.5271	0.0148	0.0018						1.7956	0.3704	0.0609	0.5672
3. Transport	1651.9002	0.3897	0.1168						16.8128	93.4424	17.6745	2.2771
4. Other Sectors	2203.5166	1.8096	0.0229						5.0878	27.5881	3.3028	6.4610
5. Other	50.9179	0.0034	0.0014						0.2844	0.4406	0.0815	0.3090
B. Fugitive Emissions from Fuels	1.2260	27.3303	0.0000						0.0000	0.0000	0.6793	0.0000
1. Solid Fuels	NO	NO	NO						NO	NO	NO	NO
2. Oil and Natural Gas	1.2260	27.3303	0.0000						0.0000	0.0000	0.6793	0.0000
C. CO_2 Transport and Storage	NO											
2. Industrial Processes and Product Use	**654.1156**	**NO**	**0.0001**	**54.7020**	**0.0231**	**NO**	**0.0000**	**NO**	**1.7861**	**2.9378**	**39.4337**	**0.7256**
A. Mineral Industry	543.7505								1.6749	1.3863	0.0164	0.6789
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	82.3885	NO	NO						0.0124	0.0697	33.3990	0.0062
E. Electronic Industry				NO	NO	NO	NO	NO				
F. Product Use as Substitutes for ODS				54.7020	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**	**39.3774**	**4.9614**						**NO**	**NO**	**NE, NO**	
A. Enteric Fermentation		35.8795										
B. Manure Management		3.4979	1.6153								NO	
C. Rice Cultivation		NO										
D. Agricultural Soils			3.3461									
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											
J. Other	NO	NO	NO						NO	NO	NO	
4. LULUCF	**-5101.9787**	**0.0105**	**0.2222**						**0.0078**	**0.2819**	**NE**	
A. Forest Land	-2347.2587	0.0068	0.0004						0.0043	0.1540	NE	
B. Cropland	-608.3183	0.0038	0.2152						0.0035	0.1279	NE	
C. Grassland	-2227.5442	NE	NE						NE	NE	NE	
D. Wetlands	NO	NE	NE						NE	NE	NE	
E. Settlements	53.6737	NE	0.0067						NE	NE	NE	
F. Other Land	70.2812	NE	NE						NE	NE	NE	

SOURCES OF GHG EMISSIONS	Net CO_2 Emissions/ sinks	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	-42.8125											
H. Other	NO	NO	NO						NO	NO	NO	
5. Waste	**16.4929**	**57.7751**	**0.2553**						**0.1650**	**2.8801**	**1.6799**	**0.0059**
A. Solid Waste Disposal	NA, NO	42.4729							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	16.4929	0.3380	0.0078						0.1650	2.8801	0.0637	0.0059
D. Wastewater Treatment and Discharge		14.9642	0.2475						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	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 and Stored	NO											
Long-term Storage of C in waste disposal sites	NO											
Indirect N_2O			**0.9734**									
Indirect CO_2	**74.4362**											

2007

SOURCES OF GHG EMISSIONS	Net CO_2 Emissions/ sinks	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 sinks	**3032.8304**	**119.9505**	**3.6330**	**69.8086**	**0.0231**	**NO**	**0.0000**	**NO**	**35.0645**	**129.1874**	**64.1206**	**9.2497**
1. Energy	**7208.6350**	**30.8524**	**0.1495**						**32.5239**	**120.7018**	**22.2713**	**8.3615**
A. Fuel Combustion Reference Approach	7129.2618											
Sectoral Approach	7207.3774	1.7986	0.1495						32.5239	120.7018	21.4002	8.3615
1. Energy Industries	2890.4481	0.0592	0.0063						7.7534	1.2656	0.2688	0.5638
2. Manufacturing Industries and Construction	831.1775	0.0169	0.0019						2.2278	0.4592	0.0748	0.3809
3. Transport	1757.8033	0.4066	0.1216						17.9824	96.8558	18.3272	2.4643
4. Other Sectors	1666.7458	1.3113	0.0178						4.1758	21.4422	2.6024	4.7091
5. Other	61.2028	0.0046	0.0019						0.3845	0.6790	0.1271	0.2434
B. Fugitive Emissions from Fuels	1.2577	29.0538	0.0000						0.0000	0.0000	0.8710	0.0000
1. Solid Fuels	NO	NO	NO						NO	NO	NO	NO
2. Oil and Natural Gas	1.2577	29.0538	0.0000						0.0000	0.0000	0.8710	0.0000
C. CO_2 Transport and Storage	NO											
2. Industrial Processes and Product Use	**901.0373**	**NO**	**NO**	**69.8086**	**0.0231**	**NO**	**0.0000**	**NO**	**2.3331**	**4.0697**	**39.7471**	**0.8823**
A. Mineral Industry	776.1316								2.1837	2.0250	0.0244	0.8179
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

SOURCES OF GHG EMISSIONS	Net CO_2 Emissions/ sinks	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	85.3456	NO	NO						0.0130	0.0732	35.2553	0.0065
E. Electronic Industry				NO	NO	NO	NO	NO				
F. Product Use as Substitutes for ODS				69.8086	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**	**31.4767**	**3.0116**						**NO**	**NO**	**NE, NO**	
A. Enteric Fermentation		28.9885										
B. Manure Management		2.4883	1.2329								NO	
C. Rice Cultivation		NO										
D. Agricultural Soils			1.7788									
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											
J. Other	NO	NO	NO						NO	NO	NO	
4. LULUCF	**-5093.5290**	**0.0650**	**0.2272**						**0.0433**	**1.5498**	**NE**	
A. Forest Land	-2445.1609	0.0589	0.0033						0.0376	1.3419	NE	
B. Cropland	-561.2881	0.0061	0.2178						0.0056	0.2079	NE	
C. Grassland	-2164.3852	NE	NE						NE	NE	NE	
D. Wetlands	NO	NE	NE						NE	NE	NE	
E. Settlements	49.2742	NE	0.0061						NE	NE	NE	
F. Other Land	70.2812	NE	NE						NE	NE	NE	
G. Harvested Wood Products	-42.2503											
H. Other	NO	NO	NO						NO	NO	NO	
5. Waste	**16.4239**	**57.5563**	**0.2447**						**0.1642**	**2.8661**	**2.1023**	**0.0059**
A. Solid Waste Disposal	NA, NO	42.5927							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	16.4239	0.3365	0.0078						0.1642	2.8661	0.0634	0.0059
D. Wastewater Treatment and Discharge		14.6272	0.2369						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	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 and Stored	NO											
Long-term Storage of C in waste disposal sites	NO											
Indirect N_2O			**0.6086**									
Indirect CO_2	**78.5091**											

2008

SOURCES OF GHG EMISSIONS	Net CO_2 Emissions/ sinks	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 sinks	**4237.7119**	**119.3775**	**5.6159**	**84.6748**	**0.0288**	**NO**	**0.0000**	**NO**	**37.5679**	**134.1375**	**58.5079**	**15.7014**
1. Energy	**7797.1121**	**30.7646**	**0.1602**						**34.8468**	**126.1410**	**23.5029**	**14.7669**
A. Fuel Combustion Reference Approach	7708.5089											
Sectoral Approach	7795.8374	1.8660	0.1602						34.8468	126.1410	22.3546	14.7669
1. Energy Industries	3292.3392	0.0691	0.0118						8.9779	1.4975	0.3003	4.5794
2. Manufacturing Industries and Construction	914.5002	0.0349	0.0047						2.5416	0.7142	0.1050	2.6179
3. Transport	1848.7566	0.4221	0.1233						18.8620	101.0306	19.1218	2.6186
4. Other Sectors	1677.3708	1.3356	0.0186						4.1047	22.2423	2.7039	4.5404
5. Other	62.8705	0.0042	0.0017						0.3607	0.6564	0.1236	0.4105
B. Fugitive Emissions from Fuels	1.2748	28.8986	0.0000						0.0000	0.0000	1.1483	0.0000
1. Solid Fuels	NO	NO	NO						NO	NO	NO	NO
2. Oil and Natural Gas	1.2748	28.8986	0.0000						0.0000	0.0000	1.1483	0.0000
C. CO_2 Transport and Storage	NO											
2. Industrial Processes and Product Use	**978.6462**	**NO**	**NO**	**84.6748**	**0.0288**	**NO**	**0.0000**	**NO**	**2.5297**	**4.1271**	**32.6079**	**0.9287**
A. Mineral Industry	874.7129								2.3984	2.3142	0.0277	0.8718
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	67.5356	NO	NO						0.0075	0.0427	26.9460	0.0037
E. Electronic Industry				NO	NO	NO	NO	NO				
F. Product Use as Substitutes for ODS				84.6748	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**	**30.0773**	**4.9854**						**NO**	**NO**	**NE, NO**	
A. Enteric Fermentation		27.6304										
B. Manure Management		2.4469	1.2103								NO	
C. Rice Cultivation		NO										
D. Agricultural Soils			3.7751									
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											
J. Other	NO	NO	NO						NO	NO	NO	
4. LULUCF	**-4555.2731**	**0.0311**	**0.2246**						**0.0276**	**1.0136**	**NE**	
A. Forest Land	-2447.9362	0.0041	0.0002						0.0026	0.0933	NE	
B. Cropland	-517.9302	0.0270	0.2183						0.0250	0.9203	NE	
C. Grassland	-1883.4658	NE	NE						NE	NE	NE	
D. Wetlands	NO	NE	NE						NE	NE	NE	
E. Settlements	49.2742	NE	0.0061						NE	NE	NE	
F. Other Land	291.0044	NE	NE						NE	NE	NE	

SOURCES OF GHG EMISSIONS	Net CO_2 Emissions/ sinks	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	-46.2195											
H. Other	NO	NO	NO						NO	NO	NO	
5. Waste	**16.3761**	**58.5045**	**0.2457**						**0.1637**	**2.8558**	**2.3971**	**0.0059**
A. Solid Waste Disposal	NA, NO	43.3686							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	16.3761	0.3354	0.0077						0.1637	2.8558	0.0632	0.0059
D. Wastewater Treatment and Discharge		14.8004	0.2379						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	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 and Stored	NO											
Long-term Storage of C in waste disposal sites	NO											
Indirect N_2O			**0.9767**									
Indirect CO_2	**60.2670**											

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SOURCES OF GHG EMISSIONS	Net CO_2 Emissions/ sinks	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 sinks	**5169.5702**	**115.6662**	**4.9233**	**93.2489**	**0.0288**	**NO**	**0.0000**	**NO**	**37.5550**	**131.2280**	**52.8153**	**19.4449**
1. Energy	**8606.6397**	**25.9034**	**0.1613**						**36.1288**	**125.9630**	**23.3804**	**18.9374**
A. Fuel Combustion Reference Approach	8524.5226											
Sectoral Approach	8605.3665	1.9861	0.1613						36.1288	125.9630	22.2479	18.9374
1. Energy Industries	4452.7046	0.0914	0.0185						12.2184	1.9199	0.3947	9.5045
2. Manufacturing Industries and Construction	507.6894	0.0221	0.0031						1.4245	0.4309	0.0619	1.7887
3. Transport	1807.3330	0.4302	0.1199						18.3053	100.3654	18.9797	2.5152
4. Other Sectors	1824.7201	1.4415	0.0195						4.1212	23.0987	2.7846	5.0117
5. Other	12.9193	0.0010	0.0003						0.0593	0.1482	0.0271	0.1172
B. Fugitive Emissions from Fuels	1.2732	23.9173	0.0000						0.0000	0.0000	1.1325	0.0000
1. Solid Fuels	NO	NO	NO						NO	NO	NO	NO
2. Oil and Natural Gas	1.2732	23.9173	0.0000						0.0000	0.0000	1.1325	0.0000
C. CO_2 Transport and Storage	NO											
2. Industrial Processes and Product Use	**466.2423**	**NO**	**NO**	**93.2489**	**0.0288**	**NO**	**0.0000**	**NO**	**1.2535**	**2.0770**	**27.2539**	**0.5017**
A. Mineral Industry	389.8573								1.1819	0.9974	0.0122	0.4733
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

SOURCES OF GHG EMISSIONS	Net CO_2 Emissions/ sinks	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	58.6232	NO	NO						0.0056	0.0316	23.4326	0.0028
E. Electronic Industry				NO	NO	NO	NO	NO				
F. Product Use as Substitutes for ODS				93.2489	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**	**31.5015**	**4.3026**						**NO**	**NO**	**NE, NO**	
A. Enteric Fermentation		28.7094										
B. Manure Management		2.7921	1.3661								NO	
C. Rice Cultivation		NO										
D. Agricultural Soils			2.9365									
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											
J. Other	NO	NO	NO						NO	NO	NO	
4. LULUCF	**-3920.2377**	**0.0133**	**0.2274**						**0.0095**	**0.3406**	**NE**	
A. Forest Land	-2511.3674	0.0100	0.0006						0.0064	0.2276	NE	
B. Cropland	-373.2147	0.0033	0.2212						0.0031	0.1130	NE	
C. Grassland	-1123.9641	NE	NE						NE	NE	NE	
D. Wetlands	NO	NE	NE						NE	NE	NE	
E. Settlements	45.5694	NE	0.0057						NE	NE	NE	
F. Other Land	79.9357	NE	NE						NE	NE	NE	
G. Harvested Wood Products	-37.1965											
H. Other	NO	NO	NO						NO	NO	NO	
5. Waste	**16.3396**	**58.2481**	**0.2320**						**0.1633**	**2.8474**	**2.1810**	**0.0059**
A. Solid Waste Disposal	NA, NO	44.6029							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	16.3396	0.3346	0.0077						0.1633	2.8474	0.0631	0.0059
D. Wastewater Treatment and Discharge		13.3105	0.2243						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	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 and Stored	NO											
Long-term Storage of C in waste disposal sites	NO											
Indirect N_2O			**0.8514**									
Indirect CO_2	**52.2514**											

SOURCES OF GHG EMISSIONS	Net CO_2 Emissions/ sinks	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 sinks	**6359.5912**	**116.5438**	**5.5238**	**113.4282**	**0.0403**	**NO**	**0.0000**	**NO**	**40.5575**	**130.3057**	**57.0391**	**19.0192**
1. Energy	**9148.1087**	**25.3241**	**0.1594**						**39.0509**	**125.3956**	**23.0859**	**18.4660**
A. Fuel Combustion Reference Approach	9065.9930											
Sectoral Approach	9146.8340	2.1313	0.1594						39.0509	125.3956	22.2089	18.4660
1. Energy Industries	4589.7895	0.0965	0.0180						12.5571	2.0615	0.4139	8.4258
2. Manufacturing Industries and Construction	539.5862	0.0228	0.0032						1.5074	0.4630	0.0644	1.7348
3. Transport	2007.4377	0.4354	0.1187						20.4225	100.2581	18.9936	2.9510
4. Other Sectors	1985.9921	1.5743	0.0190						4.4650	22.4025	2.7027	5.0653
5. Other	24.0285	0.0022	0.0006						0.0989	0.2105	0.0343	0.2890
B. Fugitive Emissions from Fuels	1.2747	23.1928	0.0000						0.0000	0.0000	0.8770	0.0000
1. Solid Fuels	NO	NO	NO						NO	NO	NO	NO
2. Oil and Natural Gas	1.2747	23.1928	0.0000						0.0000	0.0000	0.8770	0.0000
C. CO_2 Transport and Storage	NO											
2. Industrial Processes and Product Use	**490.8096**	**NO**	**NO**	**113.4282**	**0.0403**	**NO**	**0.0000**	**NO**	**1.3392**	**1.9101**	**31.9434**	**0.5474**
A. Mineral Industry	412.7424								1.2872	1.0448	0.0126	0.5294
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	67.4640	NO	NO						0.0069	0.0392	27.0436	0.0034
E. Electronic Industry				NO	NO	NO	NO	NO				
F. Product Use as Substitutes for ODS				113.4282	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**	**31.5606**	**4.8959**						**NO**	**NO**	**NE, NO**	
A. Enteric Fermentation		28.5047										
B. Manure Management		3.0558	1.4165								NO	
C. Rice Cultivation		NO										
D. Agricultural Soils			3.4794									
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											
J. Other	NO	NO	NO						NO	NO	NO	
4. LULUCF	**-3297.3873**	**0.0058**	**0.2253**						**0.0044**	**0.1587**	**NE**	
A. Forest Land	-2489.6089	0.0035	0.0002						0.0022	0.0795	NE	
B. Cropland	-399.2688	0.0023	0.2194						0.0022	0.0792	NE	
C. Grassland	-555.7508	NE	NE						NE	NE	NE	
D. Wetlands	NO	NE	NE						NE	NE	NE	
E. Settlements	45.5885	NE	0.0057						NE	NE	NE	
F. Other Land	131.6759	NE	NE						NE	NE	NE	

