National Inventory Report

Greenhouse Gas Sources and Sinks in the Republic of Moldova 1990-2013

Submission to the United Nations Framework Convention on Climate Change

Chisinau, 2015

Ministry of Environment

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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 Environment (MoEN) and United Nations Environment Programme (UNEP), with financial support of the Global Environment Facility (GEF), from July 2014 through June 2017.

The National Inventory Report reflects the efforts made by the National Inventory Team during 2014-2015, 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Europe and CIS countries)", that ended with the National Inventory Report of the Republic of Moldova: 1990-2002 (unpublished); under the UNDP-GEF Project „Republic of Moldova: Enabling Activities for the Preparation of the First National Communication under the United Nations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); as well as 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).

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 1990-2013 time periods was made in August-September 2015 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 and Institute of Pedology, Agrochemistry and Soil Protection „N. Dimo" of the Academy of Sciences of Moldova, 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 storage) within the greenhouse gas national inventory of the Republic of Moldova.

Dr. Vasile SCORPAN
30 September, 2015

Manager, Climate Change Office,
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LIST OF ACRONYMS, ABBREVIATIONS AND UNITS

ABS	Acrilonitril Butadien Stiren
AD	Activity Data
AEZ	Agro-Ecological Zones
Al	Aluminium
Al_2O_3	Aluminium oxide
AN	Antonov
ANRE	National Agency for Energy Regulation
AR4	IPCC 4th Assessment Report (IPCC, 2007)
AR5	IPCC 5th Assessment Report (IPCC, 2013)
$Area_{(T)}$	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
ATR	Avions de Transport Règional
ATULBD	Administrative-Territorial Units on the Left Bank of Dniester
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
BWTP	Biological Wastewater Treatment Plants
c	Flight cycle: cruise
ºC	Celsius degrees
C	Carbon
C_a	Animal Feeding Situation Coefficient
CAA	Civil Aeronautical Authority
CA	Honrbeam species (Carpinsus ssp.)
$CaCO_3$	Limestone
$CaCO_3{\bullet}MgCO_3$	Dolomite
CaO	Lime
CaO • MgO	Dolomite lime
CCO	Climate Change Office
$CBrCIF_2$	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	Perfluormethane
C_2F_6	Perfluorethane
C_3F_8	Perfluorpropan
C_4F_{10}	Perfluorbutan
c-C_4F_8	Perfluorciclobutan

C_5F_{12}	Perfluorpentan
C_6F_{14}	Perfluorhexan
CFC	Chlorofluorocarbons
CH_4	Methane
$C_6H_{12}O_6$	Glucose
C_2H_5OH	Ethanol
$CHClF_2$	HCFC-22
CH_2FCF_3	HFC-134a
CHF_3	HFC-23
CH_2F_3	HFC-32
C_2HF_5	HFC-125
CHP	Combined Heat and Power Plant
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
cm	Centimeter
cm^2	Square centimeter
CMIP5	Coupled Model Intercomparison Project Phase 5
CO	Carbon monoxide
CO_2	Carbon dioxide
COD	Chemical Oxygen Demand
$CO(NH_2)_2$	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
CP	Conference of the Parties
CR	Crop Residues
CRJ	Canadian Regional Jet
$Crop_{(T)}$	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
EBs	Energy Balances
EC	European Community
EE	Eastern Europe

EEA	European Environment Agency
EF	Emission Factor
EMB	Embraer
EMEP	European Monitoring and Evaluation Programme
Eq	Equivalent
EU	European Union
EV_{milk}	Energy value for milk
f	Force
F	Methane fraction in biogas
F_{AM}	Quantity of nitrogen incorporated in soil with manure
F_{COMP}	Annual amount of total compost N applied to soils
F_{CR}	Annual amount of N in crop residues returned to soils
F_{ON}	Annual amount of managed animal manure, compost, sewage sludge and other organic N additions applied to soils
F_{OOA}	Annual amount of other organic amendments used as fertilizer
F_{PRP}	Annual amount of 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 NH_3 and NO_x
$Frac_{GASM}$	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
g	Grams
G_w	Average annual above and belowground biomass increment
Gcal	Gigacalory
g.c.e.	Grams coal equivalent
GCM	Global Climate Models
GDP	Gross Domestic Product
GE	Gross Energy
GEF	Global Environment Facility
Gg	Gigagram
GHG	Greenhouse Gas
GPG	Good Practice Guidance
GSTI	Gas-Steam Turbine Installations
Gt	Gigatons
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
HPP	Hydro Power Plant
ICA	International Consultation and Analysis
I_v	Average annual net increment in volume suitable for industrial processing
IE	Included Elsewhere
INC	Initial National Communication
INDC	Intended National Determined Contributions
IP	Industrial Processes
IPCC	Intergovernmental Panel for Climate Change
J.S.C.	Joint Stock Company
k	Methane generation rate constant
KCA	Key Category Analysis
kg	Kilogram
km	Kilometer
km^2	Square kilometer
KP	Kyoto Protocol
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
LBDR	Left Bank of Dniester River
LDP	Low Density Polyethylene
LDLP	Low Density Linear Polyethylene
LEDS	Low Emission Development Strategy
LNG	Liquefied Natural Gas
LPG	Liquefied Petroleum Gas
Ltd.	Limited Liability Company
LTO	Cycle: Landing/Take Off
LULUCF	Land Use, Land-Use Change and Forestry
m	Meter
m^2	Square meter
m^3	Cubic meter
MAFI	Ministry of Agriculture and Food Industry
MCF	Methane Correction Factor
MD	Ministry of Defense
ME	Municipal Enterprise
MENR	Ministry of Ecology and Natural Resources
MF	Ministry of Finance
MITC	Ministry of Information Technologies and Communications
MH	Ministry of Health
MoEN	Ministry of Environment
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
MTRI	Ministry of Transport and Road Infrastructure
MTTP	Moldovan Thermal Power Plant in Dnestrovsk
MW_{animal}	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
NAER	National Agency for Energy Regulation
NBS	National Bureau of Statistics
NCs	National Communications
NCVs	National Caloric Values
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
NAIIS	Non-Annex I Parties Inventory Software
NAMA	National Appropriate Mitigation Actions
NaOH	Sodium Hydroxide (caustic soda)
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
NGO	Non-Governmental Organization
NH_3	Ammonia
NH_4^+	Ammonium
NH_4NO_3	Ammonia Nitrate
$NH_4H_2PO_4$	Monoammonium phosphate
$(NH_4)_2HPO_4$	Diammonium phosphate
NIIP	National Inventory Improvement Plan
NIS	National Inventory System
NIR	National Inventory Report
NIT	National Inventory Team
NMVOC	Non Methane Volatile Organic Compounds
NO	Not Occurring
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
NRS-UNFCCC	National Reporting Systems under the UNFCCC
O_3	Ozone
ODS	Ozone-Depleting Substances
ODP	Ozone-Depleting Potential
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
Pag.	Page
PE	Polyethylene sacks
PET	Polyethylene Terephthalate Packaging
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
PPP	Public-Private Partnerships
ppt	Parts per trillion of volume
q	Quintal (100 kg)
QA	Quality Assurance
QC	Quality Control
QU	Species of oak (Quercus spp.)
R	Root-to-shoot ratio
$R_{AG (T)}$	Ratio of above-ground residues dry matter to harvested yield for crop *T*
$R_{BG (T)}$	Ratio of below-ground residues to harvested yield for crop *T*
RB	Species of Acacia (Robinia spp.)
RBDR	Right Bank of Dniester River
RCP	Representative Concentration Pathway
REG	Ratio of net energy available for growth in a diet to digestible energy consumed
REM	Ratio of net energy available in diet for maintenance to digestible energy consumed
RM	Republic of Moldova
SAR	Second Assessment Report of the IPCC (IPCC, 1996)
SAUM	State Agrarian University of Moldova
SEI	State Ecological Inspectorate
SF	Saab Fairchild
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
SOE	State Owned Enterprise
SOPU	Solvents and Other Products Use
SO_2	Sulphur dioxide
SS_{ix}	Fraction of anaerobically treated sludge
SWDS	Solid Waste Disposal Sites
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
TI	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
TU	Tupolev
TUM	Technical University of Moldova
UCTE	Union for the Coordination of Transmission of Electricity
UL	Species of elm tree (Ulmus spp.)
USA	United States of America
UN	United Nations
UNDP	United Nations Development Programme
UNEP	United Nations Environment Program
US EPA	United States Environmental Protection Agency
US $	US Dollar
VS	Volatile solid excretion per day
W	Animal Body Weight
W_{ind}	Amount of wastewater generated per unit of industrial output
WB	World Bank
WBTP	Wastewater Biological Treatment Plant
WE	Western Europe
WG	Daily weight gain
WM	Emissions from wastewater handling
WS_{ix}	Fraction of wastewater treated anaerobically
x	Average value
Y_m	Methane conversion factor
YAK	Yakovlev
$YieldFresh_{(T)}$	Harvested fresh yield for crop *T*
%	Per cent

CONTENTS

EXECUTIVE SUMMARY

The Convention, Kyoto Protocol 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 (4thNC) is under preparation.

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 Republic of Moldova ratified the Kyoto Protocol on February 13, 2003. As a non-Annex I Party, the Republic of Moldova has no commitments to reduce GHG emissions under this Protocol.

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

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

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*".

[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.

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 draft *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, providing 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 draft 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. Draft 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 country office of the United Nations Development Programme. 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.

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 an update of the information contained in Decision 17/CP.8, Annex, Chapter III (National greenhouse gas inventories). The inventory section is expected 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.

Simultaneously, 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 will be conducted by a team of technical experts (TTE) and will be initiated within six months of BUR submission to the Secretariat.

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 15, 2015[2], only 41 countries had ratified the Doha Amendment to the Kyoto Protocol, most of which are non-Annex I Parties to the UNFCCC and the Kyoto Protocol.

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

The COP 20 took place in Lima (2014). The Parties agreed over Lima Call for Climate Action and were repeatedly invited to communicate to the Secretariat their intended nationally determined contributions, in order to facilitate clarity, transparency and understanding. The INDC may include, as 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 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^{o}C. Following this statement, at 25th of September 2015, the Republic of Moldova communicated its Intended Nationally Determined Contribution (INDC)[3] 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.

Inventory Process in the Republic of Moldova

The Ministry of Environment (MoEN) of the Republic of Moldova (RM) is the state authority responsible for the 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, MoEN 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 Environment is also the National Focal Point to the UNFCCC.

[2] <http://unfccc.int/kyoto_protocol/doha_amendment/items/7362.php>.
[3] <http://www4.unfccc.int/submissions/INDC/Published%20Documents/Republic%20of%20Moldova/1/INDC_Republic_of_Moldova_25.09.2015.pdf>.

Within the MoEN, 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 Sectoral and Summary Report Tables, as employed by the Greenhouse Gas Inventory Software for non-Annex I Parties (NAIIS)[4].

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', Chapter 5 'Solvents and Other Products Use', Chapter 6 'Agriculture', Chapter 7 'Land Use, Land Use Change and Forests', Chapter 8 'Waste', Chapter 9 'Recalculations and Planned Improvements', 'References' and 'Annexes'.

Direct (CO_2, CH_4, N_2O, HFC, PFC and SF_6) and indirect (NO_x, CO, NMVOC and SO_2) greenhouse gas emissions were estimated in compliance with methodologies provided for in the Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories (IPCC, 1997), Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories (IPCC, 2000), Good Practice Guidance for Land Use, Land-Use Change and Forestry (IPCC, 2003), Air Pollutant Emission Inventory Guidebook (EMEP/EEA, 2013) and 2006 IPCC Guidelines for National Greenhouse Gas Inventories (IPCC, 2006).

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 (ministries and subordinated institutions); central administrative authorities (agencies, services and bureaus), private sector and industrial associations.

The results of the key categories analysis carried out following a Tier 1 methodological approach, by use of the Key Categories Calculation Tool developed by the US Environment Protection Agency (US EPA), revealed 17 key categories by level and by trend (with LULUCF), as well as 17 key categories by level and 13 key categories by trend (without LULUCF).

As a part of continuous efforts to develop an accurate, complete, consistent, transparent and reliable inventory, the Republic of Moldova developed a Quality Assurance and Quality Control Plan, the key attributes of which include detailed Tier 1 (general procedures) and Tier 2 (source-specific) procedures and standard verification and quality control forms and checklists, that serve to standardize the process of implementing quality assurance and quality control activities meant to ensure the quality of the national inventory; peer reviews (technical audits) carried out by experts not directly involved in the national inventory drafting and development process; activity data quality check, inclusive by comparing data obtained from different sources, as well as further documentation of the national inventory development 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 Sector 3 'Solvents and Other Products Use'; the Institute of Pedology, Agrochemistry and Soil Protection 'N. Dimo' – for Sector 4 'Agriculture' and partially for Sector 5 'Land Use, Land-Use Change and Forestry'; the Forest Research and Management Institute – for Sector 5 'Land Use, Land-Use Change and Forestry'; an independent consultant in the field of environmental protection – for Sector 6 'Waste'.

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.

[4] <http://unfccc.int/national_reports/non-annex_i_national_communications/non-annex_i_inventory_software/items/7627.php>.

Direct Greenhouse Gas Emission Trends

In comparison with the base year level (1990), by 2013, the Republic of Moldova has reduced its GHG emissions by 70.4 per cent. Table R-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 6.8 per cent within this time periods, the real value of GDP – by 32.2 per cent, the GHG intensity (CO_2eq/GDP) – by 56.4 per cent, electricity consumption – by 52.3 per cent, heat consumption – by 82.4 per cent, consumption of primary energy resources – by 78.3 per cent.

Table R-1: RM's total GHG Emissions and Accompanying Variables within 1990-2013 periods

	1990	1995	2000	2005	2010	2011	2012	2013
Population, millions inhabitants	**4.3616**	**4.3479**	**4.2815**	**4.1479**	**4.0817**	**4.0738**	**4.0690**	**4.0647**
Compared to 1990, %		-0.3	-1.8	-4.9	-6.4	-6.6	-6.7	-6.8
Inter-annual fluctuation, %		-0.1	-0.3	-0.3	-0.2	-0.2	-0.1	-0.1
Total GHG emissions, Mt CO_2 eq.	**43.4188**	**17.4240**	**10.7307**	**12.7530**	**13.9394**	**14.1417**	**13.3642**	**12.8363**
Compared to 1990, %		-59.9	-75.3	-70.6	-67.9	-67.4	-69.2	-70.4
Inter-annual fluctuation, %		-17.0	-8.8	3.6	6.1	1.5	-5.5	-4.0
GHG per capita, tons per capita	**10.0**	**4.0**	**2.5**	**3.1**	**3.4**	**3.5**	**3.3**	**3.2**
Compared to 1990, %		-59.7	-74.8	-69.1	-65.7	-65.1	-67.0	-68.3
Inter-annual fluctuation, %		-16.9	-8.6	4.0	6.3	1.6	-5.4	-3.8
GDP, billion 2010 US $	**9.8935**	**3.9663**	**3.5229**	**4.9597**	**5.8116**	**6.2068**	**6.1633**	**6.7119**
Compared to 1990, %		-59.9	-64.4	-49.9	-41.3	-37.3	-37.7	-32.2
Inter-annual fluctuation, %		-1.4	2.1	7.5	7.1	6.8	-0.7	8.9
GHG intensity, kg CO_2 eq. /2010 US $	**4.4**	**4.4**	**3.0**	**2.6**	**2.4**	**2.3**	**2.2**	**1.9**
Compared to 1990, %		0.1	-30.6	-41.4	-45.3	-48.1	-50.6	-56.4
Inter-annual fluctuation, %		-15.8	-10.7	-3.6	-0.9	-5.0	-4.8	-11.8
Imported energy, million t.c.e.	**16.703**	**5.109**	**2.535**	**3.123**	**2.960**	**3.075**	**2.918**	**2.977**
Compared to 1990, %		-69.4	-84.8	-81.3	-82.3	-81.6	-82.5	-82.2
Inter-annual fluctuation, %		11.0	-18.0	4.2	5.0	3.9	-5.1	2.0
Consumed energy, million t.c.e.	**14.269**	**5.085**	**2.647**	**3.257**	**3.157**	**3.201**	**3.068**	**3.091**
Compared to 1990, %		-64.4	-81.4	-77.2	-77.9	-77.6	-78.5	-78.3
Inter-annual fluctuation, %		9.7	-20.2	6.3	6.7	1.4	-4.2	0.7
Produced electricity, billion kWh	**15.690**	**6.168**	**3.624**	**4.225**	**6.115**	**5.785**	**5.802**	**4.491**
Compared to 1990, %		-60.7	-76.9	-73.1	-61.0	-63.1	-63.0	-71.4
Inter-annual fluctuation, %		-25.8	-11.8	1.1	-1.3	-5.4	0.3	-22.6
Consumed electricity, billion kWh	**11.426**	**7.022**	**4.510**	**5.838**	**5.257**	**5.416**	**5.604**	**5.449**
Compared to 1990, %		-38.5	-60.5	-48.9	-54.0	-52.6	-51.0	-52.3
Inter-annual fluctuation, %		-3.9	-4.4	-3.1	-0.9	3.0	3.5	-2.8
Produced heat, million Gcal	**22.212**	**7.278**	**3.846**	**4.830**	**4.487**	**4.376**	**4.239**	**4.307**
Compared to 1990, %		-65.3	-81.7	-77.0	-78.6	-79.1	-79.8	-79.5
Inter-annual fluctuation, %		-3.1	-31.9	11.1	10.1	-2.5	-3.1	1.6
Consumed heat, million Gcal	**20.983**	**6.283**	**3.358**	**4.160**	**3.798**	**3.764**	**3.600**	**3.694**
Compared to 1990, %		-70.1	-84.0	-80.2	-81.9	-82.1	-82.8	-82.4
Inter-annual fluctuation, %		-5.6	-29.6	11.6	9.4	-0.9	-4.4	2.6

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, 1993-2013 and Statistical Yearbooks of ATULBD.

The significant reduction of socio-economic indicators between 1990 and 2013 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.

The 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 2014 the natural gas tariff increased 13.0 times; electricity tariff increased 6.6 times; gasoline, diesel and liquefied gases prices increased 1.9 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 11.3 per cent.

At the same time, within 2000-2013 period, the real GDP increased by 90.5 per cent, from 3.5229 to 6.7119 billion 2010 US$, while the real GDP per capita increased by 120.0 per cent, from 842.8 to 1,854.1 2010 US$. 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 2013 the real GDP reached only 68 per cent of the 1990 year level. It is worth mentioning that from 2000 to 2013, the electricity consumption increased in the Republic of Moldova by 20.8 per cent; the heat consumption – by 10.0 per cent, the consumption of primary energy resources – by 16.8 per cent; while the GHG intensity (CO_2eq/GDP) decreased during the same period by 37.2 per cent, showing the first signs of the decoupling of economic growth from the growth in greenhouse gas emissions, by 19.6 per cent within 2000-2013 periods (see Figure R-1).

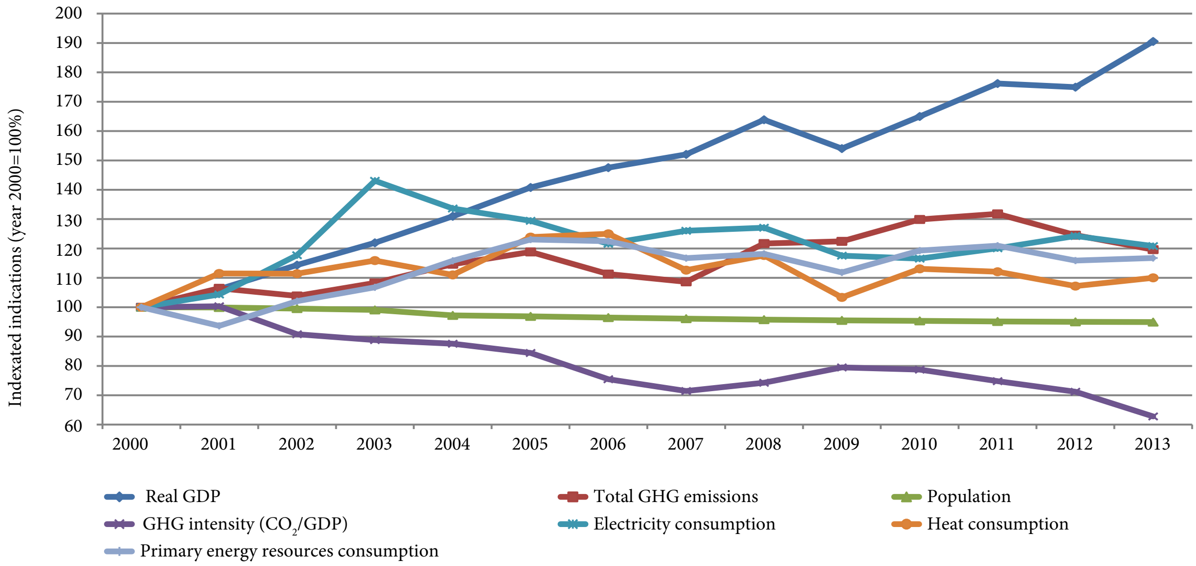

Figure R-1: Trends in total GHG emissions and associated variables in the Republic of Moldova within 2000-2013 periods

Table R-2 provides data on total and net GHG emissions in the Republic of Moldova in 2013. The share of CO_2 emissions in the total direct GHG emissions was 64.9 per cent, CH_4 contributed with 21.0 per cent, N_2O emissions accounted for 13.0 per cent of the total, while the share of F-gases (HFCs, PFCs, SF_6) being totally insignificant, circa 1.1 per cent of the total (Figure R-2).

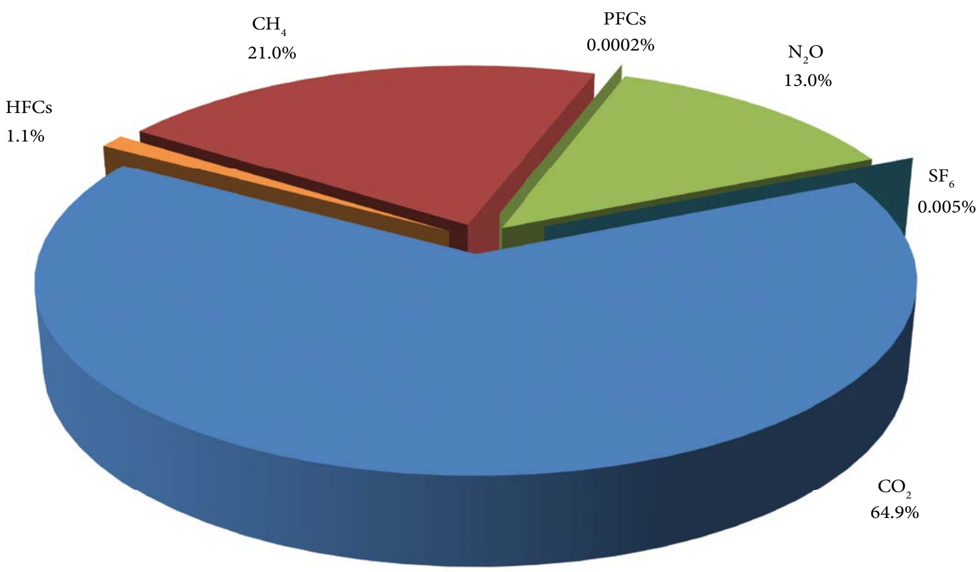

Figure R-2: Republic of Moldova's GHG Emissions by Gas in 2013

Table R-2: Republic of Moldova's Total Direct GHG Emissions in 2013

Categories of emissions and sinks	CO_2	CH_4		N_2O		HFC		PFC		SF_6		Total
	Gg	Gg	Gg CO_2 eq.	Gg	Gg CO_2 eq.	Gg	Gg CO_2 eq.	Gg	Gg CO_2 eq.	Gg	Gg CO_2 eq.	Gg CO_2 eq.
Total emissions (without LULUCF)	**8325.4727**	**128.2716**	**2693.7044**	**5.4008**	**1674.2552**	**0.1033**	**142.1872**	**0.0000**	**0.0273**	**0.0000**	**0.6803**	**12836.3270**
Total emissions (with LULUCF)	**8226.1217**	**128.3178**	**2694.6736**	**5.4033**	**1675.0222**	**0.1033**	**142.1872**	**0.0000**	**0.0273**	**0.0000**	**0.6803**	**12738.7123**
1. Energy	**7729.1857**	**29.4091**	**617.5915**	**0.1866**	**57.8454**							**8404.6226**
A. Fuel Combustion Activities	7727.0268	4.6165	96.9465	0.1866	57.8401							7881.8135
1. Energy Industries	3308.1821	0.0654	1.3734	0.0141	4.3651							3313.9206
2. Manufacturing Industries and Construction	607.6708	0.0322	0.6760	0.0046	1.4119							609.7587
3. Transport	1835.2651	0.3203	6.7267	0.1135	35.1848							1877.1767
4. Other Sectors	1945.5770	4.1985	88.1695	0.0542	16.7922							2050.5388
5. Other (Other Works and Needs in Energy Sector)	30.3317	0.0000	0.0009	0.0003	0.0862							30.4188
B. Fugitive Emissions	2.1589	24.7926	520.6450	0.0000	0.0053							522.8092
1. Solid Fuels	NO	NO	NO	NO	NO							NO
2. Oil and Natural Gas	2.1589	24.7926	520.6450	0.0000	0.0053							522.8092
2. Industrial Processes	**529.6953**	**NO**	**NO**	**NO**	**NO**	**0.1033**	**142.1872**	**0.0000**	**0.0273**	**0.0000**	**0.6803**	**672.5900**
A. Mineral Products	526.5511	NO	NO	NO	NO							526.5511
B. Chemical Industry	NO	NO	NO	NO	NO							NO
C. Metal Production	3.1441	NO	NO	NO	NO							3.1441
D. Other Production	NO, NE	NO, NE	NO, NE	NO, NE	NO, NE							NO, NE
E. Production of Halocarbons and SF_6						NO	NO	NO	NO	NO	NO	NO
F. Consumption of Halocarbons and SF_6						0.1033	142.1872	0.0000	0.0273	0.0000	0.6803	142.8948
3. Solvents and Other Products Use	**66.5917**			**NO**	**NO**							**66.5917**
A. Paint Application	20.4569			NO	NO							20.4569
B. Degreasing and Dry Cleaning	29.9961			NO	NO							29.9961
C. Chemical Products and Manufacture	4.6492			NO	NO							4.6492
D. Other	11.4896			NO	NO							11.4896
4. Agriculture		**28.3682**	**595.7331**	**4.9387**	**1530.9923**							**2126.7254**
A. Enteric Fermentation		25.7746	541.2669									541.2669
B. Manure Management		2.5936	54.4662	1.2761	395.6009							450.0670
C. Rice cultivation		NO	NO									NO
D. Agricultural Soils				3.6626	1135.3915							1135.3915
E. Prescribed Burning of Savannas		NO	NO	NO	NO							NO
F. Field Burning of Agricultural Residues		IE	IE	IE	IE							IE
5. LULUCF	**-99.3510**	**0.0462**	**0.9692**	**0.0025**	**0.7670**							**-97.6148**
A. Forest Land	-1887.6165	0.0435	0.9128	0.0024	0.7454							-1885.9582
B. Cropland	3245.4858	0.0027	0.0564	0.0001	0.0216							3245.5637
C. Grassland	-1457.2203	NE	NE	NE	NE							-1457.2203
D. Wetlands	NE, IE	NE	NE	NE	NE							NE, IE
E. Settlements	NE, IE	NE	NE	NE	NE							NE, IE
F. Other Land	NE, IE	NE	NE	NE	NE							NE, IE
6. Waste		**70.4943**	**1480.3798**	**0.2755**	**85.4174**							**1565.7972**
A. Solid Waste Disposal on Land		63.9950	1343.8942									1343.8942
B. Wastewater Handling		6.4993	136.4857	0.2755	85.4174							221.9031
C. Waste Incineration		NO, NE	NO, NE	NO, NE	NO, NE							NO, NE
7. Other	**NO, NE**	**NO, NE**	**NO, NE**	**NO, NE**	**NO, NE**							**NO, NE**
Memo Items												
International Bunkers	**115.1928**	**0.0147**	**0.3097**	**0.0038**	**1.1813**							**116.6838**
CO_2 Emissions from Biomass	**1246.2329**											**1246.2329**

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

In 2013, in the Republic of Moldova, approximately 65.5 per cent of the total national direct GHG emissions originated from the Energy Sector. Other relevant direct GHG sources are represented by Agriculture (16.6 per cent of the total), Waste (12.2 per cent of the total) and Industrial Processes (5.2 per cent of the total). The share of two other sectors (Solvents and Other Product Use and Land Use, Land-Use Change and Forestry Sectors) is insignificant (Figure R-3).

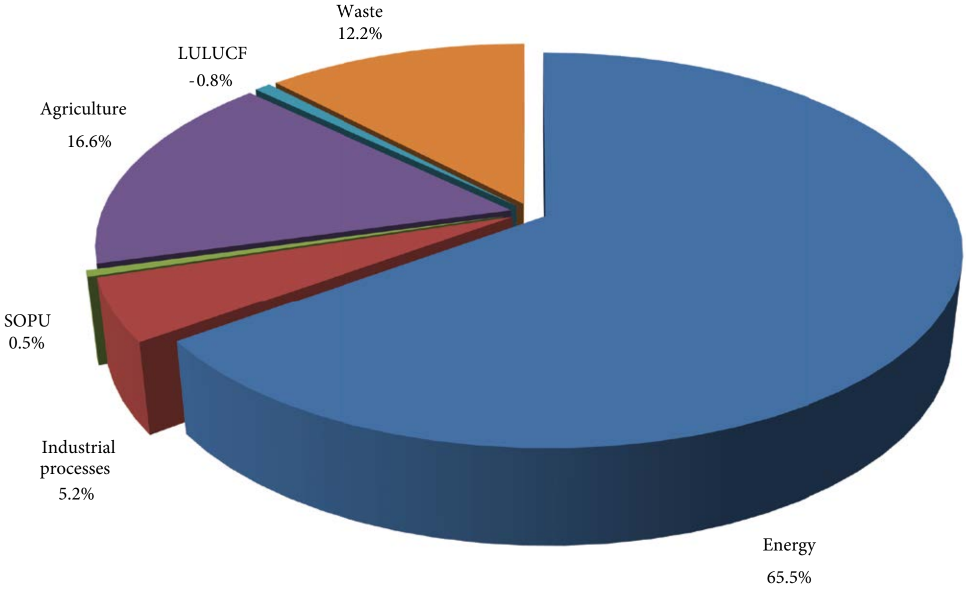

Figure R-3: Sectoral Breakdown of the Republic of Moldova's Total GHG Emissions in 2013

Table R-3 shows the evolution of total GHG emissions and removals in the Republic of Moldova for the time series from 1990 through 2013. As it can be noted, the total national direct GHG emissions (without LULUCF) decreased during the period under review by 70.4 per cent, from 43.4188 Mt CO_2 equivalent to 12.8363 Mt CO_2 equivalent (compared to 2012, the respective emissions decreased by 4.0 per cent).

To be noted that during the period under review, the GHG emissions from Energy Sector have decreased by 75.7 per cent (by 11.2 per cent compared to 2012), emissions from Industrial Processes have decreased by 63.5 per cent (in 2013 an increase by 8.0 per cent occurred, compared to 2012 year level), emissions from SOPU decreased by 47.2 per cent (a decrease by 12.2 per cent in 2013, compared to 2012 year level), emissions from Agriculture decreased by 58.0 per cent (in comparison to 2012, in 2013 an increase by 29.7 per cent was recorded), net removals in LULUCF decreased by 98.3 per cent (a decrease by 96.0 per cent in 2013, compared to 2012 year level), respectively, emissions from Waste decreased by 16.1 per cent (increasing in 2013 by 0.6 per cent, compared to 2012 year level).

The most significant reduction of GHG emissions by source categories during the period under review took place in: 1A1 "Energy Industries" (-82.9 per cent), 1A4 "Other Sectors" (-74.5 per cent), 4B „Manure Management" (-73.4 per cent), 2C "Metal Production" (-73.2 per cent), 1A2 "Manufacturing Industries and Constructions" (-72.2 per cent), 2A "Mineral Products" (-71.2 per cent), 4A "Enteric Fermentation" (-70.6 per cent) and 1A3 „Transport" (-53.7 per cent).

Between 2012 and 2013, total direct GHG emissions decreased by 4.0 per cent. At the same time, emissions from particular source categories increased, such as: 4D „Agricultural Soils" (+81.5 per cent), 2F „Consumption of halocarbons and sulphur hexafluoride" (+12.8 per cent), 1A2 „Manufacturing Industries and Construction" (+8.3 per cent), 2A „Mineral Products" (+7.3 per cent), 1A3 „Transport" (+6.5 per cent) and 4A "Enteric Fermentation" (+1.6 per cent).

Table R-3: Republic of Moldova's Direct GHG Emissions within 1990-2013 periods, Mt CO_2 equivalent

Categories of emissions and stocks	1990	1995	2000	2005	2006	2007	2008	2009	2010	2011	2012	2013
Total	**43.4188**	**17.4240**	**10.7307**	**12.7530**	**11.9433**	**11.6586**	**13.0587**	**13.1368**	**13.9394**	**14.1417**	**13.3642**	**12.8363**
Total net emission	**37.5322**	**16.3946**	**9.3385**	**12.3776**	**11.3042**	**8.5926**	**12.9992**	**11.8519**	**13.2823**	**13.7120**	**10.8939**	**12.7387**
1. Energy	**34.5213**	**11.7222**	**6.6728**	**8.4684**	**7.6334**	**7.7455**	**8.3514**	**9.0709**	**9.6473**	**9.8255**	**9.4690**	**8.4046**
A. Fuel Combustion Activities	33.8384	11.1663	6.1693	7.8081	7.0582	7.1338	7.7426	8.5666	9.1586	9.2689	8.9205	7.8818
1. Energy Industries	19.3933	6.9318	3.1524	3.2361	2.4941	2.8955	3.2951	4.4605	4.5950	4.1855	4.1908	3.3139
2. Manufacturing Industries and Construction	2.1959	0.4530	0.5318	0.5919	0.6517	0.8179	0.9131	0.5086	0.5407	0.6061	0.5632	0.6098
3. Transport	4.0566	1.3384	0.8635	1.6567	1.5821	1.6514	1.7425	1.6591	1.9057	2.0202	1.7634	1.8772
4. Other Sectors	8.0378	2.2616	1.5594	2.2558	2.2504	1.6986	1.7062	1.8885	2.0597	2.3903	2.3616	2.0505
5. Other (Other Works and Needs in Energy Sector)	0.1548	0.1815	0.0623	0.0676	0.0798	0.0704	0.0857	0.0500	0.0574	0.0667	0.0415	0.0304
B. Fugitive Emissions	0.6829	0.5560	0.5034	0.6603	0.5752	0.6117	0.6088	0.5043	0.4888	0.5566	0.5485	0.5228
1. Solid Fuels	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
2. Oil and Natural Gas	0.6829	0.5560	0.5034	0.6603	0.5752	0.6117	0.6088	0.5043	0.4888	0.5566	0.5485	0.5228
2. Industrial Processes	**1.8420**	**0.4784**	**0.2702**	**0.5605**	**0.6563**	**0.9385**	**1.0150**	**0.5137**	**0.5594**	**0.6011**	**0.6227**	**0.6726**
A. Mineral Products	1.8303	0.4656	0.2418	0.5037	0.5977	0.8619	0.9236	0.4190	0.4524	0.4828	0.4908	0.5266
B. Chemical Industry	NO	NO	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
C. Metal Production	0.0117	0.0109	0.0150	0.0173	0.0112	0.0160	0.0146	0.0070	0.0040	0.0053	0.0052	0.0031
D. Other Production	NO, NE	NO, NE	NO, NE	NO, NE	NO, NE	NO, NE	NO, NE	NO, NE	NO, NE	NO, NE	NO, NE	NO, NE
E. Production of Halocarbons and SF_6	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
F. Consumption of Halocarbons and SF_6	NO, NE	0.0019	0.0134	0.0395	0.0474	0.0607	0.0768	0.0876	0.1030	0.1130	0.1267	0.1429
3. Solvents and Other Products Use	**0.1261**	**0.0346**	**0.0288**	**0.0675**	**0.0772**	**0.0981**	**0.1328**	**0.1197**	**0.0612**	**0.0689**	**0.0759**	**0.0666**
4. Agriculture	**5.0639**	**3.2844**	**2.2899**	**2.3588**	**2.2656**	**1.5124**	**2.1006**	**1.9181**	**2.1007**	**2.0865**	**1.6400**	**2.1267**
A. Enteric Fermentation	1.8402	1.3612	0.9119	0.7785	0.7534	0.6087	0.5795	0.6029	0.5986	0.5639	0.5327	0.5413
B. Manure Management	1.6906	0.9957	0.5759	0.5987	0.6208	0.4671	0.4665	0.5318	0.5592	0.5328	0.4818	0.4501
C. Rice Cultivation	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
D. Agricultural Soils	1.5331	0.9275	0.8021	0.9816	0.8913	0.4366	1.0545	0.7834	0.9429	0.9898	0.6256	1.1354
E. Prescribed Burning of Savannas	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
F. Field Burning of Agricultural Residues	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE
5. LULUCF	**-5.8866**	**-1.0294**	**-1.3922**	**-0.3754**	**-0.6391**	**-3.0660**	**-0.0595**	**-1.2849**	**-0.6571**	**-0.4296**	**-2.4704**	**-0.0976**
A. Forest Land	-2.1972	-1.6208	-2.1403	-2.2462	-2.0876	-2.1895	-2.2228	-2.2513	-2.1931	-2.0828	-2.0056	-1.8860
B. Cropland	-2.2132	1.9211	2.3051	3.4183	2.9786	0.6367	3.6586	2.4478	2.9877	3.1147	0.9973	3.2456
C. Grassland	-1.4762	-1.3297	-1.5570	-1.5475	-1.5302	-1.5131	-1.4953	-1.4814	-1.4517	-1.4616	-1.4621	-1.4572
D. Wetlands	NE, IE	NE, IE	NE, IE	NE, IE	NE, IE	NE, IE	NE, IE	NE, IE	NE, IE	NE, IE	NE, IE	NE, IE
E. Settlements	NE, IE	NE, IE	NE, IE	NE, IE	NE, IE	NE, IE	NE, IE	NE, IE	NE, IE	NE, IE	NE, IE	NE, IE
F. Other Land	NE, IE	NE, IE	NE, IE	NE, IE	NE, IE	NE, IE	NE, IE	NE, IE	NE, IE	NE, IE	NE, IE	NE, IE
6. Waste	**1.8655**	**1.9044**	**1.4690**	**1.2978**	**1.3109**	**1.3640**	**1.4589**	**1.5145**	**1.5707**	**1.5597**	**1.5567**	**1.5658**
A. Solid Waste Disposal on Land	1.5442	1.6952	1.3093	1.0955	1.1126	1.1742	1.2630	1.3279	1.3714	1.3534	1.3414	1.3439
B. Wastewater Handling	0.3212	0.2092	0.1597	0.2024	0.1983	0.1897	0.1959	0.1866	0.1993	0.2064	0.2152	0.2219
C. Waste Incineration	NO, NE	NO, NE	NO, NE	NO, NE	NO, NE	NO, NE	NO, NE	NO, NE	NO, NE	NO, NE	NO, NE	NO, NE
7. Other	**NO, NE**	**NO, NE**	**NO, NE**	**NO, NE**	**NO, NE**	**NO, NE**	**NO, NE**	**NO, NE**	**NO, NE**	**NO, NE**	**NO, NE**	**NO, NE**
Memo Items	**0.2204**	**0.0425**	**0.0670**	**0.0685**	**0.0769**	**0.0808**	**0.0903**	**0.0836**	**0.0836**	**0.0965**	**0.1083**	**0.1167**
International Bunkers	0.2204	0.0425	0.0670	0.0685	0.0769	0.0808	0.0903	0.0836	0.0836	0.0965	0.1083	0.1167
CO_2 Emissions from Biomass	0.2108	0.6456	0.3679	0.2950	0.3237	0.2932	0.3367	0.3212	0.8280	1.0169	1.0536	1.2462

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. 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 2013, total nitrogen oxides emissions decreased by 71.6 per cent: from 137.4740 kt to 36.3703 kt, total carbon monoxide emissions decreased by 68.3 per cent: from 433.8751 kt to 146.9860 kt, non-methane volatile organic compounds emissions decreased by 80.4 per cent: from 517.8048 kt to 128.2985 kt, while sulphur dioxide emissions decreased by 93.2 per cent: from 294.7812 kt to 21.8608 kt (Figure R-4).

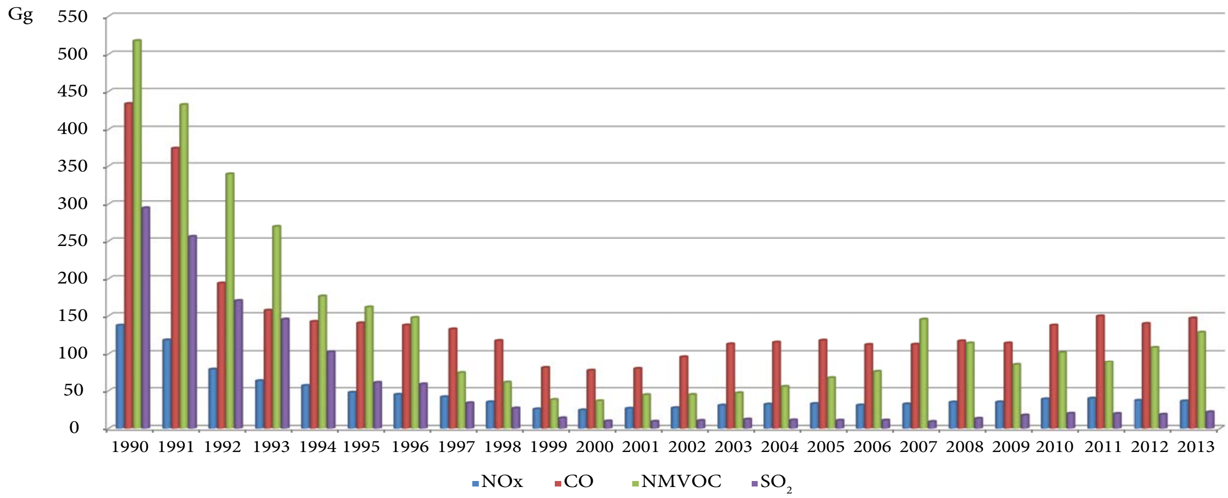

Figure R-4: National Indirect GHG Emissions in the RM within 1990-2013 periods

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).

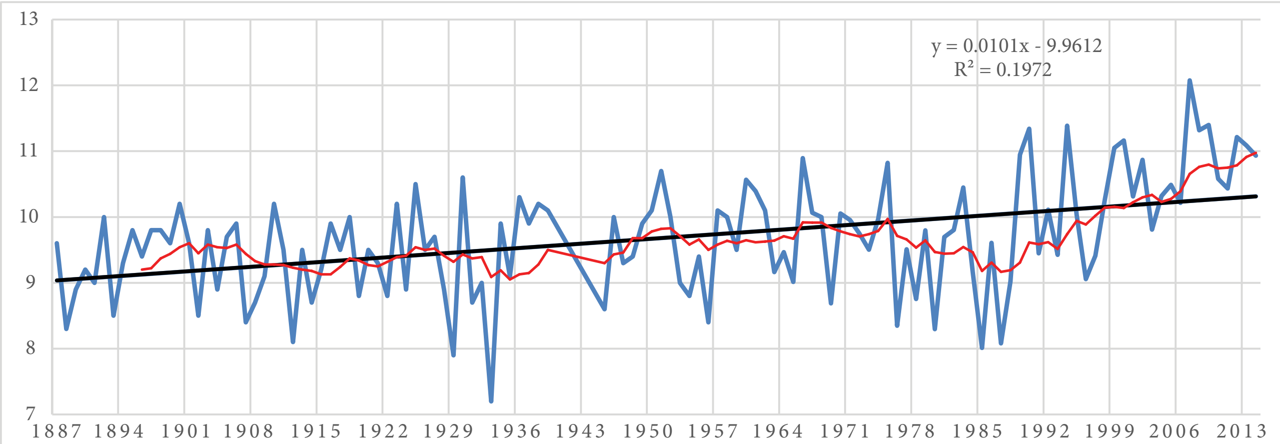

Figure 1-1: Trends of annual average air temperature change (°C) for 1887-2014: blue (actual course trend), black solid line (linear trend secular course) and red line (10 year moving average trend) at the meteorological station Chisinau, Central part of the Republic of Moldova

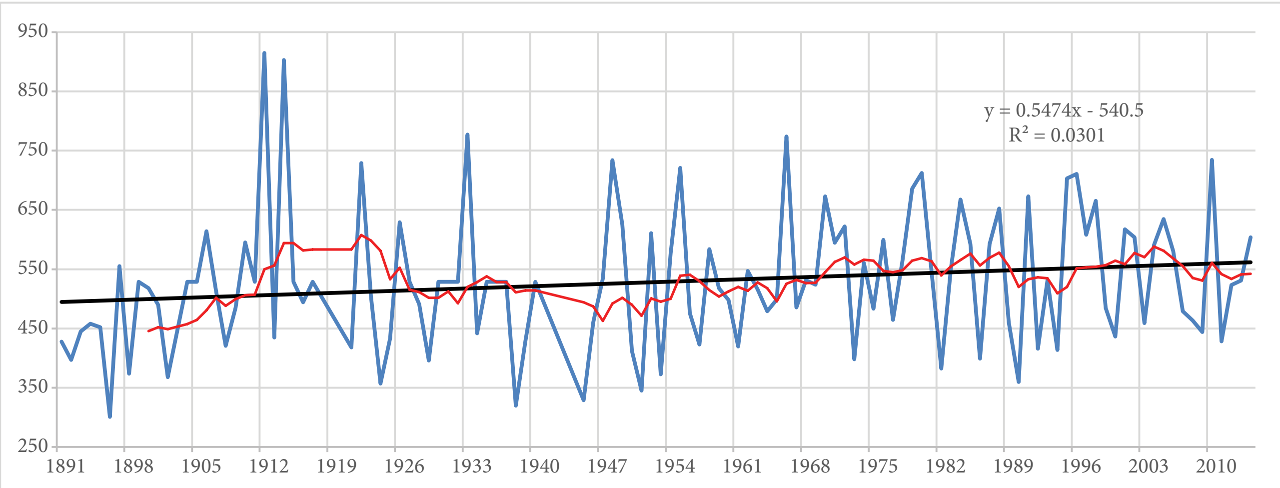

Figure 1-2: Trends of annual average precipitation (mm) for 1891-2014: blue (actual course trend), black solid line (linear trend secular course) and red line (10 year moving average trend) at the meteorological station Chisinau, Central part of the Republic of Moldova

At the same time, the Republic of Moldova has experienced an increased number of extreme weather events, such as droughts and floods. An analysis of national climate data revealed that the frequency of droughts in the Republic of Moldova in a 10-year time span is 1-2 droughts in the Northern part of the country; 2-3 droughts in the Central part and 5-6 droughts in the South. Their frequency is increasing, especially over the last decades. During the 1990-2014 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 under the Forth National Communication Project, 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.

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

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

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

The ensemble projections from the RCP 8.5 forcing scenario show that the three AEZs would exhibit a general annual decrease in precipitation varying from 9.9% 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 2013, the concentration of CO_2 increased by 41 per cent, concentration of CH_4 – by 162 per cent, while N_2O concentration – by circa 21 per cent[5] (Table 1-1). To a great extent these trends can be attributed to human activities — in particular, to fossil fuels combustion and continuous deforestation of forest lands.

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

Greenhouse Gases	Preindustrial tropospheric concentration (1850-1900)	Recent tropospheric concentration (end of 2013)	GWP (100-yr time horizon) (IPCC, 2013)	Tropospheric lifetime (years)	Increased radiative forcing[6] (W/m²)
Concentration in parts per million (ppm)					
Carbon dioxide (CO_2)	280	395.4	1	~ 100	1.88
Concentration in parts per billion (ppb)					
Methane (CH_4)	722	1893	28	12.4	0.49
Nitrous oxide (N_2O)	270	326	265	121	0.17
Tropospheric ozone (O_3)	237	337	n.a.	ore-zile	0.40
Concentration in parts per trillion (ppt)					
CFC-11 (CCl_3F)	zero	236	4660	45	0.061
CFC-12 (CCl_2F_2)	zero	527	10200	100	0.169
CF-113 (CCl_2CClF_2)	zero	74	5820	85	0.022
HCFC-22 ($CHClF_2$)	zero	231	1760	11.9	0.046
HCFC-141b (CH_3CCl_2F)	zero	24	782	9.2	0.0036
HCFC-142b (CH_3CClF_2)	zero	23	1980	17.2	0.0042
Halon 1211 ($CBrClF_2$)	zero	4.1	1750	16	0.0012
Halon 1301 ($CBrClF_3$)	zero	3.3	6290	65	0.0010
HFC-134a (CH_2FCF_3)	zero	75	1300	13.4	0.0108
Carbon tetrachloride (CCl_4)	zero	85	1730	26	0.0143
Sulphur hexafluoride (SF_6)	zero	7.79	23500	3200	0.0043

By the end of 2013, globally, the amount of annual emissions of carbon dioxide represented circa 35.3 Gigatons (Gt)[7], 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 is, on average, 100 years. It can be removed from atmosphere through a complex set of natural sinks mechanisms. Also, it is considered that circa 40 per cent of the emitted carbon dioxide can be absorbed by oceans. Photosynthesis, in particular in sea vegetation and plankton is an important, though transitory, mechanism of CO_2 emissions removal, because after the perishing of plants, carbon dioxide is again emitted into the atmosphere.

Concentration of methane in atmosphere is affected 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

[5] <http://cdiac.ornl.gov/pns/current_ghg.html>.
[6] 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).
[7] <http://edgar.jrc.ec.europa.eu/news_docs/jrc-2014-trends-in-global-co2-emissions-2014-report-93171.pdf>.

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[8]).

It has been stated that circa 30 per cent of the atmospheric N_2O is of anthropogenic origin[9], 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 2/3 of the atmospheric N_2O comes from the soil and denitrification of water in anaerobic conditions. N_2O breaks down photochemically in atmosphere. Global annual N_2O emissions from anthropogenic activities are estimated at circa 9Mt[10].

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 (IPCC Second Assessment Report, 1996) for use in GHG emissions inventory under UNFCCC and adopted at COP 3 (Table 1-2).

Table 1-2: GWP for a Period of 100 Years and Direct GHG Atmospheric Lifetimes[11]

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_2	5.2	650	550	675	677
HFC-125	C_2HF_5	28.2	2800	3400	3500	3170
HFC-134a	$C_2H_2F_4$ (CH_2FCF_3)	13.4	1300	1300	1430	1300
HFC-143a	$C_2H_3F_3$ (CF_3CH_3)	47.1	3800	4300	4470	4800
HFC-152a	C_2H4F_2 (CH_3CHF_2)	1.5	140	120	124	138
HFC-227ea	CF_3CHFCF_3	38.9	2900	3500	3220	3350
HFC-236fa	$CF_3CH_2CF_3$	242	6300	9400	9810	8060
HFC-245fa	$CHF_2CH_2CF_3$	7.7	NA	950	1030	858
HFC-365mfc	$CH_3CF_2CH_2CF_3$	8.7	NA	890	794	804
HFC-43-10mee	$CF_3CHFCHFCF_2CF_3$	16.1	1300	1500	1640	1650
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).

[8] <https://www.globalmethane.org/documents/analysis_fs_en.pdf>.
[9] <https://www.wmo.int/pages/mediacentre/press_releases/pr_1002_en.html>.
[10] <http://edgar.jrc.ec.europa.eu/part_N2O.php#1overview>, <http://edgar.jrc.ec.europa.eu/ingos/JRC-INGOS-report.pdf>.
[11] < http://www.epa.gov/climatechange/Downloads/ghgemissions/US-GHG-Inventory-2014-Annex-6-Additional-Information.pdf>.

1.1.4. Convention, Kyoto Protocol and Party's Commitments

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

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

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

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

The COP 8 (New Delhi, 2002) adopted a new Guideline on national communications for non-Annex I Parties (Decision 17/CP 8). In conformity with these Guidelines, during 2005-2009 time period, under the *UNEP-GEF Project "Enabling Activities for the preparation of the Second National Communication under the UNFCCC"*, Republic of Moldova developed its SNC under the UNFCCC, within 2010-2013 period – the Third National Communication (TNC), while from 2014 to 2017, the Fourth National Communication (4^{th}NC) is under preparation.

With reference to UNFCCC implementation instruments it should be noted that the COP 3 (Kyoto, 1997) adopted the Kyoto Protocol[12], 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 Republic of Moldova ratified the Kyoto Protocol on February 13, 2003. As a non-Annex I Party, the Republic of Moldova has 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*

[12] 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.

national level of greenhouse gas emissions by 2020, by implementing economic mechanisms focused on global climate change mitigation, in accordance with the principles and provisions of the Convention". This target is presented without indicating specific national appropriate mitigation actions, identified and quantified, and without further clarification of the necessary support to achieve it. Simultaneously, it is recognized that achieving this target will require significant financial, technological and capacity-building support, which can be provided through the UNFCCC mechanisms.

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

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 an update of the information contained in Decision 17/CP.8, Annex, Chapter III (National Greenhouse Gas Inventories). The inventory section is expected 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.

Simultaneously, 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 will be conducted by a team of technical experts (TTE) and will be initiated within six months of BUR submission to the Secretariat.

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 15, 2015[13], only 41 countries had ratified the Doha Amendment to the KP, most of which are non-Annex I Parties to the UNFCCC and the KP.

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

The COP 20 took place in Lima (2014). The Parties agreed over Lima Call for Climate Action and were repeatedly invited to communicate to the Secretariat their intended nationally determined contributions, in order to facilitate clarity, transparency and understanding. The INDC may include, as 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 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. Following this statement, at 25th of September 2015, the Republic of Moldova communicated its Intended Nationally Determined Contribution (INDC)[14] 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.

1.1.5. Republic of Moldova's Contribution to Global Warming

The Republic of Moldova historic contribution to global warming is low. In 2013, the country contributed with circa 12.8 Mt CO_2 equivalent (without LULUCF) and 12.7 Mt CO_2 equivalent (with LULUCF), representing less than 0.03 per cent of total global GHG emissions. Total and net emissions

[13] <http://unfccc.int/kyoto_protocol/doha_amendment/items/7362.php>.
[14] <http://www4.unfccc.int/submissions/INDC/Published%20Documents/Republic%20of%20Moldova/1/INDC_Republic_of_Moldova_25.09.2015.pdf>.

per capita, respectively, were less than half of the global average (3.2 tCO_2 equivalent/per capita compared to 6.4 tCO_2 equivalent/per capita, respectively, 3.1 tCO_2 equivalent/per capita compared to 6.8 tCO_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)[15].

Between 1990 and 2013, the total national GHG emissions (without LULUCF) decreased by 70.4 per cent, which is much more than in some industrialized countries and economies in transition included in Annex I to Convention (Figure 1-3).

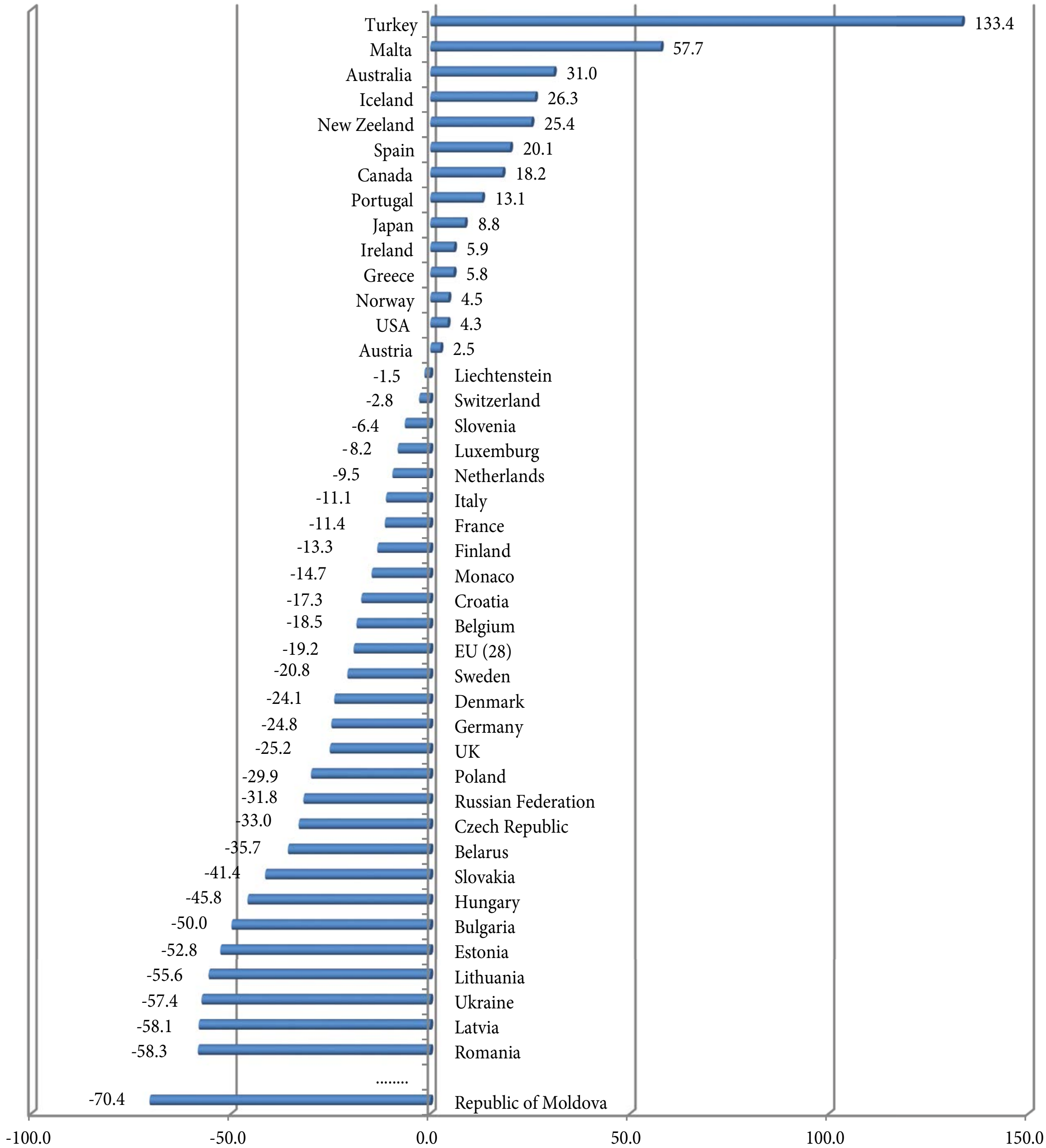

Figure 1-3: Total GHG Emissions from the Republic of Moldova (2013) and Annex I Parties to the Convention (2012) (% compared to 1990).

1.2. Institutional and Legal Arrangements for Inventory Preparation

1.2.1. National Inventory System

The Ministry of Environment (MoEN) of the Republic of Moldova (RM) is the state authority responsible for development and promotion of policies and strategies addressing environment protection, rational

[15] CAIT 2.0 WIR's Climate Data Explorer: <http://cait.wri.org/profile/Moldova>

use of natural resources and biodiversity conservation. On behalf of the Government of Republic of Moldova, MoEN is in charge for implementation of international environment treaties to which the Republic of Moldova is a Part (including UNFCCC). Minister of Environment 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 into Ministry of Environment and Natural Resources based on Government Decision No. 357 dated 23 April 2005*).

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 of the Ministry of Environment 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 process, as well as reporting this information (National Inventory Reports, Biennial Update Reports and National Communications) on the national and international level. 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 MoEN, the Climate Change Office (CCO) is totally responsible for the activities related to preparation of National Communications (NCs), Biennial Update Reports (BURs), National Inventory Reports (NIRs) and National GHG Emission Inventory Reports. Figure 1-4 reveals the responsibilities and arrangements for the National Inventory System (NIS) of the Republic of Moldova.

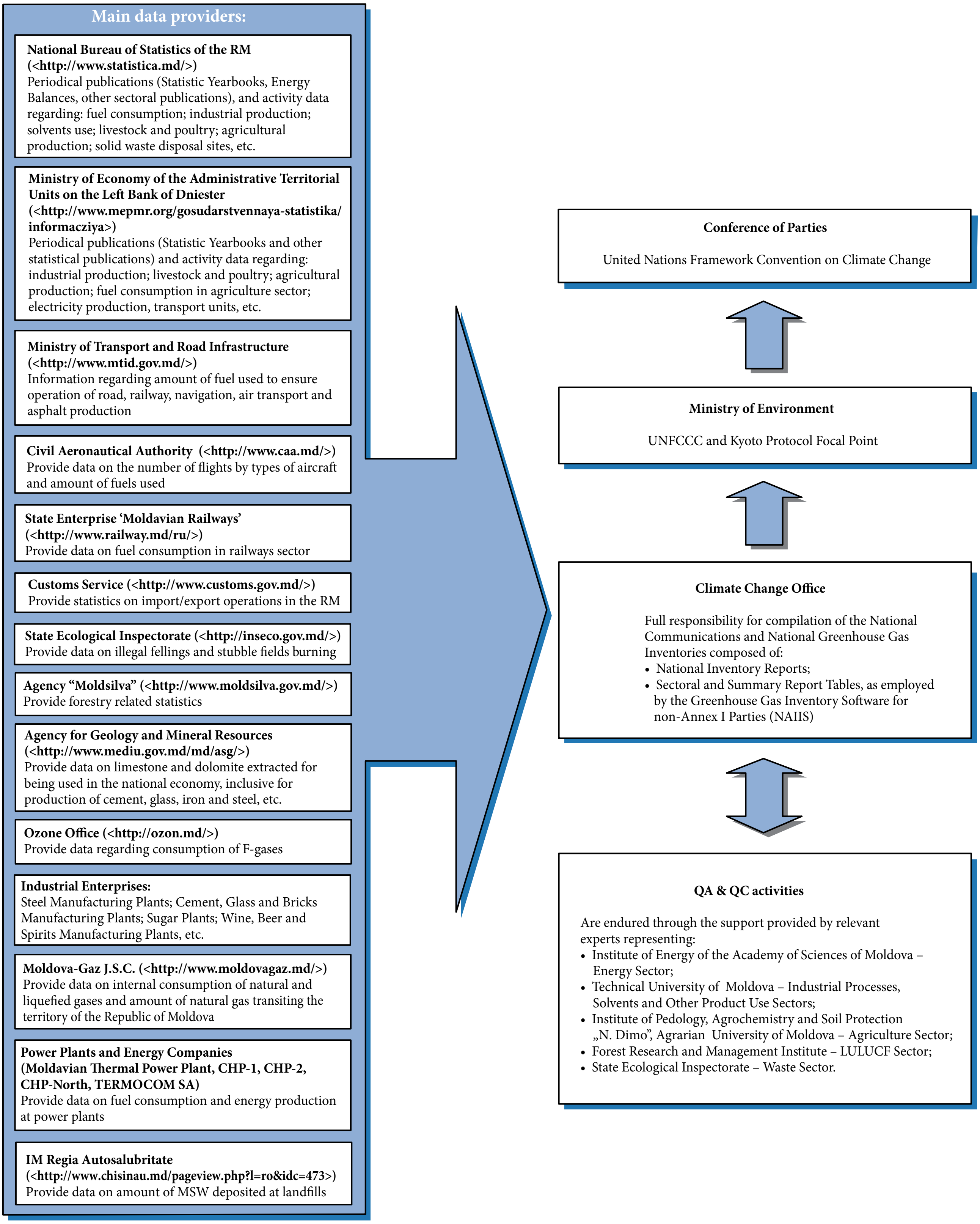

Figure 1-4: Institutional arrangements under the National Inventory System of the Republic Moldova

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.

- The task group leads and 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 (Energy, Industrial Processes, Solvents and Other Products Use, Agriculture, LULUCF and 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 task group leads are responsible for development the NIR's sectoral chapters.

The AD needed for developing the national GHG inventories are available in the Statistical Yearbooks (SY), Energy Balances (EBs) and other sectoral statistic publications of the National Bureau of Statistics (NBS) of the Republic of Moldova. It is worth mentioned that the activity data provided by the NBS of the RM in the Statistical Yearbooks, Energy Balances[16], sectoral statistical publications and on its website, as part of the statistical database (see on <http://statbank.statistica.md/pxweb/Database/EN/databasetree.asp>) are available for the period until 1992 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 State Statistical Service beside the Ministry of Economy of the ATULBD[17], being published in the Statistical Yearbooks[18], and other periodic statistical publications available on the website of the Ministry of Economy of the ATULBD (see on <http://www.mepmr.org/gosudarstvennaya-statistika/informacziya>).

Additional statistical data (in some cases 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 state institutions and enterprises:

- from Ministry of Transports and Roads Infrastructure is collected information on the amount of fuel used to ensure operation of road, railway, naval transport and asphalt production;
- from State Enterprise 'Moldavian Railways" – information of fuel used for rail transport;
- from Civil Aeronautical Authority – information on the number of flights by type of aircrafts and amount of fuels used in air transportation;
- from Ministry of Information Technology and Communications – information on transport units registered, ages of fleet and/or production year and other relevant characteristics;
- from the Ministry of Defense – information on fuel used by the National Army;
- from the Ministry of Health – information on 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 extraction of mineral resources, inclusive of limestone and dolomite use (for cement, glass, iron and steel production, etc.);
- from Ozone Office – information on import/export of freons in bulk and type of freons used in the imported refrigeration and air-conditioning equipment;

[16] Energy Balances of the RM have been not developed only for two years, 1991 and 1992, respectively. CCO of the MoEN has copies of EBs for 1990 and 1993-2013 years.
[17] State Statistical Service, Ministry of Economy of the ATULBD.
[18] CCO of the MoEN has copies of the Statistical Yearbooks of ATULBD for the years of 2000-2014, covering the statistical data for the 1990 year and 1995-2013 periods.

- from Municipal Enterprise "Regia Autosalubritate" in Chisinau – information on the amount of municipal solid waste generated in Chisinau municipality;
- from "Moldova-Gaz" J.S.C. – information on the amount of natural gas transited through the territory of the Republic of Moldova, as well as on the consumption of natural gas in the national economy;
- from Power Plants („TERMOELECTRICA" S.A. in Chisinau [former 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 (Î.S. „Moldelectrica", Î.C.S. „Red Union Fenosa", S.A. „Red-North", S.A. „Red North-West") – 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" S.A., "Macon" S.A., 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, etc.

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

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

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

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

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

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

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

1.3. Process for Inventory Preparation

The Climate Change Office adopted a centralized approach to the process of preparing the national inventory comprising the NIR and standard estimation and reporting tables. The National Inventory preparation process is outlined in Figure 1-5.

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, task group leads and 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', Chapter 5 'Solvents and Other Products Use', Chapter 6 'Agriculture', Chapter 7 'LULUCF' and Chapter 8 '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 9 'Recalculations', 'Bibliography' and 'Annexes'), as well as for checking the correctness of the key category analysis, compatible with Good Practice Guidance - GPG (IPCC, 2000) and GPG for Land Use, Land Use Change and Forestry (IPCC, 2003) requirements.

The NIR was produced in compliance with UNFCCC reporting guidelines on annual inventories. In addition to NIR, the Sectoral and Summary Reporting Tables, as employed by the Greenhouse Gas Inventory Software for non-Annex I Parties (NAIIS) were filled-in. The Coordinator of the National GHG Inventory has the task to monitor the process of producing of standard 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 2005 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 GPG (IPCC, 2000) requirements. Subsequently, it was periodically updated during the national GHG inventory processes.

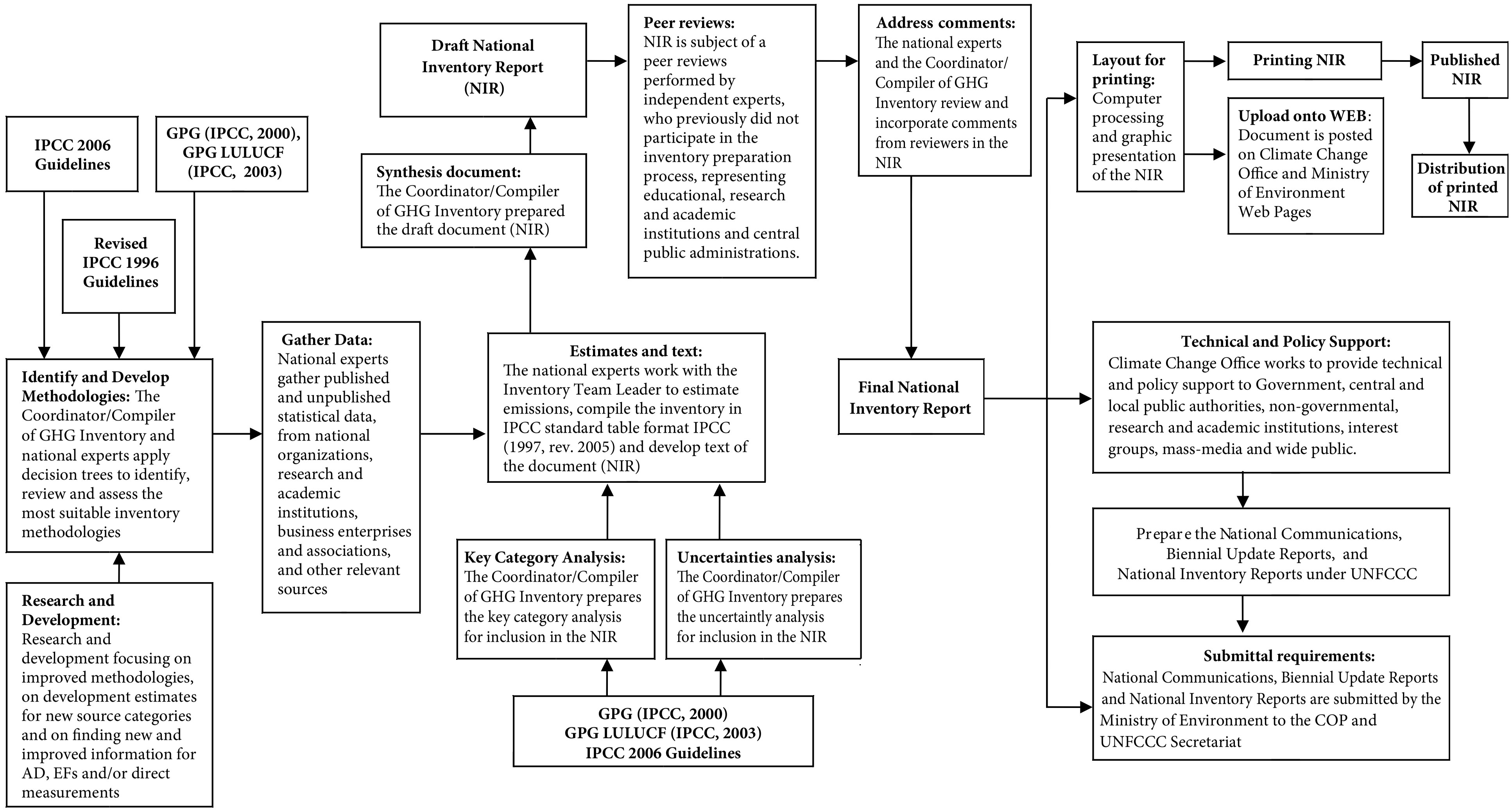

Figure 1-5: Inventory Process in the Republic of Moldova

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 MoEN. 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 MoEN 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 six main sectors: (1) Energy, (2) Industrial Processes, (3) Solvents and Other Products Use, (4) Agriculture, (5) Land Use, Land-Use Change and Forestry and (6) Waste. Each of these sectors is further subdivided, within the inventory, by sources and sinks categories (Table 1-3).

Emissions of direct (CO_2, CH_4, N_2O, HFCs, PFCs and SF_6) and indirect (NO_x, CO, NMVOC, SO_2) greenhouse gases were estimated based on methodologies contained in the Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories (IPCC, 1997).

Further, the National Inventory Team used methodologies available in Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories (IPCC, 2000), GPG for LULUCF (IPCC, 2003), Air Pollutant Emission Inventory Guidebook (EMEP/EEA, 2013) and 2006 IPCC Guidelines for National Greenhouse Gas Inventories (IPCC, 2006).

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 at a sectoral level of segregation without attribution to individual emitters. 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 Climate Change Office 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 detailed source specific data.

To the extent possible, AD used in this report are based on officially published data: national (Statistical Yearbooks of the RM, respectively of the Administrative-Territorial Units from the Left Bank of Dniester River (Transnistria), Energy Balances, etc.) and international statistical publications (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 "N. 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 (MITC, MAFI, MD, MH, MTRI, CAA, MF, MoEN, Customs Service; Agency „Moldsilva", SEI, SHS, Agency for Geology and Mineral Resources, Ozon Office) and central administrative authorities (National Bureau of Statistics, Agency for Land Relations and Cadaster), 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; *Complex 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 *Complex 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.).

Table 1-3: 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	T1	D, CS	T1	D	T1	D						
A. Fuel Combustion Activities	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 (other works and needs in energy sector)	T1	D, CS	T1	D	T1	D						
B. Fugitive Emissions	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						
2. Industrial Processes	T2, T1	D, CS	T1	D	T1	D	T2, T1	D	NO, NE	NO, NE	T2, T1	D
A. Mineral Products	T2, T1	D, CS	NA	NA	NA	NA						
B. Chemical Industries	NO, NE	NO, NE	NO, NE	NO, NE	NO, NE	NO, NE						
C. Metal Production	T1	D	T1	D	T1	D						
D. Other Production	NA	NA	NA	NA	NA	NA						
E. Production of halocarbons and SF_6							NO, NE	NO, NE	NO, NE	NO, NE	NO, NE	NO, NE
F. Consumption of halocarbons and SF_6							T2, T1	D	NO, NE	NO, NE	T2, T1	D
3. Solvents and Other Products Use	T2, T3 (C)	CS, D	NA	NA	T2 (C)	D						
A. Paint application	T3 (C)	CS, D	NA	NA	NA	NA						
B. Degreasing and dry cleaning	T3 (C)	CS, D	NA	NA	NA	NA						
C. Chemical Products, Manufacture and Processing	T2 (C)	D	NA	NA	NA	NA						
D. Other	T2 (C)	D	NA	NA	T2 (C)	D						
4. Agriculture			T2, T1	D, CS	T2, T1	D, CS						
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	D, CS						
E. Prescribed burning of savannas			NO	NO	NA	NA						
F. Field burning of agricultural residues			IE	IE	IE	IE						
5. LULUCF	T2, T1	D, CS	T1	D	T1	D						
A. Forest lands	T2, T1	D, CS	T1	D	T1	D						
B. Croplands	T2, T1	D, CS	T1	D	T1	D						
C. Grasslands	T2, T1	D, CS	NE	NE	NE	NE						
D. Wetlands	NE, IE	NE, IE	NE	NE	NE	NE						
E. Settlements	NE, IE	NE, IE	NE	NE	NE	NE						
F. Other Lands	NE, IE	NE, IE	NE	NE	NE	NE						
6. Waste			T2, T1	D, CS	T1	D						
A. Solid Waste Disposal on Land			T2, T1	D, CS	NA	NA						
B. Wastewater Handling			T1	D, CS	T1	D						
C. Waste Incineration			NO, NE	NO, NE	NO, NE	NO, NE						
7. Other	NO, NE	NO, NE	NO, NE	NO, NE	NO, NE	NO, NE						
Memo Items	T2, T1	D, CS	T1	D	T1	D						
International bunkers	T2, T1	D, CS	T1	D	T1	D						
CO_2 emissions from biomass	T1	D, CS										

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.

1.5 Key Categories

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

Table 1-4 presents the key categories for the Republic of Moldova inventory based on the Tier 1 methodological approach [with LULUCF: 17 key categories by level (L) and 17 key categories by trend (T); without LULUCF: 17 key categories by level (L) and 13 key categories by trend (T)] using emissions data in this report for the 1990-2013 period.