SOURCES OF GHG EMISSIONS	Net CO_2 Emissions/ sinks	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	-30.0233											
H. Other	NO	NO	NO						NO	NO	NO	
5. Waste	**16.3159**	**59.6532**	**0.2432**						**0.1630**	**2.8412**	**2.0097**	**0.0059**
A. Solid Waste Disposal	NA, NO	45.5148							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	16.3159	0.3341	0.0077						0.1630	2.8412	0.0629	0.0059
D. Wastewater Treatment and Discharge		13.8043	0.2355						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	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	343.3412											
CO_2 Captured and Stored	NO											
Long-term Storage of C in waste disposal sites	NO											
Indirect N_2O			**0.9686**									
Indirect CO_2	**60.4006**											

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SOURCES OF GHG EMISSIONS	Net CO_2 Emissions/ sinks	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 sinks	**7115.7241**	**119.0761**	**5.5240**	**119.5378**	**0.0403**	**NO**	**0.0000**	**NO**	**41.2523**	**136.9815**	**60.7789**	**17.8646**
1. Energy	**9230.5492**	**28.6717**	**0.1637**						**39.4830**	**131.6881**	**24.2590**	**17.2073**
A. Fuel Combustion Reference Approach	9135.9071											
Sectoral Approach	9229.2351	2.2555	0.1637						39.4830	131.6881	23.2423	17.2073
1. Energy Industries	4181.2774	0.0859	0.0152						11.4061	1.8179	0.3760	6.6957
2. Manufacturing Industries and Construction	599.6756	0.0273	0.0038						1.6749	0.5802	0.0746	2.1379
3. Transport	2116.7005	0.4384	0.1228						21.5408	104.1850	19.7559	3.1333
4. Other Sectors	2309.8144	1.7026	0.0214						4.7683	24.9419	3.0066	5.0153
5. Other	21.7672	0.0013	0.0005						0.0928	0.1631	0.0292	0.2251
B. Fugitive Emissions from Fuels	1.3141	26.4162	0.0000						0.0000	0.0000	1.0167	0.0000
1. Solid Fuels	NO	NO	NO						NO	NO	NO	NO
2. Oil and Natural Gas	1.3141	26.4162	0.0000						0.0000	0.0000	1.0167	0.0000
C. CO_2 Transport and Storage	NO											
2. Industrial Processes and Product Use	**578.2196**	**NO**	**NO**	**119.5378**	**0.0403**	**NO**	**0.0000**	**NO**	**1.6013**	**2.2818**	**34.4817**	**0.6513**
A. Mineral Industry	491.5026								1.5377	1.2638	0.0155	0.6282
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

SOURCES OF GHG EMISSIONS	Net CO_2 Emissions/ sinks	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	72.7635	NO	NO						0.0078	0.0443	29.2885	0.0039
E. Electronic Industry				NO	NO	NO	NO	NO				
F. Product Use as Substitutes for ODS				119.5378	NO	NO	NO	NO				
G. Other Product Manufacture and Use	1.0979	NO	NO	NO	0.0403	NO	0.0000	NO	0.0140	0.4272	0.4990	NO
H. Other									NO	NO	4.6461	NO
3. Agriculture	**3.6752**	**29.7443**	**4.8884**						**NO**	**NO**	**NE, NO**	
A. Enteric Fermentation		26.8550										
B. Manure Management		2.8892	1.2930								NO	
C. Rice Cultivation		NO										
D. Agricultural Soils			3.5954									
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											
J. Other	NO	NO	NO						NO	NO	NO	
4. LULUCF	**-2713.1019**	**0.0068**	**0.2313**						**0.0049**	**0.1772**	**NE**	
A. Forest Land	-2373.3313	0.0047	0.0003						0.0030	0.1065	NE	
B. Cropland	-400.4227	0.0021	0.2252						0.0019	0.0707	NE	
C. Grassland	-442.6724	NE	NE						NE	NE	NE	
D. Wetlands	NO	NE	NE						NE	NE	NE	
E. Settlements	61.5457	NE	0.0058						NE	NE	NE	
F. Other Land	466.0972	NE	NE						NE	NE	NE	
G. Harvested Wood Products	-24.3184											
H. Other	NO	NO	NO						NO	NO	NO	
5. Waste	**16.3820**	**60.6535**	**0.2406**						**0.1631**	**2.8344**	**2.0381**	**0.0060**
A. Solid Waste Disposal	NA, NO	46.2036							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	16.3820	0.3348	0.0077						0.1631	2.8344	0.0630	0.0060
D. Wastewater Treatment and Discharge		14.1151	0.2329						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	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	386.2234											
CO_2 Captured and Stored	NO											
Long-term Storage of C in waste disposal sites	NO											
Indirect N_2O			**0.9688**									
Indirect CO_2	**65.5327**											

SOURCES OF GHG EMISSIONS	Net CO_2 Emissions/ sinks	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 sinks	**6489.1628**	**117.1909**	**4.2108**	**128.8468**	**0.0403**	**NO**	**0.0000**	**NO**	**38.4685**	**123.6520**	**59.7134**	**16.9376**
1. Energy	**8897.8193**	**28.4484**	**0.1527**						**36.7628**	**117.4788**	**21.3257**	**16.3476**
A. Fuel Combustion Reference Approach	8791.1695											
Sectoral Approach	8896.5089	2.4119	0.1527						36.7628	117.4788	20.3960	16.3476
1. Energy Industries	4190.8271	0.0806	0.0144						11.4154	1.6530	0.3687	6.3171
2. Manufacturing Industries and Construction	563.6377	0.0232	0.0032						1.5729	0.5298	0.0671	1.5965
3. Transport	1862.8628	0.3734	0.1120						19.0501	87.9904	16.6961	2.8130
4. Other Sectors	2271.4679	1.9341	0.0229						4.6777	27.1805	3.2403	5.5744
5. Other	7.7134	0.0006	0.0002						0.0466	0.1251	0.0239	0.0466
B. Fugitive Emissions from Fuels	1.3104	26.0365	0.0000						0.0000	0.0000	0.9297	0.0000
1. Solid Fuels	NO	NO	NO						NO	NO	NO	NO
2. Oil and Natural Gas	1.3104	26.0365	0.0000						0.0000	0.0000	0.9297	0.0000
C. CO_2 Transport and Storage	NO											
2. Industrial Processes and Product Use	**586.7346**	**NO**	**NO**	**128.8468**	**0.0403**	**NO**	**0.0000**	**NO**	**1.5106**	**2.1929**	**36.3735**	**0.5841**
A. Mineral Industry	496.8003								1.4504	1.2952	0.0157	0.5606
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	76.1943	NO	NO						0.0088	0.0500	31.3721	0.0044
E. Electronic Industry				NO	NO	NO	NO	NO				
F. Product Use as Substitutes for ODS				128.8468	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	4.4796	NO
3. Agriculture	**5.5908**	**28.1173**	**3.5815**						**NO**	**NO**	**NE, NO**	
A. Enteric Fermentation		25.3728										
B. Manure Management		2.7445	1.1839								NO	
C. Rice Cultivation		NO										
D. Agricultural Soils			2.3976									
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											
J. Other	NO	NO	NO						NO	NO	NO	
4. LULUCF	**-3017.3416**	**0.0504**	**0.2380**						**0.0322**	**1.1504**	**NE**	
A. Forest Land	-2208.0703	0.0501	0.0028						0.0320	1.1403	NE	
B. Cropland	-476.4351	0.0003	0.2338						0.0003	0.0101	NE	
C. Grassland	-426.1414	NE	NE						NE	NE	NE	
D. Wetlands	NO	NE	NE						NE	NE	NE	
E. Settlements	11.8308	NE	0.0015						NE	NE	NE	
F. Other Land	87.3375	NE	NE						NE	NE	NE	

SOURCES OF GHG EMISSIONS	Net CO_2 Emissions/ sinks	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	-5.8631											
H. Other	NO	NO	NO						NO	NO	NO	
5. Waste	**16.3598**	**60.5748**	**0.2386**						**0.1629**	**2.8300**	**2.0142**	**0.0060**
A. Solid Waste Disposal	NA, NO	45.7457							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	16.3598	0.3343	0.0077						0.1629	2.8300	0.0629	0.0060
D. Wastewater Treatment and Discharge		14.4948	0.2309						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	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	404.3122											
CO_2 Captured and Stored	NO											
Long-term Storage of C in waste disposal sites	NO											
Indirect N_2O			**0.7371**									
Indirect CO_2	**70.0614**											

2013

SOURCES OF GHG EMISSIONS	Net CO_2 Emissions/ sinks	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 sinks	**5871.5812**	**114.8765**	**5.7704**	**137.5611**	**0.0403**	**NO**	**0.0000**	**NO**	**37.4833**	**122.3843**	**58.9806**	**19.8122**
1. Energy	**7835.9759**	**27.2620**	**0.1535**						**35.5789**	**116.6533**	**21.0355**	**19.1181**
A. Fuel Combustion Reference Approach	7706.7256											
Sectoral Approach	7834.3318	2.4637	0.1535						35.5789	116.6533	20.1562	19.1181
1. Energy Industries	3310.5699	0.0656	0.0141						9.1042	1.4032	0.2912	7.2180
2. Manufacturing Industries and Construction	599.5639	0.0310	0.0044						1.6913	0.6181	0.0799	2.6151
3. Transport	1972.4617	0.3736	0.1114						20.1215	86.1610	16.3683	3.0321
4. Other Sectors	1947.9381	1.9933	0.0235						4.6348	28.4029	3.4037	6.2194
5. Other	3.7983	0.0003	0.0001						0.0271	0.0682	0.0131	0.0335
B. Fugitive Emissions from Fuels	1.6441	24.7983	0.0000						0.0000	0.0000	0.8793	0.0000
1. Solid Fuels	NO	NO	NO						NO	NO	NO	NO
2. Oil and Natural Gas	1.6441	24.7983	0.0000						0.0000	0.0000	0.8793	0.0000
C. CO_2 Transport and Storage	NO											
2. Industrial Processes and Product Use	**631.7162**	**NO**	**NO**	**137.5611**	**0.0403**	**NO**	**0.0000**	**NO**	**1.7172**	**2.0236**	**35.7659**	**0.6881**
A. Mineral Industry	551.5523								1.6760	1.4190	0.0171	0.6722
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

SOURCES OF GHG EMISSIONS	Net CO_2 Emissions/ sinks	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	71.3632	NO	NO						0.0088	0.0501	29.0945	0.0044
E. Electronic Industry				NO	NO	NO	NO	NO				
F. Product Use as Substitutes for ODS				137.5611	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**	**28.4554**	**5.1458**						**NO**	**NO**	**NE, NO**	
A. Enteric Fermentation		25.7538										
B. Manure Management		2.7015	1.1095								NO	
C. Rice Cultivation		NO										
D. Agricultural Soils			4.0363									
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. LULUCF	**-2616.6284**	**0.0374**	**0.2304**						**0.0246**	**0.8819**	**NE**	
A. Forest Land	-2055.1211	0.0348	0.0019						0.0222	0.7921	NE	
B. Cropland	-458.6019	0.0026	0.2270						0.0024	0.0898	NE	
C. Grassland	-277.4696	NE	NE						NE	NE	NE	
D. Wetlands	NO	NE	NE						NE	NE	NE	
E. Settlements	11.8308	NE	0.0015						NE	NE	NE	
F. Other Land	87.3375	NE	NE						NE	NE	NE	
G. Harvested Wood Products	75.3959											
H. Other	NO	NO	NO						NO	NO	NO	
5. Waste	**16.3335**	**59.1217**	**0.2408**						**0.1626**	**2.8255**	**2.1793**	**0.0060**
A. Solid Waste Disposal	NA, NO	43.3916							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	16.3335	0.3337	0.0077						0.1626	2.8255	0.0628	0.0060
D. Wastewater Treatment and Discharge		15.3964	0.2331						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	130.4626	0.0046	0.0042						0.5235	0.3098	0.3098	0.0414
Aviation	130.4626	0.0046	0.0042						0.5235	0.3098	0.3098	0.0414
Navigation	NO	NO	NO						NO	NO	NO	NO
Multilateral Operations	**NO**	**NO**	**NO**						**NO**	**NO**	**NO**	**NO**
CO_2 Emissions from Biomass	431.4636											
CO_2 Captured and Stored	NO											
Long-term Storage of C in waste disposal sites	NO											
Indirect N_2O			**1.0310**									
Indirect CO_2	**65.1517**											

2014

SOURCES OF GHG EMISSIONS	Net CO_2 Emissions/ sinks	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 sinks	**6537.6243**	**117.4727**	**6.4144**	**151.3701**	**0.0403**	**NO**	**0.0000**	**NO**	**41.2896**	**160.2992**	**72.1587**	**22.5976**
1. Energy	**8581.9429**	**28.3945**	**0.1776**						**39.4038**	**155.1296**	**25.7186**	**21.9002**
A. Fuel Combustion Reference Approach	8429.1226											
Sectoral Approach	8580.2708	4.5816	0.1776						39.4038	155.1296	24.9414	21.9002
1. Energy Industries	4014.9274	0.0810	0.0153						10.9980	1.8876	0.3667	6.8685
2. Manufacturing Industries and Construction	585.7254	0.0274	0.0038						1.6513	0.5392	0.0740	2.2402
3. Transport	2049.6073	0.3748	0.1051						20.7783	86.9611	16.5327	3.1761
4. Other Sectors	1927.7357	4.0980	0.0533						5.9605	65.6711	7.9546	9.5958
5. Other	2.2750	0.0003	0.0001						0.0156	0.0705	0.0134	0.0196
B. Fugitive Emissions from Fuels	1.6721	23.8129	0.0000						0.0000	0.0000	0.7772	0.0000
1. Solid Fuels	NO	NO	NO						NO	NO	NO	NO
2. Oil and Natural Gas	1.6721	23.8129	0.0000						0.0000	0.0000	0.7772	0.0000
C. CO_2 Transport and Storage	NO											
2. Industrial Processes and Product Use	**652.4526**	**NO**	**NO**	**151.3701**	**0.0403**	**NO**	**0.0000**	**NO**	**1.7200**	**2.2174**	**44.1349**	**0.6915**
A. Mineral Industry	548.2551								1.6573	1.4047	0.0167	0.6644
B. Chemical Industry	NO	NO	NO						NO	NO	0.0161	NO
C. Metal Industry	13.7976	NO	NO	NO	NO	NO	NO	NO	0.0449	0.5868	0.0186	0.0207
D. Non-energy Products From Fuels and Solvent Use	89.3660	NO	NO						0.0128	0.0723	37.2835	0.0064
E. Electronic Industry				NO	NO	NO	NO	NO				
F. Product Use as Substitutes for ODS				151.3701	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**	**30.1482**	**5.7851**						**NO**	**NO**	**NE, NO**	
A. Enteric Fermentation		27.2645										
B. Manure Management		2.8838	1.2202								NO	
C. Rice Cultivation		NO										
D. Agricultural Soils			4.5649									
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											
J. Other	NO	NO	NO						NO	NO	NO	
4. LULUCF	**-2723.2521**	**0.0049**	**0.2083**						**0.0037**	**0.1341**	**NE**	
A. Forest Land	-2019.3088	0.0029	0.0002						0.0018	0.0651	NE	
B. Cropland	-582.4370	0.0020	0.2069						0.0019	0.0690	NE	
C. Grassland	-271.1606	NE	NE						NE	NE	NE	
D. Wetlands	NO	NE	NE						NE	NE	NE	
E. Settlements	18.7098	NE	0.0013						NE	NE	NE	
F. Other Land	70.4783	NE	NE						NE	NE	NE	

SOURCES OF GHG EMISSIONS	Net CO_2 Emissions/ sinks	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	60.4660											
H. Other	NO	NO	NO						NO	NO	NO	
5. Waste	**16.2752**	**58.9252**	**0.2434**						**0.1621**	**2.8182**	**2.3051**	**0.0059**
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	16.2752	0.3327	0.0077						0.1621	2.8182	0.0626	0.0059
D. Wastewater Treatment and Discharge		15.2693	0.2357						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	154.5065	0.0034	0.0049						0.6256	0.3250	0.1444	0.0490
Aviation	154.5065	0.0034	0.0049						0.6256	0.3250	0.1444	0.0490
Navigation	NO	NO	NO						NO	NO	NO	NO
Multilateral Operations	**NO**	**NO**	**NO**						**NO**	**NO**	**NO**	**NO**
CO_2 Emissions from Biomass	1317.1650											
CO_2 Captured and Stored	NO											
Long-term Storage of C in waste disposal sites	NO											
Indirect N_2O			**1.1763**									
Indirect CO_2	**83.0575**											