Table 1-4: Summary Overview of the Republic of Moldova's Key Categories for 1990-2013, Based on a Tier 1 Approach

IPCC classification	Key Categories	Gas	Tier 1 Approach				2013 GHG Emissions ($Gg\ CO_2$ eq.)
			With LULUCF		Without LULUCF		
			L	T	L	T	
5B	Cropland	CO_2	X	X			3245.4858
1A1	Energy Industries - Gas	CO_2	X	X	X	X	2753.2020
5A	Forest Lands	CO_2	X	X			-1887.6165
1A3b	Road Transportation	CO_2	X		X	X	1759.1150
5C	Grasslands	CO_2	X	X			-1461.3867
6A	Solid Waste Disposal on Land	CH_4	X	X	X	X	1343.8942
1A4b	Other: Residential	CO_2	X	X	X		1309.0059
4D	Direct Emissions from Agricultural Soils	N_2O	X	X	X	X	908.0039
1A2	Manufacturing Industries and Construction	CO_2	X	X	X		607.6708
4A	Enteric Fermentation	CH_4	X	X	X		541.2669
1B2	Fugitive Emissions from Oil and Natural Gas	CH_4	X		X	X	520.6450
2A1	Cement Production	CO_2	X	X	X	X	476.9147
1A4a	Other: Commercial/Institutional	CO_2	X	X	X		471.6212
1A1	Energy Industries - Coal	CO_2	X	X	X	X	470.1322
4B	Direct Emissions from Manure Management	N_2O	X	X	X		328.6530
4D	Indirect Emissions from Agricultural Soils	N_2O	X	X	X	X	227.3876
1A4c	Other: Agriculture/Forestry/Fishing	CO_2	X	X	X	X	164.9499
6B	Waste water treatment	CH_4			X	X	136.4857
2F1	HFC Emissions from Refrigeration and Air Conditioning Equipment	HFCs			X		96.9365
6B	Wastewater Handling	N_2O			X		85.4174
1A1	Energy Industries – Residual Fuel Oil	CO_2		X		X	84.8480
1A3c	Railways	CO_2		X		X	62.3858
2A3	Limestone and Dolomite Use	CO_2				X	14.3708
Sub-total without LULUCF							**12362.9064**
Total National Emissions without LULUCF							12836.3270
Per cent of National Emissions without LULUCF							96.31%
Sub-total with LULUCF							**11926.1787**
Total National Emissions with LULUCF							12738.7123
Per cent of Total National Emissions with LULUCF							93.62%

Abbreviations: L – Level Assessment; T – Trend Assessment.

Following the recommendations set in the GPG (IPCC, 2000), the inventory was first disaggregated by source and sink categories which further were used to identify key categories. Source and sink categories were defined in conformity with the following guidelines:

(1) IPCC categories should be used with emissions specified in CO_2 equivalent units according to standard 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 should be aggregated before analysis.

Key categories were identified from two perspectives:

- the first analysis the emission contribution that each category makes to the national total (with and without LULUCF); and
- 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 (with and without LULUCF categories).

The per cent contributions to both levels and trends in emissions are calculated and sorted from greatest to least. The 95% cumulative contribution threshold has been used in this analysis to define an upper boundary for the key category identification.

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

1.6. Quality Assurance and Quality Control

Following the GPG recommendations (IPCC, 2000), national inventories have to be transparent, well documented, consistent, complete, comparable, assessed for uncertainties, subject to verification and QA/QC.

Good Practice Guidance (IPCC, 2000) 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 Tier 1 (general procedures) and Tier 2 (source-specific procedures) detailed specific procedures (see Figure 1-6 below) and standard verification and quality control forms and checklists (Annex 4), 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.

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

In the Republic of Moldova, the National Inventory Team has a sufficiently transparent documentation allowing to fully reproducing the GHG emissions estimates. A standard system for documenting and archiving numeric and qualitative information, in compliance with the Revised 1996 IPCC Guidelines (IPCC, 1997) and GPG (IPCC, 2000) 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 (3-8), as well as in the Chapter 9 '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 ensured a better quality inventory.

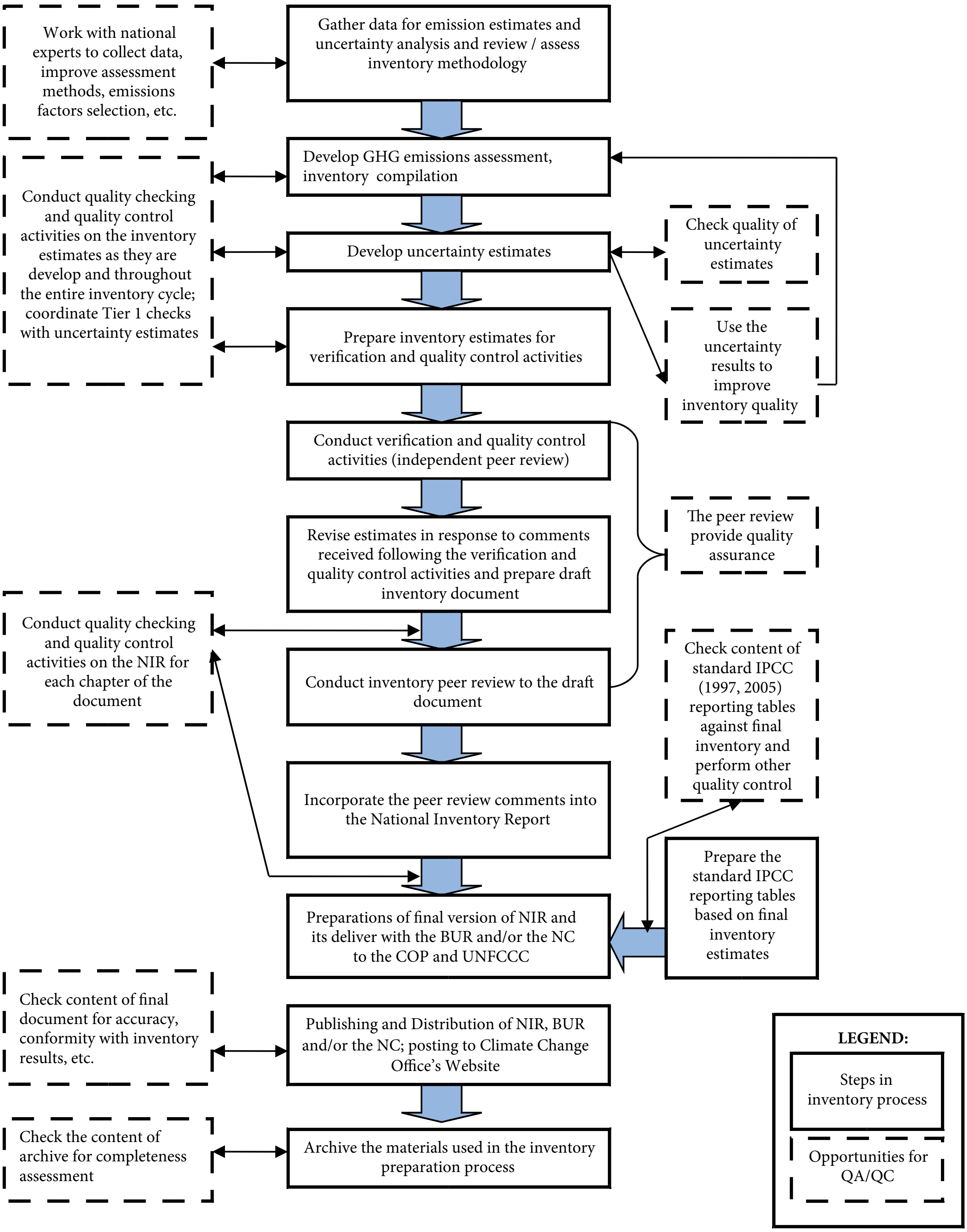

Figure 1-6: The Role of QA/QC Activities in the Inventory Preparing Process

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 energy-related activities and cement processing, 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. In particular, emissions from a number of categories in Industrial Processes and Land Use, Land-Use Changes and Forestry sectors are not included in the inventory because data are incomplete.
- *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 use, indirect N_2O emissions from waste management and indirect N_2O emissions from agricultural soils etc., is highly uncertain.
- *Collecting more detailed activity data.* Although methodologies for estimating emissions for some sources exist, problems arise in obtaining activity data at a level of detail in which aggregate emission factor can be applied (for example, the ability to estimate emissions of F-gases (HFCs, PFCs and SF_6) from Industrial Processes sector is limited).

The overall inventory uncertainty was estimated using a Tier 1 methodological approach (IPCC, 2000). An estimate of the overall quantitative uncertainty, ±7.55 per cent level uncertainty and, respectively ±3.11 per cent trend uncertainty, are shown in Table 1-5, as well as in the Annex 5.

Table 1-5: Estimated Overall National Inventory Quantitative Uncertainty

	CO_2	CH_4	N_2O	Total
Level Uncertainty	±10.09	±11.24	±22.43	±7.55
Trend Uncertainty	±3.63	±6.43	±8.85	±3.11

Emissions evaluated under the RM's 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, HFCs, PFCs and SF_6, using 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 F-gases (HFCs, PFCs and SF_6) from 2F3 'Fire Extinguishers', 2F5 'Solvents' and 2F6 'Other Applications with ODS';
- CO_2 emissions and removals from 5D 'Wetlands', 5E 'Settlements' and 5F 'Other Lands';
- GHG emissions from 6C 'Waste Incineration' (in particular, from medical 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 2013, the total direct greenhouse gas emissions dynamic expressed in CO_2 equivalent, revealed a decreasing trend in the Republic of Moldova, reducing by circa 70.4 per cent: from 43.4188 to 12.8363 Mt CO_2 equivalent (Figure 2-1).

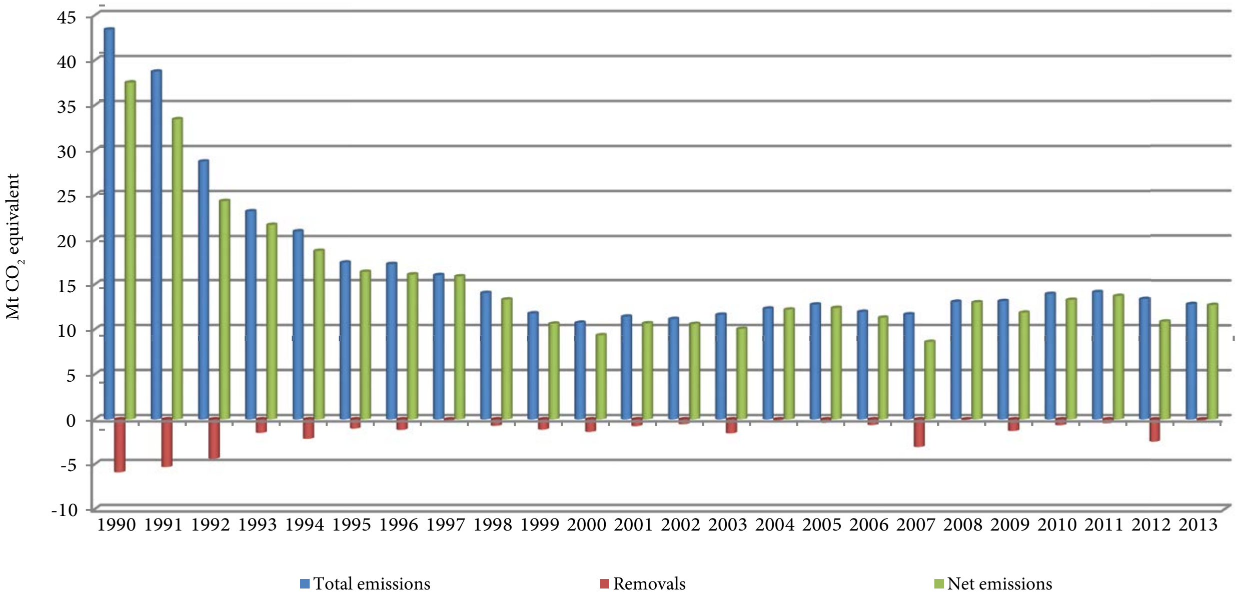

Figure 2-1: Greenhouse Gas Emission and Removals Trends in the Republic of Moldova within 1990-2013 time series

The most significant GHG emissions reductions have been registered under the following source categories: 1A1 'Energy Industries' (-82.9 per cent), 1A4 'Other Sectors' (-74.5 per cent), 4B 'Manure Management' (-73.4 per cent), 2C 'Metal Production' (-73.2 per cent), 1A2 'Manufacturing Industries and Constructions' (-72.2 per cent), 2A 'Mineral Products' (-71.2 per cent), 4A 'Enteric Fermentation' (-70.6 per cent) and 1A3 'Transport' (-53.7 per cent).

Between 2012 and 2013, total direct GHG emissions decreased in the Republic of Moldova by circa 4.0 per cent. At the same time, emissions from certain source categories increased, in particular from: 4D 'Agricultural Soil' (+81.5 per cent), 2F 'Consumption of HFCs and SF_6' (+12.8 per cent), 1A2 'Manufacturing Industries and Constructions' (+8.3 per cent), 2A 'Mineral Products' (+7.3 per cent), 1A3 'Transport' (+6.5 per cent) and 4A 'Enteric Fermentation' (+1.6 per cent).

2.2. Emission Trends by Gas

In the time periods from 1990 through 2013, the total CO_2 emissions (without LULUCF) decreased by circa 76.4 per cent (from 35.3337 to 8.3255 Mt). CH_4 and N_2O emissions (without LULUCF) decreased by circa 44.7 per cent (from 4.8724 to 2.6937 Mt CO_2 equivalent), respectively by 47.9 per cent (from 3.2128 to 1.6743 Mt CO_2 equivalent) (Table 2-1).

Table 2-1: Direct GHG Emissions in the Republic of Moldova within 1990-2013, Mt CO_2 equivalent

	1990	1991	1992	1993	1994	1995	1996	1997
CO_2 (without LULUCF)	35.3337	31.0500	21.8049	16.5695	14.9980	11.5527	11.6556	10.6885
CO_2 (with LULUCF)	29.4438	25.7222	17.4179	15.0653	12.8319	10.5207	10.4871	10.5485
CH_4 (without LULUCF)	4.8724	4.7236	4.5852	4.3179	4.1921	3.9534	3.8140	3.4065
CH_4 (with LULUCF)	4.8747	4.7256	4.5871	4.3204	4.1935	3.9553	3.8153	3.4088
N_2O (without LULUCF)	3.2128	2.9738	2.3644	2.3306	1.8014	1.9159	1.7903	1.9239
N_2O (with LULUCF)	3.2138	3.0032	2.3651	2.3316	1.8020	1.9166	1.7908	1.9248
HFCs	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	0.0019	0.0041	0.0066
PFCs	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO
SF_6	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO
Total (without LULUCF)	43.4188	38.7474	28.7545	23.2180	20.9914	17.4240	17.2640	16.0256
Total (with LULUCF)	37.5322	33.4510	24.3701	21.7173	18.8274	16.3946	16.0973	15.8886

	1998	1999	2000	2001	2002	2003	2004	2005
CO_2 (without LULUCF)	9.0630	7.1544	6.3884	6.9920	6.6679	7.4392	7.9122	8.3103
CO_2 (with LULUCF)	8.3375	6.0167	4.9951	6.2404	6.1349	5.8844	7.8086	7.9346
CH_4 (without LULUCF)	3.2493	3.0418	2.9138	2.8462	2.8444	2.7640	2.7233	2.7555
CH_4 (with LULUCF)	3.2513	3.0439	2.9146	2.8473	2.8447	2.7641	2.7235	2.7557
N_2O (without LULUCF)	1.7225	1.5641	1.4151	1.5663	1.6100	1.3882	1.6369	1.6477
N_2O (with LULUCF)	1.7233	1.5649	1.4154	1.5668	1.6101	1.3883	1.6371	1.6478
HFCs	0.0095	0.0115	0.0134	0.0165	0.0195	0.0259	0.0320	0.0394
PFCs	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO
SF_6	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	0.0000	0.0000	0.0000
Total (without LULUCF)	14.0442	11.7718	10.7307	11.4210	11.1419	11.6173	12.3044	12.7530
Total (with LULUCF)	13.3216	10.6370	9.3385	10.6710	10.6092	10.0626	12.2012	12.3776
	2006	2007	2008	2009	2010	2011	2012	2013
CO_2 (without LULUCF)	7.6519	8.0283	8.7278	9.0304	9.5523	9.6871	9.3542	8.3255
CO_2 (with LULUCF)	7.0124	4.9594	8.6673	7.7449	8.8950	9.2572	6.8814	8.2261
CH_4 (without LULUCF)	2.6644	2.5860	2.6488	2.6332	2.7027	2.7335	2.6933	2.6937
CH_4 (with LULUCF)	2.6646	2.5877	2.6495	2.6335	2.7029	2.7337	2.6946	2.6947
N_2O (without LULUCF)	1.5797	0.9835	1.6053	1.3856	1.5814	1.6080	1.1901	1.6743
N_2O (with LULUCF)	1.5799	0.9848	1.6056	1.3859	1.5815	1.6081	1.1912	1.6750
HFCs	0.0471	0.0604	0.0763	0.0871	0.1024	0.1124	0.1260	0.1422
PFCs	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
SF_6	0.0003	0.0004	0.0004	0.0005	0.0006	0.0006	0.0006	0.0007
Total (without LULUCF)	11.9433	11.6586	13.0587	13.1368	13.9394	14.1417	13.3642	12.8363
Total (with LULUCF)	11.3042	8.5926	12.9992	11.8519	13.2823	13.7120	10.8939	12.7387

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

Halocarbons emissions (HFCs, PFCs) and sulphur hexafluoride (SF6) emissions have been recorded beginning with 1995, considered as a starting year for monitoring F-gases (HFCs, PFCs and SF6) 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 2013.

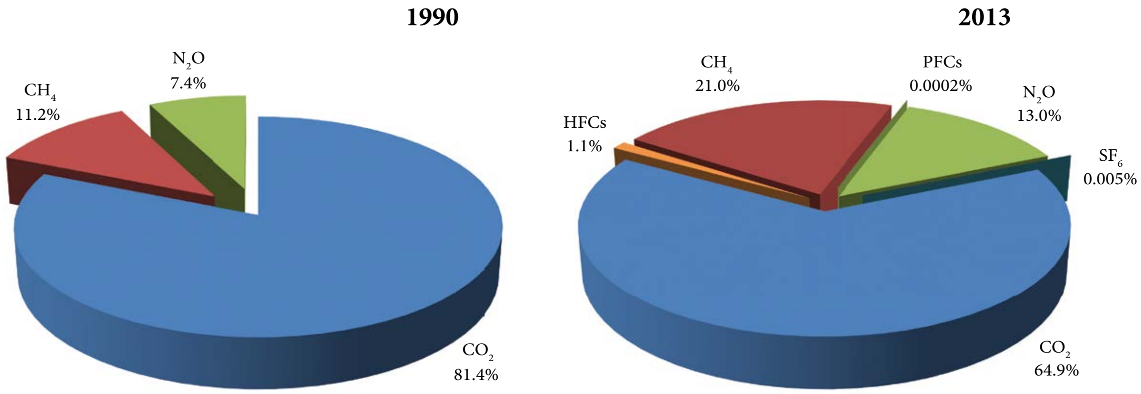

Figure 2-2: Direct GHGs share in the structure of total GHG emissions in the Republic of Moldova in 1990 and 2013 years

In 2013, the source categories having the biggest share in the total dioxide of carbon emissions in the Republic of Moldova were: 1A1 'Energy Industries' (3.3082 Mt or 39.7 per cent of the total), 1A4 'Other Sectors' (1.9456 Mt or 23.4 per cent of the total), 1A3 'Transport' (1.8353 Mt or 22.0 per cent of the total), 1A2 'Manufacturing Industries and Constructions' (0.6077 Mt or 7.3 per cent of the total) and 2A 'Mineral Production' (0.5266 Mt or 6.3 per cent of the total) (Figure 2-3).

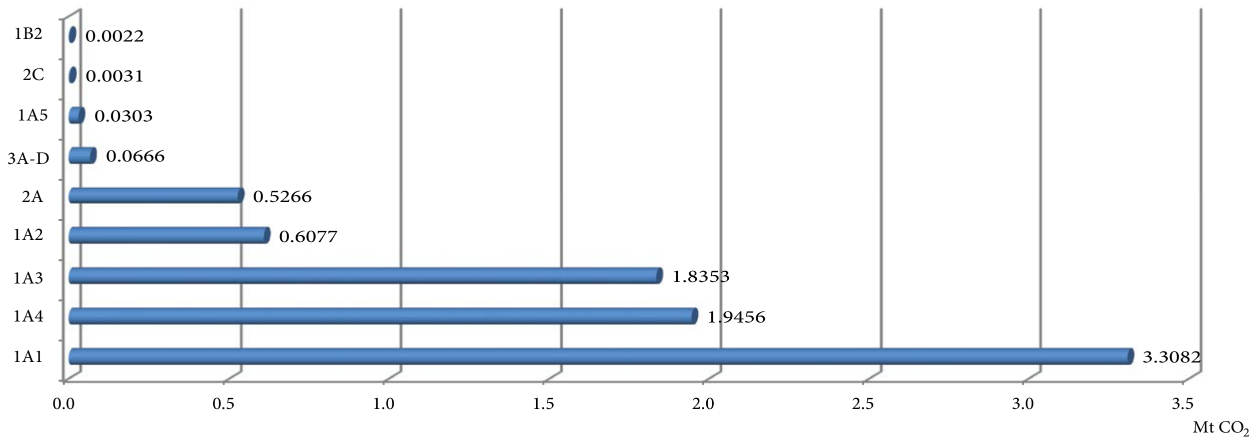

Figure 2-3: Source Categories of CO_2 in the Republic of Moldova in 2013

In 2013, the source categories having the biggest share in the total methane emissions in the Republic of Moldova were: 6A 'Solid Waste Disposal on Land' (1.3439 Mt CO_2 equivalent or 49.9 per cent of the total), 4A 'Enteric Fermentation' (0.5413 Mt CO_2 equivalent or 20.1 per cent of the total), 1B2 'Fugitive Emissions From Oil and Natural Gas' (0.5206 Mt CO_2 equivalent or 19.3 per cent of the total), 6B 'Wastewater Handling' (0.1365 Mt CO_2 equivalent or 5.1 per cent of the total), 1A4 'Other sectors' (0.0882 Mt CO_2 equivalent or 3.3 per cent of the total) and 4B 'Manure Management' (0.0545 Mt CO_2 equivalent or 2.0 per cent of the total) (Figure 2-4).

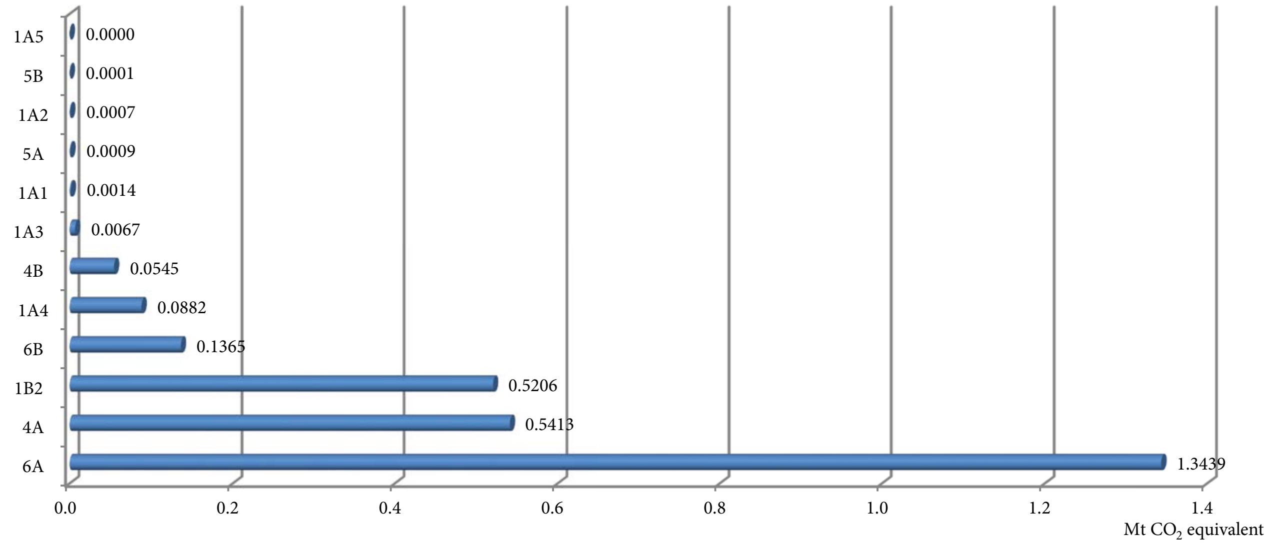

Figure 2-4: Source Categories of CH_4 in the Republic of Moldova in 2013

In 2013, the source categories having the biggest share in the total nitrous oxide emissions in the Republic of Moldova were: 4D 'Agricultural Soils' (1.1354 Mt CO_2 equivalent or 67.8 per cent of the total), 4B 'Manure Management' (0.3956 Mt CO_2 equivalent or 23.6 per cent of the total), 6B 'Wastewater Handling' (0.0854Mt CO_2 equivalent or 5.1 per cent of the total), 1A3 'Transport' (0.0352 Mt CO_2 equivalent or 2.1 per cent of the total) and 1A4 'Other sectors' (0.0168 Mt or 1.0 per cent of the total) (Figure 2-5).

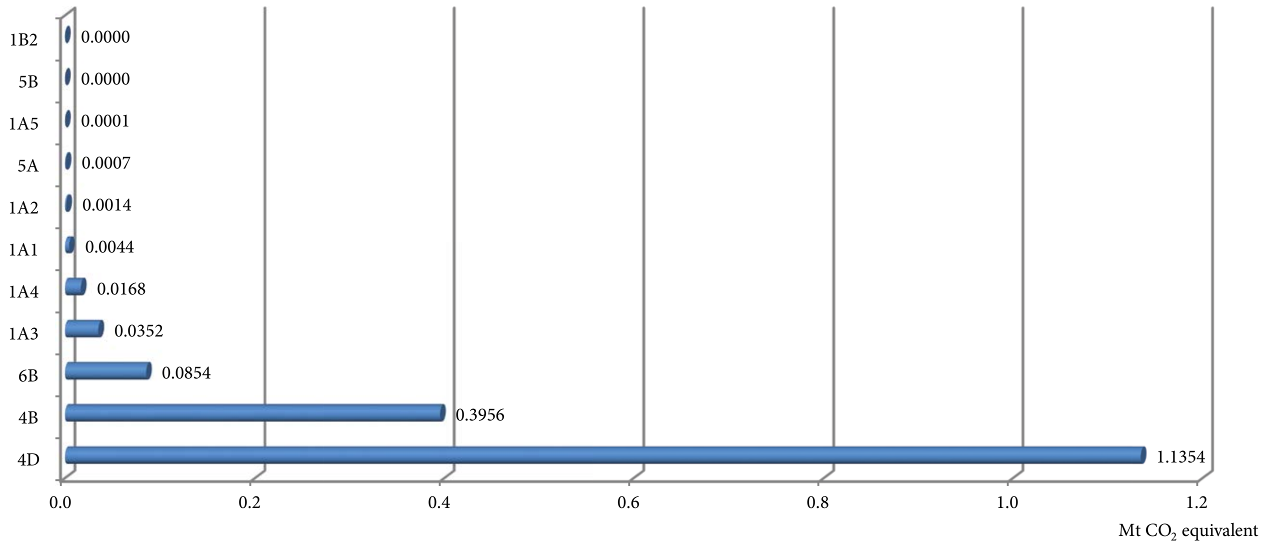

Figure 2-5: Source Categories of N_2O in the Republic of Moldova in 2013

2.3. Emission Trends by Sources

According to the UNFCCC Reporting Guidelines (IPCC, 1997), emissions estimates are grouped into six large categories: Energy, Industrial Processes (IP), Solvents and Other Products Use (SOPU), Agriculture, Land Use, Land-Use Change and Forestry (LULUCF) and Waste Sectors. Interpretation of

GHG emissions inventory results under Land Use, Land-Use Change and Forestry 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.

In the time series 1990 through 2013, total GHG emissions in the Republic of Moldova tended to decrease, thus emissions under Energy Sector decreased by circa 75.7 per cent, Industrial Processes Sector – by circa 63.5 per cent, Solvents and Other Products Use Sector – by circa 47.2 per cent, Agriculture Sector – by 58.0 per cent, Land Use, Land-Use Change and Forestry Sector – by 98.3 per cent, while from Waste Sector – by 16.1 per cent (Table 2-2).

Table 2-2: Direct Greenhouse Gas Emissions in the Republic of Moldova by Sector within 1990-2013, Mt CO_2 equivalent

	1990	1991	1992	1993	1994	1995	1996	1997
1. Energy	34.5213	30.2217	21.3789	16.4721	15.0185	11.7222	11.9472	10.7884
2. Industrial Processes	1.8420	1.7560	1.1472	0.7394	0.6077	0.4784	0.4256	0.4778
3. SOPU	0.1261	0.1009	0.0764	0.0576	0.0438	0.0346	0.0300	0.0258
4. Agriculture	5.0639	4.6906	4.0899	3.9268	3.3627	3.2844	3.0403	2.9853
5. LULUCF	-5.8866	-5.2964	-4.3844	-1.5008	-2.1641	-1.0294	-1.1666	-0.1369
6. Waste	1.8655	1.9782	2.0621	2.0221	1.9587	1.9044	1.8209	1.7483
	1998	1999	2000	2001	2002	2003	2004	2005
1. Energy	9.2725	7.3732	6.6728	7.2688	6.9519	7.7253	8.1841	8.4684
2. Industrial Processes	0.3321	0.2971	0.2702	0.2620	0.3204	0.3715	0.4201	0.5605
3. SOPU	0.0195	0.0268	0.0288	0.0426	0.0363	0.0329	0.0417	0.0675
4. Agriculture	2.7514	2.5192	2.2899	2.4549	2.5085	2.1956	2.3790	2.3588
5. LULUCF	-0.7226	-1.1349	-1.3922	-0.7500	-0.5327	-1.5547	-0.1032	-0.3754
6. Waste	1.6686	1.5555	1.4690	1.3927	1.3247	1.2920	1.2795	1.2978
	2006	2007	2008	2009	2010	2011	2012	2013
1. Energy	7.6334	7.7455	8.3514	9.0709	9.6473	9.8255	9.4690	8.4046
2. Industrial Processes	0.6563	0.9385	1.0150	0.5137	0.5594	0.6011	0.6227	0.6726
3. SOPU	0.0772	0.0981	0.1328	0.1197	0.0612	0.0689	0.0759	0.0666
4. Agriculture	2.2656	1.5124	2.1006	1.9181	2.1007	2.0865	1.6400	2.1267
5. LULUCF	-0.6391	-3.0660	-0.0595	-1.2849	-0.6571	-0.4296	-2.4704	-0.0976
6. Waste	1.3109	1.3640	1.4589	1.5145	1.5707	1.5597	1.5567	1.5658

Energy Sector is the most important source of total national direct GHG emissions, its share varying over the time series from 1990 through 2013 from 79.6 per cent to 65.5 per cent. Other relevant sources are represented by Agriculture, Waste, and Industrial Processes Sectors (Figure 2-6).

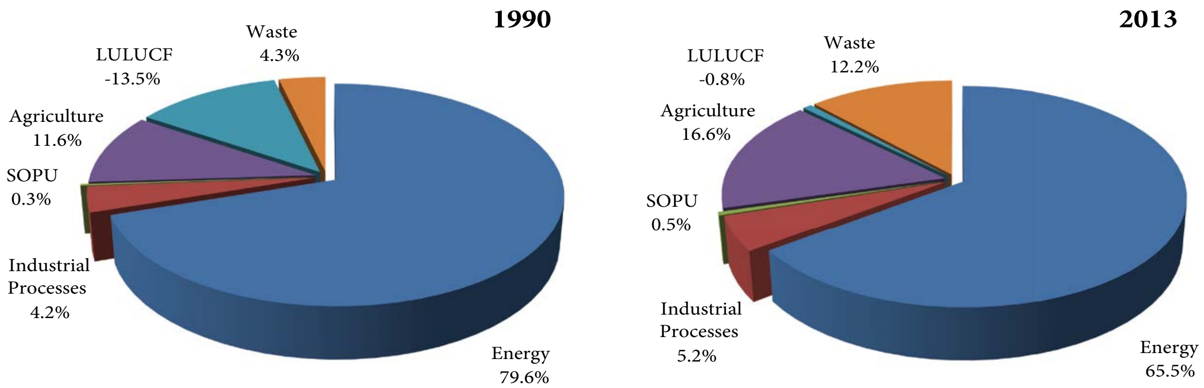

Figure 2-6: Sectoral Breakdown of the Republic of Moldova's total GHG Emissions within 1990-2013

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 for the primary purpose of delivering energy (93.8 per of total emissions per sector in 2013), 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 (6.2 per cent of total emissions per sector in 2013) (Figure 2-7, Table 2-3).

Overall, these emissions accounted, in 2013 circa 65.5 per of total Republic of Moldova's GHG emissions. Between 1990 and 2013, total GHG emissions from Energy Sector decreased by circa 75.7 per cent: from 34.5204 to 8.9465 Mt CO_2 equivalents.

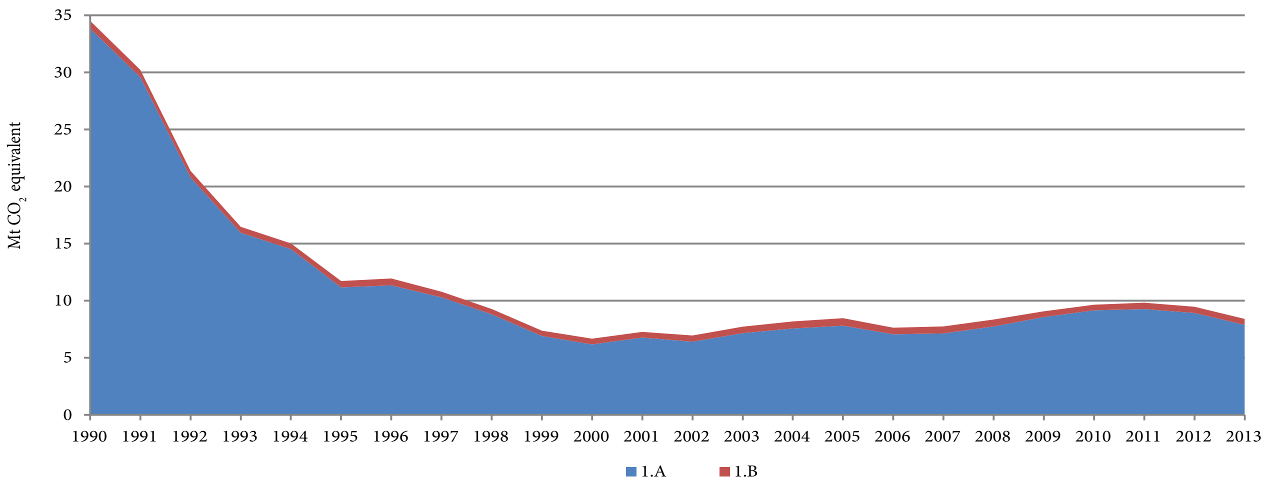

Figure 2-7: GHG Emissions from Energy Sector in the Republic of Moldova within 1990-2013

Table 2-3: GHG Emissions from Energy Sector within 1990-2013, Mt CO_2 equivalent

Source Categories	1990	1995	2000	2005	2010	2011	2012	2013
1. Energy	**34.5213**	**11.7222**	**6.6728**	**8.4684**	**9.6473**	**9.8255**	**9.4690**	**8.4046**
A. Fuel Combustion	33.8384	11.1663	6.1693	7.8081	9.1586	9.2689	8.9205	7.8818
A.1. Energy Industries	19.3933	6.9318	3.1524	3.2361	4.5950	4.1855	4.1908	3.3139
A.2. Manufacturing industries and constructions	2.1959	0.4530	0.5318	0.5919	0.5407	0.6061	0.5632	0.6098
A.3. Transport	4.0566	1.3384	0.8635	1.6567	1.9057	2.0202	1.7634	1.8772
A.4. Other sectors	8.0378	2.2616	1.5594	2.2558	2.0597	2.3903	2.3616	2.0505
A.5. Other works and needs in energy	0.1548	0.1815	0.0623	0.0676	0.0574	0.0667	0.0415	0.0304
B. Fugitive Emissions	0.6829	0.5560	0.5034	0.6603	0.4888	0.5566	0.5485	0.5228
1B.2. Oil and Natural Gas	0.6829	0.5560	0.5034	0.6603	0.4888	0.5566	0.5485	0.5228

The 1A1 'Energy Industries' contribute more than any other category to the Republic of Moldova's emissions under Energy Sector, accounting for circa 39.4 per cent of the total per sector in 2013 (56.2 per cent in 1990). Other relevant categories are represented by 1A4 'Other Sectors', accounting for circa 24.4 per cent of the total (23.3 per cent in 1990) and 1A3 'Transport', accounting for 22.3 per cent of the total per sector (11.8 per cent in 1990) (Figure 2-8).

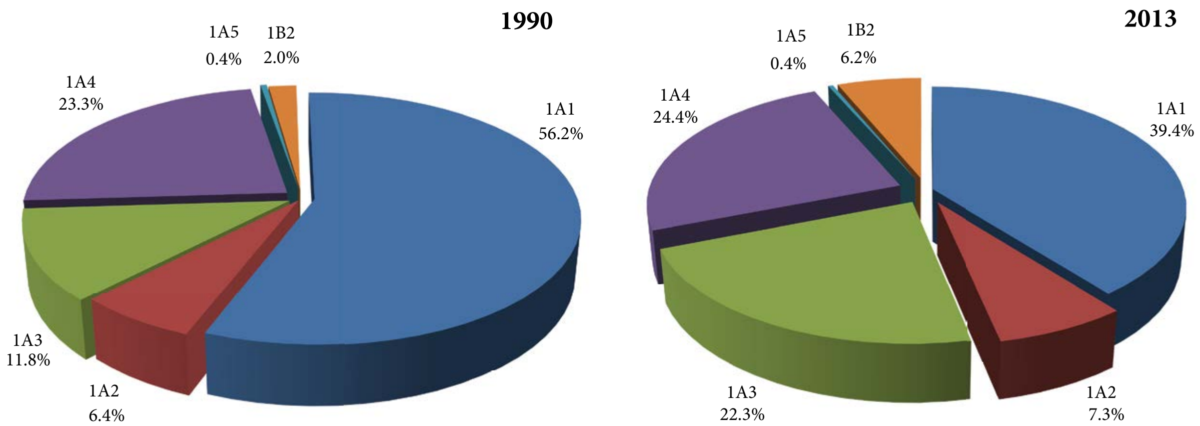

Figure 2-8: Energy Sector Greenhouse Gas Sources in the Republic of Moldova in 1990 and 2013

2.3.2. Industrial Processes Sector

The Industrial Processes Sector represents an important GHG emission source in the Republic of Moldova that includes emissions generated by non-energy industrial activities. In 2013, this sector accounted for 5.2 per cent of the total national GHG emissions (4.2 per cent in 1990). During 1990-2013 time periods, total sectoral GHG emissions decreased by circa 63.5 per cent: from 1.8420 to 0.6726 Mt CO_2 eq. (Figure 2-9).

Between 2008 and 2009, the respective emissions decreased by 49.4 per cent as a consequence of the global and regional economic crises that significantly affected the industrial sector in the Republic of Moldova. At the same time, between 2012 and 2013, the sectoral GHG emissions increased by 8.0 per cent, in particular as a result of cement production growth, widespread use of soda ash (Na_2CO_3), as well as due to the increased use of halocarbons and SF_6 (Table 2-4).

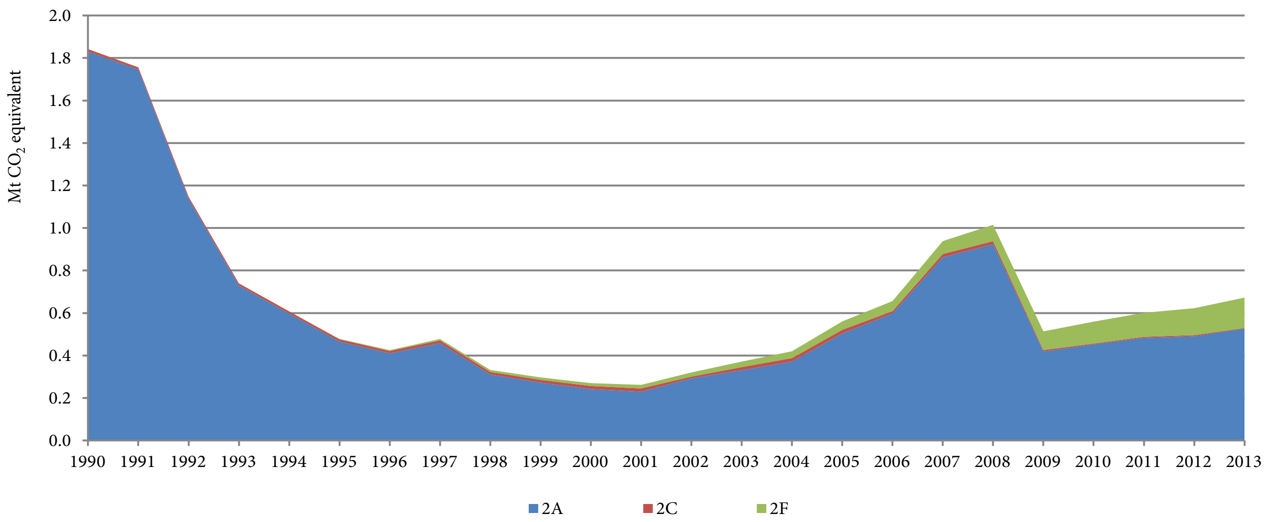

Figure 2-9: GHG Emissions from Industrial Processes in the Republic of Moldova within 1990-2013

Table 2-4: Direct GHG Emissions from Industrial Processes within 1990-2013, Mt CO_2 equivalent

Source Categories	1990	1995	2000	2005	2010	2011	2012	2013
2. Industrial Processes	**1.8420**	**0.4784**	**0.2702**	**0.5605**	**0.5594**	**0.6011**	**0.6227**	**0.6726**
A. Mineral Products	1.8303	0.4656	0.2418	0.5037	0.4524	0.4828	0.4908	0.5266
A1. Cement Production	0.9717	0.2485	0.1728	0.3651	0.3498	0.4273	0.4422	0.4769
A2. Lime Production	0.1487	0.0282	0.0110	0.0066	0.0023	0.0055	0.0051	0.0041
A3. Limestone and Dolomite Use	0.6195	0.1625	0.0322	0.0988	0.0745	0.0178	0.0201	0.0144
A4. Soda Ash Use	0.0330	0.0146	0.0140	0.0182	0.0120	0.0154	0.0093	0.0155
A7. Other Mineral Products	0.0575	0.0118	0.0119	0.0151	0.0138	0.0168	0.0140	0.0157
B. Chemical Industry	NO, NE	NO, NE	NO, NE	NO, NE	NO, NE	NO, NE	NO, NE	NO, NE
C. Metal Production	0.0117	0.0109	0.0150	0.0173	0.0040	0.0053	0.0052	0.0031
C1. Iron and Steel Production	0.0117	0.0109	0.0150	0.0173	0.0040	0.0053	0.0052	0.0031
D. Other	NO, NE	NO, NE	NO, NE	NO, NE	NO, NE	NO, NE	NO, NE	NO, NE
E. Production of Halocarbons and SF_6	NO	NO	NO	NO	NO	NO	NO	NO
F. Consumption of Halocarbons and SF_6	NO, NE	0.0019	0.0134	0.0395	0.1030	0.1130	0.1267	0.1429
F1. Refrigeration and Air Conditioning Equipment	NO, NE	0.0002	0.0081	0.0235	0.0654	0.0722	0.0831	0.0969
F2. Foam Blowing	NO, NE	0.0017	0.0053	0.0159	0.0370	0.0402	0.0429	0.0452
F4. Aerosols	NO, NE	NO, NE	0.0000	0.0000	0.0000	0.0000	0.0001	0.0001
F8. Electrical Equipment	NO, NE	NO, NE	NO, NE	0.0000	0.0006	0.0006	0.0007	0.0007

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

The most important source of emission in this sector is represented by 2A1 „Cement Production", with a share of circa 70.9 per cent of the total sectoral emissions in 2013 (52.8 per cent in 1990). Other relevant sources in 2013 were represented by 2F1 'Refrigeration and Air Conditioning Equipment' – accounting for circa 14.4 per cent of the total, 2F2 'Foam Blowing' - 6.7 per cent of the total, 2A4 'Soda Ash Use' - 2.3 per cent of the total (1.8 per cent in 1990), 2A7 'Other Mineral Products' (Mineral Wool Production, Brick Production, Expanded Clay Production) accounting for 2.3 per cent of the total (3.1 per cent in 1990) and 2A3 'Limestone and Dolomite Use' accounting for 2.1% of the total (33.6 per cent in 1990) (Figure 2-10).

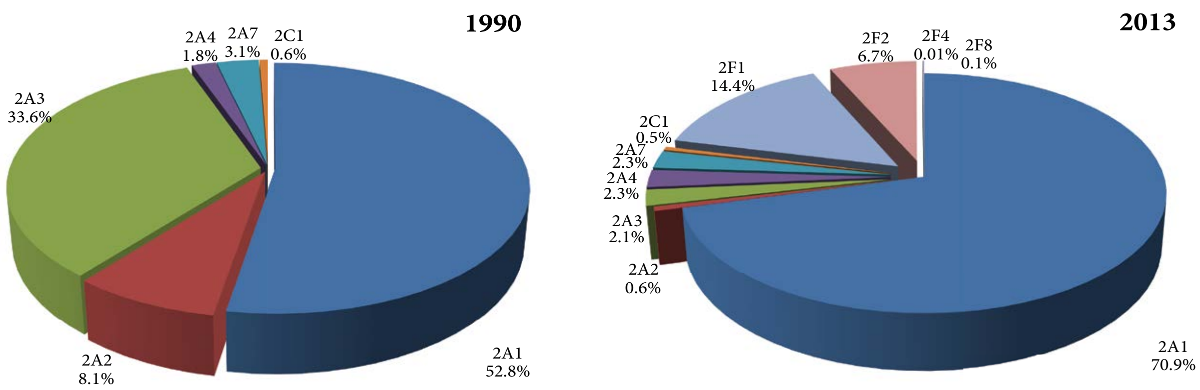

Figure 2-10: Breakdown of Industrial Processes' GHG Emissions by Category in the Republic of Moldova in 1990 and 2013

2.3.3. Solvents and Other Products Use Sector

In the Republic of Moldova the Solvents and Other Products Use Sector is a modest source and includes emissions of non-methane volatile organic compounds (NMVOC), also considered as a CO_2 emissions source - as the majority of solvents are obtained from fossil fuels, as well as N_2O emissions from use of N_2O for anesthesia.

In 2013, the respective sector accounted for as little as circa 0.5 per cent of the total national GHG emissions (0.3 per cent in 1990). Between 1990 and 2013 the total GHG emissions covered by this sector decreased by 47.2 per cent: from 0.1261 to 0.0666 Mt CO_2 equivalents (Table 2-5). From 2012 to 2013, the respective emissions decreased by 12.2 per cent.

Table 2-5: GHG Emissions from SOPU within 1990-2013, Mt CO_2 equivalent

Source Categories	1990	1995	2000	2005	2010	2011	2012	2013
3. Solvents and Other Products Use	**0.1261**	**0.0346**	**0.0288**	**0.0675**	**0.0612**	**0.0689**	**0.0759**	**0.0666**
A. Paint Application	0.0416	0.0037	0.0060	0.0308	0.0227	0.0278	0.0273	0.0205
B. Degreasing and Dry Cleaning	0.0628	0.0197	0.0121	0.0221	0.0234	0.0253	0.0329	0.0300
C. Chemical Products, Manufacture and Processing	0.0077	0.0012	0.0008	0.0019	0.0029	0.0035	0.0038	0.0046
D. Other	0.0140	0.0100	0.0100	0.0126	0.0122	0.0123	0.0119	0.0115
D1. Printing	0.0007	0.0001	0.0001	0.0004	0.0004	0.0004	0.0003	0.0004
D2. Domestic Solvents Use	0.0092	0.0091	0.0090	0.0087	0.0086	0.0086	0.0086	0.0085
D3. Other Products Use	0.0041	0.0007	0.0009	0.0035	0.0033	0.0033	0.0029	0.0025

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

In the SOPU Sector, the largest source of emissions is represented by 3B 'Degreasing and Dry Cleaning' accounting for circa 45.0 per cent of the total sectoral emissions (49.8 per cent in 1990). Other relevant source categories are represented by 3A 'Paint Application' accounting for 30.7 per cent of the total sectoral emissions in 2013 (33.0 per cent in 1990), 3D 'Other' accounting for 17.3 per cent of the total (11.1 per cent in 1990) and 3C 'Chemical Products, Manufacture and Processing' with a share of 7.0 per cent of the total (6.1 per cent in 1990) (Figure 2-11).

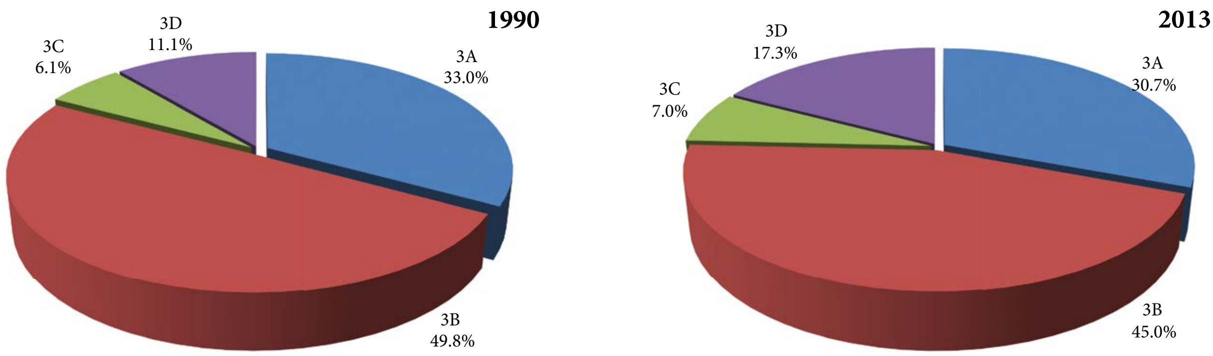

Figure 2-11: Breakdown of SOPU GHG Emissions by Category in the Republic of Moldova in 1990 and 2013

2.3.4 Agriculture Sector

The Agriculture Sector represents an important source of GHG emissions in the Republic of Moldova: CH_4 emissions, in particular from 4A 'Enteric Fermentation', 4B 'Manure Management'; N_2O emissions from 4B 'Manure Management' and 4D 'Agricultural Soils'. In the Republic of Moldova there are no registered emissions from 4C 'Rice Cultivation' and 4E 'Prescribed Burning of Savannas', as for the emissions from 4F Field Burning of Agricultural Residues, these are monitored in the LULUCF Sector, under the category 5B 'Cropland'.

In 2013, Agriculture Sector accounted for circa 16.6 per cent of the total national direct GHG emissions (11.6 per cent in 1990). Between 1990 and 2013 total GHG emissions originated from this sector decreased by circa 58.0 per cent: from 5.0639 to 2.1267 Mt CO_2 equivalent (Figure 2-12), 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.

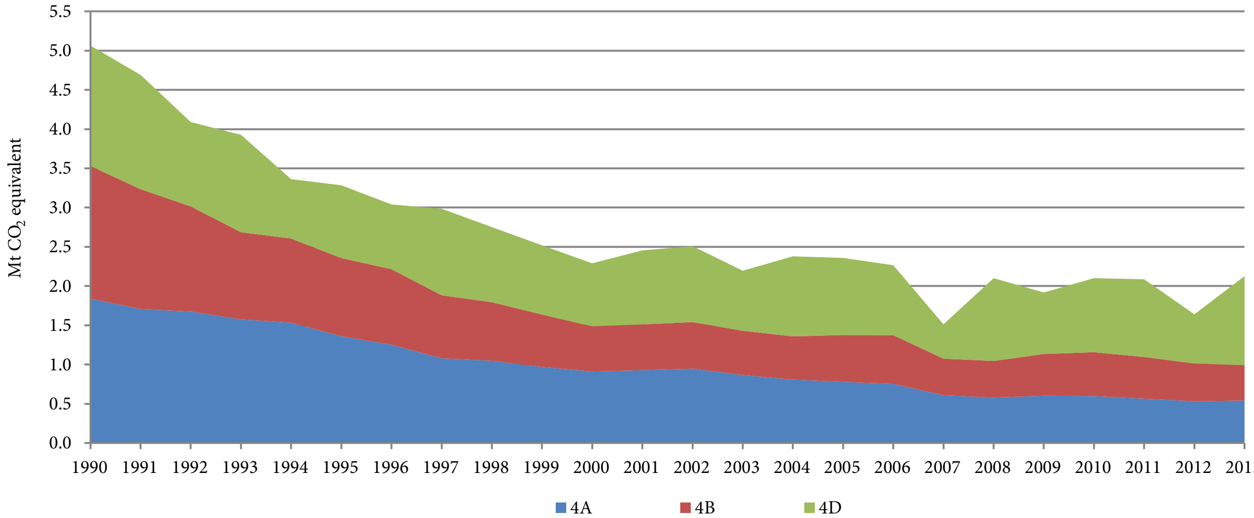

Figure 2-12: GHG Emissions from Agriculture Sector in the Republic of Moldova within 1990-2013

Between 2012 and 2013, direct GHG emissions from Agriculture Sector increased by circa 29.7 per cent, in particular as a result of increase of N_2O emissions from 4D 'Agricultural Soils' (Table 2-6).

Table 2-6: GHG Emissions from Agriculture Sector within 1990-2013, Mt CO_2 equivalent

Source Categories	1990	1995	2000	2005	2010	2011	2012	2013
4. Agriculture	**5.0639**	**3.2844**	**2.2899**	**2.3588**	**2.1007**	**2.0865**	**1.6400**	**2.1267**
A. Enteric Fermentation	1.8402	1.3612	0.9119	0.7785	0.5986	0.5639	0.5327	0.5413
B. Manure Management	1.6906	0.9957	0.5759	0.5987	0.5592	0.5328	0.4818	0.4501
C. Rice Cultivation	NO	NO	NO	NO	NO	NO	NO	NO
D. Agricultural Soils	1.5331	0.9275	0.8021	0.9816	0.9429	0.9898	0.6256	1.1354
E. Prescribed Burning of Savannas	NO	NO	NO	NO	NO	NO	NO	NO
F. Field Burning of Agricultural Residues	IE	IE	IE	IE	IE	IE	IE	IE

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

In 2013, the largest source of emission was 4D 'Agricultural Soils', accounting for 53.4 per cent of the total sectoral emissions (30.3 per cent in 1990). Other relevant sources are represented by 4A 'Enteric Fermentation', accounting for 25.5 per cent of the total (36.3 per cent in 1990) and 4B 'Manure Management', accounting for circa 21.2 per cent of the total (33.4 per cent in 1990) (Figure 2-13).

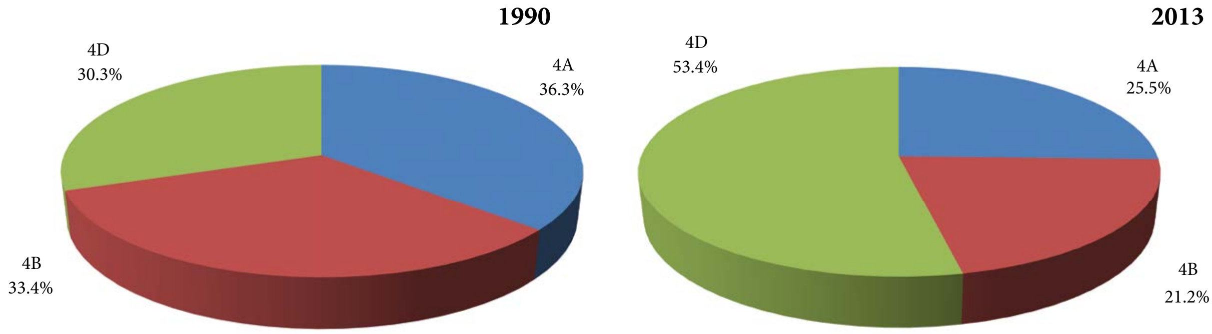

Figure 2-13: Breakdown of Agriculture GHG Emissions by Category in the Republic of Moldova in 1990 and 2013

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

Between 1990 and 2013, the LULUCF Sector represented a sink of net carbon removals. Within the respective period, net CO_2 removals registered a decreasing trend, reducing by 98.3 per cent, from -5.8866 Mt recorded in 1990 to -0.0976 Mt in 2013 (Table 2-7, Figure 2-14).

Table 2-7: Emissions and Removals in LULUCF Sector within 1990–2013, Mt CO_2 equivalent

Sink Categories	1990	1995	2000	2005	2010	2011	2012	2013
5. LULUCF	**-5.8866**	**-1.0294**	**-1.3922**	**-0.3754**	**-0.6571**	**-0.4296**	**-2.4704**	**-0.0976**
A. Forest Land	-2.1972	-1.6208	-2.1403	-2.2462	-2.1931	-2.0828	-2.0056	-1.8860
B. Cropland	-2.2132	1.9211	2.3051	3.4183	2.9877	3.1147	0.9973	3.2456
C. Grassland	-1.4762	-1.3297	-1.5570	-1.5475	-1.4517	-1.4616	-1.4621	-1.4572
D. Wetlands	NE, IE	NE, IE	NE, IE	NE, IE	NE, IE	NE, IE	NE, IE	NE, IE
E. Settlements	NE, IE	NE, IE	NE, IE	NE, IE	NE, IE	NE, IE	NE, IE	NE, IE
F. Other	NE, IE	NE, IE	NE, IE	NE, IE	NE, IE	NE, IE	NE, IE	NE, IE

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

This situation can be explained, in particular, due to changes in the use and management of agricultural soils (5B 'Cropland'), that contributed to the substantial decrease of organic carbon from the agricultural soils, changing the humus balance from a positive one like in 1990-1992 years, to a relatively neutral balance, specific to 1993-1994 years, respectively to a profoundly negative balance, like in 1995-2013 time periods.

This process was also influenced by some changes in the maintenance and use of forests (5A 'Forest Land'), authorized increased amounts of harvested wood, substantial increase of illegal fellings, increased conversion of forest lands into croplands, etc.

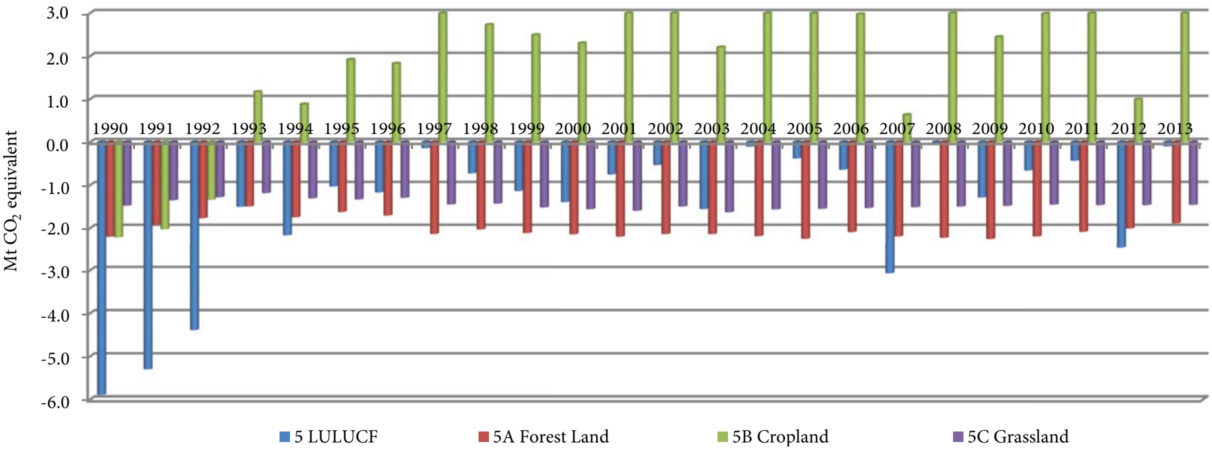

Figure 2-14: Emissions/Removals in LULUCF Sector by Source/Sink Categories within 1990-2013

In 1990, the largest source of carbon removals under LULUCF Sector was 5B 'Cropland' (lands covered with wood vegetation – multiannual plantations as well as the agricultural soils) accounting for 37.6 per cent of the total, followed by 'Forest Land' (forests, protective forests, etc.) accounting for 37.3 per cent, respectively by 5C 'Grassland', accounting for 25.1 per cent (Figure 2-15).

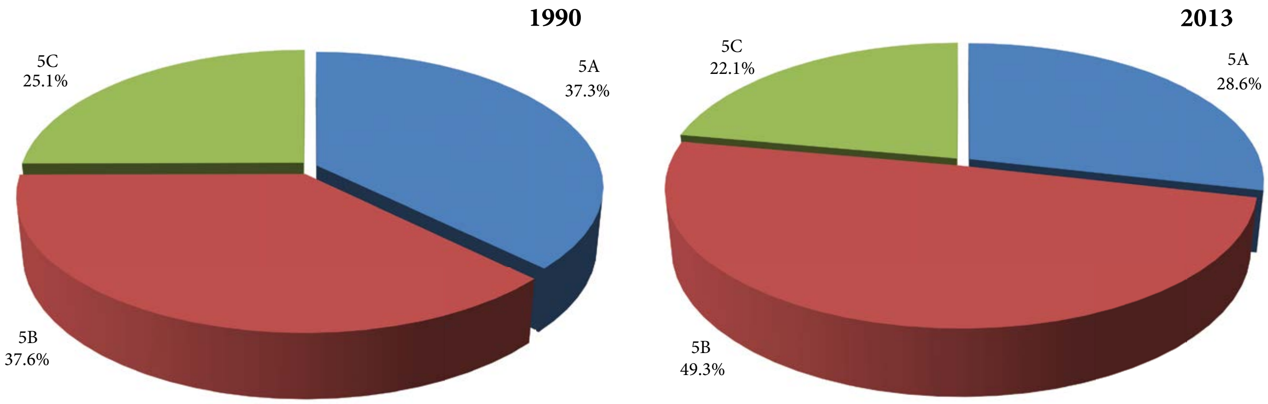

Figure 2-15: Breakdown of GHG Emissions and Removals by source and sink categories in LULUCF Sector in 1990 and 2013.

The contribution of land areas occupied by forest ecosystems (5A 'Forest Land') in the process of carbon removals is continuously growing since 1995, especially due to the expansion of areas covered with forest vegetation. In future, the respective growth could be extended at the expense of increasing productivity of existing forests by applying broader reconstruction of damaged trees and with low productivity. Starting with 1993, the 5B 'Cropland' category became a source of CO_2 emissions, as a result of profoundly carbon negative balance in agricultural soils, as well as due to reduction of multiannual plantation areas. In the RM the emissions/removals from 5F 'Other Land' were not estimated, only partly being considered within the 5C 'Grassland' category, in particular CO_2 removals from grasslands located on degraded agricultural lands. The emissions/removals from 5E 'Settlements' were partly taken into account in 5B 'Cropland' category, especially CO_2 removals from land covered with wood vegetation, including terrestrial and underground biomass of orchards, vineyards, and trees in individual gardens. The emissions/removals from 5D 'Wetlands' were considered partially within the 5C 'Grassland' category, in particular CO_2 removals from grasslands locate in wet zones.

2.3.6. Waste Sector

Waste Sector is an important source of GHG emissions: CH_4 emissions from 'Solid Waste Disposal on Land' (Category 6A) and 'Wastewater Handling' (Category 6B), as well as N_2O emissions from 'Human Sewage' (Category 6B). At the moment, in RM there are no any emissions registered in 6C 'Waste Incineration' category ('NO' and 'NE' notation keys were used).

In 2013, Waste Sector accounted for circa 12.2 per cent of the total national direct GHG emissions (4.3 per cent in 1990). In the time series from 1990 through 2013, total GHG emissions from this sector decreased by circa 16.1 per cent: from 1.8655 to 1.5658 Mt CO_2 equivalents (Table 2-8). Between 2012 and 2013, GHG emissions from Waste Sector increased by 0.6 per cent.

Table 2-8: GHG Emissions from Waste Sector within1990-2013, Mt CO_2 equivalent

Source Categories	1990	1995	2000	2005	2010	2011	2012	2013
6. Waste	**1.8655**	**1.9044**	**1.4690**	**1.2978**	**1.5707**	**1.5597**	**1.5567**	**1.5658**
A. Solid Waste Disposal on Land	1.5442	1.6952	1.3093	1.0955	1.3714	1.3534	1.3414	1.3439
B. Wastewater Handling	0.3212	0.2092	0.1597	0.2024	0.1993	0.2064	0.2152	0.2219
C. Waste Incineration	NO, NE	NO, NE	NO, NE	NO, NE	NO, NE	NO, NE	NO, NE	NO, NE

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 2006, there has been a clear growing trend of direct GHG emissions from the 'Waste Sector' (Figure 2-16).

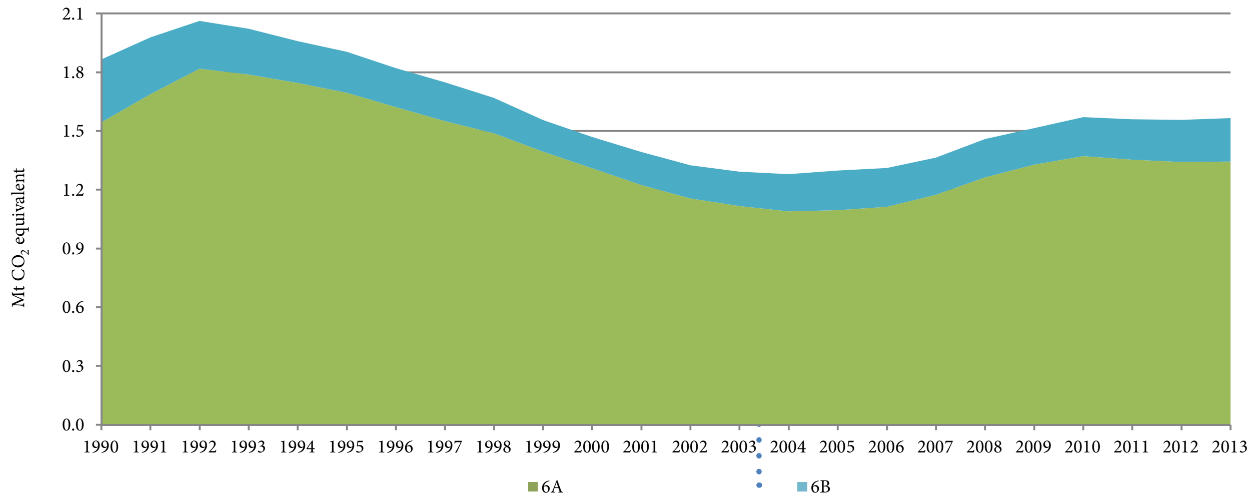

Figure 2-16: Total Waste Sector GHG Emissions Trends in the RM within 1990-2013

In 2013, the largest source of GHG emissions within the Waste Sector was 6A 'SWDL', accounting for 85.8 per cent of the total sectoral emissions (82.8 per cent in 1990) (Figure 2-17).

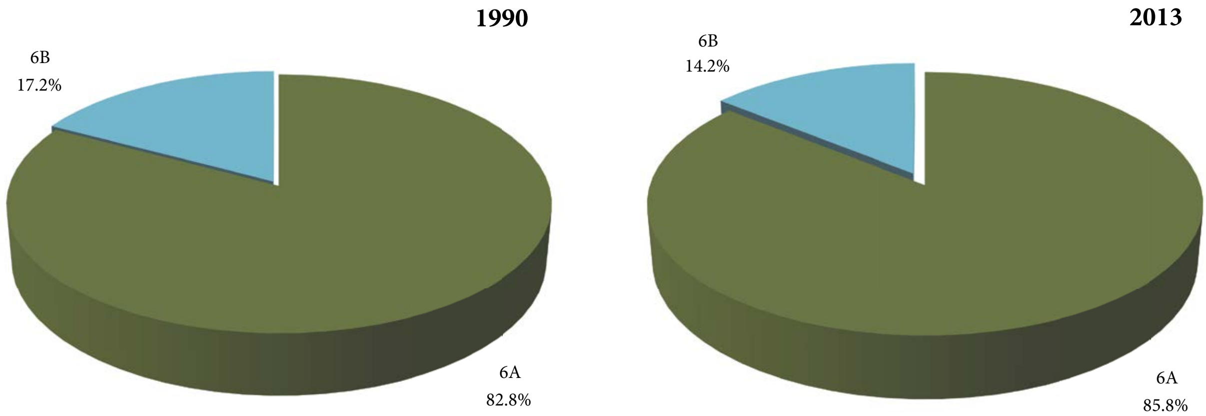

Figure 2-17: Breakdown of Waste GHG Emissions by Category in the RM in 1990 and 2013

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.

In the time series from 1990 through 2013, nitrogen oxides emissions decreased by 71.6 per cent: from 137.4740 to 36.3703 kt, total carbon monoxide emissions decreased by 68.3 per cent: from 433.8751 to 146.9860 kt, non-methane volatile organic compounds emissions decreased by 80.4 per cent: from 517.8048 kt to 128.2985 kt, while sulphur dioxide emissions decreased by 93.2 per cent: from 294.7812 kt to 21.8608 kt (Table 2-9).

Table 2-9: Ozone and Aerosol Precursors Emission Trends in the RM within 1990-2013, kt

	1990	1991	1992	1993	1994	1995	1996	1997
NO_x	137.4740	118.1256	78.5301	63.2389	56.8169	47.8562	45.0918	41.8912
CO	433.8751	375.0938	194.1732	157.3955	142.4926	140.5712	137.7967	132.6081
NMVOC	517.8048	432.5641	339.5211	269.2725	175.9493	161.5871	147.7475	73.8989
SO_2	294.7812	256.0414	170.0244	145.5388	102.5450	60.9425	58.8845	33.8644
	1998	1999	2000	2001	2002	2003	2004	2005
NO_x	35.1409	25.7394	24.4303	26.6523	27.3799	30.7111	32.1177	32.8714
CO	117.3456	80.7215	77.0622	79.4615	95.8651	112.8889	115.2139	117.7508
NMVOC	61.2282	38.2089	36.5216	44.6699	44.8823	47.1698	55.6361	67.1886
SO_2	26.9025	13.9042	9.8013	9.3216	10.4256	12.2190	11.1254	10.7556
	2006	2007	2008	2009	2010	2011	2012	2013
NO_x	30.9001	32.4470	34.8352	35.0592	39.1098	39.9538	37.0639	36.3703
CO	112.1234	112.4844	116.8356	114.1050	137.6408	149.8077	139.7743	146.9860
NMVOC	75.5299	145.4701	114.0611	84.8130	101.6484	88.6763	108.2620	128.2985
SO_2	10.9519	9.0310	13.2886	17.6388	19.9704	19.6706	18.6718	21.8608

In 2013, the source categories having the biggest share in the total nitrogen oxides emissions in the Republic of Moldova were: 1A3 'Transport' (18.9230 kt or 52.0 per cent of the total), 1A1 'Energy Industries' (9.0957 kt or 25.0 per cent of the total), 1A4 'Other Sectors' (5.3637 kt or 14.7 per cent of the total), 1A2 'Manufacturing Industries and Constructions' (1.7193 kt or 4.7 per cent of the total) and 2A 'Mineral Products' (1.1294 kt or 3.1 per cent of the total) (Figure 2-18).

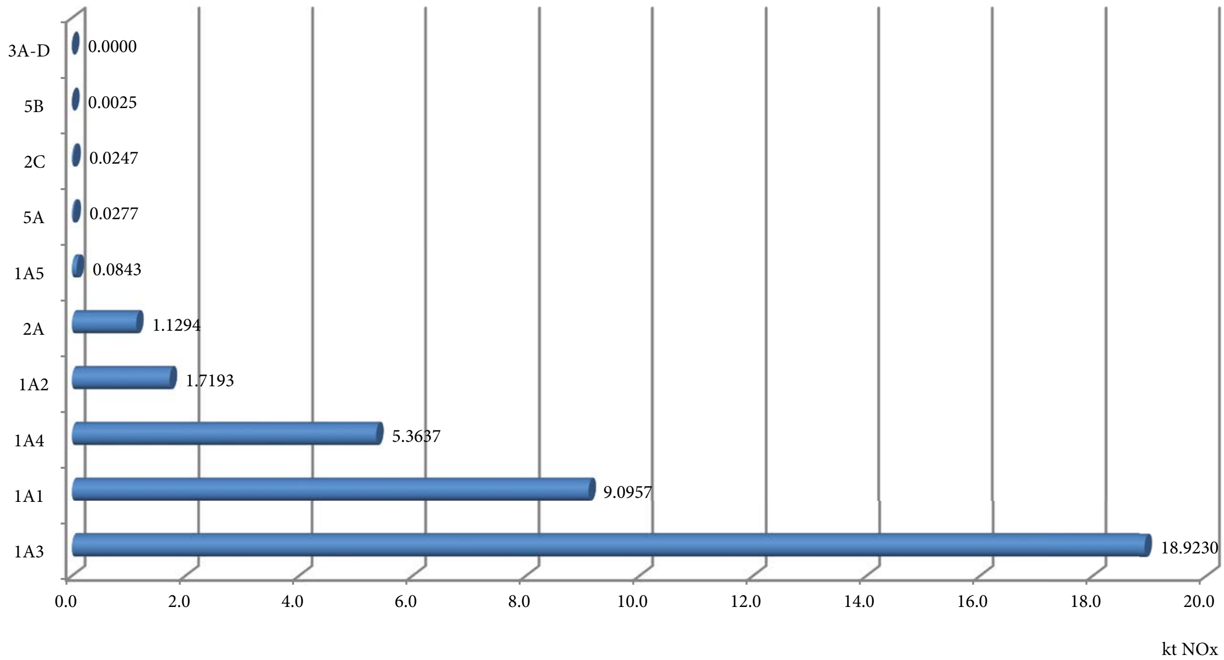

Figure 2-18: Source Categories of NO_x in the Republic of Moldova in 2013 year

In 2013, the source categories having the biggest share in the total carbon monoxide emissions in the Republic of Moldova were: 1A3 'Transport' (78.5783 kt or 53.5 per cent of the total), 1A4 'Other Sectors'

(64.9480 kt or 44.2 per cent of the total), 1A1 'Energy Industries' (1.3662 kt or 0.9 per cent of the total), 5A 'Forest Land' (affected by fires) (0.9856 kt or 0.7 per cent of the total), 1A2 'Manufacturing Industries and Constructions' (0.6476 kt or 0.4 per cent of the total) and 2C 'Metal Production' (0.3233 kt or 0.2 per cent of the total) (Figure 2-19).

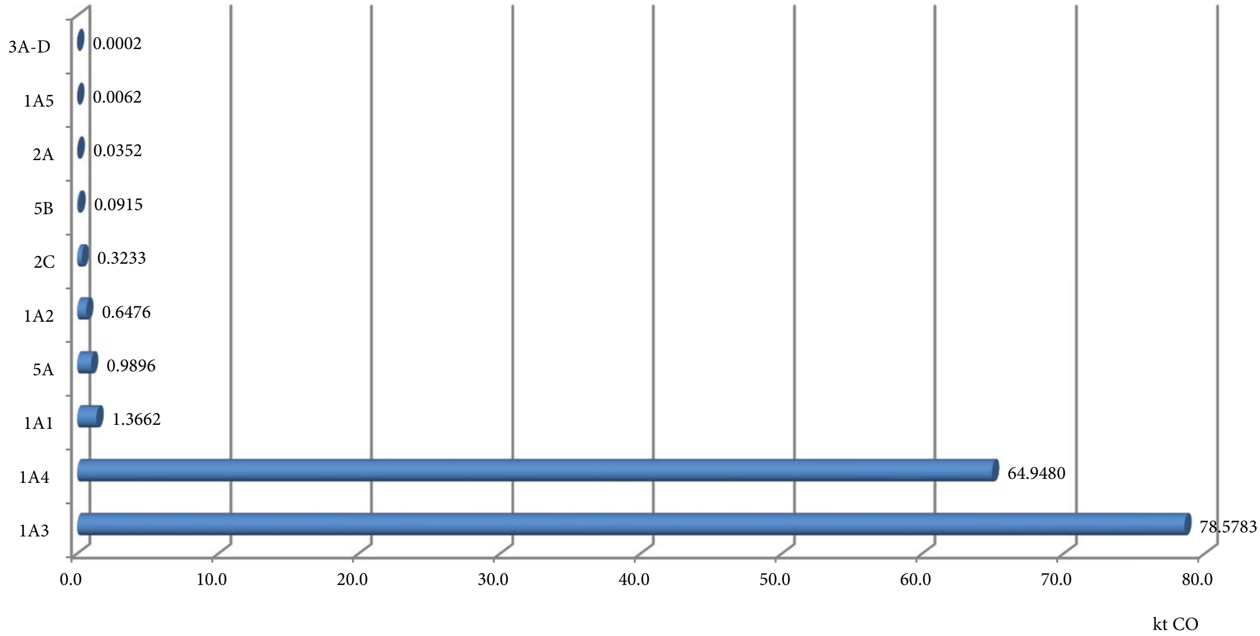

Figure 2-19: Source Categories of CO in the Republic of Moldova in 2013 year

In 2013, the source categories having the biggest share in the total non-methane volatile organic compounds emissions in the RM were: 2A 'Mineral Products' (76.7637 kt or 59.8 per cent of the total), 3A-D 'Solvents and Other Products Use' (22.7398 kt or 17.7 per cent of the total), 1A3 'Transport' (14.9469 kt or 11.7 per cent of the total), 1A4 'Other Sectors' (7.8002 kt or 6.1 per cent of the total), 2D 'Other Production' (foods and beverages) (4.7530 kt or 3.7 per cent of the total) and 1B2 'Fugitive Emissions From Oil and Natural Gas' (0.8712 kt or 0.7 per cent of the total) (Figure 2-20).

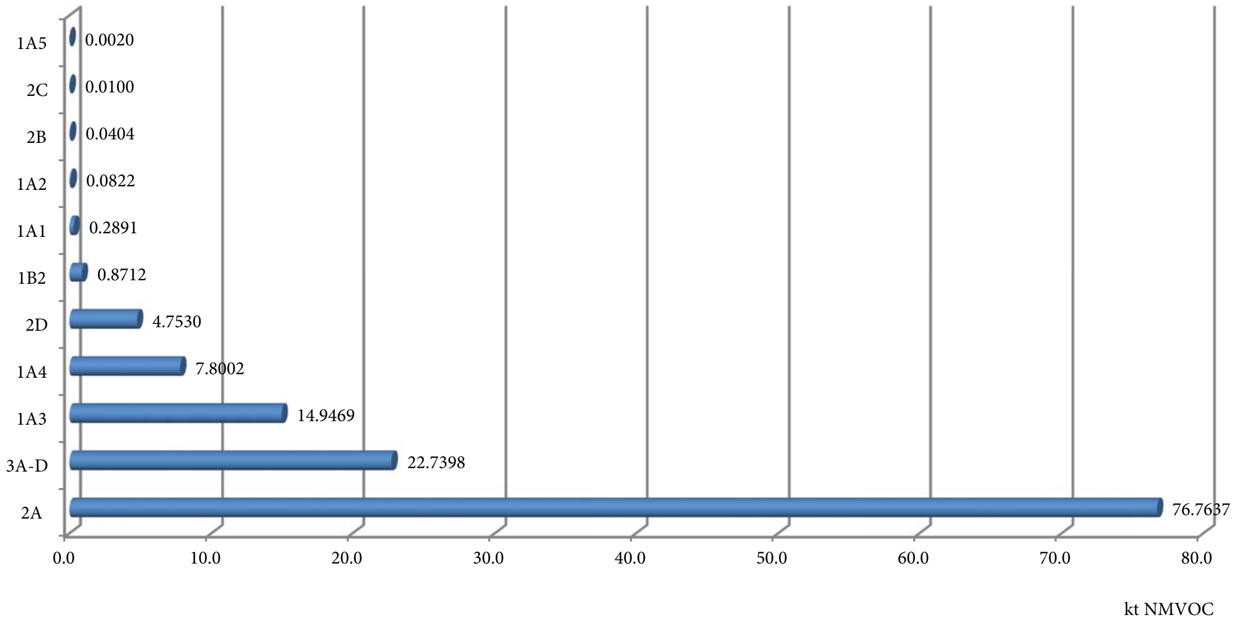

Figure 2-20: Source Categories of NMVOC in the Republic of Moldova in 2013 year

In 2013, the source categories having the biggest share in the total sulphur dioxide emissions in the Republic of Moldova were: 1A4 'Other Sectors' (8.2087 kt or 37.5 per cent of the total), 1A1 'Energy Industries' (7.2092 kt or 33.0 per cent of the total), 1A3 'Transport' (2.8612 kt or 13.1 per cent of the total), 1A2 'Manufacturing Industries and Constructions' (2.7863 kt or 12.7 per cent of the total) and 2A 'Mineral Products' (0.6862 kt or 3.1 per cent of the total) (Figure 2-21).

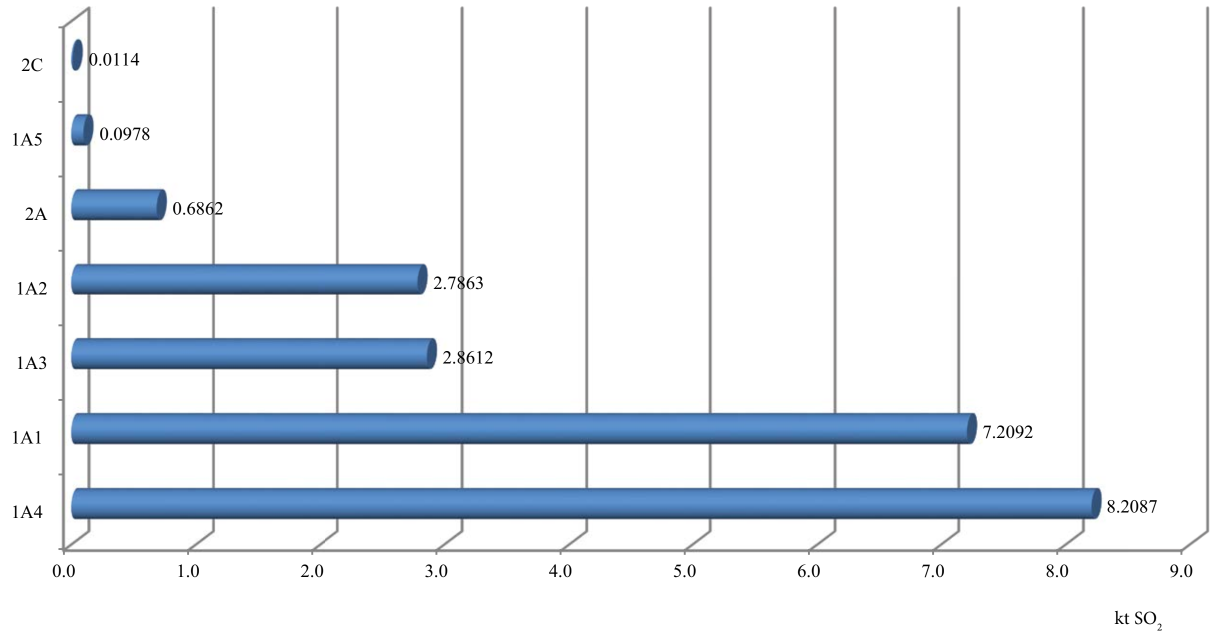

Figure 2-21: Source Categories of SO_2 in the Republic of Moldova in 2013 year

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), IPCC Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories (IPCC, 2000) and 2006 IPCC Guidelines for National Greenhouse Gas Inventories (IPCC, 2006).

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
      1A2. Manufacturing Industry and Construction
      1A3. Transport (Civil Aviation, Road Transport, Railways, Navigation, Pipeline Transport)
      1A4. Other Sectors (Commercial/Institutional, Residential, Agriculture/Forestry/Fishing)
      1A5. Other
   1B. Fugitive emissions
      1B2. Oil and Natural Gas

Memo items
   International Bunkers
   CO_2 Emissions from Biomass

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

GHG emissions in the 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

In 2013, Energy Sector accounted for circa 65.5 per cent of total national direct GHG emissions (without LULUCF), being the most important source of GHG emissions at the national level. To be noted that the respective sector was also a relevant source of CH_4 and N_2O emissions, with a share of circa 22.9 per cent and, respectively 3.5 per cent of total methane and nitrous oxide emissions registered at the national level.

Between 1990 and 2013, the total GHG emissions from the Energy Sector tended to lower values, decreasing by 75.7 per cent (Table 3-1, Figure 3-1), in particular, due to the economic decline in the Republic of Moldova, mainly within 1990-2000 periods.

Table 3-1: Total Direct GHG Emissions from Energy Sector in the Republic of Moldova within 1990-2013 periods, Gg CO_2 equivalent

	1990	1991	1992	1993	1994	1995	1996	1997
Energy Sector	34521.3158	30221.7163	21378.9094	16472.0623	15018.4635	11722.2406	11947.2474	10788.3762
	1998	1999	2000	2001	2002	2003	2004	2005
Energy Sector	9272.5132	7373.2500	6672.7679	7268.7844	6951.9177	7725.3056	8184.1495	8468.4040
	2006	2007	2008	2009	2010	2011	2012	2013
Energy Sector	7633.3822	7745.5404	8351.4173	9070.9351	9647.3410	9825.4771	9469.0343	8404.6226

Compared to the base year (1990), by 2013 the GHG emissions decreased significantly: CO_2 by 76.8 per cent, CH_4 by 35.9 per cent, N_2O by 69.9 per cent, NO_x by 73.9 per cent, CO by 66.0 per cent, NMVOC by 66.8 per cent, while SO_2 emissions decreased by 92.8 per cent (Tables 3-2 and 3-3).

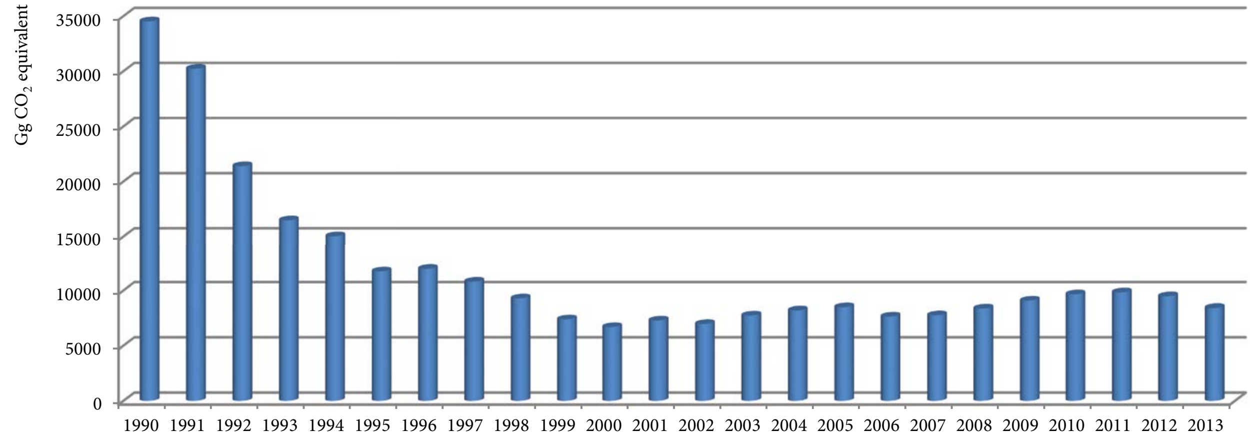

Figure 3-1: Total Direct GHG Emissions from Energy Sector in the Republic of Moldova within 1990-2013 periods

Table 3-2: Direct and Indirect GHG Emissions from the Energy Sector within 1990-2013 periods, Gg

	1990	1991	1992	1993	1994	1995	1996	1997
CO_2	33365.5535	29193.0936	20581.3267	15772.5160	14346.4226	11041.7064	11204.1202	10191.5242
CH_4	45.8847	40.9872	32.7498	28.9677	28.1397	29.4520	32.5540	26.0910
N_2O	0.6200	0.5416	0.3543	0.2943	0.2616	0.2001	0.1919	0.1579
NO_x	134.9883	115.6795	76.9851	61.7586	55.7779	46.9387	44.3267	40.9422
CO	427.8225	372.8662	189.6403	151.9012	138.8412	136.2274	134.2790	127.3155
NMVOC	72.8422	64.6544	33.3360	25.4446	23.2294	23.4038	22.6668	22.5155
SO_2	293.0068	254.5103	169.0182	144.5634	101.8866	60.4181	58.4069	33.3373
	1998	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**
CO_2	8720.8485	6842.0509	6102.7447	6703.9021	6330.7130	7060.6998	7482.4685	7721.8697
CH_4	24.1940	23.9267	25.6899	25.3406	27.7259	29.4614	31.2627	33.3638
N_2O	0.1406	0.0927	0.0985	0.1056	0.1257	0.1481	0.1457	0.1480
NO_x	34.2994	25.0082	23.5467	25.7926	26.4799	29.8082	31.1477	31.7455
CO	112.5636	75.9929	74.1975	76.0577	94.5804	111.2909	113.2212	115.5713
NMVOC	19.6852	13.0083	12.8195	13.3166	16.5281	19.5053	20.8005	21.3345
SO_2	26.4386	13.5100	9.2996	8.8515	9.9084	11.7085	10.5448	10.1124
	2006	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**
CO_2	6965.8294	7052.4028	7656.7600	8484.6735	9034.6186	9130.1626	8782.3211	7729.1857
CH_4	29.4697	30.8011	30.7197	25.7839	26.5804	30.3212	30.1571	29.4091
N_2O	0.1571	0.1494	0.1598	0.1445	0.1759	0.1889	0.1723	0.1866
NO_x	29.7355	30.9478	33.3493	34.2665	38.2707	38.9199	36.1156	35.1859
CO	110.6030	108.8763	114.2198	112.9589	137.0287	149.0177	137.7611	145.5462
NMVOC	19.7945	20.0416	21.2488	20.9979	23.7712	25.5742	23.1422	23.9916
SO_2	10.2559	8.1631	12.4070	17.1364	19.4418	19.0397	18.1033	21.1631

Table 3-3: Direct and Indirect GHG Emissions from the Energy Sector within 1990-2013, in comparison with 1990 level, %

	1990	1991	1992	1993	1994	1995	1996	1997
CO_2	100.0	87.5	61.7	47.3	43.0	33.1	33.6	30.5
CH_4	100.0	89.3	71.4	63.1	61.3	64.2	70.9	56.9
N_2O	100.0	87.4	57.2	47.5	42.2	32.3	31.0	25.5
NO_x	100.0	85.7	57.0	45.8	41.3	34.8	32.8	30.3
CO	100.0	87.2	44.3	35.5	32.5	31.8	31.4	29.8
NMVOC	100.0	88.8	45.8	34.9	31.9	32.1	31.1	30.9
SO_2	100.0	86.9	57.7	49.3	34.8	20.6	19.9	11.4
	1998	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**
CO_2	26.1	20.5	18.3	20.1	19.0	21.2	22.4	23.1
CH_4	52.7	52.1	56.0	55.2	60.4	64.2	68.1	72.7
N_2O	22.7	15.0	15.9	17.0	20.3	23.9	23.5	23.9
NO_x	25.4	18.5	17.4	19.1	19.6	22.1	23.1	23.5
CO	26.3	17.8	17.3	17.8	22.1	26.0	26.5	27.0
NMVOC	27.0	17.9	17.6	18.3	22.7	26.8	28.6	29.3
SO_2	9.0	4.6	3.2	3.0	3.4	4.0	3.6	3.5
	2006	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**
CO_2	20.9	21.1	22.9	25.4	27.1	27.4	26.3	23.2
CH_4	64.2	67.1	66.9	56.2	57.9	66.1	65.7	64.1
N_2O	25.3	24.1	25.8	23.3	28.4	30.5	27.8	30.1
NO_x	22.0	22.9	24.7	25.4	28.4	28.8	26.8	26.1
CO	25.9	25.4	26.7	26.4	32.0	34.8	32.2	34.0
NMVOC	27.2	27.5	29.2	28.8	32.6	35.1	31.8	32.9
SO_2	3.5	2.8	4.2	5.8	6.6	6.5	6.2	7.2

Within 1990-2013, practically all source categories under the Energy Sector revealed in the Republic of Moldova a GHG emission decreasing trend (Table 3-4, Figure 3-2):

- 1A1 'Energy Industries' – by 82.9 per cent;
- 1A2 'Manufacturing Industry and Construction' – by 72.2 per cent;
- 1A3 'Transport' – by 53.7 per cent;
- 1A4 'Other Sectors' – by 74.5 per cent;
- 1A5 'Other' – by 80.4 per cent;
- 1B2 'Fugitive Emissions from Oil and Natural Gas' – by 23.4 per cent.

Table 3-4: Breakdown of the Republic of Moldova's Energy Sector Direct GHG Emissions by Category, Gg CO_2 equivalent

	1990	1991	1992	1993	1994	1995	1996	1997
1A1	19393.2858	17414.4185	13049.3384	11360.3417	10029.8177	6931.7635	7152.4697	5651.6191
1A2	2195.8930	1690.8854	965.3383	541.7823	809.2528	453.0153	360.9377	587.4922
1A3	4056.6151	3663.9848	2052.0292	1513.9925	1317.5788	1338.3695	1305.8589	1331.6625
1A4	8037.7787	6507.3984	4494.1909	2338.1399	2203.3690	2261.5942	2375.9818	2575.0334
1A5	154.8111	304.0746	237.8193	196.5047	156.7369	181.5126	147.6613	144.4420
1B2	682.9320	640.9545	580.1931	521.3013	501.7084	555.9854	604.3381	498.1270
	1998	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**
1A1	4854.8011	3674.2878	3152.4214	3678.7653	2943.9751	3041.9389	3113.0195	3236.0698
1A2	538.3181	496.0956	531.7701	617.8880	424.1633	451.5848	456.5067	591.8781
1A3	1161.5385	792.1933	863.4656	920.4987	1166.7509	1455.7657	1624.9498	1656.7370
1A4	2151.0656	1889.1021	1559.4160	1485.4127	1808.8142	2122.4556	2302.8534	2255.7659
1A5	100.5624	56.4785	62.2763	66.0531	65.9448	80.1935	69.2504	67.6491
1B2	466.2276	465.0927	503.4185	500.1666	542.2695	573.3672	617.5696	660.3041
	2006	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**
1A1	2494.1332	2895.5143	3295.1211	4460.5118	4595.0003	4185.5488	4190.7797	3313.9206
1A2	651.7256	817.8938	913.0712	508.5564	540.7465	606.0959	563.2148	609.7587
1A3	1582.1066	1651.3635	1742.5257	1659.1092	1905.7039	2020.2412	1763.4096	1877.1767
1A4	2250.3843	1698.6077	1706.1998	1888.4903	2059.6768	2390.2800	2361.6297	2050.5388
1A5	79.8003	70.4336	85.6930	49.9653	57.4318	66.7006	41.4710	30.4188
1B2	575.2321	611.7275	608.8065	504.3022	488.7817	556.6107	548.5296	522.8092

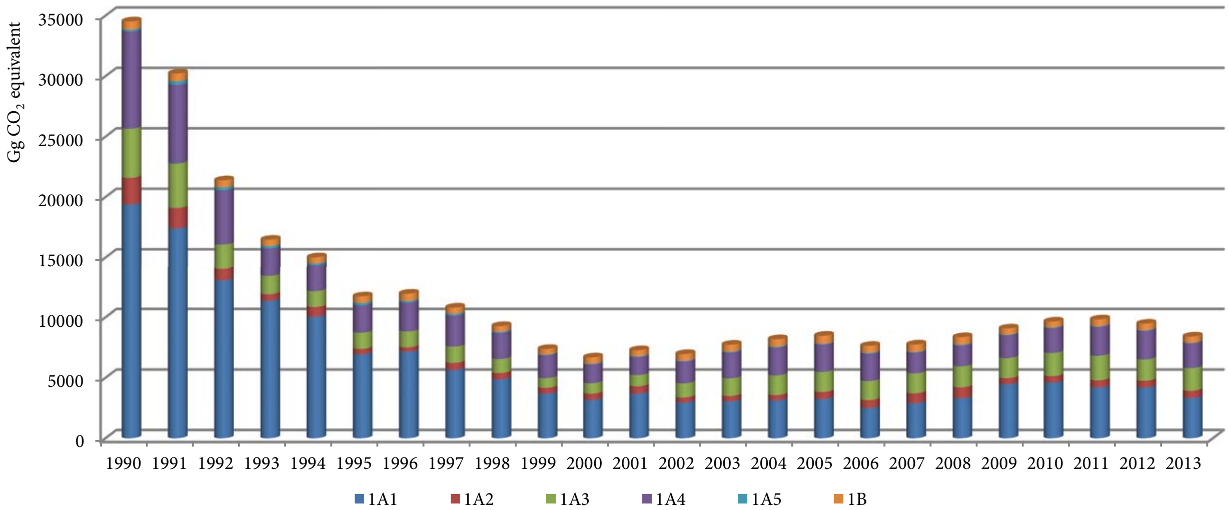

Figure 3-2: Breakdown of the Republic of Moldova's Energy Sector Direct GHG Emissions by Category within 1990-2013 periods

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 69.0 per cent (1993) to a minimum of 32.7 per cent (2006). Other major emissions sources within the Energy Sector are represented by 1A4 'Other Sectors', with a share varying from 29.5 per cent (2006), to 14.2 per cent (1993), 1A3 'Transport', with a share varying from 22.3 per cent (2013) to 8.8 per cent (1994), and 1B2 'Fugitive Emissions from Oil and Natural Gas', with a share varying from 7.9 per cent (2007) to 2.0 per cent (2000) (Table 3-5, Figure 3-3).

Table 3-5: Breakdown of the Republic of Moldova's Energy Sector Direct GHG Emissions by Category within 1990-2013 periods, %

	1990	1991	1992	1993	1994	1995	1996	1997
1A1	56.2	57.6	61.0	69.0	66.8	59.1	59.9	52.4
1A2	6.4	5.6	4.5	3.3	5.4	3.9	3.0	5.4
1A3	11.8	12.1	9.6	9.2	8.8	11.4	10.9	12.3
1A4	23.3	21.5	21.0	14.2	14.7	19.3	19.9	23.9
1A5	0.4	1.0	1.1	1.2	1.0	1.5	1.2	1.3
1B2	2.0	2.1	2.7	3.2	3.3	4.7	5.1	4.6
	1998	1999	2000	2001	2002	2003	2004	2005
1A1	52.4	49.8	47.2	50.6	42.3	39.4	38.0	38.2
1A2	5.8	6.7	8.0	8.5	6.1	5.8	5.6	7.0
1A3	12.5	10.7	12.9	12.7	16.8	18.8	19.9	19.6
1A4	23.2	25.6	23.4	20.4	26.0	27.5	28.1	26.6
1A5	1.1	0.8	0.9	0.9	0.9	1.0	0.8	0.8
1B2	5.0	6.3	7.5	6.9	7.8	7.4	7.5	7.8
	2006	2007	2008	2009	2010	2011	2012	2013
1A1	32.7	37.4	39.5	49.2	47.6	42.6	44.3	39.4
1A2	8.5	10.6	10.9	5.6	5.6	6.2	5.9	7.3
1A3	20.7	21.3	20.9	18.3	19.8	20.6	18.6	22.3
1A4	29.5	21.9	20.4	20.8	21.3	24.3	24.9	24.4
1A5	1.0	0.9	1.0	0.6	0.6	0.7	0.4	0.4
1B2	7.5	7.9	7.3	5.6	5.1	5.7	5.8	6.2

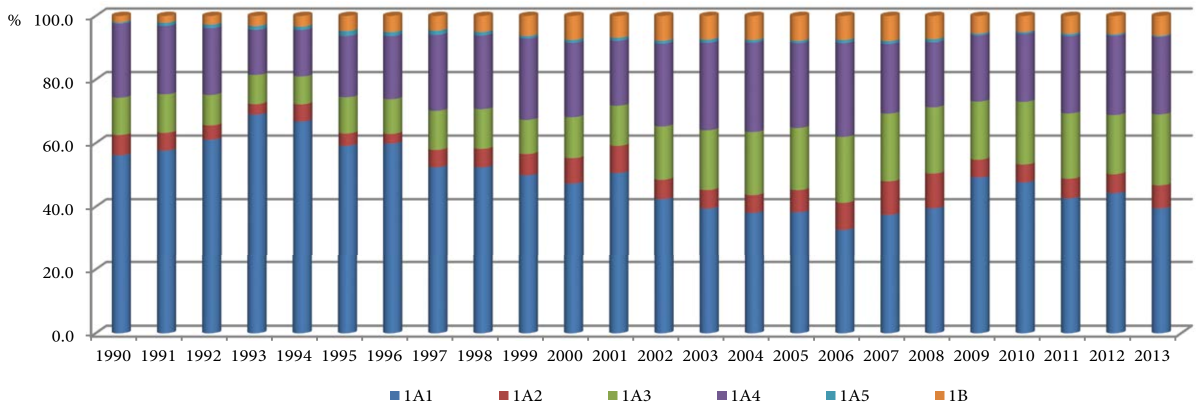

Figure 3-3: Breakdown of the Republic of Moldova's Energy Sector Direct GHG Emissions by Category within 1990-2013, %

To be noted, that the share of 'Stationary Fuel Combustion' (included source categories 1A1, 1A2 and 1A4) within the total GHG emissions originated from the sub-sector 1A 'Fuel Combustion Activities' under the Energy Sector, has varied considerably over the reference period: from 89.8 per cent of the total in 1994 to 75.8 per cent in 2013. At the same time, the share of 'Mobile Combustion Activities' (include source categories 1A3 and 1A5) within the total GHG emissions originated from the respective sub-sector under the Energy Sector, increased from 10.2 per cent of the total in 1994 to 24.2 per cent in 2013 (Table 3-6, Figure 3-4).

Table 3-6: GHG Emissions from the 'Stationary Fuel Combustion' and 'Mobile Fuel Combustion' sub-sectors in the Republic of Moldova within 1990-2013 periods, Gg CO2 equivalent

	1990	1991	1992	1993	1994	1995	1996	1997
Stationary Fuel Combustion	29626.9575	25612.7023	18508.8677	14240.2638	13042.4395	9646.3731	9889.3892	8814.1448
% from the total	87.6	86.6	89.0	89.3	89.8	86.4	87.2	85.7
Mobile Fuel Combustion	4211.4262	3968.0595	2289.8486	1710.4972	1474.3156	1519.8821	1453.5201	1476.1044
% from the total	12.4	13.4	11.0	10.7	10.2	13.6	12.8	14.3
Total Sub-sector 1A	33838.3837	29580.7618	20798.7162	15950.7610	14516.7551	11166.2552	11342.9093	10290.2492
	1998	1999	2000	2001	2002	2003	2004	2005
Stationary Fuel Combustion	7544.1847	6059.4855	5243.6074	5782.0660	5176.9526	5615.9793	5872.3797	6083.7138
% from the total	85.7	87.7	85.0	85.4	80.8	78.5	77.6	77.9
Mobile Fuel Combustion	1262.1009	848.6718	925.7420	986.5518	1232.6956	1535.9592	1694.2002	1724.3861
% from the total	14.3	12.3	15.0	14.6	19.2	21.5	22.4	22.1
Total Sub-sector 1A	8806.2857	6908.1573	6169.3494	6768.6178	6409.6482	7151.9384	7566.5798	7808.0999
	2006	2007	2008	2009	2010	2011	2012	2013
Stationary Fuel Combustion	5396.2431	5412.0158	5914.3920	6857.5584	7195.4236	7181.9247	7115.6241	5974.2180
% from the total	76.5	75.9	76.4	80.0	78.6	77.5	79.8	75.8
Mobile Fuel Combustion	1661.9070	1721.7971	1828.2188	1709.0745	1963.1358	2086.9417	1804.8806	1907.5954
% from the total	23.5	24.1	23.6	20.0	21.4	22.5	20.2	24.2
Total Sub-sector 1A	7058.1501	7133.8129	7742.6108	8566.6329	9158.5594	9268.8665	8920.5048	7881.8135

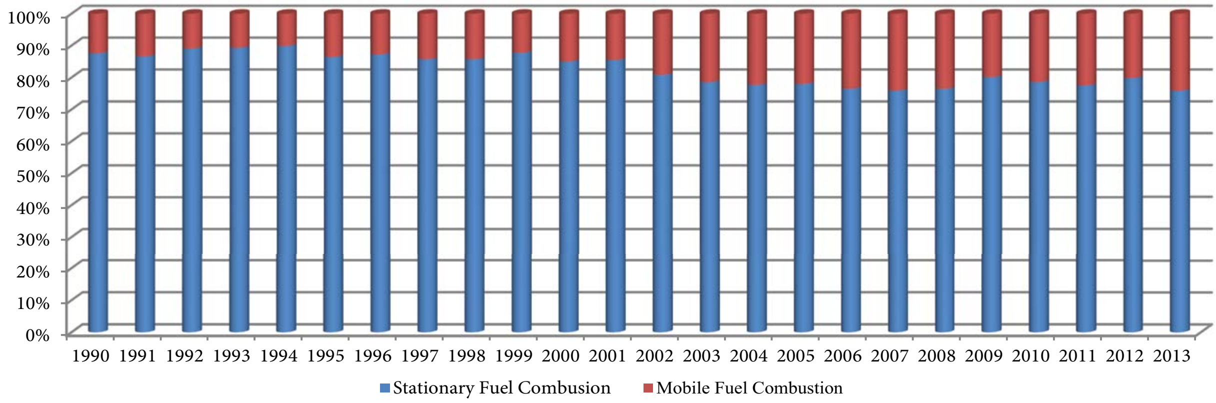

Figure 3-4: GHG Emissions from the 'Stationary Fuel Combustion' and 'Mobile Fuel Combustion' sub-sectors in the RM, % from the total 1A sub-sector

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 2.0 per cent in 1990 to maximum of 7.9 per cent in 2007. At the same time, the share of GHG emissions originated from the sub-sector 1A 'Fuel Combustion Activities' varied from 92.1 per cent in 2007 to 98.0 per cent in 1990 (Table 3-7, Figure 3-5).

Table 3-7: Direct GHG Emissions from 1A 'Fuel Combustion Activities' and 1B 'Fugitive Emissions' sub-sectors within 1990-2013 periods, Gg CO_2 equivalent

	1990	1991	1992	1993	1994	1995	1996	1997
1A Fuel Combustion Activities	33838.3837	29580.7618	20798.7162	15950.7610	14516.7551	11166.2552	11342.9093	10290.2492
% from the total	98.0	97.9	97.3	96.8	96.7	95.3	94.9	95.4
1B Fugitive Emissions	682.9320	640.9545	580.1931	521.3013	501.7084	555.9854	604.3381	498.1270
% from the total	2.0	2.1	2.7	3.2	3.3	4.7	5.1	4.6
1 Energy Sector	34521.3158	30221.7163	21378.9094	16472.0623	15018.4635	11722.2406	11947.2474	10788.3762
	1998	1999	2000	2001	2002	2003	2004	2005
1A Fuel Combustion Activities	8806.2857	6908.1573	6169.3494	6768.6178	6409.6482	7151.9384	7566.5798	7808.0999
% from the total	95.0	93.7	92.5	93.1	92.2	92.6	92.5	92.2
1B Fugitive Emissions	466.2276	465.0927	503.4185	500.1666	542.2695	573.3672	617.5696	660.3041
% from the total	5.0	6.3	7.5	6.9	7.8	7.4	7.5	7.8
1 Energy Sector	9272.5132	7373.2500	6672.7679	7268.7844	6951.9177	7725.3056	8184.1495	8468.4040
	2006	2007	2008	2009	2010	2011	2012	2013
1A Fuel Combustion Activities	7058.1501	7133.8129	7742.6108	8566.6329	9158.5594	9268.8665	8920.5048	7881.8135
% from the total	92.5	92.1	92.7	94.4	94.9	94.3	94.2	93.8
1B Fugitive Emissions	575.2321	611.7275	608.8065	504.3022	488.7817	556.6107	548.5296	522.8092
% from the total	7.5	7.9	7.3	5.6	5.1	5.7	5.8	6.2
1 Energy Sector	7633.3822	7745.5404	8351.4173	9070.9351	9647.3410	9825.4771	9469.0343	8404.6226

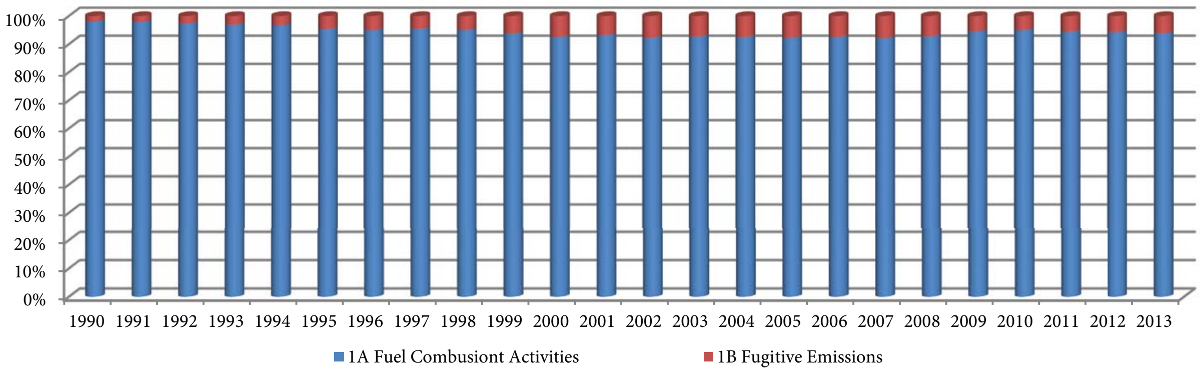

Figure 3-5: Direct GHG Emissions from 1A 'Fuel Combustion Activities' and 1B 'Fugitive Emissions' sub-sectors within 1990-2013 periods, %

The CO_2 has the largest share in the structure of total GHG emissions originated from the Energy Sector, varying over the reference period, from a minimum of 91.05 per cent in 2007, to a maximum of 96.65 per cent in 1990. Other direct GHG had smaller contribution: CH_4, between 2.79 per cent in 1990 and 8.38 per cent in 2002; while N_2O respectively, between the minimum of 0.39 per cent in 1999 and a maximum of 0.69 per cent in 2013 (Table 3-8).

Table 3-8: Direct GHG Emissions from the Energy Sector in the Republic of Moldova within 1990-2013 periods

		1990	1991	1992	1993	1994	1995	1996	1997
CO_2	GHG emissions, Gg CO_2 equivalent	33365.5535	29193.0936	20581.3267	15772.5160	14346.4226	11041.7064	11204.1202	10191.5242
CH_4		963.5777	860.7302	687.7457	608.3215	590.9332	618.4923	683.6344	547.9106
N_2O		192.1846	167.8924	109.8371	91.2248	81.1078	62.0419	59.4929	48.9414
CO_2	Share in the total GHG emissions, %	96.65	96.60	96.27	95.75	95.53	94.19	93.78	94.47
CH_4		2.79	2.85	3.22	3.69	3.93	5.28	5.72	5.08
N_2O		0.56	0.56	0.51	0.55	0.54	0.53	0.50	0.45
		1998	1999	2000	2001	2002	2003	2004	2005
CO_2	GHG emissions, Gg CO_2 equivalent	8720.8485	6842.0509	6102.7447	6703.9021	6330.7130	7060.6998	7482.4685	7721.8697
CH_4		508.0732	502.4615	539.4878	532.1532	582.2430	618.6885	656.5158	700.6404
N_2O		43.5916	28.7376	30.5355	32.7291	38.9618	45.9173	45.1652	45.8940
CO_2	Share in the total GHG emissions, %	94.05	92.80	91.46	92.23	91.06	91.40	91.43	91.18
CH_4		5.48	6.81	8.08	7.32	8.38	8.01	8.02	8.27
N_2O		0.47	0.39	0.46	0.45	0.56	0.59	0.55	0.54
		2006	2007	2008	2009	2010	2011	2012	2013
CO_2	GHG emissions, Gg CO_2 equivalent	6965.8294	7052.4028	7656.7600	8484.6735	9034.6186	9130.1626	8782.3211	7729.1857
CH_4		618.8636	646.8230	645.1129	541.4624	558.1894	636.7442	633.2981	617.5915
N_2O		48.6891	46.3147	49.5445	44.7993	54.5330	58.5703	53.4152	57.8454
CO_2	Share in the total GHG emissions, %	91.25	91.05	91.68	93.54	93.65	92.92	92.75	91.96
CH_4		8.11	8.35	7.72	5.97	5.79	6.48	6.69	7.35
N_2O		0.64	0.60	0.59	0.49	0.57	0.60	0.56	0.69

3.1.2 Key Categories

The results of key category analysis (with and without LULUCF) carried out following a Tier 1 approach (IPCC, 2000), are provided in Chapter 1.5 (Annex 1-2). Table 3-9 provides information on identified key categories (by level and trend assessment) within the Energy Sector of the Republic of Moldova.

Table 3-9: Key Categories Identified within the Energy Sector of the Republic of Moldova

IPCC Categories	GHG	Source Categories	Key Categories
1.A.1	CO_2	CO_2 Emissions from Energy Industries – solid fuels	Yes (L, T)
1.A.1	CO_2	CO_2 Emissions from Energy Industries – gaseous fuels	Yes (L, T)
1.A.1	CO_2	CO_2 Emissions from Energy Industries – liquid fuels	Yes (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 Civil Aviation	No
1.A.3a	CH_4	CH_4 Emissions from Civil Aviation	No
1.A.3a	N_2O	N_2O Emissions from Civil 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 (T)
1.A.3c	CH_4	CH_4 Emissions from Railways	No
1.A.3c	N_2O	N_2O Emissions from Railways	No
1.A.3d	CO_2	CO_2 Emissions from Navigation	No
1.A.3d	CH_4	CH_4 Emissions from Navigation	No
1.A.3d	N_2O	N_2O Emissions from Navigation	No
1.A.3e	CO_2	CO_2 Emissions from Pipeline Transportation	No
1.A.3e	CH_4	CH_4 Emissions from Pipeline Transportation	No
1.A.3e	N_2O	N_2O Emissions from Pipeline Transportation	No
1.A.4a	CO_2	CO_2 Emissions from Institutional/Commercial Sectors	Yes (L, T)
1.A.4a	CH_4	CH_4 Emissions from Institutional/Commercial Sectors	No
1.A.4a	N_2O	N_2O Emissions from Institutional/Commercial Sectors	No
1.A.4b	CO_2	CO_2 Emissions from Residential Sector	Yes (L, T)
1.A.4b	CH_4	CH_4 Emissions from Residential Sector	No
1.A.4b	N_2O	N_2O Emissions from Residential Sector	No
1.A.4c	CO_2	CO_2 Emissions from Agriculture/Forestry/Fishing	Yes (L, T)
1.A.4c	CH_4	CH_4 Emissions from Agriculture/Forestry/Fishing	No
1.A.4c	N_2O	N_2O Emissions from Agriculture/Forestry/Fishing	No
1.A.5	CO_2	CO_2 Emissions from Other Works and Needs in Energy	No
1.A.5	CH_4	CH_4 Emissions from Other Works and Needs in Energy	No
1.A.5	N_2O	N_2O Emissions from Other Works and Needs in Energy	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 3-10).

Table 3-10: Summary of Methods Used to Estimate GHG Emissions from the Energy Sector

IPCC Categories	Source Category	Method	EF
1.A.1	Energy Industries	T1	D, CS
1.A.2	Manufacturing Industry and Construction	T1	D, CS
1.A.3	Transport (Civil Aviation, Road Transportation, Railways, Navigation, Pipeline Transportation)	T1	D, CS
1.A.4	Other Sectors (Commercial/Institutional, Residential, Agriculture/Forestry/Fishing)	T1	D, CS
1.A.5	Other (Other Works and Needs in Energy Sector)	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.

3. ENERGY SECTOR

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.

Practically all fuels consumed at the national level are imported (coal - from Ukraine, Russian Federation, Kazakhstan; natural gas – from Russian Federation; oil products – from Romania, Ukraine, Russian Federation, Belarus, Lithuania, etc.). Since 1997, oil and natural gas exploration works were initiated in the South of the country; however, the extracted amounts are insignificant.

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, 1993-2013 years (Annex 2) and Statistical Yearbooks, including those of ATULBN (activity data regarding fuel consumption on the territory on the left bank of the Dniester River are available in Annex 3-1.2).

Additional AD were provided by central public authorities (Ministry of Transport and Road Infrastructure - MTRI, Ministry of Agriculture and Food Industry - MAFI, Ministry of Defense - MD, Ministry of Information Technology and Communication - MITC), central administrative authorities (Customs Service, "Moldsilva" Agency), public institutions (Civil Aeronautical Authority - CAA), as well as by some enterprises ("Moldavian Railways" State Owned Enterprises and "Moldovagaz" J.S.C.), as response to the requests coming from the Climate Change Office (CCO) of the Ministry of Environment (MoEN) (the national entity responsible for developing the national GHG inventories).

The Energy Balance for 1990 year ensured geographical coverage of the whole country, while the Energy Balances for the time series from 1993 through 2013 covered only the territory on the right bank of the Dniester River (in the 1991-1992 years the Energy Balances were not published). The estimation of GHG emissions was based on country specific values (Table 3-11).

Table 3-11: 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

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
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	15.00	15.6	29.9	30.5	0.98	1
Agricultural residues	14.67	14.67	15.20		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 Department 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 IPCC 2006 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).

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. Combined uncertainties as a percentage of total direct sectoral emissions were estimated at circa ±12.3544 per cent. The uncertainties introduced in trend in sectoral emissions were estimated at ±3.7942 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 Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories (IPCC, 2000).

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:

- verification of activity data;
- verification of the units of measure and conversion factors;
- consulting alternative sources of activity data;
- comparison of alternative data sets obtained from various sources of information;
- make recalculations based on the availability of new sources of information;
- compare the results obtained using different calculation methodologies;
- identifying and removing the errors in the calculation tool etc.

Verification of Activity Data

Preparation of the initial information for completing the database with new information is a tedious job that requires consultation of various sources of information as well as a comparative analysis of activity data available. A common problem is the frequent change of the format of reporting the statistical data in various sources of information, including the Energy Balances of the Republic of Moldova, in particular following 2010, which induces the need for additional verification and comparison of alternative data sets. It is necessary to mention the fact that the Energy Balances for the ATULBD are missing, information on fuel consumption and energy resources is collected using various sources of information and the process is quite difficult.

Verification of units of measure and conversion factors values

In order to calculate GHG emissions from the source category 1A1 "Energy Industries" available emission factors values for each greenhouse gas are required, as well as conversion coefficients values from natural units to energy units. In Republic of Moldova there are used default values of emission factors for GHGs. With reference to the conversion factors values from natural units to energy units, within each inventory cycle is carried out a laborious work on analyzing the information provided by the Customs Service of the Republic of Moldova (the amount of imported fuels, including countries of origin) and by the National Bureau of Statistics of the Republic of Moldova (for each type of fuel in the Energy Balance there are available the average net caloric values, as well as the range to be used for converting the natural units into TJ, and tons of coal and oil equivalent; the conversion coefficients varies depending on the country of origin for each type of imported fossil fuel (ex., it should be taken into consideration the coal, oil and natural gas basins from which origins the fossil fuels); thus, the average net caloric values used in the Energy Balances can vary from year to year and require a steady and continuous verification, including a comparison with the default values). To be noted, that the fuel consumption is available within the Energy Balance of the Republic of Moldova in natural units as well as in energy units (in TJ, as well as in tons of oil equivalent and in tons of coal equivalent).

Consulting various alternative sources of activity data

Within each inventory cycle, alternative sources of information are consulted, such as Energy Balances, Statistical Yearbooks, official letters received from different organizations and companies. Also, the websites of various organizations and companies are analyzed. The information collected is systematized and documented, inclusive the national database used for the compilation of the national inventory of GHG emissions is updated every inventory cycle.

Comparison of alternative data sets obtained from various sources

Within each inventory cycle, information collected from different sources is evaluated through a comparison verification analysis with the purpose to identify the most reliable sources of information. It is selected a set of activity data, which then serves as a basis for evaluating GHG emissions. For each source category comparative checks are carried out for available activity data sets, also there are identified and explained the discrepancies between different data sets. These exercises allow identifying the most reliable sources of information, which helps to reduce uncertainty and offer higher accuracy assessment.

Undertake recalculations based on the availability of new information

Within each inventory cycle for individual source categories, recalculations are undertaken for the periods covered by previous inventory cycles, specifically in cases where: new sources of information were identified, activity data were revised/updated, more disaggregated data are available or higher precision data were identified, errors were identified in completing the database, or if it is applied a higher level tier methodology.

Comparing the results obtained using different methodologies

Under the current inventory cycle, there were used Tier 1 methodologies for calculating the GHG emissions from the Energy Sector. For source categories 1A1 'Energy Industries' and 1A3 'Transport' it was initiated the process of assessing the opportunity to move in the next inventory cycles to a Tier 2 methodology. There were assessed the calculation methodologies, the activity data required and the data gaps. Available activity data do not allow so far assessment of GHG for the entire period of analysis (1990-2013), but only for the past few years (2010-2013). It should be noted that GHG emissions from "Memo Items" (International Aviation) were assessed using a Tier 2b methodology.

3.1.6 Recalculations

GHG emissions under the Energy Sector were recalculated due to the availability of an updated set of activity data for ATULBD from 1995 through 2010, as well as due to some errors correction associated with activity data entry. The reasons of recalculations performed at the category level are presented in the sub-chapters (3.2-3.9) of the NIR. In comparison with the results included into the TNC, the performed recalculation resulted in insignificant decrease of direct GHG emissions between 1992-

1993, 2003-2006 and in 2008, respectively an increase in the following years: 1990-1991, 1994-2002, 2007, 2009 and 2010 (Table 3-12).

Table 3-12: Recalculated GHG Emissions under the Energy Sector for 1990-2010 periods included in the TNC of the Republic of Moldova under UNFCCC, Gg CO_2 equivalent

	1990	1991	1992	1993	1994	1995	1996
TNC	34520.3934	30220.3831	21384.2436	16475.2288	15007.7005	11710.7161	11941.7032
BUR	34521.3158	30221.7163	21378.9094	16472.0623	15018.4635	11722.2406	11947.2474
Difference, %	0.0027	0.0044	-0.0249	-0.0192	0.0717	0.0984	0.0464
	1997	1998	1999	2000	2001	2002	2003
TNC	10776.1010	9260.5249	7372.7948	6662.3193	7265.2698	6949.6719	7762.1833
BUR	10788.3762	9272.5132	7373.2500	6672.7679	7268.7844	6951.9177	7725.3056
Difference, %	0.1139	0.1295	0.0062	0.1568	0.0484	0.0323	-0.4751
	2004	2005	2006	2007	2008	2009	2010
TNC	8234.3880	8518.8831	7703.5778	7408.5283	8427.4354	9065.9645	8946.5232
BUR	8184.1495	8468.4040	7633.3822	7745.5404	8351.4173	9070.9351	9647.3410
Difference, %	-0.6101	-0.5926	-0.9112	4.5490	-0.9020	0.0548	7.8334

Abbreviations: TNC – Third National Communication; BUR – 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 3-13). As no coal mining exists in the country, no GHG emissions from the category 1B1 'Fugitive Emissions from Coal Mining' were registered.

Table 3-13: 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 Industry and Construction	X	X	X
1.A.3	Transport (Civil Aviation, Road Transportation, Railways, Navigation, Pipeline)	X	X	X
1.A.4	Other Sectors (Commercial/Institutional, Residential, Agriculture/Forestry/Fishing)	X	X	X
1.A.5	Other (Other Works and Needs in Energy Sector)	X	X	X
1.B.1	Fugitive Emissions from Coal Mining	NO	NO	NO
1.B.2	Fugitive Emissions from Oil and Natural Gas	X	X	X
Memo items	International Aviation	X	X	X
Memo items	CO_2 Emissions from Biomass	X	X	X

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

3.1.8 Planned Improvements

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

3.2 Energy Industries (Category 1A1)

Energy Industries (in the national statistics, this economical sector is known as "Electricity, Heat, Natural Gas and Water") plays an important role in national economy, accounting for 2.0 per cent of the GDP. Around twenty four thousand specialists or approximately 2.0 per cent of active population are involved in this sector (NBS, 2014).

In 2013, the industry included 417 enterprises and production units, of which 261 publicly owned, 145 - private, 3 - with mixed ownership (public and private ownership without foreign contribution), 2 - with foreign capital and 6 – joint ventures (Table 3-14).

Table 3-14: Total number of industrial enterprises and production units, by ownership, in the "Electricity, Heat, Natural Gas and Water" sector within 2007-2013

	2007	2008	2009	2010	2011	2012	2013
Total number of industrial enterprises and production units, including :	4749	4677	4922	5277	4985	4994	5089
Industrial enterprises in "Electric and Thermal Energy, Gas and Water":	640	582	463	546	384	390	417
Public	504	456	315	376	248	248	261
Private	118	116	140	162	124	131	145
Mixed (public and private)	8	4	3	3	4	3	3
Foreign	4	2	1	2	2	2	2
Joint ventures	6	4	4	3	6	6	6

Source: Statistical Yearbooks of the RM for 2010 (pages 274-275), 2012 (pages 286-287), 2014 (pages 281-284).

Of the total of 417 industrial enterprises and production units in "Electricity, Heat, Natural Gas and Water", in 2013, 59 were active in the production and distribution of electricity, steam and hot water, natural gas, including: 22 - in the production and distribution of electricity, 18 - in the production and distribution of gaseous fuel, 19 - in steam and hot water supply and 358 - the capture, handling and distribution of water (Table 3-15).

Table 3-15: Total number of industrial enterprises and production units in "Electricity, Heat, Natural Gas and Water" sector within 2007-2013

	2007	2008	2009	2010	2011	2012	2013
Electricity, Heat, Natural Gas and Water	640	582	463	546	384	390	417
Production and Distribution of Electricity, Heat, Natural Gas and Water	87	84	61	62	57	56	59
Production and Distribution of Electricity	17	13	14	13	16	16	22
Production and Distribution of Gaseous Fuels	23	24	20	23	22	19	18
Steam and Hot Water Supply	47	47	27	26	19	21	19
Capture, Handling and Distribution of Water	553	498	402	484	327	334	358

Source: Statistical Yearbooks of the RM for 2010 (page 278), 2012 (page 290), 2014 (page 284).

Brief Description of the Energy System of the Republic of Moldova

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, operating on natural gas, residual fuel oil and coal, built between 1964-1982; CHP-2 Chisinau, with an installed capacity of 240 MW (available 210 MW) and 1,200 Gcal/h heat capacity, built between 1976-1980; CHP-1 Chisinau, with an installed capacity of 66 MW (available 40 MW) and 254 Gcal/h heat capacity, built between 1951-1961; CHP-North Balti, with an installed capacity of 28.5 MW (available 24 MW) and 200 Gcal/h heat capacity built in during 1956-1970; HPP Dubasari on the Dniester River with an installed capacity of 48 MW (30 MW available), 75 per cent overused degree, built between 1954-1966; HPP Costesti on the Prut River, with an installed capacity of 16 MW (10 MW available), built in 1978; other power plants, including nine 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.

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 25877.4 km radial lines of 35 and 6-10 kV. Interconnections include 7 lines of 330kV and 11 lines of 110kV with Ukraine, 3 lines of 110kV and just one line of 400kV with Romania and from there, to Bulgaria. The Republic of Moldova's electricity system operates synchronously with the IPS/UPS system and in island mode with Romania, when it is needed. While currently, the connection with Ukraine is entirely used, a large volume of the use is the maximum security transit; operation of the connection with Romania offers a reduced transborder exchange, as well as a low supply security.

In 2000, the Republic of Moldova privatized a large part of the distribution sector (approximately 70%), that including three of the five power distribution units, which, subsequently, merged in the ICS RED "Union Fenosa" J.S.C., while the other two remained state-owned enterprises: J.S.C "RED-North" and "RED North-West" J.S.C. On the left bank of the Dniester River the service is provided by "RED East" J.S.C. and "RED South-East".

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'.

1A1a i Public Electricity Generation

The energy system of the Republic of Moldova owns only one thermal power plant, situated in Dnestrovsk, on the left bank of the Dniester. The Power Plant 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, of which only five are currently operational energy groups; during 1999-2007 none was working), 2 energy groups on residual fuel oil and natural gas with an electric power of 210 MW (in service since 1973-1974, both operational) 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, both operational).

The technological processes used by MTPP are based on the classical cycle of steam turbines with condensation and involve combusting fossil fuels for electricity generation, heat production representing only a secondary process. Under specific fuel consumption, MTPP's energy groups of 200-210 MW are less efficient than analogue energy groups in the world. Note that the use of combined cycle gas-steam turbine installation (GSTI) type compared with usual blocks with condensation provides a fuel economy of about 20 per cent of the group total and can be fast included during the peak hours. The gas-steam facility used by MTPP has an efficiency of 24.8 per cent, which is much lower than modern gas turbine parameters.

Electricity generation during 1990-2013 at MTPP decreased by 4.5 times (Table 3-16), respectively MTPP efficiency has also decreased considerably in recent years. Within 1970-1980 the average specific fuel consumption was below 340 grams of coal equivalent (g.c.e.)/kWh, thereafter, especially during the period from 1990 to 1997, this index ranged between 370-470 g.c.e./kWh.

Table 3-16: Electricity Generation at MTPP within 1990-2013 periods, million kWh

	1990	1991	1992	1993	1994	1995	1996	1997
Electricity Generation	13569.13	11222.53	9468.15	8626.28	6835.73	4746.90	4560.40	3628.50
	1998	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**
Electricity Generation	3369.40	2687.50	2463.30	3365.80	2942.00	2793.10	2890.50	2700.90
	2006	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**
Electricity Generation	1399.80	2482.00	2621.77	4861.61	4723.07	4493.91	4614.61	3030.80

Source: Statistical Yearbooks of the ATULBD for 2000 (pages 99, 101, 175, 183), 2006 (pages 93, 95, 173, 179), 2009 (pages 92, 94, 169, 175), 2010 (pages 93, 96, 167, 173), 2011 (pages 94, 97, 171, 177), 2012 (pages 98, 101, 175, 181), 2014 (pages 88, 91, 163, 169); State Statistical Service of the Ministry of Economy of the Transnistrian Moldovan Republic (2014), *Express Information, Key Performance Indicators for the Industry Sector in the Republic for 2013 (other than the Small Industries)*. - Tiraspol, 2014 – 14 p.; State Statistical Service of the Ministry of Economy of the Transnistrian Moldovan Republic (2013), *Express Information, Key Performance Indicators for the Industry Sector in the Republic for 2012* - Tiraspol, 2013 – 13 p.; State Statistical Service of the Ministry of Economy of the Transnistrian Moldovan Republic (2012), *Express Information, Key Performance Indicators for the Industry Sector in the Republic for 2011* - Tiraspol, 2012 – 13 p.; State Statistical Service of the Ministry of Economy of the Transnistrian Moldovan Republic (2011), *Express Information, Key Performance Indicators for the Industry Sector in the Republic for 2010* - Tiraspol, 2011 – 13 p.; State Statistical Service of the Ministry of Economy of the Transnistrian Moldovan Republic (2010), *Express Information, Key Performance Indicators for the Industry Sector in the Republic for January- December 2010 (Preliminary Data)*. - Tiraspol, 2011 – 13 p; State Statistical Service of the Ministry of Economy of the Transnistrian Moldovan Republic (2009), *Express Information, Key Performance Indicators for the Industry, Road Transport, Trade and Paid Services Sectors for 2009* - Tiraspol, 2009 – 15 p.

Starting with the conservation of the energy units based on coal consumption and the use of those energy units using only residual fuel oil and natural gas, as well as those two energy units that operate on gas-steam combined cycle, using natural gas, a process that evolved during 1999-2007, the specific fuel consumption decreased to circa 360 g.c.e./kWh. When the Russian Federation increased the price for imported natural gas, MTPP changed its tariff policy, increasing the price of electricity supplied to the Republic of Moldova.

In this context, from November 2005 through September 2009, the Republic of Moldova has stopped buying electricity from MTPP, opting for cheaper electricity imports from Ukraine. The lack of demand during 09.11.2005-11.01.2007 forced the MTPP to use just one energy unit that operated by gas-steam combined cycle based on natural gas consumption. In January-March 2007, MTPP exported 211 million kWh in Belarus and Russian Federation, but as a consequence of the increased fees adopted by Ukraine for electricity transit on its territory, the export of electricity was reoriented to Romania. From July to December 2007, MTPP managed to export about 554 million kWh. In 2008, electricity supplies provided to Romania represented about 900 million kWh. The supply of electricity to Romania was doubled in 2009-2010 years and in this context, a new scheme was applied, a scheme that implies the exclusion of some MTPP energy units from the energy system of the RM and joining them to the Romanian energy system (the energy systems of Moldova and Romania are in different synchronization areas; to ensure full synchronization of MTPP to Romania's energy system, it was necessary a change of the plant generator rotation frequency).

Exports of energy takes place through interconnection power transmission lines of 110 kW and 400 kW: MTPP (ATULBD) – Vulcanesti (RM) and Vulcanesti (RM) – Isaccea (Romania). Implementation of this scheme has allowed increasing the supply of electricity to Romania (part of Zone 2 of the Union for the Coordination of Transmission of Electricity (UCTE), on whose territory it was created by prior coordination with the administration UCTE a passive energy island – towards which MTPP delivers electricity through a radial connection). The long-term strategy of the MTTP is to create operating conditions for the plant to a capacity of at least 1,500 MW, providing energy exports to the Balkans countries, over 6.0 billion kWh annually. In order to achieve modernization plans, during 2005-2013, about 100 million dollars were invested in upgrading MTPP.

During 1995-2013, the annual production of electricity on the left bank of the Dniester (MTPP from Dnestrovsk and HPP Dubasari) varied between 1.7-5.2 billion kWh, of which about 40-60% was exported to Moldova and the southern regions of Ukraine (Table 3-17).

Table 3-17: Electricity Generation in ATULBD within 1995-2013 periods

	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
Electricity Generation, mill. kWh, including at:	4986.6	4839.8	3923.5	3593.4	2973.1	2720.0	3649.9	3228.5	3016.1	3156.6
HPP Dubasari, mill. kWh	239.7	279.4	295.0	224.0	285.6	256.7	284.1	286.5	223.0	266.1
MTPP Dnestrovsk, mil. kWh	4746.9	4560.4	3628.5	3369.4	2687.5	2463.3	3365.8	2942.0	2793.1	2890.5
Electricity Imports in ATULBD, mill. kWh	0.0	0.0	0.0	0.0	2.8	0.0	0.0	285.4	921.3	812.0
Electricity consumption in ATULBD, mill. kWh	2878.0	2589.4	2363.6	1928.8	2098.4	2100.0	2183.1	1899.2	2111.6	2124.3
Electricity exports from ATULBD, mill. kWh	2108.6	2250.4	1559.9	1664.6	877.5	620.0	1466.8	1614.7	1825.8	1844.3
	2005	2006	2007	2008	2009	2010	2011	2012	2013	%
Electricity Generation, mill. kWh, including at:	2995.9	1674.8	2769.2	2929.1	5164.5	5051.0	4769.9	4869.4	3586.3	-28.1
HPP Dubasari, mill. kWh	295.0	275.0	275.0	307.4	302.9	328.0	276.0	234.7	265.1	10.6
MTPP Dnestrovsk, mil. kWh	2700.9	1399.8	2482.0	2621.8	4861.6	4723.1	4493.9	4614.6	3030.8	-36.2
Electricity Imports in ATULBD, mill. kWh	659.2	275.8	0.0	0.0	2.1	1.9	1.6	1.9	1.6	NA
Electricity consumption in ATULBD, mill. kWh	2107.9	1898.9	2133.5	2151.1	1815.4	1669.8	1763.0	1832.3	1643.8	-42.9
Electricity exports from ATULBD, mill. kWh	1547.2	51.7	635.7	793.1	3357.5	3390.8	3023.1	3054.4	1962.0	-7.0

Source: Statistical Yearbooks of the ATULBD for 2000 (pages 99, 101, 175, 183), 2006 (pages 93, 95, 173, 179), 2009 (pages 92, 94, 169, 175), 2010 (pages 93, 96, 167, 173), 2011 (pages 94, 97, 171, 177), 2012 (pages 98, 101, 175, 181), 2014 (pages 88, 91, 163, 169); State Statistical Service of the Ministry of Economy of the Transnistrian Moldovan Republic (2014), *Express Information, Key Performance Indicators for the Industry Sector in the Republic for 2013 (other than the Small Industries).* - Tiraspol, 2014 – 14 p.; State Statistical Service of the Ministry of Economy of the Transnistrian Moldovan Republic (2013), *Express Information, Key Performance Indicators for the Industry Sector in the Republic for 2012* - Tiraspol, 2013 – 13 p.; State Statistical Service of the Ministry of Economy of the Transnistrian Moldovan Republic (2012), *Express Information, Key Performance Indicators for the Industry Sector in the Republic for 2011* - Tiraspol, 2012 – 13 p.; State Statistical Service of the Ministry of Economy of the Transnistrian Moldovan Republic (2011), *Express Information, Key Performance Indicators for the Industry Sector in the Republic for 2010* - Tiraspol, 2011 – 13 p.; State Statistical Service of the Ministry of Economy of the Transnistrian Moldovan Republic (2010), *Express Information, Key Performance Indicators for the Industry Sector in the Republic for January- December 2010 (Preliminary Data).* - Tiraspol, 2011 – 13 p; State Statistical Service of the Ministry of Economy of the Transnistrian Moldovan Republic (2009), *Express Information, Key Performance Indicators for the Industry, Road Transport, Trade and Paid Services Sectors for 2009* - Tiraspol, 2009 – 15 p.

1A1a ii 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.

The installed capacity of cogeneration power plants on the right bank of the Dniester River is only about 14% of the total installed capacity of power plants in the Republic of Moldova. Unlike the overall territory of the country, the right bank of Dniester River is deficient in terms of installed capacity for electricity generation. Of the total nominal installed capacity on the right bank of Dniester River, the largest share has CHP-2 in Chisinau, about 55% of the total, followed by CHP-1 in Chisinau, with a share of about 14% and CHP-North in Balti, with a share of about 7%. Total nominal installed capacity in this region covers only around 30 per cent of the electricity needs.

Total production of electricity on the right bank of Dniester River decreased from approximately 1.697 billion kWh in 1990 to about 0.905 billion kWh in 2013 (Table 3-18), which indicates that the installed capacity of power generation in this region is used inefficiently. 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.

Table 3-18: Electricity Generation, Import and Consumption on the Right Bank of Dniester River, within 2001-2013 periods, million kWh

	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
Electricity Generation	1249	1167	1039	1011	990	1118	1087	1067	1027	1060	1016	932	905
Electricity Imports	668	987	1757	1836	1600	2881	2931	2961	2941	2662	3142	3279	3332
Electricity Consumption	3413	3495	3570	3455	3686	3871	4030	4065	3979	4106	4161	4211	4151

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

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 3-19.

Table 3-19: Fuel Consumption, Electricity and Heat Generation from the Combined Heat and Power Plants in the Republic of Moldova within 1990-2013 periods

		1990	1991	1992	1993	1994	1995	1996	1997
CHP-1	Residual Fuel Oil, thousands tons	13.4	26.1	14.2	14.0	6.2	4.7	8.5	3.7
	Natural Gas, millions m^3	271.2	290.0	245.8	184.2	161.0	137.6	118.6	113.4
	Electricity, millions kWh	207.5	207.0	196.3	150.2	136.5	106.4	114.6	93.2
	Heat, thousands Gcal	2249.2	2618.7	2178.1	1023.7	1308.5	1035.1	1006.3	882.1
CHP-2	Residual Fuel Oil, thousands tons	76.4	135.9	164.9	120.4	53.1	57.3	67.5	49.9
	Natural Gas, millions m^3	486.1	419.0	337.1	318.4	315.2	270.7	323.2	386.5
	Electricity, millions kWh	1150.0	951.4	923.4	883.4	751.2	670.9	838.8	896.2
	Heat, thousands Gcal	2544.7	2775.8	2577.6	2021.6	1631.6	1518.2	1515.0	1524.6
CHP-North	Residual Fuel Oil, thousands tons	40.0	35.0	31.9	19.6	3.8	8.1	1.4	1.1
	Natural Gas, millions m^3	15.7	87.6	136.3	102.0	98.5	86.9	107.2	93.6
	Electricity, millions kWh	121.0	100.0	102.0	75.0	87.0	81.0	100.0	96.0
	Heat, thousands Gcal	1360.0	1450.0	1144.0	834.0	625.0	596.0	642.0	500.0
		1998	1999	2000	2001	2002	2003	2004	2005
CHP-1	Residual Fuel Oil, thousands tons	4.6	4.1	1.2	0.4	0.0	0.1	0.1	0.9
	Natural Gas, millions m^3	135.2	73.0	65.2	82.3	85.7	81.3	76.3	84.8
	Electricity, millions kWh	138.6	115.0	100.8	138.5	142.1	138.8	136.5	154.9
	Heat, thousands Gcal	1045.9	448.3	387.4	408.8	386.3	405.9	335.6	375.6
CHP-2	Residual Fuel Oil, thousands tons	34.3	22.3	3.7	3.1	1.2	1.9	0.0	2.9
	Natural Gas, millions m^3	313.5	312.2	267.4	365.1	313.0	286.0	278.9	326.8
	Electricity, millions kWh	723.3	801.0	658.1	942.2	804.7	741.9	714.3	854.4
	Heat, thousands Gcal	1296.0	1286.5	947.0	1068.4	1069.2	1018.6	885.7	1198.1
CHP-North	Residual Fuel Oil, thousands tons	6.8	10.1	0.9	0.0	0.0	0.0	0.0	0.0
	Natural Gas, millions m^3	70.1	39.3	25.0	40.5	38.0	44.6	41.6	44.3
	Electricity, millions kWh	75.0	50.7	27.3	44.4	40.6	52.5	57.7	67.8
	Heat, thousands Gcal	416.0	247.0	125.7	206.1	198.5	246.0	229.6	232.6
		2006	2007	2008	2009	2010	2011	2012	2013
CHP-1	Residual Fuel Oil, thousands tons	0.0	0.0	0.0	1.2	0.0	0.0	0.0	0.0
	Natural Gas, millions m^3	83.5	81.1	78.3	70.0	51.2	40.3	33.8	33.1
	Electricity, millions kWh	148.0	151.9	140.3	135.6	94.9	70.2	56.7	59.5
	Heat, thousands Gcal	378.8	329.1	319.6	271.9	245.4	203.5	184.7	171.0
CHP-2	Residual Fuel Oil, thousands tons	0.0	0.0	0.0	9.6	0.0	0.0	0.0	0.0
	Natural Gas, millions m^3	316.3	308.5	294.8	284.6	304.2	295.3	288.9	267.0
	Electricity, millions kWh	818.4	805.4	755.3	754.6	782.4	765.2	742.9	649.7
	Heat, thousands Gcal	1204.2	1159.3	1153.8	1126.8	1193.4	1166.0	1135.7	1047.0
CHP-North	Residual Fuel Oil, thousands tons	0.0	0.0	0.0	0.8	0.0	0.0	0.0	0.0
	Natural Gas, millions m^3	44.4	38.0	37.8	38.0	41.5	39.2	39.1	33.5
	Electricity, millions kWh	74.7	67.7	67.4	66.5	70.0	69.8	66.3	60.2
	Heat, thousands Gcal	222.7	193.5	199.1	205.8	227.5	225.9	227.7	253.9

Source: CHP-1 through Letter No. 01-11/6-56 from 22.02.2011, as a response to the request of the MoEN No. 03-07/175 from 02.02.2011; Letter No. 01-11/6-10 dated 13.01.2014, as a response to the request of the Climate Change Office No. 320/2014-01-01 dated 03.01.2014; Letter No. 18/215 dated 16.02.2015, as a response to the request of the Climate Change Office No. 408/2015-01-10 dated 31.01.2015; CHP-2 through Letter No. 43/195 dated 14.02.2011, as a response to the request of the Ministry of Environment No. 03-07/175 dated 02.02.2011; Letter No. 18/37 dated 13.01.2014, as a response to the request of the Climate Change Office No. 320/2014-01-01 dated 03.01.2014; Letter No. 18/188 dated 10.02.2015, as a response to the request of the Climate Change Office No. 408/2015-01-10 dated 31.01.2015; CHP-North through Letter No. 04/14-119 dated 28.02.2011, as a response to the request of the Ministry of Environment No. 03-07/175 dated 02.02.2011; Letter No. 04-14/34 dated 22.01.2014, as a response to the request of the Climate Change Office No. 320/2014-01-01 dated 03.01.2014; Letter No. 04-14/71 dated 06.02.2015, as a response to the request of the Climate Change Office No. 497/2015-01-11 dated 31.01.2015.

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.

During 1993-2010, the number of Heat Plants decreased by approximately 1.5 times, from 4764 units in 1993 to 3276 units in 2013 (Table 3-20).

Table 3-20: Public Heat Plants in Operation on the right bank of Dniester River within 1993-2013 periods, units

	1993	1994	1995	1996	1997	1998	1999	2000	2001
Heat Plants, units	4764	5068	4890	4640	4608	4421	3921	3355	3260
	2002	2003	2005	2006	2007	2010	2011	2012	2013
Heat Plants, units	3235	3176	3188	3146	3169	3351	3331	3374	3276

Source: Energy Balances of the Republic of Moldova for 1993-2013.

Table 3-21 below present information on heat generation, starting with 1993 it refers to the right bank of the Dniester River only.

Table 3-21: Heat Generation on the Right Bank of Dniester River within 1990-2013 periods, thousand Gcal

	1990	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
Heat generation, including:	22212	10208.1	7507	7097	7077	6590	6120	4647	3057	3298	3217
CHPs	7220	4656.9	3641	3528	3659	3294	3127	2534	1847	2113	2128
HPs	14802	5542.4	3862	3568	3417	3296	2991	2113	1207	1183	1087
Other installations	190	8.7	3	1	1	0	2	0	3	2	2
	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
Heat generation, including:	3347	3347	3591	3552	3094	3074	2638	2874	2721	2596	2681
CHPs	1922	1922	2140	2165	1855	1939	1647	1874	1780	1701	1655
HPs	1423	1423	1451	1358	1386	1133	990	1000	940	895	1022
Other installations	2	2	-	1	1	2	1	-	-	-	-

Source: Energy Balances of the Republic of Moldova, 1993-2013.

For the right bank of the Dniester River it is characteristic a decreasing tendency of heat generation – during 1993-2013, the decrease represented about 73.7 per cent (from 10208 thousands Gcal in 1993 to 2681 thousands Gcal in 2013), while for the left bank of the Dniester River it was revealed a reversed tendency, compared to the production level recorded in 1995 (181 thousands Gcal), in 2013 it was produced 9 times more heat (1626 thousands Gcal) (Table 3-22).

Table 3-22: Heat Generation in the Republic of Moldova within 1996-2013 periods

	1996	1997	1998	1999	2000	2001	2002	2003	2004
Republic of Moldova: total, thousands Gcal	7665	7126	7371	5650	3846	4375	4417	4605	4547
Right Bank of Dniester River, thousands Gcal	7077	6590	6120	4647	3057	3298	3217	3347	3147
Left Bank of Dniester River, thousands Gcal	588	536	1251	1003	789	1077	1200	1258	1200
Right Bank of Dniester River ,% of total	92.3	92.5	83.0	82.2	79.5	75.4	72.8	72.7	72.4
Left Bank of Dniester River ,% of total	7.7	7.5	17.0	17.8	20.5	24.6	27.2	27.3	27.6
	2005	2006	2007	2008	2009	2010	2011	2012	2013
Republic of Moldova: total, thousands Gcal	4830	5043	4508	4683	4075	4488	4376	4240	4307
Right Bank of Dniester River, thousands Gcal	3591	3552	3094	3074	2638	2874	2721	2596	2681
Left Bank of Dniester River, thousands Gcal	1239	1491	1414	1609	1437	1614	1655	1644	1626
Right Bank of Dniester River ,% of total	74.3	70.4	68.6	65.6	64.7	64.0	62.2	61.2	62.2
Left Bank of Dniester River ,% of total	25.7	29.6	31.4	34.4	35.3	36.0	37.8	38.8	37.8

Source: Energy Balances of the Republic of Moldova for 1996-2013; Statistical Yearbooks of the ATULBD: 2000 (page 99), 2006 (page 93), 2009 (page 92), 2010 (page 93), 2011 (page 94), 2012 (page 98), 2014 (page 88).

Overall, the amount of heat produced in the Republic of Moldova has decreased by 80.6 per cent, from 22212 thousands Gcal in 1990 to 4307 thousands Gcal in 2013.

Trend of GHG Emission within the Source Category 1A1 „Energy Industry"

During 1990-2013, 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 1990-2013 periods, Gg

	1990	1991	1992	1993	1994	1995	1996	1997
CO_2	19332.7655	17361.2078	13009.2232	11323.7149	9998.7215	6913.6176	7135.1010	5641.7033
CH_4	0.4423	0.3826	0.2828	0.2531	0.1898	0.1314	0.1349	0.1107
N_2O	0.1653	0.1457	0.1102	0.1010	0.0875	0.0496	0.0469	0.0245
NO_x	54.2987	48.8473	36.6784	32.0190	28.6601	19.4831	19.9904	15.3909
CO	4.9157	4.4530	3.3396	2.8820	2.8304	2.0275	2.1475	1.8340
NMVOC	1.3281	1.2021	0.8992	0.7706	0.7050	0.5135	0.5422	0.4618
SO_2	203.2514	172.1415	128.3280	121.2480	82.8434	46.0290	42.2225	21.4411
	1998	1999	2000	2001	2002	2003	2004	2005
CO_2	4846.8481	3670.0376	3149.1129	3674.9208	2940.7433	3038.6698	3109.5867	3232.6387
CH_4	0.0964	0.0727	0.0600	0.0705	0.0582	0.0594	0.0622	0.0627
N_2O	0.0191	0.0088	0.0066	0.0076	0.0065	0.0065	0.0069	0.0068
NO_x	13.1501	9.7970	8.4121	9.8228	7.8718	8.1377	8.3348	8.6577
CO	1.5935	1.2779	1.1286	1.3623	1.1571	1.1963	1.2814	1.2731
NMVOC	0.4015	0.3199	0.2786	0.3280	0.2656	0.2750	0.2843	0.2928
SO_2	17.0883	6.1854	2.5730	2.3780	1.9609	1.3954	1.3138	1.1564
	2006	2007	2008	2009	2010	2011	2012	2013
CO_2	2491.4432	2892.5257	3290.3984	4453.2554	4587.4073	4179.0392	4184.6346	3308.1821
CH_4	0.0492	0.0556	0.0631	0.0848	0.0965	0.0857	0.0803	0.0654
N_2O	0.0053	0.0059	0.0110	0.0177	0.0180	0.0152	0.0144	0.0141
NO_x	6.6759	7.7470	8.9530	12.1983	12.5498	11.4004	11.3991	9.0957
CO	1.0122	1.1434	1.2979	1.7020	2.0605	1.8163	1.6517	1.3662
NMVOC	0.2273	0.2628	0.2902	0.3838	0.4137	0.3757	0.3682	0.2891
SO_2	0.8759	0.5434	4.5144	9.4752	8.4583	6.7064	6.2607	7.2092

Compared to the base year - 1990, in 2013 the level of GHG emissions from the source category 1A1 'Energy Industries' represented: CO2 emissions – 17.1 per cent, CH_4 – 14.8 per cent, N_2O – 8.5 per cent, NO_x – 16.8 per cent, CO – 27.8 per cent, NMVOC – 21.8 per cent and SO2 – 3.5 per cent (Table 3-24).