2015

SOURCES OF GHG EMISSIONS	Net CO_2 Emissions/ sinks	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 sinks	**6490.9952**	**114.5375**	**5.2785**	**179.4375**	**0.0403**	**NO**	**0.0000**	**NO**	**43.2364**	**169.6707**	**70.3063**	**294.2491**
1. Energy	**8759.0707**	**27.5275**	**0.1936**						**41.4066**	**164.0111**	**26.8381**	**292.9100**
A. Fuel Combustion Reference Approach	8606.2644											
Sectoral Approach	8757.4126	4.8634	0.1936						41.4066	164.0111	26.1223	292.9100
1. Energy Industries	4141.2201	0.0717	0.0136						11.2794	1.4073	0.3526	203.2479
2. Manufacturing Industries and Construction	665.6173	0.0407	0.0056						1.9040	2.2239	0.1007	24.1751
3. Transport	2158.1164	0.3941	0.1175						21.9992	90.0932	17.1297	5.1060
4. Other Sectors	1790.2120	4.3567	0.0568						6.2097	70.2315	8.5288	59.7859
5. Other	2.2468	0.0002	0.0001						0.0144	0.0551	0.0105	0.5951
B. Fugitive Emissions from Fuels	1.6581	22.6641	0.0000						0.0000	0.0000	0.7158	0.0000
1. Solid Fuels	NO	NO	NO						NO	NO	NO	NO
2. Oil and Natural Gas	1.6581	22.6641	0.0000						0.0000	0.0000	0.7158	0.0000
C. CO_2 Transport and Storage	NO											
2. Industrial Processes and Product Use	**614.5157**	**NO**	**NO**	**179.4375**	**0.0403**	**NO**	**0.0000**	**NO**	**1.6503**	**2.1966**	**41.1605**	**1.3330**
A. Mineral Industry	509.6941								1.5815	1.2964	0.0160	1.2687
B. Chemical Industry	NO	NO	NO						NO	NO	0.0114	NO
C. Metal Industry	17.2258	NO	NO	NO	NO	NO	NO	NO	0.0560	0.7325	0.0221	0.0427

SOURCES OF GHG EMISSIONS	Net CO_2 Emissions/ sinks	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	86.8119	NO	NO						0.0089	0.0503	36.0209	0.0216
E. Electronic Industry				NO	NO	NO	NO	NO				
F. Product Use as Substitutes for ODS				179.4375	NO	NO	NO	NO				
G. Other Product Manufacture and Use	0.7840	NO	NO	NO	0.0403	NO	0.0000	NO	0.0038	0.1174	0.3564	NO
H. Other									NO	NO	4.7339	NO
3. Agriculture	**5.8323**	**28.9985**	**4.6440**						**NO**	**NO**	**NE, NO**	
A. Enteric Fermentation		26.1841										
B. Manure Management		2.8145	1.1814								NO	
C. Rice Cultivation		NO										
D. Agricultural Soils			3.4625									
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	5.8323											
I. Other Carbon-containing Fertilizers	NO											
J. Other	NO	NO	NO						NO	NO	NO	
4. LULUCF	**-2904.5678**	**0.0283**	**0.1962**						**0.0186**	**0.6651**	**NE**	
A. Forest Land	-2027.2895	0.0265	0.0015						0.0169	0.6041	NE	
B. Cropland	-727.4181	0.0018	0.1930						0.0017	0.0610	NE	
C. Grassland	-306.2291	NE	NE						NE	NE	NE	
D. Wetlands	NO	NE	NE						NE	NE	NE	
E. Settlements	38.8867	NE	0.0017						NE	NE	NE	
F. Other Land	60.8445	NE	NE						NE	NE	NE	
G. Harvested Wood Products	56.6377											
H. Other	NO	NO	NO						NO	NO	NO	
5. Waste	**16.1442**	**57.9832**	**0.2448**						**0.1609**	**2.7979**	**2.3076**	**0.0060**
A. Solid Waste Disposal	NA, NO	43.4861							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	16.1442	0.3301	0.0076						0.1609	2.7979	0.0621	0.0060
D. Wastewater Treatment and Discharge		14.1671	0.2371						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	218.4093	0.0058	0.0070						0.9142	0.4451	0.2206	0.0689
Aviation	218.4093	0.0058	0.0070						0.9142	0.4451	0.2206	0.0689
Navigation	NO	NO	NO						NO	NO	NO	NO
Multilateral Operations	**NO**	**NO**	**NO**						**NO**	**NO**	**NO**	**NO**
CO_2 Emissions from Biomass	1439.8048											
CO_2 Captured and Stored	NO											
Long-term Storage of C in waste disposal sites	NO											
Indirect N_2O			**0.9361**									
Indirect CO_2	**80.0300**											

Annex 6-7: Summary Reports for GHG Emissions in CO_2 equivalent in the Republic of Moldova within 1990-2015

1990

SOURCES OF GHG EMISSIONS	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)	**29 012.7530**	**5 706.2689**	**2 861.3769**	**NO**	**NO**	**NO**	**NO**	**NO**	**37 580.3987**
1. Energy	**33 296.4997**	**1 147.8526**	**186.4271**						**34 630.7793**
A. Fuel Combustion (Sectoral approach)	33 295.8620	335.6111	186.4269						33 817.9000
1. Energy Industries	19 338.0195	11.0724	49.2565						19 398.3484
2. Manufacturing Industries and Construction	2 206.2753	2.4544	5.0856						2 213.8153
3. Transport	4 346.0289	32.6324	103.1032						4 481.7645
4. Other Sectors	7 291.5661	289.1794	27.6563						7 608.4017
5. Other	113.9722	0.2726	1.3253						115.5701
B. Fugitive Emissions from Fuels	0.6377	812.2415	0.0002						812.8794
1. Solid Fuels	NO	NO	NO						NO
2. Oil and Natural Gas	0.6377	812.2415	0.0002						812.8794
C. CO_2 Transport and Storage	NO								NO
2. Industrial Processes and Product Use	**1 580.9940**	**NO**	**0.0197**	**NO**	**NO**	**NO**	**NO**	**NO**	**1 581.0137**
A. Mineral Industry	1 316.1041								1 316.1041
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	233.2089	NO	NO						233.2089
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**	**2 685.5119**	**2 524.4565**						**5 210.5504**
A. Enteric Fermentation		2 190.6944							2 190.6944
B. Manure Management		494.8175	1 116.6179						1 611.4354
C. Rice Cultivation		NO							NO
D. Agricultural Soils			1 407.8386						1 407.8386
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								NO
J. Other	NO	NO	NO						NO
4. LULUCF	**-5 882.4287**	**2.6698**	**60.1081**						**-5 819.6508**
A. Forest Land	-2 543.7403	0.2237	0.1475						-2 543.3691
B. Cropland	-578.1271	2.4461	56.8256						-518.8554
C. Grassland	-2 850.2941	NE	NE						-2 850.2941
D. Wetlands	-17.4403	NE	NE						-17.4403
E. Settlements	84.7480	NE	3.1350						87.8830
F. Other Land	152.4756	NE	NE						152.4756
G. Harvested Wood Products	-130.0504								-130.0504

SOURCES OF GHG EMISSIONS	CO_2	CH_4	N_2O	HFCs	PFCs	SF_6	Unspecified mix of HFCs and PFCs	NF_3	Total
	CO_2 equivalent (kt)								
H. Other	NO	NO	NO						NO
5. Waste	**17.1060**	**1 870.2346**	**90.3656**						**1 977.7062**
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	2.4157						28.3035
D. Wastewater Treatment and Discharge		814.7250	87.9499						902.6749
E. Other	NO	NO	NO						NO
6. Other	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	NO
Memo Items									
International Bunkers	**217.3668**	**1.0750**	**2.0860**						**220.5278**
Aviation	217.3668	1.0750	2.0860						220.5278
Navigation	NO	NO	NO						NO
Multilateral Operations	**NO**	**NO**	**NO**						**NO**
CO_2 Emissions from Biomass	229.3072								229.3072
CO_2 Captured and Stored	NO								NO
Long-term Storage of C in waste disposal sites	NO								NO
Indirect N_2O			583.3295						583.3295
Indirect CO_2	207.3247								207.3247
Total CO_2 equivalent (without Sector 4 „LULUCF)									**43 400.0496**
Total CO_2 equivalent (with Sector 4 „LULUCF")									**37 580.3987**

1991

SOURCES OF GHG EMISSIONS	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)	**23 396.6278**	**5 289.6746**	**2 724.1242**	**NO**	**NO**	**NO**	**NO**	**NO**	**31 410.4266**
1. Energy	**29 615.6682**	**994.5383**	**170.1157**						**30 780.3222**
A. Fuel Combustion (Sectoral approach)	29 615.0542	232.2238	170.1156						30 017.3935
1. Energy Industries	17 363.5768	9.5640	43.4282						17 416.5690
2. Manufacturing Industries and Construction	1 751.5621	1.9274	3.9708						1 757.4603
3. Transport	4 435.3173	29.6577	102.6323						4 567.6074
4. Other Sectors	5 984.1624	190.9006	19.1687						6 194.2317
5. Other	80.4355	0.1741	0.9156						81.5251
B. Fugitive Emissions from Fuels	0.6140	762.3145	0.0001						762.9286
1. Solid Fuels	NO	NO	NO						NO
2. Oil and Natural Gas	0.6140	762.3145	0.0001						762.9286
C. CO_2 Transport and Storage	NO								NO
2. Industrial Processes and Product Use	**1 402.6293**	**NO**	**0.0164**	**NO**	**NO**	**NO**	**NO**	**NO**	**1 402.6457**
A. Mineral Industry	1 182.6733								1 182.6733
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	192.3631	NO	NO						192.3631

SOURCES OF GHG EMISSIONS	CO_2	CH_4	N_2O	HFCs	PFCs	SF_6	Unspecified mix of HFCs and PFCs	NF_3	Total
	CO_2 equivalent (kt)								
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**	**2 445.5377**	**2 410.8373**						**4 856.8975**
A. Enteric Fermentation		2 030.6501							2 030.6501
B. Manure Management		414.8876	1 042.7426						1 457.6302
C. Rice Cultivation		NO							NO
D. Agricultural Soils			1 368.0946						1 368.0946
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								NO
J. Other	NO	NO	NO						NO
4. LULUCF	**-7 639.3179**	**2.4026**	**59.5672**						**-7 577.3481**
A. Forest Land	-2 323.6314	0.0374	0.0247						-2 323.5693
B. Cropland	-2 097.4265	2.3651	56.3904						-2 038.6710
C. Grassland	-3 317.4207	NE	NE						-3 317.4207
D. Wetlands	-17.4403	NE	NE						-17.4403
E. Settlements	88.7139	NE	3.1521						91.8660
F. Other Land	152.4756	NE	NE						152.4756
G. Harvested Wood Products	-124.5885								-124.5885
H. Other	NO	NO	NO						NO
5. Waste	**17.1256**	**1 847.1960**	**83.5877**						**1 947.9094**
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	2.4183						28.3351
D. Wastewater Treatment and Discharge		739.7863	81.1694						820.9558
E. Other	NO	NO	NO						NO
6. Other	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	NO
Memo Items									
International Bunkers	**232.8115**	**1.2175**	**2.2052**						**236.2342**
Aviation	232.8115	1.2175	2.2052						236.2342
Navigation	NO	NO	NO						NO
Multilateral Operations	**NO**	**NO**	**NO**						**NO**
CO_2 Emissions from Biomass	427.7268								427.7268
CO_2 Captured and Stored	NO								NO
Long-term Storage of C in waste disposal sites	NO								NO
Indirect N_2O			541.1010						541.1010
Indirect CO_2	170.6429								170.6429
Total CO_2 equivalent (without Sector 4 „LULUCF)									**38 987.7748**
Total CO_2 equivalent (with Sector 4 „LULUCF”)									**31 410.4266**

1992

SOURCES OF GHG EMISSIONS	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)	**14 211.5365**	**4 859.5700**	**2 262.4750**	**NO**	**NO**	**NO**	**NO**	**NO**	**21 333.5815**
1. Energy	**20 487.2378**	**780.7597**	**101.9488**						**21 369.9464**
A. Fuel Combustion (Sectoral approach)	20 486.7203	90.6526	101.9487						20 679.3217
1. Energy Industries	13 010.9387	7.0694	32.8540						13 050.8621
2. Manufacturing Industries and Construction	1 013.7705	1.0293	2.1117						1 016.9115
3. Transport	2 142.4037	14.2055	57.4796						2 214.0887
4. Other Sectors	4 257.3797	68.2375	8.8965						4 334.5137
5. Other	62.2278	0.1110	0.6070						62.9457
B. Fugitive Emissions from Fuels	0.5175	690.1071	0.0001						690.6247
1. Solid Fuels	NO	NO	NO						NO
2. Oil and Natural Gas	0.5175	690.1071	0.0001						690.6247
C. CO_2 Transport and Storage	NO								NO
2. Industrial Processes and Product Use	**814.3567**	**NO**	**0.0149**	**NO**	**NO**	**NO**	**NO**	**NO**	**814.3716**
A. Mineral Industry	634.3365								634.3365
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	153.7706	NO	NO						153.7706
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**	**2 367.5139**	**2 029.7671**						**4 397.6714**
A. Enteric Fermentation		1 994.4621							1 994.4621
B. Manure Management		373.0518	935.4783						1 308.5300
C. Rice Cultivation		NO							NO
D. Agricultural Soils			1 094.2888						1 094.2888
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								NO
J. Other	NO	NO	NO						NO
4. LULUCF	**-7 107.5776**	**2.2003**	**53.9513**						**-7 051.4260**
A. Forest Land	-2 164.6662	0.0410	0.0270						-2 164.5982
B. Cropland	-2 231.6719	2.1593	49.4702						-2 180.0423
C. Grassland	-3 383.3454	NE	NE						-3 383.3454
D. Wetlands	-17.4403	NE	NE						-17.4403
E. Settlements	386.6196	NE	4.4541						391.0737
F. Other Land	418.8904	NE	NE						418.8904
G. Harvested Wood Products	-115.9639								-115.9639
H. Other	NO	NO	NO						NO
5. Waste	**17.1291**	**1 709.0961**	**76.7929**						**1 803.0181**

SOURCES OF GHG EMISSIONS	CO_2	CH_4	N_2O	HFCs	PFCs	SF_6	Unspecified mix of HFCs and PFCs	NF_3	Total
	CO_2 equivalent (kt)								
A. Solid Waste Disposal	NA, 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	2.4186						28.3399
D. Wastewater Treatment and Discharge		558.3477	74.3744						632.7221
E. Other	NO	NO	NO						NO
6. Other	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	NO
Memo Items									
International Bunkers	**96.2635**	**0.4725**	**0.9238**						**97.6598**
Aviation	96.2635	0.4725	0.9238						97.6598
Navigation	NO	NO	NO						NO
Multilateral Operations	**NO**	**NO**	**NO**						**NO**
CO_2 Emissions from Biomass	531.1505								531.1505
CO_2 Captured and Stored	NO								NO
Long-term Storage of C in waste disposal sites	NO								NO
Indirect N_2O			452.0686						452.0686
Indirect CO_2	140.7804								140.7804
Total CO_2 equivalent (without Sector 4 „LULUCF)									**28 385.0075**
Total CO_2 equivalent (with Sector 4 „LULUCF")									**21 333.5815**

1993

SOURCES OF GHG EMISSIONS	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)	**8 898.1834**	**4 597.3891**	**2 306.3866**	NO	NO	NO	NO	NO	**15 801.9591**
1. Energy	**15 345.5359**	**684.5489**	**102.9320**						**16 133.0168**
A. Fuel Combustion (Sectoral approach)	15 345.0977	64.4829	102.9320						15 512.5126
1. Energy Industries	10 737.0218	6.1175	27.6687						10 770.8079
2. Manufacturing Industries and Construction	563.0714	0.6825	1.3318						565.0857
3. Transport	1 699.7939	11.5341	65.8268						1 777.1549
4. Other Sectors	2 253.3852	46.0140	7.4045						2 306.8036
5. Other	91.8254	0.1348	0.7002						92.6604
B. Fugitive Emissions from Fuels	0.4382	620.0660	0.0000						620.5042
1. Solid Fuels	NO	NO	NO						NO
2. Oil and Natural Gas	0.4382	620.0660	0.0000						620.5042
C. CO_2 Transport and Storage	NO								NO
2. Industrial Processes and Product Use	**733.1321**	**NO**	**0.0179**	**NO**	**NO**	**NO**	**NO**	**NO**	**733.1500**
A. Mineral Industry	583.4616								583.4616
B. Chemical Industry	NO	NO	NO						NO
C. Metal Industry	24.4250	NO	NO	NO	NO	NO	NO	NO	24.4250
D. Non-energy Products From Fuels and Solvent Use	123.3910	NO	NO						123.3910
E. Electronic Industry				NO	NO	NO	NO	NO	NO
F. Product Use as Substitutes for ODS				NO	NO	NO	NO	NO	NO

SOURCES OF GHG EMISSIONS	CO_2	CH_4	N_2O	HFCs	PFCs	SF_6	Unspecified mix of HFCs and PFCs	NF_3	Total
	CO_2 equivalent (kt)								
G. Other Product Manufacture and Use	1.8544	NO	0.0179	NO	NO	NO	NO	NO	1.8723
H. Other									
3. Agriculture	**0.1276**	**2 149.4445**	**2 073.1365**						**4 222.7086**
A. Enteric Fermentation		1 875.3305							1 875.3305
B. Manure Management		274.1139	809.2207						1 083.3347
C. Rice Cultivation		NO							NO
D. Agricultural Soils			1 263.9157						1 263.9157
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								NO,NE
J. Other	NO	NO	NO						NO
4. LULUCF	**-7 197.7136**	**2.9469**	**58.1205**						**-7 136.6461**
A. Forest Land	-2 173.9910	0.0028	0.0018						-2 173.9864
B. Cropland	-2 078.6361	2.9441	53.8787						-2 021.8132
C. Grassland	-3 109.7949	NE	NE						-3 109.7949
D. Wetlands	-17.4403	NE	NE						-17.4403
E. Settlements	114.6181	NE	4.2400						118.8581
F. Other Land	164.1286	NE	NE						164.1286
G. Harvested Wood Products	-96.5980								-96.5980
H. Other	NO	NO	NO						NO
5. Waste	**17.1013**	**1 760.4488**	**72.1797**						**1 849.7299**
A. Solid Waste Disposal	NA, NO	1 204.7053							1 204.7053
B. Biological Treatment of Solid Waste		NO, NE	NO, NE						NO, NE
C. Incineration and Open Burning of Waste	17.1013	8.7772	2.4144						28.2929
D. Wastewater Treatment and Discharge		546.9664	69.7653						616.7317
E. Other	NO	NO	NO						NO
6. Other	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	NO
Memo Items									
International Bunkers	**62.0927**	**0.2475**	**0.5960**						**62.9362**
Aviation	62.0927	0.2475	0.5960						62.9362
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			427.7940						427.7940
Indirect CO_2	112.0762								112.0762
Total CO_2 equivalent (without Sector 4 „LULUCF)									**22 938.6052**
Total CO_2 equivalent (with Sector 4 „LULUCF")									**15 801.9591**

SOURCES OF GHG EMISSIONS	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)	**8 572.0914**	**4 425.3956**	**1 859.6577**	**NO**	**NO**	**NO**	**NO**	**NO**	**14 857.1447**
1. Energy	**14 410.2040**	**674.6385**	**66.2220**						**15 151.0645**
A. Fuel Combustion (Sectoral approach)	14 409.7955	77.8529	66.2220						14 553.8704
1. Energy Industries	9 935.3786	4.7137	25.8628						9 965.9551
2. Manufacturing Industries and Construction	828.8950	0.5723	0.9181						830.3854
3. Transport	1 485.6786	10.4212	31.3512						1 527.4509
4. Other Sectors	2 086.3753	61.9720	7.6567						2 156.0040
5. Other	73.4680	0.1738	0.4331						74.0749
B. Fugitive Emissions from Fuels	0.4085	596.7856	0.0000						597.1941
1. Solid Fuels	NO	NO	NO						NO
2. Oil and Natural Gas	0.4085	596.7856	0.0000						597.1941
C. CO_2 Transport and Storage	NO								NO
2. Industrial Processes and Product Use	**552.8842**	**NO**	**0.0149**	**NO**	**NO**	**NO**	**NO**	**NO**	**552.8991**
A. Mineral Industry	441.6001								441.6001
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	84.6033	NO	NO						84.6033
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**	**2 089.3133**	**1 662.3048**						**3 751.6719**
A. Enteric Fermentation		1 825.4271							1 825.4271
B. Manure Management		263.8862	782.3676						1 046.2538
C. Rice Cultivation		NO							NO
D. Agricultural Soils			879.9372						879.9372
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								NO,NE
J. Other	NO	NO	NO						NO
4. LULUCF	**-6 408.1835**	**1.6601**	**60.9789**						**-6 345.5445**
A. Forest Land	-2 088.6098	0.0624	0.0411						-2 088.5063
B. Cropland	-1 821.2418	1.5977	56.8713						-1 762.7727
C. Grassland	-3 104.1950	NE	NE						-3 104.1950
D. Wetlands	NO	NE	NE						NO, NE
E. Settlements	130.4883	NE	4.0664						134.5547
F. Other Land	541.0720	NE	NE						541.0720
G. Harvested Wood Products	-65.6972								-65.6972
H. Other	NO	NO	NO						NO

SOURCES OF GHG EMISSIONS	CO_2	CH_4	N_2O	HFCs	PFCs	SF_6	Unspecified mix of HFCs and PFCs	NF_3	Total
	CO_2 equivalent (kt)								
5. Waste	**17.1330**	**1 659.7837**	**70.1371**						**1 747.0538**
A. Solid Waste Disposal	NA, NO	1 209.7998							1 209.7998
B. Biological Treatment of Solid Waste		NO, NE	NO, NE						NO, NE
C. Incineration and Open Burning of Waste	17.1330	8.7926	2.4187						28.3443
D. Wastewater Treatment and Discharge		441.1912	67.7185						508.9097
E. Other	NO	NO	NO						NO
6. Other	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	NO
Memo Items									
International Bunkers	**37.8235**	**0.1450**	**0.3576**						**38.3261**
Aviation	37.8235	0.1450	0.3576						38.3261
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			345.2371						345.2371
Indirect CO_2	73.5058								73.5058
Total CO_2 equivalent (without Sector 4 „LULUCF)									**21 202.6893**
Total CO_2 equivalent (with Sector 4 „LULUCF")									**14 857.1447**

1995

SOURCES OF GHG EMISSIONS	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)	**5 037.3423**	**4 169.4919**	**1 956.3230**	**4.5879**	**NO**	**NO**	**NO**	**NO**	**11 167.7451**
1. Energy	**11 122.6101**	**709.7665**	**53.1161**						**11 885.4927**
A. Fuel Combustion (Sectoral approach)	11 122.1908	48.3784	53.1161						11 223.6852
1. Energy Industries	6 886.3081	3.2976	14.7808						6 904.3865
2. Manufacturing Industries and Construction	463.9562	0.3873	0.6676						465.0111
3. Transport	1 482.0856	10.6891	30.1708						1 522.9456
4. Other Sectors	2 172.1646	33.7536	6.8659						2 212.7842
5. Other	117.6762	0.2508	0.6309						118.5579
B. Fugitive Emissions from Fuels	0.4194	661.3881	0.0000						661.8075
1. Solid Fuels	NO	NO	NO						NO
2. Oil and Natural Gas	0.4194	661.3881	0.0000						661.8075
C. CO_2 Transport and Storage	NO								NO
2. Industrial Processes and Product Use	**448.9341**	**NO**	**0.0003**	**4.5879**	**NO**	**NO**	**NO**	**NO**	**453.5222**
A. Mineral Industry	345.1199								345.1199
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	76.4826	NO	NO						76.4826
E. Electronic Industry				NO	NO	NO	NO	NO	NO

SOURCES OF GHG EMISSIONS	CO_2	CH_4	N_2O	HFCs	PFCs	SF_6	Unspecified mix of HFCs and PFCs	NF_3	Total
	CO_2 equivalent (kt)								
F. Product Use as Substitutes for ODS				4.5879	NO	NO	NO	NO	4.5879
G. Other Product Manufacture and Use	1.0947	NO	0.0003	NO	NO	NO	NO	NO	1.0950
H. Other									
3. Agriculture	**0.0607**	**1 825.3852**	**1 765.1411**						**3 590.5870**
A. Enteric Fermentation		1 620.6669							1 620.6669
B. Manure Management		204.7183	722.6727						927.3910
C. Rice Cultivation		NO							NO
D. Agricultural Soils			1 042.4684						1 042.4684
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								NO,NE
J. Other	NO	NO	NO						NO
4. LULUCF	**-6 551.3841**	**2.2399**	**67.0894**						**-6 482.0548**
A. Forest Land	-2 025.7694	0.0036	0.0024						-2 025.7634
B. Cropland	-1 919.9573	2.2363	63.1320						-1 854.5890
C. Grassland	-3 088.4744	NE	NE						-3 088.4744
D. Wetlands	NO	NE	NE						NO, NE
E. Settlements	106.9167	NE	3.9551						110.8718
F. Other Land	392.7422	NE	NE						392.7422
G. Harvested Wood Products	-16.8419								-16.8419
H. Other	NO	NO	NO						NO
5. Waste	**17.1216**	**1 632.1003**	**70.9760**						**1 720.1979**
A. Solid Waste Disposal	NA, NO	1 209.1845							1 209.1845
B. Biological Treatment of Solid Waste		NO, NE	NO, NE						NO, NE
C. Incineration and Open Burning of Waste	17.1216	8.7859	2.4168						28.3243
D. Wastewater Treatment and Discharge		414.1298	68.5592						482.6890
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	230.0502								230.0502
CO_2 Captured and Stored	NO								NO
Long-term Storage of C in waste disposal sites	NO								NO
Indirect N_2O			357.6355						357.6355
Indirect CO_2	65.3743								65.3743
								Total CO_2 equivalent (without Sector 4 „LULUCF)	**17 649.7999**
								Total CO_2 equivalent (with Sector 4 „LULUCF")	**11 167.7451**

1996

SOURCES OF GHG EMISSIONS	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)	**5 471.7141**	**4 095.1671**	**1 913.9897**	**5.1847**	**NO**	**NO**	**NO**	**NO**	**11 486.0556**
1. Energy	**11 342.9211**	**792.9911**	**52.7801**						**12 188.6923**
A. Fuel Combustion (Sectoral approach)	11 342.4485	74.1036	52.7801						11 469.3322
1. Energy Industries	7 155.3361	3.3949	14.2024						7 172.9335
2. Manufacturing Industries and Construction	377.6208	0.3440	0.6059						378.5707
3. Transport	1 451.6525	10.3124	28.9638						1 490.9287
4. Other Sectors	2 274.8811	59.7762	8.3157						2 342.9730
5. Other	82.9580	0.2761	0.6922						83.9263
B. Fugitive Emissions from Fuels	0.4726	718.8875	0.0000						719.3601
1. Solid Fuels	NO	NO	NO						NO
2. Oil and Natural Gas	0.4726	718.8875	0.0000						719.3601
C. CO_2 Transport and Storage	NO								NO
2. Industrial Processes and Product Use	**407.6878**	**NO**	**0.0006**	**5.1847**	**NO**	**NO**	**NO**	**NO**	**412.8731**
A. Mineral Industry	308.9247								308.9247
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	70.9984	NO	NO						70.9984
E. Electronic Industry				NO	NO	NO	NO	NO	NO
F. Product Use as Substitutes for ODS				5.1847	NO	NO	NO	NO	5.1847
G. Other Product Manufacture and Use	1.0386	NO	0.0006	NO	NO	NO	NO	NO	1.0392
H. Other									
3. Agriculture	**0.0911**	**1 677.8577**	**1 722.9511**						**3 400.9000**
A. Enteric Fermentation		1 491.1824							1 491.1824
B. Manure Management		186.6754	768.5050						955.1803
C. Rice Cultivation		NO							NO
D. Agricultural Soils			954.4462						954.4462
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								NO
J. Other	NO	NO	NO						NO
4. LULUCF	**-6 296.0942**	**1.5426**	**68.3186**						**-6 226.2331**
A. Forest Land	-2 171.1779	0.0209	0.0138						-2 171.1433
B. Cropland	-1 535.5834	1.5217	64.5468						-1 469.5149
C. Grassland	-2 903.6947	NE	NE						-2 903.6947
D. Wetlands	NO	NE	NE						NO, NE
E. Settlements	101.5910	NE	3.7581						105.3491
F. Other Land	208.9434	NE	NE						208.9434
G. Harvested Wood Products	3.8273								3.8273
H. Other	NO	NO	NO						NO
5. Waste	**17.1083**	**1 622.7757**	**69.9393**						**1 709.8232**

SOURCES OF GHG EMISSIONS	CO_2	CH_4	N_2O	HFCs	PFCs	SF_6	Unspecified mix of HFCs and PFCs	NF_3	Total
	CO_2 equivalent (kt)								
A. Solid Waste Disposal	NA, NO	1 216.7840							1 216.7840
B. Biological Treatment of Solid Waste		NO, NE	NO, NE						NO, NE
C. Incineration and Open Burning of Waste	17.1083	8.7782	2.4147						28.3012
D. Wastewater Treatment and Discharge		397.2135	67.5246						464.7381
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**
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	295.4440								295.4440
CO_2 Captured and Stored	NO								NO
Long-term Storage of C in waste disposal sites	NO								NO
Indirect N_2O			350.2694						350.2694
Indirect CO_2	60.4993								60.4993
								Total CO_2 equivalent (without Sector 4 „LULUCF)	**17 712.2886**
								Total CO_2 equivalent (with Sector 4 „LULUCF")	**11 486.0556**

1997

SOURCES OF GHG EMISSIONS	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)	**4 563.4052**	**3 720.8109**	**1 923.9268**	**5.9997**	**NO**	**NO**	**NO**	**NO**	**10 214.1426**
1. Energy	**10 252.1997**	**650.5698**	**44.8799**						**10 947.6494**
A. Fuel Combustion (Sectoral approach)	10 251.7346	59.5005	44.8799						10 356.1150
1. Energy Industries	5 615.5061	2.7691	7.2855						5 625.5607
2. Manufacturing Industries and Construction	597.7916	0.5052	0.8056						599.1025
3. Transport	1 469.7744	11.4066	28.7902						1 509.9711
4. Other Sectors	2 496.0098	44.6268	7.4329						2 548.0695
5. Other	72.6527	0.1929	0.5657						73.4112
B. Fugitive Emissions from Fuels	0.4651	591.0693	0.0000						591.5343
1. Solid Fuels	NO	NO	NO						NO
2. Oil and Natural Gas	0.4651	591.0693	0.0000						591.5343
C. CO_2 Transport and Storage	NO								NO
2. Industrial Processes and Product Use	**449.0073**	**NO**	**0.0009**	**5.9997**	**NO**	**NO**	**NO**	**NO**	**455.0080**
A. Mineral Industry	373.6804								373.6804
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	42.0075	NO	NO						42.0075
E. Electronic Industry				NO	NO	NO	NO	NO	NO
F. Product Use as Substitutes for ODS				5.9997	NO	NO	NO	NO	5.9997

SOURCES OF GHG EMISSIONS	CO_2	CH_4	N_2O	HFCs	PFCs	SF_6	Unspecified mix of HFCs and PFCs	NF_3	Total
	CO_2 equivalent (kt)								
G. Other Product Manufacture and Use	0.9389	NO	0.0009	NO	NO	NO	NO	NO	0.9398
H. Other									
3. Agriculture	**1.0992**	**1 436.6865**	**1 743.2337**						**3 181.0194**
A. Enteric Fermentation		1 285.0958							1 285.0958
B. Manure Management		151.5907	592.7501						744.3408
C. Rice Cultivation		NO							NO
D. Agricultural Soils			1 150.4836						1 150.4836
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								NO
J. Other	NO	NO	NO						NO
4. LULUCF	**-6 155.9621**	**2.6885**	**64.6443**						**-6 088.6293**
A. Forest Land	-2 213.0439	0.0063	0.0042						-2 213.0333
B. Cropland	-1 451.2728	2.6821	60.9763						-1 387.6144
C. Grassland	-2 771.9741	NE	NE						-2 771.9741
D. Wetlands	NO	NE	NE						NO, NE
E. Settlements	100.7954	NE	3.6638						104.4592
F. Other Land	179.8504	NE	NE						179.8504
G. Harvested Wood Products	-0.3171								-0.3171
H. Other	NO	NO	NO						NO
5. Waste	**17.0610**	**1 630.8662**	**71.1680**						**1 719.0952**
A. Solid Waste Disposal	NA, NO	1 203.7861							1 203.7861
B. Biological Treatment of Solid Waste		NO, NE	NO, NE						NO, NE
C. Incineration and Open Burning of Waste	17.0610	8.7529	2.4077						28.2217
D. Wastewater Treatment and Discharge		418.3272	68.7603						487.0875
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	291.0280								291.0280
CO_2 Captured and Stored	NO								NO
Long-term Storage of C in waste disposal sites	NO								NO
Indirect N_2O			348.5356						348.5356
Indirect CO_2	32.0316								32.0316
Total CO_2 equivalent (without Sector 4 „LULUCF)									**16 302.7720**
Total CO_2 equivalent (with Sector 4 „LULUCF”)									**10 214.1426**