Table 3-24: Direct GHG Emissions from 1A1 'Energy Industries' in the Republic of Moldova within 1990-2013 periods, where 1990 represents 100 per cent

	1990	1991	1992	1993	1994	1995	1996	1997
CO_2	100.0	89.8	67.3	58.6	51.7	35.8	36.9	29.2
CH_4	100.0	86.5	63.9	57.2	42.9	29.7	30.5	25.0
N_2O	100.0	88.2	66.7	61.1	52.9	30.0	28.4	14.8
NO_x	100.0	90.0	67.5	59.0	52.8	35.9	36.8	28.3
CO	100.0	90.6	67.9	58.6	57.6	41.2	43.7	37.3
NMVOC	100.0	90.5	67.7	58.0	53.1	38.7	40.8	34.8
SO_2	100.0	84.7	63.1	59.7	40.8	22.6	20.8	10.5
	1998	1999	2000	2001	2002	2003	2004	2005
CO_2	25.1	19.0	16.3	19.0	15.2	15.7	16.1	16.7
CH_4	21.8	16.4	13.6	15.9	13.2	13.4	14.1	14.2
N_2O	11.6	5.3	4.0	4.6	3.9	3.9	4.2	4.1
NO_x	24.2	18.0	15.5	18.1	14.5	15.0	15.3	15.9
CO	32.4	26.0	23.0	27.7	23.5	24.3	26.1	25.9
NMVOC	30.2	24.1	21.0	24.7	20.0	20.7	21.4	22.0
SO_2	8.4	3.0	1.3	1.2	1.0	0.7	0.6	0.6
	2006	2007	2008	2009	2010	2011	2012	2013
CO_2	12.9	15.0	17.0	23.0	23.7	21.6	21.6	17.1
CH_4	11.1	12.6	14.3	19.2	21.8	19.4	18.2	14.8
N_2O	3.2	3.6	6.6	10.7	10.9	9.2	8.7	8.5
NO_x	12.3	14.3	16.5	22.5	23.1	21.0	21.0	16.8
CO	20.6	23.3	26.4	34.6	41.9	37.0	33.6	27.8
NMVOC	17.1	19.8	21.9	28.9	31.1	28.3	27.7	21.8
SO_2	0.4	0.3	2.2	4.7	4.2	3.3	3.1	3.5

In 2013, source category 1A1 'Energy Industries' accounted for circa 25.8 per cent of the total national GHG emissions (without LULUCF), being thus an important source of GHG emissions.

Between 1990 and 2013, direct GHG emissions from source category 1A1 'Energy Industries' tended to reveal lower values, decreasing by 82.9 per cent: from 19393.29 Gg CO_2 eq. in 1990, to 3313.92 Gg CO_2 eq. in 2013 (Figure 3-6, Table 3-25).

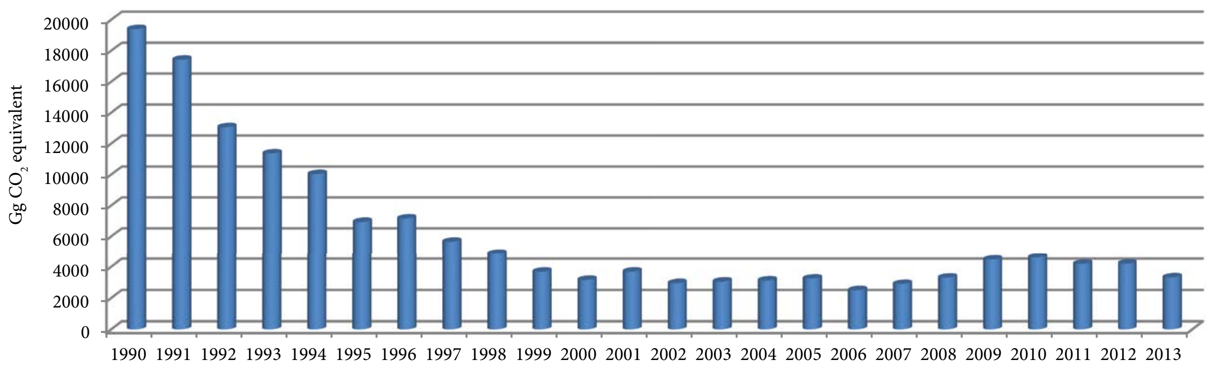

Figure 3-6: GHG Emissions from 1A1 'Energy Industries' in the Republic of Moldova, 1990-2013, Gg CO_2 equivalent

Table 3-25: Direct GHG Emissions from 1A1 'Energy Industries' in the Republic of Moldova within 1990-2013 periods, Gg CO_2 equivalent

		1990	1991	1992	1993	1994	1995	1996	1997
CO_2	GHG Emissions, Gg CO_2 equivalent	19332.7655	17361.2078	13009.2232	11323.7149	9998.7215	6913.6176	7135.1010	5641.7033
CH_4		9.2887	8.0338	5.9383	5.3158	3.9864	2.7592	2.8329	2.3243
N_2O		51.2316	45.1769	34.1769	31.3109	27.1098	15.3867	14.5358	7.5915
Total		**19393.2858**	**17414.4185**	**13049.3384**	**11360.3417**	**10029.8177**	**6931.7635**	**7152.4697**	**5651.6191**
CO_2	Share in the total GHG emissions, %	99.69	99.69	99.69	99.68	99.69	99.74	99.76	99.82
CH_4		0.05	0.05	0.05	0.05	0.04	0.04	0.04	0.04
N_2O		0.26	0.26	0.26	0.28	0.27	0.22	0.20	0.13
		1998	1999	2000	2001	2002	2003	2004	2005
CO_2	GHG Emissions, Gg CO_2 equivalent	19332.7655	17361.2078	13009.2232	11323.7149	9998.7215	6913.6176	7135.1010	5641.7033
CH_4		9.2887	8.0338	5.9383	5.3158	3.9864	2.7592	2.8329	2.3243
N_2O		51.2316	45.1769	34.1769	31.3109	27.1098	15.3867	14.5358	7.5915
Total		**19393.2858**	**17414.4185**	**13049.3384**	**11360.3417**	**10029.8177**	**6931.7635**	**7152.4697**	**5651.6191**
CO_2	Share in the total GHG emissions, %	99.69	99.69	99.69	99.68	99.69	99.74	99.76	99.82
CH_4		0.05	0.05	0.05	0.05	0.04	0.04	0.04	0.04
N_2O		0.26	0.26	0.26	0.28	0.27	0.22	0.20	0.13

		2006	2007	2008	2009	2010	2011	2012	2013
CO_2	GHG Emissions, Gg CO_2 equivalent	2491.4432	2892.5257	3290.3984	4453.2554	4587.4073	4179.0392	4184.6346	3308.1821
CH_4		1.0322	1.1666	1.3243	1.7818	2.0270	1.8004	1.6869	1.3734
N_2O		1.6578	1.8220	3.3984	5.4747	5.5660	4.7092	4.4582	4.3651
Total		**2494.1332**	**2895.5143**	**3295.1211**	**4460.5118**	**4595.0003**	**4185.5488**	**4190.7797**	**3313.9206**
CO_2	Share in the total GHG emissions, %	99.89	99.90	99.86	99.84	99.83	99.84	99.85	99.83
CH_4		0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04
N_2O		0.07	0.06	0.10	0.12	0.12	0.11	0.11	0.13

Compared to the base year - 1990, in 2013, the source category 1A1 'Energy Industries' accounted only for circa 17.1 per cent of the total sectoral GHG emissions (Table 3-26).

Table 3-26: Direct GHG Emissions from 1A1 'Energy Industries' within 1990-2013 periods, where 1990 represents 100 per cent

	1990	1991	1992	1993	1994	1995	1996	1997
CO_2	100.0	89.8	67.3	58.6	51.7	35.8	36.9	29.2
CH_4	100.0	86.5	63.9	57.2	42.9	29.7	30.5	25.0
N_2O	100.0	88.2	66.7	61.1	52.9	30.0	28.4	14.8
Total	100.0	89.8	67.3	58.6	51.7	35.7	36.9	29.1
	1998	1999	2000	2001	2002	2003	2004	2005
CO_2	25.1	19.0	16.3	19.0	15.2	15.7	16.1	16.7
CH_4	21.8	16.4	13.6	15.9	13.2	13.4	14.1	14.2
N_2O	11.6	5.3	4.0	4.6	3.9	3.9	4.2	4.1
Total	25.0	18.9	16.3	19.0	15.2	15.7	16.1	16.7
	2006	2007	2008	2009	2010	2011	2012	2013
CO_2	12.9	15.0	17.0	23.0	23.7	21.6	21.6	17.1
CH_4	11.1	12.6	14.3	19.2	21.8	19.4	18.2	14.8
N_2O	3.2	3.6	6.6	10.7	10.9	9.2	8.7	8.5
Total	12.9	14.9	17.0	23.0	23.7	21.6	21.6	17.1

3.2.2 Methodological Issues, Emission Factors and Data Sources

GHG emissions originated from 1A1 'Energy Industry' was estimated following a Tier 1 methodology using default emission factors. To assure the natural conversion from natural units to energy units, country specific NCVs were used (Table 3-11).

The carbon oxidation fraction values used were those recommended by 2006 IPCC Guidelines (Table 3-27).

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	EF, t C/TJ	Method	EF, kg/TJ	Method	EF, 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) and 2006 IPCC Guidelines were used for estimating non-CO_2[19] emissions (Table 3-28).

Table 3-28: Emission Factors Used for Estimating non-CO_2 Emissions Originated from 1A1 'Energy Industries', kg/TJ

GHG	Coal	Natural Gas	Oil Products	Fuel Wood	Other Biomass
CH_4	1	1	3	30	30
N_2O	1.5	0.1	0.6	4	4
NO_x	300	150	200	100	100
CO	20	20	15	1 000	1 000
NMVOC	5	5	5	50	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.

Activity Data

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 National Bureau of Statistics, 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 also it was used the information available in the Statistical Yearbooks of ATULBD as well as other sectoral statistical publications.

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

Table 3-29: Fuel Consumption for Electricity and Heat Generation in the Republic of Moldova within 1990-2013 periods

	1990	1991	1992	1993	1994	1995	1996	1997
Kerosene, kt	0.00	0.00	0.00	3.20	1.00	0.00	0.00	0.00
Diesel Oil, kt	62.00	50.00	30.00	9.10	8.00	8.00	7.00	5.00
Residual Fuel Oil, kt	2119.00	1715.00	1248.50	1204.80	559.00	335.10	308.60	213.06
Kerosene, kt	0.00	0.00	0.00	0.90	0.00	0.00	0.00	0.00
Anthracite, kt	0.00	0.00	0.00	20.10	7.00	5.00	2.00	1.00
Coking Coal, kt	0.00	0.00	0.00	0.10	0.00	0.00	0.00	0.00
Bituminous Coal, kt	2657.00	2419.00	1868.00	1683.60	1716.60	900.90	826.34	299.87
Lignite, kt	0.00	0.00	0.00	15.80	4.00	2.00	2.00	2.00
Natural Gas, millions m^3	3239.00	3184.00	2388.00	1804.00	2146.95	1928.40	2188.50	2230.40
	1998	1999	2000	2001	2002	2003	2004	2005
Kerosene, kt	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Diesel Oil, kt	3.00	3.00	4.00	3.00	2.00	3.00	2.00	3.00
Residual Fuel Oil, kt	188.92	99.00	42.00	39.00	30.00	20.00	18.00	16.00
Kerosene, kt	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Anthracite, kt	1.00	0.00	0.00	0.00	2.00	2.00	2.00	3.00
Coking Coal, kt	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Bituminous Coal, kt	198.42	7.00	0.00	0.00	2.00	3.00	4.00	2.00
Lignite, kt	2.00	1.00	1.00	0.00	0.00	0.00	0.00	0.00
Natural Gas, millions m^3	1983.33	1755.50	1581.80	1865.80	1490.50	1555.50	1596.50	1664.10
	2006	2007	2008	2009	2010	2011	2012	2013
Kerosene, kt	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00
Diesel Oil, kt	1.00	1.00	1.00	1.00	1.00	0.00	0.00	0.00
Residual Fuel Oil, kt	12.00	7.00	17.61	44.77	41.57	32.23	25.88	26.27
Kerosene, kt	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Anthracite, kt	2.00	2.00	3.00	4.00	3.00	2.00	3.00	11.00
Coking Coal, kt	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Bituminous Coal, kt	2.00	1.00	116.44	231.89	201.11	161.64	160.00	183.81
Lignite, kt	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Natural Gas, millions m^3	1285.10	1505.70	1550.20	1970.30	2086.50	1939.80	1953.90	1449.40

With reference to the activity data used to calculate GHG emissions from the source category 1A1 'Energy Industries' it is necessary to specify the following:

- for 1990-2010 time series, activity data were collected for both the right and the left bank of the Dniester River, which allowed to calculate the GHG emissions for the entire territory of the RM;
- activity data on fuel consumption for heat generation are not registered separately in the current statistical system in the RM, so that GHG emissions from this sub-category of sources were evaluated together with those from electricity generation (1A1 'Energy Industries');
- in the official sources of information at the moment there are not available disaggregated activity data on fuel consumption for heat generation on the left bank of the Dniester River;
- starting with 2013, the Energy Balances of the Republic of Moldova include a new type of fuel – biogas; biogas consumption is still insignificant (circa 36 TJ).

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 ±7.07 per cent, while those pertaining to EFs used to estimate CH_4 and N_2O emissions reach up to ±50.25 per cent. At the same time, combined uncertainties presented as a per cent of total direct GHG emissions within the Energy Sector were estimated at circa ±2.3949 per cent for CO_2 emissions, ±0.0071 per cent for CH_4 emissions and ±0.0224 per cent for N_2O emissions. Uncertainties introduced in trend in sectoral emissions were estimated at ±0.7326 per cent for CO_2 emissions, ±0.0018 per cent for CH_4 emissions, and ±0.0142 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 sustainable practices used for GHG emission inventory (IPCC, 2000).

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 (IPCC, 2000).

The 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. Following the recommendations included into the GPG (IPCC, 2000), GHG emissions were estimated using AD and CS NCVs available in the official sources of information.

3.2.5 Recalculations

GHG emissions under the 1A1 'Energy Industries' were recalculated for 1993 as a result of some data entry errors correction while for 2007 and 2010, due to the availability of an updated set of statistical data from the NBS.

In comparison with the results included into the TNC, the performed recalculations resulted in increased values of direct GHG emissions for 2007 and 2010, respectively in decreased values for 1993 (Table 3-30). The GHG emissions originated from 1A1 'Energy Industries' were estimated for the first time for the 2011-2013 time periods and the obtained result revealed that between 1990 and 2013, the respective emissions decreased by 82.9 per cent.

Table 3-30: Comparative Results of CO_2 Emissions Originated from 1A1 'Energy Industries' included in the TNC and the BUR of the RM under the UNFCCC, Gg CO_2 eq.

	1990	1991	1992	1993	1994	1995	1996	1997
TNC	19393.2858	17414.4185	13049.3384	11373.2009	10029.8177	6931.7635	7152.4697	5651.6191
BUR	19393.2858	17414.4185	13049.3384	11360.3417	10029.8177	6931.7635	7152.4697	5651.6191
Difference, %	0.0	0.0	0.0	-0.1	0.0	0.0	0.0	0.0
	1998	1999	2000	2001	2002	2003	2004	2005
TNC	4854.8011	3674.2878	3152.4214	3678.7653	2943.9751	3041.9389	3113.0195	3236.0698
BUR	4854.8011	3674.2878	3152.4214	3678.7653	2943.9751	3041.9389	3113.0195	3236.0698
Difference, %	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	2006	2007	2008	2009	2010	2011	2012	2013
TNC	2494.1332	2476.0860	3295.1211	4460.5118	4194.5671			
BUR	2494.1332	2895.5143	3295.1211	4460.5118	4595.0003	4185.5488	4190.7797	3313.9206
Difference, %	0.0	16.9	0.0	0.0	9.5			

Abbreviations: TNC – Third National Communication; BUR – 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 heat generation in the ATULBD are available, as well as a consequence of switching to a higher level methodology in order to estimate direct GHG emissions.

3.3 Manufacturing Industries and Construction (Category 1A2)

Manufacturing Industries and Construction sectors play a significant role in the national economy, contributing to the GDP with a share of 13.8 per cent and, respectively 3.4 per cent (NBS, 2014).

According to the data of the NBS the 'Manufacturing Industries and Construction' sectors provides jobs to 142, respectively 65 thousand persons, or 12.2, respectively 5.5 per cent of employed population of the country (NBS, 2014).

In 2013, 5089 enterprises and production units were active in the industrial sector, including 100 in 'Mining Industry', 4572 in 'Manufacturing Industries' and 417 in the 'Electricity and Heat, Gas and Water Supply' sector (NBS, 2014).

The 'Manufacturing Industries' of the Republic of Moldova include: Manufacture of Food Products (production, processing and preservation of meat, fruit and vegetables, milk products, grain mill products and starches, bread and bakery products, sugar, cocoa, chocolate and confectionery products) and Beverages (distilled spirits, wine, mineral water and soft drinks); Manufacture of Tobacco Products; Manufacture of Textiles; Manufacture of Wearing Apparel; Dressing and Dyeing Furs; Manufacture of Leather; Leather Products and Manufacture of Footwear; Manufacture of Wood and Wood Products; Manufacture of Paper and Paperboard; Publishing; Printing and Reproduction of Information Materials; Chemical Industry (manufacture of medicaments and pharmaceuticals products; manufacture of soaps, detergents, cleaning products, perfumes and cosmetics); Manufacture of Rubber and Plastic Products; Manufacture of Other Non-Metallic Mineral Products (glass and glassware, tiles and bricks in baked clay; articles of concrete, gypsum and cement); Metallurgical Industry; Manufacture of Fabricated Metal Products, Except Machinery and Equipment; Manufacture of Machinery and Equipment; Manufacture of Electrical Machinery and Apparatus; Manufacture of Medical Equipment, Precision and Optical Instruments; Manufacture of Furniture, etc.

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' Sector).

Between 1990 and 2013, the GHG emissions from category 1A2 'Manufacturing Industries and Construction' tended to decrease (Table 3-31).

Table 3-31: GHG Emissions from 1A2 'Manufacturing Industries and Construction' within 1990-2013 periods, Gg

	1990	1991	1992	1993	1994	1995	1996	1997
CO_2	2188.7285	1684.7939	962.3355	539.8762	807.8587	452.0136	360.0648	586.4696
CH_4	0.0953	0.0827	0.0403	0.0267	0.0224	0.0153	0.0131	0.0165
N_2O	0.0167	0.0140	0.0070	0.0043	0.0030	0.0022	0.0019	0.0022
NO_x	5.8887	4.6748	2.6619	1.4796	2.1880	1.2336	0.9864	1.5900
CO	1.4012	1.3740	0.4088	0.6719	0.5786	0.3226	0.2736	0.3945
NMVOC	0.1954	0.1698	0.0879	0.0576	0.0778	0.0455	0.0371	0.0569
SO_2	24.1072	19.1446	10.8429	5.0323	1.5249	1.3217	1.2002	0.9572
	1998	1999	2000	2001	2002	2003	2004	2005
CO_2	537.4686	495.3902	531.0553	616.9501	423.5694	450.9660	455.8446	591.0838
CH_4	0.0141	0.0118	0.0122	0.0153	0.0101	0.0106	0.0112	0.0137
N_2O	0.0018	0.0015	0.0015	0.0020	0.0012	0.0013	0.0014	0.0016
NO_x	1.4532	1.3352	1.4303	1.6795	1.1434	1.2142	1.2277	1.5904
CO	0.3393	0.2861	0.3089	0.3457	0.2553	0.2802	0.3231	0.3990
NMVOC	0.0518	0.0461	0.0494	0.0573	0.0401	0.0422	0.0430	0.0554
SO_2	0.8653	0.4769	0.4589	0.6479	0.3329	0.4528	0.5484	0.4599
	2006	2007	2008	2009	2010	2011	2012	2013
CO_2	650.9260	817.0164	910.8888	507.1516	539.2670	604.2945	561.7258	607.6708
CH_4	0.0140	0.0159	0.0348	0.0220	0.0232	0.0281	0.0236	0.0322
N_2O	0.0016	0.0018	0.0047	0.0030	0.0032	0.0039	0.0032	0.0046
NO_x	1.7463	2.1872	2.5335	1.4262	1.5124	1.6908	1.5715	1.7193
CO	0.3660	0.4318	0.6858	0.4126	0.5025	0.6462	0.6091	0.6476
NMVOC	0.0593	0.0730	0.1051	0.0622	0.0652	0.0764	0.0678	0.0822
SO_2	0.5159	0.3075	0.5308	0.2667	1.4850	2.2493	1.6522	2.7863

Compared to 1990, in 2013, the GHG emissions within the source category 1A2 'Manufacturing Industries and Construction' accounted for: CO_2 – 27.8 per cent, CH_4 – 33.8 per cent, N_2O – 27.3 per cent, NO_x – 29.2 per cent, CO – 46.2 per cent, NMVOC – 42.1 per cent, respectively SO_2 – 11.6 per cent of emissions registered during the reference year (Table 3-32).

Table 3-32: GHG Emissions from 1A2 'Manufacturing Industries and Construction' within 1990-2013 periods, where 1990 represents 100 per cent

	1990	1991	1992	1993	1994	1995	1996	1997
CO_2	100.0	77.0	44.0	24.7	36.9	20.7	16.5	26.8
CH_4	100.0	86.8	42.3	28.0	23.5	16.1	13.8	17.3
N_2O	100.0	84.3	41.8	26.1	17.9	13.2	11.6	13.1
NO_x	100.0	79.4	45.2	25.1	37.2	20.9	16.8	27.0
CO	100.0	98.1	29.2	48.0	41.3	23.0	19.5	28.2
NMVOC	100.0	86.9	45.0	29.5	39.8	23.3	19.0	29.1
SO_2	100.0	79.4	45.0	20.9	6.3	5.5	5.0	4.0
	1998	1999	2000	2001	2002	2003	2004	2005
CO_2	24.6	22.6	24.3	28.2	19.4	20.6	20.8	27.0
CH_4	14.8	12.4	12.9	16.1	10.6	11.1	11.7	14.4
N_2O	10.7	8.8	8.9	11.9	7.4	7.7	8.3	9.8
NO_x	24.7	22.7	24.3	28.5	19.4	20.6	20.8	27.0
CO	24.2	20.4	22.0	24.7	18.2	20.0	23.1	28.5
NMVOC	26.5	23.6	25.3	29.3	20.5	21.6	22.0	28.4
SO_2	3.6	2.0	1.9	2.7	1.4	1.9	2.3	1.9
	2006	2007	2008	2009	2010	2011	2012	2013
CO_2	29.7	37.3	41.6	23.2	24.6	27.6	25.7	27.8
CH_4	14.7	16.7	36.5	23.1	24.3	29.5	24.7	33.8
N_2O	9.8	10.5	28.1	18.2	19.2	23.4	19.2	27.3
NO_x	29.7	37.1	43.0	24.2	25.7	28.7	26.7	29.2
CO	26.1	30.8	48.9	29.4	35.9	46.1	43.5	46.2
NMVOC	30.4	37.3	53.8	31.8	33.4	39.1	34.7	42.1
SO_2	2.1	1.3	2.2	1.1	6.2	9.3	6.9	11.6

In 2013, the category 1A2 'Manufacturing Industries and Construction' accounted for 4.8 per cent of the total national direct GHG emissions (without LULUCF) being thus, an important source of GHG emissions.

Between 1990 and 2013, the GHG emissions from 1A2 'Manufacturing Industries and Construction' tended to reveal lower values, decreasing by circa 72.2 per cent: from 2195.89 to 609.76 Gg CO_2 eq. (Table 3-33).

Table 3-33: Direct GHG Emissions from 1A2 'Manufacturing Industries and Construction' in the Republic of Moldova within 1990-2013 periods, Gg CO_2 equivalent

		1990	1991	1992	1993	1994	1995	1996	1997
CO_2	GHG Emissions, Gg CO_2 equivalent	2188.7285	1684.7939	962.3355	539.8762	807.8587	452.0136	360.0648	586.4696
CH_4		2.0005	1.7361	0.8464	0.5604	0.4709	0.3212	0.2761	0.3461
N_2O		5.1641	4.3554	2.1564	1.3456	0.9232	0.6805	0.5967	0.6765
Total		**2195.8930**	**1690.8854**	**965.3383**	**541.7823**	**809.2528**	**453.0153**	**360.9377**	**587.4922**
CO_2	Share in the total GHG emissions, %	99.69	99.69	99.69	99.68	99.69	99.74	99.76	99.82
CH_4		0.05	0.05	0.05	0.05	0.04	0.04	0.04	0.04
N_2O		0.26	0.26	0.26	0.28	0.27	0.22	0.20	0.13
		1998	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**
CO_2	GHG Emissions, Gg CO_2 equivalent	537.4686	495.3902	531.0553	616.9501	423.5694	450.9660	455.8446	591.0838
CH_4		0.2954	0.2484	0.2571	0.3216	0.2128	0.2221	0.2344	0.2877
N_2O		0.5540	0.4569	0.4577	0.6163	0.3810	0.3966	0.4278	0.5065
Total		**538.3181**	**496.0956**	**531.7701**	**617.8880**	**424.1633**	**451.5848**	**456.5067**	**591.8781**
CO_2	Share in the total GHG emissions, %	99.84	99.88	99.90	99.90	99.89	99.89	99.89	99.89
CH_4		0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04
N_2O		0.12	0.07	0.06	0.06	0.07	0.07	0.07	0.07
		2006	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**
CO_2	GHG Emissions, Gg CO_2 equivalent	650.9260	817.0164	910.8888	507.1516	539.2670	604.2945	561.7258	607.6708
CH_4		0.2934	0.3338	0.7303	0.4626	0.4862	0.5908	0.4950	0.6760
N_2O		0.5062	0.5436	1.4521	0.9421	0.9933	1.2106	0.9941	1.4119
Total		**651.7256**	**817.8938**	**913.0712**	**508.5564**	**540.7465**	**606.0959**	**563.2148**	**609.7587**
CO_2	Share in the total GHG emissions, %	99.89	99.90	99.86	99.84	99.83	99.84	99.85	99.83
CH_4		0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04
N_2O		0.07	0.06	0.10	0.12	0.12	0.11	0.11	0.13

During 2002-2008, the Republic of Moldova registered an increase in industrial production, reflected in increased quantities of fuels used in this sector, namely a significant increase in direct GHG emissions within this source category. The 2009 economic crisis has affected most negatively the industrial production in the RM, GHG emissions decreasing by 44.3 per cent between 2008 and 2009 (Figure 3-7).

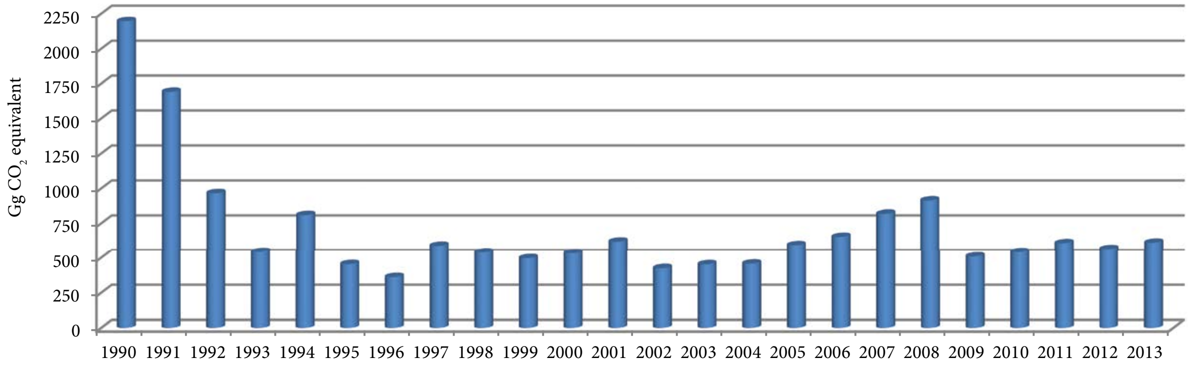

Figure 3-7: GHG Emissions from 1A2 'Manufacturing Industries and Construction' in the Republic of Moldova within 1990-2013 periods, Gg CO_2 equivalent

Compared to 1990, in 2013, the level of total direct GHG emissions within the source category 1A2 'Manufacturing Industries and Construction' represented only 27.8 per cent of the emission level registered in the reference year (Table 3-34).

Table 3-34: Direct GHG Emissions from 1A2 'Manufacturing Industries and Construction' within 1990-2013 periods, where 1990 represents 100 per cent

	1990	1991	1992	1993	1994	1995	1996	1997
CO_2	100.0	77.0	44.0	24.7	36.9	20.7	16.5	26.8
CH_4	100.0	86.8	42.3	28.0	23.5	16.1	13.8	17.3
N_2O	100.0	84.3	41.8	26.1	17.9	13.2	11.6	13.1
Total	100.0	77.0	44.0	24.7	36.9	20.6	16.4	26.8

	1998	1999	2000	2001	2002	2003	2004	2005
CO_2	24.6	22.6	24.3	28.2	19.4	20.6	20.8	27.0
CH_4	14.8	12.4	12.9	16.1	10.6	11.1	11.7	14.4
N_2O	10.7	8.8	8.9	11.9	7.4	7.7	8.3	9.8
Total	24.5	22.6	24.2	28.1	19.3	20.6	20.8	27.0
	2006	2007	2008	2009	2010	2011	2012	2013
CO_2	29.7	37.3	41.6	23.2	24.6	27.6	25.7	27.8
CH_4	14.7	16.7	36.5	23.1	24.3	29.5	24.7	33.8
N_2O	9.8	10.5	28.1	18.2	19.2	23.4	19.2	27.3
Total	29.7	37.2	41.6	23.2	24.6	27.6	25.6	27.8

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 using default emission factors. To assure the natural conversion from measure units to energy units, country specific net calorific values were used (see Table 3-11). The value used for carbon oxidation fraction is recommended by 2006 IPCC Guidelines (Table 3-35).

Table 3-35: 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, T C/TJ	Method	EF, kg/TJ	Method	EF, kg/TJ
1A2 Manufacturing Industries and Construction	T1	CS	1	D	T1	D	T1	D

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

Default EF available in the Revised 1996 IPCC Guidelines (IPCC, 1997) and 2006 IPCC Guidelines were used for estimating non-CO_2[20] emissions (Table 3-36).

Table 3-36: Emission Factors Used for Estimating non-CO_2 Emissions Originated from 1A2 'Manufacturing Industries and Construction', kg/TJ

GHG	Coal	Natural Gas	Oil Products	Fuel Wood	Other Biomass
CH_4	10	1	3	30	30
N_2O	1.5	0.1	0.6	4	4
NOx	300	150	200	100	100
CO	150	30	10	2 000	4 000
NMVOC	20	5	5	50	50

Source: NO_x, CO and NMVOC – *Revised 1996 IPCC Guidelines,* Vol. 3, Tab. 1-9, 1-10 and 1-11, pages 1.37-1.42; CH_4, N_2O – *2006 IPCC Guidelines*, Vol. 2, Ch. 2, Tab. 2.3, pages 2.18 – 2.19.

Activity Data

The AD related to fuel consumption with energy purposes within the 1A2 'Manufacturing Industries and Construction' (Table 3-37) include information from the following sources: (1) for the Right Bank of Dniester, data were collected from the Energy Balances for 1990, 1993-2013 generated by the NBS in MS-DOS, available on paper and since 2005, electronically; statistical collections of Energy Balances for 2007-2014, electronic publications available on <http://www.statistica.md/>; Official Letters from „Moldovagaz" J.S.C.21 as a response to the requests from the Climate Change Office of the MoEN; (2) for the Left Bank of Dniester, data were collected from the electronic editions of the publication Social-economic development „Materials and Energy Resources", with information regarding the amount of fuel used in the region.

Table 3-37: Fuel Consumption with Energy Purposes within the 1A2 'Manufacturing Industries and Construction' within 1990-2013 periods

	1990	1991	1992	1993	1994	1995	1996	1997
Gasoline, kt	13.00	8.10	1.00	0.60	1.00	1.00	1.00	1.00
Diesel Oil, kt	99.00	75.00	35.00	21.00	19.00	19.00	17.00	16.00
Kerosene, kt	15.00	0.00	0.00	4.60	1.00	0.00	0.00	0.00
Residual Fuel Oil, kt	350.00	261.00	155.50	65.70	13.00	11.00	10.00	7.00
LPG, kt	0.00	0.00	0.00	0.40	0.00	0.00	0.00	0.00
Anthracite, kt	42.00	42.00	0.00	4.00	0.00	1.00	1.00	1.00
Coking Coal, kt	39.00	33.00	24.00	16.80	12.00	13.00	14.00	12.00
Bituminous Coal, kt	0.00	0.00	0.00	8.30	8.00	4.00	2.00	2.00
Brown Coal, kt	1.00	1.00	0.00	2.90	2.00	1.00	0.00	0.00
Gaseous Coke, kt	0.00	32.00	25.00	0.00	0.00	0.00	0.00	0.00
Natural Gas, millions m^3	262.00	204.00	148.00	93.00	342.10	162.72	121.11	249.50

[20] The methodology used to estimate SO_2 emissions is described in Annex 3-1.1 of this Report.
[21] <http://www.moldovagaz.md/>.

	1998	1999	2000	2001	2002	2003	2004	2005
Gasoline, kt	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Diesel Oil, kt	8.00	11.00	8.00	8.00	7.00	6.00	7.00	7.00
Kerosene, kt	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Residual Fuel Oil, kt	7.00	3.00	3.00	4.00	1.00	4.00	5.00	4.00
LPG, kt	0.00	0.00	0.00	12.00	0.00	0.00	0.00	0.00
Anthracite, kt	3.00	1.00	1.00	1.00	1.00	1.00	5.00	6.00
Coking Coal, kt	9.00	7.00	6.00	8.00	7.00	5.00	2.00	0.00
Bituminous Coal, kt	1.00	0.00	1.00	1.00	0.00	0.00	0.00	2.00
Brown Coal, kt	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Gaseous Coke, kt	240.50	227.10	250.90	273.50	199.20	213.00	210.90	282.50
	2006	2007	2008	2009	2010	2011	2012	2013
Gasoline, kt	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Diesel Oil, kt	7.00	7.00	7.00	5.00	7.00	6.00	7.00	7.00
Kerosene, kt	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Residual Fuel Oil, kt	5.00	3.00	3.87	1.57	2.33	2. 31	1.26	1.37
LPG, kt	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.00
Anthracite, kt	6.00	3.00	9.00	3.00	10.00	72.00	5.00	86.00
Coking Coal, kt	0.00	0.00	0.00	2.00	4.00	0.00	1.00	0.00
Bituminous Coal, kt	0.00	0.00	75.07	54.15	42.11	0.11	47.08	7.03
Brown Coal, kt	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Gaseous Coke, kt	314.90	409.60	354.50	180.90	193.50	207.00	212.90	182.80

Source: Energy Balances of the RM for 1990, 1993-2013; State Statistical Service of the Transnistrian Moldovan Republic (2014), *Socio-economic development of the TMR, 2013 (final data). Chapter 4 "Material and Energy Resources", page 22.* / State Statistical Service of the Ministry of Economy of the TMR - Tiraspol, 2014 – 88p.; .; State Statistical Service of the Transnistrian Moldovan Republic (2013), *Socio-economic development of the TMR, 2012, Chapter 4 «Material and Energy Resources», page 23.* 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.; „Moldovagaz" J.S.C. through Official Letter No. 07-730 dated 6.6.2007, answer to Letter No. 47/21-103 dated 31.05.2007 from the MoEN; Letter No. 02/1-476 dated 23.02.2011, answer to Letter No. 03-07/175 dated 02.02.2011 from the MoEN; Letter No. 02/1-288 dated 22.01.2014, answer to Letter No. 320/2014-01-01 dated 03.01.2014 from the Climate Change Office; Letter No. 02/1-507 dated 10.02.2015, answer to Letter No. 407/2015-01-09 dated 29.01.2015 from the Climate Change Office.

From 1990 through 2013, the structure of Republic of Moldova's industries has changed significantly. The share of energy-intensive industries has reduced and the fuel consumption in the industry fell almost twice. We should note that some types of fuel (kerosene, liquefied petroleum gas, brown coal, gaseous coke) practically are no longer used.

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 can be considered relatively low (±5 per cent). Uncertainties related to GHG emissions from the 1A2 'Manufacturing Industries and Construction' were estimated at ±7.07 per cent for CO_2 emissions, and at ±50.25 per cent for CH_4 and N_2O emissions. At the same time, combined uncertainties, presented as a per cent of total sectoral emissions were estimated at ±0.4399 per cent for CO_2 emissions, circa ±0.0035 per cent for CH_4 emissions, and ±0.0072 per cent for N_2O. Uncertainties introduced in trend in sectoral GHG emissions were estimated at ±0.1229 per cent for CO_2 emissions, at ±0.0002 per cent for CH_4 emissions, and at ±0.0002 per cent for 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 GPG (IPCC, 2000).

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 (IPCC, 2000). 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. Following the recommendations included into the

GPG (IPCC, 2000), GHG emissions were estimated using AD and CS NCVs from official sources of information.

3.3.5 Recalculations

Due to the availability of an updated set of statistical data from the NBS, GHG emission recalculations were performed under the 1A2 'Manufacturing Industries and Construction' for 2010 year. In comparison with the results included into the TNC, the performed recalculations resulted in an insignificant increase of direct GHG emissions in respective year (Table 3-38).

Table 3-38: Comparative Results of GHG Emissions from 1A2 'Manufacturing Industries and Construction' included in the TNC and the BUR of the RM under the UNFCCC, Gg CO_2 eq.

	1990	1991	1992	1993	1994	1995	1996	1997
TNC	2195.8930	1690.8854	965.3383	541.7823	809.2528	453.0153	360.9377	587.4922
BUR	2195.8930	1690.8854	965.3383	541.7823	809.2528	453.0153	360.9377	587.4922
Difference, %	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	1998	1999	2000	2001	2002	2003	2004	2005
TNC	538.3181	496.0956	531.7701	617.8880	424.1633	451.5848	456.5067	591.8781
BUR	538.3181	496.0956	531.7701	617.8880	424.1633	451.5848	456.5067	591.8781
Difference, %	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	2006	2007	2008	2009	2010	2011	2012	2013
TNC	651.7256	817.8938	913.0712	508.5564	540.6841			
BUR	651.7256	817.8938	913.0712	508.5564	540.7465	606.0959	563.2148	609.7587
Difference, %	0.0000	0.0000	0.0000	0.0000	0.0115			

Abbreviations: TNC – Third National Communication; BUR – Biennial Update Report

For the 2011-2013 periods, the respective emissions were estimated for the first time. The results allow assert that between 1990 and 2013, GHG emissions from 1A2 'Manufacturing Industries and Construction' source category decreased by 72.2 per cent.

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.

3.4 Transport (Category 1A3)

Transport Sector plays a significant role in the national economy of the Republic of Moldova, its current contribution to the GDP being circa 10.1 per cent (NBS, 2014). In recent years, its share in the GDP has varied only marginally (between 10 and 12 per cent). According the NBS the Transport Sector provides jobs to 73 thousand persons or to 6.2 per cent of the employed population of the country (NBS, 2014).

3.4.1 Source Category Description

The 1A3 'Transport' category includes greenhouse gases generated by the following sources: 1A3a 'Civil Aviation', 1A3b 'Road Transportation', 1A3c 'Railways', 1A3d 'Navigation' and 1A3e 'Other' (Pipeline Transportation).

1A3a Civil Aviation

In recent years, the aircraft fleet of the Republic of Moldova significantly changed its structure. Before 2000, about 80% of flights were operated by aircrafts produced in CIS countries, by 2013 their share decreased to 60%. Most aircrafts used today are modern, with low GHG emissions, produced mainly in Western European countries. Table 3-39 presents information on the number of aircraft in use at the end of each year during 1996-2013.

Table 3-39: Air Transport Means Existing by the end of the year within 1996-2013 periods, units

	1996	1997	1998	1999	2000	2001	2002	2003	2004
Civil aircrafts for passenger transportation	40	40	32	20	26	21	19	19	20
Civil aircrafts for goods transportation	9	6	6	5	6	6	7	9	8
	2005	2006	2007	2008	2009	2010	2011	2012	2013
Civil aircrafts for passenger transportation	32	35	20	23	24	22	20	9	21
Civil aircrafts for goods transportation	7	16	3	3	4	3	4	2	2

Source: Statistical Yearbooks of the RM for 2004 (page 562), 2006 (page 407), 2008 (page 399), 2010 (page 399), 2012 (page 399), 2014 (page 399).

Previously, only GHG emissions from international air transport have been considered, while domestic civil air transport contribution was considered insignificant. In the last two inventory cycles, there were collected activity data on aviation gasoline consumption in domestic civil aviation for 2001-2013. GHG emissions from the source category 1A3a 'Civil Aviation' (Tables 3-40 and 3-41) were calculated using a Tier 1 approach (IPCC, 2006) and default EFs.

Table 3-40: GHG Emissions from 1A3a 'Civil Aviation' Source Category within 2001-2013, Gg

	2001	2002	2003	2004	2005	2006	2007
CO_2	0.0982	0.0850	0.6561	0.4134	0.1128	0.2203	0.1432
CH_4	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
N_2O	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
NO_x	0.0004	0.0003	0.0023	0.0015	0.0004	0.0008	0.0005
CO	0.0001	0.0001	0.0009	0.0006	0.0002	0.0003	0.0002
NMVOC	0.0001	0.0001	0.0005	0.0003	0.0001	0.0002	0.0001
	2008	2009	2010	2011	2012	2013	%
CO_2	0.1717	0.1142	0.1381	0.1208	0.2067	0.1966	100.2
CH_4	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	100.2
N_2O	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	100.2
NO_x	0.0006	0.0004	0.0005	0.0004	0.0007	0.0008	140.3
CO	0.0002	0.0002	0.0002	0.0002	0.0003	0.0003	100.2
NMVOC	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	100.2

Table 3-41: GHG Emissions from 1A3a 'Civil Aviation' within 2001-2013, Gg CO_2 equivalent

	2001	2002	2003	2004	2005	2006	2007
1A3a	0.0991	0.0857	0.6620	0.4171	0.1138	0.2223	0.1445
	2008	2009	2010	2011	2012	2013	%
1A3a	0.1733	0.1152	0.1393	0.1219	0.2086	0.1984	100.2

1A3b Road Transportation

In the Republic of Moldova road transportation is represented by a wide range of transport means: cars, buses and minibuses, trucks, special destination vehicles (ambulances, hook-and-ladder trucks, mobile cranes and other) (Table 3-42).

Table 3-42: Road Transportation Means Existent by the end of the year in the Republic of Moldova (RBDR – Right Bank of Dniester River) within 1990-2013 periods, units

	1990	1991	1992	1993	1994	1995	1996	1997
Trucks	74626	77941	61595	63235	62171	59888	57138	56924
Buses and Minibuses	10577	11226	8924	9101	9139	9181	9798	11169
Cars	156764	218059	166259	166440	169387	165941	173618	205973
Special Destination Vehicles	17627	19632	16155	15241	15228	14589	13668	12677
	1998	1999	2000	2001	2002	2003	2004	2005
Trucks	57404	52430	46351	45809	46277	46905	73774	81798
Buses and Minibuses	12917	13582	12769	14703	15777	15723	19741	19825
Cars	222769	232278	238380	256459	268882	265841	269551	292994
Special Destination Vehicles	11860	10305	8979	8497	8061	7555	7521	7497
	2006	2007	2008	2009	2010	2011	2012	2013
Trucks	84087	94828	115967	120174	131243	141696	151830	154163
Buses and Minibuses	21056	21095	21491	21346	21395	21349	21433	21344
Cars	319311	338944	366351	386365	404290	426973	456379	487418
Special Destination Vehicles	7194	6942	6699	6465	6238	6020	5809	5606

Source: Statistical Yearbooks for 1994 (page 325), 1999 (page 390), 2006 (page 407), 2008 (page 399), 2010 (page 399), 2012 (page 402), 2014 (page 399).

During the period under review, the number of special destination vehicles decreased significantly, by 68.2 per cent, while the number of cars increased by 210.9 per cent, trucks – by 106.6 per cent, buses and minibuses – by 101.8 per cent.

The main types of fuels consumed by road transportation are Gasoline, Diesel Oil, LPG – Liquefied Petroleum Gases and LNG – Liquefied Natural Gases.

The activity data used for estimating GHG emissions from road transportation were collected from the NBS as well as from MTRI of the Republic of Moldova.

By the end of 2013, the length of communication lines in exploitation represented, on the right bank of Dniester River, approximately 9.35 thousand km (Table 3-43).

Table 3-43: Length and Density of Road Communication Lines by the end of the year in the Republic of Moldova (RBDR) per 1000 km² within 1996-2013 periods

	1996	1997	1998	1999	2000	2001	2002	2003	2004
Public Roads – total, km	9388	9403	9402	9401	9378	9433	9461	9462	9464
With hard surface, km	8929	8920	8919	8918	8780	8835	8877	8878	8880
National Roads, km	2817	2816	2814	2813	2812	3328	3324	3325	3326
Local Roads, km	6571	6587	6587	6587	6566	6105	6137	6137	6138
Density of Public Roads, km/1000 km²	309.4	309.9	309.9	308.4	307.7	309.5	310.4	310.4	310.4
With hard surface, km/1000 km²	294.2	293.9	294	292.6	288.1	289.9	291.2	291.3	291.3
	2005	2006	2007	2008	2009	2010	2011	2012	2013
Public Roads – total, km	9467	9467	9337	9343	9344	9344	9352	9352	9352
With hard surface, km	8883	8887	8791	8810	8811	8811	8827	8835	8836
National Roads, km	3329	3329	3329	3335	3336	3336	3336	3336	3336
Local Roads, km	6138	6138	6008	6008	6008	6008	6016	6016	6016
Density of Public Roads, km/1000 km²	310.6	310.6	306.3	306.5	306.5	306.5	306.8	306.8	306.8
With hard surface, km/1000 km²	291.4	291.5	288.4	289.0	289.0	289.0	289.6	289.8	289.9

Source: Statistical Yearbooks of the RM for 2003 (page 500), 2006 (page 405), 2012 (page 400), 2014 (page 397).

Between 1990 and 2013, on the Left Bank of Dniester River (LBDR) a clear decreasing trend was registered regarding the number of transportation units for most of the vehicles categories (trucks – 83.6 per cent, special destination vehicles – 65.0 per cent, buses – 38.5 per cent), with the exception of private cars, which number increased by 142.6 per cent (Table 3-44).

Table 3-44: Road Transportation Means Existent by the end of the year in the Republic of Moldova (LBDR – Left Bank of Dniester River) within 1990-2013 periods, units

	1990	1995	1996	1997	1998	1999	2000	2001	2002	2003
Trucks	2283	1545	1459	1282	1154	1009	1149.5	1290	1165	968
Buses	728	516	484	454	428	423	407	391	355	346
Service Cars and Taxi Cabs	1635	1261	1265	1267	1257	1374	1365	1356	1343	1311
Cars	50585	65664	70632	81865	82799	89612	89685	89759	90263	89600
Special Destination Vehicles	2701	2666	2646	2304	2216	2150	2045	1940	1857	1756
	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
Trucks	910	747	595	759	837	465	342	319	415	374
Buses	322	298	280	577	571	593	578	570	552	448
Service Cars and Taxi Cabs	1336	1254	1270	1308	1403	1615	1617	1573	1682	1651
Cars	88361	91786	93734	101739	103172	104501	106479	108599	116586	122743
Special Destination Vehicles	1537	1454	1316	1244	1284	1166	1135	1078	938	946

Source: Statistical Yearbooks of the ATULBD for 2000 (page 127), 2006 (page 121), 2009 (page 119), 2010 (page 123), 2012 (page 128), 2014 (page 117).

On the Left Bank of Dniester River the length of communication lines in exploitation by the end of 2013 represented approximately 1.47 thousand km with a public roads density of 354.3 km per 1000 km² (Table 3-45).

Table 3-45: Length and Density of Road Communication Lines by the end of the year in the Republic of Moldova (LBDR) per 1000 km² within 1996-2013 periods

	1996	1997	1998	1999	2000	2001	2002	2003	2004
Public Roads – total, km	1277	1277	1277	1277	1277	1278	1278	1278	1279
With hard surface, km	1223	1223	1223	1223	1223	1224	1224	1224	1225
Density of Public Roads, km/1000 km²	307.0	307.0	307.0	307.0	307.0	307.2	307.2	307.2	307.5
With hard surface, km/1000 km²	294.0	294.0	294.0	294.0	294.0	294.2	294.2	294.2	294.5
	2005	2006	2007	2008	2009	2010	2011	2012	2013
Public Roads – total, km	1279	1279	1278	1278	1473	1474	1474	1474	1474
With hard surface, km	1225	1225	1224	1224	1423	1428	1430	1430	1430
Density of Public Roads, km/1000 km²	307.5	307.5	307.2	307.2	354.1	354.3	354.3	354.3	354.3
With hard surface, km/1000 km²	294.5	294.5	294.2	294.2	342.1	343.3	343.8	343.8	343.8

Source: Statistical Yearbooks of the ATULBD for 2000 (page 127), 2006 (page 121), 2009 (page 119), 2010 (page 123), 2012 (page 128), 2014 (page 117).

Table 3-46 presents summary information for the entire territory of the Republic of Moldova regarding the number of road transportation vehicles by the end of the year.

Table 3-46: Total Road Transportation Means in the Republic of Moldova by the end of the year, within 1990-2013 periods, units

	1990	1991	1992	1993	1994	1995	1996	1997
Trucks	76909	77941	61595	63235	62171	61433	58597	58206
Buses and Minibuses	11305	11226	8924	9101	9139	9697	10282	11623
Cars	208984	218059	166259	166440	169387	232866	245515	289105
Special Destination Vehicles	20328	19632	16155	15241	15228	17255	16314	14981

	1998	1999	2000	2001	2002	2003	2004	2005
Trucks	58558	53439	47501	47099	47442	47873	74684	82545
Buses and Minibuses	13345	14005	13176	15094	16132	16069	20063	20123
Cars	306825	323264	329431	347574	360488	356752	359248	386034
Special Destination Vehicles	14076	12455	11024	10437	9918	9311	9058	8951
	2006	2007	2008	2009	2010	2011	2012	2013
Trucks	84682	95587	116804	120639	131585	142015	152245	154537
Buses and Minibuses	21336	21672	22062	21939	21973	21919	21985	21792
Cars	414315	441991	470926	492481	512386	537145	574647	611812
Special Destination Vehicles	8510	8186	7983	7631	7373	7098	6747	6552

This information highlights that during 1990-2013, the number of transportation units in the RM tended to increase. Compared with 1990, by 2013, the total number of transportation units increased by approximately 150.3 per cent (by 157.5 per cent on the RBDR, and by 117.8 per cent on the LBDR).

In 2013, about 84.1 per cent of the total number of the vehicles was registered on the RBDR, and 15.9 per cent respectively, on the LBDR (Table 3-47).

Table 3-47: Road Transportation Means in the Republic of Moldova by the end of the year within 1990-2013 periods, units

	1990	1995	1996	1997	1998	1999	2000	2001	2002	2003
Total in the RM, units	317526	321251	330708	373915	392804	403163	401131	420204	433980	430005
RBDR, units	259594	249599	254222	286743	304950	308595	306479	325468	338997	336024
LBDR, units	57932	71652	76486	87172	87854	94568	94652	94736	94983	93981
RBDR, % of total	81.8	77.7	76.9	76.7	77.6	76.5	76.4	77.5	78.1	78.1
LBDR, % of total	18.2	22.3	23.1	23.3	22.4	23.5	23.6	22.5	21.9	21.9
	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
Total in the RM, units	463053	497653	528843	567436	617775	642690	673317	708177	755624	794693
RBDR, units	370587	402114	431648	461809	510508	534350	563166	596038	635451	668531
LBDR, units	92466	95539	97195	105627	107267	108340	110151	112139	120173	126162
RBDR, % of total	80.0	80.8	81.6	81.4	82.6	83.1	83.6	84.2	84.1	84.1
LBDR, % of total	20.0	19.2	18.4	18.6	17.4	16.9	16.4	15.8	15.9	15.9

From 1990 to 2013, the share of trucks, buses and minibuses as well as special destination vehicles decreased, while the share of cars increased (Table 3-48).

Table 3-48: The Structure of Rolling Stock registered in the Republic of Moldova, as share of total number of road transportation means within 1990-2013 periods, % from total

	1990	1991	1992	1993	1994	1995	1996	1997
Trucks	24.2	23.8	24.4	24.9	24.3	19.1	17.7	15.6
Buses and minibuses	3.6	3.4	3.5	3.6	3.6	3.0	3.1	3.1
Cars	65.8	66.7	65.7	65.5	66.2	72.5	74.2	77.3
Special Destination Vehicles	6.4	6.0	6.4	6.0	6.0	5.4	4.9	4.0
	1998	1999	2000	2001	2002	2003	2004	2005
Trucks	14.9	13.3	11.8	11.2	10.9	11.1	16.1	16.6
Buses and minibuses	3.4	3.5	3.3	3.6	3.7	3.7	4.3	4.0
Cars	78.1	80.2	82.1	82.7	83.1	83.0	77.6	77.6
Special Destination Vehicles	3.6	3.1	2.7	2.5	2.3	2.2	2.0	1.8
	2006	2007	2008	2009	2010	2011	2012	2013
Trucks	16.0	16.8	18.9	18.8	19.5	20.1	20.1	19.4
Buses and minibuses	4.0	3.8	3.6	3.4	3.3	3.1	2.9	2.7
Cars	78.3	77.9	76.2	76.6	76.1	75.8	76.0	77.0
Special Destination Vehicles	1.6	1.4	1.3	1.2	1.1	1.0	0.9	0.8

GHG emissions from vehicles equipped with catalytic converters could not be estimated due to lack of information on the number of vehicles with such equipment.

1A3c Railways

By the end of 2013, the length of railways of general use in the RM (total) represented about 1.271 thousand km (Table 3-49).

Table 3-49: Length (km) and Density (km per 1000 km^2) of Railways by the end of the year in the Republic of Moldova within 1990-2013 periods

		1990	1991	1992	1993	1994	1995	1996	1997
Railways, km	RBDR	977	977	977	977	977	977	977	967
	LBDR	173	173	173	173	173	173	173	173
Railways density, km per 1000 km^2	RBDR	33.0	32.9	32.9	32.9	32.9	32.9	32.9	32.6
	LBDR	41.6	41.6	41.6	41.6	41.6	41.6	41.6	41.6
		1998	1999	2000	2001	2002	2003	2004	2005
Railways, km	RBDR	964	967	999	981	980	971	970	1034
	LBDR	173	173	140	140	140	140	105	105
Railways density, km per 1000 km^2	RBDR	32.5	32.6	33.7	33.1	33.0	32.7	32.7	34.8
	LBDR	41.6	41.6	33.6	33.6	33.6	33.6	25.2	25.2

		2006	2007	2008	2009	2010	2011	2012	2013
Railways, km	RBDR	1049	1049	1043	1043	1043	1043	1043	1043
	LBDR	105	105	114	114	114	114	114	114
Railways density, km per 1000 km²	RBDR	35.3	35.3	35.1	35.1	35.1	35.1	35.1	35.1
	LBDR	25.2	25.2	27.4	27.4	27.4	27.4	27.4	27.4

Source: Statistical Yearbooks of the RM for 1994 (page 319), 1999 (page 382), 2006 (page 405), 2012 (page 400) and 2014 (page 397); Statistical Yearbooks of the ATULBD for 2000 (page 127), 2006 (page 121), 2009 (page 119), 2010 (page 123), 2012 (page 128), 2014 (page 117)

The railway transport in the RM is assured by Diesel Locomotives (400-4000 kW), Maneuvering Locomotives (200-2000 kW), Diesel Trains, Cargo and Passenger Trains (Table 3-50).

Table 3-50: Railway Transport Means Existent by the end of the year in the RM within 1990-2013 periods, units

	1990	1995	1996	1997	1998	1999	2000
Diesel Locomotives	324	113	103	97	82	78	76
Maneuvering Locomotives	139	114	100	75	72	50	42
Diesel Trains (Sections)	44	29	28	26	26	24	22
Cargo Wagons	14960	14097	13316	12838	12233	11010	10577
Passenger Coaches	486	482	480	470	458	461	460
	2001	2002	2003	2004	2005	2006	2007
Diesel Locomotives	78	89	100	95	100	100	100
Maneuvering Locomotives	44	48	54	50	56	56	56
Diesel Trains (Sections)	22	22	22	18	20	20	20
Cargo Wagons	10033	9303	8723	8492	8318	8177	7940
Passenger Coaches	440	460	452	452	440	436	416
	2008	2009	2010	2011	2012	2013	2014
Diesel Locomotives	90	57	57	150	139	138	138
Maneuvering Locomotives	53	39	39	67	67	67	67
Diesel Trains (Sections)	18	15	15	21	21	21	21
Cargo Wagons	7921	7919	7835	7606	7433	7435	6866
Passenger Coaches	398	990	413	399	399	388	381

Source: Official Letters from "Moldavian Railways" State Enterprise" dated 26.03.1999, No. 94/T, dated 17.12.2003, No. H-4/993 and dated 19.09.2006, No. Nteh /338; Letter dated 28.02.2011, No. 54/Nteh, answer to Letter No. 03-07/175 dated 02.02.2011; Letter dated 17.01.2014, No. H-4/147, answer to Letter No. 02/9-6-206 dated 03.01.2014; Letter dated 02.03.2015, No. H-4/458, answer to Letter No. 407/2015-01-09 dated 29.01.2015.

During 1990-2014, the rolling stock has decreased significantly: Diesel Locomotives (by 57.4 per cent); Maneuvering Locomotives (by 51.8 per cent); Diesel Trains (by 52.3 per cent); Cargo Wagons (by 54.1 per cent) and Passenger Coaches (by 21.6 per cent).

The main type of fuel used in railways is Diesel Oil. Other types of fuels, such as: Coal, Residual Fuel Oil, Gasoline, Natural Gas and Lubricants are also used for auxiliary needs (GHG emissions from the use of these types of fuels are included in 1A5 'Other' Source Category).

The data used for estimating GHG emissions from railway transport were collected from the NBS (AD are available in the Energy Balances and Statistical Yearbooks of the RM), as well as directly from the "Moldavian Railways" State Owned Enterprise (SOE).

1A3d Navigation

The current length of navigable waterways of public use in the RM is around 624 km (which includes 558 km on the RBDR and 66 km on the LBDR). The number of river transport means used in the RM (both on the RBDR and LBDR) for both passenger and cargo transportation on Danube, Dniester and Prut, especially in the warm season, is relatively small (Table 3-51 and 3-52).

Table 3-51: River Transport Means Existent by the end of the year on the Right Bank of Dniester River within 1990-2013 periods, units

	1990	1991	1992	1993	1994	1995	1996	1997
Goods Self-Propelled Ships	14	9	5	5	5	5	5	4
Goods Non-Self-Propelled Ships	72	67	67	67	20	20	15	15
Towboats, Stamps & Stamp-Towboats	49	48	47	47	12	12	11	11
Passenger Self-Propelled Ships	36	37	32	32	3	3	3	4
	1998	1999	2000	2001	2002	2003	2004	2005
Goods Self-Propelled Ships	4	3	-	-	-	-	-	-
Goods Non-Self-Propelled Ships	15	15	15	15	15	15	15	15
Towboats, Stamps & Stamp-Towboats	11	11	11	10	10	10	10	10
Passenger Self-Propelled Ships	3	3	3	3	3	3	3	3
	2006	2007	2008	2009	2010	2011	2012	2013
Goods Self-Propelled Ships	-	-	-	-	-	-	-	-
Goods Non-Self-Propelled Ships	13	12	9	9	9	9	9	9
Towboats, Stamps & Stamp-Towboats	8	8	8	8	8	8	8	8
Passenger Self-Propelled Ships	2	1	1	1	1	1	1	1

Source: Statistical Yearbooks of the RM for 1993 (page 330), 1994 (page 325), 1999 (page 390), 2006 (page 407), 2008 (page 399), 2010 (page 399), 2012 (page 402) and 2014 (page 399).

Table 3-52: River Transport Means Existent by the end of the year on the Left Bank of Dniester River within 1990-2013 periods, units

	1990	1991	1992	1993	1994	1995	1996	1997
Goods Ships including Towboats, Stamps & Stamp-Towboats	73	71	69	67	65	63	59	59
Passenger Ships	33	32	31	30	29	28	25	25
	1998	1999	2000	2001	2002	2003	2004	2005
Goods Ships including Towboats, Stamps & Stamp-Towboats	58	57	54	52	52	52	52	50
Passenger Ships	25	25	24	23	23	23	23	14
	2006	2007	2008	2009	2010	2011	2012	2013
Goods Ships including Towboats, Stamps & Stamp-Towboats	45	42	42	42	42	42	42	41
Passenger Ships	8	8	8	8	8	8	9	9

Source: Statistical Yearbooks of the ATULBD for 2000 (page 128), 2006 (page 121), 2009 (page 119), 2011 (page 124), 2012 (page 128), 2014 (page 128).

The main type of fuel used by river transport means in the Republic of Moldova is Diesel Oil. For inventory purposes - estimation of GHG emissions originated from the navigation in the Republic of Moldova, activity data provided by the Ministry of Transport and Road Infrastructure (for 1993-2013) and the Energy Balances of the Republic of Moldova for 1990 were used.

1A3e Pipeline Transportation

The Republic of Moldova has a developed natural gas transportation and distribution network (Table 3-53).

Table 3-53: Natural Gas Transportation and Distribution Networks in the Republic of Moldova (situation as of 01.01.2006, 01.01.2011 and 01.01.2015)

Type of Networks	Pipelines diameter (mm)	Pressure (kg f/cm²)	Year of construction	Pipelines Length (km), as of 01.01.2006	Pipelines Length (km), as of 01.01.2011	Pipelines Length (km), as of 01.01.2015	2006-2015, %
Main Gas Pipelines	530-1220	55-75	1966-2007	593.57	656.24	656.24	+10.6%
Connected Gas Pipelines	Up to 530	55	1966-2011	714.09	818.20	903.33	+26.5%
Natural Gas Distribution Networks	Up to 700	0.05-12	1966-2014	12259.05	19502.59	21531.30	+75.6%

Source: „Moldovagaz" J.S.C., through Letter No. 06-1253 dated 27.09.2006, answer to Letter No. 01-07/1400 dated 25.08.2006 from the Ministry of Environment; Letter No. 02/1-476 dated 23.02.2011, answer to Letter No. 03-07/175 dated 02.02.2011 from the Ministry of Environment; Letter No. 02/1-288 dated 22.01.2014, answer to Letter No. 320/2014-01-01 dated 03.01.2014 from the Climate Change Office; Letter No. 02/1-507 dated 10.02.2015, answer to Letter No. 407/2015-01-09 dated 29.01.2015 from the Climate Change Office.

In the Republic of Moldova, the natural gas distribution networks are expanded at relatively high annual rate, in particular between 2004 and 2010 (Table 3-54).

Table 3-54: Implementation of Production Capacities - Natural Gas Pipes in the Republic of Moldova within 1995-2013 periods

	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
Implementation of production capacities - gas pipes, km/year	373.15	230.97	253.04	207.16	146.47	159.60	143.90	87.63	195.76	509.20
	2005	2006	2007	2008	2009	2010	2011	2012	2013	%
Implementation of production capacities - gas pipes, km/year	355.30	516.40	741.30	926.60	745.70	520.20	321.20	199.70	101.60	-72.8

Source: Statistical Yearbooks of the RM for 1999 (page 367), 2003 (page 478), 2006 (page 382), 2012 (page 378) and 2014 (page 376)

Only a small portion of the natural gases delivered towards the Republic of Moldova are consumed locally, including in the ATULBD, the largest part being transited towards the Balkans countries (Table 3-55). The main source of reference for AD used in the current inventory cycle is „Moldovagaz" J.S.C., as well as the Energy Balances of the Republic of Moldova.

Table 3-55: Amount of Natural Gas Transited towards the Balkans and Sold in the Republic of Moldova within 1990-2013 periods

	1990	1991	1992	1993	1994	1995	1996	1997
Natural gas transited across the RM, billion m³	25.000	23.000	21.000	19.000	18.265	20.909	22.396	16.934
Natural gas sold in the RM, million m³	3814.0	3843.0	3377.0	2960.0	2861.0	2791.0	3222.0	3492.0
	1998	1999	2000	2001	2002	2003	2004	2005
Natural gas transited across the RM, billion m³	16.021	17.142	19.365	18.625	21.332	22.132	23.873	25.313
Natural gas sold in the RM, million m³	3169.0	2685.3	2320.2	2628.0	2231.6	2405.4	2565.7	2715.6
	2006	2007	2008	2009	2010	2011	2012	2013
Natural gas transited across the RM, billion m³	22.339	23.693	23.290	17.891	17.034	19.890	19.620	19.651
Natural gas sold in the RM, million m³	2376.2	2489.9	2505.0	2775.0	2970.9	3099.5	3078.1	2386.0

Source: „Moldovagaz" J.S.C. through Letter No. 06-1253 dated 27.09.2006, answer to Letter No. 01-07/1400 dated 25.08.2006 from the Ministry of Environment; Letter No. 02/1-476 dated 23.02.2011, answer to Letter No. 03-07/175 dated 02.02.2011 from the Ministry of Environment; Letter No. 02/1-288 dated 22.01.2014, answer to Letter No. 320/2014-01-01 dated 03.01.2014 from the Climate Change Office; Letter No. 02/1-507 dated 10.02.2015, answer to Letter No. 407/2015-01-09 dated 29.01.2015 from the Climate Change Office.

GHG Emissions Trend within 1A3 'Transport' Source Category

In 1990-2013 periods, the total GHG emissions from the 1A3 'Transport' have significantly decreased (Table 3-56).

Table 3-56: GHG Emissions from 1A3 'Transport' in the Republic of Moldova within 1990-2013 periods, Gg

	1990	1991	1992	1993	1994	1995	1996	1997
CO_2	3926.6606	3548.3245	1983.1429	1463.2667	1271.1186	1297.6775	1267.6092	1292.0143
CH_4	1.2119	1.1143	0.5576	0.3617	0.3311	0.3473	0.3302	0.3751
N_2O	0.3371	0.2976	0.1844	0.1391	0.1274	0.1077	0.1010	0.1025
NO_x	38.9861	34.9355	20.0606	15.2657	12.5564	12.4668	11.7816	12.5360
CO	294.3999	270.8410	131.9720	88.2204	80.5874	84.5649	80.4356	91.3353
NMVOC	55.4240	50.9779	24.8817	16.6396	15.1833	15.9296	15.1429	17.1833
SO_2	4.3700	3.9274	2.4029	1.8949	1.4527	1.4669	1.3726	1.4286
	1998	1999	2000	2001	2002	2003	2004	2005
CO_2	1126.3239	770.1737	838.3532	892.9560	1132.2331	1413.6200	1581.1835	1612.7510
CH_4	0.3203	0.1903	0.1924	0.2068	0.2666	0.3257	0.3916	0.3649
N_2O	0.0919	0.0581	0.0680	0.0748	0.0933	0.1139	0.1147	0.1172
NO_x	10.9565	7.3429	8.4152	9.1675	11.4486	14.4757	15.9045	16.2364
CO	78.0073	46.4687	47.0637	50.5723	65.1431	79.5794	86.5728	89.1903
NMVOC	14.6741	8.7438	8.8676	9.5319	12.2797	15.0205	16.3519	16.8446
SO_2	1.2511	0.8862	1.0574	1.1545	1.4349	1.8835	2.1130	2.1507
	2006	2007	2008	2009	2010	2011	2012	2013
CO_2	1535.8525	1606.1891	1696.5716	1619.4923	1861.9021	1973.8665	1723.5767	1835.2651
CH_4	0.3392	0.3506	0.3668	0.3621	0.3673	0.3807	0.3228	0.3203
N_2O	0.1262	0.1220	0.1234	0.1033	0.1164	0.1238	0.1066	0.1135
NO_x	16.0388	16.6547	17.5305	16.3804	19.1324	20.3403	17.7956	18.9230
CO	82.8139	85.6515	89.6832	88.5445	89.9024	93.2318	79.1029	78.5783
NMVOC	15.6779	16.2163	16.9720	16.7396	17.0587	17.6990	15.0256	14.9469
SO_2	2.1698	2.2855	2.4258	2.2617	2.8018	2.9835	2.6512	2.8612

Compared to the reference year, by 2013, GHG emissions from 1A3 'Transport' source category represented: CO_2 - circa 46.7 per cent, CH_4 – 26.4 per cent, N_2O – 33.7 per cent, NO_x – 48.5 per cent, CO – 26.7 per cent, NMVOC – 27.0 per cent and SO_2 – 65.5 per cent of the total national GHG emissions from 1990 (Table 3-57).

In 2013, the 'Transport' sub-sector accounted for 14.6 per cent of the total national direct GHG emissions (without LULUCF), being an important source of direct GHG emissions. To be noted that the 1A3 'Transport' source category also represented a relevant source of N_2O emissions, accounting for 2.2 per cent of the total national N_2O emissions.

Table 3-57: GHG Emissions from the Category 1A3 'Transport' by Source in the Republic of Moldova within 1990-2013, where 1990 represents 100 %

	1990	1991	1992	1993	1994	1995	1996	1997
CO_2	100.0	90.4	50.5	37.3	32.4	33.0	32.3	32.9
CH_4	100.0	91.9	46.0	29.8	27.3	28.7	27.2	31.0
N_2O	100.0	88.3	54.7	41.3	37.8	32.0	30.0	30.4
NO_x	100.0	89.6	51.5	39.2	32.2	32.0	30.2	32.2
CO	100.0	92.0	44.8	30.0	27.4	28.7	27.3	31.0
NMVOC	100.0	92.0	44.9	30.0	27.4	28.7	27.3	31.0
SO_2	100.0	89.9	55.0	43.4	33.2	33.6	31.4	32.7
	1998	1999	2000	2001	2002	2003	2004	2005
CO_2	28.7	19.6	21.4	22.7	28.8	36.0	40.3	41.1
CH_4	26.4	15.7	15.9	17.1	22.0	26.9	32.3	30.1
N_2O	27.3	17.2	20.2	22.2	27.7	33.8	34.0	34.8
NO_x	28.1	18.8	21.6	23.5	29.4	37.1	40.8	41.6
CO	26.5	15.8	16.0	17.2	22.1	27.0	29.4	30.3
NMVOC	26.5	15.8	16.0	17.2	22.2	27.1	29.5	30.4
SO_2	28.6	20.3	24.2	26.4	32.8	43.1	48.4	49.2
	2006	2007	2008	2009	2010	2011	2012	2013
CO_2	39.1	40.9	43.2	41.2	47.4	50.3	43.9	46.7
CH_4	28.0	28.9	30.3	29.9	30.3	31.4	26.6	26.4
N_2O	37.4	36.2	36.6	30.6	34.5	36.7	31.6	33.7
NO_x	41.1	42.7	45.0	42.0	49.1	52.2	45.6	48.5
CO	28.1	29.1	30.5	30.1	30.5	31.7	26.9	26.7
NMVOC	28.3	29.3	30.6	30.2	30.8	31.9	27.1	27.0
SO_2	49.7	52.3	55.5	51.8	64.1	68.3	60.7	65.5

Between 1990 and 2013, the total direct GHG emissions from the 1A3 'Transport' decreased by 53.7 per cent: from 4056.61 to 1877.18 Gg CO_2 equivalent (Table 3-58, Figure 3-8).

Table 3-58: Direct GHG Emissions from 1A3 'Transport' in the Republic of Moldova within 1990-2013 periods, Gg CO_2 equivalent

		1990	1991	1992	1993	1994	1995	1996	1997
CO_2	GHG Emissions, Gg CO_2 equivalent	3926.6606	3548.3245	1983.1429	1463.2667	1271.1186	1297.6775	1267.6092	1292.0143
CH_4		25.4493	23.3994	11.7093	7.5950	6.9530	7.2939	6.9348	7.8773
N_2O		104.5052	92.2609	57.1770	43.1308	39.5072	33.3982	31.3149	31.7708
Total		**4056.6151**	**3663.9848**	**2052.0292**	**1513.9925**	**1317.5788**	**1338.3695**	**1305.8589**	**1331.6625**
CO_2	Share in the total GHG emissions, %	96.80	96.84	96.64	96.65	96.47	96.96	97.07	97.02
CH_4		0.63	0.64	0.57	0.50	0.53	0.54	0.53	0.59
N_2O		2.58	2.52	2.79	2.85	3.00	2.50	2.40	2.39
		1998	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**
CO_2	GHG Emissions, Gg CO_2 equivalent	1126.3239	770.1737	838.3532	892.9560	1132.2331	1413.6200	1581.1835	1612.7510
CH_4		6.7253	3.9963	4.0410	4.3425	5.5986	6.8390	8.2228	7.6638
N_2O		28.4894	18.0233	21.0714	23.2002	28.9191	35.3067	35.5435	36.3222
Total		**1161.5385**	**792.1933**	**863.4656**	**920.4987**	**1166.7509**	**1455.7657**	**1624.9498**	**1656.7370**
CO_2	Share in the total GHG emissions, %	96.97	97.22	97.09	97.01	97.04	97.10	97.31	97.35
CH_4		0.58	0.50	0.47	0.47	0.48	0.47	0.51	0.46
N_2O		2.45	2.28	2.44	2.52	2.48	2.43	2.19	2.19
		2006	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**
CO_2	GHG Emissions, Gg CO_2 equivalent	1535.8525	1606.1891	1696.5716	1619.4923	1861.9021	1973.8665	1723.5767	1835.2651
CH_4		7.1236	7.3633	7.7035	7.6048	7.7123	7.9950	6.7793	6.7267
N_2O		39.1305	37.8111	38.2506	32.0121	36.0895	38.3797	33.0536	35.1848
Total		**1582.1066**	**1651.3635**	**1742.5257**	**1659.1092**	**1905.7039**	**2020.2412**	**1763.4096**	**1877.1767**
CO_2	Share in the total GHG emissions, %	97.08	97.26	97.36	97.61	97.70	97.70	97.74	97.77
CH_4		0.45	0.45	0.44	0.46	0.40	0.40	0.38	0.36
N_2O		2.47	2.29	2.20	1.93	1.89	1.90	1.87	1.87

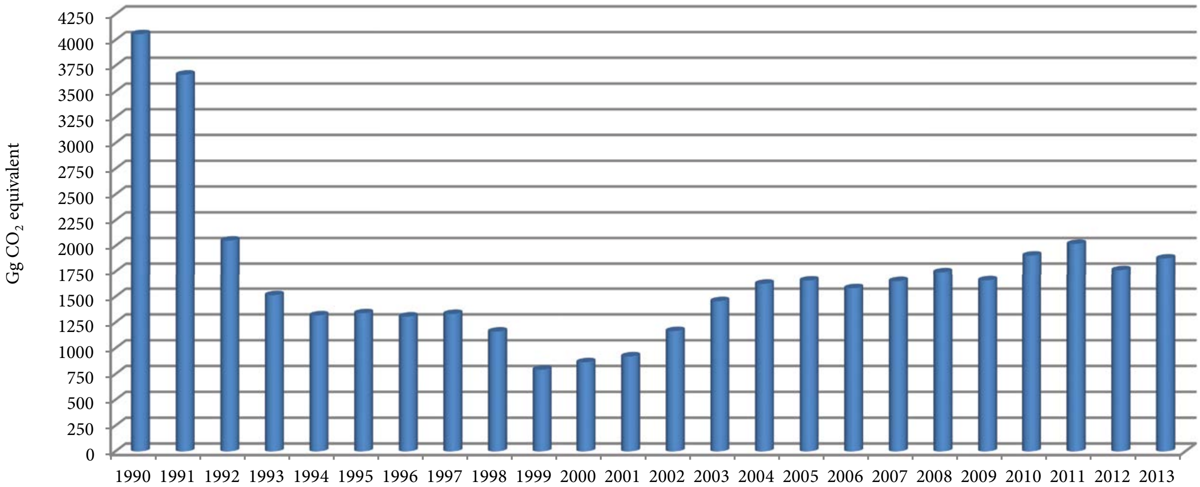

Figure 3-8: Direct GHG Emissions from 1A3 'Transport' in the Republic of Moldova within 1990-2013 periods

Comparing to 1990, in 2013 the total direct GHG emissions from 1A3 ‚Transport' represented about 46.3 per cent of the total emissions registered for the reference year (Table 3-59).