1998

SOURCES OF GHG EMISSIONS	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)	**2 974.0273**	**3 535.2299**	**1 747.9833**	**7.4843**	**NO**	**NO**	**NO**	**NO**	**8 264.7248**
1. Energy	**8 794.4337**	**595.6524**	**36.8939**						**9 426.9800**
A. Fuel Combustion (Sectoral approach)	8 794.0063	42.5281	36.8939						8 873.4283
1. Energy Industries	4 848.6438	2.4079	5.7192						4 856.7709
2. Manufacturing Industries and Construction	559.0312	0.4007	0.6246						560.0565
3. Transport	1 273.6172	9.7440	23.9388						1 307.3000
4. Other Sectors	2 056.9647	29.7831	6.0686						2 092.8164
5. Other	55.7495	0.1924	0.5426						56.4845
B. Fugitive Emissions from Fuels	0.4274	553.1242	0.0000						553.5516
1. Solid Fuels	NO	NO	NO						NO
2. Oil and Natural Gas	0.4274	553.1242	0.0000						553.5516
C. CO_2 Transport and Storage	NO								NO
2. Industrial Processes and Product Use	**373.4402**	**NO**	**0.0015**	**7.4843**	**NO**	**NO**	**NO**	**NO**	**380.9260**
A. Mineral Industry	306.5335								306.5335
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	37.5225	NO	NO						37.5225
E. Electronic Industry				NO	NO	NO	NO	NO	NO
F. Product Use as Substitutes for ODS				7.4843	NO	NO	NO	NO	7.4843
G. Other Product Manufacture and Use	0.7020	NO	0.0015	NO	NO	NO	NO	NO	0.7035
H. Other									
3. Agriculture	**0.2721**	**1 374.5289**	**1 571.9426**						**2 946.7437**
A. Enteric Fermentation		1 247.5501							1 247.5501
B. Manure Management		126.9789	572.5096						699.4885
C. Rice Cultivation		NO							NO
D. Agricultural Soils			999.4330						999.4330
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								NO
J. Other	NO	NO	NO						NO
4. LULUCF	**-6 211.1275**	**2.4766**	**67.2812**						**-6 141.3696**
A. Forest Land	-2 269.2309	0.0628	0.0414						-2 269.1268
B. Cropland	-1 348.2104	2.4139	63.5760						-1 282.2206
C. Grassland	-2 848.0605	NE	NE						-2 848.0605
D. Wetlands	NO	NE	NE						NO,NE
E. Settlements	99.0440	NE	3.6638						102.7078
F. Other Land	176.6218	NE	NE						176.6218
G. Harvested Wood Products	-21.2914								-21.2914
H. Other	NO	NO	NO						NO
5. Waste	**17.0087**	**1 562.5719**	**71.8641**						**1 651.4447**

SOURCES OF GHG EMISSIONS	CO_2	CH_4	N_2O	HFCs	PFCs	SF_6	Unspecified mix of HFCs and PFCs	NF_3	Total
	CO_2 equivalent (kt)								
A. Solid Waste Disposal	NA, NO	1 189.3434							1 189.3434
B. Biological Treatment of Solid Waste		NO, NE	NO, NE						NO, NE
C. Incineration and Open Burning of Waste	17.0087	8.7250	2.4001						28.1338
D. Wastewater Treatment and Discharge		364.5035	69.4640						433.9675
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			310.5215						310.5215
Indirect CO_2	29.8264								29.8264
Total CO_2 equivalent (without Sector 4 „LULUCF)									**14 406.0944**
Total CO_2 equivalent (with Sector 4 „LULUCF")									**8 264.7248**

1999

SOURCES OF GHG EMISSIONS	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)	**1 017.6408**	**3 393.9296**	**1 590.6439**	**8.5714**	**NO**	**NO**	**NO**	**NO**	**6 010.7857**
1. Energy	**6 849.6505**	**598.7975**	**24.0593**						**7 472.5074**
A. Fuel Combustion (Sectoral approach)	6 849.2574	38.6850	24.0593						6 912.0017
1. Energy Industries	3 660.4440	1.8166	2.6147						3 664.8753
2. Manufacturing Industries and Construction	491.5201	0.3307	0.4892						492.3400
3. Transport	854.3647	5.8532	15.0693						875.2873
4. Other Sectors	1 798.5838	30.5267	5.4281						1 834.5386
5. Other	44.3448	0.1578	0.4579						44.9606
B. Fugitive Emissions from Fuels	0.3931	560.1125	0.0000						560.5056
1. Solid Fuels	NO	NO	NO						NO
2. Oil and Natural Gas	0.3931	560.1125	0.0000						560.5056
C. CO_2 Transport and Storage	NO								NO
2. Industrial Processes and Product Use	**336.6304**	**NO**	**0.0128**	**8.5714**	**NO**	**NO**	**NO**	**NO**	**345.2145**
A. Mineral Industry	272.6662								272.6662
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	31.5638	NO	NO						31.5638
E. Electronic Industry				NO	NO	NO	NO	NO	NO
F. Product Use as Substitutes for ODS				8.5714	NO	NO	NO	NO	8.5714

SOURCES OF GHG EMISSIONS	CO_2	CH_4	N_2O	HFCs	PFCs	SF_6	Unspecified mix of HFCs and PFCs	NF_3	Total
	CO_2 equivalent (kt)								
G. Other Product Manufacture and Use	0.6062	NO	0.0128	NO	NO	NO	NO	NO	0.6190
H. Other									
3. Agriculture	**0.0034**	**1 265.6370**	**1 423.5440**						**2 689.1844**
A. Enteric Fermentation		1 154.2198							1 154.2198
B. Manure Management		111.4172	517.9332						629.3504
C. Rice Cultivation		NO							NO
D. Agricultural Soils			905.6109						905.6109
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								NO
J. Other	NO	NO	NO						NO
4. LULUCF	**-6 185.6213**	**2.3923**	**71.1684**						**-6 112.0606**
A. Forest Land	-2 317.6962	0.0469	0.0309						-2 317.6183
B. Cropland	-1 413.2991	2.3454	67.7134						-1 343.2403
C. Grassland	-2 972.0904	NE	NE						-2 972.0904
D. Wetlands	NO	NE	NE						NO, NE
E. Settlements	111.8259	NE	3.4240						115.2499
F. Other Land	416.7695	NE	NE						416.7695
G. Harvested Wood Products	-11.1310								-11.1310
H. Other	NO	NO	NO						NO
5. Waste	**16.9778**	**1 527.1028**	**71.8594**						**1 615.9400**
A. Solid Waste Disposal	NA, NO	1 195.2115							1 195.2115
B. Biological Treatment of Solid Waste		NO, NE	NO, NE						NO, NE
C. Incineration and Open Burning of Waste	16.9778	8.7081	2.3954						28.0813
D. Wastewater Treatment and Discharge		323.1832	69.4640						392.6472
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**
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			278.8858						278.8858
Indirect CO_2	26.1011								26.1011
Total CO_2 equivalent (without Sector 4 „LULUCF)									**12 122.8464**
Total CO_2 equivalent (with Sector 4 „LULUCF")									**6 010.7857**

SOURCES OF GHG EMISSIONS	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)	**319.9055**	**3 321.8503**	**1 498.5143**	**10.4630**	**NO**	**NO**	**NO**	**NO**	**5 150.7331**
1. Energy	**6 124.4101**	**638.8655**	**24.5354**						**6 787.8110**
A. Fuel Combustion (Sectoral approach)	6 124.0342	38.2310	24.5353						6 186.8005
1. Energy Industries	3 155.7517	1.5249	2.0520						3 159.3286
2. Manufacturing Industries and Construction	537.2463	0.3069	0.4433						537.9965
3. Transport	926.2051	5.9241	16.7172						948.8464
4. Other Sectors	1 478.8536	30.3852	5.0960						1 514.3349
5. Other	25.9774	0.0898	0.2269						26.2941
B. Fugitive Emissions from Fuels	0.3759	600.6346	0.0000						601.0105
1. Solid Fuels	NO	NO	NO						NO
2. Oil and Natural Gas	0.3759	600.6346	0.0000						601.0105
C. CO_2 Transport and Storage	NO								NO
2. Industrial Processes and Product Use	**308.5696**	**NO**	**0.0131**	**10.4630**	**NO**	**NO**	**NO**	**NO**	**319.0457**
A. Mineral Industry	240.0428								240.0428
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	31.3591	NO	NO						31.3591
E. Electronic Industry				NO	NO	NO	NO	NO	NO
F. Product Use as Substitutes for ODS				10.4630	NO	NO	NO	NO	10.4630
G. Other Product Manufacture and Use	0.8987	NO	0.0131	NO	NO	NO	NO	NO	0.9118
H. Other									
3. Agriculture	**0.4397**	**1 170.2811**	**1 329.4855**						**2 500.2063**
A. Enteric Fermentation		1 085.6884							1 085.6884
B. Manure Management		84.5927	464.7815						549.3742
C. Rice Cultivation		NO							NO
D. Agricultural Soils			864.7040						864.7040
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								NO
J. Other	NO	NO	NO						NO
4. LULUCF	**-6 130.4573**	**0.9124**	**72.5239**						**-6 057.0210**
A. Forest Land	-2 288.3306	0.0017	0.0011						-2 288.3278
B. Cropland	-1 284.6926	0.9107	69.7241						-1 214.0578
C. Grassland	-2 844.3351	NE	NE						-2 844.3351
D. Wetlands	NO	NE	NE						NO, NE
E. Settlements	100.1768	NE	2.7987						102.9755
F. Other Land	170.1387	NE	NE						170.1387
G. Harvested Wood Products	16.5854								16.5854
H. Other	NO	NO	NO						NO
5. Waste	**16.9434**	**1 511.7913**	**71.9564**						**1 600.6911**

SOURCES OF GHG EMISSIONS	CO_2	CH_4	N_2O	HFCs	PFCs	SF_6	Unspecified mix of HFCs and PFCs	NF_3	Total
	CO_2 equivalent (kt)								
A. Solid Waste Disposal	NA, NO	1 169.5079							1 169.5079
B. Biological Treatment of Solid Waste		NO, NE	NO, NE						NO, NE
C. Incineration and Open Burning of Waste	16.9434	8.6893	2.3902						28.0229
D. Wastewater Treatment and Discharge		333.5941	69.5662						403.1602
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			258.6705						258.6705
Indirect CO_2	26.4431								26.4431
Total CO_2 equivalent (without Sector 4 „LULUCF)									**11 207.7541**
Total CO_2 equivalent (with Sector 4 „LULUCF”)									**5 150.7331**

2001

SOURCES OF GHG EMISSIONS	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)	**1 183.6537**	**3 323.7409**	**1 663.1026**	**12.8513**	**NO**	**NO**	**NO**	**NO**	**6 183.3485**
1. Energy	**6 731.0024**	**630.6624**	**26.3824**						**7 388.0471**
A. Fuel Combustion (Sectoral approach)	6 730.5931	35.1419	26.3823						6 792.1173
1. Energy Industries	3 677.7189	1.8154	2.3940						3 681.9284
2. Manufacturing Industries and Construction	618.7855	0.3762	0.5826						619.7443
3. Transport	989.3629	6.2887	18.1976						1 013.8491
4. Other Sectors	1 416.7615	26.5451	4.8642						1 448.1708
5. Other	27.9644	0.1164	0.3439						28.4247
B. Fugitive Emissions from Fuels	0.4092	595.5205	0.0001						595.9298
1. Solid Fuels	NO	NO	NO						NO
2. Oil and Natural Gas	0.4092	595.5205	0.0001						595.9298
C. CO_2 Transport and Storage	NO								NO
2. Industrial Processes and Product Use	**311.3929**	**NO**	**0.0131**	**12.8513**	**NO**	**NO**	**NO**	**NO**	**324.2573**
A. Mineral Industry	237.3637								237.3637
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	34.6288	NO	NO						34.6288
E. Electronic Industry				NO	NO	NO	NO	NO	NO
F. Product Use as Substitutes for ODS				12.8513	NO	NO	NO	NO	12.8513

SOURCES OF GHG EMISSIONS	CO_2	CH_4	N_2O	HFCs	PFCs	SF_6	Unspecified mix of HFCs and PFCs	NF_3	Total
	CO_2 equivalent (kt)								
G. Other Product Manufacture and Use	0.7730	NO	0.0131	NO	NO	NO	NO	NO	0.7861
H. Other									
3. Agriculture	**0.1496**	**1 190.6828**	**1 481.9718**						**2 672.8041**
A. Enteric Fermentation		1 105.3365							1 105.3365
B. Manure Management		85.3462	472.7172						558.0634
C. Rice Cultivation		NO							NO
D. Agricultural Soils			1 009.2546						1 009.2546
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								NO
J. Other	NO	NO	NO						NO
4. LULUCF	**-5 875.8873**	**1.2780**	**81.7760**						**-5 792.8332**
A. Forest Land	-2 254.6081	0.1061	0.0700						-2 254.4319
B. Cropland	-1 106.4081	1.1719	79.2242						-1 026.0120
C. Grassland	-2 755.9956	NE	NE						-2 755.9956
D. Wetlands	NO	NE	NE						NO, NE
E. Settlements	67.0898	NE	2.4818						69.5716
F. Other Land	170.1387	NE	NE						170.1387
G. Harvested Wood Products	3.8960								3.8960
H. Other	NO	NO	NO						NO
5. Waste	**16.9961**	**1 501.1177**	**72.9594**						**1 591.0731**
A. Solid Waste Disposal	NA, NO	1 137.4601							1 137.4601
B. Biological Treatment of Solid Waste		NO, NE	NO, NE						NO, NE
C. Incineration and Open Burning of Waste	16.9961	8.7152	2.3973						28.1086
D. Wastewater Treatment and Discharge		354.9424	70.5620						425.5045
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			287.7677						287.7677
Indirect CO_2	29.0498								29.0498
Total CO_2 equivalent (without Sector 4 „LULUCF)									**11 976.1817**
Total CO_2 equivalent (with Sector 4 „LULUCF")									**6 183.3485**

2002

SOURCES OF GHG EMISSIONS	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)	**1 832.4957**	**3 368.3558**	**1 717.3178**	**16.8928**	**NO**	**NO**	**NO**	**NO**	**6 935.0621**
1. Energy	**6 405.6634**	**691.4185**	**35.2365**						**7 132.3183**
A. Fuel Combustion (Sectoral approach)	6 405.2733	44.3563	35.2364						6 484.8660
1. Energy Industries	2 933.2101	1.5342	2.0510						2 936.7953
2. Manufacturing Industries and Construction	431.7808	0.2573	0.3789						432.4170
3. Transport	1 261.6952	8.1078	26.5949						1 296.3979
4. Other Sectors	1 743.4526	34.2532	5.7503						1 783.4561
5. Other	35.1345	0.2037	0.4615						35.7997
B. Fugitive Emissions from Fuels	0.3901	647.0622	0.0001						647.4523
1. Solid Fuels	NO	NO	NO						NO
2. Oil and Natural Gas	0.3901	647.0622	0.0001						647.4523
C. CO_2 Transport and Storage	NO								NO
2. Industrial Processes and Product Use	**360.0955**	**NO**	**0.0131**	**16.8928**	**NO**	**NO**	**NO**	**NO**	**377.0015**
A. Mineral Industry	302.8397								302.8397
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	36.0221	NO	NO						36.0221
E. Electronic Industry				NO	NO	NO	NO	NO	NO
F. Product Use as Substitutes for ODS				16.8928	NO	NO	NO	NO	16.8928
G. Other Product Manufacture and Use	0.7307	NO	0.0131	NO	NO	NO	NO	NO	0.7438
H. Other									
3. Agriculture	**0.0470**	**1 218.1391**	**1 524.2668**						**2 742.4530**
A. Enteric Fermentation		1 128.6451							1 128.6451
B. Manure Management		89.4941	476.8327						566.3268
C. Rice Cultivation		NO							NO
D. Agricultural Soils			1 047.4341						1 047.4341
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								NO
J. Other	NO	NO	NO						NO
4. LULUCF	**-4 950.2508**	**0.2701**	**83.0170**						**-4 866.9638**
A. Forest Land	-2 248.5141	0.0570	0.0376						-2 248.4195
B. Cropland	-696.2856	0.2131	80.4976						-615.5749
C. Grassland	-2 512.2749	NE	NE						-2 512.2749
D. Wetlands	NO	NE	NE						NO, NE
E. Settlements	67.0898	NE	2.4818						69.5716
F. Other Land	447.8610	NE	NE						447.8610
G. Harvested Wood Products	-8.1271								-8.1271
H. Other	NO	NO	NO						NO
5. Waste	**16.9406**	**1 458.5282**	**74.7844**						**1 550.2532**