Table 3-59: Direct GHG Emissions from 1A3 'Transport' Source Category in the Republic of Moldova within 1990-2013 periods, where 1990 represents 100%

	1990	1991	1992	1993	1994	1995	1996	1997
CO_2	100.0	90.4	50.5	37.3	32.4	33.0	32.3	32.9
CH_4	100.0	91.9	46.0	29.8	27.3	28.7	27.2	31.0
N_2O	100.0	88.3	54.7	41.3	37.8	32.0	30.0	30.4
Total	100.0	90.3	50.6	37.3	32.5	33.0	32.2	32.8
	1998	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**
CO_2	28.7	19.6	21.4	22.7	28.8	36.0	40.3	41.1
CH_4	26.4	15.7	15.9	17.1	22.0	26.9	32.3	30.1
N_2O	27.3	17.2	20.2	22.2	27.7	33.8	34.0	34.8
Total	28.6	19.5	21.3	22.7	28.8	35.9	40.1	40.8
	2006	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**
CO_2	39.1	40.9	43.2	41.2	47.4	50.3	43.9	46.7
CH_4	28.0	28.9	30.3	29.9	30.3	31.4	26.6	26.4
N_2O	37.4	36.2	36.6	30.6	34.5	36.7	31.6	33.7
Total	39.0	40.7	43.0	40.9	47.0	49.8	43.5	46.3

The decreasing trend in GHG emissions is characteristic to all emission sources covered by the category 1A3 'Transport': 1A3b – 47.9 per cent; 1A3c – 86.2 per cent; 1A3d – 98.6 per cent; 1A3e – 85.4 per cent (Table 3-60, Figure 3-9).

Table 3-60: Breakdown of the Category 1A3 'Transport' GHG Emissions by Source within 1990-2013 periods, Gg CO_2 equivalent

	1990	1991	1992	1993	1994	1995	1996	1997
1A3a	NO, NE	NO, NE	NO, NE	NO, NE	NO, NE	NO, NE	NO, NE	NO, NE
1A3b	3439.2955	3155.0229	1693.6910	1268.8186	997.5295	1092.9497	1038.1259	1141.7304
1A3c	507.0409	432.7382	301.1449	226.3196	232.4823	161.6583	149.7637	140.3306
1A3d	19.1005	0.2419	0.2069	0.2388	0.1878	0.1815	0.1974	0.2133
1A3e	91.1782	75.9818	56.9864	18.6156	87.3791	83.5800	117.7719	49.3882
	1998	1999	2000	2001	2002	2003	2004	2005
1A3a	NO, NE	NO, NE	NO, NE	0.0991	0.0857	0.6620	0.4171	0.1138
1A3b	982.5595	662.5346	739.8796	800.6078	1004.3929	1282.5441	1460.0794	1491.1743
1A3c	131.3567	76.2486	93.0946	104.4171	129.5661	149.3893	126.0804	129.0328
1A3d	0.1337	0.2228	0.0987	0.1783	0.4138	0.3756	0.3820	0.3247
1A3e	47.4887	53.1873	30.3927	15.1964	32.2923	22.7946	37.9909	36.0914
	2006	2007	2008	2009	2010	2011	2012	2013
1A3a	0.2223	0.1445	0.1733	0.1152	0.1393	0.1219	0.2086	0.1984
1A3b	1409.3975	1507.3392	1609.2830	1573.3094	1828.1270	1939.3584	1698.2988	1793.4808
1A3c	166.5144	139.7656	128.9234	75.9131	75.3057	80.5219	64.6294	69.9269
1A3d	0.2738	0.3152	0.3470	0.2738	0.2324	0.2390	0.2728	0.2738
1A3e	5.6986	3.7991	3.7991	9.4977	1.8995	NO, NE	NO, NE	13.2968

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

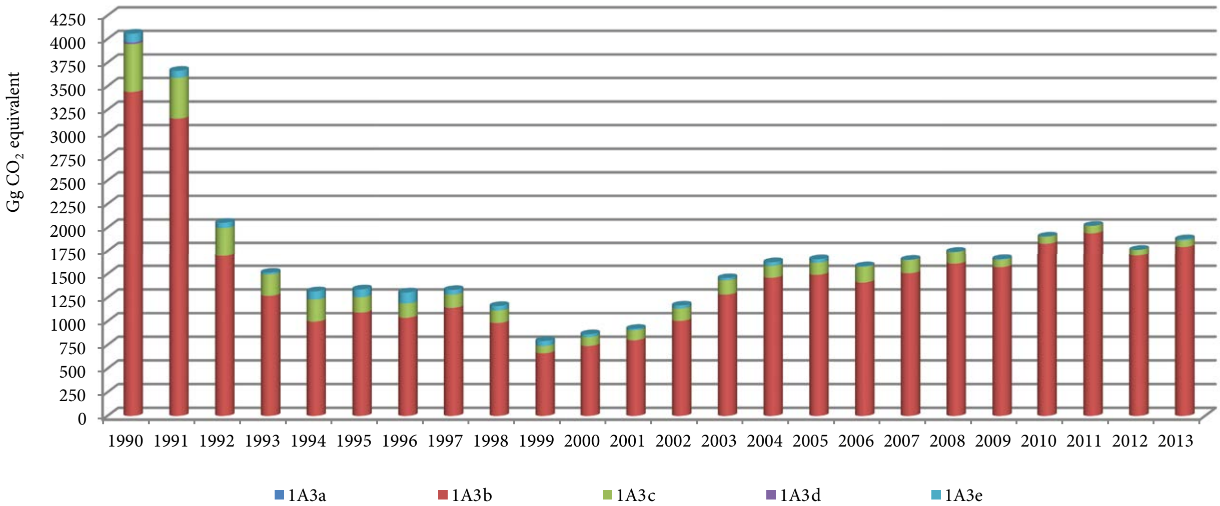

Figure 3-9: Breakdown of the Category 1A3 'Transport' GHG Emissions by Source within 1990-2013 periods

The emissions source with the largest share in the total direct GHG emissions under category 1A3 'Transport' is 1A3b 'Road Transportation', with a share that varied over the reference period from 75.71 per cent in 1994 to 96.31 per cent in 2011. Other major emissions sources are represented by 1A3c 'Railways', with a share varying between 3.67 per cent in 2012 and 17.64 per cent in 1994, respectively 1A3e 'Pipeline Transportation', with a share varying between 0.10 per cent in 2010 and 9.02 per cent in 1996 (Table 3-61, Figure 3-10).

Table 3-61: Breakdown of the Category 1A3 'Transport' GHG Emissions by Source within 1990-2013 periods, % from the total

	1990	1991	1992	1993	1994	1995	1996	1997
1A3a	NO, NE	NO, NE	NO, NE	NO, NE	NO, NE	NO, NE	NO, NE	NO, NE
1A3b	84.78	86.11	82.54	83.81	75.71	81.66	79.50	85.74
1A3c	12.50	11.81	14.68	14.95	17.64	12.08	11.47	10.54
1A3d	0.47	0.01	0.01	0.02	0.01	0.01	0.02	0.02
1A3e	2.25	2.07	2.78	1.23	6.63	6.24	9.02	3.71
	1998	1999	2000	2001	2002	2003	2004	2005
1A3a	NO, NE	NO, NE	NO, NE	0.01	0.01	0.05	0.03	0.01
1A3b	84.59	83.63	85.69	86.98	86.08	88.10	89.85	90.01
1A3c	11.31	9.62	10.78	11.34	11.10	10.26	7.76	7.79
1A3d	0.01	0.03	0.01	0.02	0.04	0.03	0.02	0.02
1A3e	4.09	6.71	3.52	1.65	2.77	1.57	2.34	2.18
	2006	2007	2008	2009	2010	2011	2012	2013
1A3a	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
1A3b	89.08	91.28	92.35	94.83	95.93	96.00	96.31	95.54
1A3c	10.52	8.46	7.40	4.58	3.95	3.99	3.67	3.73
1A3d	0.02	0.02	0.02	0.02	0.01	0.01	0.02	0.01
1A3e	0.36	0.23	0.22	0.57	0.10	NO, NE	NO, NE	0.71

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

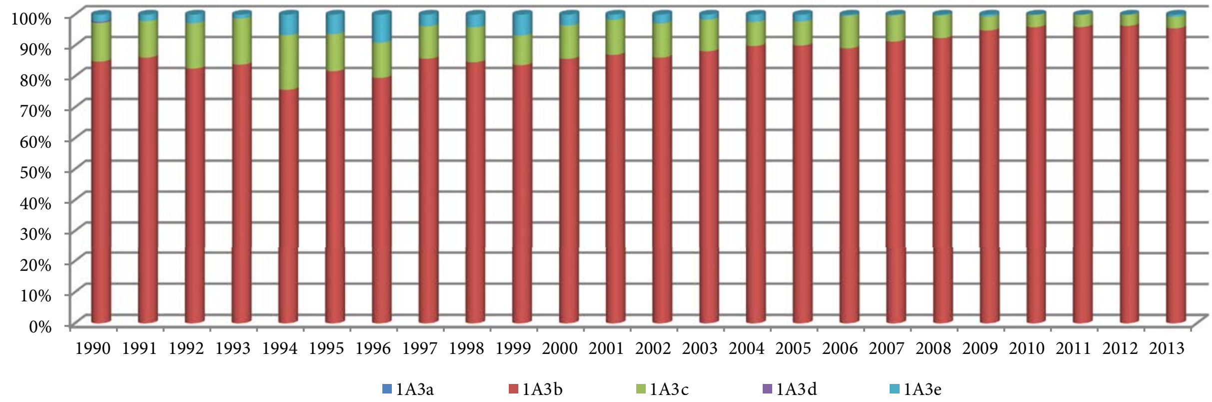

Figure 3-10: Breakdown of the Category 1A3 'Transport' GHG Emissions by Source within 1990-2013 periods, % from the total

3.4.2 Methodological Issues, Emission Factors and Activity Data

1A3a Civil Aviation

GHG emissions from 1A3a 'Civil Aviation' were estimated following a Tier 1 methodological approach, based on activity data on fuel consumption (Table 3-62) and default values of emission factors. To assure the natural conversion from nature units to energy units, country specific net calorific values were used (see Table 3-11). The used value of carbon oxidation fraction is that recommended in the 2006 IPCC Guidelines.

Table 3-62: Activity Data used for GHG Emissions Assessment within 1A3a 'Civil Aviation' in the Republic of Moldova within 2001-2013 periods

	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
Aviation Gasoline, tons	32.116	27.789	214.577	135.204	36.887	72.065	46.824	56.165	37.348	45.153	39.500	67.600	64.300

Source: Civil Aeronautical Authority, through Letter No. 1328 dated 13.09.2011, answer to Letters No. 03-07/175 dated 02.02.2011 and No. 03-07/1337 dated 08.08.2011 from the MoEN; 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.

In order to estimate non-CO_2 emissions, default EFs values available in the Revised 1996 IPCC Guidelines (IPCC, 1997) and 2006 IPCC Guidelines (Table 3-63) were used.

Table 3-63: Emission Factors Used for Estimating Non-CO_2 Emissions Originated from 1A3a 'Civil Aviation', kg/TJ

	CH_4	N_2O	NO_x	CO	NMVOC
Aviation Gasoline	0.5	2	250	100	50

Source: CO and NMVOC – *Revised 1996 IPCC Guidelines*, Vol. 3, Tab. 1-10 and 1-11, page 1.40, 1.42; CH_4, N_2O, NO_x – *2006 IPCC Guidelines*, Vol. 2, Cap. 3, Tab. 3.6.5, page 3.64.

1A3b Road Transportation

GHG emissions from the 1A3b 'Road Transportation' were estimated following a Tier 1 methodological approach (based on AD on fuel consumption and default EFs values). It was not possible yet to use a Tier 2 or Tier 3 method due to lack of activity data on total annual kilometers travelled per vehicle[22], disaggregated for each vehicle category.

EFs used to estimate CO_2 emissions are described in Table 3-11. Default EFs values available in the Revised 1996 IPCC Guidelines (IPCC, 1997) and 2006 IPCC Guidelines (Table 3-64) were used to estimate non-CO_2 emissions.

Table 3-64: Emission Factors Used for Estimating Non-CO_2 Emissions Originated from Road Transportation, kg/TJ

Fuel Type	CH_4	N_2O	NO_x	CO	NMVOC
Gasoline	33	3.2	600	8000	1500
Diesel Oil	3.9	3.9	800	1000	200
Natural Gas	92	3	600	400	5

Source: NO_x, CO and NMVOC – *Revised 1996 IPCC Guidelines*, Vol. 3, Tab. 1-9, 1-10 and 1-11, pages 1.37-1.42; CH_4, N_2O – *2006 IPCC Guidelines*, Vol. 2, Chap. 3, Tab. 3.2.2, page 3.21.

Activity data pertaining to fuel consumption for 1A3b 'Road Transportation' (Gasoline, Diesel Oil, LPG - Liquefied Petroleum Gas and LNG - Liquefied Natural Gas) were collected from the Energy

[22] Track log is monitored only for certain categories of vehicles, information being available in the State Register of Transport: <http://www.registru.md/rst/>.

Balances of the RM for 1990, 1993-2013 years, Statistical Yearbooks of ATULBD, as well as from other relevant sources, including central public authorities (i.e., Ministry of Transport and Roads Infrastructure), central administration authorities (National Bureau of Statistics, Customs Service) and individual enterprises („Moldovagaz" J.S.C.).

Activity data pertaining to Diesel Oil consumption for 1A3b 'Road Transportation' (Table 3-65) are available in the Energy Balances of the Republic of Moldova, see Chapter S.2.1. 'Consumed as Fuel or Energy', columns: 'for transport operation', 'for agriculture' and 'sold to population' (diesel oil consumption was added). In order to estimate the total quantity of Diesel Oil consumed by the transport means in the Republic of Moldova, there were summed up the amount of Diesel Oil used for 'transport operation', 'sold to population', and 10 per cent of the amount of Diesel Oil used in 'agriculture sector' (for both RBDR and LBDR); the remaining 90 per cent were reallocated under the 1A4c 'Agriculture/Forestry/Fishing' category.

Table 3-65: Diesel Oil Consumption under the 1A3b 'Road Transportation' in the Republic of Moldova within 1990-2013 periods, thousand tons

	1990	1991	1992	1993	1994	1995	1996	1997
Diesel Oil	308.400	279.000	194.000	173.400	104.300	123.175	114.582	115.977
	1998	1999	2000	2001	2002	2003	2004	2005
Diesel Oil	100.955	84.667	109.718	120.294	147.040	201.760	241.971	245.139
	2006	2007	2008	2009	2010	2011	2012	2013
Diesel Oil	244.047	268.226	288.995	276.689	367.224	396.000	354.800	390.300

Source: Energy Balances of the RM for 1990, 1993-2013; Statistical Yearbooks of the ATULBD 2000 (page 106), 2006 (page 107), 2009 (page 106), 2010 (page 108), 2011 (page 109), 2012 (page 113), 2014 (page 102).

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 3-66).

Table 3-66: Gasoline Consumption under the 1A3b 'Road Transportation' in the Republic of Moldova within 1990-2013 periods, thousand tons

	1990	1991	1992	1993	1994	1995	1996	1997
Transport operation	655.0	600.0	275.2	209.8	159.0	143.0	135.0	112.0
Sold to population	117.0	107.0	58.0	6.7	47.0	75.0	73.0	127.0
Total consumption	772.0	707.0	333.2	216.5	206.0	218.0	208.0	239.0
	1998	1999	2000	2001	2002	2003	2004	2005
Transport operation	93.0	56.0	50.0	55.0	80.0	99.0	71.0	69.0
Sold to population	110.0	61.0	66.0	70.0	82.0	92.0	137.0	146.0
Total consumption	203.0	117.0	116.0	125.0	162.0	191.0	208.0	215.0
	2006	2007	2008	2009	2010	2011	2012	2013
Transport operation	73.0	80.0	77.0	64.0	69.0	82.0	62.0	161.0
Sold to population	123.0	121.0	129.0	142.0	127.0	123.0	105.0	IE
Total consumption	196.0	201.0	206.0	206.0	196.0	205.0	167.0	161.0

Source: Energy Balances of the RM for 1990, 1993-2013.

AD pertaining to consumption of LPG and LNG under the 1A3b 'Road Transportation' are based on Energy Balances and data provided by „Moldovagaz" J.S.C. (Table 3-67).

Table 3-67: Liquefied Petroleum Gases and Liquefied Natural Gases Consumption under the 1A3b 'Road Transportation' in the Republic of Moldova within 1990-2013 periods

	1990	1991	1992	1993	1994	1995	1996	1997
LPG, kt	13.00	17.29	10.38	8.40	6.00	4.00	4.00	2.64
LNG, mil. m^3	8.24	7.72	4.89	11.83	7.32	6.81	9.42	10.50
	1998	1999	2000	2001	2002	2003	2004	2005
LPG, kt	2.66	2.38	1.45	0.82	1.29	6.00	5.00	5.00
LNG, mil. m^3	10.87	10.83	12.34	12.74	13.68	13.00	12.00	12.00
	2006	2007	2008	2009	2010	2011	2012	2013
LPG, kt	5.00	6.00	10.00	10.00	13.00	10.00	13.00	13.00
LNG, mil. m^3	2.00	3.00	7.10	8.90	2.00	2.00	2.00	2.00

Source: Energy Balances of the RM for 1990, 1993-2013; „Moldovagaz" J.S.C. through Letter No. 604 dated 01.04.1999, answer to Letter No. 02-541 dated 28.05.2001 from the MoEN; Letter No. 02-156 dated 06.02.2004, answer to Letter No. 257-01-07 dated 26.01.2004 from the MENR; Letter No. 06-1253 dated 27.09.2006, answer to Letter No. 01-07/1400 dated 25.08.2006 from the MoEN; Letter No. 02/1-476 dated 23.02.2011, answer to Letter No. 03-07/175 dated 02.02.2011 from the MoEN; Letter No. 02/1-288 dated 22.012.2014, answer to Letter No. 320/2014-01-01 dated 03.01.2014 from the Climate Change Office of the MoEN; Letter No. 02/1-507 dated 10.02.2015, answer to Letter No. 407/2015-01-09 dated 29.01.2015 from the Climate Change Office of the MoEN.

1A3c Railways

GHG emissions from the 1A3c 'Railways' source category were estimated following a Tier 1 methodological approach (based on AD on fuel consumption and default EFs values). EFs used to estimate CO_2 emissions are mentioned in Table 3-11. Default EFs values available in the Revised 1996 IPCC Guidelines (IPCC, 1997) and 2006 IPCC Guidelines (Table 3-68) were used to estimate non-CO_2 emissions.

Table 3-68: Emission Factors Used for Estimating Non-CO_2 Emissions Originated from 1A3c 'Railways', kg/TJ

Fuel Type	CH_4	N_2O	NOx	CO	NMVOC
Diesel Oil	4.15	28.6	1200	1000	200

Source: 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, Chap. 3, Tab. 3.4.1, Page 3.43.

Activity data pertaining to fuel consumption used to ensure railway transport operation (mainly Diesel Oil) were collected from the Energy Balances of the RM for 1990, 1993-2013, as well as directly from "Moldavian Railways" SOE (Table 3-69)

Table 3-69: Diesel Oil Consumption under the 1A3c 'Railways' in the Republic of Moldova within 1990-2013 periods, thousand tons

	1990	1991	1992	1993	1994	1995	1996	1997
Diesel Oil	143.550	122.530	85.270	64.080	65.830	45.770	42.410	39.740
	1998	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**
Diesel Oil	37.190	21.590	26.360	29.566	36.687	42.300	35.700	36.536
	2006	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**
Diesel Oil	47.149	39.575	36.505	21.495	21.323	22.800	18.300	19.800

Source: „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 and Letter dated 02.03.2015 No.H-4/458.

Certain discrepancies were identified between data pertaining to the fuel consumption used to ensure the railway transport operation from the Energy Balances of the RM and data provided by the "Moldavian Railways" SOE. As a consequence, in order to estimate the GHG emissions originated from the 1A3c 'Railways' source category, AD provided by the "Moldavian Railways" SOE were used, as being more credible.

"Moldavian Railways" SOE uses and other types of fossil fuels (Table 3-70), most of them with other purposes then railway transport operation (for example, for heating the administrative buildings, rolling stock maintenance, the supply of spare parts and other materials needed for the normal railway operation). These fuels are taken into account in assessing GHG emissions from 1A5 'Other' source category.

Table 3-70: The Use of Other Fossil Fuels by the "Moldavian Railways" SOE within 2000-2013 periods

	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
Coal, kt	3.872	4.118	5.159	5.743	4.483	3.807	5.858	4.479	4.392	4.225	4.178	4.100	5.400	3.700
Residual Fuel Oil, kt	2.274	0.879	0.880	0.391	0.177	0.000	0.026	0.000	0.018	0.048	0.000	0.090	0.089	0.900
Gasoline, kt	0.624	0.665	1.081	1.514	1.418	1.337	1.213	1.298	1.253	0.561	0.231	0.300	0.300	0.300
Natural Gas, mill. m^3	1.572	3.846	5.202	6.650	5.630	5.778	5.624	5.213	4.756	4.158	4.289	4.684	4.755	3.914
Kerosene, kt	0.016	0.009	0.025	0.009	0.007	0.006	0.004	0.007	0.007	0.005	0.006	0.000	0.000	0.000
Diesel Oils, kt	0.650	1.162	1.110	0.888	0.888	0.863	1.158	1.091	0.945	0.648	0.623	0.600	0.500	0.600

Source: „Moldavian Railways" SOE through 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 and Letter dated 02.03.2015 No. H-4/458.

1A3d Navigation

GHG emissions from the 1A3d 'Navigation' were estimated following a Tier 1 methodological approach (based on AD on fuel consumption and default EFs values). EFs used to estimate CO_2 emissions are mentioned in Table 3-11.

Default EFs values available in the Revised 1996 IPCC Guidelines (IPCC, 1997) and 2006 IPCC Guidelines were used to estimate non-CO_2 emissions (Table 3-71).

Table 3-71: Emission Factors Used for Estimating Non-CO_2 Emissions Originated from 1A3d 'Navigation', kg/TJ

Fuel Type	CH_4	N_2O	NO_x	CO	NMVOC
Diesel Oil	7	2	1500	1000	200

Source: 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, Chap. 3, Tab. 3.5.3, Page 3.50

To be noted that Energy Balances of the Republic of Moldova do not contain data on fuel consumption used to ensure water borne transport operation (except the Energy Balance for 1990 year). The reason for that is the insignificant quantity of fuel consumed to ensure operation of this type of transport in the Republic of Moldova. As a consequence, for estimating the GHG emissions originated from the 1A3d 'Navigation', for the rest of the period (1991-2013) there was used information obtained from the Ministry of Transport and Roads Infrastructure (Table 3-72).

Table 3-72: Diesel Oil Consumption under the 1A3d 'Navigation' in the Republic of Moldova within 1990-2013 periods, thousand tons

	1990	1991	1992	1993	1994	1995	1996	1997
Diesel Oil	6.000	0.076	0.065	0.075	0.059	0.057	0.062	0.067
	1998	1999	2000	2001	2002	2003	2004	2005
Diesel Oil	0.042	0.070	0.031	0.056	0.130	0.118	0.120	0.102
	2006	2007	2008	2009	2010	2011	2012	2013
Diesel Oil	0.086	0.099	0.109	0.086	0.073	0.075	0.086	0.086

Source: Official Letter from the Ministry of Transport and Communications No. 03-5-2/2-32 dated 31st of March 1999; Official Letter from the Ministry of Transport and Roads Infrastructure No. 04-01-3/754 dated 2nd of October 2006 and No. 04/2-2-05 dated 12 of March 2011, as well as Official Letter No. 03-02-5/52 dated January 21st 2014 and No. 03-02-5/102 dated February 20, 2015.

3. ENERGY SECTOR

1A3e Pipeline Transportation

GHG emissions from the 1A3e 'Pipeline Transportation' source category were estimated following a Tier 1 methodological approach, based on AD on fuel consumption (Table 3-73) and default EFs values (Table 3-11).

Table 3-73: Natural Gas Consumption under the 1A3e 'Pipeline Transportation' in the Republic of Moldova within 1990-2013 periods

	1990	1991	1992	1993	1994	1995	1996	1997
Natural Gas, mil m^3	48	40	30	9.8	46	44	62	26
	1998	1999	2000	2001	2002	2003	2004	2005
Natural Gas, mil m^3	25	28	16	8	17	12	20	19
	2006	2007	2008	2009	2010	2011	2012	2013
Natural Gas, mil m^3	3	2	2	5	1	NO, NE	NO, NE	7

Source: Energy Balances of the RM for 1990 and 1993-2013; AD for 1991-1992 were interlaced due to the fact that no Energy Balances were published in that period.

AD pertaining to fuel consumption to ensure pipeline transportation was collected from the Energy Balances of the Republic of Moldova (see Chapter S.2.3 'Consumed as Fuel or Energy for Transport Operations', Section 'Pipeline Transportation').

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). The uncertainties related to GHG emissions within the 1A3 'Transport' category were estimated, at ±7.07 per cent for CO_2 emissions, for CH_4 emissions at ±40.31 per cent, and for N_2O emissions at ±50.25 per cent. At the same time, combined uncertainties, presented as a per cent of total sectoral emissions were estimated for CO_2 emissions at ±1.3286 per cent, for CH_4 emissions at ±0.0278 per cent and for N_2O emissions at ±0.1810 per cent. Uncertainties associated to the total direct GHG emissions trend within the Energy Sector were estimated at about ±0.3860 per cent for CO_2 emissions, ±0.0014 per cent for CH_4 emissions and, respectively ±0.0111 per cent for N_2O emissions (Annex 5-3.1).

In view of ensuring time-series consistency of the obtained results, the same approach was used for the entire period under review, in conformity with the recommendations included in the GPG (IPCC, 2000).

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 (IPCC, 2000).

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 (IPCC, 2000), GHG emissions were estimated using AD and CS NCVs from official sources of information.

3.4.5 Recalculations

1A3a Civil Aviation

GHG emissions originated from 1A3a 'Civil Aviation' were recalculated for 2001-2010 time period due to an updated set of activity data made available by the Civil Aviation Authority of the Republic of Moldova. To be noted also, that during the previous inventory cycles the activity data (expressed in thousands of tons) were included in the calculation model with an accuracy of 3 digits after the decimal point, while in the current inventory cycle, the AD were considered with an accuracy of 5 digits after the decimal point.

In comparison with the results included into the TNC, the performed recalculations revealed an increasing trend of direct GHG emissions from 1A3a 'Civil Aviation' source category, varying from a minimum of 0.003 per cent in 2004, up to a maximum of 11.5 per cent in 2007 (Table 3-74).

Table 3-74: Comparative Results of GHG Emissions Inventory from 1A3a 'Civil Aviation' included into the TNC and the BUR of the RM under the UNFCCC, Gg CO_2 equivalent

	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
TNC	0.0990	0.0833	0.6618	0.4171	0.1104	0.2221	0.1296	0.1731	0.1151	0.1388			
BUR	0.0991	0.0857	0.6620	0.4171	0.1138	0.2223	0.1445	0.1733	0.1152	0.1393	0.1219	0.2086	0.1984
Difference, %	0.0498	2.9222	0.0359	0.0030	3.0363	0.0903	11.4857	0.1159	0.1287	0.3400			

Abbreviations: TNC – Third National Communication; BUR – Biennial Update Report

For 2011-2013 periods, the GHG emissions originated from 1A3a 'Civil Aviation' were estimated for the first time. The results allow assert that, between 2001 and 2013, the respective emissions increased by 100.2 per cent.

1A3b Road Transportation

GHG emission recalculations performed under the 1A3b 'Road Transportation' covering the 1990-2010 periods were due to the availability of an updated set of activity data for the ATULBD, as well as a result of separate estimation of LPG, in particular regarding the non-CO_2 emissions calculation.

Previously, in the absence of a separate recording of the emissions from this particular fuel, the respective amount of fuel was accounted aggregated with gasoline. In comparison with the results included into the TNC, the performed recalculations revealed an increasing trend of direct GHG emissions from 1A3b 'Road Transportation', varying from a minimum of 0.008 per cent in 2001, up to a maximum of 0.055 per cent in 2010, excluding 1992 when an insignificant decrease was registered (Table 3-75).

Table 3-75: Comparative Results of GHG Emissions Inventory from 1A3b 'Road Transportation' included into the TNC and the BUR of the RM under the UNFCCC, Gg CO_2 equivalent

	1990	1991	1992	1993	1994	1995	1996	1997
TNC	3438.2866	3153.6808	1695.9873	1268.3491	997.2773	1092.7316	1037.9412	1141.5255
BUR	3439.2955	3155.0229	1693.6910	1268.8186	997.5295	1092.9497	1038.1259	1141.7304
Difference, %	0.0293	0.0426	-0.1354	0.0370	0.0253	0.0200	0.0178	0.0179
	1998	1999	2000	2001	2002	2003	2004	2005
TNC	982.3530	662.3499	739.7670	800.5442	1004.2928	1282.0785	1459.6913	1490.7862
BUR	982.5595	662.5346	739.8796	800.6078	1004.3929	1282.5441	1460.0794	1491.1743
Difference, %	0.0210	0.0279	0.0152	0.0079	0.0100	0.0363	0.0266	0.0260
	2006	2007	2008	2009	2010	2011	2012	2013
TNC	1409.0094	1506.8735	1608.5069	1572.5333	1827.1181			
BUR	1409.3975	1507.3392	1609.2830	1573.3094	1828.1270	1939.3584	1698.2988	1793.4808
Difference, %	0.0275	0.0309	0.0483	0.0494	0.0552			

Abbreviations: TNC – Third National Communication; BUR – Biennial Update Report

For 2011-2013 periods, the GHG emissions originated from 1A3b 'Road Transportation' were estimated for the first time. The results allow assert that, between 1990 and 2013, the respective emissions decreased by 47.9 per cent.

1A3c Railways

No recalculations were performed under the 1A3c 'Railways'. Since 1990 to 2013 the respective emissions decreased by circa 86.2 per cent (Table 3-76).

Table 3-76: GHG Emissions from 1A3c 'Railways' included into the BUR of the RM under the UNFCCC, Gg CO_2 equivalent

	1990	1991	1992	1993	1994	1995	1996	1997
1A3c	507.0409	432.7382	301.1449	226.3196	232.4823	161.6583	149.7637	140.3306
	1998	1999	2000	2001	2002	2003	2004	2005
1A3c	131.3567	76.2486	93.0946	104.4171	129.5661	149.3893	126.0804	129.0328
	2006	2007	2008	2009	2010	2011	2012	2013
1A3c	166.5144	139.7656	128.9234	75.9131	75.3057	80.5219	64.6294	69.9269

Abbreviation: BUR – Biennial Update Report.

1A3d Navigation

No recalculations were performed under the 1A3d 'Navigation'. Since 1990 to 2013 the respective emissions decreased by 98.6 per cent (Table 3-77).

Table 3-77: GHG Emissions from 1A3d 'Navigation' included into the BUR of the RM under the UNFCCC, Gg CO_2 equivalent

	1990	1991	1992	1993	1994	1995	1996	1997
1A3d	19.1005	0.2419	0.2069	0.2388	0.1878	0.1815	0.1974	0.2133
	1998	1999	2000	2001	2002	2003	2004	2005
1A3d	0.1337	0.2228	0.0987	0.1783	0.4138	0.3756	0.3820	0.3247
	2006	2007	2008	2009	2010	2011	2012	2013
1A3d	0.2738	0.3152	0.3470	0.2738	0.2324	0.2390	0.2728	0.2738

Abbreviation: BUR – Biennial Update Report.

1A3e Pipeline Transportation

No recalculations were performed under the 1A3e 'Pipeline Transportation'. Since 1990 to 2013 the respective emissions decreased by 85.4 per cent (Table 3-78).

Table 3-78: GHG Emissions from 1A3e 'Pipeline Transportation' included into the BUR of the RM under the UNFCCC, Gg CO_2 equivalent

	1990	1991	1992	1993	1994	1995	1996	1997
1A3e	91.1782	75.9818	56.9864	18.6156	87.3791	83.5800	117.7719	49.3882
	1998	1999	2000	2001	2002	2003	2004	2005
1A3e	47.4887	53.1873	30.3927	15.1964	32.2923	22.7946	37.9909	36.0914
	2006	2007	2008	2009	2010	2011	2012	2013
1A3e	5.6986	3.7991	3.7991	9.4977	1.8995	NO, NE	NO, NE	13.2968

Abbreviation: BUR – Biennial Update Report.

1A3 Transport

GHG emissions originated from 1A3 'Transport' were recalculated for 2001-2010 time period (details with reference to the sub-categories included in the respective category can be seen above).

In comparison with the results included into the TNC, the performed recalculations resulted in insignificant increase of direct GHG emissions within the 1A3 'Transport' category, varying from a minimum of 0.007 per cent in 2001, up to a maximum of 0.053 per cent in 2010, excluding 1992 when an insignificant decrease was registered (Table 3-79).

Table 3-79: Comparative Results of GHG Emissions Inventory from 1A3 'Transport' category included into the TNC and the BUR of the RM under the UNFCCC, Gg CO_2 equivalent

	1990	1991	1992	1993	1994	1995	1996	1997
TNC	4055.6062	3662.6428	2054.3256	1513.5229	1317.3265	1338.1514	1305.6741	1331.4576
BUR	4056.6151	3663.9848	2052.0292	1513.9925	1317.5788	1338.3695	1305.8589	1331.6625
Difference, %	0.0249	0.0366	-0.1118	0.0310	0.0191	0.0163	0.0141	0.0154
	1998	1999	2000	2001	2002	2003	2004	2005
TNC	1161.3321	792.0086	863.3531	920.4350	1166.6483	1455.2998	1624.5617	1656.3456
BUR	1161.5385	792.1933	863.4656	920.4987	1166.7509	1455.7657	1624.9498	1656.7370
Difference, %	0.0178	0.0233	0.0130	0.0069	0.0088	0.0320	0.0239	0.0236
	2006	2007	2008	2009	2010	2011	2012	2013
TNC	1581.7184	1650.8829	1741.7494	1658.3330	1904.6945			
BUR	1582.1066	1651.3635	1742.5257	1659.1092	1905.7039	2020.2412	1763.4096	1877.1767
Difference, %	0.0245	0.0291	0.0446	0.0468	0.0530			

Abbreviations: TNC – Third National Communication; BUR – Biennial Update Report

For 2011-2013 periods, the GHG emissions originated from 1A3 'Transport' category were estimated for the first time. The results allow assert that, between 1990 and 2013, the respective emissions decreased by 53.7 per cent.

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.

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'.

1A4a 'Commercial/Institutional Sectors'

Commercial Sector holds a significant position in the national economy of the RM, its contribution to GDP varying within 2000-2013 time periods, from a minimum of 10.4 per cent in 2005, to a maximum of 13.9 per cent in 2013 (Table 3-80).

Table 3-80: Commercial Sector Contribution to the Republic of Moldova's GDP within 2000-2013 periods, %

	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
Wholesale and Retail	12.5	12.0	11.0	10.7	10.6	10.4	11.5	12.6	13.0	13.2	12.8	13.5	13.7	13.9

Source: NBS of the Republic of Moldova, <www.statbank.statistica.md>.

According to the data of the NBS (2014), over 211 thousand persons or 18.0 per cent of employed population of the country work in the Commercial Sector. As of 1st of January 2014, there were circa 11333 commercial units in the Republic of Moldova (Table 3-81).

Table 3-81: Number of Commercial Units in the Republic of Moldova within 1990-2013 periods

	1990	1991	1992	1993	1994	1995	1996	1997
Commercial Units	11267	11069	8781	8926	7928	7770	7802	7759
Shops	8874	8908	7279	7379	6785	6434	6432	6315
Booths	2393	2161	1502	1547	1143	1336	1370	1444
Total Commercial Area, thousand m^2	840	853.1	708.6	685.7	643.4	622.7	621.2	578.9
On average per one shop, m^2	94.6	95.8	97.3	92.9	94.8	79.8	79.6	91.7
	1998	1999	2000	2001	2002	2003	2004	2005
Commercial Units	7499	6501	6549	5858	6960	7158	7718	8350
Shops	6068	5299	5316	4788	5792	5791	6220	6662
Booths	1431	1202	1233	1070	1168	1367	1498	1688
Total Commercial Area, thousand m^2	546.9	469.4	438	399.2	442.7	444	485.7	521.1
On average per one shop, m^2	90.1	88.6	82.3	83.4	76.4	76.7	78.1	78.2
	2006	2007	2008	2009	2010	2011	2012	2013
Commercial Units	9014	9980	11066	11082	12215	7385	9594	11333
Shops	7159	7833	8527	8889	9556	5340	7012	8356
Booths	1855	2147	2539	2193	2659	2045	2582	2977
Total Commercial Area, thousand m^2	549.8	626.6	699.0	750.6	850.9	707.6	848.2	908.7
On average per one shop, m^2	76.8	80.0	82.0	84.0	89.0	132.5	121.0	108.8

Source: Statistical Yearbooks of the RM for 1994 (page 351), 1999 (page 456), 2006 (page 474), 2012 (page 470), 2013 (page 469) and 2014 (page 470).

The Institutional Sector includes education and research, health care, culture and sports, post and telecommunication institutions (Table 3-82). Commercial and institutional premises are preponderantly heated with natural gas, as well as with coal, residual fuel oil, diesel oil, oven fuel, liquefied petroleum gas, fuel wood, wood and agricultural residues.

Table 3-82: Number of Institutional Premises in the Republic of Moldova within 1990-2013

	1990	1991	1992	1993	1994	1995	1996	1997
Preschool institutions	2336	2306	1940	1877	1774	1680	1596	1497
Non-school educational institutions	830	826	686	613	562	534	516	495
Primary, secondary and high schools	1635	1654	1482	1488	1504	1515	1530	1536
Secondary, professional educational institutions	114	109	86	78	78	78	78	81
Colleges	50	53	44	48	47	50	51	53
Universities and institutes	9	13	14	17	18	20	24	28

	1990	1991	1992	1993	1994	1995	1996	1997
R&D Institutions	95	93	91	84	81	85	89	93
Hospitals	334	335	342	339	334	335	325	294
Ambulatories and out-patient clinics	586	588	594	616	599	612	601	581
Sanitary-epidemiological institutions	55	55	55	55	54	53	53	53
Emergency stations	66	67	70	69	69	68	70	71
Children Homes	5	5	4	4	4	4	4	4
Orphanages	7	7	2	3	3	3	3	3
Boarding schools	6	6	2	2	2	7	7	7
Tuberculosis sanatoriums	8	7	6	6	6	5	5	5
Public libraries	2079	2037	1730	1627	1594	1602	1583	1562
Cinemas	1791	1582	1172	960	784	671	628	666
Museums	79	79	66	66	66	65	65	67
Theatres	10	13	12	13	13	13	13	13
Cultural institutions	1790	1725	1487	1385	1335	1305	1268	1284
Sports facilities	8789	9873	7254	6888	6659	6486	6007	5468
Post and telecommunication offices	1395	1398	1395	1417	1394	1406	1406	1373
	1998	1999	2000	2001	2002	2003	2004	2005
Preschool institutions	1399	1201	1135	1128	1192	1246	1269	1295
Non-school educational institutions	481	448	427	407	409	417	419	418
Primary, secondary and high schools	1556	1565	1573	1584	1587	1583	1577	1558
Secondary, professional educational institutions	80	87	81	80	82	83	83	81
Colleges	56	57	60	67	63	60	56	51
Universities and institutes	38	43	47	47	45	40	35	35
R&D Institutions	88	85	83	81	76	79	86	88
Hospitals	276	150	132	110	110	111	116	114
Ambulatories and out-patient clinics	625	473	571	545	562	577	509	522
Sanitary-epidemiological institutions	53	47	50	40	40	40	40	40
Emergency stations	70	89	105	107	114	122	122	127
Children Homes	4	4	4	3	3	3	3	3
Orphanages	3	3	3	3	3	3	3	3
Boarding schools	7	6	6	6	6	6	6	6
Tuberculosis sanatoriums	5	5	5	3	2	2	2	2
Public libraries	1551	1439	1419	1378	1372	1380	1386	1389
Cinemas	512	353	104	115	70	71	77	57
Museums	68	70	70	71	73	76	82	83
Theatres	13	13	13	14	15	15	15	15
Cultural institutions	1277	1256	1245	1244	1245	1227	1221	1223
Sports facilities	5614	4766	4842	4926	4947	4609	4764	4848
Post and telecommunication offices	1222	1176	1174	1176	1177	1178	1176	1171
	2006	2007	2008	2009	2010	2011	2012	2013
Preschool institutions	1305	1334	1349	1362	1381	1400	1418	1440
Non-school educational institutions	418	405	401	402	399	396	402	402
Primary, secondary and high schools	1546	1541	1526	1512	1489	1460	1396	1374
Secondary, professional educational institutions	78	78	75	75	75	70	67	67
Colleges	49	49	47	47	48	48	47	45
Universities and institutes	31	31	31	33	33	34	34	32
R&D Institutions	67	76	70	68	69	68	65	69
Hospitals	84	83	82	83	84	86	85	85
Ambulatories and out-patient clinics	679	706	748	754	790	837	818	947
Sanitary-epidemiological institutions	40	40	40	40	42	42	42	42
Emergency stations	132	132	132	136	136	136	133	132
Children Homes	3	3	3	3	3	3	3	3
Orphanages	3	3	3	3	3	3	3	3
Boarding schools	6	6	6	6	6	6	6	6
Tuberculosis sanatoriums	2	2	2	2	2	2	2	2
Public libraries	1391	1383	1381	1385	1380	1383	1374	1368
Cinemas	34	34	32	37	30	29	18	14
Museums	82	87	89	89	106	108	109	116
Theatres	14	14	14	14	14	14	14	16
Cultural institutions	1227	1225	1227	1229	1228	1230	1234	1232
Sports facilities	4882	4907	4918	4906	4891	4885	4910	4901
Post and telecommunication offices	1169	1170	1168	1169	1167	1166	1165	1164

Source: Statistical Yearbooks of the RM for 1994 (pages 135-358), 1999 (pages 74-473), 2006 (pages 156-419), 2012 (pages 149-411) and 2014 (pages 148, 150-151, 156, 158, 163, 175-178, 189, 214, 221, 224-225, 229, 411)

1A4b 'Residential Sector'

As of 1st of January 2014, the population of the Republic of Moldova represented circa 4064.7 thousand inhabitants, including 3559.5 thousand inhabitants on the Right Bank of Dniester River (NBS, 2014), respectively 505.2 thousand people on the Left Bank of Dniester River. Almost 45.3 per cent (1841.4 thousand inhabitants) of the country population live in urban areas, while 54.7 per cent (2223.3 thousand inhabitants) live in rural areas.

The dwelling stock represented around 80.6 million m^2, including urban dwelling stock – 31.7 million m^2 and rural dwelling stock – 48.9 million m^2. Table 3-83 presents the situation regarding the evolution of dwelling stock in the Republic of Moldova, from 1990 through 2013.

Table 3-83: Dwelling Stock in the Republic of Moldova, 1990-2013

Years	Total			Urban			Rural		
	Total dwelling stock, mil. m^2	On average per person, m^2	Of which share of living space connected to natural gas, %	Urban dwelling stock, mil. m^2	On average per person, m^2	Of which share of living space connected to natural gas, %	Rural dwelling stock, mil. m^2	On average per person, m^2	Of which share of living space connected to natural gas, %
1990	77.9	17.8	NA	29.5	14.2	NA	48.4	21.1	NA
1991	79.1	18.2	NA	30.1	14.7	NA	49.0	21.3	NA
1992	66.9	18.2	NA	23.5	14.9	NA	43.4	20.7	NA
1993	68.7	19.0	NA	23.9	15.3	NA	44.8	21.8	NA
1994	70.2	19.5	NA	24.9	16.0	NA	45.3	22.1	NA
1995	71.8	19.9	NA	26.0	16.9	NA	45.8	22.2	NA
1996	72.2	20.1	NA	26.1	17.0	NA	46.1	22.4	NA
1997	73.2	20.0	81.3	26.6	17.3	89.0	46.6	22.0	77.3
1998	74.5	20.4	82.9	27.1	17.7	90.4	47.4	22.4	79.1
1999	75.4	20.7	81.9	27.9	18.2	90.0	47.5	22.4	77.7
2000	75.6	20.8	82.6	28.1	18.8	91.0	47.5	22.3	78.2
2001	75.9	20.9	83.2	28.4	18.9	91.2	47.5	22.3	78.9
2002	76.2	21.0	83.3	28.5	19.0	91.1	47.7	22.5	79.4
2003	76.8	21.3	84.4	28.5	19.1	91.4	48.3	22.9	80.7
2004	76.8	21.3	85.1	28.4	19.1	91.8	48.4	22.9	81.6
2005	77.1	21.4	85.4	28.6	19.2	92.1	48.5	23.0	81.8
2006	77.1	21.5	85.7	28.6	19.3	92.4	48.5	23.1	82.2
2007	77.8	21.8	86.2	29.1	19.7	93.0	48.7	23.2	82.6
2008	78.4	22.0	86.6	29.7	20.1	93.1	48.7	23.3	83.1
2009	78.9	22.1	87.3	30.1	20.4	93.4	48.8	23.4	84.0
2010	79.3	22.3	87.8	30.4	20.5	92.6	48.9	23.5	84.9
2011	79.9	22.4	88.7	30.9	20.8	93.4	49.0	23.6	85.6
2012	80.2	22.5	89.0	31.1	20.9	93.7	49.1	23.7	85.9
2013	80.6	22.7	89.4	31.7	21.1	93.9	48.9	23.8	86.5

Source: Statistical Yearbooks of the RM for 1994 (pages 312-314), 1999 (pages 214-216), 2006 (pages 149-152), 2011 (pages 138-141), 2014 (pages 137, 139-140).

To be noted that around 89.4 per cent of living space is connected to natural gas supply systems. Besides natural gas, living space is heated with coal, residual fuel oil and biomass while natural gases, liquefied petroleum gases and biomass are preponderantly used for cooking.

1A4c 'Agriculture/Forestry/Fishing Sectors'

Agriculture, forestry and fishing play an important role in the national economy, contributing with circa 12.5 per cent to GDP (NBS, 2014) (Table 3-84). According to the NBS, more than 323 thousand persons or 27.5 per cent of employed population is involved in these sectors.

Table 3-84: Contribution of Agriculture/Forestry/Fishing to GDP in the Republic of Moldova within 2000-2013 periods, %

	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
Agriculture/Forestry/Fishing	25.4	22.4	21.0	18.3	17.6	16.4	14.5	10.0	8.8	8.5	12.0	12.3	11.2	12.5

Source: NBS of the RM, <www.statbank.statistica.md>.

According to the NBS, more than 338 thousand persons or 28.8 per cent of employed population is involved in these sectors. As for the most used fuels within the respective sectors these include diesel oil, natural gases, liquefied petroleum gases and biomass.

Direct GHG Emissions Trend from 1A4 'Other Sectors' Source Category

Between 1990 and 2013, the GHG emissions originated from the 1A4 'Other Sectors' category decreased significantly (Table 3-85).

Table 3-85: GHG Emissions from 1A4 'Other Sectors' within 1990-2013 periods, Gg

		CO_2	CH_4	N_2O	NO_x	CO	NMVOC	SO_2
1990	1A4	**7762.4898**	**11.6427**	**0.0993**	**35.3755**	**127.0250**	**15.3004**	**60.5137**
	1A4a	1412.4933	0.2488	0.0205	1.5232	25.1126	2.5521	
	1A4b	4407.6336	10.9660	0.0626	4.7893	76.5723	7.8015	
	1A4c	1942.3629	0.4279	0.0163	29.0629	25.3400	4.9468	

		CO_2	CH_4	N_2O	NO_x	CO	NMVOC	SO_2
1991	1A4	**6294.8303**	**8.9152**	**0.0818**	**26.4241**	**96.1384**	**11.7409**	**56.4259**
	1A4a	804.0293	0.0873	0.0098	0.8734	10.9544	1.1033	
	1A4b	3340.6505	7.3738	0.0522	3.9439	59.6958	6.3610	
	1A4c	2150.1505	1.4540	0.0197	21.6069	25.4883	4.2766	
1992	1A4	**4388.8608**	**4.2655**	**0.0508**	**16.9686**	**53.8737**	**6.9587**	**26.7322**
	1A4a	378.8167	0.0444	0.0031	0.4437	1.8106	0.1893	
	1A4b	2419.3329	2.8690	0.0330	2.9918	33.3468	3.8370	
	1A4c	1590.7112	1.3521	0.0147	13.5331	18.7163	2.9324	
1993	1A4	**2249.3719**	**3.5220**	**0.0478**	**12.4355**	**60.0628**	**7.5191**	**15.0889**
	1A4a	564.7967	0.0989	0.0080	0.6065	9.8375	0.9994	
	1A4b	981.6243	3.2568	0.0339	1.6394	41.2641	4.7795	
	1A4c	702.9509	0.1664	0.0059	10.1896	8.9612	1.7403	
1994	1A4	**2112.0567**	**3.7236**	**0.0423**	**11.9397**	**54.7840**	**6.8245**	**14.8890**
	1A4a	400.1638	0.0774	0.0060	0.4353	7.4963	0.7628	
	1A4b	1081.1592	3.5158	0.0311	1.5844	38.6676	4.3730	
	1A4c	630.7338	0.1305	0.0053	9.9200	8.6202	1.6887	
1995	1A4	**2197.0892**	**2.5004**	**0.0387**	**13.2510**	**49.2158**	**6.4242**	**9.8365**
	1A4a	394.4757	0.0848	0.0061	0.4312	7.6861	0.7842	
	1A4b	1075.9579	2.2841	0.0266	1.5601	31.8595	3.7350	
	1A4c	726.6556	0.1314	0.0060	11.2597	9.6702	1.9050	
1996	1A4	**2293.7489**	**3.3183**	**0.0405**	**11.1565**	**51.3362**	**6.4164**	**12.4324**
	1A4a	364.8401	0.1020	0.0058	0.4042	7.2700	0.7494	
	1A4b	1353.7827	3.1040	0.0299	1.8285	36.3523	4.1526	
	1A4c	575.1261	0.1122	0.0048	8.9238	7.7138	1.5144	
1997	1A4	**2526.3271**	**1.9191**	**0.0271**	**11.0201**	**33.6538**	**4.3822**	**8.5392**
	1A4a	323.6291	0.0769	0.0049	0.3519	6.3093	0.6460	
	1A4b	1626.2044	1.7448	0.0175	1.7902	19.7649	2.2393	
	1A4c	576.4936	0.0974	0.0047	8.8779	7.5796	1.4969	
1998	1A4	**2108.9252**	**1.6119**	**0.0267**	**8.4569**	**32.5668**	**4.1570**	**6.7725**
	1A4a	335.5718	0.0811	0.0053	0.3680	6.7579	0.6918	
	1A4b	1335.9716	1.4523	0.0179	1.5899	20.2208	2.3662	
	1A4c	437.3818	0.0785	0.0036	6.4990	5.5882	1.0990	
1999	1A4	**1849.2274**	**1.5519**	**0.0235**	**6.3673**	**27.8802**	**3.4965**	**5.6539**
	1A4a	261.3460	0.0545	0.0037	0.2838	4.6084	0.4708	
	1A4b	1279.1010	1.4434	0.0172	1.5280	19.3531	2.2548	
	1A4c	308.7804	0.0541	0.0025	4.5555	3.9187	0.7709	
2000	1A4	**1521.1745**	**1.5001**	**0.0217**	**5.1110**	**25.6371**	**3.1853**	**4.9842**
	1A4a	228.7467	0.0565	0.0031	0.2509	3.7235	0.3844	
	1A4b	1054.4654	1.4092	0.0167	1.3272	18.9347	2.2094	
	1A4c	237.9625	0.0345	0.0019	3.5328	2.9789	0.5915	
2001	1A4	**1452.2801**	**1.2790**	**0.0202**	**4.9262**	**23.7036**	**2.9651**	**4.4063**
	1A4a	260.3201	0.0705	0.0035	0.2873	4.0938	0.4252	
	1A4b	961.1635	1.1722	0.0149	1.2101	16.6767	1.9608	
	1A4c	230.7964	0.0364	0.0019	3.4288	2.9331	0.5791	
2002	1A4	**1767.4954**	**1.6165**	**0.0238**	**5.8213**	**27.9602**	**3.4688**	**5.7726**
	1A4a	448.4583	0.0977	0.0043	0.4557	5.1178	0.5306	
	1A4b	1062.3936	1.4790	0.0174	1.3649	19.4216	2.2619	
	1A4c	256.6435	0.0397	0.0021	4.0007	3.4208	0.6763	
2003	1A4	**2076.4566**	**1.8136**	**0.0255**	**5.7520**	**30.1763**	**3.6347**	**7.6472**
	1A4a	574.4129	0.2153	0.0072	0.6102	8.8708	0.9407	
	1A4b	1265.7189	1.5614	0.0164	1.4962	18.1804	2.0770	
	1A4c	236.3248	0.0369	0.0019	3.6456	3.1251	0.6170	
2004	1A4	**2265.0630**	**1.4754**	**0.0220**	**5.4847**	**24.9636**	**3.0161**	**6.3810**
	1A4a	829.3860	0.1591	0.0061	0.8081	7.0293	0.7305	
	1A4b	1221.0034	1.2853	0.0142	1.4191	15.1733	1.7382	
	1A4c	214.6736	0.0310	0.0017	3.2575	2.7610	0.5473	
2005	1A4	**2216.1375**	**1.5670**	**0.0217**	**5.0697**	**24.6433**	**2.9563**	**6.1363**
	1A4a	706.2874	0.1435	0.0052	0.6882	6.0786	0.6339	
	1A4b	1327.4402	1.3965	0.0150	1.5220	16.1366	1.8409	
	1A4c	182.4099	0.0270	0.0015	2.8594	2.4280	0.4814	
2006	1A4	**2206.7315**	**1.7398**	**0.0230**	**5.0458**	**26.3516**	**3.1512**	**6.4079**
	1A4a	650.3973	0.0612	0.0039	0.6115	4.4931	0.4496	
	1A4b	1379.1178	1.6495	0.0176	1.6206	19.4247	2.2224	
	1A4c	177.2164	0.0292	0.0015	2.8137	2.4338	0.4792	
2007	1A4	**1664.8721**	**1.3257**	**0.0190**	**4.1589**	**21.6076**	**2.6207**	**4.6981**
	1A4a	362.4683	0.1256	0.0040	0.3789	4.9183	0.5223	
	1A4b	1151.0977	1.1797	0.0138	1.3565	14.6694	1.6946	
	1A4c	151.3061	0.0204	0.0012	2.4235	2.0199	0.4038	

		CO_2	CH_4	N_2O	NO_x	CO	NMVOC	SO_2
2008	1A4	**1671.5326**	**1.3581**	**0.0198**	**4.0887**	**22.4985**	**2.7338**	**4.5003**
	1A4a	367.6021	0.1360	0.0040	0.3880	4.8353	0.5176	
	1A4b	1155.3499	1.1995	0.0146	1.3823	15.6854	1.8249	
	1A4c	148.5806	0.0226	0.0012	2.3184	1.9778	0.3914	
2009	1A4	**1852.8870**	**1.4003**	**0.0200**	**4.1224**	**22.2567**	**2.6828**	**4.9038**
	1A4a	466.3586	0.1777	0.0049	0.5007	5.4897	0.5946	
	1A4b	1248.4325	1.1987	0.0140	1.4399	14.8592	1.7143	
	1A4c	138.0959	0.0240	0.0012	2.1818	1.9078	0.3740	
2010	1A4	**1986.9783**	**2.9042**	**0.0378**	**4.9119**	**44.5507**	**5.3609**	**6.4779**
	1A4a	480.8328	0.1451	0.0039	0.4973	4.1610	0.4506	
	1A4b	1350.0752	2.7319	0.0326	1.9724	38.2499	4.4913	
	1A4c	156.0703	0.0272	0.0013	2.4423	2.1398	0.4190	
2011	1A4	**2304.5277**	**3.4138**	**0.0454**	**5.3001**	**53.3094**	**6.4101**	**6.7712**
	1A4a	804.5970	0.1601	0.0041	0.7682	4.2039	0.4497	
	1A4b	1349.6853	3.2254	0.0400	2.1815	47.0118	5.5530	
	1A4c	150.2455	0.0284	0.0013	2.3504	2.0937	0.4073	
2012	1A4	**2269.1808**	**3.6979**	**0.0477**	**5.2335**	**56.3886**	**6.7561**	**7.4276**
	1A4a	780.3670	0.1702	0.0041	0.7476	4.2998	0.4633	
	1A4b	1342.4213	3.4982	0.0423	2.2262	50.0410	5.8973	
	1A4c	146.3925	0.0295	0.0013	2.2598	2.0477	0.3955	
2013	1A4	**1945.5770**	**4.1985**	**0.0542**	**5.3637**	**64.9480**	**7.8002**	**8.2087**
	1A4a	471.6212	0.1314	0.0035	0.4697	3.9813	0.4276	
	1A4b	1309.0059	4.0281	0.0492	2.3712	58.6555	6.9290	
	1A4c	164.9499	0.0391	0.0014	2.5228	2.3112	0.4435	

Within the 1A4 'Other Sectors', in 2013 the level of GHG emissions, compared to the level of emissions registered in the reference year, represented: for CO_2 emissions - circa 25.1 per cent, for CH_4 – 36.1 per cent, for N_2O – 54.5 per cent, for NO_x – 15.2 per cent, for CO – 15.1 per cent, for NMVOC – 51.0 per cent and for SO_2 – 13.6 per cent (Table 3-86).

Table 3-86: GHG Emissions from the Category 1A4 'Other Sectors' within 1990-2013 periods, where 1990 represents 100 per cent

	1990	1991	1992	1993	1994	1995	1996	1997
CO_2	100.0	81.1	56.5	29.0	27.2	28.3	29.5	32.5
CH_4	100.0	76.6	36.6	30.3	32.0	21.5	28.5	16.5
N_2O	100.0	82.3	51.2	48.1	42.6	39.0	40.8	27.3
NO_x	100.0	74.7	48.0	35.2	33.8	37.5	31.5	31.2
CO	100.0	75.7	42.4	47.3	43.1	38.7	40.4	26.5
NMVOC	100.0	76.7	45.5	49.1	44.6	42.0	41.9	28.6
SO_2	100.0	93.2	44.2	24.9	24.6	16.3	20.5	14.1
	1998	1999	2000	2001	2002	2003	2004	2005
CO_2	27.2	23.8	19.6	18.7	22.8	26.7	29.2	28.5
CH_4	13.8	13.3	12.9	11.0	13.9	15.6	12.7	13.5
N_2O	26.9	23.7	21.9	20.4	23.9	25.7	22.1	21.8
NO_x	23.9	18.0	14.4	13.9	16.5	16.3	15.5	14.3
CO	25.6	21.9	20.2	18.7	22.0	23.8	19.7	19.4
NMVOC	27.2	22.9	20.8	19.4	22.7	23.8	19.7	19.3
SO_2	11.2	9.3	8.2	7.3	9.5	12.6	10.5	10.1
	2006	2007	2008	2009	2010	2011	2012	2013
CO_2	28.4	21.4	21.5	23.9	25.6	29.7	29.2	25.1
CH_4	14.9	11.4	11.7	12.0	24.9	29.3	31.8	36.1
N_2O	23.1	19.1	20.0	20.1	38.0	45.7	48.0	54.5
NO_x	14.3	11.8	11.6	11.7	13.9	15.0	14.8	15.2
CO	20.7	17.0	17.7	17.5	35.1	42.0	44.4	51.1
NMVOC	20.6	17.1	17.9	17.5	35.0	41.9	44.2	51.0
SO_2	10.6	7.8	7.4	8.1	10.7	11.2	12.3	13.6

In 2013, the 'Other Sectors' category accounted for 16.0 per cent of the total national direct GHG emissions (without LULUCF), being an important source of direct GHG emissions. To be noted that this category also represented an important source of CH_4 and N_2O emissions, accounting for 3.3 per cent, respectively 1.0 per cent of total national CH_4 and N_2O emissions.

Within the 1990-2013 time periods, the total direct GHG emissions originated from the 1A4 'Other Sectors' category tended to lower values, decreasing by 74.5 per cent: from 8037.78 to 2050.54 Gg CO_2 equivalent (Figure 3-11, Table 3-87).

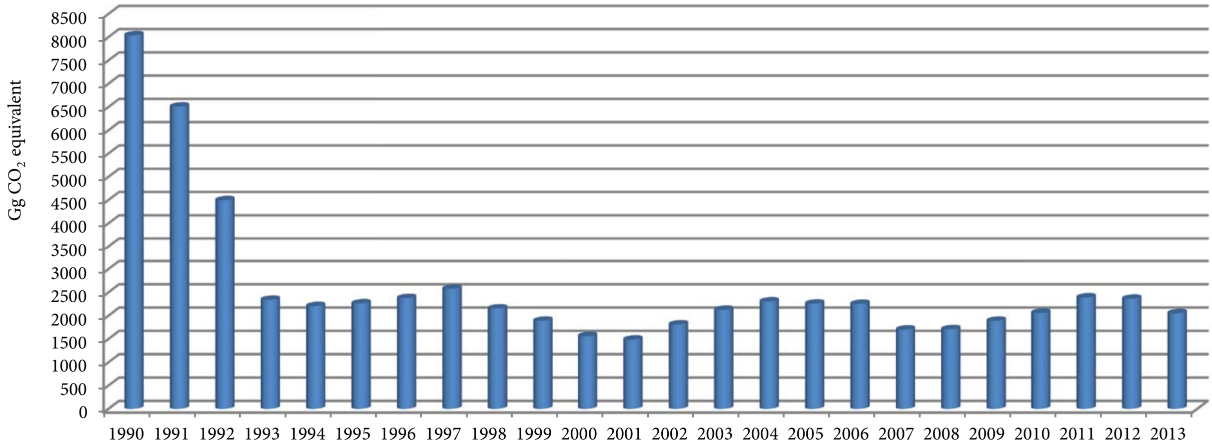

Figure 3-11: GHG Emissions from 1A4 'Other Sectors' Category in the Republic of Moldova within 1990-2013 periods, Gg CO_2 equivalent

Table 3-87: Direct GHG Emissions from 1A4 'Other Sectors' in the Republic of Moldova within 1990-2013 periods, Gg CO_2 equivalent

		1990	1991	1992	1993	1994	1995	1996	1997
CO_2	GHG Emissions, Gg CO_2 equivalent	7762.4898	6294.8303	4388.8608	2249.3719	2112.0567	2197.0892	2293.7489	2526.3271
CH_4		244.4965	187.2196	89.5761	73.9626	78.1965	52.5083	69.6841	40.3002
N_2O		30.7924	25.3485	15.7541	14.8054	13.1158	11.9968	12.5489	8.4061
Total		**8037.7787**	**6507.3984**	**4494.1909**	**2338.1399**	**2203.3690**	**2261.5942**	**2375.9818**	**2575.0334**
CO_2	Share in the total GHG emissions, %	96.58	96.73	97.66	96.20	95.86	97.15	96.54	98.11
CH_4		3.04	2.88	1.99	3.16	3.55	2.32	2.93	1.57
N_2O		0.38	0.39	0.35	0.63	0.60	0.53	0.53	0.33
		1998	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**
CO_2	GHG Emissions, Gg CO_2 equivalent	2108.9252	1849.2274	1521.1745	1452.2801	1767.4954	2076.4566	2265.0630	2216.1375
CH_4		33.8496	32.5908	31.5020	26.8590	33.9460	38.0855	30.9842	32.9078
N_2O		8.2907	7.2839	6.7394	6.2737	7.3728	7.9135	6.8063	6.7205
Total		**2151.0656**	**1889.1021**	**1559.4160**	**1485.4127**	**1808.8142**	**2122.4556**	**2302.8534**	**2255.7659**
CO_2	Share in the total GHG emissions, %	98.04	97.89	97.55	97.77	97.72	97.83	98.36	98.24
CH_4		1.57	1.73	2.02	1.81	1.88	1.79	1.35	1.46
N_2O		0.39	0.39	0.43	0.42	0.41	0.37	0.30	0.30
		2006	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**
CO_2	GHG Emissions, Gg CO_2 equivalent	2206.7315	1664.8721	1671.5326	1852.8870	1986.9783	2304.5277	2269.1808	1945.5770
CH_4		36.5352	27.8398	28.5194	29.4070	60.9880	71.6896	77.6561	88.1695
N_2O		7.1176	5.8959	6.1478	6.1962	11.7105	14.0627	14.7928	16.7922
Total		**2250.3843**	**1698.6077**	**1706.1998**	**1888.4903**	**2059.6768**	**2390.2800**	**2361.6297**	**2050.5388**
CO_2	Share in the total GHG emissions, %	98.06	98.01	97.97	98.11	96.47	96.41	96.09	94.88
CH_4		1.62	1.64	1.67	1.56	2.96	3.00	3.29	4.30
N_2O		0.32	0.35	0.36	0.33	0.57	0.59	0.63	0.82

Compared to 1990, by 2013, the direct GHG emissions originated in 1A4 'Other Sectors' source category accounted for circa 25.5 per cent (Table 3-88).

Table 3-88: GHG Emissions from 1A4 'Other Sectors' Category within 1990-2013 time periods, where 1990 represents 100 per cent

	1990	1991	1992	1993	1994	1995	1996	1997
CO_2	100.0	81.1	56.5	29.0	27.2	28.3	29.5	32.5
CH_4	100.0	76.6	36.6	30.3	32.0	21.5	28.5	16.5
N_2O	100.0	82.3	51.2	48.1	42.6	39.0	40.8	27.3
Total	100.0	81.0	55.9	29.1	27.4	28.1	29.6	32.0
	1998	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**
CO_2	27.2	23.8	19.6	18.7	22.8	26.7	29.2	28.5
CH_4	13.8	13.3	12.9	11.0	13.9	15.6	12.7	13.5
N_2O	26.9	23.7	21.9	20.4	23.9	25.7	22.1	21.8
Total	26.8	23.5	19.4	18.5	22.5	26.4	28.7	28.1
	2006	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**
CO_2	28.4	21.4	21.5	23.9	25.6	29.7	29.2	25.1
CH_4	14.9	11.4	11.7	12.0	24.9	29.3	31.8	36.1
N_2O	23.1	19.1	20.0	20.1	38.0	45.7	48.0	54.5
Total	28.0	21.1	21.2	23.5	25.6	29.7	29.4	25.5

The decreasing trend in GHG emissions is characteristic to all sources under the category 1A4 'Other Sectors': 1A4a decreased by 66.6 per cent; 1A4b - by 69.8 per cent; 1A4c - by 91.5 per cent (Figure 3-12, Table 3-89).

Table 3-89: Direct GHG Emissions within 1A4 'Other Sectors' Category by Source within 1990-2013 periods, Gg CO_2 equivalent

	1990	1991	1992	1993	1994	1995	1996	1997
1A4a 'Commercial / Institutional Sector'	1424.0685	808.9106	380.6989	569.3391	403.6435	398.1422	368.7724	326.7785
1A4b 'Residential Sector'	4657.3239	3511.6971	2489.8212	1060.5292	1164.6211	1132.1712	1428.2501	1668.2665
1A4c 'Agriculture / Forestry / Fishing Sector'	1956.3862	2186.7907	1623.6708	708.2716	635.1044	731.2809	578.9593	579.9885
1A4 'Other Sectors'	8037.7787	6507.3984	4494.1909	2338.1399	2203.3690	2261.5942	2375.9818	2575.0334
	1998	1999	2000	2001	2002	2003	2004	2005
1A4a 'Commercial / Institutional Sector'	338.9146	263.6408	230.8968	262.8719	451.8441	581.1564	834.6139	710.9191
1A4b 'Residential Sector'	1372.0178	1314.7584	1089.2413	990.3885	1098.8397	1303.6011	1252.3923	1361.4120
1A4c 'Agriculture / Forestry / Fishing Sector'	440.1331	310.7029	239.2779	232.1523	258.1304	237.6981	215.8473	183.4348
1A4 'Other Sectors'	2151.0656	1889.1021	1559.4160	1485.4127	1808.8142	2122.4556	2302.8534	2255.7659
	2006	2007	2008	2009	2010	2011	2012	2013
1A4a 'Commercial / Institutional Sector'	652.8965	366.3582	371.7121	471.5949	485.0870	809.2339	785.2225	475.4756
1A4b 'Residential Sector'	1419.1993	1180.1395	1185.0593	1277.9343	1417.5418	1429.8049	1429.0009	1408.8471
1A4c 'Agriculture / Forestry / Fishing Sector'	178.2885	152.1100	149.4284	138.9611	157.0480	151.2413	147.4063	166.2161
1A4 'Other Sectors'	2250.3843	1698.6077	1706.1998	1888.4903	2059.6768	2390.2800	2361.6297	2050.5388

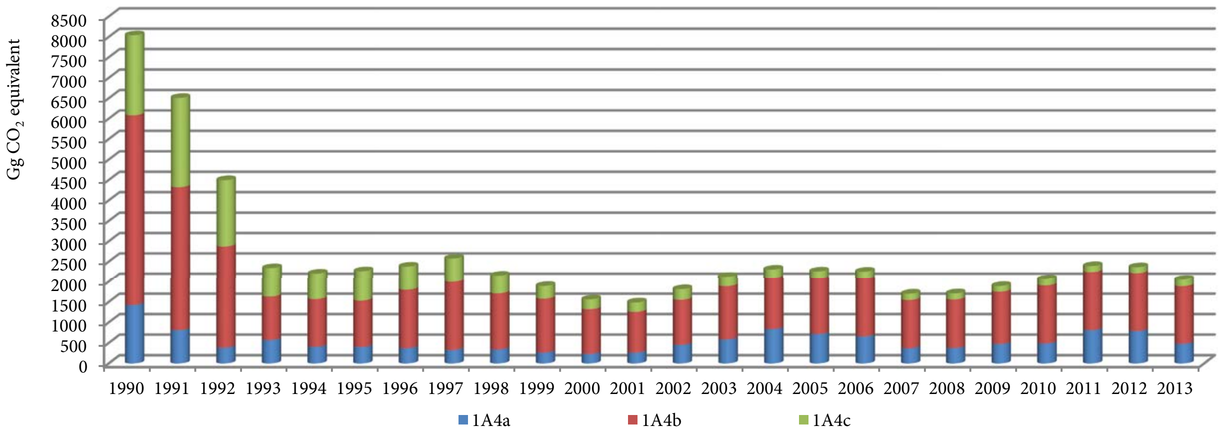

Figure 3-12: Direct GHG Emissions within 1A4 'Other Sectors' Category, by Source, in the Republic of Moldova within 1990-2013 periods

The emissions source having the largest share in the total GHG emissions under category 1A4 'Other Sectors' is 1A4b 'Residential', with a share that varied over the reference period from the minimum of 45.4 per cent in 1993 to a maximum of 69.8 per cent in 2000. Another major emission source is represented by 1A4a 'Commercial/Institutional', with a share varying between 8.5 per cent in 1992 to 36.2 per cent in 2004. The share of 1A4c 'Agriculture/Forestry/Fishing' varied between 6.2 per cent in 2012 and 36.1 per cent in 1992 (Figure 3-13, Table 3-90).

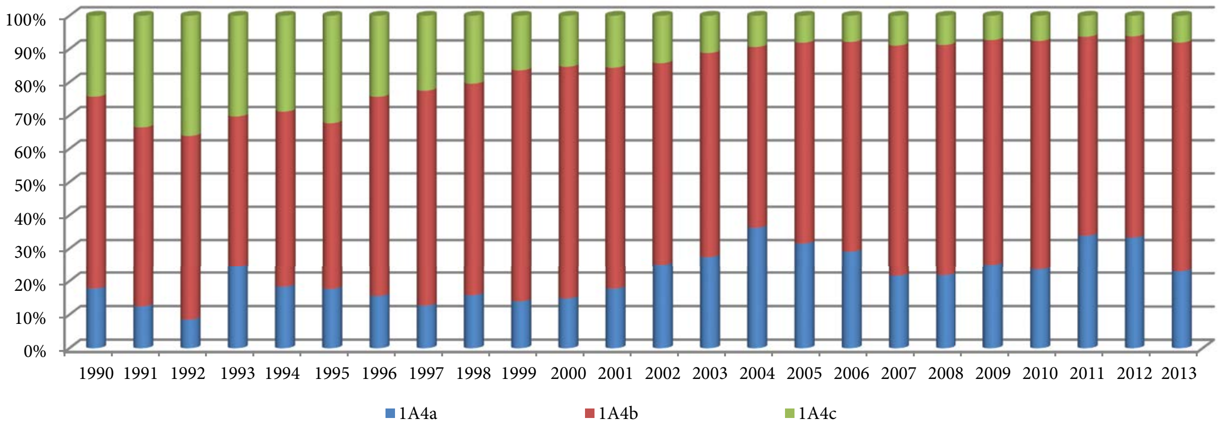

Figure 3-13: Breakdown of the 1A4 'Other Sectors' Category Direct GHG Emissions by Source within 1990-2013 periods, %

Table 3-90: Breakdown of the 1A4 'Other Sectors' Category Direct GHG Emissions by Source, within 1990-2013 periods, %

	1990	1991	1992	1993	1994	1995	1996	1997
1A4a 'Commercial / Institutional Sector'	17.7	12.4	8.5	24.4	18.3	17.6	15.5	12.7
1A4b 'Residential Sector'	57.9	54.0	55.4	45.4	52.9	50.1	60.1	64.8
1A4c 'Agriculture / Forestry / Fishing Sector'	24.3	33.6	36.1	30.3	28.8	32.3	24.4	22.5

	1998	1999	2000	2001	2002	2003	2004	2005
1A4a 'Commercial / Institutional Sector'	15.8	14.0	14.8	17.7	25.0	27.4	36.2	31.5
1A4b 'Residential Sector'	63.8	69.6	69.8	66.7	60.7	61.4	54.4	60.4
1A4c 'Agriculture / Forestry / Fishing Sector'	20.5	16.4	15.3	15.6	14.3	11.2	9.4	8.1
	2006	2007	2008	2009	2010	2011	2012	2013
1A4a 'Commercial / Institutional Sector'	29.0	21.6	21.8	25.0	23.6	33.9	33.2	23.2
1A4b 'Residential Sector'	63.1	69.5	69.5	67.7	68.8	59.8	60.5	68.7
1A4c 'Agriculture / Forestry / Fishing Sector'	7.9	9.0	8.8	7.4	7.6	6.3	6.2	8.1

3.5.2 Methodological Issues, Emission Factors and Activity Data

1A4a 'Commercial / Institutional Sector'

GHG emissions originated from the 1A4a 'Commercial/Institutional' source category were estimated following a Tier 1 methodology (based on activity data on fuel consumption and default emission factors values).

EFs used for estimating CO_2 emissions are described in Table 3-11. Default values of EFs available in the Revised 1996 IPCC Guidelines (IPCC, 1997) and 2006 IPCC Guidelines were used to estimate non-CO_2 emissions (Table 3-91).

Table 3-91: Emission Factors Used to Estimate Non-CO_2 Emissions from 1A4a 'Commercial / Institutional', kg/TJ

Fuel Type	CH_4	N_2O	NOx	CO	NMVOC
Coal	10	1.5	100	2000	200
Natural Gas	5	0.1	50	50	5
Oil Products	10	0.6	100	20	5
Fuel Wood	300	4	100	5000	600
Other Biomass	300	4	100	5000	600

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, Chap. 2, Tab. 2.5, Pages 2.22 - 2.23

Activity data related to fuel consumption in commercial and institutional sectors (Table 3-92) are available in the Energy Balances of the Republic of Moldova (see Chapter S.2.1 'Consumed as Fuel or Energy', in columns: "for Commerce" and "for Communal Services").