SOURCES OF GHG EMISSIONS	CO_2	CH_4	N_2O	HFCs	PFCs	SF_6	Unspecified mix of HFCs and PFCs	NF_3	Total
	CO_2 equivalent (kt)								
A. Solid Waste Disposal	NA, NO	1 108.0536							1 108.0536
B. Biological Treatment of Solid Waste		NO, NE	NO, NE						NO, NE
C. Incineration and Open Burning of Waste	16.9406	8.6854	2.3892						28.0151
D. Wastewater Treatment and Discharge		341.7891	72.3953						414.1844
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**
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	324.9000								324.9000
CO_2 Captured and Stored	NO								NO
Long-term Storage of C in waste disposal sites	NO								NO
Indirect N_2O			298.1908						298.1908
Indirect CO_2	31.0887								31.0887
Total CO_2 equivalent (without Sector 4 „LULUCF)									**11 802.0259**
Total CO_2 equivalent (with Sector 4 „LULUCF")									**6 935.0621**

2003

SOURCES OF GHG EMISSIONS	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)	**2 473.1835**	**3 294.0401**	**1 503.8766**	**23.6694**	**NO**	**0.0071**	**NO**	**NO**	**7 294.7767**
1. Energy	**7 080.9417**	**733.0357**	**36.0183**						**7 849.9958**
A. Fuel Combustion (Sectoral approach)	7 079.8825	56.5730	36.0169						7 172.4724
1. Energy Industries	3 036.7432	1.5649	2.0677						3 040.3758
2. Manufacturing Industries and Construction	456.6402	0.2578	0.3734						457.2714
3. Transport	1 477.1916	9.5268	26.0088						1 512.7271
4. Other Sectors	2 082.5048	45.1340	7.3205						2 134.9593
5. Other	26.8027	0.0896	0.2465						27.1388
B. Fugitive Emissions from Fuels	1.0592	676.4627	0.0014						677.5233
1. Solid Fuels	NO	NO	NO						NO
2. Oil and Natural Gas	1.0592	676.4627	0.0014						677.5233
C. CO_2 Transport and Storage	NO								NO
2. Industrial Processes and Product Use	**388.2276**	**NO**	**0.0131**	**23.6694**	**NO**	**0.0071**	**NO**	**NO**	**411.9173**
A. Mineral Industry	311.0548								311.0548
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	40.8564	NO	NO						40.8564
E. Electronic Industry				NO	NO	NO	NO	NO	NO
F. Product Use as Substitutes for ODS				23.6694	NO	NO	NO	NO	23.6694

SOURCES OF GHG EMISSIONS	CO_2	CH_4	N_2O	HFCs	PFCs	SF_6	Unspecified mix of HFCs and PFCs	NF_3	Total
	CO_2 equivalent (kt)								
G. Other Product Manufacture and Use	0.8881	NO	0.0131	NO	NO	0.0071	NO	NO	0.9083
H. Other									
3. Agriculture	**0.2381**	**1 114.4621**	**1 309.8618**						**2 424.5620**
A. Enteric Fermentation		1 031.1265							1 031.1265
B. Manure Management		83.3355	453.3829						536.7184
C. Rice Cultivation		NO							NO
D. Agricultural Soils			856.4789						856.4789
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								NO
J. Other	NO	NO	NO						NO
4. LULUCF	**-5 013.0963**	**0.0658**	**85.6987**						**-4 927.3318**
A. Forest Land	-2 250.9181	0.0624	0.0411						-2 250.8146
B. Cropland	-646.0039	0.0034	83.4751						-562.5254
C. Grassland	-2 277.6455	NE	NE						-2 277.6455
D. Wetlands	NO	NE	NE						NO, NE
E. Settlements	67.8615	NE	2.1825						70.0440
F. Other Land	152.1220	NE	NE						152.1220
G. Harvested Wood Products	-58.5123								-58.5123
H. Other	NO	NO	NO						NO
5. Waste	**16.8724**	**1 446.4765**	**72.2847**						**1 535.6336**
A. Solid Waste Disposal	NA, NO	1 070.2266							1 070.2266
B. Biological Treatment of Solid Waste		NO, NE	NO, NE						NO, NE
C. Incineration and Open Burning of Waste	16.8724	8.6490	2.3792						27.9006
D. Wastewater Treatment and Discharge		367.6009	69.9055						437.5064
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			257.0113						257.0113
Indirect CO_2	33.5726								33.5726
Total CO_2 equivalent (without Sector 4 „LULUCF)									**12 222.1086**
Total CO_2 equivalent (with Sector 4 „LULUCF”)									**7 294.7767**

SOURCES OF GHG EMISSIONS	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)	**4 046.3301**	**3 262.4156**	**1 747.2048**	**31.0742**	**NO**	**0.0071**	**NO**	**NO**	**9 087.0319**
1. Energy	**7 540.7092**	**783.5355**	**39.4695**						**8 363.7142**
A. Fuel Combustion (Sectoral approach)	7 539.6047	49.2892	39.4680						7 628.3619
1. Energy Industries	3 107.0816	1.5984	2.1069						3 110.7870
2. Manufacturing Industries and Construction	471.0767	0.3169	0.4794						471.8730
3. Transport	1 668.7316	10.2351	30.3077						1 709.2744
4. Other Sectors	2 258.9904	37.0540	6.2527						2 302.2970
5. Other	33.7244	0.0849	0.3213						34.1306
B. Fugitive Emissions from Fuels	1.1045	734.2463	0.0015						735.3523
1. Solid Fuels	NO	NO	NO						NO
2. Oil and Natural Gas	1.1045	734.2463	0.0015						735.3523
C. CO_2 Transport and Storage	NO								NO
2. Industrial Processes and Product Use	**458.6192**	**NO**	**0.0149**	**31.0742**	**NO**	**0.0071**	**NO**	**NO**	**489.7155**
A. Mineral Industry	353.3699								353.3699
B. Chemical Industry	NO	NO	NO						NO
C. Metal Industry	40.5084	NO	NO	NO	quNO	NO	NO	NO	40.5084
D. Non-energy Products From Fuels and Solvent Use	63.7753	NO	NO						63.7753
E. Electronic Industry				NO	NO	NO	NO	NO	NO
F. Product Use as Substitutes for ODS				31.0742	NO	NO	NO	NO	31.0742
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**	**1 043.3273**	**1 548.3781**						**2 592.0722**
A. Enteric Fermentation		962.2832							962.2832
B. Manure Management		81.0440	438.9507						519.9947
C. Rice Cultivation		NO							NO
D. Agricultural Soils			1 109.4274						1 109.4274
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								NO
J. Other	NO	NO	NO						NO
4. LULUCF	**-3 969.9582**	**0.2129**	**85.0970**						**-3 884.6483**
A. Forest Land	-2 315.5844	0.1639	0.1081						-2 315.3124
B. Cropland	524.5167	0.0490	83.0035						607.5692
C. Grassland	-2 316.5028	NE	NE						-2 316.5028
D. Wetlands	NO	NE	NE						NO, NE
E. Settlements	53.6737	NE	1.9855						55.6592
F. Other Land	150.8347	NE	NE						150.8347
G. Harvested Wood Products	-66.8962								-66.8962
H. Other	NO	NO	NO						NO
5. Waste	**16.5930**	**1 435.3399**	**74.2453**						**1 526.1783**

SOURCES OF GHG EMISSIONS	CO_2	CH_4	N_2O	HFCs	PFCs	SF_6	Unspecified mix of HFCs and PFCs	NF_3	Total
	CO_2 equivalent (kt)								
A. Solid Waste Disposal	NA, NO	1 055.1542							1 055.1542
B. Biological Treatment of Solid Waste		NO, NE	NO, NE						NO, NE
C. Incineration and Open Burning of Waste	16.5930	8.5040	2.3393						27.4363
D. Wastewater Treatment and Discharge		371.6817	71.9060						443.5877
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			301.5084						301.5084
Indirect CO_2	56.4699								56.4699
Total CO_2 equivalent (without Sector 4 „LULUCF)									**12 971.6802**
Total CO_2 equivalent (with Sector 4 „LULUCF")									**9 087.0319**

2005

SOURCES OF GHG EMISSIONS	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)	**3 544.7338**	**3 303.2225**	**1 759.5731**	**42.1522**	**NO**	**0.0569**	**NO**	**NO**	**8 649.7384**
1. Energy	**7 811.9510**	**827.2272**	**42.5564**						**8 681.7347**
A. Fuel Combustion (Sectoral approach)	7 810.8291	51.7932	42.5550						7 905.1774
1. Energy Industries	3 229.4503	1.6505	2.1572						3 233.2579
2. Manufacturing Industries and Construction	603.9661	0.3633	0.5291						604.8584
3. Transport	1 723.9901	10.5545	33.4283						1 767.9729
4. Other Sectors	2 218.7801	39.1561	6.1343						2 264.0705
5. Other	34.6426	0.0689	0.3062						35.0177
B. Fugitive Emissions from Fuels	1.1219	775.4340	0.0015						776.5573
1. Solid Fuels	NO	NO	NO						NO
2. Oil and Natural Gas	1.1219	775.4340	0.0015						776.5573
C. CO_2 Transport and Storage	NO								NO
2. Industrial Processes and Product Use	**556.3237**	**NO**	**0.0182**	**42.1522**	**NO**	**0.0569**	**NO**	**NO**	**598.5509**
A. Mineral Industry	444.8424								444.8424
B. Chemical Industry	NO	NO	NO						NO
C. Metal Industry	41.9358	NO	NO	NO	NO	NO	NO	NO	41.9358
D. Non-energy Products From Fuels and Solvent Use	68.4829	NO	NO						68.4829
E. Electronic Industry				NO	NO	NO	NO	NO	NO
F. Product Use as Substitutes for ODS				42.1522	NO	NO	NO	NO	42.1522

SOURCES OF GHG EMISSIONS	CO_2	CH_4	N_2O	HFCs	PFCs	SF_6	Unspecified mix of HFCs and PFCs	NF_3	Total
	CO_2 equivalent (kt)								
G. Other Product Manufacture and Use	1.0626	NO	0.0182	NO	NO	0.0569	NO	NO	1.1377
H. Other									
3. Agriculture	**0.1739**	**1 012.5368**	**1 563.8059**						**2 576.5167**
A. Enteric Fermentation		926.8686							926.8686
B. Manure Management		85.6682	468.0568						553.7250
C. Rice Cultivation		NO							NO
D. Agricultural Soils			1 095.7492						1 095.7492
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								NO
J. Other	NO	NO	NO						NO
4. LULUCF	**-4 840.2625**	**0.2494**	**75.6478**						**-4 764.3654**
A. Forest Land	-2 390.3683	0.0156	0.0103						-2 390.3424
B. Cropland	-489.2386	0.2337	73.6520						-415.3529
C. Grassland	-2 240.7618	NE	NE						-2 240.7618
D. Wetlands	NO	NE	NE						NO, NE
E. Settlements	53.6737	NE	1.9855						55.6592
F. Other Land	281.6495	NE	NE						281.6495
G. Harvested Wood Products	-55.2171								-55.2171
H. Other	NO	NO	NO						NO
5. Waste	**16.5476**	**1 463.2092**	**77.5447**						**1 557.3015**
A. Solid Waste Disposal	NA, NO	1 064.2940							1 064.2940
B. Biological Treatment of Solid Waste		NO, NE	NO, NE						NO, NE
C. Incineration and Open Burning of Waste	16.5476	8.4792	2.3324						27.3593
D. Wastewater Treatment and Discharge		390.4359	75.2123						465.6482
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**
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			305.8731						305.8731
Indirect CO_2	61.1468								61.1468
								Total CO_2 equivalent (without Sector 4 „LULUCF)	**13 414.1038**
								Total CO_2 equivalent (with Sector 4 „LULUCF")	**8 649.7384**

SOURCES OF GHG EMISSIONS	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)	**2 637.7945**	**3 169.0653**	**1 665.0808**	**54.7020**	**0.0231**	**0.3302**	**NO**	**NO**	**7 526.9959**
1. Energy	**7 069.0187**	**739.9885**	**44.2763**						**7 853.2835**
A. Fuel Combustion (Sectoral approach)	7 067.7927	56.7300	44.2745						7 168.7973
1. Energy Industries	2 492.9310	1.2935	1.6959						2 495.9204
2. Manufacturing Industries and Construction	668.5271	0.3703	0.5330						669.4305
3. Transport	1 651.9002	9.7414	34.8018						1 696.4435
4. Other Sectors	2 203.5166	45.2403	6.8341						2 255.5911
5. Other	50.9179	0.0844	0.4096						51.4118
B. Fugitive Emissions from Fuels	1.2260	683.2584	0.0018						684.4862
1. Solid Fuels	NO	NO	NO						NO
2. Oil and Natural Gas	1.2260	683.2584	0.0018						684.4862
C. CO_2 Transport and Storage	NO								NO
2. Industrial Processes and Product Use	**654.1156**	**NO**	**0.0176**	**54.7020**	**0.0231**	**0.3302**	**NO**	**NO**	**709.1884**
A. Mineral Industry	543.7505								543.7505
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	82.3885	NO	NO						82.3885
E. Electronic Industry				NO	NO	NO	NO	NO	NO
F. Product Use as Substitutes for ODS				54.7020	NO	NO	NO	NO	54.7020
G. Other Product Manufacture and Use	0.9584	NO	0.0176	NO	0.0231	0.3302	NO	NO	1.3293
H. Other									
3. Agriculture	**0.1460**	**984.4359**	**1 478.4928**						**2 463.0747**
A. Enteric Fermentation		896.9885							896.9885
B. Manure Management		87.4474	481.3605						568.8079
C. Rice Cultivation		NO							NO
D. Agricultural Soils			997.1323						997.1323
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								NO
J. Other	NO	NO	NO						NO
4. LULUCF	**-5 101.9787**	**0.2629**	**66.2198**						**-5 035.4959**
A. Forest Land	-2 347.2587	0.1691	0.1115						-2 346.9781
B. Cropland	-608.3183	0.0938	64.1228						-544.1016
C. Grassland	-2 227.5442	NE	NE						-2 227.5442
D. Wetlands	NO	NE	NE						NO, NE
E. Settlements	53.6737	NE	1.9855						55.6592
F. Other Land	70.2812	NE	NE						70.2812
G. Harvested Wood Products	-42.8125								-42.8125
H. Other	NO	NO	NO						NO

SOURCES OF GHG EMISSIONS	CO_2	CH_4	N_2O	HFCs	PFCs	SF_6	Unspecified mix of HFCs and PFCs	NF_3	Total
	CO_2 equivalent (kt)								
5. Waste	**16.4929**	**1 444.3781**	**76.0743**						**1 536.9452**
A. Solid Waste Disposal	NA, NO	1 061.8223							1 061.8223
B. Biological Treatment of Solid Waste		NO, NE	NO, NE						NO, NE
C. Incineration and Open Burning of Waste	16.4929	8.4496	2.3243						27.2667
D. Wastewater Treatment and Discharge		374.1062	73.7500						447.8563
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			290.0650						290.0650
Indirect CO_2	74.4362								74.4362
Total CO_2 equivalent (without Sector 4 „LULUCF)									**12 562.4918**
Total CO_2 equivalent (with Sector 4 „LULUCF")									**7 526.9959**