Table 3-92: Fuel Consumption under the 1A4a 'Commercial/Institutional' in the Republic of Moldova within 1990-2013 periods

Fuel Type	1990	1991	1992	1993	1994	1995	1996	1997
Kerosene, kt	1.0	0.0	0.0	1.1	0.0	1.0	1.0	2.4
Diesel Oil, kt	32.0	25.0	15.0	4.9	3.0	2.0	2.0	2.0
Residual Oil, kt	21.0	33.0	40.0	12.6	6.0	6.0	5.0	1.0
Kerosene, kt	6.0	4.7	10.6	1.0	2.8	1.0	1.0	0.0
Anthracite, kt	452.0	178.0	0.0	61.7	27.0	17.0	18.0	15.0
Other Bituminous Coal, kt	2.0	31.4	31.6	97.8	94.0	108.0	91.0	87.0
Lignite, kt	1.0	1.0	0.0	41.0	30.0	24.0	26.0	15.0
Natural Gas, mil. m^3	42.0	42.0	51.3	33.8	18.0	17.0	22.0	22.0
Fuel Type	1998	1999	2000	2001	2002	2003	2004	2005
Kerosene, kt	1.3	2.6	4.6	3.2	3.2	1.0	1.0	1.0
Diesel Oil, kt	2.0	4.0	4.0	6.0	2.0	1.0	3.0	1.0
Residual Oil, kt	1.0	1.0	1.0	2.0	1.0	1.0	1.0	0.0
Anthracite, kt	13.0	13.0	25.0	11.0	27.0	70.0	0.0	0.0
Other Bituminous Coal, kt	98.0	65.0	34.0	52.0	50.0	46.0	69.0	55.0
Lignite, kt	13.0	6.0	5.0	4.0	3.0	1.0	32.0	30.0
Natural Gas, mil. m^3	18.0	21.7	25.3	35.6	124.8	145.5	296.1	257.5
Fuel Type	2006	2007	2008	2009	2010	2011	2012	2013
Kerosene, kt	0.0	0.0	0.0	0.0	1.0	0.0	0.0	0.0
Gasoline, kt	0.0	1.0	1.0	0.0	0.0	0.0	0.0	0.0
Diesel Oil, kt	1.0	0.0	0.0	0.0	3.0	3.0	0.0	0.0
Residual Oil, kt	0.0	0.0	2.0	4.0	1.0	0.0	0.0	0.0
Liquefied Fuel Oil, kt	1.0	1.0	1.0	8.0	7.0	2.0	3.0	3.0
Anthracite, kt	44.0	39.0	31.0	46.0	32.0	34.0	36.0	37.0
Other Bituminous Coal, kt	36.0	24.0	27.0	13.0	11.0	8.0	4.0	6.0
Natural Gas, mil. m^3	235.1	105.4	111.7	149.1	177.7	360.2	353. 3	186. 9

Source: EBs of the RM for 1990, 1993-2013; Official Letter from „Moldovagaz"J.S.C., No. 604 dated 01.04.1999, answer to Letter No. 02-541 dated 28.05.2001 from the MoEN; Letter No. 02-156 dated 06.02.2004, answer to Letter No. 257-01-07 dated 26.01.2004 from the MENR; Letter No. 06-1253 dated 27.09.2006, answer to Letter No. 01-07/1400 dated 25.08.2006 from the MoEN; Letter No.02/1-476 dated 23.02.2011, answer to Letter No. 03-07/175 dated 02.02.2011 from the MoEN; Letter No.02/1-288 dated 22.012.2014, answer to Letter No. 320/2014-01-01 dated 03.01.2014 from the Climate Change Office; Letter No. 02/1-507 dated 10.02.2015, answer to Letter No. 407/2015-01-09 dated 29.01.2015 from the Climate Change Office.

As for the fuel consumption in commercial and institutional sectors on the left bank of Dniester River (ATULBD), AD are available only for 1999-2014 time series (Table 3-93) and the main sources of references are the Official Letters from „Moldovagaz" J.S.C.

Table 3-93: Fuel Consumption under the 1A4a 'Commercial/Institutional' Source Category in the ATULBD within 1999-2014 periods

	1999	2000	2001	2002	2003	2004	2005	2006
Natural Gas, mil. m^3	6.7	9.3	13.6	81.8	87.5	229.1	181.5	152.1
	2007	2008	2009	2010	2011	2012	2013	2014
Natural Gas, mil. m^3	14.4	19.7	16.1	37.7	209.2	202.3	99.9	105.1

Source: Official Letter from „Moldovagaz" J.S.C., No. 02/1-476 dated 23.02.2011, answer to Letter No. 03-07/175 dated 02.02.2011 from the Ministry of Environment; Letter No. 02/1-288 dated 22.01.2014, answer to Letter No. 320/2014-01-01 dated 03.01.2014 from the Climate Change Office; Letter No. 02/1-507 dated 10.02.2015, answer to Letter No. 407/2015-01-09 dated 29.01.2015 from the Climate Change Office.

1A4b 'Residential Sector'

GHG emissions originated from the 1A4b 'Residential' source category were estimated following a Tier 1 methodology (based on AD on fuel consumption and default EFs values). EFs used to estimate CO_2 emissions are described in Table 3-11. In order to estimate non-CO_2 emissions default EFs values available in the Revised 1996 IPCC Guidelines (IPCC, 1997) and 2006 IPCC Guidelines were used (Table 3-94).

Table 3-94: Emission Factors Used to Estimate Non-CO_2 Emissions from 1A4b 'Residential' Source Category, kg/TJ

Fuel Type	CH_4	N_2O	NOx	CO	NMVOC
Coal	300	1.5	100	2000	200
Natural Gas	5	0.1	50	50	50
Oil Products	10	0.6	100	20	5
Fuel Wood	300	4	100	5000	600
Other Biomass	300	4	100	5000	600

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, Chap. 2, Tab. 2.5, Pages 2.22-2.23

For the territory on the Right Bank of Dniester River, activity data related to fuel consumption in residential sector (Table 3-95) are available in the Energy Balances of the Republic of Moldova (see Chapter S.2.1 'Consumed as Fuel or Energy', in column: "Sold to Population"); the amount of 'Diesel Oil' and 'Gasoline' were reallocated to 1A3b 'Road Transportation' source category.

Table 3-95: Fuel Consumption under the 1A4b 'Residential' within 1990-2013 periods

	1990	1991	1992	1993	1994	1995	1996	1997
Kerosene, kt	10.0	0.0	0.0	0.6	0.0	0.0	0.0	0.0
Diesel Oil, kt	28.0	202.0	13.0	0.3	0.0	0.0	0.0	0.0
Residual Fuel Oil, kt	0.0	26.5	191.9	0.0	1.0	0.0	0.0	0.0
Liquefied Petroleum Gas, kt	125.0	0.0	18.8	28.6	12.0	14.5	17.5	21.4
Anthracite, kt	1264.0	200.0	0.0	93.6	136.0	51.0	60.0	70.0
Other Bituminous Coal, kt	30.0	384.9	155.7	61.8	118.0	21.0	132.0	38.0
Lignite, kt	164.0	441.0	0.0	16.9	3.0	2.0	2.0	3.0
Natural Gas, mil. m^3	257.0	311.0	704.5	258.3	217.0	448.6	438.0	680.3
	1998	1999	2000	2001	2002	2003	2004	2005
Diesel Oil, kt	0.0	2.0	1.0	0.0	0.0	0.0	0.0	0.0
Residual Fuel Oil, kt	0.0	0.0	1.0	0.0	0.0	0.0	0.0	0.0
Liquefied Fuel Oil, kt	21.3	25.8	28.0	27.3	42.4	42.5	46.5	45.5
Anthracite, kt	17.0	37.0	44.0	28.0	57.0	87.0	67.0	77.0
Other Bituminous Coal, kt	24.0	13.0	6.0	0.0	1.0	4.0	3.0	4.0
Lignite, kt	0.0	1.0	0.0	1.0	0.0	0.0	0.0	0.0
Natural Gas, mil. m^3	617.7	564.4	438.6	426.4	417.4	480.6	478.8	521.8
	2006	2007	2008	2009	2010	2011	2012	2013
Diesel Oil, kt	0.0	0.0	0.0	1.0*	0.0	0.0	0.0	0.0
Liquefied Fuel Oil, kt	43.4	45.5	43.4	42.6	40.6	54.6	56.5	58.4
Anthracite, kt	90.0	51.0	43.0	55.0	83.0	72.0	94.0	97.0
Other Bituminous Coal, kt	3.0	3.0	2.0	0.0	0.0	3.0	1.0	1.0
Natural Gas, mil. m^3	536.2	464.8	482.0	499.0	538.3	527.5	494.1	469.6

Source: Energy Balances of the RM for 1990, 1993-2013. **Note:** * - reallocated from „Other Oil Products" to „Diesel Oil" category; Official Letter from „Moldovagaz" J.S.C., No. 604 dated 01.04.1999, answer to Letter No. 02-541 dated 28.05.2001 from the MoEN; Letter No. 02-156 dated 06.02.2004, answer to Letter No. 257-01-07 dated 26.01.2004 from the MENR; Letter No. 06-1253 dated 27.09.2006, answer to Letter No.01-07/1400 dated 25.08.2006 from the MoEN; Letter No. 02/1-476 dated 23.02.2011, answer to Letter No. 03-07/175 dated 02.02.2011 from the MoEN; Letter No. 02/1-288 dated 22.012.2014, answer to Letter No. 320/2014-01-01 dated 03.01.2014 from the Climate Change Office; Letter No. 02/1-507 dated 10.02.2015, answer to Letter No. 407/2015-01-09 dated 29.01.2015 from the Climate Change Office; Statistical Yearbooks of the ATULBD for 2000 (page 22), 2006 (page 22), 2012 (page 23), 2014 (page 24).

Table 3-96: Fuel Consumption under the 1A4b 'Residential' for ATULBD within 1995-2013

	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
Natural Gas, million m³	216.6	163.4	354.8	321.6	293.2	217.9	196.4	175.4	176.6	162.8
LPG, kt	2.5000	2.3000	1.4000	1.3000	0.8000	0.4000	0.3000	0.4000	0.5000	0.5000
Electricity, mil kWh	397.6	434.5	316.1	293.7	286.9	253.1	249.4	264.1	260.4	254.1
	2005	2006	2007	2008	2009	2010	2011	2012	2013	%
Natural Gas, million m³	164.8	161.2	150.8	150.0	156.0	174.3	184.5	184.1	180.6	-16.6
LPG, kt	0.5000	0.5000	0.4486	0.4962	0.3869	0.5798	0.6060	0.4767	0.3863	-84.5
Electricity, mil kWh	258.9	272.8	282.4	285.9	319.5	329.4	330.2	352.3	354.1	-10.9

Source: Statistical Yearbooks of the ATULBD for 2000 (page 22), 2003 (page 22), 2006 (page 22), 2009 (page 23), 2010 (page 23), 2011 (page 23), 2012 (page 23), 2014 (page 23).

For the territory on the Left Bank of Dniester River, the main data source is the Statistical Yearbooks of the ATULBD (that contain AD regarding liquefied petroleum gases, natural gas and electricity consumption in Residential Sector)

1A4c 'Agriculture/Forestry/Fishing Sectors'

GHG emissions originated from the 1A4c 'Agriculture/Forestry/Fishing' source category were estimated following a Tier 1 methodology (based on the AD regarding fuel consumption and default EFs). Default EFs values available in the Revised 1996 IPCC Guidelines (IPCC, 1997) and 2006 IPCC Guidelines were used for estimating non-CO_2 emissions (Table 3-97).

Table 3-97: Emission Factors Used to Estimate Non-CO_2 Emissions from 1A4c 'Agriculture / Forestry / Fishing' Source Category, kg/TJ

Fuel Type	CH_4	N_2O	NOx		CO		NMVOC	
			stationary	mobile	stationary	mobile	stationary	mobile
Coal	300	1.5	100		2000		200	
Natural Gas	5	0.1	50	1000	50	400	5	5
Petroleum Products	10	0.6	100	1200	20	1000	5	200
Fuel Wood	300	4	100		5000		600	
Other Biomass	300	4	100		5000		600	

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

Activity data related to fuel consumption in agriculture, forestry and fishing (Table 3-98) are available in the Energy Balances of the RM for the territory on the Right Bank of Dniester River (see Chapter S.2.1 'Consumed as Fuel or Energy', in column: "for agriculture"; 10 per cent of the Diesel Oil share was reallocated to 1A3b 'Transport' source category, while the rest of 90 per cent – to 1A4c Agriculture / Forestry / Fishing' ('Mobile Combustion') sub-category).

Table 3-98: Fuel Consumption under the 1A4c 'Agriculture/Forestry/Fishing' Source Category on the Right Bank of Dniester River within 1990-2013 periods

	1990	1991	1992	1993	1994	1995	1996	1997
Gasoline, kt	7.000	6.400	3.800	1.300	2.000	11.700	11.100	11.900
Kerosene, kt	9.000	0.000	0.000	5.700	1.000	0.000	0.000	0.000
Diesel Oil (Stationary), kt	27.000	9.600	4.800	6.300	1.000	6.000	3.000	2.000
Diesel Oil (Mobile), kt	549.000	396.000	243.000	196.300	190.800	207.673	162.737	160.000
Residual Fuel Oil, kt	6.000	25.000	17.000	5.000	0.000	0.000	0.000	1.000
Kerosene, kt	1.000	79.500	56.300	0.300	0.000	0.000	0.000	1.000
Anthracite, kt	21.000	0.000	0.000	3.800	2.000	1.000	1.000	0.000
Other Bituminous Coal, kt	0.000	153.700	150.700	4.800	3.000	2.000	3.000	1.000
Lignite, kt	0.000	0.000	0.000	1.400	1.000	1.000	0.000	0.000
Natural Gas, mil. m³	2.000	84.300	108.300	2.000	2.000	5.000	5.000	10.000
	1998	1999	2000	2001	2002	2003	2004	2005
Gasoline, kt	7.800	4.100	2.800	2.700	1.200	1.300	0.800	0.600
Diesel Oil (Stationary), kt	6.000	3.000	4.000	5.000	1.000	1.000	0.000	0.000
Diesel Oil (Mobile), kt	118.370	84.303	65.858	63.849	76.864	69.841	62.737	55.255
Residual Fuel Oil, kt	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003
Other Bituminous Coal, kt	2.000	1.000	0.000	0.000	0.000	0.000	0.000	0.000
Natural Gas, mil. m³	9.000	5.000	5.000	3.000	4.000	4.900	7.700	3.400
	2006	2007	2008	2009	2010	2011	2012	2013
Gasoline, kt	0.574	0.398	0.334	0.423	0.660	0.582	0.613	0.849
Diesel Oil (Mobile), kt	54.424	47.033	44.951	42.204	47.020	45.290	43.440	48.300
Residual Fuel Oil, kt	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003
Other Bituminous Coal, kt	0.000	0.000	0.015	0.012	0.009	0.031	0.024	1.024
Natural Gas, mil. m³	2.100	1.000	3.100	2.000	3.100	3.000	4.000	4.000

For the territory on the left bank of Dniester River, the main activity data sources are: the Statistical Yearbooks of the ATULBD (contain AD on consumption of diesel oil, gasoline and lubricants for agriculture; the lubricants were reallocated to 1A5 'Other' category); annual editions of "Socio-economic development of the Transnistian Moldovan Republic" (available only for 2009-2014 time series) contain AD on consumption of residual fuel oil and coal for agriculture; as well as the Official Letters from „Moldovagaz" J.S.C. containing AD on natural gas consumption within the respective sector (Table 3-99).

Table 3-99: Fuel Consumption under the 1A4c 'Agriculture/Forestry/Fishing' Source Category on the Left Bank of Dniester River within 1995-2014 periods

	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
Gasoline, kt	9.6830	6.1160	8.8580	5.7920	3.0730	1.7550	1.6930	1.2220	1.2580	0.7810
Diesel Oil, kt	29.7480	23.8190	31.7730	24.5220	22.6700	16.1760	15.9490	12.4040	8.6010	7.7080
Natural Gas, mil. m^3	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.9000	0.7000
	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
Gasoline, kt	0.6120	0.5740	0.3980	0.3340	0.4230	0.6608	0.5818	0.6126	0.8485	0.7207
Diesel Oil, kt	5.3940	4.4710	3.2590	2.9450	3.8930	8.2439	9.3260	10.2722	11.6636	11.3853
Natural Gas, mil. m^3	0.4000	0.1000	0.0000	0.1000	0.0000	0.1000	0.1000	0.2000	0.0000	0.0000
Coal, kt	NA	NA	NA	0.0153	0.0115	0.0090	0.0310	0.0240	0.0240	0.0240
Residual Fuel Oil, kt	NA	NA	NA	0.0032	0.0032	0.0032	0.0032	0.0032	0.0032	0.0032

Source: Statistical Yearbooks of the ATULBD for 2000 (page 106), 2003 (page 112), 2006 (page 107), 2009 (page 106), 2010 (page 108), 2011 (page 109), 2012 (page 113), 2014 (page 102). Official Letter from „Moldovagaz" J.S.C., No. 02/1-476 dated 23.02.2011, answer to Letter No. 03-07/175 dated 02.02.2011 from the Ministry of Environment; Letter No. 02/1-288 dated 22.01.2014, answer to Letter No. 320/2014-01-01 dated 03.01.2014 from the Climate Change Office; Letter No. 02/1-507 dated 10.02.2015, answer to Letter No. 407/2015-01-09 dated 29.01.2015 from the Climate Change Office. State Statistical Service of the Transnistrian Moldovan Republic (2015), *Socio-economic development of the TMR, 2014 (final data). Chapter 4 "Material and Energy Resources", page 22* / State Statistical Service of the Ministry of Economy of the TMR - Tiraspol, 2015 – 81p.; State Statistical Service of the Transnistrian Moldovan Republic (2014), *Socio-economic development of the TMR, 2013 (final data). Chapter 4 "Material and Energy Resources", page 22* / State Statistical Service of the Ministry of Economy of the TMR - Tiraspol, 2014 – 88p.; .; State Statistical Service of the Transnistrian Moldovan Republic (2013), *Socio-economic development of the TMR, 2012, Chapter 4 "Material and Energy Resources", page 23*. 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.

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 can be considered relatively low (±5 per cent). Within the 1A4 'Other Sectors' category GHG emissions uncertainties estimated CO_2 emissions at circa ±7.07 per cent, while CH_4 and N_2O, at about ±50.25 per cent. At the same time, combined uncertainties, presented as a per cent of total sectoral emissions were estimated for CO_2 emissions at ±1.4085 per cent; for CH_4 emissions at ±0.4536 per cent; while for N_2O emissions at ±0.0861 per cent. Uncertainties related to the trend of total direct GHG emissions originated in the Energy Sector were estimated at about ±0.3949 per cent for CO_2 emissions, ±0.0335 per cent for CH_4 emissions and ±0.0119 per cent for N_2O emissions (Annex 5-3.1).

In view of ensuring time-series consistency of the obtained results, the same approach was used for the entire period under review, in conformity with the recommendations included in the GPG (IPCC, 2000).

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 (IPCC, 2000). Also, 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 GPG (IPCC, 2000), GHG emissions originated from the 1A4 'Other Sectors' were estimated based on AD and CS NCVs from official sources of information.

3.5.5 Recalculations

1A4a 'Commercial / Institutional Sector'

GHG emission recalculations performed under the 1A4a 'Commercial / Institutional' covering the 1995-2004, 2007 and 2010 years were due to the availability of an updated set of activity data (including for the ATULBD), as well as due to the correction of activity data entry errors: the kerosene was incorrectly entered in the accounting files as liquefied petroleum gas.

In comparison with the results included into the TNC, the performed recalculations under the 1A4a 'Commercial / Institutional' resulted in insignificant increased values of GHG emissions, varying from a minimum of 0.03 per cent in 2003, up to a maximum of 1.21 per cent in 1998 (Table 3-100). For 2011-2013 time periods the GHG emissions from 1A4a 'Commercial / Institutional' were estimated for the first time. The results allow assert that between 1990 and 2013, the GHG emissions originated from this sector decreased by 66.6 per cent.

Table 3-100: Comparative Results of GHG Emissions from 1A4a 'Commercial / Institutional' included into the TNC and the BUR of the RM under the UNFCCC, Gg CO_2 equivalent

	1990	1991	1992	1993	1994	1995	1996	1997
TNC	1424.0685	808.9106	380.6989	569.3391	403.6435	395.0255	365.6557	326.1969
BUR	1424.0685	808.9106	380.6989	569.3391	403.6435	398.1422	368.7724	326.7785
Difference, %	0.0000	0.0000	0.0000	0.0000	0.0000	0.7890	0.8524	0.1783
	1998	1999	2000	2001	2002	2003	2004	2005
TNC	334.8629	263.1959	230.0159	262.1940	451.1369	580.9628	831.4972	710.9191
BUR	338.9146	263.6408	230.8968	262.8719	451.8441	581.1564	834.6139	710.9191
Difference, %	1.2100	0.1690	0.3830	0.2586	0.1568	0.0333	0.3748	0.0000
	2006	2007	2008	2009	2010	2011	2012	2013
TNC	652.8965	366.2886	371.7121	471.5949	484.6585			
BUR	652.8965	366.3582	371.7121	471.5949	485.0870	809.2339	785.2225	475.4756
Difference, %	0.0000	0.0190	0.0000	0.0000	0.0884			

Abbreviations: TNC – Third National Communication; BUR – Biennial Update Report

1A4b 'Residential Sector'

GHG emission recalculations performed under the 1A4b 'Residential Sector' covering the 1999-2000, 2006-2007 and 2009-2010 years were due to the availability of an updated set of activity data, including for both the Right and Left Bank of Dniester River, as well as due to the identification of some mechanical errors related to data entry activities; also, in the previous inventory cycle, natural gas consumption for several years was recorded only for the territory on the Right Bank of Dniester River, without considering ATULBD consumption.

In comparison with the results included into the TNC, the performed recalculations under the 1A4b 'Residential Sector' resulted in increased values of GHG emissions, varying from a minimum of 0.025 per cent in 2007, up to a maximum of 34.9 per cent in 2010, with the exception of 1999 and 2006 when an insignificant decrease of direct GHG emissions was recorded (Table 3-101).

Table 3-101: Comparative Results of GHG Emissions from 1A4b 'Residential Sector' included into the TNC and the BUR of the RM under the UNFCCC, Gg CO_2 equivalent

	1990	1991	1992	1993	1994	1995	1996	1997
TNC	4657.3239	3511.6971	2489.8212	1060.5292	1164.6211	1132.1712	1428.2501	1668.2665
BUR	4657.3239	3511.6971	2489.8212	1060.5292	1164.6211	1132.1712	1428.2501	1668.2665
Difference, %	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	1998	1999	2000	2001	2002	2003	2004	2005
TNC	1372.0178	1314.8603	1081.0535	990.3885	1098.8397	1303.6011	1252.3923	1361.4120
BUR	1372.0178	1314.7584	1089.2413	990.3885	1098.8397	1303.6011	1252.3923	1361.4120
Difference, %	0.0000	-0.0078	0.7574	0.0000	0.0000	0.0000	0.0000	0.0000
	2006	2007	2008	2009	2010	2011	2012	2013
TNC	1419.4916	1179.8472	1185.0593	1242.7960	1050.9161			
BUR	1419.1993	1180.1395	1185.0593	1277.9343	1417.5418	1429.8049	1429.0009	1408.8471
Difference, %	-0.0206	0.0248	0.0000	2.8274	34.8863			

Abbreviations: TNC – Third National Communication; BUR – Biennial Update Report

For 2011-2013 time periods the GHG emissions from 1A4b 'Residential Sector' source category were estimated for the first time. The results allow assert that between 1990 and 2013, the GHG emissions originated from this sector decreased by 69.7 per cent.

1A4c 'Agriculture/Forestry/Fishing Sectors'

GHG emission recalculations performed under the 1A4c 'Agriculture/Forestry/Fishing' covering the 1997, 1999-2002, 2004, 2006-2007 and 2010 years were due to the availability of an updated set of activity data, including for both the Right and Left Bank of Dniester River, as well as due to the identification of some mechanical errors related to data entry activities.

In comparison with the results included into the TNC, the performed recalculations under the 1A4c 'Agriculture/Forestry/Fishing' resulted in increased values of GHG emissions, varying from a minimum of 0.003 per cent in 1999, up to a maximum of 0.54 per cent in 1997 (Table 3-102).

Table 3-102: Comparative Results of GHG Emissions from 1A4c 'Agriculture/Forestry/Fishing' included into the TNC and the BUR of the RM under the UNFCCC, Gg CO_2 equivalent

	1990	1991	1992	1993	1994	1995	1996	1997
TNC	1956.3862	2186.7907	1623.6708	708.2716	635.1044	731.2809	578.9593	576.8718
BUR	1956.3862	2186.7907	1623.6708	708.2716	635.1044	731.2809	578.9593	579.9885
Difference, %	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.5403
	1998	1999	2000	2001	2002	2003	2004	2005
TNC	440.1331	310.6935	239.2685	232.1429	258.1211	237.6981	215.8379	183.4348
BUR	440.1331	310.7029	239.2779	232.1523	258.1304	237.6981	215.8473	183.4348
Difference, %	0.0000	0.0030	0.0039	0.0040	0.0036	0.0000	0.0043	0.0000
	2006	2007	2008	2009	2010	2011	2012	2013
TNC	178.2791	152.1006	149.4284	138.9611	156.9027			
BUR	178.2885	152.1100	149.4284	138.9611	157.0480	151.2413	147.4063	166.2161
Difference, %	0.0053	0.0062	0.0000	0.0000	0.0926			

Abbreviations: TNC – Third National Communication; BUR – Biennial Update Report

For 2011-2013 time periods the GHG emissions from 1A4c 'Agriculture/Forestry/Fishing' were estimated for the first time. The results allow assert that between 1990 and 2013, the GHG emissions originated from this sector decreased by 91.5 per cent.

1A4 'Other Sectors'

GHG emission recalculations were performed under the 1A4 'Other Sectors' covering the 1995-2004, 2006-2007 and 2009-2010 years (details related to the sub-categories included within the respective category can be seen above).

In comparison with the results included into the TNC, the performed recalculations resulted in insignificant increased values of direct GHG emissions, varying from a minimum of 0.009 per cent in 2003, up to a maximum of 21.7 per cent in 2010; with the exception of 2006 when an insignificant decrease of direct GHG emissions was recorded (Table 3-103).

Table 3-103: Comparative Results of GHG Emissions from 1A 'Other Sectors' included into the TNC and the BUR of the RM under the UNFCCC, Gg CO_2 equivalent

	1990	1991	1992	1993	1994	1995	1996	1997
TNC	8037.7787	6507.3984	4494.1909	2338.1399	2203.3690	2258.4776	2372.8651	2571.3352
BUR	8037.7787	6507.3984	4494.1909	2338.1399	2203.3690	2261.5942	2375.9818	2575.0334
Difference, %	0.0000	0.0000	0.0000	0.0000	0.0000	0.1380	0.1313	0.1438
	1998	1999	2000	2001	2002	2003	2004	2005
TNC	2147.0139	1888.7497	1550.3379	1484.7254	1808.0977	2122.2620	2299.7274	2255.7659
BUR	2151.0656	1889.1021	1559.4160	1485.4127	1808.8142	2122.4556	2302.8534	2255.7659
Difference, %	0.1887	0.0187	0.5856	0.0463	0.0396	0.0091	0.1359	0.0000
	2006	2007	2008	2009	2010	2011	2012	2013
TNC	2250.6673	1698.2365	1706.1998	1853.3520	1692.4772			
BUR	2250.3843	1698.6077	1706.1998	1888.4903	2059.6768	2390.2800	2361.6297	2050.5388
Difference, %	-0.0126	0.0219	0.0000	1.8959	21.6960			

Abbreviations: TNC – Third National Communication; BUR – Biennial Update Report

For 2011-2013 time periods the GHG emissions from 1A4 'Other Sectors' were estimated for the first time. The results allow assert that between 1990 and 2013, the GHG emissions originated from this category decreased by 74.5 per cent.

3.5.6 Planned Improvements

Potential improvements within the 1A4 'Other Sectors' category could be possible by updating the AD on fuel consumption on the territory of ATULBD.

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 (see Energy Balances, Chapter S.2.1 'Consumed as Fuel or Energy', in column: "for other works and needs"). To be noted as well that the respective category includes the total amount of lubricants consumed at the national level while the consumption of "oven fuel" was reported together with that of "Diesel Oil".

Between 1990 and 2013, GHG emissions originated from 1A5 'Other' category registered a decreasing trend (Table 3-104).

Table 3-104: GHG Emissions from 1A5 'Other' Category within 1990-2013 periods, Gg

	1990	1991	1992	1993	1994	1995	1996	1997
CO_2	154.2715	303.3231	237.2468	195.8481	156.2586	180.8891	147.1236	143.8993
CH_4	0.0023	0.0000	0.0000	0.0012	0.0013	0.0021	0.0020	0.0023
N_2O	0.0016	0.0024	0.0018	0.0020	0.0015	0.0019	0.0016	0.0016
NO_x	0.4393	0.7977	0.6156	0.5589	0.4338	0.5042	0.4118	0.4053
CO	0.0808	0.0597	0.0462	0.0641	0.0607	0.0967	0.0861	0.0980
NMVOC	0.0126	0.0198	0.0154	0.0139	0.0118	0.0149	0.0123	0.0129
SO_2	0.7646	2.8710	0.7122	1.2993	1.1766	1.7640	1.1793	0.9712
	1998	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**
CO_2	100.2098	56.1841	62.0247	65.7398	65.6289	79.8865	68.9503	67.3380
CH_4	0.0012	0.0022	0.0016	0.0019	0.0018	0.0014	0.0021	0.0041
N_2O	0.0011	0.0008	0.0007	0.0009	0.0009	0.0009	0.0008	0.0007
NO_x	0.2828	0.1658	0.1781	0.1965	0.1948	0.2286	0.1960	0.1913
CO	0.0566	0.0799	0.0592	0.0738	0.0646	0.0588	0.0803	0.0657
NMVOC	0.0085	0.0071	0.0065	0.0075	0.0067	0.0075	0.0080	0.0073
SO_2	0.4613	0.3075	0.2262	0.2648	0.4072	0.3297	0.1886	0.2090
	2006	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**
CO_2	79.4440	70.1294	85.3206	49.7367	57.2223	66.4516	41.3266	30.3317
CH_4	0.0039	0.0031	0.0039	0.0029	0.0019	0.0022	0.0015	0.0000
N_2O	0.0009	0.0008	0.0009	0.0005	0.0005	0.0007	0.0004	0.0003
NO_x	0.2287	0.2000	0.2436	0.1392	0.1642	0.1882	0.1159	0.0843
CO	0.0593	0.0420	0.0544	0.0431	0.0126	0.0140	0.0089	0.0062
NMVOC	0.0075	0.0060	0.0075	0.0050	0.0039	0.0043	0.0028	0.0020
SO_2	0.2863	0.3285	0.4357	0.2290	0.2187	0.3293	0.1115	0.0978

Compared to the level registered in the reference year, in 2013 the level of GHG emissions from 1A5 'Other' category accounted for CO_2 – 80.3 per cent, CH_4 – 98.2 per cent, N_2O – 82.4 per cent, NO_x – 80.8 per cent, CO – 92.3 per cent, NMVOC – 84.1 per cent, respectively SO_2 – 87.1 per cent (Table 3-105).

Table 3-105: GHG Emissions from 1A5 'Other' Category within 1990-2013 periods, where 1990 represents 100 per cent

	1990	1991	1992	1993	1994	1995	1996	1997
CO_2	100.0	196.6	153.8	127.0	101.3	117.3	95.4	93.3
CH_4	100.0	2.0	0.0	51.0	54.7	90.2	84.7	98.4
N_2O	100.0	152.8	116.6	128.7	92.0	118.1	101.1	100.8
NO_x	100.0	181.6	140.1	127.2	98.7	114.8	93.7	92.2
CO	100.0	73.9	57.1	79.3	75.2	119.7	106.6	121.3
NMVOC	100.0	157.4	122.1	110.6	94.0	117.9	97.7	102.1
SO_2	100.0	375.5	93.2	169.9	153.9	230.7	154.2	127.0
	1998	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**
CO_2	65.0	36.4	40.2	42.6	42.5	51.8	44.7	43.6
CH_4	52.2	96.4	70.2	84.0	77.3	62.6	91.6	175.7
N_2O	66.6	50.4	44.3	55.5	56.7	56.3	52.1	46.0
NO_x	64.4	37.7	40.5	44.7	44.3	52.0	44.6	43.5
CO	70.0	98.9	73.3	91.3	79.9	72.7	99.4	81.3
NMVOC	67.2	56.6	52.0	59.2	53.5	59.2	63.5	57.9
SO_2	60.3	40.2	29.6	34.6	53.3	43.1	24.7	27.3
	2006	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**
CO_2	51.5	45.5	55.3	32.2	37.1	43.1	26.8	19.7
CH_4	169.6	136.4	170.2	125.1	83.7	94.7	67.1	1.8
N_2O	55.8	48.5	59.0	34.2	34.4	41.3	22.8	17.6
NO_x	52.0	45.5	55.4	31.7	37.4	42.8	26.4	19.2
CO	73.4	52.0	67.3	53.3	15.6	17.3	11.0	7.7
NMVOC	59.4	47.5	59.4	39.8	30.7	34.3	22.5	15.9
SO_2	37.4	43.0	57.0	29.9	28.6	43.1	14.6	12.8

In 2013, the category 1A5 'Other' accounted for 0.2 per cent of the total national GHG emissions (without LULUCF).

Between 1990 and 2013, CO_2 emissions originated from 1A5 'Other' category has decreased by 80.4 per cent: from 154.81 to 30.42 Gg CO_2 equivalent (Table 3-106, Figure 3-14).

Table 3-106: Direct GHG Emissions from 1A5 'Other' Category in the Republic of Moldova within 1990-2013 periods, Gg CO_2 equivalent

		1990	1991	1992	1993	1994	1995	1996	1997
CO_2	GHG Emissions, Gg CO_2 equivalent	154.2715	303.3231	237.2468	195.8481	156.2586	180.8891	147.1236	143.8993
CH_4		0.0484	0.0010	0.0000	0.0247	0.0265	0.0437	0.0410	0.0477
N_2O		0.4911	0.7506	0.5725	0.6320	0.4518	0.5798	0.4966	0.4950
Total		**154.8111**	**304.0746**	**237.8193**	**196.5047**	**156.7369**	**181.5126**	**147.6613**	**144.4420**
CO_2	Share in the total GHG emissions, %	99.65	99.75	99.76	99.67	99.69	99.66	99.64	99.62
CH_4		0.03	0.00	0.00	0.01	0.02	0.02	0.03	0.03
N_2O		0.32	0.25	0.24	0.32	0.29	0.32	0.34	0.34
		1998	1999	2000	2001	2002	2003	2004	2005
CO_2	GHG Emissions, Gg CO_2 equivalent	100.2098	56.1841	62.0247	65.7398	65.6289	79.8865	68.9503	67.3380
CH_4		0.0253	0.0467	0.0340	0.0407	0.0375	0.0303	0.0444	0.0851
N_2O		0.3273	0.2478	0.2176	0.2726	0.2784	0.2767	0.2557	0.2260
Total		**100.5624**	**56.4785**	**62.2763**	**66.0531**	**65.9448**	**80.1935**	**69.2504**	**67.6491**
CO_2	Share in the total GHG emissions, %	99.65	99.48	99.60	99.53	99.52	99.62	99.57	99.54
CH_4		0.03	0.08	0.05	0.06	0.06	0.04	0.06	0.13
N_2O		0.33	0.44	0.35	0.41	0.42	0.35	0.37	0.33
		2006	2007	2008	2009	2010	2011	2012	2013
CO_2	GHG Emissions, Gg CO_2 equivalent	79.4440	70.1294	85.3206	49.7367	57.2223	66.4516	41.3266	30.3317
CH_4		0.0822	0.0661	0.0825	0.0606	0.0406	0.0459	0.0325	0.0009
N_2O		0.2742	0.2382	0.2900	0.1680	0.1690	0.2031	0.1119	0.0862
Total		**79.8003**	**70.4336**	**85.6930**	**49.9653**	**57.4318**	**66.7006**	**41.4710**	**30.4188**
CO_2	Share in the total GHG emissions, %	99.55	99.57	99.57	99.54	99.64	99.63	99.65	99.71
CH_4		0.10	0.09	0.10	0.12	0.07	0.07	0.08	0.00
N_2O		0.34	0.34	0.34	0.34	0.29	0.30	0.27	0.28

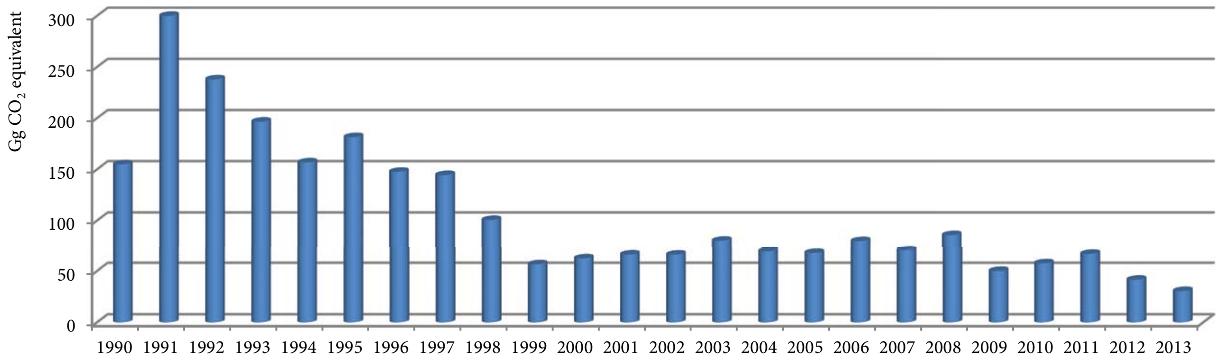

Figure 3-14: Direct GHG Emissions from 1A5 'Other' Category in the Republic of Moldova within 1990-2013 periods, Gg CO_2 equivalent

Compared with reference year level, in 2013 the level of total direct GHG emissions from 1A5 ‚Other' category accounted only circa 19.6 per cent (Table 3-107).

Table 3-107: Direct GHG Emissions from 1A5 'Other' Category in the Republic of Moldova within 1990-2013 periods, where 1990 represents 100 per cent

	1990	1991	1992	1993	1994	1995	1996	1997
CO_2	100.0	196.6	153.8	127.0	101.3	117.3	95.4	93.3
CH_4	100.0	2.0	0.0	51.0	54.7	90.2	84.7	98.4
N_2O	100.0	152.8	116.6	128.7	92.0	118.1	101.1	100.8
Total	100.0	196.4	153.6	126.9	101.2	117.2	95.4	93.3
	1998	1999	2000	2001	2002	2003	2004	2005
CO_2	65.0	36.4	40.2	42.6	42.5	51.8	44.7	43.6
CH_4	52.2	96.4	70.2	84.0	77.3	62.6	91.6	175.7
N_2O	66.6	50.4	44.3	55.5	56.7	56.3	52.1	46.0
Total	65.0	36.5	40.2	42.7	42.6	51.8	44.7	43.7
	2006	2007	2008	2009	2010	2011	2012	2013
CO_2	51.5	45.5	55.3	32.2	37.1	43.1	26.8	19.7
CH_4	169.6	136.4	170.2	125.1	83.7	94.7	67.1	1.8
N_2O	55.8	48.5	59.0	34.2	34.4	41.3	22.8	17.6
Total	51.5	45.5	55.4	32.3	37.1	43.1	26.8	19.6

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 3-11. Default EFs values available in the Revised 1996 IPCC Guidelines (IPCC, 1997) and 2006 IPCC Guidelines were used to estimate non-CO_2 emissions. Since these guidelines do not provide emission factors for 1A5 'Other' category, coefficients recommended for 1A1 "Energy industry" category were used (see Table 3-36).

Activity data pertaining to the fuel consumption within 1A5 'Other' category were collected from the Energy Balances of the Republic of Moldova for 1990 and 1993-2013 years, as well as from the Statistical Yearbooks and sectoral statistical publications of ATULBD (Table 3-108).

Table 3-108: Fuel Consumption under the 1A5 'Other' Category within 1990-2013 periods, kt

	1990	1991	1992	1993	1994	1995	1996	1997
Gasoline, kt	4.0000	2.5000	1.2000	2.0850	3.5160	3.2340	1.9690	2.4090
Kerosene, kt	1.0000	0.0000	0.0000	26.3000	1.0000	0.0000	0.0000	0.0000
Diesel Oil, kt	19.0000	15.0000	10.0000	8.6080	3.8830	4.4210	7.1710	3.3080
Residual Fuel Oil, kt	1.0000	6.8000	8.7000	8.1000	12.0000	21.0000	11.0000	8.0000
LPG, kt	1.0000	0.0000	0.0000	2.7000	1.0000	3.2000	3.6000	1.0000
Bitumen, kt	0.0000	34.3000	34.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Lubricants, kt	0.0000	36.0000	21.0000	0.0000	17.0000	18.0650	17.1190	16.5740
Other Oil Products, kt	0.0000	0.0000	0.0000	1.0000	1.0000	0.0000	2.0000	9.0000
Anthracite, kt	16.0000	0.0000	0.0000	1.9000	2.0000	3.0000	2.0000	2.0000
Other Bituminous Coal, kt	0.0000	0.0000	0.0000	13.2000	5.0000	5.0000	5.0000	4.0000
Lignite, kt	4.0000	4.0000	0.0000	5.9000	4.0000	4.0000	5.0000	5.0000
Natural Gas, million m^3	14.8000	0.0000	0.0000	0.3000	6.7000	1.2000	0.0000	0.0000
Fuel Wood, kt	3.7000	0.0000	0.0000	1.0000	2.2000	3.7000	2.2000	4.4000
Other Biomass, kt	0.0000	0.0000	0.0000	0.8000	0.0000	1.0000	2.0000	1.0000
	1998	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**
Gasoline, kt	3.3420	0.4499	0.1365	2.1849	0.1846	1.2150	0.2200	0.1746
Kerosene, kt	0.0000	1.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000
Diesel Oil, kt	6.1640	0.5268	2.2730	2.3435	2.2879	2.2650	5.2670	3.2051
Residual Fuel Oil, kt	2.0000	1.0000	0.0000	0.0000	1.0000	1.0000	0.0000	1.0000
LPG, kt	1.0000	1.0000	1.0000	4.0000	1.0000	1.0000	0.0000	2.0000
Bitumen, kt	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Lubricants, kt	12.1880	9.1330	7.6050	7.7560	7.6150	11.4030	11.3160	10.2200
Other Oil Products, kt	4.0000	0.0000	3.0000	1.0000	1.0000	3.0000	1.0000	1.0000
Anthracite, kt	0.0000	6.0000	0.0000	0.0000	1.0000	0.0000	1.0000	1.0000
Other Bituminous Coal, kt	3.0000	4.0000	3.0000	5.0000	8.0000	5.0000	1.0000	0.0000
Lignite, kt	4.0000	2.0000	2.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Natural Gas, million m^3	0.0000	2.0000	5.0000	0.6000	1.0000	2.0000	3.0000	4.0000
Fuel Wood, kt	2.9000	0.7000	3.7000	3.7000	2.9000	2.1900	2.9200	2.9200
Other Biomass, kt	0.0000	4.0000	0.0000	1.0000	1.0000	1.0000	2.0000	1.0000
	2006	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**
Gasoline, kt	2.2070	1.1770	1.1690	1.2650	1.1450	2.1820	1.1170	0.1270
Kerosene, kt	0.0000	0.0000	0.0000	0.0000	1.0000	0.0000	0.0000	0.0000
Diesel Oil, kt	3.1970	4.2410	4.1740	2.2350	1.1170	2.1880	1.1400	0.1500
Residual Fuel Oil, kt	0.0000	1.0000	2.0000	2.0000	0.0000	1.0000	0.0000	0.0000
LPG, kt	1.0000	1.0000	1.0000	0.0000	2.0000	0.0000	1.0000	0.0000
Bitumen, kt	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Lubricants, kt	12.1601	9.1649	11.8010	9.1219	8.2010	10.1992	8.2105	8.2092
Other Oil Products, kt	0.0000	0.0000	0.0000	0.0000	0.0000	0.0210	0.0180	0.0000
Anthracite, kt	1.0000	5.0000	2.0000	1.0000	1.0000	2.0000	1.0000	1.0000
Other Bituminous Coal, kt	5.0000	1.0000	5.0000	0.0000	4.0000	4. 6823	0.6502	0.6441
Lignite, kt	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Natural Gas, million m^3	4.0000	2.0000	3.0000	1.0000	2.0000	1.0000	1.0000	0.0000
Fuel Wood, kt	2.1900	2.1900	2.9200	1.4600	0.0000	0.0000	0.0000	0.0000
Other Biomass, kt	1.0000	0.0000	0.0000	1.0000	0.0000	0.0000	0.0000	0.0000

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 other works and needs in the industrial sector of the RM could be considered relatively low (±5 per cent). Uncertainties pertaining to GHG emissions from the 1A5 'Other' category were estimated at ±7.07 per cent for CO_2 emissions and at ±50.25 per cent for CH_4 and N_2O emissions. At the same time, combined uncertainties, presented as a per cent of total sectoral GHG emissions were estimated at ±0.0220 per cent for CO_2 emissions, ±0.00001 per cent for CH_4 emissions, and ±0.0004 per cent for N_2O. Uncertainties introduced in trend in sectoral GHG emissions were estimated at ±0.0064 per cent for CO_2 emissions, at ±0.00002 per cent for CH_4 emissions, and at ±0.00005 per cent for N_2O emissions (Annex 5-3.1).

In view of ensuring time-series consistency of the obtained results, the same approach was used for the entire period under review, in conformity with the recommendations included in the GPG (IPCC, 2000).

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 (IPCC, 2000). Also, 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 GPG (IPCC, 2000), GHG emissions originated from the 1A5 'Other' were estimated based on AD and EFs from official sources of reference.

3.6.5 Recalculations

GHG emission recalculations performed under the 1A5 'Other' category covering the 1990-2010 time series were due to the availability of an updated set of activity data for the Left Bank of Dniester River (ATULBD), as a result of adding AD related to military transport, as well as due to the identification of some mechanical errors related to data entry activities and use of emission factors.

In comparison with the results included into the TNC, the performed changes resulted in a decrease of GHG emissions within 1990-1992, 1999 and 2003-2010 years, varying from a minimum decrease by 0.003 per cent in 1991, up to a maximum decrease of 54.2 per cent in 2007; respectively, it was revealed an increasing trend of direct GHG emissions between 1993-1998 and 2000-2002, varying from a minimum of 1.5 per cent in 1996, up to a maximum of 8.3 per cent in 1998 (Table 3-109).

Table 3-109: Comparative Results of GHG Emissions from 1A5 'Other' Category included in the TNC and the BUR of the RM under the UNFCCC, Gg CO_2 equivalent

	1990	1991	1992	1993	1994	1995	1996	1997
TNC	154.8976	304.0835	240.8572	187.2816	146.2261	173.3229	145.4184	136.0699
BUR	154.8111	304.0746	237.8193	196.5047	156.7369	181.5126	147.6613	144.4420
Difference, %	-0.0559	-0.0029	-1.2613	4.9248	7.1880	4.7251	1.5424	6.1528
	1998	1999	2000	2001	2002	2003	2004	2005
TNC	92.8322	56.5604	61.0183	63.2896	64.5181	117.7306	123.0030	118.5196
BUR	100.5624	56.4785	62.2763	66.0531	65.9448	80.1935	69.2504	67.6491
Difference, %	8.3271	-0.1448	2.0616	4.3664	2.2113	-31.8839	-43.7003	-42.9216
	2006	2007	2008	2009	2010	2011	2012	2013
TNC	150.1013	153.7016	162.4874	80.9092	125.0546			
BUR	79.8003	70.4336	85.6930	49.9653	57.4318	66.7006	41.4710	30.4188
Difference, %	-46.8357	-54.1751	-47.2617	-38.2452	-54.0746			

Abbreviations: TNC – Third National Communication; BUR – Biennial Update Report

For 2011-2013 time periods the GHG emissions from 1A5 'Other' category were estimated for the first time. The results allow assert that between 1990 and 2013, the GHG emissions originated from this category decreased by 80.4 per cent.

3.6.6 Planned Improvements

For the next inventory cycle, potential improvements in 1A5 'Other' category are unlikely.

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

'Oil Exploration'

Between 1957-1964, in the southern part of the country, nearby Valeni village and Beleu Lake, 40 oil wells were drilled at 400 m depth. The amount of oil extracted from 27 wells was insignificant so, in 1973 the works stopped and the oil wells were preserved. More recently, the lake Beleu became part of 'Prutul de Jos' scientific reservation.

On July 6, 1995 the Government of the Republic of Moldova has signed a 20 years concession agreement with an American company Redeco LTD regarding the research and extraction of natural gas and oil resources in the Republic of Moldova. The works started in 1997. Though about 10 million US$ were invested between 1995-1998 years, there were no palpable results.

Since 2003, AS Petrol of the RM joined to the Redeco LTD business. Between 2003-2014 time periods, 9 of the old oil wells (drilled between 1957 and 1964) were reopened (at the moment, 8 oil wells are servicing and 1 is in repair works) and 14 new wells were drilled (at the moment, 10 oil wells are servicing and 4 are in repair works).

The oil exploration in Valeni village, Cahul district is refined at Comrat refinery (set into exploitation on July 15, 2005) which has a capacity of 30 kt per year (this refinery can produce diesel oil, gasoline, residual fuel oil, lubricants, as well as bitumen and bitumen for road construction, but is focused mainly on producing residual fuel oils and diasel oil). Thus, as a result of refining the oil extracted in the Republic of Moldova, in 2013, the company "Arnaut Petrol" produced about 1231.0 tons of diesel oil (1955.4 tons in 2012).

By the end of 2006, Valiexchimp LTD Company became the main partner of Redeco LTD group. In 2007, Valiexchimp LTD founded a joint venture with the Irish 'Island Oil&Gaz plc', starting together a joint investment program in oil and natural gas extraction and refining, estimated at 12 million euro.

On October 10th, 2007 the Government accepted Redeco LTD's leasing concession to Valiexchimp LTD on all rights and obligations under the Concession Agreement for research and exploration of oil and natural gas reserves in the Republic of Moldova as of July 6th, 1995.

According to the information provided by the Institute of Ecology and Geography of the ASM, the specific density of the oil extracted in Valeni is 941 kg/m^3, while its retail price is approximately equal to residual fuel oil price on the regional markets.

Table 3-110 reveals that between 2003 and 2013, the annual oil production in the RM has not exceeded 17 thousand tons per year.

Table 3-110: Oil Extraction in the Republic of Moldova within 2003-2013 periods

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

Source: Energy Balances of the RM for 2004-2013.

The estimated amount of oil reserves in Valeni is circa 2-3 million tons, of which about 1.0 million tons are available reserves.

Natural Gas Exploration

During 1945-1972, about 700 wells were drilled to depths up to 3000 meters in order to identify fossil fuel resources. Natural gas reserves have been identified nearby Victorovca village, Cantemir district. Natural gas reserves at a depth of 400 meters are estimated at about 70-90 million m^3, at a depth of 600 meters - about 0.7-1.2 billion m^3, while at a depth of 4 km - about 7-10 billion m^3. Natural gas extracted from the respective reserves at Victorovca field is of good quality, containing about 86-92% methane.

The Government of the RM has allocated an area of 6.3 thousand km^2 to Valiexchimp LTD for geological exploration works. During 2004-2014, from the 6 wells in service at a depth of 400 meters, up to 250,000 m^3 were extracted annually (potentially, the amount of natural gas that could be explored annually represents about 1.8-3.0 million m^3).

The natural gas explored at Victorovca field is supplied to the following settlements: Ciobaclia, Suhat, Baimaclia, Flocoasa and Victorovca (around 700 households are supplied in total) and it is planned to supply natural gas to other 3 settlements in the South of the Republic of Moldova. In this respect, „Moldovagaz" J.S.C. constructed a 9 km of gas pipeline to connect the Victorovca field to its distribution network.

'Natural Gas Transportation and Distribution'

Currently, the most used type of fuel in the Republic of Moldova is natural gas. This type of fuel has been used in the Republic of Moldova since 1966, being 100 per cent imported from Russian Federation through the gas pipeline system. The main operator on the natural gas market in the country is the Moldovan-Russian joint venture "MOLDOVAGAZ".

The infrastructure of the 'Natural Gas Supply Sector' currently includes: high and medium pressure main gas pipelines (circa 656.24 km), high and medium pressure connection gas pipelines – circa 903.33 km, medium and low pressure gas distribution pipelines – circa 21531.30 km, 5 transported gas compression and metering stations and 65 gas distribution stations.

Two main gas pipelines systems cross the territory of the Republic of Moldova, in the North: the Ananiev – Cernauti – Bogorodciani gas pipeline (transit capacity: 8.7 billion m^3/year); in the South: Sebelinka – Dnepropetrovsk – Krivoi Rog – Ismail and Razdelnaia – Ismail gas pipeline (total transit capacity: 15.8 billion m^3/year) and Ananiev – Tiraspol – Ismail gas pipeline (transit capacity: 20.0 billion m^3/year). The total capacity of the gas transit system towards the Balkans is around 43 billion m^3/year; however it is currently used at a capacity of only circa 25 billion m^3/year.

Connection gas pipelines and gas distribution stations situated on the territory of the RM allow deliver around 9 billion m^3/year to the consumers in the Republic of Moldova, while the current real consumption is around 2.5-3.0 billion m^3/year.

'Liquefied Petroleum Gases'

LPG is used in the RM since 1946, and is currently sold to settlements not connected to gas networks (specific density of the sold LPG is around 584 kg/m^3). LPG is refined and supplied to consumers through filling stations having a total storage capacity of 6.9 thousand m^3.

Information regarding the LPG consumption is available from several alternative sources: the Energy Balances of the Republic of Moldova, Official Letters from „Moldovagaz" J.S.C., as well as from the Annual Reports of National Energy Regulatory Agency[23] (Table 3-111).

Table 3-111: Liquefied Petroleum Gases Imports in the Republic of Moldova within 2002-2014 periods, thousand tons

	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
Liquefied Petroleum Gases	47.900	56.200	52.600	53.500	50.200	50.500	60.100	60.500	66.773	78.142	70.790	72.000	78.000

Source: Activity Reports of National Energy Regulatory Agency of Moldova for 2008-2014.

In the previous inventory cycles activity data provided by „Moldovagaz" J.S.C. were used (in 1990-1998 the share of this company in the import of liquefied gas in the RM exceeded 90 per cent of the total), while in the current inventory cycle, there were used the activity data available in the Energy Balances of the Republic of Moldova (Table 3-112), since it is considered to be complete and take into consideration the quantities provided by all companies which import LPG in the RM as well as the consumption of this particular fuel by all eligible consumers.

Table 3-112: Liquefied Petroleum Gases Consumption in the Republic of Moldova within 1990-2013 periods, thousand tons

	1990	1991	1992	1993	1994	1995	1996	1997
Liquefied Petroleum Gases	146.0	128.0	75.4	39.9	19. 0	19.0	22.0	26.0
	1998	1999	2000	2001	2002	2003	2004	2005
Liquefied Petroleum Gases	25.0	31.0	35.0	47.0	48.0	50.0	52.0	53.0
	2006	2007	2008	2009	2010	2011	2012	2013
Liquefied Petroleum Gases	50.0	53.0	55.0	60.0	64.0	67.0	74.0	74.0

Source: EBs of the RM for 1990, 1993-2013; Official Letter from „Moldovagaz" J.S.C. No. 02-156 dated 06.02.2004, for 1991-1992 years.

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.).

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

Between 1990 and 2013, GHG emissions originated from the 1B2 'Fugitive Emissions from Oil and Natural Gas' category tended to reveal lower values (other GHGs revealed an increasing trend comparing with 1990 year) (Table 3-113).

Table 3-113: GHG Emissions within 1B2 'Fugitive Emissions from Oil and Natural Gas' Category within 1990-2013 periods, Gg

	1990	1991	1992	1993	1994	1995	1996	1997
CO_2	0.6377	0.6140	0.5175	0.4382	0.4085	0.4194	0.4726	1.1105
CH_4	32.4902	30.4924	27.6036	24.8030	23.8714	26.4555	28.7555	23.6674
N_2O	5.4962E-07	4.8219E-07	2.8404E-07	1.5030E-07	7.1566E-08	7.1566E-08	8.2874E-08	4.8054E-06
NMVOC	0.5817	0.5438	0.4931	0.4437	0.4269	0.4761	0.5160	0.4183
	1998	1999	2000	2001	2002	2003	2004	2005
CO_2	1.0729	1.0378	1.0240	1.0554	1.0428	1.1010	1.8405	1.9206
CH_4	22.1502	22.0978	23.9235	23.7671	25.7726	27.2507	29.3202	31.3513
N_2O	4.8016E-06	4.8242E-06	4.8393E-06	4.8845E-06	4.8883E-06	5.3723E-06	1.6202E-05	1.7014E-05
NMVOC	0.3923	0.3950	0.4321	0.4269	0.4672	0.5255	1.0973	1.1781
	2006	2007	2008	2009	2010	2011	2012	2013
CO_2	1.4322	1.6702	2.0480	2.1505	1.8417	1.9830	1.8765	2.1589
CH_4	27.3237	29.0502	28.8930	23.9117	23.1874	26.4106	26.0309	24.7926
N_2O	9.2627E-06	1.2504E-05	1.8166E-05	1.9802E-05	1.4968E-05	1.6593E-05	1.5006E-05	1.7120E-05
NMVOC	0.6713	0.8628	1.1402	1.1245	0.8689	1.0086	0.9216	0.8712

In 2013, the 1B2 'Fugitive Emissions from Oil and Natural Gas' accounted for 4.1 per cent of total national greenhouse gas emissions (excluding LULUCF).

Over the period under review, GHG emissions covered by the respective source category tended to reveal lower values, decreasing by 23.4 per cent: from 682.93 to 522.81 Gg CO_2 equivalents (Table 3-114, Figure 3-15).

Table 3-114: Direct GHG Emissions from 1B2 'Fugitive Emissions from Oil and Natural Gas' in the Republic of Moldova within 1990-2013 periods, Gg CO_2 equivalent

		1990	1991	1992	1993	1994	1995	1996	1997
CO_2	GHG Emissions, Gg CO_2 equivalent	0.6377	0.6140	0.5175	0.4382	0.4085	0.4194	0.4726	1.1105
CH_4		682.2942	640.3404	579.6756	520.8630	501.2999	555.5660	603.8655	497.0149
N_2O		0.0002	0.0001	0.0001	0.0000	0.0000	0.0000	0.0000	0.0015
Total		682.9320	640.9545	580.1931	521.3013	501.7084	555.9854	604.3381	498.1270
CO_2	Share in the total GHG emissions, %	0.0934	0.0958	0.0892	0.0841	0.0814	0.0754	0.0782	0.2229
CH_4		99.9066	99.9042	99.9108	99.9159	99.9186	99.9246	99.9218	99.7768
N_2O		0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0003
		1998	1999	2000	2001	2002	2003	2004	2005
CO_2	GHG Emissions, Gg CO_2 equivalent	1.0729	1.0378	1.0240	1.0554	1.0428	1.1010	1.8405	1.9206
CH_4		465.1532	464.0533	502.3930	499.1097	541.2252	572.2646	615.7241	658.3782
N_2O		0.0015	0.0015	0.0015	0.0015	0.0015	0.0017	0.0050	0.0053
Total		466.2276	465.0927	503.4185	500.1666	542.2695	573.3672	617.5696	660.3041
CO_2	Share in the total GHG emissions, %	0.2301	0.2231	0.2034	0.2110	0.1923	0.1920	0.2980	0.2909
CH_4		99.7696	99.7765	99.7963	99.7887	99.8074	99.8077	99.7012	99.7083
N_2O		0.0003	0.0003	0.0003	0.0003	0.0003	0.0003	0.0008	0.0008
		2006	2007	2008	2009	2010	2011	2012	2013
CO_2	GHG Emissions, Gg CO_2 equivalent	1.4322	1.6702	2.0480	2.1505	1.8417	1.9830	1.8765	2.1589
CH_4		573.7970	610.0534	606.7529	502.1456	486.9353	554.6226	546.6484	520.6450
N_2O		0.0029	0.0039	0.0056	0.0061	0.0046	0.0051	0.0047	0.0053
Total		575.2321	611.7275	608.8065	504.3022	488.7817	556.6107	548.5296	522.8092
CO_2	Share in the total GHG emissions, %	0.2490	0.2730	0.3364	0.4264	0.3768	0.3563	0.3421	0.4129
CH_4		99.7505	99.7263	99.6627	99.5724	99.6223	99.6428	99.6571	99.5860
N_2O		0.0005	0.0006	0.0009	0.0012	0.0009	0.0009	0.0008	0.0010

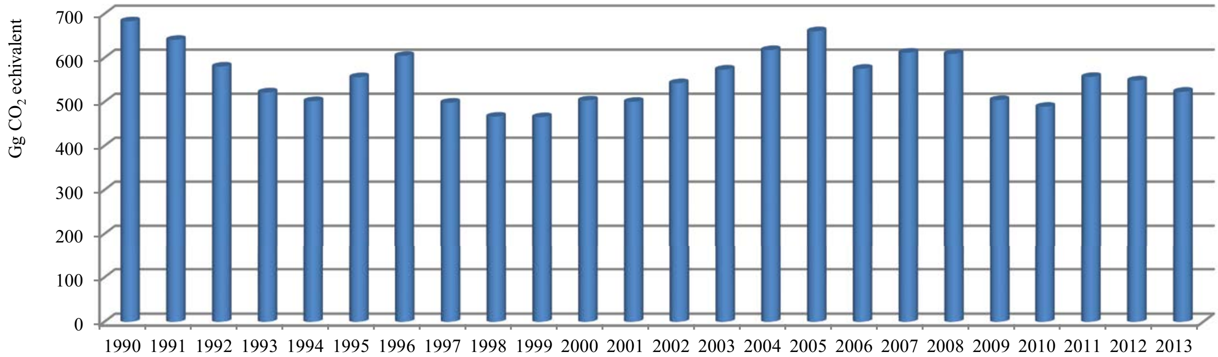

Figure 3-15: GHG Emissions from 1B2 'Fugitive Emissions from Oil and Natural Gas' in the Republic of Moldova within 1990-2013 periods

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 (IPCC, 2006). Fugitive emissions of CH_4, N_2O CO_2 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 (Gg);

$A_{industry\ segment}$ – activity data for the respective industry segment;

$EF_{gas,\ industry\ segment}$ – emission factor (Gg/activity unit).

Default EF values were used to estimate GHG emission according to 2006 IPCC Guidelines (Table 3-115).

Table 3-115: Default EF Values Used to Estimate GHG emissions from 1B2 'Fugitive Emissions from Oil and Natural Gas' in the Republic of Moldova

Category	IPCC Code	CH_4	CO_2	NMVOC	N_2O	UM	Source: 2006 IPCC Guidelines, Vol. 2, Ch. 4
		Ranges and Average for EFs Values Used					
Well drilling	1B2a	33-560 **296.5**	100-1700 **900**	0.87-15.0 **7.935**	-	kg/well/year	Page 4.55
Well testing	1B2a	51-850 **450.5**	9000-150000 **79500**	12-200 **106**	0.068-1.1 **0.584**	kg/well/year	Page 4.55
Well servicing	1B2a	110-1800 **955**	1.9-32.0 **17.0**	17-2800 **1408.5**	-	kg/well/year	Page 4.55
Fugitives from oil production	1B2a	2-60000 **30000**	0.1-4300 **2150**	1.8-75000 **37500.9**	-	$kg/10^3m^3/year$	
Fugitives from natural gas production	1B2b	380-24000 **12190**	14-180 **97**	91-1200 **645.5**	-	$kg/10^6m^3/year$	Page 4.55
Fugitives from natural gas transportation	1B2b	166-1100 **633**	0.88-2.00 **1.44**	7.0-16.0 **11.5**	-	$kg/10^6m^3/year$	Page 4.57
Fugitives from natural gas distribution	1B2b	1100-2500 **1800**	51-140 **95.5**	16-36 **26**	-	$kg/10^6m^3/year$	
Fugitives from liquefied petroleum gas transportation	1B2b	-	430	-	0.0022	$kg/10^3m^3/year$	Page 4.57
Flaring at natural gas production	1B2c	0.76-1.00 **0.88**	1200-1600 **1400**	0.62-0.85 **0.74**	0.021-0.029 **0.025**	$kg/10^6m^3/year$	Page 4.55
Ventilation at natural gas transportation	1B2c	44-740 **392**	3.1-7.3 **5.2**	4.6-11.0 **7.8**	-	$kg/10^6m^3/year$	page 4.57
Ventilation at oil extraction	1B2c	720-990 **855**	95-130 **112.5**	430-590 **510**	-	$kg/10^3m^3/year$	Page 4.58
Flaring at oil production	1B2c	25-34 **30**	41000-56000 **48500**	21-29 **25**	0.64-0.88 **0.76**	$kg/10^3m^3/year$	Page 4.58
Oil transportation in tanks	1B2c	25	2.3	250	-	$kg/10^3m^3/year$	Page 4.61

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 3-116).

Table 3-116: AD used to estimate GHG Emissions originated from 1B2 'Fugitive Emissions from Oil and Natural Gas' in the Republic of Moldova within 1990-2013 periods

		1990	1991	1992	1993	1994	1995	1996	1997
LPG	kt	146.000	128.000	75.400	39.900	19.000	19.000	22.000	26.000
	thousand m^3	250.000	219.178	129.110	68.322	32.534	32.534	37.671	44.521
		1998	1999	2000	2001	2002	2003	2004	2005
Oil Exploration	kt	0.000	0.000	0.000	0.000	0.000	1.000	8.000	5.000
	thousand m^3	0.000	0.000	0.000	0.000	0.000	1.063	8.502	5.313
Natural Gas Exploration	TJ	0.000	0.000	0.000	0.000	0.000	8.000	8.000	8.000
	million m^3	0.000	0.000	0.000	0.000	0.000	0.236	0.236	0.236
LPG	kt	25.000	31.000	35.000	47.000	48.000	50.000	52.000	53.000
	thousand m^3	42.808	53.082	59.932	80.479	82.192	85.616	89.041	90.753
		2006	2007	2008	2009	2010	2011	2012	2013
Oil Exploration	kt	4.000	8.000	15.000	17.000	11.000	13.000	11.000	10.000
	thousand m^3	4.251	8.502	15.940	18.066	11.690	13.815	11.690	10.630
Natural Gas Exploration	TJ	5.000	4.000	5.000	8.000	3.000	2.000	4.000	4.000
	million m^3	0.148	0.118	0.148	0.236	0.089	0.059	0.118	0.118
LPG	kt	50.000	53.000	55.000	60.000	64.000	67.000	74.000	74.000
	thousand m^3	85.616	90.753	94.178	102.740	109.589	114.726	126.712	126.712

Activity data related to the exploration of oil and natural gas are available in the Energy Balances of the Republic of Moldova. In order to fill in the calculation worksheets (see the Non-Annex I National Greenhouse Gas Inventory Software, Version 1.3.2), it is necessary to add in the worksheet 1-7s1-4 other measurement units (for oil and LPG in thousand m^3, for natural gas in million m^3) than those that are available in Energy Balances (oil and liquefied gas in kilotons and natural gas in TJ). For converting the activity data in the units recommended by the 2006 IPCC Guidelines the following conversion factors were used: the density of oil extracted in Valeni is 0.941 tons/m^3, liquefied gas density is 0.584 tons/m3; the conversion factor of natural gas from TJ in million m^3 represents 0.0295 (1/33.86). The Table below provides the activity data used to calculate the GHG emissions originated from the source category 1B2 'Fugitive Emissions from Oil and Natural Gas' in the RM in 1990-2013 periods (Table 3-117).

Table 3-117: Natural Gas Transited, Imported and Consumed in the RM within 1990-2013

	1990	1991	1992	1993	1994	1995	1996	1997
Natural Gas Transited, billion m^3	25.000	23.000	21.000	19.000	18.265	20.909	22.396	16.934
Natural Gas Imported, million m^3	3844.0	3873.0	3435.0	3093.0	3012.0	3005.0	3489.0	3676.0
Technological Losses, million m^3, including:	30.0	30.0	58.0	133.0	151.0	214.0	267.0	184.0
in distribution networks	NA	NA	NA	NA	52.0	71.0	112.0	68.0
in main networks	NA	NA	NA	NA	98.0	143.0	155.0	116.0
Natural Gas sold in the RM, million m^3	3814.0	3843.0	3377.0	2960.0	2861.0	2791.0	3222.0	3492.0
On the Right Bank of the Dniester, million m^3	NA	NA	NA	NA	1729.0	1558.0	1770.0	1883.0
On the Left Bank of Dniester, million m^3	NA	NA	NA	NA	1132.0	1233.0	1452.0	1609.0
	1998	1999	2000	2001	2002	2003	2004	2005
Natural Gas Transited, billion m^3	16.021	17.142	19.365	18.625	21.332	22.132	23.873	25.313
Natural Gas Imported, million m^3	3333.0	2856.8	2477.5	2732.1	2419.8	2614.6	2687.2	2819.2
Technological Losses, million m^3, including:	164.0	154.7	116.9	90.1	92.6	103.3	73.3	102.8
in distribution networks	107.0	102.5	79.4	72.8	65.5	66.1	52.9	54.2
in main networks	58.0	52.2	37.5	17.3	27.0	37.2	20.4	48.6
Natural Gas sold in the RM, million m^3	3169.0	2685.3	2320.2	2628.0	2231.6	2405.4	2565.7	2715.6
On the Right Bank of the Dniester, million m^3	1700.0	1219.8	918.3	1055.7	1050.6	1129.9	1141.5	1314.9
On the Left Bank of Dniester, million m^3	1469.0	1465.5	1401.9	1572.3	1181.0	1275.5	1424.2	1400.7
	2006	2007	2008	2009	2010	2011	2012	2013
Natural Gas Transited, billion m^3	22.339	23.693	23.290	17.891	17.034	19.889	19.620	19.651
Natural Gas Imported, million m^3	2472.3	2714.7	2725.5	2979.4	3176.2	3213.1	3182.5	2472.5
Technological Losses, million m^3, including:	94.0	96.2	94.7	93.9	98.6	113.6	104.4	86.5
in distribution networks	55.6	54.5	55.5	55.7	57.9	54.4	52.1	49.8
in main networks	38.4	41.7	39.2	38.2	40.7	59.2	52.3	36.7
Natural Gas sold in the RM, million m^3	2376.2	2489.9	2505.0	2775.0	2970.9	3099.5	3078.1	2386.0
On the Right Bank of the Dniester, million m^3	1322.0	1208.0	1130.8	1029.9	1089.8	1152.1	1095.1	1031.2
On the Left Bank of Dniester, million m^3	1054.2	1281.9	1374.2	1745.1	1881.1	1974.4	1982.6	1354.8

Source: Official Letter from „Moldovagaz" J.S.C. No. 01-07/1400 dated 25.08.2006 from the Ministry of Environment; Letter No. 02/1-476 dated 23.02.2011, answer to Letter No. 03-07/175 dated 02.02.2011 from the Ministry of Environment; Letter No. 02/1-288 dated 22.01.2014, answer to Letter No. 320/2014-01-01 dated 03.01.2014 from the Climate Change Office of the Ministry of Environment; Letter No. 02/1-507 dated 10.02.2015, answer to Letter No. 407/2015-01-09 dated 29.01.2015 from the Climate Change Office of the Ministry of Environment.

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.

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 up to ±25 per cent. The uncertainties related to GHG emissions covered by the 1B2 'Fugitive Emissions from Oil and Natural Gas' were estimated at ±35.36 per cent. At the same time, the combined uncertainties presented as a per cent of total sectoral emissions were estimated at ±0.0078 per cent for CO_2 emissions and ±1.8846 per cent for CH_4 emissions. Uncertainties introduced in trend in sectoral emissions were estimated at ±0.0026 per cent for CO_2 emissions and ±0.5771 per cent for CH_4 emissions (Annex 5-3.1).

In view of ensuring time-series consistency of the obtained results, the same approach was used for the entire period under review, in conformity with the recommendations included in the GPG (IPCC, 2000).

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 (IPCC, 2000).

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 GPG (IPCC, 2000), 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.

3.7.5 Recalculations

GHG emissions from the 1B2 'Fugitive Emissions from Oil and Natural Gas' were recalculated for 1995-1999 and 2010 years, in particular due to the identification of some mechanical errors related to data entry activities. In comparison with the results included into the TNC, the performed recalculations resulted in an insignificant increase of direct GHG emissions between 1995 and 1999, while for 2010 it was recorded an insignificant decrease (Table 3-118).

Table 3-118: Comparative Results of GHG Emissions from 1B2 'Fugitive Emissions from Oil and Natural Gas' included in the TNC and the BUR of the RM under the UNFCCC, Gg CO_2 equivalent

	1990	1991	1992	1993	1994	1995	1996	1997
TNC	682.9320	640.9545	580.1931	521.3013	501.7084	555.9818	604.3335	498.1220
BUR	682.9320	640.9545	580.1931	521.3013	501.7084	555.9854	604.3381	498.1270
Difference, %	0.0000	0.0000	0.0000	0.0000	0.0000	0.0006	0.0008	0.0010
	1998	1999	2000	2001	2002	2003	2004	2005
TNC	466.2238	465.0773	503.4185	500.1666	542.2695	573.3672	617.5696	660.3041
BUR	466.2276	465.0927	503.4185	500.1666	542.2695	573.3672	617.5696	660.3041
Difference, %	0.0008	0.0033	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	2006	2007	2008	2009	2010	2011	2012	2013
TNC	575.2321	611.7275	608.8065	504.3022	489.0456			
BUR	575.2321	611.7275	608.8065	504.3022	488.7817	556.6107	548.5296	522.8092
Difference, %	0.0000	0.0000	0.0000	0.0000	-0.0540			

Abbreviations: TNC – Third National Communication; BUR – Biennial Update Report

For 2011-2013 time periods, 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 2013, the GHG emissions originated from this sector decreased by 23.4 per cent.

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.)

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 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, NMVOC and SO_2).

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) (IPCC, 2006).

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.

Between the 1990 and 2013, GHG emissions covered from the 'International Bunkers: Aviation' have a decreasing trend (Table 3-119).