2007

SOURCES OF GHG EMISSIONS	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)	**3 032.8304**	**2 998.7636**	**1 082.6442**	**69.8086**	**0.0231**	**0.4298**	**NO**	**NO**	**7 184.4996**
1. Energy	**7 208.6350**	**771.3108**	**44.5600**						**8 024.5058**
A. Fuel Combustion (Sectoral approach)	7 207.3774	44.9646	44.5582						7 296.9002
1. Energy Industries	2 890.4481	1.4797	1.8906						2 893.8184
2. Manufacturing Industries and Construction	831.1775	0.4229	0.5730						832.1733
3. Transport	1 757.8033	10.1642	36.2225						1 804.1901
4. Other Sectors	1 666.7458	32.7824	5.3158						1 704.8440
5. Other	61.2028	0.1154	0.5564						61.8745
B. Fugitive Emissions from Fuels	1.2577	726.3461	0.0018						727.6056
1. Solid Fuels	NO	NO	NO						NO
2. Oil and Natural Gas	1.2577	726.3461	0.0018						727.6056
C. CO_2 Transport and Storage	NO								NO
2. Industrial Processes and Product Use	**901.0373**	**NO**	**NO**	**69.8086**	**0.0231**	**0.4298**	**NO**	**NO**	**971.2988**
A. Mineral Industry	776.1316								776.1316
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	85.3456	NO	NO						85.3456
E. Electronic Industry				NO	NO	NO	NO	NO	NO

SOURCES OF GHG EMISSIONS	CO_2	CH_4	N_2O	HFCs	PFCs	SF_6	Unspecified mix of HFCs and PFCs	NF_3	Total
	CO_2 equivalent (kt)								
F. Product Use as Substitutes for ODS				69.8086	NO	NO	NO	NO	69.8086
G. Other Product Manufacture and Use	0.9474	NO	NO	NO	0.0231	0.4298	NO	NO	1.4002
H. Other									
3. Agriculture	**0.2631**	**786.9180**	**897.4717**						**1 684.6528**
A. Enteric Fermentation		724.7117							724.7117
B. Manure Management		62.2063	367.3939						429.6002
C. Rice Cultivation		NO							NO
D. Agricultural Soils			530.0778						530.0778
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								NO
J. Other	NO	NO	NO						NO
4. LULUCF	**-5 093.5290**	**1.6261**	**67.6975**						**-5 024.2053**
A. Forest Land	-2 445.1609	1.4736	0.9717						-2 442.7156
B. Cropland	-561.2881	0.1525	64.9031						-496.2325
C. Grassland	-2 164.3852	NE	NE						-2 164.3852
D. Wetlands	NO	NE	NE						NO, NE
E. Settlements	49.2742	NE	1.8228						51.0970
F. Other Land	70.2812	NE	NE						70.2812
G. Harvested Wood Products	-42.2503								-42.2503
H. Other	NO	NO	NO						NO
5. Waste	**16.4239**	**1 438.9086**	**72.9150**						**1 528.2475**
A. Solid Waste Disposal	NA, NO	1 064.8166							1 064.8166
B. Biological Treatment of Solid Waste		NO, NE	NO, NE						NO, NE
C. Incineration and Open Burning of Waste	16.4239	8.4125	2.3141						27.1505
D. Wastewater Treatment and Discharge		365.6796	70.6009						436.2804
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			181.3540						181.3540
Indirect CO_2	78.5091								78.5091
								Total CO_2 equivalent (without Sector 4 „LULUCF)	**12 208.7049**
								Total CO_2 equivalent (with Sector 4 „LULUCF")	**7 184.4996**

2008

SOURCES OF GHG EMISSIONS	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)	**4 237.7119**	**2 984.4364**	**1 673.5317**	**84.6748**	**0.0288**	**0.5175**	**NO**	**NO**	**8 980.9011**
1. Energy	**7 797.1121**	**769.1145**	**47.7363**						**8 613.9630**
A. Fuel Combustion (Sectoral approach)	7 795.8374	46.6497	47.7345						7 890.2216
1. Energy Industries	3 292.3392	1.7269	3.5043						3 297.5705
2. Manufacturing Industries and Construction	914.5002	0.8725	1.4061						916.7788
3. Transport	1 848.7566	10.5535	36.7563						1 896.0664
4. Other Sectors	1 677.3708	33.3909	5.5519						1 716.3136
5. Other	62.8705	0.1060	0.5159						63.4923
B. Fugitive Emissions from Fuels	1.2748	722.4649	0.0018						723.7414
1. Solid Fuels	NO	NO	NO						NO
2. Oil and Natural Gas	1.2748	722.4649	0.0018						723.7414
C. CO_2 Transport and Storage	NO								NO
2. Industrial Processes and Product Use	**978.6462**	**NO**	**NO**	**84.6748**	**0.0288**	**0.5175**	**NO**	**NO**	**1 063.8673**
A. Mineral Industry	874.7129								874.7129
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	67.5356	NO	NO						67.5356
E. Electronic Industry				NO	NO	NO	NO	NO	NO
F. Product Use as Substitutes for ODS				84.6748	NO	NO	NO	NO	84.6748
G. Other Product Manufacture and Use	0.9859	NO	NO	NO	0.0288	0.5175	NO	NO	1.5322
H. Other									
3. Agriculture	**0.8505**	**751.9315**	**1 485.6434**						**2 238.4254**
A. Enteric Fermentation		690.7592							690.7592
B. Manure Management		61.1723	360.6617						421.8340
C. Rice Cultivation		NO							NO
D. Agricultural Soils			1 124.9817						1 124.9817
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								NO
J. Other	NO	NO	NO						NO
4. LULUCF	**-4 555.2731**	**0.7777**	**66.9445**						**-4 487.5510**
A. Forest Land	-2 447.9362	0.1024	0.0675						-2 447.7663
B. Cropland	-517.9302	0.6752	65.0542						-452.2008
C. Grassland	-1 883.4658	NE	NE						-1 883.4658
D. Wetlands	NO	NE	NE						NO, NE
E. Settlements	49.2742	NE	1.8228						51.0970
F. Other Land	291.0044	NE	NE						291.0044
G. Harvested Wood Products	-46.2195								-46.2195

SOURCES OF GHG EMISSIONS	CO_2	CH_4	N_2O	HFCs	PFCs	SF_6	Unspecified mix of HFCs and PFCs	NF_3	Total
	CO_2 equivalent (kt)								
H. Other	NO	NO	NO						NO
5. Waste	**16.3761**	**1 462.6126**	**73.2076**						**1 552.1963**
A. Solid Waste Disposal	NA, NO	1 084.2157							1 084.2157
B. Biological Treatment of Solid Waste		NO, NE	NO, NE						NO, NE
C. Incineration and Open Burning of Waste	16.3761	8.3862	2.3069						27.0691
D. Wastewater Treatment and Discharge		370.0107	70.9008						440.9115
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**
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			291.0518						291.0518
Indirect CO_2	60.2670								60.2670
Total CO_2 equivalent (without Sector 4 „LULUCF)									**13 468.4521**
Total CO_2 equivalent (with Sector 4 „LULUCF”)									**8 980.9011**

2009

SOURCES OF GHG EMISSIONS	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)	**5 169.5702**	**2 891.6556**	**1 467.1406**	**93.2489**	**0.0288**	**0.5602**	**NO**	**NO**	**9 622.2044**
1. Energy	**8 606.6397**	**647.5842**	**48.0676**						**9 302.2915**
A. Fuel Combustion (Sectoral approach)	8 605.3665	49.6523	48.0658						8 703.0846
1. Energy Industries	4 452.7046	2.2841	5.5187						4 460.5074
2. Manufacturing Industries and Construction	507.6894	0.5520	0.9113						509.1528
3. Transport	1 807.3330	10.7543	35.7429						1 853.8302
4. Other Sectors	1 824.7201	36.0368	5.8095						1 866.5664
5. Other	12.9193	0.0251	0.0834						13.0278
B. Fugitive Emissions from Fuels	1.2732	597.9319	0.0018						599.2069
1. Solid Fuels	NO	NO	NO						NO
2. Oil and Natural Gas	1.2732	597.9319	0.0018						599.2069
C. CO_2 Transport and Storage	NO								NO
2. Industrial Processes and Product Use	**466.2423**	**NO**	**NO**	**93.2489**	**0.0288**	**0.5602**	**NO**	**NO**	**560.0802**
A. Mineral Industry	389.8573								389.8573
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	58.6232	NO	NO						58.6232

SOURCES OF GHG EMISSIONS	CO_2	CH_4	N_2O	HFCs	PFCs	SF_6	Unspecified mix of HFCs and PFCs	NF_3	Total
	CO_2 equivalent (kt)								
E. Electronic Industry				NO	NO	NO	NO	NO	NO
F. Product Use as Substitutes for ODS				93.2489	NO	NO	NO	NO	93.2489
G. Other Product Manufacture and Use	0.6998	NO	NO	NO	0.0288	0.5602	NO	NO	1.2888
H. Other									
3. Agriculture	**0.5864**	**787.5366**	**1 282.1672**						**2 070.2902**
A. Enteric Fermentation		717.7349							717.7349
B. Manure Management		69.8017	407.0993						476.9009
C. Rice Cultivation		NO							NO
D. Agricultural Soils			875.0679						875.0679
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								NO
J. Other	NO	NO	NO						NO
4. LULUCF	**-3 920.2377**	**0.3329**	**67.7735**						**-3 852.1313**
A. Forest Land	-2 511.3674	0.2499	0.1648						-2 510.9527
B. Cropland	-373.2147	0.0829	65.9230						-307.2088
C. Grassland	-1 123.9641	NE	NE						-1 123.9641
D. Wetlands	NO	NE	NE						NO, NE
E. Settlements	45.5694	NE	1.6857						47.2551
F. Other Land	79.9357	NE	NE						79.9357
G. Harvested Wood Products	-37.1965								-37.1965
H. Other	NO	NO	NO						NO
5. Waste	**16.3396**	**1 456.2019**	**69.1323**						**1 541.6738**
A. Solid Waste Disposal	NA, NO	1 115.0733							1 115.0733
B. Biological Treatment of Solid Waste		NO, NE	NO, NE						NO, NE
C. Incineration and Open Burning of Waste	16.3396	8.3657	2.3012						27.0065
D. Wastewater Treatment and Discharge		332.7629	66.8311						399.5940
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			253.7048						253.7048
Indirect CO_2	52.2514								52.2514
Total CO_2 equivalent (without Sector 4 „LULUCF)									**13 474.3357**
Total CO_2 equivalent (with Sector 4 „LULUCF")									**9 622.2044**

SOURCES OF GHG EMISSIONS	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)	**6 359.5912**	**2 913.5939**	**1 646.0785**	**113.4282**	**0.0403**	**0.6796**	**NO**	**NO**	**11 033.4118**
1. Energy	**9 148.1087**	**633.1036**	**47.5013**						**9 828.7136**
A. Fuel Combustion (Sectoral approach)	9 146.8340	53.2826	47.4995						9 247.6161
1. Energy Industries	4 589.7895	2.4136	5.3675						4 597.5705
2. Manufacturing Industries and Construction	539.5862	0.5704	0.9429						541.0995
3. Transport	2 007.4377	10.8858	35.3630						2 053.6866
4. Other Sectors	1 985.9921	39.3569	5.6522						2 031.0012
5. Other	24.0285	0.0559	0.1739						24.2583
B. Fugitive Emissions from Fuels	1.2747	579.8210	0.0018						581.0975
1. Solid Fuels	NO	NO	NO						NO
2. Oil and Natural Gas	1.2747	579.8210	0.0018						581.0975
C. CO_2 Transport and Storage	NO								NO
2. Industrial Processes and Product Use	**490.8096**	**NO**	**NO**	**113.4282**	**0.0403**	**0.6796**	**NO**	**NO**	**604.9577**
A. Mineral Industry	412.7424								412.7424
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	67.4640	NO	NO						67.4640
E. Electronic Industry				NO	NO	NO	NO	NO	NO
F. Product Use as Substitutes for ODS				113.4282	NO	NO	NO	NO	113.4282
G. Other Product Manufacture and Use	0.9046	NO	NO	NO	0.0403	0.6796	NO	NO	1.6246
H. Other									
3. Agriculture	**1.7443**	**789.0144**	**1 458.9670**						**2 249.7258**
A. Enteric Fermentation		712.6183							712.6183
B. Manure Management		76.3961	422.1117						498.5078
C. Rice Cultivation		NO							NO
D. Agricultural Soils			1 036.8553						1 036.8553
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								NO
J. Other	NO	NO	NO						NO
4. LULUCF	**-3 297.3873**	**0.1454**	**67.1303**						**-3 230.1116**
A. Forest Land	-2 489.6089	0.0873	0.0576						-2 489.4639
B. Cropland	-399.2688	0.0581	65.3870						-333.8237
C. Grassland	-555.7508	NE	NE						-555.7508
D. Wetlands	NO	NE	NE						NO, NE
E. Settlements	45.5885	NE	1.6857						47.2742
F. Other Land	131.6759	NE	NE						131.6759
G. Harvested Wood Products	-30.0233								-30.0233
H. Other	NO	NO	NO						NO
5. Waste	**16.3159**	**1 491.3304**	**72.4799**						**1 580.1262**

SOURCES OF GHG EMISSIONS	CO_2	CH_4	N_2O	HFCs	PFCs	SF_6	Unspecified mix of HFCs and PFCs	NF_3	Total
	CO_2 equivalent (kt)								
A. Solid Waste Disposal	NA, NO	1 137.8702							1 137.8702
B. Biological Treatment of Solid Waste		NO, NE	NO, NE						NO, NE
C. Incineration and Open Burning of Waste	16.3159	8.3517	2.2974						26.9649
D. Wastewater Treatment and Discharge		345.1085	70.1826						415.2911
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	343.3412								343.3412
CO_2 Captured and Stored	NO								NO
Long-term Storage of C in waste disposal sites	NO								NO
Indirect N_2O			288.6536						288.6536
Indirect CO_2	60.4006								60.4006
Total CO_2 equivalent (without Sector 4 „LULUCF)									**14 263.5234**
Total CO_2 equivalent (with Sector 4 „LULUCF")									**11 033.4118**

2011

SOURCES OF GHG EMISSIONS	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)	**7 115.7241**	**2 976.9034**	**1 646.1485**	**119.5378**	**0.0403**	**0.7140**	**NO**	**NO**	**11 859.0681**
1. Energy	**9 230.5492**	**716.7917**	**48.7795**						**9 996.1204**
A. Fuel Combustion (Sectoral approach)	9 229.2351	56.3863	48.7777						9 334.3990
1. Energy Industries	4 181.2774	2.1473	4.5393						4 187.9640
2. Manufacturing Industries and Construction	599.6756	0.6826	1.1310						601.4892
3. Transport	2 116.7005	10.9596	36.5998						2 164.2599
4. Other Sectors	2 309.8144	42.5649	6.3697						2 358.7490
5. Other	21.7672	0.0320	0.1378						21.9369
B. Fugitive Emissions from Fuels	1.3141	660.4055	0.0018						661.7214
1. Solid Fuels	NO	NO	NO						NO
2. Oil and Natural Gas	1.3141	660.4055	0.0018						661.7214
C. CO_2 Transport and Storage	NO								NO
2. Industrial Processes and Product Use	**578.2196**	**NO**	**NO**	**119.5378**	**0.0403**	**0.7140**	**NO**	**NO**	**698.5117**
A. Mineral Industry	491.5026								491.5026
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	72.7635	NO	NO						72.7635
E. Electronic Industry				NO	NO	NO	NO	NO	NO
F. Product Use as Substitutes for ODS				119.5378	NO	NO	NO	NO	119.5378

SOURCES OF GHG EMISSIONS	CO_2	CH_4	N_2O	HFCs	PFCs	SF_6	Unspecified mix of HFCs and PFCs	NF_3	Total
	CO_2 equivalent (kt)								
G. Other Product Manufacture and Use	1.0979	NO	NO	NO	0.0403	0.7140	NO	NO	1.8522
H. Other									
3. Agriculture	**3.6752**	**743.6065**	**1 456.7476**						**2 204.0293**
A. Enteric Fermentation		671.3756							671.3756
B. Manure Management		72.2309	385.3168						457.5476
C. Rice Cultivation		NO							NO
D. Agricultural Soils			1 071.4308						1 071.4308
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								NO
J. Other	NO	NO	NO						NO
4. LULUCF	**-2 713.1019**	**0.1688**	**68.9153**						**-2 644.0178**
A. Forest Land	-2 373.3313	0.1169	0.0771						-2 373.1372
B. Cropland	-400.4227	0.0519	67.0986						-333.2723
C. Grassland	-442.6724	NE	NE						-442.6724
D. Wetlands	NO	NE	NE						NO, NE
E. Settlements	61.5457	NE	1.7396						63.2853
F. Other Land	466.0972	NE	NE						466.0972
G. Harvested Wood Products	-24.3184								-24.3184
H. Other	NO	NO	NO						NO
5. Waste	**16.3820**	**1 516.3363**	**71.7061**						**1 604.4245**
A. Solid Waste Disposal	NA, NO	1 155.0902							1 155.0902
B. Biological Treatment of Solid Waste		NO, NE	NO, NE						NO, NE
C. Incineration and Open Burning of Waste	16.3820	8.3688	2.3021						27.0530
D. Wastewater Treatment and Discharge		352.8773	69.4041						422.2813
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**
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	386.2234								386.2234
CO_2 Captured and Stored	NO								NO
Long-term Storage of C in waste disposal sites	NO								NO
Indirect N_2O			288.6902						288.6902
Indirect CO_2	65.5327								65.5327
Total CO_2 equivalent (without Sector 4 „LULUCF)									**14 503.0859**
Total CO_2 equivalent (with Sector 4 „LULUCF")									**11 859.0681**

2012

SOURCES OF GHG EMISSIONS	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)	**6 489.1628**	**2 929.7724**	**1 254.8124**	**128.8468**	**0.0403**	**0.7710**	**NO**	**NO**	**10 803.4058**
1. Energy	**8 897.8193**	**711.2097**	**45.5007**						**9 654.5298**
A. Fuel Combustion (Sectoral approach)	8 896.5089	60.2972	45.4989						9 002.3050
1. Energy Industries	4 190.8271	2.0148	4.3039						4 197.1458
2. Manufacturing Industries and Construction	563.6377	0.5797	0.9409						565.1582
3. Transport	1 862.8628	9.3348	33.3636						1 905.5612
4. Other Sectors	2 271.4679	48.3530	6.8275						2 326.6485
5. Other	7.7134	0.0149	0.0630						7.7913
B. Fugitive Emissions from Fuels	1.3104	650.9126	0.0018						652.2248
1. Solid Fuels	NO	NO	NO						NO
2. Oil and Natural Gas	1.3104	650.9126	0.0018						652.2248
C. CO_2 Transport and Storage	NO								NO
2. Industrial Processes and Product Use	**586.7346**	**NO**	**NO**	**128.8468**	**0.0403**	**0.7710**	**NO**	**NO**	**716.3927**
A. Mineral Industry	496.8003								496.8003
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	76.1943	NO	NO						76.1943
E. Electronic Industry				NO	NO	NO	NO	NO	NO
F. Product Use as Substitutes for ODS				128.8468	NO	NO	NO	NO	128.8468
G. Other Product Manufacture and Use	1.0427	NO	NO	NO	0.0403	0.7710	NO	NO	1.8540
H. Other									
3. Agriculture	**5.5908**	**702.9324**	**1 067.2790**						**1 775.8023**
A. Enteric Fermentation		634.3201							634.3201
B. Manure Management		68.6123	352.8017						421.4140
C. Rice Cultivation		NO							NO
D. Agricultural Soils			714.4773						714.4773
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								NO
J. Other	NO	NO	NO						NO
4. LULUCF	**-3 017.3416**	**1.2596**	**70.9352**						**-2 945.1468**
A. Forest Land	-2 208.0703	1.2522	0.8257						-2 205.9924
B. Cropland	-476.4351	0.0074	69.6719						-406.7558
C. Grassland	-426.1414	NE	NE						-426.1414
D. Wetlands	NO	NE	NE						NO, NE
E. Settlements	11.8308	NE	0.4376						12.2684
F. Other Land	87.3375	NE	NE						87.3375
G. Harvested Wood Products	-5.8631								-5.8631
H. Other	NO	NO	NO						NO

SOURCES OF GHG EMISSIONS	CO_2	CH_4	N_2O	HFCs	PFCs	SF_6	Unspecified mix of HFCs and PFCs	NF_3	Total
	CO_2 equivalent (kt)								
5. Waste	**16.3598**	**1 514.3706**	**71.0975**						**1 601.8279**
A. Solid Waste Disposal	NA, NO	1 143.6432							1 143.6432
B. Biological Treatment of Solid Waste		NO, NE	NO, NE						NO, NE
C. Incineration and Open Burning of Waste	16.3598	8.3570	2.2988						27.0156
D. Wastewater Treatment and Discharge		362.3704	68.7987						431.1691
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	404.3122								404.3122
CO_2 Captured and Stored	NO								NO
Long-term Storage of C in waste disposal sites	NO								NO
Indirect N_2O			219.6508						219.6508
Indirect CO_2	70.0614								70.0614
Total CO_2 equivalent (without Sector 4 „LULUCF)									**13 748.5526**
Total CO_2 equivalent (with Sector 4 „LULUCF")									**10 803.4058**

2013

SOURCES OF GHG EMISSIONS	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)	**5 871.5812**	**2 871.9116**	**5.7704**	**137.5611**	**0.0403**	**0.9700**	**NO**	**NO**	**8 887.8348**
1. Energy	**7 835.9759**	**681.5499**	**45.7435**						**8 563.2692**
A. Fuel Combustion (Sectoral approach)	7 834.3318	61.5931	45.7408						7 941.6657
1. Energy Industries	3 310.5699	1.6395	4.2013						3 316.4107
2. Manufacturing Industries and Construction	599.5639	0.7754	1.3073						601.6466
3. Transport	1 972.4617	9.3392	33.2027						2 015.0035
4. Other Sectors	1 947.9381	49.8318	6.9895						2 004.7593
5. Other	3.7983	0.0073	0.0400						3.8456
B. Fugitive Emissions from Fuels	1.6441	619.9568	0.0027						621.6035
1. Solid Fuels	NO	NO	NO						NO
2. Oil and Natural Gas	1.6441	619.9568	0.0027						621.6035
C. CO_2 Transport and Storage	NO								NO
2. Industrial Processes and Product Use	**631.7162**	**NO**	**NO**	**137.5611**	**0.0403**	**0.9700**	**NO**	**NO**	**770.2877**
A. Mineral Industry	551.5523								551.5523
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	71.3632	NO	NO						71.3632

SOURCES OF GHG EMISSIONS	CO_2	CH_4	N_2O	HFCs	PFCs	SF_6	Unspecified mix of HFCs and PFCs	NF_3	Total
	CO_2 equivalent (kt)								
E. Electronic Industry				NO	NO	NO	NO	NO	NO
F. Product Use as Substitutes for ODS				137.5611	NO	NO	NO	NO	137.5611
G. Other Product Manufacture and Use	1.1438	NO	NO	NO	0.0403	0.9700	NO	NO	2.1542
H. Other									
3. Agriculture	**4.1840**	**711.3840**	**1 533.4545**						**2 249.0224**
A. Enteric Fermentation		643.8453							643.8453
B. Manure Management		67.5387	330.6386						398.1773
C. Rice Cultivation		NO							NO
D. Agricultural Soils			1 202.8159						1 202.8159
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	**-2 616.6284**	**0.9357**	**68.6457**						**-2 547.0470**
A. Forest Land	-2 055.1211	0.8699	0.5736						-2 053.6776
B. Cropland	-458.6019	0.0659	67.6345						-390.9015
C. Grassland	-277.4696	NE	NE						-277.4696
D. Wetlands	NO	NE	NE						NO, NE
E. Settlements	11.8308	NE	0.4376						12.2684
F. Other Land	87.3375	NE	NE						87.3375
G. Harvested Wood Products	75.3959								75.3959
H. Other	NO	NO	NO						NO
5. Waste	**16.3335**	**1 478.0421**	**71.7473**						**1 566.1229**
A. Solid Waste Disposal	NA, NO	1 084.7888							1 084.7888
B. Biological Treatment of Solid Waste		NO, NE	NO, NE						NO, NE
C. Incineration and Open Burning of Waste	16.3335	8.3436	2.2951						26.9722
D. Wastewater Treatment and Discharge		384.9097	69.4522						454.3619
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	431.4636								431.4636
CO_2 Captured and Stored	NO								NO
Long-term Storage of C in waste disposal sites	NO								NO
Indirect N_2O			307.2402						307.2402
Indirect CO_2	65.1517								65.1517
Total CO_2 equivalent (without Sector 4 „LULUCF)									**11 434.8817**
Total CO_2 equivalent (with Sector 4 „LULUCF")									**8 887.8348**

SOURCES OF GHG EMISSIONS	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)	**6 537.6243**	**2 936.8186**	**1 911.4961**	**151.3701**	**0.0403**	**1.0575**	**NO**	**NO**	**11 538.4069**
1. Energy	**8 581.9429**	**709.8616**	**52.9170**						**9 344.7215**
A. Fuel Combustion (Sectoral approach)	8 580.2708	114.5390	52.9143						8 747.7242
1. Energy Industries	4 014.9274	2.0250	4.5538						4 021.5062
2. Manufacturing Industries and Construction	585.7254	0.6849	1.1423						587.5527
3. Transport	2 049.6073	9.3704	31.3121						2 090.2898
4. Other Sectors	1 927.7357	102.4512	15.8826						2 046.0694
5. Other	2.2750	0.0074	0.0236						2.3060
B. Fugitive Emissions from Fuels	1.6721	595.3226	0.0027						596.9973
1. Solid Fuels	NO	NO	NO						NO
2. Oil and Natural Gas	1.6721	595.3226	0.0027						596.9973
C. CO_2 Transport and Storage	NO								NO
2. Industrial Processes and Product Use	**652.4526**	**NO**	**NO**	**151.3701**	**0.0403**	**1.0575**	**NO**	**NO**	**804.9205**
A. Mineral Industry	548.2551								548.2551
B. Chemical Industry	NO	NO	NO						NO
C. Metal Industry	13.7976	NO	NO	NO	NO	NO	NO	NO	13.7976
D. Non-energy Products From Fuels and Solvent Use	89.3660	NO	NO						89.3660
E. Electronic Industry				NO	NO	NO	NO	NO	NO
F. Product Use as Substitutes for ODS				151.3701	NO	NO	NO	NO	151.3701
G. Other Product Manufacture and Use	1.0338	NO	NO	NO	0.0403	1.0575	NO	NO	2.1317
H. Other									
3. Agriculture	**10.2058**	**753.7058**	**1 723.9607**						**2 487.8723**
A. Enteric Fermentation		681.6116							681.6116
B. Manure Management		72.0942	363.6188						435.7130
C. Rice Cultivation		NO							NO
D. Agricultural Soils			1 360.3419						1 360.3419
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								NO
J. Other	NO	NO	NO						NO
4. LULUCF	**-2 723.2521**	**0.1221**	**62.0853**						**-2 661.0447**
A. Forest Land	-2 019.3088	0.0715	0.0472						-2 019.1901
B. Cropland	-582.4370	0.0506	61.6597						-520.7267
C. Grassland	-271.1606	NE	NE						-271.1606
D. Wetlands	NO	NE	NE						NO, NE
E. Settlements	18.7098	NE	0.3785						19.0884
F. Other Land	70.4783	NE	NE						70.4783
G. Harvested Wood Products	60.4660								60.4660
H. Other	NO	NO	NO						NO
5. Waste	**16.2752**	**1 473.1291**	**72.5331**						**1 561.9373**

SOURCES OF GHG EMISSIONS	CO_2	CH_4	N_2O	HFCs	PFCs	SF_6	Unspecified mix of HFCs and PFCs	NF_3	Total
	CO_2 equivalent (kt)								
A. Solid Waste Disposal	NA, NO	1 083.0811							1 083.0811
B. Biological Treatment of Solid Waste		NO, NE	NO, NE						NO, NE
C. Incineration and Open Burning of Waste	16.2752	8.3163	2.2876						26.8791
D. Wastewater Treatment and Discharge		381.7317	70.2455						451.9772
E. Other	NO	NO	NO						NO
6. Other	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	NO
Memo Items									
International Bunkers	**154.5065**	**0.0840**	**1.4725**						**156.0630**
Aviation	154.5065	0.0840	1.4725						156.0630
Navigation	NO	NO	NO						NO
Multilateral Operations	**NO**	**NO**	**NO**						**NO**
CO_2 Emissions from Biomass	1 317.1650								1 317.1650
CO_2 Captured and Stored	NO								NO
Long-term Storage of C in waste disposal sites	NO								NO
Indirect N_2O			350.5447						350.5447
Indirect CO_2	83.0575								83.0575
Total CO_2 equivalent (without Sector 4 „LULUCF)									**14 199.4516**
Total CO_2 equivalent (with Sector 4 „LULUCF")									**11 538.4069**

2015

SOURCES OF GHG EMISSIONS	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)	**6 490.9952**	**2 863.4377**	**1 572.9806**	**179.4375**	**0.0403**	**1.0575**	**NO**	**NO**	**11 107.9488**
1. Energy	**8 759.0707**	**688.1863**	**57.6853**						**9 504.9423**
A. Fuel Combustion (Sectoral approach)	8 757.4126	121.5847	57.6826						8 936.6798
1. Energy Industries	4 141.2201	1.7930	4.0598						4 147.0729
2. Manufacturing Industries and Construction	665.6173	1.0172	1.6577						668.2922
3. Transport	2 158.1164	9.8514	35.0077						2 202.9754
4. Other Sectors	1 790.2120	108.9172	16.9359						1 916.0651
5. Other	2.2468	0.0059	0.0215						2.2742
B. Fugitive Emissions from Fuels	1.6581	566.6016	0.0027						568.2625
1. Solid Fuels	NO	NO	NO						NO
2. Oil and Natural Gas	1.6581	566.6016	0.0027						568.2625
C. CO_2 Transport and Storage	NO								NO
2. Industrial Processes and Product Use	**614.5157**	**NO**	**NO**	**179.4375**	**0.0403**	**1.0575**	**NO**	**NO**	**795.0511**
A. Mineral Industry	509.6941								509.6941
B. Chemical Industry	NO	NO	NO						NO
C. Metal Industry	17.2258	NO	NO	NO	NO	NO	NO	NO	17.2258
D. Non-energy Products From Fuels and Solvent Use	86.8119	NO	NO						86.8119
E. Electronic Industry				NO	NO	NO	NO	NO	NO
F. Product Use as Substitutes for ODS				179.4375	NO	NO	NO	NO	179.4375

SOURCES OF GHG EMISSIONS	CO_2	CH_4	N_2O	HFCs	PFCs	SF_6	Unspecified mix of HFCs and PFCs	NF_3	Total
	CO_2 equivalent (kt)								
G. Other Product Manufacture and Use	0.7840	NO	NO	NO	0.0403	1.0575	NO	NO	1.8818
H. Other									
3. Agriculture	**5.8323**	**724.9634**	**1 383.8981**						**2 114.6937**
A. Enteric Fermentation		654.6016							654.6016
B. Manure Management		70.3618	352.0708						422.4326
C. Rice Cultivation		NO							NO
D. Agricultural Soils			1 031.8273						1 031.8273
E. Prescribed Burning of Savannas		NO	NO						NO
F. Field Burning of Agricultural Residues		IE	IE						IE
G. Liming	NO								NO
H. Urea Application	5.8323								5.8323
I. Other Carbon-containing Fertilizers	NO								NO,NE
J. Other	NO	NO	NO						NO
4. LULUCF	**-2 904.5678**	**0.7081**	**58.4603**						**-2 845.3994**
A. Forest Land	-2 027.2895	0.6633	0.4374						-2 026.1888
B. Cropland	-727.4181	0.0448	57.5206						-669.8527
C. Grassland	-306.2291	NE	NE						-306.2291
D. Wetlands	NO	NE	NE						NO, NE
E. Settlements	38.8867	NE	0.5023						39.3890
F. Other Land	60.8445	NE	NE						60.8445
G. Harvested Wood Products	56.6377								56.6377
H. Other	NO	NO	NO						NO
5. Waste	**16.1442**	**1 449.5799**	**72.9370**						**1 538.6611**
A. Solid Waste Disposal	NA, NO	1 087.1519							1 087.1519
B. Biological Treatment of Solid Waste		NO, NE	NO, NE						NO, NE
C. Incineration and Open Burning of Waste	16.1442	8.2516	2.2698						26.6656
D. Wastewater Treatment and Discharge		354.1764	70.6672						424.8436
E. Other	NO	NO	NO						NO
6. Other	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	NO
Memo ItemS									
International Bunkers	**218.4093**	**0.1451**	**2.0736**						**220.6280**
Aviation	218.4093	0.1451	2.0736						220.6280
Navigation	NO	NO	NO						NO
Multilateral Operations	**NO**	**NO**	**NO**						**NO**
CO_2 Emissions from Biomass	1 439.8048								1 439.8048
CO_2 Captured and Stored	NO								NO
Long-term Storage of C in waste disposal sites	NO								NO
Indirect N_2O			278.9598						278.9598
Indirect CO_2	80.0300								80.0300
Total CO_2 equivalent (without Sector 4 „LULUCF)									**13 953.3482**
Total CO_2 equivalent (with Sector 4 „LULUCF")									**11 107.9488**