Table 3-119: GHG Emissions from 'International Bunkers: Aviation' in the Republic of Moldova within 1990-2013 periods, Gg

	1990	1991	1992	1993	1994	1995	1996	1997
CO_2	217.3668	232.8115	96.2635	62.0927	37.8235	41.9185	65.8650	75.6443
CH_4	0.0430	0.0487	0.0189	0.0099	0.0058	0.0060	0.0048	0.0055
N_2O	0.0070	0.0074	0.0031	0.0020	0.0012	0.0013	0.0021	0.0024
NO_x	0.7949	0.8447	0.3512	0.2331	0.1433	0.1573	0.2556	0.2921
CO	0.8733	0.9641	0.3847	0.2215	0.1323	0.1413	0.1687	0.1965
NMVOC	0.5202	0.5792	0.2288	0.1293	0.0766	0.0820	0.0901	0.1020
SO_2	0.0689	0.0738	0.0305	0.0197	0.0120	0.0133	0.0209	0.0240
	1998	1999	2000	2001	2002	2003	2004	2005
CO_2	72.4974	72.4938	66.1989	61.9061	62.0776	73.5472	67.3626	67.6961
CH_4	0.0046	0.0044	0.0041	0.0041	0.0039	0.0039	0.0040	0.0038
N_2O	0.0023	0.0022	0.0021	0.0021	0.0021	0.0025	0.0023	0.0024
NO_x	0.2802	0.2641	0.2528	0.2253	0.2401	0.2837	0.2627	0.2608
CO	0.1828	0.1693	0.1657	0.1718	0.1719	0.1957	0.1969	0.2005
NMVOC	0.0919	0.0862	0.0818	0.0727	0.0677	0.0736	0.0626	0.0592
SO_2	0.0230	0.0213	0.0210	0.0188	0.0197	0.0233	0.0213	0.0214
	2006	2007	2008	2009	2010	2011	2012	2013
CO_2	75.9977	79.9382	89.3145	82.6447	82.7287	95.4567	107.1666	115.1928
CH_4	0.0045	0.0029	0.0018	0.0030	0.0028	0.0043	0.0052	0.0147
N_2O	0.0026	0.0027	0.0030	0.0028	0.0028	0.0031	0.0035	0.0038
NO_x	0.3029	0.3261	0.3677	0.3397	0.3427	0.3959	0.4447	0.4647
CO	0.2160	0.1974	0.1904	0.1939	0.1983	0.2279	0.2503	0.2849
NMVOC	0.0676	0.0664	0.0713	0.0754	0.0701	0.0991	0.1194	0.1361
SO_2	0.0241	0.0253	0.0283	0.0262	0.0262	0.0303	0.0340	0.0375

In comparison with the reference year level, in 2013 the GHG emissions from 'International Bunkers: Aviation' source category represented: for CO_2 – 53.0 per cent, for CH_4 – 34.3 per cent, for N_2O – 54.8 per cent, for NOx – 58.5 per cent, for CO – 32.6 per cent, for NMVOC – 26.2 per cent and for SO_2 – 54.4 per cent (Table 3-120).

Table 3-120: GHG Emissions from 'International Bunkers: Aviation' in the Republic of Moldova within 1990-2013 periods, where 1990 represents 100 per cent

	1990	1991	1992	1993	1994	1995	1996	1997
CO_2	100.0	107.1	44.3	28.6	17.4	19.3	30.3	34.8
CH_4	100.0	113.1	43.9	23.1	13.5	14.0	11.1	12.7
N_2O	100.0	107.0	44.3	28.6	17.4	19.3	30.4	35.1
NO_x	100.0	106.3	44.2	29.3	18.0	19.8	32.2	36.8
CO	100.0	110.4	44.1	25.4	15.1	16.2	19.3	22.5
NMVOC	100.0	111.4	44.0	24.9	14.7	15.8	17.3	19.6
SO_2	100.0	107.1	44.3	28.6	17.4	19.3	30.3	34.8
	1998	1999	2000	2001	2002	2003	2004	2005
CO_2	33.4	33.4	30.5	28.5	28.6	33.8	31.0	31.1
CH_4	10.8	10.2	9.4	9.6	9.0	9.0	9.3	8.7
N_2O	33.7	31.0	30.9	29.6	29.6	35.5	33.0	33.9
NO_x	35.3	33.2	31.8	28.3	30.2	35.7	33.1	32.8
CO	20.9	19.4	19.0	19.7	19.7	22.4	22.5	23.0
NMVOC	17.7	16.6	15.7	14.0	13.0	14.2	12.0	11.4
SO_2	33.4	30.9	30.5	27.2	28.5	33.8	30.9	31.1
	2006	2007	2008	2009	2010	2011	2012	2013
CO_2	35.0	36.8	41.1	38.0	38.1	43.9	49.3	53.0
CH_4	10.5	6.7	4.1	6.9	6.6	9.9	12.0	34.3
N_2O	37.7	38.8	42.8	39.7	39.8	45.0	49.8	54.8
NO_x	38.1	41.0	46.3	42.7	43.1	49.8	55.9	58.5
CO	24.7	22.6	21.8	22.2	22.7	26.1	28.7	32.6
NMVOC	13.0	12.8	13.7	14.5	13.5	19.0	22.9	26.2
SO_2	34.9	36.7	41.1	38.0	38.0	43.9	49.3	54.4

Between 1990 and 2013, GHG emissions originated from the 'International Bunkers: Aviation' decreased by 47.1 per cent: from 220.43 to 116.68 Gg CO_2 equivalents (Figure 3-16, Table 3-121).

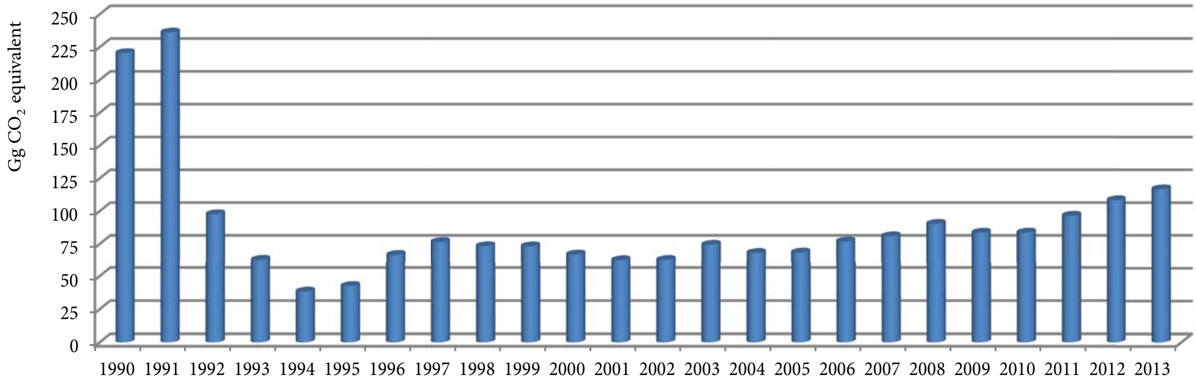

Figure 3-16: Direct GHG Emissions from 'International Bunkers: Aviation' in the Republic of Moldova within 1990-2013 periods, Gg CO_2 equivalent

Table 3-121: Direct GHG Emissions from 'International Bunkers: Aviation' in the Republic of Moldova within 1990-2013 periods, Gg CO_2 equivalent

		1990	1991	1992	1993	1994	1995	1996	1997
CO_2	GHG Emissions, Gg CO_2 equivalent	217.3668	232.8115	96.2635	62.0927	37.8235	41.9185	65.8650	75.6443
CH_4		0.9036	1.0222	0.3964	0.2083	0.1218	0.1267	0.1007	0.1148
N_2O		2.1560	2.3076	0.9551	0.6162	0.3755	0.4161	0.6555	0.7567
Total		**220.4265**	**236.1412**	**97.6150**	**62.9173**	**38.3208**	**42.4613**	**66.6212**	**76.5157**
CO_2	Share in the total GHG emissions, %	98.61	98.59	98.62	98.69	98.70	98.72	98.86	98.86
CH_4		0.41	0.43	0.41	0.33	0.32	0.30	0.15	0.15
N_2O		0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.99
		1998	1999	2000	2001	2002	2003	2004	2005
CO_2	GHG Emissions, Gg CO_2 equivalent	72.4974	72.4938	66.1989	61.9061	62.0776	73.5472	67.3626	67.6961
CH_4		0.0976	0.0920	0.0851	0.0868	0.0816	0.0815	0.0840	0.0789
N_2O		0.7274	0.6694	0.6663	0.6374	0.6391	0.7648	0.7122	0.7316
Total		**73.3224**	**73.2552**	**66.9503**	**62.6303**	**62.7983**	**74.3935**	**68.1588**	**68.5066**
CO_2	Share in the total GHG emissions, %	98.87	98.96	98.88	98.84	98.85	98.86	98.83	98.82
CH_4		0.13	0.13	0.13	0.14	0.13	0.11	0.12	0.12
N_2O		0.99	0.91	1.00	1.02	1.02	1.03	1.04	1.07
		2006	2007	2008	2009	2010	2011	2012	2013
CO_2	GHG Emissions, Gg CO_2 equivalent	75.9977	79.9382	89.3145	82.6447	82.7287	95.4567	107.1666	115.1928
CH_4		0.0946	0.0605	0.0373	0.0622	0.0598	0.0895	0.1085	0.3097
N_2O		0.8127	0.8372	0.9220	0.8568	0.8581	0.9693	1.0741	1.1813
Total		**76.9051**	**80.8360**	**90.2738**	**83.5638**	**83.6467**	**96.5155**	**108.3493**	**116.6838**
CO_2	Share in the total GHG emissions, %	98.82	98.89	98.94	98.90	98.90	98.90	98.91	98.72
CH_4		0.12	0.07	0.04	0.07	0.07	0.09	0.10	0.27
N_2O		1.06	1.04	1.02	1.03	1.03	1.00	0.99	1.01

Comparing with the reference year level, in 2013 the amount of total direct GHG emissions represented only 52.9 per cent (Table 3-122).

Table 3-122: Direct GHG Emissions from 'International Bunkers: Aviation' in the Republic of Moldova within 1990-2013 periods, where 1990 represents 100 per cent

	1990	1991	1992	1993	1994	1995	1996	1997
CO_2	100.0	107.1	44.3	28.6	17.4	19.3	30.3	34.8
CH_4	100.0	113.1	43.9	23.1	13.5	14.0	11.1	12.7
N_2O	100.0	107.0	44.3	28.6	17.4	19.3	30.4	35.1
Total	100.0	107.1	44.3	28.5	17.4	19.3	30.2	34.7
	1998	1999	2000	2001	2002	2003	2004	2005
CO_2	33.4	33.4	30.5	28.5	28.6	33.8	31.0	31.1
CH_4	10.8	10.2	9.4	9.6	9.0	9.0	9.3	8.7
N_2O	33.7	31.0	30.9	29.6	29.6	35.5	33.0	33.9
Total	33.3	33.2	30.4	28.4	28.5	33.7	30.9	31.1
	2006	2007	2008	2009	2010	2011	2012	2013
CO_2	35.0	36.8	41.1	38.0	38.1	43.9	49.3	53.0
CH_4	10.5	6.7	4.1	6.9	6.6	9.9	12.0	34.3
N_2O	37.7	38.8	42.8	39.7	39.8	45.0	49.8	54.8
Total	34.9	36.7	41.0	37.9	37.9	43.8	49.2	52.9

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 (Table 3-123 and 3-124).

Table 3-123: 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.

Table 3-124: Default Emission Factors Available in the 2006 IPCC Guidelines, Used to Estimate GHG Emissions from 'International Bunkers: Aviation'

Aircraft used in the RM	Consumption, t per LTO	CO_2	CH_4	N_2O	NO_x		CO	NMVOC	SO_2
					LTO	Cruise			
TU-154-B	2.23	7030	11.90	0.20	14.33	9.10	143.05	107.13	2.22
TU-134	0.93	2930	1.80	0.10	8.68	8.50	27.98	16.19	0.93
IL-76	2.31	7300	7.40	0.20	31.64	15.70	103.33	66.56	2.31
IAK-42	0.91	2880	0.25	0.10	10.66	15.60	10.22	2.27	0.91
A320	0.77	2440	0.06	0.10	9.01	12.90	6.19	0.51	0.77
B707	1.86	5890	9.75	0.20	10.96	5.90	92.37	87.81	1.86
B737-100/200	0.87	2740	0.45	0.10	6.74	8.70	16.04	4.06	0.87
B747-100	3.21	10140	4.84	0.30	49.17	15.50	114.59	43.59	3.21
B757-300	1.46	4630	0.01	0.10	17.85	9.80	11.62	0.10	1.46
L-410	2.31	7300	7.40	0.20	31.64	15.70	103.33	66.56	2.31
MD-83	1.01	3180	0.19	0.10	11.97	12.40	6.46	1.69	1.01
RJ-RJ85	0.60	1910	0.13	0.10	4.34	15.60	11.21	1.21	0.60
BAE-146	0.57	1800	0.14	0.10	4.07	8.40	11.18	1.27	0.57
CRJ-100ER	0.33	1060	0.06	0.03	2.27	8.00	6.70	0.56	0.33
ERJ-145	0.31	990	0.06	0.03	2.69	7.90	6.18	0.50	0.31
F-100/70/28	0.76	2390	0.14	0.10	5.75	8.40	13.84	1.29	0.76
BAC-561RC	0.80	2520	0.15	0.10	7.40	12.00	13.07	1.36	0.80
ATR-42	0.20	620	0.03	0.02	1.82	14.20	2.33	0.26	0.20
SF-340B	0.68	2160	0.14	0.10	5.63	8.00	8.88	1.23	0.68
Saab 2000	0.60	1890	0.03	0.10	5.58	9.50	8.42	0.28	0.60
LEAR-35	0.34	1070	0.33	0.03	0.74	7.20	34.07	3.01	0.34
SA-227	0.34	1070	0.33	0.03	0.74	7.20	34.07	3.01	0.34
Falcon 2000EX	0.34	1070	0.33	0.03	0.74	7.20	34.07	3.01	0.34

To be noted, that the 2006 IPCC Guidelines does not include EFs for all types of aircraft used in the Republic of Moldova under the international air transportation. Thus, for some of them it was necessary to use EFs specific to other similar group aircrafts (turbo or jet prop aircrafts), taking into account the engine type used. Over the period under review the aircraft park used in the Republic of Moldova for international air transport has essentially changed its structure (Table 3-125).

Table 3-125: Number of international flights operated by aircrafts from the Republic of Moldova within 1995-2014 periods

	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
An 2	0	0	0	0	0	0	0	0	0	0
An 12	0	0	23	9	13	15	7	25	27	197
An 24	729	929	950	1037	755	976	749	562	124	3241
An 26	3	0	0	12	7	570	182	1	6	243
An 28	0	0	0	0	1	6	6		3	2
An 32	0	0	0	55	95	964	968	850	250	1131
An 72	23	15	19	17	21	49	53	24	28	27
An 74	31	7	5	11	7	4	1	2	1	2

	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
Il 18	15	23	23	45	71	62	18	0	0	10
Il 76	22	23		20	28	20		7	8	2
Ka-26	0	0	0	0	0	0	0	0	0	0
Ka-32	0	0	0	0	0	0	0	0	0	0
Mi-2	0	0	0	0	0	0	0	0	0	0
Mi-8	0	0	0	0	0	688	1300	3294	5375	3906
Mi-17	0	0	0	0	0	0	0	0	0	0
Mi-26	0	0	0	0	0	0	0	0	0	0
Tu 134	1001	1395	1261	1299	1325	1268	1329	1024	887	403
Tu 154	287	114	189	53	23	26	25	16	5	12
Yak 18	0	0	0	0	0	0	0	0	0	0
Yak 40	169	561	779	662	770	655	283	289	304	230
Yak 42	371	342	527	642	531	499	367	668	638	283
Others	158	176	366	137	104	102	91	178	142	255
Total flights with aircrafts of CIS production	**2809**	**3585**	**4142**	**3999**	**3751**	**5904**	**5379**	**6940**	**7798**	**9944**
A 320	0	0	0	0	15	0	0	0	142	924
A 321	0	0	0	0	0	0	0	0	0	0
ATR-42	0	0	58	131	141	141	151	145	159	198
BAE-146	0	0	0	0	0	0	0	0	0	115
MD-81	0	0	0	0	0	0	0	0	0	0
MD-82	0	0	0	0	0	0	0	0	0	0
MD-83	0	0	0	0	0	0	0	0	0	16
B-707	9	7	0	0	0	0	0	0	0	0
B-733	0	0	0	0	0	0	0	0	0	0
B-737	0	27	84	128	110	16	35	102	201	341
B-739	0	0	0	0	0	0	0	2	0	0
B-747	0	0	0	0	0	0	0	2	2	5
B-757	0	0	0	7	0	0	0	0	0	0
CRG-2	0	0	0	0	0	0	96	103	218	350
CRJ	0	0	0	0	36	100	0	0	0	0
DHC-8	0	0	45	0	0	0	0	0	0	0
EMB-120	0	0	0	0	0	0	667	627	495	842
EMB-135	0	0	0	0	0	0	323	208	1	2
EMB-190	0	0	0	0	0	0	0	0	0	0
Fairchild SA227	0	0	0	0	0	0	0	0	0	0
Fokker-70	0	0	0	0	23	0	0	0	0	0
Fokker-100	0	0	0	0	0	0	0	0	0	0
HS-25	0	0	9	0	0	0	0	0	0	0
Let 410	11	0	0	56	45	19	0	7	7	37
Learjet-35	0	0	8	0	0	0	0	0	0	0
Learjet-60	0	0	0	0	0	0	0	0	0	0
Robinson R44	0	0	0	0	0	0	0	0	0	0
RJ-70	0	0	0	0	0	7	10	22	5	2
RJ-85	0	0	0	0	2	0	0	0	0	0
RJ-100	0	0	0	0	0	25	118	51	19	10
RomBac-561RC	0	0	0	0	0	0	0	39	0	0
ENSTROM F28F	0	0	0	0	0	0	0	0	0	0
X-32-912 BECAS	0	0	0	0	0	0	0	0	0	0
Falcon 2000EX	0	0	0	0	0	0	0	0	0	0
SAAB-340	0	0	372	550	505	1259	1467	1024	1671	369
SAAB-2000	0	0	0	0	0	0	0	0	269	970
Total Flights with Other Aircrafts	**20**	**34**	**576**	**872**	**877**	**1567**	**2867**	**2332**	**3189**	**4181**
Total Flights Performed	**2829**	**3619**	**4718**	**4871**	**4628**	**7471**	**8246**	**9272**	**10987**	**14125**
	2005	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**
An 2	1	144	126	145	227	202	0	0	0	0
An 12	111	194	149	1	0	0	0	0	0	0
An 24	2811	2782	1573	5	0	0	0	0	0	0
An 26	861	3085	1690	264	1175	863	463	652	689	302
An 28	3	0	0	0	0	0	0	0	0	0
An 32	1038	672	379	47	0	0	0	0	0	0
An 72	87	68	198	0	0	0	0	0	0	0
An 74	1	0	0	0	0	0	0	0	0	0
Il 18	98	155	12	1	31	78	247	128	6	0
Il 76	5	0	0	0	0	0	0	52	377	216
Ka-26	0	0	0	0	0	0	0	0	0	0
Ka-32	0	42	283	126	126	139	300	284	309	268
Mi-2	0	0	0	0	0	0	1297	1022	1214	2626
Mi-8	3375	3088	3974	5032	4321	6720	2315	1264	3462	4133
Mi-17	0	0	0	0	0	0	320	493	1129	969
Mi-26	4	3	64	84	84	0	0	0	0	0
Tu 134	15	65	236	52	1	0	0	0	0	0
Tu 154	14	0	0	0	0	0	0	0	0	0
Yak 18	0	0	2	16	88	5	5	5	5	5
Yak 40	94	52	3	1	0	0	0	0	0	0
Yak 42	518	0	0	0	0	0	0	0	3	3
Others	475	0	0	0	0	0	0	0	0	0
Total flights with aircrafts of CIS production	**9511**	**10350**	**8689**	**5774**	**6053**	**8007**	**4947**	**3900**	**7194**	**8522**
A 320	1256	1679	1340	1517	1935	1779	1524	1399	1041.5	1239
A 321	0	2	0	0	0	0	0	0	2	552
ATR-42	199	0	0	0	0	0	0	0	0	0

	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
BAE-146	253	0	0	0	0	0	0	0	0	0
MD-81	0	0	9	134	0	0	0	0	0	0
MD-82	0	0	196	182	0	11	20	35	3.5	157.5
MD-83	10	0	28	54	31	0	6	0	0	10.5
B-707	1	0	0	0	0	0	0	0	0	0
B-733	0	0	0	0	0	0	0	58	0	0
B-737	311	0	61	1	0	0	0	6	22	6
B-739	0	0	0	0	0	0	0	0	0	1
B-747	1	0	0	0	0	0	0	0	0	0
B-757	0	0	0	0	0	0	0	0	0	0
CRG-2	356	0	0	0	0	0	0	0	0	0
CRJ	0	0	0	0	0	0	0	0	0	0
DHC-8	0	0	11	0	0	0	0	0	0	0
EMB-120	821	525	600	614	622	555	604	767	779	828
EMB-135	2	0	0	0	0	0	0	0	0	16
EMB-190	0	0	0	0	0	458	711	744	1500.5	1559
Fairchild SA227	7	0	0	0	0	0	0	0	95	0
Fokker-70	0	455	85	10	12	13	3.5	3	0	0
Fokker-100	0	58	0	0	5	4	26	25	8	2
HS-25	0	0	0	0	0	0	0	0	0	0
Let 410	3	1	2	0	0	0	117	258	144.5	0
Learjet-35	0	0	0	0	0	0	0	0	425	215
Learjet-60	0	0	0	0	0	0	415	399	0	0
Robinson R44	0	0	0	0	0	0	0	0	0	19
RJ-70	0	0	0	0	0	0	0	0	0	0
RJ-85	36	0	0	0	0	0	0	0	0	0
RJ-100	0	0	0	0	0	0	0	0	0	0
RomBac-561RC	0	0	0	0	0	0	0	0	0	0
ENSTROM F28F	0	0	0	0	0	0	0	0	0	89
X-32-912 BECAS	0	0	0	0	0	0	0	0	384	865
Falcon 2000EX	0	0	0	0	0	0	0	0	350	298
SAAB-340	132	21	2	0	0	0	12	0	0	0
SAAB-2000	2238	1934	1469	1442	1269	969	486	48	0	0
Total Flights with Other Aircrafts	**5626**	**4675**	**3803**	**3954**	**3874**	**3789**	**3925**	**3742**	**4755**	**5857**
Total Flights Performed	**15137**	**15025**	**12492**	**9728**	**9927**	**11796**	**8872**	**7642**	**11949**	**14379**

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.

Thus, before 1995, the majority of flights (99.3 per cent of the total) were operated with aircrafts produced in the former CIS countries (TU-154, TU-134, IL-76, IL-18, YAK-40, YAK-42, AN-12, AN-24, AN-26, AN-32, AN-72 etc.), by 2014 the share of these aircrafts in international air transport in the Republic of Moldova decreased to 59.3 per cent (Table 3-126), the rest being represented by aircrafts produced in western countries, such as: Airbus A-320, Saab 2000, Embraer EMB-120, Embraer EMB-145, Embraer EMB-190, Fokker-70, Fokker-100, Canadair Regional Jet CRJ-200, Boeing 737-300, British Aerospace BAE-146, Avions de Transport Règional ATR-42, Saab Fairchild SF-340B, etc.

AD related to the consumption of fuel for international aviation was provided by the Civil Aeronautical Authority (CAA) (http://www.caa.md/)[24].

Table 3-126: Share of international flights by aircrafts producers in the Republic of Moldova within 1995-2014 periods, % from total

	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
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
Flights with Other Aircrafts, %	0.7	0.9	12.2	17.9	18.9	21.0	34.8	25.2	29.0	29.6
	2005	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**
Flights with Aircrafts from CIS, %	62.8	68.9	69.6	59.4	61.0	67.9	55.8	51.0	60.2	59.3
Flights with Other Aircrafts, %	37.2	31.1	30.4	40.6	39.0	32.1	44.2	49.0	39.8	40.7

Source: Civil Aviation State Administration through Official Letters No.3978 dated 02.10.2006 and No. 1328 dated 13.09.2011; Civil Aviation Authority of the RM through Official Letters No. 474 dated 13.02.2014 and No. 366 dated 02.03.2015.

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 1993-2013 years and data provided by CAA (for 2003-2013 the difference being quite significant) (Table 3-127).

Table 3-127: Kerosene Consumption for International Aviation in the Republic of Moldova within 1990-2013 periods, thousand tons

	1990	1991	1992	1993	1994	1995	1996	1997
Data available in the EBs	69.0000	-	-	19.7000	11.0000	11.0000	18.0000	21.0000
Data provided by CAA	68.9600	73.8600	30.5400	19.7000	12.0000	13.3000	20.9000	24.0000
Difference, %	-0.1	-	-	0.0	9.1	20.9	16.1	14.3

[24] Until 2012 the institution was called the Civil Aviation Administration of the Republic of Moldova.

	1998	1999	2000	2001	2002	2003	2004	2005
Data available in the EBs	17.0000	20.0000	20.0000	16.0000	19.0000	11.0000	11.0000	12.0000
Data provided by CAA	23.0000	23.0000	21.0000	19.6201	19.6701	23.304	22.3914	21.4357
Difference, %	35.3	15.0	5.0	22.6	3.5	111.9	103.6	78.6
	2006	2007	2008	2009	2010	2011	2012	2013
Data available in the EBs	12.0000	14.0000	14.0000	14.0000	13.0000	13.0000	15.0000	13.0000
Data provided by CAA	24.0745	25.331	28.3185	26.2157	26.2148	30.264	34.155	41.3796
Difference, %	100.6	80.9	102.3	87.3	101.7	132.8	127.7	218.3

Source: EBs of the RM for 1990, 1993-2010; Civil Aviation Administration of the RM through Official Letters No.3978 dated 02.10.2006 and No. 1328 dated 13.09.2011; Civil Aeronautical Authority of the RM through Official Letters No. 474 dated 13.02.2014 and No. 366 dated 02.03.2015.

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 reliable.

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 statistical data regarding aviation kerosene consumption for international air transport is deemed to be relatively low (±5 per cent). Uncertainties pertaining to GHG emissions from the 'International Bunkers: Aviation' were estimated at ±7.07 per cent for CO_2 emissions, ±11.18 per cent for CH_4 emissions and ±100.12 per cent for N_2O. At the same time, combined uncertainties, presented as a per cent of total sectoral emissions were estimated at ±0.0834 per cent for CO_2 emissions, ±0.0004 per cent for CH_4 emissions, and ±0.0121 per cent for N_2O. Uncertainties introduced in trend in the sectoral emissions were estimated at ±0.0246 per cent for CO_2 emissions, at ±0.0001 per cent for CH_4 emissions, and at ±0.0017 per cent for N_2O emissions (Annex 5-3.1).

In view of ensuring time-series consistency of the obtained results, the same approach was used for the entire period under review, in conformity with the recommendations included in the GPG (IPCC, 2000).

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 (IPCC, 2000). 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 GPG (IPCC, 2000), 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

GHG emissions from the 'International Bunkers: Aviation' were recalculated for 2004, in particular due to the identification of a mechanical error related to data entry activities (instead of 21.325 kt of kerosene, it was introduced erroneously a value of 22.391 kt). In comparison with the results included into the TNC, the performed recalculations revealed a decrease of GHG emissions recorded in 2004 (Table 3-128).

Table 3-128: Comparative Results of GHG Emissions from 'International Bunkers: Aviation' included into the TNC and the BUR of the RM under the UNFCCC, Gg CO_2 equivalent

	1990	1991	1992	1993	1994	1995	1996	1997
TNC	220.4265	236.1412	97.6150	62.9173	38.3208	42.4613	66.6212	76.5157
BUR	220.4265	236.1412	97.6150	62.9173	38.3208	42.4613	66.6212	76.5157
Difference, %	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	1998	1999	2000	2001	2002	2003	2004	2005
TNC	73.3224	73.2552	66.9503	62.6303	62.7983	74.3935	71.5352	68.5066
BUR	73.3224	73.2552	66.9503	62.6303	62.7983	74.3935	68.1588	68.5066
Difference, %	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	-4.7198	0.0000
	2006	2007	2008	2009	2010	2011	2012	2013
TNC	76.9051	80.8360	90.2738	83.5638	83.6467			
BUR	76.9051	80.8360	90.2738	83.5638	83.6467	96.5155	108.3493	116.6838
Difference, %	0.0000	0.0000	0.0000	0.0000	0.0000			

Abbreviations: TNC – Third National Communication; BUR – Biennial Update Report

For the 2011-2013 time periods, the GHG emissions from 'International Bunkers: Aviation' were estimated for the first time. The results allow assert that between 1990 and 2013, the GHG emissions originated from this source category decreased by 47.1 per cent.

3.8.6 Planned Improvements

Within the 'International Bunkers: Aviation', potential improvements could be achieved once a higher methodology is used, as well as new disaggregated AD are collected.

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 IPCC Guidelines (1997, 2006), 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 2013 the CO_2 emissions from biomass increased by 5.9 times (Table 3-129, Figure 3-17)

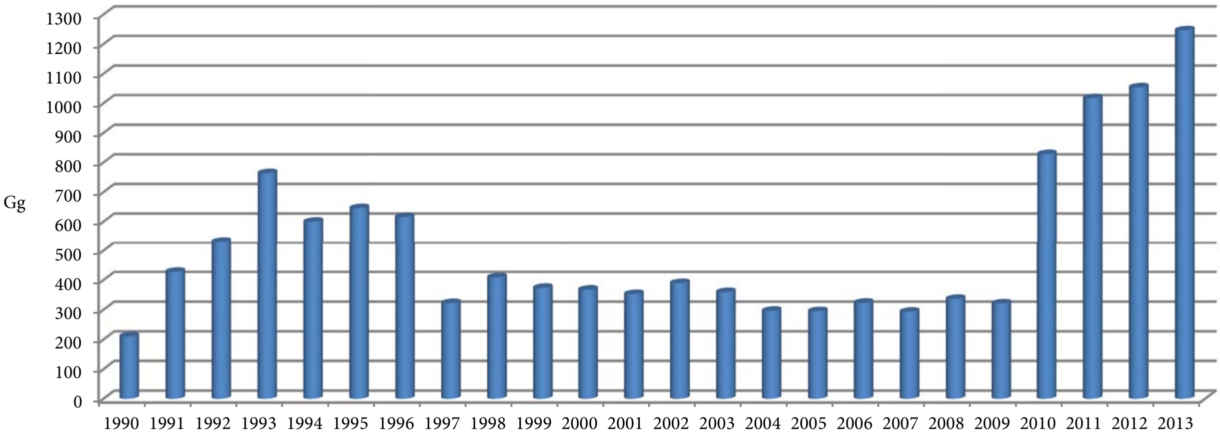

Figure 3-17: CO_2 emissions from biomass (Memo Items) in the Republic of Moldova within 1990-2013 periods

Table 3-129: CO_2 emissions from biomass (Memo Items) in the Republic of Moldova within 1990-2013 periods, Gg

	1990	1991	1992	1993	1994	1995	1996	1997
CO_2 emissions from biomass	210.8274	427.7268	531.1505	763.4134	599.5042	645.5674	615.3433	322.4374
	1998	1999	2000	2001	2002	2003	2004	2005
CO_2 emissions from biomass	409.1761	373.6048	367.8560	353.0871	389.5020	359.7899	296.5059	295.0374
	2006	2007	2008	2009	2010	2011	2012	2013
CO_2 emissions from biomass	323.6620	293.1867	336.6568	321.2484	828.0265	1016.9471	1053.5877	1246.2329

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 Revised 1996 IPCC Guidelines (IPCC, 1997), Vol. 3, Chap. 1.4.3; as well as in the 2006 IPCC Guidelines, Vol. 2, Chap. 2.3.3.4 (IPCC, 2006).

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; 1 kt of agricultural residues – 14.67 TJ; Fuel Wood Carbon Emission Factor – 30.5 t C/TJ; Agricultural Residues Carbon Emission Factor – 27.3 t C/TJ.

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) in such sectors as 'Energy Industries' (1A1), 'Manufacturing Industry and Construction' (1A2), 'Commercial / Institutional' (1A4a), 'Residential' (1A4b), 'Agriculture / Forestry / Fishing' (1A4c), and 'Other Needs and Works in Energy Sector' (1A5) have been collected from the Energy Balances of the Republic of Moldova for 1990 and 1993-2013 years, as well as from the Socio-Economic Development publications of the ATULBD (Table 3-130).

Table 3-130: Biomass Consumption in the Republic of Moldova within 1990-2013 periods

	Fuel Type	1A1	1A2	1A4a	1A4b	1A4c	1A5
1990	Fuel Wood, thousand m³ comp.	1	15	37	117	4	5
	Wood and Agricultural Residues, thousand t.c.e.	2	6		8		
1993	Fuel Wood, thousand m³ comp.	0.6	8.4	14.0	98.3	1.1	1.3
	Wood and Agricultural Residues, thousand t.c.e.	1.7	2.3	0.2	5.0	0.1	0.4
1994	Fuel Wood, thousand m³ comp.	1	1	13	107	2	3
	Wood and Agricultural Residues, thousand t.c.e.	5	1		7		
1995	Fuel Wood, thousand m³ comp.	1	4	16	195	3	5
	Wood and Agricultural Residues, thousand t.c.e.	3			7		1
1996	Fuel Wood, thousand m³ comp.	1	4	19	238	2	11
	Wood and Agricultural Residues, thousand t.c.e.	3		1	11		
1997	Fuel Wood, thousand m³ comp.	1	4	16	244	2	6
	Wood and Agricultural Residues, thousand t.c.e.	2			10		1
1998	Fuel Wood, thousand m³ comp.	2	2	17	252	2	4
	Wood and Agricultural Residues, thousand t.c.e.	1			6		
1999	Fuel Wood, thousand m³ comp.	1	1	10	238	2	4
	Wood and Agricultural Residues, thousand t.c.e.	1			11		1
2000	Fuel Wood, thousand m³ comp.		1	12	220	1	5
	Wood and Agricultural Residues, thousand t.c.e.	2			17		
2001	Fuel Wood, thousand m³ comp.		1	16	198	2	5
	Wood and Agricultural Residues, thousand t.c.e.	5			20		1
2002	Fuel Wood, thousand m³ comp.	1	1	20	242	2	4
	Wood and Agricultural Residues, thousand t.c.e.	8			17		1
2003	Fuel Wood, thousand m³ comp.	1	2	51	252	2	3
	Wood Residues, thousand t.c.e.	1		5	15		
	Agricultural Crop Residues, thousand t.c.e.	7			3		1
2004	Fuel Wood, thousand m³ comp.		1	30	214	1	4
	Wood Residues, thousand t.c.e.	1	1	2	11		1
	Agricultural Crop Residues, thousand t.c.e.	11			4		1
2005	Fuel Wood, thousand m³ comp.		1	27	218	1	4
	Wood Residues, thousand t.c.e.	1	1	1	10		
	Agricultural Crop Residues, thousand t.c.e.	8			7		1
2006	Fuel Wood, thousand m³ comp.		1	33	272	2	3
	Wood Residues, thousand t.c.e.			1	12		
	Agricultural Crop Residues, thousand t.c.e.	7			8		1
2007	Fuel Wood, thousand m³ comp.			32	220	2	3
	Wood Residues, thousand t.c.e.			1	9		
	Agricultural Crop Residues, thousand t.c.e.	8			7		
2008	Fuel Wood, thousand m³ comp.			34	249	1	4
	Wood Residues, thousand t.c.e.			1	11		
	Agricultural Crop Residues, thousand t.c.e.	12		1	7		
2009	Fuel Wood, thousand m³ comp.			31	236	2	2
	Wood Residues, thousand t.c.e.			1	13		1
	Agricultural Crop Residues, thousand t.c.e.	15		10			
2010	Fuel Wood, TJ	2	11	237	6304	15	
	Wood Residues, TJ	2	16	44	237		
	Agricultural Crop Residues, TJ	514		48	66	6	
2011	Fuel Wood, TJ		17	231	7887	15	
	Wood Residues, TJ	1	25	23	137		
	Agricultural Crop Residues, TJ	399	5	33	419	12	
2012	Fuel Wood, TJ	1	17	218	8472	31	
	Wood Residues, TJ	3	36	19	273		
	Agricultural Crop Residues, TJ	226	2	88	96	2	
	Charcoal, TJ			4	13		
2013	Fuel Wood, TJ	37	20	185	10245	28	
	Wood Residues, TJ	3	5	35	164	1	
	Agricultural Crop Residues, TJ	229	10	68	134	3	
	Charcoal, TJ			3	11		
	Biogas, TJ	36					

Source: Energy Balances of the RM for 1990, 1993-2013; State Statistical Service of the Transnistrian Moldovan Republic (2015), *Socio-economic development of the TMR, 2014 (final data). Chapter 4 "Material and Energy Resources", page 22* / State Statistical Service of the Ministry of Economy of the TMR - Tiraspol, 2015 – 81p.; State Statistical Service of the Transnistrian Moldovan Republic (2014), *Socio-economic development of the TMR, 2013 (final data). Chapter 4 "Material and Energy Resources", page 22* / State Statistical Service of the Ministry of Economy of the TMR - Tiraspol, 2014 – 88p.; .; State Statistical Service of the Transnistrian Moldovan Republic (2013), *Socio-economic development of the TMR, 2012, Chapter 4 "Material and Energy Resources", page 23.* 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.

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 – 50 per cent. CO_2 emissions from biomass uncertainties were estimated at ±94.34 per cent. At the same time, combined uncertainties, presented as a per cent of total sectoral emissions were estimated at ±12.0367 per cent, while uncertainties introduced in trend in sectoral emissions were estimated at ±3.7068 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 GPG (IPCC, 2000).

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 (IPCC, 2000). 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 GPG (IPCC, 2000), 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.

3.9.5 Recalculations

GHG emissions from the 'CO_2 emissions from biomass' (Memo Items) were recalculated for 2010, in particular due to the NBS updating of the activity data included within the Energy Balances. These actions aim to improve the statistical accounting system of the amount of biomass used in the Republic of Moldova. In comparison with the results included into the TNC, the performed recalculations revealed an increase of direct GHG emissions recorded in 2010 by 2.9 times (Table 3-131).

Table 3-131: Comparative Results of GHG Emissions from 'CO_2 emissions from biomass' (Memo Items) included into the TNC and the BUR of the RM under the UNFCCC, Gg

	1990	1991	1992	1993	1994	1995	1996	1997
TNC	210.8274	427.7268	531.1505	763.4134	599.5042	645.5674	615.3433	322.4374
BUR	210.8274	427.7268	531.1505	763.4134	599.5042	645.5674	615.3433	322.4374
Difference, %	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	1998	1999	2000	2001	2002	2003	2004	2005
TNC	409.1761	373.6048	367.8560	353.0871	389.5020	359.7899	296.5059	295.0374
BUR	409.1761	373.6048	367.8560	353.0871	389.5020	359.7899	296.5059	295.0374
Difference, %	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	2006	2007	2008	2009	2010	2011	2012	2013
TNC	323.6620	293.1867	336.6568	321.2484	289.1029			
BUR	323.6620	293.1867	336.6568	321.2484	828.0265	1016.9471	1053.5877	1246.2329
Difference, %	0.0000	0.0000	0.0000	0.0000	186.4123			

Abbreviations: TNC – Third National Communication; BUR – Biennial Update Report

For 2011-2013 years the GHG emissions from 'CO_2 emissions from biomass' (Memo Items) were estimated for the first time. The results allow assert that between 1990 and 2013, the GHG emissions originated from this source category increased by 5.9 times.

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, including for the period previous to 2010 (AD on biomass consumption were recently revised by the NBS using a new methodology, though it did not covered the entire period from 1990 to 2009, 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 Reference and Sectoral Approaches

In conformity with the recommendations provided in the GPG (IPCC, 2000), CO_2 emissions calculated by using two distinct approaches: the reference method (top-down) and the sectoral method (bottom up) were compared (Table 3-132).

Table 3-132: Comparison of CO_2 Emissions Estimated by using Reference and Sectoral Approaches in the Republic of Moldova for 1990-2013 periods, Gg

	1990	1991	1992	1993	1994	1995	1996	1997
Reference Approach	33153.7276	28965.2948	20487.1325	15711.9958	14309.3918	11000.6793	11139.6621	10117.5131
Sectoral Approach	33365.5535	29193.0936	20581.3267	15772.5160	14346.4226	11041.7064	11204.1202	10191.5242
Difference, %	0.64	0.79	0.46	0.39	0.26	0.37	0.58	0.73
	1998	1999	2000	2001	2002	2003	2004	2005
Reference Approach	8649.6771	6771.1247	6038.1764	6643.4271	6270.0030	6988.9670	7416.7595	7655.2730
Sectoral Approach	8720.8485	6842.0509	6102.7447	6703.9020	6330.7106	7060.6996	7482.4685	7721.8663
Difference, %	0.82	1.05	1.07	0.91	0.97	1.03	0.89	0.87
	2006	2007	2008	2009	2010	2011	2012	2013
Reference Approach	6891.5211	6974.2244	7569.2458	8403.8043	8953.7690	9036.7030	8676.9792	7601.5138
Sectoral Approach	6965.8293	7052.3881	7656.7598	8484.6734	9034.6186	9130.1626	8782.3211	7729.1857
Difference, %	1.08	1.12	1.16	0.96	0.90	1.03	1.21	1.68

As the table reveals, the differences do not reach the critical level of 2.0 per cent (following the GPG (IPCC, 2000) recommendations, for differences that exceed 2.0 per cent, explanations should be provided on the possible causes of discrepancies).

4. INDUSTRIAL PROCESSES SECTOR

According to the National Bureau of Statistics (NBS), industry is an important sector of the national economy, its contribution to GDP during 2000-2013 varied between 13 and 18 per cent (13.8 per cent in 2013). The largest share among branches covered by this sector is held by the 'Manufacturing Industry' – 11.3 per cent of the total, while 'Electricity, Heat, Natural Gases and Water Supply' account for 2.0 per cent and 'Mining and Quarrying Industry' – for 0.5 per cent (NBS, 2014). In 2013 the Industry Sector involved more than 12.2 per cent of active population (NBS, 2014). The sector included more than 5089 enterprises and production units, of which circa 7.8 per cent are public ownership, 84.4 per cent - private ownership, 1.0 per cent - mixed (public and private) ownership (without foreign capital), 2.6 per cent - foreign capital and 4.1 per cent joint ventures (NBS, 2014).

Industry Sector's structure covers 97 types of activities, grouped as follows: Group 1 – industries based on local raw materials, which maintained their traditional markets: food industry (winemaking, canned food, juices, sugar); manufacturing of other products of non-metal minerals (cement, plaster stone, lime, ceramics production); cosmetics and perfumery; manufacturing of wooden elements for construction, manufacturing of wooden packaging; waste and recyclable materials recovery; Group 2 – industries preponderantly based on imported raw materials that have a potential market which however, needs upgrading and fast restructuring: light industry (textiles, knit-wear, leather goods); machinery manufacturing (pumping machines, medical equipment, engineering-and-electrical goods, agricultural machinery and equipment; Group 3 – industries based on imported raw materials and parts having low competitiveness: furniture, chemical products, including pharmaceuticals; paper and carton; plastics; finished metal goods; Group 4 – science-intensive enterprises, requiring special restructuring programs, as well as investment attraction programs: information technologies and instrument making engineering. The largest share among all industries is held by enterprises of the first group, in particular, processing enterprises accounting for more than 50 per cent of the total industrial output.

4.1 Overview

'Industrial Processes' Sector includes greenhouse gas emissions generated directly from non-energy[25] industrial activities. Methodological guidance used includes the Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories (IPCC, 1997), Good Practice Guidance (IPCC, 2000) and 2006 IPCC Guidelines for National Greenhouse Gas Inventories (IPCC, 2006) and EMEP/EEA Air Pollutant Emission Inventory Guidebook 2013.

In the Republic of Moldova, the source categories covered by this sector are: 2A 'Mineral Products' (*2A1 'Cement Production', 2A2 'Lime Production', 2A3 'Limestone and Dolomite Use', 2A4 'Soda Ash Production and Use', 2A5 'Asphalt Roofing', 2A6 'Road Paving with Asphalt', 2A7 'Other' - Glass, Mineral Wood, Bricks and Expanded Clay Production),* 2B 'Chemical Industry' (*2B5 'Other' - Polyethylene, Synthetic Resins and Detergents Production*), 2C 'Metal Production' (*2C1 Iron and Steel Production*), 2D 'Other Production' *(2D2 'Food Products': bread, sugar, meat, butter, confectionery, fodder; and 'Alcoholic Beverages': wine, sparkling wine, cognac, brandy, liqueur and beer*) as well as 2F 'Consumption of Halocarbons and Sulphur Hexafluoride' (*2F1 'Refrigeration and Air Conditioning Equipment', 2F2 'Foam Blowing', 2F4 'Aerosols' and 2F8 "Electric Equipment'*). As no halocarbons and sulphur hexafluoride are produced in the Republic of Moldova, respectively, there were registered no direct greenhouse gas emissions from the source category 2E 'Production of Halocarbons and Sulphur Hexafluoride'.

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 2013, 'Industrial Processes' accounted for circa 5.2 per cent of total national GHG direct emissions (without LULUCF), being a relevant source of GHG emissions. To be noted that this sector represented an important source of CO_2 national emissions (6.4 per cent of national total) and the only source of F-gas emissions.

[25] GHG emissions from fossil fuel combustion for production of energy used for industrial activities are estimated in the Energy Sector.

Between 1990 and 2013, the total GHG emissions originated from the 'Industrial Processes' tended to lower values (Table 4-1, Figure 4-1), decreasing by circa 63.5 per cent, from 1842.0 Gg to 672.6 Gg, in particular due to reduced industrial output, such as mineral products (cement production decreased by 50.2 per cent, lime production - by 97.3 per cent, limestone use – by 97.5 per cent, dolomite use – by 99.6 per cent, soda ash use – by 52.9 per cent, bricks production – by 78.8 per cent) and metal production (steel production decreased by 73.2 per cent and rolling mills production – by 71.8 per cent).

Table 4-1: Direct GHG Emissions from "Industrial Processes" in the Republic of Moldova within 1990 – 2013 periods, Gg CO_2 equivalent

	1990	1991	1992	1993	1994	1995	1996	1997
CO_2	1842.0368	1755.9756	1147.1632	739.4274	607.7326	476.4837	421.4953	471.2245
HFC	NO, NE	NO, NE	NO, NE	NO, NE	NO, NE	1.8961	4.0738	6.6059
PFC	NO, NE	NO, NE	NO, NE	NO, NE	NO, NE	NO, NE	NO, NE	NO, NE
SF_6	NO, NE	NO, NE	NO, NE	NO, NE	NO, NE	NO, NE	NO, NE	NO, NE
Total direct GHG emissions	1842.0368	1755.9756	1147.1632	739.4274	607.7326	478.3798	425.5691	477.8304
	1998	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**
CO_2	322.6857	285.6313	256.8091	245.4626	300.8909	345.6158	388.0536	521.0151
HFC	9.4575	11.4564	13.3755	16.4898	19.5171	25.8543	32.0282	39.4124
PFC	NO, NE	NO, NE	NO, NE	NO, NE	NO, NE	NO, NE	NO, NE	NO, NE
SF_6	NO, NE	NO, NE	NO, NE	NO, NE	NO, NE	0.0057	0.0057	0.0459
Total direct GHG emissions	332.1432	297.0876	270.1846	261.9524	320.4080	371.4758	420.0876	560.4734
	2006	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**
CO_2	608.9135	877.8078	938.2415	426.0656	456.4391	488.0670	496.0046	529.6953
HFC	47.0741	60.3620	76.3309	87.1207	102.4171	112.3917	126.0156	142.1872
PFC	0.0156	0.0156	0.0195	0.0195	0.0273	0.0273	0.0273	0.0273
SF_6	0.2720	0.3523	0.4230	0.4574	0.5538	0.5814	0.6285	0.6803
Total direct GHG emissions	656.2753	938.5377	1015.0149	513.6632	559.4372	601.0675	622.6759	672.5900

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

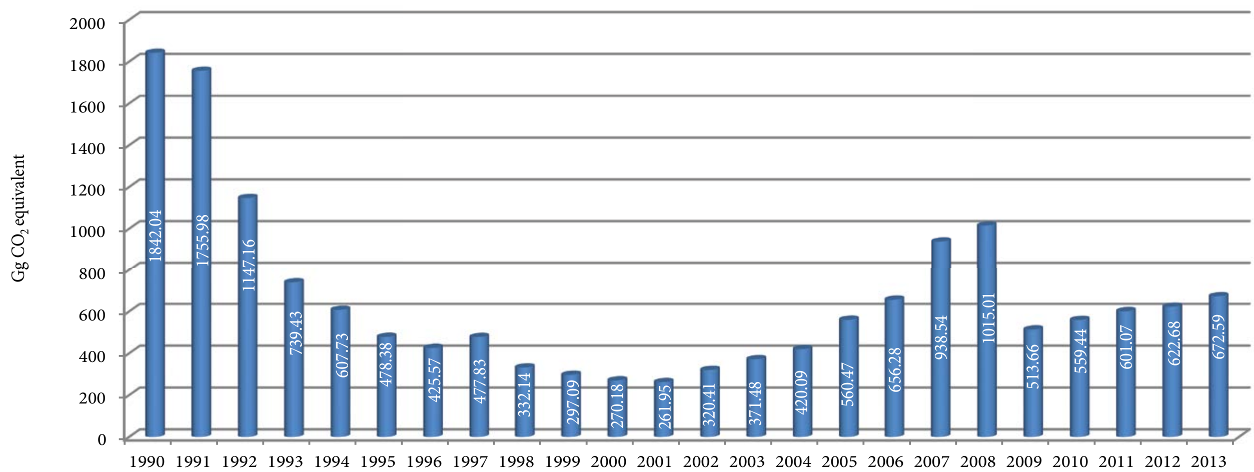

Figure 4-1: Direct GHG Emissions from Industrial Processes in the Republic of Moldova within 1990 – 2013 periods

To be noted that in 1990, there were registered only CO_2 emissions within this sector, while in 2013, the share in the total GHG emissions covered by 'Industrial Processes' represented: CO_2 – 78.75 per cent, HFC – 21.14 per cent, PFC – 0.004 per cent and SF_6 - 0.10 per cent.

Table 4-2: Total Direct GHG Emissions from the 'Industrial Processes' by Category in the Republic of Moldova within 1990 – 2013 periods

	1990	1991	1992	1993	1994	1995	1996	1997
2A 'Mineral Products'	1830.3185	1745.8036	1137.2807	729.3501	597.2654	465.6247	410.4329	457.8242
2C 'Metal Production'	11.7182	10.1720	9.8825	10.0773	10.4672	10.8590	11.0623	13.4004
2F 'Consumption of Halocarbons and SF_6'	NO, NE	NO, NE	NO, NE	NO, NE	NO, NE	1.8961	4.0738	6.6059
2 'Industrial Processes'	1842.0368	1755.9756	1147.1632	739.4274	607.7326	478.3798	425.5691	477.8304
	1998	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**
2A 'Mineral Products'	310.8141	272.4704	241.7962	229.4738	292.4069	330.9647	371.3023	503.6855
2C 'Metal Production'	11.8717	13.1608	15.0129	15.9888	8.4840	14.6511	16.7513	17.3296
2F 'Consumption of Halocarbons and SF_6'	9.4575	11.4564	13.3755	16.4898	19.5171	25.8600	32.0340	39.4583
2 'Industrial Processes'	332.1432	297.0876	270.1846	261.9524	320.4080	371.4758	420.0876	560.4734
	2006	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**
2A 'Mineral Products'	597.7500	861.8512	923.6086	419.0229	452.4453	482.7657	490.7676	526.5511
2C 'Metal Production'	11.1636	15.9566	14.6330	7.0427	3.9938	5.3013	5.2370	3.1441
2F 'Consumption of Halocarbons and SF_6'	47.3617	60.7298	76.7734	87.5976	102.9981	113.0005	126.6714	142.8948
2 'Industrial Processes'	656.2753	938.5377	1015.0149	513.6632	559.4372	601.0675	622.6759	672.5900

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

From Tables 4-2 and 4-3 one can notice that 2A 'Mineral Products' and 2F 'Consumption of Halocarbons and Sulphur Hexafluoride' categories represent the major sources of direct GHG emissions under 'Industrial Processes', with a share varying from a maximum of 99.4 per cent (1990-1991), to a minimum of 78.3 per cent (2013), respectively from a minimum of 0.4 per cent (1995), up to a maximum of 21.2 per cent (2013) of the total.

To be noted that the specific weight of the source category 2F 'Consumption of Halocarbons and Sulphur Hexafluoride' in the total direct GHG emissions covered by the 'Industrial Processes', tends to increase lately (Table 4-3).

Table 4-3: Breakdown of the Republic of Moldova's 'Industrial Processes' Sector GHG Emissions by Category within 1990 – 2013 periods

	1990	1991	1992	1993	1994	1995	1996	1997
2A 'Mineral Products'	99.4	99.4	99.1	98.6	98.3	97.3	96.4	95.8
2C 'Metal Production'	0.6	0.6	0.9	1.4	1.7	2.3	2.6	2.8
2F 'Consumption of Halocarbons and SF_6'	NA	NA	NA	NA	NA	0.4	1.0	1.4
2 'Industrial Processes'	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
	1998	1999	2000	2001	2002	2003	2004	2005
2A 'Mineral Products'	93.6	91.7	89.5	87.6	91.3	89.1	88.4	89.9
2C 'Metal Production'	3.6	4.4	5.6	6.1	2.6	3.9	4.0	3.1
2F 'Consumption of Halocarbons and SF_6'	2.8	3.9	5.0	6.3	6.1	7.0	7.6	7.0
2 'Industrial Processes'	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
	2006	2007	2008	2009	2010	2011	2012	2013
2A 'Mineral Products'	91.1	91.8	91.0	81.6	80.9	80.3	78.8	78.3
2C 'Metal Production'	1.7	1.7	1.4	1.4	0.7	0.9	0.8	0.5
2F 'Consumption of Halocarbons and SF_6'	7.2	6.5	7.6	17.1	18.4	18.8	20.3	21.2
2 'Industrial Processes'	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Abbreviations: NA – Not Applicable.

4.1.2 Key Categories

The results of key category analysis carried out following a Tier 1 approach (IPCC, 2000), 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 'Industrial Processes' Sector.

Table 4-4: Key Categories Identified under the Industrial Processes Sector

IPCC Codes	GHG	IPCC Categories	Key Categories
2A1	CO_2	Cement Production	Yes (L, T)
2A2	CO_2	Lime Production	No
2A3	CO_2	Limestone and Dolomite Use	Yes (T)
2A4	CO_2	Soda Ash Production and Use	No
2A7	CO_2	Mineral Wood Production	No
2A7	CO_2	Bricks Production	No
2C1	CO_2	Iron and Steel Production	No
2F1	HFC	Refrigeration and Air Conditioning Equipment	Yes (L)
2F2	HFC	Foam Blowing	No
2F4	HFC	Aerosols	No
2F8	PFC	Electrical Equipment	No
2F8	SF_6	Electrical Equipment	No

4.1.3 Methodological Issues

Emissions covered by source categories 2A 'Mineral Products', 2C 'Metal Production' and 2F 'Consumption of HFCs and SF_6' 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 sources 2A1 'Cement Production', 2C1 'Iron and Steel Production' and 2F1 'Refrigeration and Air Conditioning Equipment'. 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 (4.2-4.6).

Table 4-5: Summary of Methods and Emission Factors Used to Estimate GHG Emissions from the 'Industrial Processes' Sector

IPCC Codes	Category name	CO_2		HFC		PFC		SF_6	
		Method	EF	Method	EF	Method	EF	Method	EF
2A	Mineral Products	T2, T1	CS, D	NA	NA	NA	NA	NA	NA
2B	Chemical Industry	NO	NO	NO	NO	NO	NO	NO	NO
2C	Metal Production	T2	CS, D	NA	NA	NA	NA	NA	NA
2D	Other	NO	NO	NA	NA	NA	NA	NA	NA
2E	Production of Halocarbons and SF_6	NO	NO	NO	NO	NO	NO	NO	NO
2F	Consumption of Halocarbons and SF_6	NA	NA	T2, T1	D	T2, T1	D	T2, T1	D

Abbreviations: T1 – Tier 1; T2 – Tier 2; CS – Country Specific; D – Default; NA – Not Applicable; NO – Not Occurring; NE – Not Estimated.

4.1.4 Uncertainties Assessment and Time-Series Consistency

The uncertainty analysis of the GHG emissions from the 'Industrial Processes' Sector (by source categories) is described in detail in sub-chapters (4.2-4.6) 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 ±8.62 per cent. The uncertainties introduced in trend in sectoral emissions were estimated at ±3.34 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 (IPCC, 2000).

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 (IPCC, 2000). 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 GPG (IPCC, 2000), GHG emissions were estimated using AD and national coefficients and parameters from official sources of reference.

4.1.6 Recalculations

GHG emission recalculations under the 'Industrial Processes' 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; the use of new EF for non-CO_2 emissions for the source category 2C1 'Iron and Steel Production', according to the EMEP/EEA Air Pollutant Emission Inventory Guidebook 2013, thus replacing the Emission Inventory Guidebook (CORINAIR, 1996, 1999); also, due to use of updated AD regarding the amount of clay used for brick and expanded clay production.

In comparison with the results included into the TNC, the performed recalculation resulted in a decrease of direct GHG emission values, varying from a minimum of 0.7 per cent in 2008, up to maximum of 4.0 per cent in 1993 (Table 4-6). The Results of performed recalculations at the category level are presented in the respective sub-chapters of the NIR (4.2-4.6)

Table 4-6: Recalculated GHG Emissions under the 'Industrial Processes' Sector for the 1990-2010, included in the TNC of the Republic of Moldova under the UNFCCC, Gg CO_2 equivalent

	1990	1991	1992	1993	1994	1995	1996
TNC	1901.0463	1806.6507	1174.2961	770.1041	623.0019	491.4557	436.7524
BUR	1842.0368	1755.9756	1147.1632	739.4274	607.7326	478.3798	425.5691
Difference, %	-3.1	-2.8	-2.3	-4.0	-2.5	-2.7	-2.6
	1997	1998	1999	2000	2001	2002	2003
TNC	489.8430	343.2660	308.5823	281.2098	272.6618	330.3800	382.7753
BUR	477.8304	332.1432	297.0876	270.1846	261.9524	320.4080	371.4758
Difference, %	-2.5	-3.2	-3.7	-3.9	-3.9	-3.0	-3.0
	2004	2005	2006	2007	2008	2009	2010
TNC	428.8224	568.3628	663.8045	945.7798	1022.1859	520.1068	564.9866
BUR	420.0876	560.4734	656.2753	938.5377	1015.0149	513.6632	559.4372
Difference, %	-2.0	-1.4	-1.1	-0.8	-0.7	-1.2	-1.0

Abbreviations: TNC – Third National Communication; BUR – Biennial Update Report.

4.1.7 Assessment of Completeness

The current inventory covers greenhouse gas emissions from 5 source categories under the Republic of Moldova's 'Industrial Processes' Sector (Table 4-7). As halocarbons and SF_6 are not produced in the Republic of Moldova, no such emissions under the category 2E 'Production of halocarbons and SF_6' were recorded.

Table 4-7: Assessment of Completeness under the 'Industrial Processes' Sector

IPCC Categories	Source Categories	CO_2	HFC	PFC	SF_6
2A	Mineral Products	X	NO	NO	NO
2B	Chemical Industry	NO	NO	NO	NO
2C	Metal Production	X	NO	NO	NO
2D	Other Production	NO	NO	NO	NO
2E	Production of halocarbons and SF_6	NO	NO	NO	NO
2F	Consumption of halocarbons and SF_6	NO	X	X	X

Abbreviations: X – source categories included in the inventory; NO – Not Occurring.

4.1.8 Planned Improvements

Planned improvements at the source categories level within the 'Industrial Processes' Sector is described in more detail in the respective sub-chapters (4.2-4.6) of the NIR.

4.2 Mineral Products (Category 2A)

4.2.1 Source Category Description

Category 2A 'Mineral Products' includes GHG emissions from the following sources: 2A1 'Cement Production', 2A2 'Lime Production', 2A3 'Limestone and Dolomite Use', 2A4 'Soda Ash Production and Use', 2A5 'Asphalt Roofing', 2A6 'Road Paving with Asphalt' and 2A7 'Other' (Glass Production, Mineral Wool Production, Ceramics, Brick and Expanded Clay Production). Over the period under review (1990-2013), the direct GHG emissions originated from the source category 2A 'Mineral Products' decreased by circa 71.2 per cent (Table 4-8).

Table 4-8: Total Direct GHG Emissions from the Category 2A 'Mineral Products' by Source within 1990-2013 periods, Gg CO_2 equivalent

	1990	1991	1992	1993	1994	1995	1996	1997
2A1 Cement Production	971.7056	900.7959	474.3181	405.7202	328.4391	248.5280	193.1237	270.1297
2A2 Lime Production	148.6611	129.9602	63.8886	56.7575	44.3145	28.2332	39.2209	35.4371
2A3 Limestone and Dolomite Use	619.4733	634.8392	547.9296	204.3032	186.8395	162.4857	158.9194	128.0979
2A4 Soda Ash Use	32.9560	28.0686	23.7070	19.7592	16.3566	14.6218	8.1701	10.4874
2A7 Other (Other Mineral Products)	57.5225	52.1396	27.4374	42.8100	21.3157	11.7560	10.9988	13.6721
2A Mineral Products	1830.3185	1745.8036	1137.2807	729.3501	597.2654	465.6247	410.4329	457.8242
	1998	1999	2000	2001	2002	2003	2004	2005
2A1 Cement Production	215.0591	210.8141	172.7616	173.8863	219.1937	245.6298	282.5791	365.0851
2A2 Lime Production	28.1605	17.6094	10.9877	3.8566	8.2226	2.1102	2.2557	6.6217
2A3 Limestone and Dolomite Use	46.4968	24.5358	32.1833	25.5001	35.9790	55.4140	51.6439	98.7525
2A4 Soda Ash Use	8.4235	6.7014	14.0080	14.3793	14.2074	12.6321	15.9454	18.1607
2A7 Other (Other Mineral Products)	12.6742	12.8097	11.8557	11.8514	14.8043	15.1786	18.8782	15.0655
2A Mineral Products	310.8141	272.4704	241.7962	229.4738	292.4069	330.9647	371.3023	503.6855
	2006	2007	2008	2009	2010	2011	2012	2013
2A1 Cement Production	457.0795	702.6719	789.9233	340.5710	349.8365	427.2662	442.1655	476.9147
2A2 Lime Production	7.4221	10.9877	10.4055	3.3327	2.3140	5.5408	5.0723	4.0523
2A3 Limestone and Dolomite Use	100.9690	118.7989	94.1346	51.2966	74.4950	17.8023	20.1473	14.3708
2A4 Soda Ash Use	16.0597	14.1588	13.9856	10.0624	12.0466	15.3764	9.3444	15.5217
2A7 Other (Other Mineral Products)	16.2197	15.2339	15.1596	13.7602	13.7533	16.7799	14.0379	15.6916
2A Mineral Products	597.7500	861.8512	923.6086	419.0229	452.4453	482.7657	490.7676	526.5511

Compared with 2012 level, the GHG emissions originated from this category increased by 7.3 per cent in 2013 (Figure 4-2).

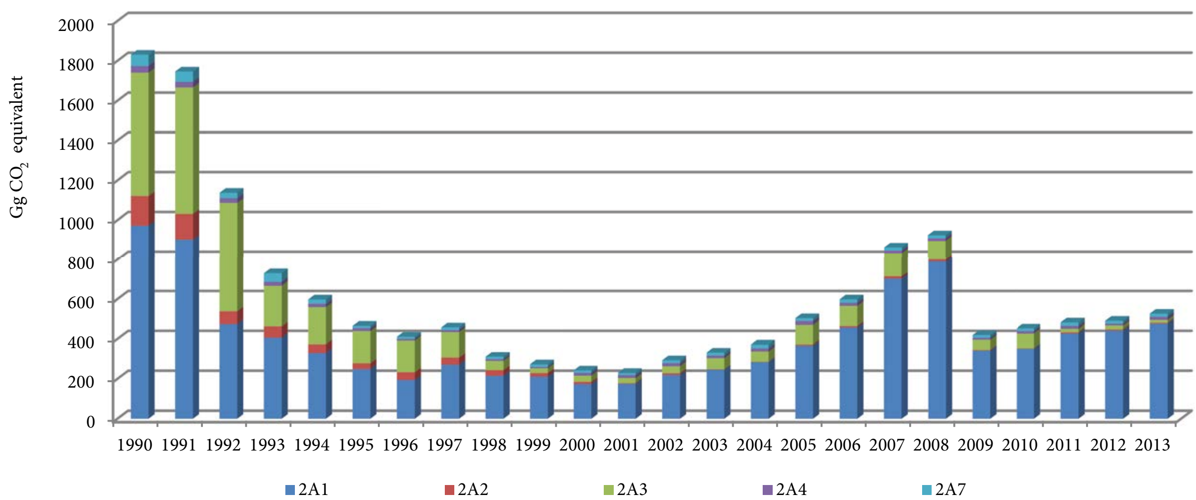

Figure 4-2: Direct GHG Emissions from the Category 2A 'Mineral Products' by Source, 1990-2013

Ozone and Aerosol Precursors Emissions (NO_x, CO, NMVOC and SO_2) covered by the respective source category demonstrated the same increasing trend (Table 4-9). Between 1990 and 2013, NO_x emissions decreased by 50.8 per cent (from 2.2958 Gg to 1.1294 Gg); CO emissions by 97.2 per cent (from 1.2584 Gg to 0.0352 Gg); NMVOC emissions by 80.4 per cent (from 392.0868 Gg to 76.7637 Gg); while SO_2 emissions by 60.4 per cent (from 1.7319 to 0.6862 Gg).

Table 4-9: Ozone and Aerosol Precursors Emissions from the Category 2A 'Mineral Products' by Gas in the Republic of Moldova within 1990-2013 periods, Gg

	1990	1991	1992	1993	1994	1995	1996	1997
NO_x	2.2958	2.1839	1.3860	1.2918	0.8955	0.7502	0.6210	0.7440
CO	1.2584	1.0436	0.5263	0.4444	0.3258	0.2171	0.2816	0.2510
NMVOC	392.0868	326.3613	274.2274	218.2458	131.9842	119.1409	107.9721	37.0856
SO_2	1.7319	1.4942	0.9704	0.9388	0.6203	0.4850	0.4375	0.4785
	1998	1999	2000	2001	2002	2003	2004	2005
NO_x	0.6567	0.5394	0.7317	0.6868	0.8236	0.7856	0.8312	0.9800
CO	0.1987	0.1239	0.0767	0.0271	0.0565	0.0153	0.0166	0.0459
NMVOC	30.2177	13.3931	11.3973	13.9627	12.4770	12.7619	16.1435	17.9288
SO_2	0.4209	0.3465	0.4472	0.4121	0.4863	0.4573	0.5198	0.5803
	2006	2007	2008	2009	2010	2011	2012	2013
NO_x	1.0679	1.3210	1.3425	0.7263	0.8027	0.9865	0.8669	1.1294
CO	0.0520	0.0827	0.0740	0.0244	0.0212	0.0407	0.0397	0.0352
NMVOC	25.0377	88.7208	44.1023	20.8339	53.4830	35.9916	55.4282	76.7637
SO_2	0.6555	0.8100	0.8285	0.4768	0.5141	0.6116	0.5495	0.6862

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, in conformity with ORTECH (1994), CaO content varies between 60-67 per cent, and MgO content is around 2 per cent.

To be noted, two cement producing plants are currently operating in the RM: Lafarge Cement Moldova J.S.C. in Rezina and Cement and Slate Combined Works in Ribnita (ATULBD). CO_2 emissions from cement production are directly proportionate to CaO fraction from the clinker used in its production. GHG emissions resulting from the combustion of fossil fuels used to produce heat which induces reaction in the oven, are covered by the Energy Sector and are not discussed in this chapter.

2A2. 'Lime Production'

Lime (CaO) is formed by heating the limestone to decompose the carbonates. This reaction takes place at high temperatures, usually in a rotating kiln, and CO_2 is emitted in the process of calcination. Primary limestone (calcite) is processed from the rock mined in the quarry to produce caustic lime (quicklime) using the above mentioned reaction (see '*Cement Production*' section). Dolomite limestone can also be heated at high temperatures to obtain dolomite lime, consequently, produce CO_2 emissions as a result of the chemical reaction described above.

2A3. 'Limestone and Dolomite Use'

Limestone ($CaCO_3$) and dolomite ($CaCO_3 \bullet MgCO_3$) represent raw materials with commercial use in a number of industries, such as: metallurgical industry, glass production, sugar production, agriculture, construction and pollution prevention. CO_2 is being generated in industrial applications involving limestone and dolomite heating at high temperatures.

2A4. 'Soda Ash Production and Use'

Soda ash or sodium carbonate (Na_2CO_3) is used as raw material in a number of industries, such as: glass, 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).

2A5. 'Asphalt Roofing'

Production of asphalt used in construction and roofing manufacture is accompanied by the non-methane volatile organic compounds (NMVOC) emissions. Asphalt roofing undergoes oxidation by air blowing, associated with polymerization and stabilization process to improve its characteristics in order to obtain a better resistance to adverse weather conditions. Blowing air is produced, as a rule, at oil refineries, asphalt plants, as well as in the asphalt manufacturing companies, and other similar products, including in rolls.

2A6. 'Road Paving with Asphalt'

Asphalt is composed of a compact aggregate and bonding material. In highly industrialized countries, typically around 80-90 per cent of the produced asphalt is used for road paving; the rest is used as roofing asphalt (US EPA, 2004). There are several types of road paving asphalt, 80 per cent of the produced asphalt is hot mix asphalt (HMA type), and the rest is liquefied asphalt. Pollutant gases are emitted from asphalt producing plants (stationary or mobile), during road paving, as well as from the road pavement itself.

2A7. 'Other (Other Mineral Products)'

'Glass Production'

Under this source category are covered GHG emissions originated from the production of different types of glass (flat window glass, glass for recipients, glassware, special glass). Glass is produced from a raw material mix containing silicon (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 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. The main polluting emissions from this process are NO_x, NMVOC and SO_2 as well as CO_2 (in the Republic of Moldova, CO_2 emissions from glass production are accounted within 2A3 'Limestone and dolomite use' and 2A4 'Soda ash production and use' source categories).

The amount of SO_2 emissions during the glass production process is mostly determined by the amount of melted dose of sulphur and its absorption capacity, by the access of air and the combustion temperature. The main mechanisms of NO_x formation are related to fuel combustion and emission of NO_x, as well as emission resulting from the use of nitrates in the raw material for some types of glass. CO_2 emissions result from lime calcinations and other carbonates at high temperatures.

'Mineral Wool Production'

The products produced of mineral fibers are composed of inorganic fibers produced from silicate melting and, depending on their use, contain different bonding agents and additives (a mix of minerals and coke heated until it melts and can be wriggled in fibers; the fibers are treated with resin to form a product resembling cotton wool). The main pollutants generated during the process of melting and wriggling, as well as during the finishing of mineral wool are: SO_2, CO and CO_2.

'Brick and Expanded Clay Production'

Brick and expanded clay production involves mining, extraction, processing and refining the raw material (clay) with such additives as kaolin or limestone, moulding, cutting, drying and kilning of the final product. The main pollutants resulting from calcination of carbonates at high temperatures in the process of brick production are CO_2 and SO_2.

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 (IPCC, 2000) 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 1990-2013 from a maximum of 1.013 to a minimum of 1.0002.

Country specific CO_2 emission factors were estimated based on information obtained directly from the producers on the CaO and MgO fractions in the produced clinker, stoichiometric ratio on CO_2/CaO and CO_2/MgO and CKD correction factor values (Table 4-10).

Table 4-10: Country Specific Emission Factors used to estimate CO_2 emissions from Clinker Production in the Republic of Moldova within 1990-2013 periods

	1990	1991	1992	1993	1994	1995	1996	1997
CaO fraction	0.6576	0.6576	0.6576	0.6566	0.6566	0.6577	0.6577	0.6577
CO_2/CaO stoichiometric ratio	0.7848	0.7848	0.7848	0.7848	0.7848	0.7848	0.7848	0.7848
MgO fraction	0.0160	0.0160	0.0160	0.0160	0.0160	0.0160	0.0160	0.0160
CO_2/MgO stoichiometric ratio	1.0919	1.0919	1.0919	1.0919	1.0919	1.0919	1.0919	1.0919
CKD fraction	1.0110	1.0130	1.0110	1.0120	1.0130	1.0130	1.0130	1.0120
$EF_{clinker}$	0.5394	0.5405	0.5394	0.5392	0.5397	0.5406	0.5406	0.5400
	1998	1999	2000	2001	2002	2003	2004	2005
CaO fraction	0.6577	0.6577	0.6569	0.6599	0.6602	0.6621	0.6586	0.6591
CO_2/CaO stoichiometric ratio	0.7848	0.7848	0.7848	0.7848	0.7848	0.7848	0.7848	0.7848
MgO fraction	0.0160	0.0160	0.0160	0.0160	0.0160	0.0181	0.0160	0.0160
CO_2/MgO stoichiometric ratio	1.0919	1.0919	1.0919	1.0919	1.0919	1.0919	1.0919	1.0919
CKD fraction	1.0130	1.0120	1.0120	1.0090	1.0060	1.0060	1.0060	1.0060
$EF_{clinker}$	0.5406	0.5400	0.5394	0.5402	0.5388	0.5426	0.5376	0.5380
	2006	2007	2008	2009	2010	2011	2012	2013
CaO fraction	0.6605	0.6570	0.6570	0.6510	0.6550	0.6529	0.6521	0.6569
CO_2/CaO stoichiometric ratio	0.7848	0.7848	0.7848	0.7848	0.7848	0.7848	0.7848	0.7848
MgO fraction	0.0140	0.0190	0.0120	0.0170	0.0160	0.0166	0.0168	0.0158
CO_2/MgO stoichiometric ratio	1.0919	1.0919	1.0919	1.0919	1.0919	1.0919	1.0919	1.0919
CKD fraction	1.0070	1.0060	1.0050	1.0030	1.0040	1.0008	1.0015	1.0002
$EF_{clinker}$	0.5374	0.5396	0.5314	0.5311	0.5337	0.5310	0.5309	0.5329

Below are presented the default EFs values (IPCC, 1997) used to estimate indirect GHG and SO_2 emissions from cement/clinker production (Table 4-11).

Table 4-11: Default Emission Factors used to Estimate NO_x and SO_2 Emissions from 2A1 'Cement Production' Source Category

Source	Process Description	NO_x [1]	SO_2 [2]
		kg / t	
Mineral Products	Clinker Production Cement Production	0.6	0.3

Sources: [1] EMEP CORINAIR Atmospheric Emissions Inventory Guidebook, 3rd edition, December 2000, B3311-11 and B3311-12, ic030311; [2] Revised 1996 IPCC Guidelines, Vol. 3, Page. 2.6.

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[26], from the Statistical Yearbooks of the ATULBD (for 2007-2013 years). For other years, following the GPG recommendations

[26] State Statistical Service of the Ministry of Economy of the Transnistrian Moldovan Republic (2010), Express Information, Key Performance Indicators for the Industry Sector in the Republic for January- December 2010 (Preliminary Data). – Tiraspol, 2011 – 13 p. (in Russian). 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 – 14 p.; 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 – 13 p.; 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 – 13 p.; 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 – 13 p.; 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 – 13 p.; 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.

(IPCC, 2000), activity data on clinker production at Cement and Slate Combined Works in Ribnita were inferred from statistical data on cement production, by using the equation below:

$$Clinker\ Production = Cement\ Production \bullet Clinker\ Fraction\ in\ Cement$$

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 was qualified as "*trade secret with commercial value*", which is in accordance with the stipulations of the Articles 1, 2 and 5, paragraph (1) of the Law "On Commercial Secrets" No. 171-XII dated 06.07.1994. In these circumstances, the activity data used to calculate GHG emissions from the source category 2A1 'Cement Production' is presented below only aggregated at the national level (Table 4-12).

Table 4-12: Activity Data on Cement and Clinker Production in the Republic of Moldova within 1990-2013 periods, kt

	1990	1991	1992	1993	1994	1995	1996	1997
Cement Production	2288.0	1800.0	1088.2	960.3	769.1	518.8	494.4	611.8
Clinker Production	1801.3	1666.6	879.3	752.5	608.6	459.7	357.3	500.2
	1998	1999	2000	2001	2002	2003	2004	2005
Cement Production	493.0	462.0	431.9	402.1	477.0	484.4	667.6	772.8
Clinker Production	397.8	390.4	320.3	321.9	406.8	452.7	525.7	678.7
	2006	2007	2008	2009	2010	2011	2012	2013
Cement Production	1051.1	1531.0	1775.9	869.4	861.4	1018.0	1051.4	1095.3
Clinker Production	850.6	1302.2	1486.6	641.3	655.6	804.7	832.8	897.6

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

2A2. 'Lime Production'

The mass of CO_2 produced per unit of lime manufactured was estimated from the molecular weights and the lime content of products (ORTECH, 1991). On the basis of calcination reaction, one mole of carbon dioxide is formed for each mole of quicklime produced from burning calcium carbonate, and two moles of CO_2 is formed for each mole of dolomitic quicklime. This principle was used to calculate emission factors on the basis of equations below.

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

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

To be noted that there are three types of lime: high-calcium lime (CaO + impurities); dolomitic lime (CaO•MgO + impurities); hydraulic lime (CaO + calcium silicates), that is a substance between lime and cement (the first two types have different stoichiometric ratios, and the third has a reduced content of CaO). Taking the types of lime into account allow improve emissions estimates.

As in the Republic of Moldova does not exist statistic information on lime production by type, following the good practice, the AD on lime production was disaggregated for the breakdown of lime types according the default values for high-calcium/dolomitic lime (85% high calcium lime and 15% dolomitic lime), the proportion of hydraulic lime being assumed as zero. The basic parameters used for estimating CO_2 emission from lime production are presented in Table 4-13.

Table 4-13: Basic Parameters for Estimating EFs from 2A2 'Lime Production'

Type of lime	Stoichiometric Ratio (1)	Range of CaO Content (%)	Range of MgO Content (%)	Default Values for CaO/CaO·MgO Content (2)	Default EF, t CO_2/t lime (1) · (2)
High-calcium lime	0.7848	93-98	0.3-2.5	0.95	0.7456
Dolomitic lime	0.9132	55-57	38-41	0.85	0.7762
Hydraulic lime	0.7848	65-92		0.75	0.5886

Source: GPG (IPCC, 2000), Chapter 3.1.2 'Lime Production', Table 3.4, Page 3.22.

The emission factors values for other greenhouse gases originated from 2A2 'Lime Production' are available in the EMEP CORINAIR Guidelines (Table 4-14).

Table 4-14: GHG Emission Factors from 2A2 'Lime Production'

Source	Process Description	NO_x	CO	SO_2
		kg / t		
Mineral Products	Limestone Calcination	1.4	5.0	1.0

Source: EMEP CORINAIR Guidelines, 3rd edition, February 1996, B3312-5, ic030312, Lime.

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 2013, activity data on lime production are available separately for the right and left bank of Dniester, the Statistical Yearbooks of the Republic of Moldova and ATULBD (Table 4-15).

Table 4-15: Activity Data on Lime Production within 1990-2013 periods, kt

	1990	1991	1992	1993	1994	1995	1996	1997
RM: left bank of Dniester River	90.00	78.60	55.00	48.00	45.00	28.00	34.00	39.00
RM: right bank of Dniester River	114.30	100.00	32.80	30.00	15.90	10.80	19.90	9.70
RM: total	204.30	178.60	87.80	78.00	60.90	38.80	53.90	48.70
	1998	1999	2000	2001	2002	2003	2004	2005
RM: left bank of Dniester River	26.00	19.00	12.00	2.00	8.00	0.00	1.00	7.00
RM: right bank of Dniester River	12.70	5.20	3.10	3.30	3.30	2.90	2.10	2.10
RM: total	38.70	24.20	15.10	5.30	11.30	2.90	3.10	9.10
	2006	2007	2008	2009	2010	2011	2012	2013
RM: left bank of Dniester River	8.00	14.00	14.00	4.28	3.18	7.44	6.84	5.49
RM: right bank of Dniester River	2.20	1.10	0.30	0.30	0.00	0.18	0.13	0.08
RM: total	10.20	15.10	14.30	4.58	3.18	7.61	6.97	5.57

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), 2007 (page 311); also, through 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 of the; 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, 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, the Ministry of Environment; Statistical Reports PRODMOLD-A „Total production, as a natural expression, in the Republic, by product type, for 2012 and 2013"; 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), 2011 (page 94), 2012 (page 98), 2013 (page 99), 2014 (page 88).

As revealed above, during the last years, in the RM (right bank of Dniester River), lime production decreased sharply. In this context, the amount of lime needed for domestic consumption is being imported. Table 4-16 provides statistical data on lime imports during 1995-2014. According to these data, lime imports increased by 83 times within this time period.

Table 4-16: Lime imports in the Republic of Moldova (Right Bank of Dniester River), 1995-2014

	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
Lime imports, kt	0.063	0.234	0.336	0.515	0.405	0.603	1.783	2.109	3.243	3.662
	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
Lime imports, kt	3.953	5.121	6.423	7.540	3.798	4.826	4.699	5.053	4.256	5.260

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.

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, 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 4-17).

Table 4-17: Activity Data on Hydrated Lime Production within 1990-2013 periods, kt

	1990	1991	1992	1993	1994	1995	1996	1997
High calcium lime	168.4454	147.2557	72.3911	64.3110	50.2121	31.9906	44.4406	40.1532
Dolomitic lime	29.7257	25.9863	12.7749	11.3490	8.8610	5.6454	7.8425	7.0859
Total hydrated lime produced	198.1710	173.2420	85.1660	75.6600	59.0730	37.6360	52.2830	47.2390
	1998	1999	2000	2001	2002	2003	2004	2005
High calcium lime	31.9082	19.9529	12.4500	4.3699	9.3169	2.3911	2.5560	7.5030
Dolomitic lime	5.6309	3.5211	2.1971	0.7712	1.6442	0.4220	0.4511	1.3241
Total hydrated lime produced	37.5390	23.4740	14.6470	5.1410	10.9610	2.8130	3.0070	8.8270
	2006	2007	2008	2009	2010	2011	2012	2013
High calcium lime	8.4099	12.4500	11.7904	3.7762	2.6219	6.2782	5.7473	4.5916
Dolomitic lime	1.4841	2.1971	2.0807	0.6664	0.4627	1.1079	1.0142	0.8103
Total hydrated lime produced	9.8940	14.6470	13.8710	4.4426	3.0846	7.3861	6.7616	5.4019

CO_2 emissions were estimated following a Tier 1 methodological approach, by multiplying the emission factors mentioned above to annual activity data on hydrated lime production, taking into account the type of lime produced.

$$Total_l = P_i \bullet EF_{lime,\, i}$$

Where:

Total $_l$ – CO_2 emissions from type *i* lime production (Gg/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 0.7762 t CO_2/ t dolomitic lime)

This approach was preferred to the one available in the Revised 1996 IPCC Guidelines (IPCC, 1997), which admitted the use of emission factors that do not take into account CaO and CaO•MgO content in lime (circa 95 per cent for CaO and circa 85 per cent for CaO•MgO), what entailed excessive increase of default EF values: 0.785 t CO_2 per ton of high calcium and 0.913 t CO_2 per ton of dolomitic lime (assuming that CaO and CaO•MgO content in lime is 100 per cent).

2A3. 'Limestone and Dolomite Use'

Methodological issues regarding estimation of CO_2 emissions from limestone and dolomite use are addressed in the Revised 1996 IPCC Guidelines (IPCC, 1997).

CO_2 emissions from limestone and dolomite use may be estimated from a consideration of consumption and purity of the raw materials, as well as the stoichiometry of the chemical processes.

Limestone emission factor (EF_{ls}) will be estimated using the following equation:

$$EF_{ls} = f \bullet [44.01\ g/mole\ CO_2] / [(100.09\ g/mole\ CaCO_3)] = (440 \bullet f)\ kg\ CO_2 / t\ limestone$$

Where:

f – fractional purity of the limestone in $CaCO_3$ per ton of total raw material weight; the default factor is 1; in the Republic of Moldova it has been considered the value of 0.9517, representing an average value for the raw material purity (the raw materials were extracted from the quarries located in: Varancau village, Soroca District; Beleavinti village, Briceni District; Caracusenii Vechi village, Briceni District; and Hincauti village, Edinet District.

Emission factor (EF_d) for dolomite use will be estimated using the following equation:

$$EF_d = f \bullet [2 \bullet 44.01\ g/mole\ CO_2] / [(184.41\ g/mole\ CaCO_3 \bullet MgCO_3)] = (477 \bullet f)\ kg\ CO_2/t\ dolomite$$

Where:

f – fractional purity of the dolomite in $CaCO_3$•$MgCO_3$ per ton of total raw material weight; the default factor is 1.

AD on limestone and dolomite use was provided by the Agency for Geology and Mineral Resources, institution subordinated to the Ministry of Environment of the Republic of Moldova. To be noted that, according to the Revised 1996 IPCC Guidelines (IPCC, 1997), consumption is assumed to equal material mined plus material imported minus material exported. Data regarding the imports and exports of limestone and dolomite were provided by the Custom Service of the Republic of Moldova (Table 4-18).

Table 4-18: AD on Limestone and Dolomite Use in the RM, 1990-2013, kt

Year	Limestone for sugar production, kt	Limestone for glass production, kt	Limestone for the metallurgical industry, kt	Imported limestone, kt	Total consumption of limestone, kt	Total consumption of dolomite, kt
1990	1,369.000	40.000	22.000	15.476	1,446.476	28.856
1991	1,417.000	40.000	22.000	10.317	1,489.317	23.460
1992	1,233.000	35.000	12.700	6.810	1,287.510	18.422
1993	437.000	25.000	4.000	4.256	470.256	15.481
1994	395.000	30.000	3.000	2.587	430.587	13.694
1995	346.000	26.000	1.000	1.522	374.522	11.856
1996	307.000	30.000	1.000	23.424	361.424	15.878
1997	250.000	25.000	8.000	3.652	286.652	16.903
1998	75.000	20.000	5.000	0.000	100.000	9.690
1999	38.000	16.000	0.000	0.000	54.000	4.032
2000	37.000	13.000	0.000	0.000	50.000	23.576
2001	29.000	7.000	0.000	0.000	36.000	21.856
2002	33.000	7.000	24.000	0.000	64.000	19.244
2003	30.000	0.000	72.000	7.334	109.334	20.190
2004	63.000	0.000	60.000	0.000	123.000	0.289
2005	130.000	42.000	62.000	1.828	235.828	0.000

Year	Limestone for sugar production, kt	Limestone for glass production, kt	Limestone for the metallurgical industry, kt	Imported limestone, kt	Total consumption of limestone, kt	Total consumption of dolomite, kt
2006	132.000	30.100	79.000	0.000	241.100	0.019
2007	166.900	13.500	103.300	0.000	283.700	0.000
2008	88.800	38.000	98.000	0.000	224.800	0.000
2009	39.500	11.700	71.300	0.000	122.500	0.000
2010	56.100	11.700	109.900	0.000	177.700	0.175
2011	42.200	0.000	0.000	0.000	42.200	0.275
2012	47.800	0.000	0.000	0.000	47.800	0.275
2013	34.200	0.000	0.000	0.000	34.200	0.104

Source: Agency for Geology and Mineral Resources, Official Letter No.103/04 dated 05.02.2015, 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. 76/05 dated 23.01.2014, 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 Letters No. 90/05 dated 17.02.2011 and No. 516/05 dated 11.08.2011, as a response to the request of the Ministry of Environment No. 03-07/175 dated 02.02.2011; Custom Service, 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.

Following the Revised 1996 IPCC Guidelines (IPCC, 1997) recommendations, the consumption entering this calculations excludes limestone used for producing cement, lime, agriculture, the dolomite used to produce lime, as well as the processes that are not associated with limestone and dolomite heating, respectively those processes where CO_2 is not generated.

The total CO_2 emission from limestone and dolomite use is estimated using the following equation:

$$Total_{ld} = \{(A_{ls} \bullet EF_{ls}) + (A_d \bullet EF_d)\}/10^6 = \{(440 \bullet f \bullet A_{ls}) + (477 \bullet f \bullet A_d)\}/10^6$$

Where:

$Total_{ld}$ – process CO_2 emissions from limestone and dolomite use (Gg/yr);

A_{ls} – limestone consumption (ton/yr); consumption is assumed to equal material mined (or dredged) plus material imported minus material exported. The consumption entering this calculation excludes limestone used for producing cement and lime, agriculture and processes where CO_2 is not generated.

A_d – dolomite consumption (ton/yr); consumption is assumed to equal material mined plus material imported minus material exported. The consumption entering this calculation excludes dolomite used for producing lime and processes where CO_2 is not generated.

2A4. Soda Ash Production and Use

Methodological issues regarding estimation of CO_2 emissions from soda ash production and use are addressed in the Revised 1996 IPCC Guidelines (IPCC, 1997).

CO_2 emissions from soda ash production and use may be estimated from a consideration of consumption, as well as the stoichiometry of the chemical processes.

The emission factor for soda ash will be estimated using the following equation:

$$EF_{sa} = 44.01 \text{ g/mole } CO_2 / 105.99 \text{ g/mole } Na_2CO_3 = 415 \text{ kg } CO_2 / \text{ton } Na_2CO_3$$

AD regarding soda ash consumption in the Republic of Moldova within 1990-2013 time series is provided in Table 4-19.

Table 4-19: AD on Soda Ash Production and Use in the Republic of Moldova within 1990-2013, kt

	1990	1991	1992	1993	1994	1995	1996	1997
Soda ash consumption	79.4121	67.6352	57.1254	47.6125	39.4136	35.2333	19.6869	25.2708
	1998	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**
Soda ash consumption	20.2975	16.1479	33.7542	34.6490	34.2346	30.4387	38.4227	43.7608
	2006	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**
Soda ash consumption	38.6980	34.1175	33.7002	24.2468	29.0280	37.0516	22.5167	37.4016

Source: Custom Service, 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.

To be noted that according the Revised 1996 IPCC Guidelines (IPCC, 1997), consumption is assumed to equal soda ash produced plus imports minus exports. No soda ash is produced in the Republic of Moldova. Data on soda ash imports and exports for 1995-2013 time series were provided by the Custom Service, while there is no information regarding 1990-1994 time series. In order to fill this gap, following the GPG (IPCC, 2000, Chapter 7, Table 7-5, Page 7.19) the trend extrapolation method was used using regression analysis. As per information provided in the Table 4-19, soda ash consumption decreased between 1990 and 2013 by 52.9 per cent.

Total CO_2 emissions from soda ash use are estimated using the following equation:

$$Total_{sa} = A_{sa} \bullet EF_{sa} / 10^6$$

Where:

Total $_{sa}$ – CO_2 emissions from soda ash use (Gg/yr);

A $_{sa}$ – soda ash consumption (ton/yr);

EF_{sa} – default emission factor for CO_2 emissions from soda ash use, equal to 415 kg CO_2/ton of product.

2A5. 'Asphalt Roofing Production'

Methodological issues regarding estimation of GHG emissions from asphalt roofing are addressed in the Revised 1996 Guidelines (IPCC, 1997). GHG emissions covered by this source category were estimated following a Tier 1 methodological approach. Default EFs values (no control) for NMVOC represents 2.4 kg per ton of asphalt blowing (Revised 1996 Guidelines, Volume 2, Table 2-3, Page 2.9).

AD regarding asphalt roofing production for 2003-2013 time periods was provided by the NBS of the Republic of Moldova (Table 4-20). According to these data, until 2003, no domestic asphalt roofing production was recorded, the respective asphalt roofing production being imported.

Table 4-20: AD on Asphalt Roofing Production in the Republic of Moldova within 2003-2013

	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
Production of asphalt or similar materials, in rolls exclusively, kt	8.8	6.7	6.9	10.4	11.2	90.5	15.3	18.9	26.2	33.5	40.9
Bituminous mixtures based on natural asphalt or natural bitumen, petroleum bitumen, mineral tar, mineral resin, kt	72.2	229.3	215.1	347.9	365.4	209.4	153.7	25.1	97.7	170.2	242.8

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 of 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 No.; Statistical Reports PRODMOLD-A „Total production, as a natural expression, in the Republic of Moldova, by product type for 2012 and 2013".

Total NMVOC emissions from asphalt roofing are estimated using the following equation:

$$Total_{asr} = A_{asr} \bullet EF_{asr} / 10^6$$

Where:

Total $_{asr}$ – NMVOC emissions from asphalt roofing production (Gg/yr);

A_{asr} – annual production of asphalt roofing (ton/yr);

EF_{asr} – default emission factor value (no control) for NMVOC emissions from asphalt blowing equal to 2.4 kg NMVOC/ton of product.

2A6. 'Road Paving with Asphalt'

Methodological issues regarding estimation of GHG emissions from road paving with asphalt are addressed in the Revised 1996 Guidelines (IPCC, 1997). GHG emissions covered by this source category were estimated following a Tier 1 methodological approach. Default EFs values for NMVOC, CO, NO_x and SO_2 are provided in Table 4-21, while the annual data related to asphalt production (provided by the Ministry of Transport and Roads Infrastructure of the Republic of Moldova) are available in Table 4-22.

Table 4-21: EF used to estimate GHG Emissions from Asphalt Production and Use for Road Paving with Asphalt

Source	Description	SO_2	NO_x	CO	NMVOC
		kg / t asphalt			
Mineral products	Asphalt plants Road surface	0.12 NAV	0.084 NAV	0.035 NAV	0.023 320

Source: Revised 1996 Guidelines, Volume 3, Table 2-4, page 2.14.

GHG emissions (NMVOC, CO, NO_x and SO_2) were estimated using the following equation:

$$Total_{rpa} = A_{rpa} \bullet EF_{rpa, i}$$

Where:

GHG emissions – NMVOC, CO, NO_x and SO_2 emissions;

A_{rpa} – annual production of asphalt (ton/yr);

EF_{rpa} – default emission factor for GHG emissions of type *i* (NMVOC, CO, NO_x and SO_2), kg GHG/ton of product.

Table 4-22: AD regarding Road Paving with Asphalt within 1990-2013 periods, kt

	1990	1991	1992	1993	1994	1995	1996	1997
Road paving with asphalt	1220.305	1014.808	853.000	678.000	410.000	370.000	335.600	113.727
	1998	1999	2000	2001	2002	2003	2004	2005
Road paving with asphalt	92.328	40.275	32.589	40.800	35.700	36.300	45.700	51.100
	2006	2007	2008	2009	2010	2011	2012	2013
Road paving with asphalt	72.400	271.500	133.100	61.900	164.500	108.700	169.660	234.440

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; Official Letter No. 04-01-3/754 dated 2.03.2011, as a response to the request of the Ministry of Environment No. 03-07/175 dated 02.02.2011; Official Letter No. 03-02-5/52 dated 21.01.2014, 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. 03-02-5/102 dated 20.02.2015, 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.

2A7. 'Other'

'Glass Production'

Methodological issues regarding estimation of indirect GHG emissions from glass production are addressed in the Revised 1996 Guidelines for National Greenhouse Gas Inventories (IPCC, 1997), as well as in the EMEP CORINAIR Atmospheric Emissions Inventory Guidebook (2005). Default EFs used to estimate NO_x, NMVOC and SO_2 emissions are provided in Table 4-23.

Table 4-23: EF Used to Estimate Indirect GHG Emissions from Glass Production

Source	Process description	NO_x*	SO_2*	NMVOC**
		kg / t glass		
Mineral products	Flat glass production	4.6	3.0	4.5
	Production of glass for receptacles	2.4	1.2	

Source: *EMEP CORINAIR Atmospheric Emissions Inventory Guidebook, 3rd Edition, June 2005, B3314-20-23 for flat glass production and B3314-24-27 for production of glass for receptacles, ic030314, Glass Production; ** Revised 1996 Guidelines, volume 3, chapter 2.7.3 „Production of other Mineral Products", page 2.14.

To be noted, CO_2 emissions from glass production are accounted in 2A3 „Limestone and Dolomite Use" and 2A4 „Soda Ash Production and Use".

Four glass plants used to produce glass in the Republic of Moldova: the "Glass Factory No.1" SOE 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.

Statistical Yearbooks of the Republic of Moldova provide activity data on flat glass production (Table 4-24). Since 1993, flat glass for the construction sector is no longer produced in the Republic of Moldova. To convert the AD in metric mass units (kt), a conversion coefficient of 0.005 t per 1 m^2 of flat glass was used.

Table 4-24: AD on Flat Glass Production, 1985-1992, thousand m^2

Category	1985	1986	1987	1988	1990	1991	1992
Flat glass for construction	94.0	124.0	118.0	265.0	226.0	287.0	184.0

Source: Statistical Yearbooks of the RM for 1988 (page 228) and 1994 (page 287).

AD related to production of glass bottles for the wine industry (expressed in conventional bottles of 0.7 liters) is available in the Statistical Yearbooks of the RM (Table 4-25). To be noted that glass bottles for the wine industry are produced only on the right bank of the Dniester River. Within 1990 to 2013 the production increased by circa 64.7 per cent.

Table 4-25: AD on Production of Glass Bottles for the Wine Industry in the Republic of Moldova within 1990-2013, million pieces

	1990	1991	1992	1993	1994	1995	1996	1997
75 cl standard wine bottles	165.50	153.00	138.80	138.20	133.40	184.00	165.20	172.20
	1998	1999	2000	2001	2002	2003	2004	2005
75 cl standard wine bottles	189.10	125.20	260.50	228.30	296.10	281.40	308.00	354.60
	2006	2007	2008	2009	2010	2011	2012	2013
75 cl standard wine bottles	321.40	302.70	284.70	201.30	246.20	326.27	223.11	272.53

Source: Statistical Yearbooks of the Republic of Moldova for 1994 (page 287), 1999 (page 303), 2003 (page 393), 2004 (page 443), 2005 (page 321-322), 2006 (page 312), 2010 (page 305) , 2011 (page 306), 2012 (page 309), 2013 (page 307), 2014 (page 303).

To convert the activity data in metric mass units (kt), a conversion coefficient of 0.5 kg per standard 75 cl wine bottle was used. Activity data on the production of glass packaging for the canning industry (in glass jars equivalent to 0.5 liters) are available for 1994-2003 time periods in the Statistical Yearbooks of the Republic of Moldova (for 2013 and 2014 these data lack, due to the confidentiality conditions), as well as in those of the ATULBD for 1998-2013 (the production of glass packaging for the canning industry on the left bank of Dniester River was stopped since 2009) (Table 4-26). According to the information presented in the Table 4-26, during 1990-2013, this type of production decreased by 62.5 per cent.

Table 4-26: AD on Production of Glass Packaging for the Canning Industry in the Republic of Moldova within 1990-2013 time periods, million glass jars equivalent to 0.5 liters

	1990	1991	1992	1993	1994	1995	1996	1997
RM: right bank of Dniester River	222.60	245.70	187.40	248.90	152.70	87.40	39.60	86.40
RM: left bank of Dniester River	435.00	448.00	330.00	284.00	111.00	89.50	71.90	81.90
RM: total	657.60	693.70	517.40	532.90	263.70	176.90	111.50	168.30
	1998	1999	2000	2001	2002	2003	2004	2005
RM: right bank of Dniester River	84.20	104.60	156.20	148.80	137.40	107.40	98.90	103.10
RM: left bank of Dniester River	52.00	19.00	56.00	69.00	77.00	69.00	45.00	33.00
RM: total	136.20	123.60	212.20	217.80	214.40	176.40	143.90	136.10
	2006	2007	2008	2009	2010	2011	2012	2013
RM: right bank of Dniester River	121.30	98.70	80.70	92.20	99.80	96.50	78.90	246.40
RM: left bank of Dniester River	37.00	40.00	0.92	0.00	0.00	0.00	0.00	0.00
RM: total	158.30	138.70	81.62	92.20	99.80	96.50	78.90	246.40

Source: NBS, Statistical Yearbooks of the Republic of Moldova for 1994 (page 287), 1999 (page 303), 2003 (page 393), 2006 (page 312), 2010 (page 305), 2012 (page 309); Statistical Reports PRODMOLD-A „Total production, as a natural expression, in the Republic of Moldova, by product type, for 2012 and 2013"; Statistical Yearbooks of the ATULBD for 1998 (page 180), 2000 (page 100), 2002 (page 104), 2005 (page 94), 2007 (page 93), 2010 (page 93).

To convert the activity data in metric mass units (kt), a conversion coefficient of 0.4 kg per one conventional 0.5 liters jar was used.

'Mineral Wool Production'

Methodological issues regarding estimation of GHG emissions from mineral wool production are addressed in the EMEP CORINAIR Guidelines (2005) (Table 4-27).

Table 4-27: EFs Used to Estimate GHG emission from Mineral Wool Production

Source	Process Description	CO_2	CO	SO_2
		kg GHG / t of product		
Mineral products	Mineral wool production	115	3.2	1.5

Source: EMEP CORINAIR Atmospheric Emissions Inventory Guidebook, 3rd edition, June 2005, B3318-7, ic030318, Mineral Wool.

Activity data regarding mineral wool production (expressed in thousand m^3) are available in the Statistical Yearbooks of the Republic of Moldova and those of the ATULBD (Table 4-28).

Table 4-28: AD on Mineral Wool Production within 1990-2002, thousand m^3

	1990	1991	1992	1993	1994	1995	1996
RM: right bank of Dniester River	124.5	110.7	66.3	55.7	14.8	29.5	21.0
RM: left bank of Dniester River	437.7	244.0	110.2	50.2	25.5	10.3	0.0
RM: total	562.2	354.7	176.5	105.9	40.3	39.8	21.0
	1997	1998	1999	2000	2001	2002	2003-2013
RM: right bank of Dniester River	21.1	13.5	8.9	5.9	NO	NO	NO
RM: left bank of Dniester River	5.9	6.0	4.0	0.0	NO	1.0	NO
RM: total	27.0	19.5	12.9	5.9	NO	1.0	NO

Source: Statistical Yearbooks of the RM for 1988 (page 228), 1994 (page 286), 1999 (page 303) and 2003 (page 392); Statistical Yearbooks of the ATULBD for 1998 (page 177), 2000 (page 99), 2002 (page 103), 2006 (page 93).

To convert the AD in metric mass units (kt), a conversion coefficient of 0.125 t per 1 m^3 of mineral wool was used. In conformity with the information provided by the NBS, starting 2001 no mineral wool is produced in the RM. On the left bank of Dniester River production of mineral wool stopped in 2002.

'Brick and Expanded Clay Production'

Methodological issues regarding estimation of GHG emissions from bricks and expanded clay production are addressed in 2006 IPCC Guidelines for National Greenhouse Gas Inventories (IPCC, 2006).

In the bricks and expanded clay production process, CO_2 emissions result from calcination of carbonates contained in clay, as well as in other additives used in the technological process. Similarly to cement and lime production processes, carbonates are heated in kilns at high temperatures and emit carbon dioxide.

CO_2 emissions can be estimated by multiplying annual activity data on the amount of carbonates used in production process (different types of clay) by a specific EF, taking into account the content of CaO and MgO in the carbonates used.

$$Emissions\ CO_2 = M_c \bullet EF_{c,}$$

Where:

M_c – mass of carbonate consumed in bricks production (tones of clay)

EF_c – emission factor for carbonates calcination (t CO_2 / t clay).

In carbonates calcination reaction 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[27]. The values of EFs used to estimate CO_2 emissions from brick and expanded clay production (see Annex 3-2) was determined based on the information provided by the producers (Table 4-29).

Table 4-29: Country Specific Emission Factors Used to Estimate CO_2 Emissions from Bricks and Expanded Clay Production within 1990-2013 time periods

	1990	1991	1992	1993	1994	1995	1996	1997
Content of CaO in clay used	0.0844	0.0844	0.0844	0.0844	0.0844	0.0844	0.0822	0.0822
Stoichiometric Ratio CO_2/CaO	0.7848	0.7848	0.7848	0.7848	0.7848	0.7848	0.7848	0.7848
Content of MgO in clay used	0.0303	0.0303	0.0303	0.0303	0.0303	0.0303	0.0303	0.0321
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	0.0993	0.0993	0.0993	0.0993	0.0993	0.0993	0.0976	0.0996
	1998	1999	2000	2001	2002	2003	2004	2005
Content of CaO in clay used	0.0822	0.0822	0.0822	0.0822	0.0822	0.0822	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
Content of MgO in clay used	0.0321	0.0321	0.0321	0.0321	0.0357	0.0357	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
EF , t CO_2/t clay used	0.0996	0.0996	0.0996	0.0996	0.1035	0.1035	0.1035	0.1035
	2006	2007	2008	2009	2010	2011	2012	2013
Content of CaO in clay used	0.0610	0.0509	0.0530	0.0769	0.0787	0.0669	0.0667	0.0668
Stoichiometric Ratio CO_2/CaO	0.7848	0.7848	0.7848	0.7848	0.7848	0.7848	0.7848	0.7848
Content of MgO in clay used	0.0304	0.0302	0.0305	0.0319	0.0326	0.0288	0.0283	0.0285
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	0.0811	0.0729	0.0750	0.0952	0.0974	0.0839	0.0833	0.0835

SO_2 emission factors from brick production are available in the third edition of the EMEP CORINAIR Inventory Guidebook (Table 4-30).

Table 4-30: EF Used to Estimate SO_2 Emissions from Brick Production

Source	Description	SO_2, kg / t
Mineral Products	Red Brick Production White Brick Production	0.175 0.600

Source: EMEP CORINAIR, Atmospheric Emissions Inventory Guidebook 3rd edition, February 15, 1996, B3319-5, ic030319, Bricks.

Statistical Yearbooks of the Republic of Moldova and those of the ATULBD contain activity data regarding brick production (Table 4-31) (*expressed in thousand units of conventional bricks; it has been considered that 85 per cent of the total represent red bricks and 15 per cent – white bricks*).

To convert the AD in metric mass units (kt), a conversion coefficient between 3.09 and 3.56 kg per one conventional brick piece was used (this is determined by the share of different types of bricks in the total production, with a mass that varies between a minimum of 1.2 kg, up to a maximum of 3.7 kg per one brick).

[27] 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 4-31: AD on Brick Production within 1990-2013 time periods, million pieces

	1990	1991	1992	1993	1994	1995	1996	1997
RM: right bank of Dniester River	190.500	177.500	83.200	149.700	64.300	39.200	37.200	47.700
RM: left bank of Dniester River	45.000	40.000	35.000	30.000	25.000	20.000	16.000	12.000
RM: total	235.500	217.500	118.200	179.700	89.300	59.200	53.200	59.700
	1998	1999	2000	2001	2002	2003	2004	2005
RM: right bank of Dniester River	48.700	44.800	39.900	38.100	45.800	52.200	54.900	55.700
RM: left bank of Dniester River	7.000	12.000	13.000	15.000	17.000	16.000	21.000	18.000
RM: total	55.700	56.800	52.900	53.100	62.800	68.200	75.900	73.700
	2006	2007	2008	2009	2010	2011	2012	2013
RM: right bank of Dniester River	52.800	55.900	53.000	38.100	36.810	40.363	27.905	35.214
RM: left bank of Dniester River	18.000	19.000	20.697	13.523	11.582	13.010	14.657	14.618
RM: total	70.800	74.900	73.697	51.623	48.392	53.373	42.562	49.832

Source: Statistical Yearbooks for 1988 (page 228), 1994 (page 287), 1999 (page 303), 2005 (page 322), 2010 (page 305), 2011 (page 306), 2012 (page 309), 2013 (page 307), 2014 (page 303); 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).

The amount of clay needed to produce one brick and, respectively the amount of clay used in brick production countrywide between 1990 and 2013 was inferred from the information provided directly from MACON J.S.C., the largest bricks producer in the Republic of Moldova (the information regarding 2005-2013 time series) (Table 4-32).

Table 4-32: Activity Data on the Amount of Clay Used in Brick Production in the Republic of Moldova within 1990-2013 time periods, kt

	1990	1991	1992	1993	1994	1995	1996	1997
Clay used	497.8	473.6	250.7	415.7	208.8	112.6	107.7	128.4
	1998	1999	2000	2001	2002	2003	2004	2005
Clay used	119.8	122.0	113.7	114.2	135.0	146.6	165.8	155.8
	2006	2007	2008	2009	2010	2011	2012	2013
Clay used	148.7	164.7	161.7	106.0	106.1	188.0	141.2	161.1

AD regarding expanded clay production in the 2001-2013 time 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 4-33).

Table 4-33: Activity Data on the Amount of Clay Used in Expanded Clay Production in the Republic of Moldova within 2001-2013 time periods

	2001	2002	2003	2004	2005	2006	2007
Expanded clay production, m^3	3,595.80	17,173.00	12,754.53	55,050.00	63,400.00	72,200.00	80,555.00
Specific weight, kg/m^3	390.1	388.9	387.3	371.1	392.9	399.7	385.4
Expanded clay production, tons	1,402.76	6,679.09	4,939.38	20,430.71	24,906.69	28,859.06	31,043.48
Clay used, t/m^3 expanded clay	0.715	0.711	0.717	0.731	0.710	0.711	0.550
Clay Used in Expanded Clay Production, tons	2,571.00	12,210.00	9,145.00	40,241.55	45,014.00	51,334.20	44,305.25
	2008	2009	2010	2011	2012	2013	%
Expanded clay production, m^3	64,963.00	61,199.00	61,420.00	35,363.00	38,150.00	42,011.00	1068.3
Specific weight, kg/m^3	376.2	399.4	353.3	374.8	403.5	376.9	-3.4
Expanded clay production, tons	24,438.43	24,440.43	21,699.07	13,255.47	15,393.91	15,833.30	1028.7
Clay used, t/m^3 expanded clay	0.624	0.629	0.572	0.731	0.717	0.639	-10.6
Clay Used in Expanded Clay Production, tons	40,536.91	38,494.17	35,132.24	25,850.35	27,353.55	26,845.03	944.1

4.2.3 Uncertainties Assessment and Time-Series Consistency

2A1 'Cement Production'

The uncertainty of the CaO and MgO fractions in clinker is low (±2 per cent), the same is the uncertainty of emission factor. The activity data related uncertainties were also estimated as being moderate: in the case of AD provided by the Lafarge Cement (Moldova) J.S.C. uncertainties account for circa ±1 per cent, while in the case of Cement and Slake Integrated Works in Ribnita, uncertainties reach up to ±5 per cent; thus, the average AD uncertainties were accepted as being ±3 per cent. Combined uncertainties related to GHG emissions from 2A1 'Cement Production' source category are considered low (±3.61 per cent). At the same time, combined uncertainties, presented as a per cent of total sectoral emissions were estimated at ±2.56 per cent. Uncertainties introduced in trend in sectoral emissions were estimated at ±1.11 per cent (see 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 GPG (IPCC, 2000).

2A2 'Lime Production'

Uncertainty of the average CaO fraction in lime was estimated at circa ±4-8 per cent. The stoichiometric ratio is an exact figure, so the uncertainties on the emission factor are about ±2 per cent. Uncertainties of activity data on lime production in the RM represent circa ±3 per cent. The correction factor used for hydrated lime adds another ±5 per cent to general uncertainties. Combined uncertainties related to GHG emissions from 2A2 'Lime Production' source category can be considered low (±8.25 per cent). At the same time, combined uncertainties, presented as a per cent of total sectoral emissions were estimated at ±0.05 per cent. Uncertainties introduced in trend in sectoral emissions were estimated at ±0.06 per cent (see 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 GPG (IPCC, 2000).

2A3 'Limestone and Dolomite Use'

In theory, uncertainties related to EF for this source are quite low, as the stoichiometric ratio determines the emission factor, reflecting the amount of CO_2 emitted during the calcination of carbonates. In practice, there are uncertainties related to changes in limestone and dolomite chemical composition. For example, in addition to calcium carbonate, limestone may contain small amounts of magnesium, silicon and sulfur. Considering that AD was correctly collected and appropriate emission factors were applied, uncertainties associated with emission factors could be accepted as negligible (IPCC, 2006). However there may be some uncertainty related to the purity ratio of limestone and dolomite, so the uncertainties associated with the emission factor represent about ±5 per cent. Uncertainties of activity data on limestone and dolomite use in the country are about ±15 per cent. The combined uncertainties related to GHG emissions from 2A3 'Limestone and Dolomite Use' source category can be considered moderate (±15.81 per cent). At the same time, the combined uncertainties presented as a percentage of total direct GHG emissions from the 'Industrial Processes' sector were estimated at about ±0.34 per cent. Uncertainties introduced in trend in total sectoral emissions were estimated at about ±0.60 per cent (see 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 GPG (IPCC, 2000).

2A4 'Soda Ash Use'

Uncertainties related to EFs for this source are insignificant (±1-2 per cent), as the stoichiometric ratio determine the emission factor, reflecting the amount of CO_2 emitted during the calcination of sodium carbonate (IPCC, 2006). Uncertainties of activity data on soda ash consumption in the country are about ±15 per cent. The combined uncertainties related to GHG emissions from the source category 2A4 'Soda Ash Use' can be considered moderate (±15.13 per cent). At the same time, the combined uncertainties presented as a percentage of total sectoral direct GHG emissions were estimated at about ±0.35 per cent. Uncertainties introduced in trend in total sectoral emissions were estimated at about ±0.18 per cent (see 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 GPG (IPCC, 2000).

2A7 'Other: Mineral Wool Production'

Uncertainties related to default emission factors used to calculate CO_2 emissions from mineral wool production were considered low (±5 per cent). Uncertainty of activity data on mineral wool production represent about ±3 per cent. However, because activity data were converted (from cubic meters into metric mass units), additional uncertainties were added (±5 per cent). The combined uncertainties related to GHG emissions from 2A7 'Other: Mineral Wool Production' can be considered relatively low (±9.43 per cent). Combined uncertainties, presented as a per cent of total sectoral emissions were insignificant (see 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 GPG (IPCC, 2000).

2A7 'Other: Brick and Expanded Clay Production'

The uncertainty of the average CaO and MgO fractions in carbonates used for bricks and expanded clay production represent about ±5 per cent. The stoichiometric ratio is an exact number, so the uncertainty of the emission factor is ±5 per cent. Uncertainties related to activity data on bricks production are circa ±5 per cent, while on expanded clay – circa ±15 per cent. However, because activity data were converted (from millions of manufactured bricks into ton, respectively from thousand m^3 into ton), additional uncertainties were added (±*10* per cent). The combined uncertainties related to GHG emissions from 2A7 'Other: Bricks and Expanded Clay Production' can be considered moderate (±15.81 per cent). At the same time, combined uncertainties, presented as a per cent of total sectoral emissions were estimated at ±0.37 per cent. Uncertainties introduced in trend in sectoral emissions were estimated at ±0.18 per cent (see Annex 5-3.2). 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 (IPCC, 2000).

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 (IPCC, 2000). Also, verification was focused on ensuring correct use of the default emission factors available in the Revised 1996 IPCC Guidelines (IPCC, 1997), GPG (IPCC, 2000), EMEP CORINAIR Atmospheric Emissions Inventory Guidebook (EMEP CORINAIR, 1996, 1999, 2000, 2005), 2006 IPCC Guidelines (IPCC, 2006) and other relevant sources; 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 Products' were documented and archived both in hard copies and electronically.

4.2.5 Recalculations

2A1. 'Cement Production'

GHG emissions from the clinker production were not recalculated for the 1990-2010 time series. The respective emissions were estimated for the first time for the 2011-2013 time periods. The results allow assert that between 1990 and 2013, CO_2 emissions from 2A1 'Cement Production' source category decreased by 50.9 per cent, NO_x emissions - by 50.2 per cent, while SO_2 emissions - by circa 52.1 per cent (Table 4-34).

Table 4-34: GHG Emissions from the 2A1 'Cement Production' in the Republic of Moldova within 1990-2013 periods, Gg

	1990	1991	1992	1993	1994	1995	1996	1997
CO_2	971.7056	900.7959	474.3181	405.7202	328.4391	248.5280	193.1237	270.1297
NO_x	1.0808	1.0000	0.5276	0.4515	0.3651	0.2758	0.2144	0.3001
SO_2	0.6864	0.5400	0.3265	0.2881	0.2307	0.1556	0.1483	0.1836
	1998	1999	2000	2001	2002	2003	2004	2005
CO_2	215.0591	210.8141	172.7616	173.8863	219.1937	245.6298	282.5791	365.0851
NO_x	0.2387	0.2342	0.1922	0.1931	0.2441	0.2716	0.3154	0.4072
SO_2	0.1479	0.1386	0.1296	0.1206	0.1431	0.1453	0.2003	0.2318
	2006	2007	2008	2009	2010	2011	2012	2013
CO_2	457.0795	702.6719	789.9233	340.5710	349.8365	427.2662	442.1655	476.9147
NO_x	0.5103	0.7813	0.8919	0.3848	0.3933	0.4828	0.4997	0.5386
SO_2	0.3153	0.4593	0.5328	0.2608	0.2584	0.3054	0.3154	0.3286

2A2. 'Lime Production'

GHG emissions from the lime production were not recalculated for the 1990-2010 time series. For the 2011-2013 time periods, the respective emissions were estimated for the first time. The results allow assert that between 1990 and 2013, GHG emissions from 2A2 'Lime Production' decreased by 97.3 per cent (Table 4-35).

Table 4-35: GHG Emissions from the 2A2 'Lime Production' in the Republic of Moldova within 1990-2013 periods, Gg

	1990	1991	1992	1993	1994	1995	1996	1997
CO_2	148.6611	129.9602	63.8886	56.7575	44.3145	28.2332	39.2209	35.4371
NO_x	0.2774	0.2425	0.1192	0.1059	0.0827	0.0527	0.0732	0.0661
CO	0.9909	0.8662	0.4258	0.3783	0.2954	0.1882	0.2614	0.2362
SO_2	0.1982	0.1732	0.0852	0.0757	0.0591	0.0376	0.0523	0.0472
	1998	1999	2000	2001	2002	2003	2004	2005
CO_2	28.1605	17.6094	10.9877	3.8566	8.2226	2.1102	2.2557	6.6217
NO_x	0.0526	0.0329	0.0205	0.0072	0.0153	0.0039	0.0042	0.0124
CO	0.1877	0.1174	0.0732	0.0257	0.0548	0.0141	0.0150	0.0441
SO_2	0.0375	0.0235	0.0146	0.0051	0.0110	0.0028	0.0030	0.0088
	2006	2007	2008	2009	2010	2011	2012	2013
CO_2	7.4221	10.9877	10.4055	3.3327	2.3140	5.5408	5.0723	4.0523
NO_x	0.0139	0.0205	0.0194	0.0062	0.0043	0.0103	0.0095	0.0076
CO	0.0495	0.0732	0.0694	0.0222	0.0154	0.0369	0.0338	0.0270
SO_2	0.0099	0.0146	0.0139	0.0044	0.0031	0.0074	0.0068	0.0054

2A3. 'Limestone and Dolomite Use'

CO_2 emissions resulting from limestone and dolomite use were recalculated for the 2004-2010 time series, as a result of use of more precise activity data. However, the result of the recalculation was insignificant (Table 4-36). For the 2011-2013 time periods, CO_2 emissions from 2A3 'Limestone and Dolomite Use' were estimated for the first time. The results allow assert that between 1990 and 2013, GHG emissions from the respective source category decreased by 97.7 percent.

Table 4-36: Comparative Results of CO_2 Emissions from 2A3 'Limestone and Dolomite Use' included into the TNC and BUR of the Republic of Moldova under the UNFCCC, Gg

	1990	1991	1992	1993	1994	1995	1996	1997
TNC	619.4745	634.8427	547.9355	204.3052	186.8468	162.4857	158.9194	128.0979
BUR	619.4733	634.8392	547.9296	204.3032	186.8395	162.4857	158.9194	128.0979
Difference, %	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	1998	1999	2000	2001	2002	2003	2004	2005
TNC	46.4965	24.5358	32.1833	25.5001	35.9790	55.4140	51.5384	98.7854
BUR	46.4968	24.5358	32.1833	25.5001	35.9790	55.4140	51.6439	98.7525
Difference, %	0.00	0.00	0.00	0.00	0.00	0.00	0.20	-0.03
	2006	2007	2008	2009	2010	2011	2012	2013
TNC	100.9513	118.8695	94.1925	51.3545	74.4613			
BUR	100.9690	118.7989	94.1346	51.2966	74.4950	17.8023	20.1473	14.3708
Difference, %	0.02	-0.06	-0.06	-0.11	0.05			

Abbreviations: TNC – Third National Communication; BUR – Biennial Update Report.

2A4. 'Soda Ash Use'

In comparison with the results obtained in the TNC, GHG emissions from the soda ash use were not recalculated. For the 2011-2013 time periods, the respective emissions were estimated for the first time. The results allow assert that between 1990 and 2013, GHG emissions from 2A4 'Soda Ash Use' source category decreased by 52.9 percent (Table 4-37).

Table 4-37: CO_2 Emissions from the 2A4 'Soda Ash Use' in the Republic of Moldova within 1990-2013 periods, Gg

	1990	1991	1992	1993	1994	1995	1996	1997
CO_2	32.9560	28.0686	23.7070	19.7592	16.3566	14.6218	8.1701	10.4874
	1998	1999	2000	2001	2002	2003	2004	2005
CO_2	8.4235	6.7014	14.0080	14.3793	14.2074	12.6321	15.9454	18.1607
	2006	2007	2008	2009	2010	2011	2012	2013
CO_2	16.0597	14.1588	13.9856	10.0624	12.0466	15.3764	9.3444	15.5217

2A5. 'Asphalt Roofing'

NMVOC emissions from the 2A5 'Asphalt Roofing' were not recalculated for the 2003-2010 time series. For the 2011-2013 time periods, the respective emissions were estimated for the first time. The results allow assert that between 1990 and 2013, GHG emissions from 2A5 'Asphalt Roofing' increased by 3.5 times (Table 4-38).

Table 4-38: NMVOC Emissions from the 2A5 'Asphalt Roofing' within 2003-2013 periods, Gg

	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
NMVOC	0.1944	0.5664	0.5328	0.8599	0.9038	0.7198	0.4056	0.1056	0.2973	0.4891	0.6808

2A6. 'Road Paving with Asphalt'

Non-CO_2 emissions (NOx, CO, NMVOC and SO2) from 2A6 'Road paving with asphalt' (resulting at the asphalt plants) were not recalculated for the 1990-2010 time series. For the 2011-2013 time periods, the respective emissions were estimated for the first time. The results allow assert that between 1990 and 2013, GHG emissions from 2A6 'Road paving with asphalt' source category decreased by 80.8 per cent (Table 4-39).

Table 4-39: Non-CO_2 Emissions from 2A6 'Road Paving with Asphalt' (Asphalt Plants) in the Republic of Moldova within 1990-2013 periods, Gg

	1990	1991	1992	1993	1994	1995	1996	1997
NO_x	0.1025	0.0852	0.0717	0.0570	0.0344	0.0311	0.0282	0.0096
CO	0.0427	0.0355	0.0299	0.0237	0.0144	0.0130	0.0117	0.0040
NMVOC	0.0281	0.0233	0.0196	0.0156	0.0094	0.0085	0.0077	0.0026
SO_2	0.1464	0.1218	0.1024	0.0814	0.0492	0.0444	0.0403	0.0136

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	1998	1999	2000	2001	2002	2003	2004	2005
NO_x	0.0078	0.0034	0.0027	0.0034	0.0030	0.0030	0.0038	0.0043
CO	0.0032	0.0014	0.0011	0.0014	0.0012	0.0013	0.0016	0.0018
NMVOC	0.0021	0.0009	0.0007	0.0009	0.0008	0.0008	0.0011	0.0012
SO_2	0.0111	0.0048	0.0039	0.0049	0.0043	0.0044	0.0055	0.0061
	2006	2007	2008	2009	2010	2011	2012	2013
NO_x	0.0061	0.0228	0.0112	0.0052	0.0138	0.0091	0.0143	0.0197
CO	0.0025	0.0095	0.0047	0.0022	0.0058	0.0038	0.0059	0.0082
NMVOC	0.0017	0.0062	0.0031	0.0014	0.0038	0.0025	0.0039	0.0054
SO_2	0.0087	0.0326	0.0160	0.0074	0.0197	0.0130	0.0204	0.0281

NMVOC emissions from asphalt used for road surfaces were not recalculated. For the 2011-2013 time periods, the respective emissions were estimated for the first time. The results allow assert that between 1990 and 2013, NMVOC emissions from asphalt used for road surfaces decreased by 80.8 per cent (Table 4-40).

Table 4-40: NMVOC Emissions from 2A6 'Road Paving with Asphalt' (Road Surfaces) in the Republic of Moldova within 1990-2013 periods, Gg

	1990	1991	1992	1993	1994	1995	1996	1997
NMVOC	390.4976	324.7386	272.9600	216.9600	131.2000	118.4000	107.3920	36.3926
	1998	1999	2000	2001	2002	2003	2004	2005
NMVOC	29.5450	12.8880	10.4285	13.0560	11.4240	11.6160	14.6240	16.3520
	2006	2007	2008	2009	2010	2011	2012	2013
NMVOC	23.1680	86.8800	42.5920	19.8080	52.6400	34.7840	54.2912	75.0208

2A7. 'Other'

'Glass Production'

Non-CO_2 emissions (NO_x, NMVOC and SO_2) from glass production were recalculated for 2010, due to updated AD for glass bottles used in wine industry. In comparison with the results obtained in the TNC, the changes made resulted in a decrease by 18.2 per cent of non-CO_2 emissions from glass production. For the 2011-2013 time periods, the respective emissions were estimated for the first time. The results allow assert that between 1990 and 2013, non-CO_2 emissions from 2A7a 'Other' [Glass Production] decreased by 32 per cent (Table 4-41).

Table 4-41: Non-CO_2 Emissions from the 2A7 'Other' [Glass Production] in the Republic of Moldova within 1990-2013 periods, Gg

	1990	1991	1992	1993	1994	1995	1996	1997
NO_x	0.8351	0.8562	0.6675	0.6774	0.4132	0.3906	0.3053	0.3682
NMVOC	1.5611	1.5994	1.2478	1.2702	0.7748	0.7324	0.5724	0.6904
SO_2	0.4183	0.4291	0.3344	0.3387	0.2066	0.1953	0.1526	0.1841
	1998	1999	2000	2001	2002	2003	2004	2005
NO_x	0.3577	0.2689	0.5163	0.4830	0.5611	0.5070	0.5077	0.5562
NMVOC	0.6706	0.5042	0.9681	0.9057	1.0521	0.9507	0.9520	1.0428
SO_2	0.1788	0.1344	0.2582	0.2415	0.2806	0.2535	0.2539	0.2781
	2006	2007	2008	2009	2010	2011	2012	2013
NO_x	0.5376	0.4964	0.4200	0.3301	0.3912	0.4842	0.3435	0.5636
NMVOC	1.0081	0.9307	0.7875	0.6189	0.7336	0.9078	0.6440	1.0567
SO_2	0.2688	0.2482	0.2100	0.1650	0.1956	0.2421	0.1717	0.2818

'Mineral Wool Production'

GHG emissions from the mineral wool production were not recalculated for the 1990-2002 time series. The results provided by Table 4-42 allow assert that between 1990 and 2002, GHG emissions from 2A7b 'Other' [Mineral Wool Production] decreased by circa 99.8 per cent. To be noted that since 2003 no mineral wool is produced in the Republic of Moldova.

Table 4-42: GHG Emissions from the 2A7 'Other' [Mineral Wool Production] in the Republic of Moldova within 1990-2003 periods, Gg

	1990	1991	1992	1993	1994	1995	1996
CO_2	8.0816	5.0988	2.5372	1.5223	0.5793	0.5721	0.3019
CO	0.2249	0.1419	0.0706	0.0424	0.0161	0.0159	0.0084
SO_2	0.1054	0.0665	0.0331	0.0199	0.0076	0.0075	0.0039
	1997	1998	1999	2000	2001	2002	2003-2012
CO_2	0.3881	0.2803	0.1854	0.0848	0.0000	0.0144	NO
CO	0.0108	0.0078	0.0052	0.0024	0.0000	0.0004	NO
SO_2	0.0051	0.0037	0.0024	0.0011	0.0000	0.0002	NO

'Brick and Expanded Clay Production'

GHG emissions from brick and expanded clay production were recalculated for the 1990-2010 time series due to updating the AD on expanded clay production, and the amount of clay used for brick and expanded clay production, as well as due to use of a new conversion ratio (kg of clay per one brick piece). In comparison with the results obtained in the TNC, the above mentioned changes resulted in an decrease of CO_2 emissions, varying from a minimum decrease of 26.4 per cent in 2007 to a maximum decrease of 53.9 per cent in 1990 (Table 4-43). For the 2011-2013 time periods, CO_2 emissions from 2A7 'Other' (Brick and Expanded Clay Production) were estimated for the first time. The results allow assert that between 1990 and 2013, CO_2 emissions from the respective category decreased by 68.3 per cent.

Table 4-43: Comparative Results of CO_2 Emissions from 2A7 'Other' [Bricks and Expanded Clay Production] included into the TNC and BUR of the Republic of Moldova under the UNFCCC, Gg

	1990	1991	1992	1993	1994	1995	1996	1997
TNC	107.2018	96.6296	50.9750	70.8896	34.8842	23.1038	20.7027	23.8674
BUR	49.4409	47.0408	24.9002	41.2877	20.7364	11.1839	10.6970	13.2840
Difference, %	-53.9	-51.3	-51.2	-41.8	-40.6	-51.6	-48.3	-44.3
	1998	1999	2000	2001	2002	2003	2004	2005
TNC	22.2483	22.7117	21.1952	20.8596	23.8478	24.9188	25.9431	21.0723
BUR	12.3939	12.6243	11.7709	11.8514	14.7899	15.1786	18.8782	15.0655
Difference, %	-44.3	-44.4	-44.5	-43.2	-38.0	-39.1	-27.2	-28.5
	2006	2007	2008	2009	2010	2011	2012	2013
TNC	22.5380	20.7032	20.7152	19.3961	18.9105			
BUR	16.2197	15.2339	15.1596	13.7602	13.7533	16.7799	14.0379	15.6916
Difference, %	-28.0	-26.4	-26.8	-29.1	-27.3			

Abbreviations: TNC – Third National Communication; BUR – Biennial Update Report.

SO_2 emissions from brick production were recalculated for the 1990-2010 time series due to updating the AD on brick production, including due to due to use of a new conversion ratio (kg of clay per one conventional brick piece). In comparison with the results obtained in the TNC, the above mentioned changes resulted in an decrease of SO_2 emissions, varying between 20.6 and 22.7 per cent (Table 4-44).

Table 4-44: Comparative Results of SO_2 Emissions from 2A7 'Other' [Bricks and Expanded Clay Production] included into the TNC and BUR of the Republic of Moldova under the UNFCCC, Gg

	1990	1991	1992	1993	1994	1995	1996	1997
TNC	0.2249	0.2077	0.1129	0.1716	0.0853	0.0565	0.0508	0.0570
BUR	0.1771	0.1636	0.0889	0.1351	0.0672	0.0445	0.0400	0.0449
Difference, %	-21.3	-21.3	-21.3	-21.3	-21.3	-21.3	-21.3	-21.3
	1998	1999	2000	2001	2002	2003	2004	2005
TNC	0.0532	0.0542	0.0505	0.0507	0.0600	0.0651	0.0725	0.0704
BUR	0.0419	0.0427	0.0398	0.0399	0.0472	0.0513	0.0572	0.0555
Difference, %	-21.3	-21.3	-21.3	-21.3	-21.3	-21.3	-21.1	-21.2
	2006	2007	2008	2009	2010	2011	2012	2013
TNC	0.0676	0.0715	0.0704	0.0493	0.0475			
BUR	0.0527	0.0553	0.0559	0.0391	0.0372	0.0437	0.0353	0.0423
Difference, %	-22.0	-22.7	-20.6	-20.8	-21.5			

Abbreviations: TNC – Third National Communication; BUR – Biennial Update Report.

For the 2011-2013 time periods, SO_2 emissions from 2A7 'Other' (Brick and Expanded Clay Production) were estimated for the first time. The results allow assert that between 1990 and 2013, SO_2 emissions from the respective category decreased by 76.1 per cent.

4.2.6 Planned Improvements

Possible improvements under the 2A ‚Mineral Products' source category aim at updating/précising the activity data used to estimate GHG emissions within this category.

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 'Carbide Production' and 2B5 'Other'. Between 1990 and 2013, no emissions were registered in the RM under the categories 2B1-2B4 (NO).

Within the 2B5 'Other', in the Republic of Moldova were monitored the NMVOC emissions from the following sources: 2B5a 'Polyethylene Production', 2B5b 'Acrylonitrile Butadiene Styrene Resins Production' and 2B5c 'Detergents Production'.

Between 1990 and 2013, the NMVOC emissions from 2B 'Chemical Industry' decreased by 89 per cent: from 0.37 Gg in 1990, to 0.04 Gg in 2013 (Figure 4-3).

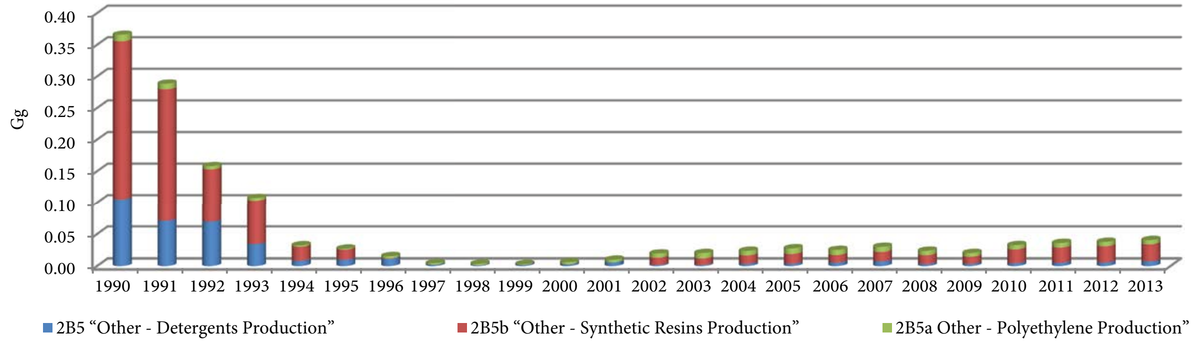


Figure 4-3: NMVOC Emissions from the 2B5 'Other' Category, by Source, within 1990-2013 periods, Gg

At the same time, in comparison with 2012 year level, in 2013 the NMVOC emissions increased by 7.3 per cent (Table 4-45).

Table 4-45: NMVOC Emissions from the 2B5 'Other' Category, by Source, within 1990-2013, Gg

	1990	1991	1992	1993	1994	1995	1996	1997
2B5a Polyethylene Production	0.0104	0.0088	0.0052	0.0046	0.0024	0.0015	0.0037	0.0025
2B5b ABS Resins Production	0.2503	0.2088	0.0835	0.0685	0.0216	0.0158	0.0006	0.0000
2B4c Detergents Production	0.1050	0.0707	0.0693	0.0343	0.0084	0.0098	0.0112	0.0021
2B5 „Other" (in Chemical Industry)	0.3657	0.2883	0.1580	0.1074	0.0323	0.0270	0.0155	0.0046
	1998	1999	2000	2001	2002	2003	2004	2005
2B5a Polyethylene Production	0.0025	0.0014	0.0034	0.0042	0.0067	0.0085	0.0072	0.0089
2B5b ABS Resins Production	0.0000	0.0000	0.0000	0.0000	0.0111	0.0101	0.0130	0.0150
2B4c Detergents Production	0.0012	0.0018	0.0027	0.0057	0.0018	0.0017	0.0035	0.0037
2B5 „Other" (in Chemical Industry)	0.0037	0.0032	0.0061	0.0099	0.0196	0.0203	0.0237	0.0276
	2006	2007	2008	2009	2010	2011	2012	2013
2B5a Polyethylene Production	0.0080	0.0081	0.0069	0.0059	0.0066	0.0072	0.0067	0.0068
2B5b ABS Resins Production	0.0118	0.0147	0.0137	0.0111	0.0217	0.0237	0.0254	0.0263
2B4c Detergents Production	0.0054	0.0072	0.0032	0.0034	0.0043	0.0051	0.0056	0.0073
2B5 „Other" (in Chemical Industry)	0.0252	0.0300	0.0238	0.0203	0.0326	0.0359	0.0377	0.0404

2B5. '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 0.92t/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.

'Detergent Production'

The term "synthetic detergent products" applies broadly to cleaning and laundering compounds containing surface-active compounds along with other ingredients. The manufacture of spray-dried detergent has 3 main processing steps: (1) slurry preparation, (2) spray drying, and (3) granule handling. The 3 major components of detergent are surfactants (to remove dirt and other unwanted materials), builders (to treat the water to improve surfactant performance), and additives to improve cleaning performance. Additives may include bleaches, bleach activators, antistatic agents, fabric softeners, optical brighteners, anti re-deposition agents, and fillers. The formulation of slurry for detergent granules requires the intimate mixing of various liquid, powdered, and granulated materials.

Detergent slurry is produced by blending liquid surfactant with powdered and liquid materials (builders and other additives) in a closed mixing tank called a soap crutcher. Premixing of various minor ingredients is performed in a variety of equipment prior to charging to the crutcher or final mixer. Liquid surfactant used in making the detergent slurry is produced by the sulfonation of either a linear alkylate or a fatty acid, which is then neutralized with a caustic solution containing sodium hydroxide (NaOH). The blended slurry is held in a surge vessel for continuous pumping to a spray dryer. The slurry is atomized by spraying through nozzles rather than by centrifugal action. The slurry is sprayed at high pressure into a vertical drying tower. The detergent granules are conveyed mechanically or by air from the tower to a mixer to incorporate additional dry or liquid ingredients, and finally to packaging and storage. The exhaust air from detergent spray drying towers contains 2 types of air contaminants: (1) fine detergent particles and (2) organics vaporized in the higher temperature zones of the tower. Dust emissions are generated at scale hoppers, mixers, and crutchers during the batching and mixing of fine dry ingredients to form slurry. Conveying, mixing, and packaging of detergent granules can also cause dust emissions. Pneumatic conveying of fine materials causes dust emissions when conveying air is separated from bulk solids. For this process, fabric filters are generally used, not only to reduce or to eliminate dust emissions, but also to recover raw materials.

The dust emissions principally consist of detergent compounds, although some of the particles are uncombined phosphates, sulfates, and other mineral compounds. Dry cyclones and cyclonic impingement scrubbers are the primary collection equipment employed to capture the detergent dust in the spray dryer exhaust for return to processing. Dry cyclones are used in parallel or in series to collect this particulate matter (PM) and recycle it back to the crutcher. The dry cyclone separators can remove 90 per cent or more by weight of the detergent product fines from the exhaust air. Cyclonic impinged scrubbers are used in parallel to collect the particulate from scrubbing slurry and to recycle it to the crutcher. Secondary collection equipment is used to collect fine particulates that escape from primary devices. For example, cyclonic impingement scrubbers are often followed by mist eliminators.

Several types of scrubbers can be used following the cyclone collectors. Venturi scrubbers have been used but are being replaced with packed bed scrubbers. Packed bed scrubbers are usually followed by wet-pipe-type electrostatic precipitators built immediately above the packed bed in the same vessel. Fabric filters have been used after cyclones but have limited applicability, especially on efficient spray dryers, due to condensing water vapors and organic aerosols binding the fabric filter.

NMVOC originate primarily from the surfactants included in the slurry. A method for controlling emissions would be to remove offending organic compounds from the slurry.

4.3.2 Methodological Issues, Emission Factors and Data Sources

2B5. 'Other'

'Polyethylene Production'

Methodological issues for estimating the NMVOC emissions from polyethylene production are addressed in the EMEP CORINAIR Inventory Guidebook (1996).

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 4-46) combined with activity data from Statistical Yearbooks of the Republic of Moldova and those of the AUTULBD (Table 4-47).

Table 4-46: EF Used to Estimate NMVOC Emissions from Polyethylene Production

Source	Description	NMVOC Emissions, kg / t
Other Chemical Products	LDPE manufacture LLDPE manufacture HDPE manufacture	2-3 2 5-6.4

Source: EMEP CORINAIR Atmospheric Emissions Inventory Guidebook, 3rd edition, February 15, 1996, B456-1 up to B456-3, pr040506, Polyethylene Production.

Table 4-47: Activity Data on Polyethylene Production within 1990-2013 periods, kt

	1990	1991	1992	1993	1994	1995	1996	1997
RM: right bank of Dniester River	3.519	3.100	1.715	1.601	0.878	0.717	1.552	1.168
RM: left bank of Dniester River	1.681	1.300	0.900	0.700	0.300	0.012	0.296	0.085
RM: total	5.200	4.400	2.615	2.301	1.178	0.729	1.848	1.253
	1998	1999	2000	2001	2002	2003	2004	2005
RM: right bank of Dniester River	1.170	0.683	1.689	2.050	3.324	4.225	3.595	4.100
RM: left bank of Dniester River	0.068	0.001	0.034	0.041	0.024	0.011	0.000	0.364
RM: total	1.238	0.684	1.723	2.091	3.348	4.236	3.595	4.464
	2006	2007	2008	2009	2010	2011	2012	2013
RM: right bank of Dniester River	3.600	3.700	3.200	2.800	3.100	3.467	3.237	3.275
RM: left bank of Dniester River	0.385	0.353	0.234	0.131	0.201	0.116	0.125	0.112
RM: total	3.985	4.053	3.434	2.931	3.301	3.583	3.362	3.387

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), 2012 (page 308); Statistical Reports PRODMOLD-A „Total production, as a natural expression, in the Republic of Moldova, by product type, for 2012 and 2013"; 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).

'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 CORINAIR Inventory Guidebook (1996). The methodology used relied on the use of a specific emission factor (Table 4-48) combined with activity data from the national statistics (Table 4-49).

Table 4-48: Emission Factor Used to Estimate NMVOC Emissions from Acrylonitrile Butadiene Styrene Resins (ABS) Production

Source	Description	NMVOC Emissions, kg / t
Other Chemical Products	Production of ABS Resins	1.4 – 27.2

Source: EMEP CORINAIR Atmospheric Emissions Inventory Guidebook, 3rd edition, February 15, 1996, B4515, pr040515, Production of ABS resins.

To be noted that, in conformity with the information provided by the NBS, since 1997, no acrylonitrile butadiene styrene (ABS) resins are produced on the right bank of the Dniester River. As it is not known what technology was used for acrylonitrile butadiene styrene resins production in the RM over the period under review, and the range for the emission factors is large (between 1.4 and 27.2 kg of NMVOC/t of product), it has been decided to use an average value, of 14.3 kg NMVOC per ton of product.

Table 4-49: Activity Data on Acrylonitrile Butadiene Styrene Resins (ABS) Production in the Republic of Moldova within 1990-2013 periods, kt

	1990	1991	1992	1993	1994	1995	1996	1997
Production of ABS Resins	17.500	14.600	5.839	4.792	1.510	1.104	0.040	NO
	1998	1999	2000	2001	2002	2003	2004	2005
Production of ABS Resins	NO	NO	NO	NO	0.776	0.708	0.910	1.048
	2006	2007	2008	2009	2010	2011	2012	2013
Production of ABS Resins	0.825	1.026	0.961	0.777	1.516	1.657	1.774	1.842

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).

'Detergent Production'

Methodological issues for estimating the NMVOC emissions from detergents production are addressed in the US EPA's publications. The methodology applied relied on the use of an emission factor specific for the detergents production technology used in the Republic of Moldova (Table 4-50), combined with activity data from the national statistics (Table 4-51).

Table 4-50: EF Used to Estimate NMVOC Emissions from Detergents Production

Source	Description	Control Devices	NMVOC, kg / t
Other Chemical Products	Detergent Production	Uncontrolled Cyclone Cyclone with spray chamber Cyclone with packed scrubber Cyclone with Venturi scrubber Cyclone with wet scrubber Cyclone with wet scrubber/electrostatic precipitation Cyclone with packed bed/electrostatic precipitation Fabric filter	45 7 3.5 2.5 1.5 0.544 0.023 0.470 0.540

Source: EPA-450/4-90-003, EPA, USA, Research Triangle Park, NC, March 1990; Emission Test Report, Procter and Gamble, Augusta, GA Georgia Department of Natural Resources, Atlanta, GA, July 1988; A.J. Buonicore and W.T. Davis, Eds., Air Pollution Engineering Manual, Van Nostrand Reinhold, New York, NY, 1992.

As in the Republic of Moldova the control devices used in detergents production are of cyclone type, the value of the NMVOC emission factor was assumed as being 7 kg per ton of detergent produced.

Table 4-51: Activity Data on Detergents Production within 1990-2013 periods, kt

	1990	1991	1992	1993	1994	1995	1996	1997
Detergents Production	15.000	10.100	9.900	4.900	1.200	1.400	1.600	0.293
	1998	1999	2000	2001	2002	2003	2004	2005
Detergents Production	0.172	0.258	0.386	0.821	0.255	0.243	0.493	0.533
	2006	2007	2008	2009	2010	2011	2012	2013
Detergents Production	0.769	1.034	0.451	0.482	0.618	0.727	0.798	1.048

Source: Statistical Yearbooks for 1994 (page 291), 1999 (page 306), 2003 (page 395), 2005 (page 321), 2006 (page 311), 2011 (page 305), 2014 (page 302).

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 GPG (IPCC, 2000).

4.3.4 Quality Assurance and Quality Control

Standard verification and quality control forms and checklists were filled in for the respective category under the 'Industrial Processes' Sector, following a Tier 1 approach (IPCC, 2000). Verification was focused on correct use of the default emission factors available in the EMEP CORINAIR Atmospheric Emissions Inventory Guidebook and other relevant sources; correct use of AD obtained from different sources of reference etc. The 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 2B5 'Other' source category were recalculated due to updating the AD on ABS production at the level of 2009 year, on polyethylene production in 2010 year, respectively on detergents production within 1992-1993, 1995-2003, and 2005-2010 years.

In comparison with the results obtained in the TNC, the above mentioned changes resulted in an insignificant decrease of NMVOC emissions, varying between a minimum decrease by 0.1 percent in 2001, to a maximum decrease by 6.6 percent in 1997, with the exception of 1992, 1995-1996, 2005 and 2010, when it was registered an increase from a minimum of 0.1 percent in 1992, up to a maximum of 11.4 percent in 2010 (Table 4-52).

Table 4-52: Comparative Results of NMVOC Emissions from 2B5 'Other' [Polyethylene Production, ABS Production, Detergents Production] included into the TNC and BUR of the Republic of Moldova under the UNFCCC, Gg

	1990	1991	1992	1993	1994	1995	1996	1997
TNC	0.3657	0.2883	0.1579	0.1077	0.0323	0.0267	0.0154	0.0049
BUR	0.3657	0.2883	0.1580	0.1074	0.0323	0.0270	0.0155	0.0046
Difference, %	0.0	0.0	0.1	-0.2	0.0	1.2	0.6	-6.6
	1998	1999	2000	2001	2002	2003	2004	2005
TNC	0.0038	0.0033	0.0063	0.0099	0.0198	0.0205	0.0237	0.0274
BUR	0.0037	0.0032	0.0061	0.0099	0.0196	0.0203	0.0237	0.0276
Difference, %	-1.9	-2.6	-2.2	-0.1	-1.0	-0.9	0.0	0.8
	2006	2007	2008	2009	2010	2011	2012	2013
TNC	0.0254	0.0298	0.0241	0.0204	0.0293			
BUR	0.0252	0.0300	0.0238	0.0203	0.0326	0.0359	0.0377	0.0404
Difference, %	-0.9	0.8	-1.4	-0.3	11.4			

Abbreviations: TNC – Third National Communication; BUR – Biennial Update Report.

For the 2011-2013 time periods, NMVOC emissions from 2B5 'Other' source category were estimated for the first time. The results allow assert that between 1990 and 2013, NMVOC emissions from the respective category decreased by 88.9 per cent.

4.3.6 Planned Improvements

Further improvements under the 2B 'Chemical Industry' category might be possible by considering the possibility to update the activity data set used to estimate GHG emissions from respective category.

4.4 Metal Production (Category 2C)

4.4.1 Source Category Description

The 2C 'Metal Production' category covers GHG emissions from the following sources: 2C1 'Iron and Steel Production', 2C2 'Ferroalloys Production', 2C3 'Aluminium Production', 2C4 'SF_6 used in Aluminium and Magnesium Foundries', and 2C5 '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 Production'.

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. The technology used in the Republic of Moldova for steel production is exclusively EAF. Electric arc furnaces are equipped with carbon electrodes (can also be made of graphite or Soderberg mix). 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. 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 2013 time series, CO_2 emissions from the source category 2C 'Metal Production' decreased in the Republic of Moldova by 73 per cent (Table 4-53).

Table 4-53: CO_2 Emissions from 2C 'Metal Production' within 1990-2013 periods, Gg

	1990	1991	1992	1993	1994	1995	1996	1997
CO_2	11.7182	10.1720	9.8825	10.0773	10.4672	10.8590	11.0623	13.4004
	1998	1999	2000	2001	2002	2003	2004	2005
CO_2	11.8717	13.1608	15.0129	15.9888	8.4840	14.6511	16.7513	17.3296
	2006	2007	2008	2009	2010	2011	2012	2013
CO_2	11.1636	15.9566	14.6330	7.0427	3.9938	5.3013	5.2370	3.1441

In comparison with 2012 level, in 2013, CO_2 emissions decreased by 40 per cent (Figure 4-4).

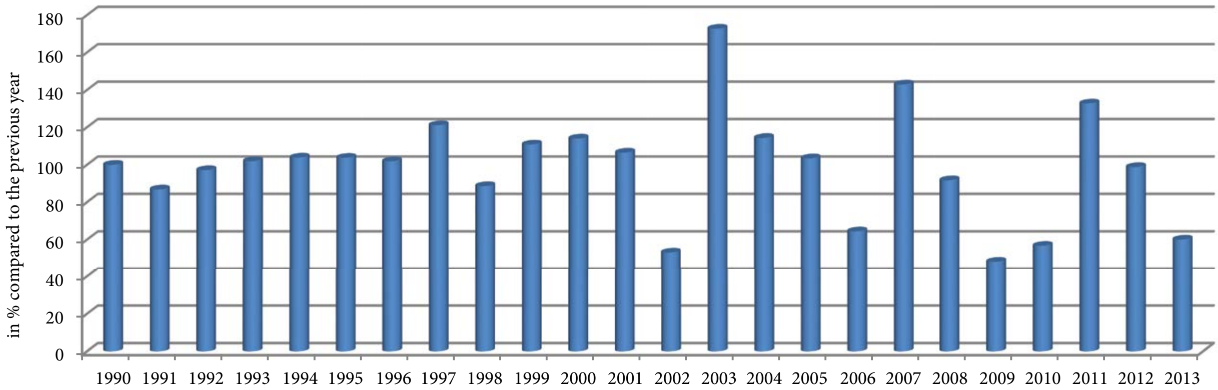


Figure 4-4: CO_2 Emissions from 2C 'Metal Production' within 1990-2013 periods, in % compared to the previous year

The indirect GHG emissions (NO_x, CO, NMVOC and SO_2) covered by the respective source category also tended to decrease. Between 1990 and 2013, non-CO_2 emissions decreased by 73 percent (Table 4-54).

Table 4-54: Indirect GHG and SO_2 Emissions from 2C 'Metal Production' within 1990-2013 periods, Gg

	1990	1991	1992	1993	1994	1995	1996	1997
NO_x	0.0921	0.0800	0.0777	0.0792	0.0823	0.0854	0.0870	0.1054
CO	1.2049	1.0459	1.0162	1.0362	1.0763	1.1166	1.1375	1.3779
NMVOC	0.0369	0.0322	0.0313	0.0314	0.0322	0.0327	0.0332	0.0401
SO_2	0.0425	0.0369	0.0359	0.0366	0.0380	0.0394	0.0401	0.0486
	1998	1999	2000	2001	2002	2003	2004	2005
NO_x	0.0933	0.1035	0.1180	0.1257	0.0667	0.1152	0.1317	0.1363
CO	1.2207	1.3532	1.5437	1.6440	0.8724	1.5065	1.7224	1.7819
NMVOC	0.0371	0.0408	0.0462	0.0500	0.0263	0.0456	0.0521	0.0544
SO_2	0.0431	0.0478	0.0545	0.0580	0.0308	0.0532	0.0608	0.0629
	2006	2007	2008	2009	2010	2011	2012	2013
NO_x	0.0878	0.1255	0.1151	0.0554	0.0314	0.0417	0.0412	0.0247
CO	1.1479	1.6407	1.5046	0.7242	0.4107	0.5451	0.5385	0.3233
NMVOC	0.0355	0.0508	0.0464	0.0227	0.0128	0.0169	0.0171	0.0100
SO_2	0.0405	0.0579	0.0531	0.0256	0.0145	0.0192	0.0190	0.0114

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 (IPCC, 2000), based on carbon track through the production process.

Total CO_2 emission from 2C1 'Iron and Steel Production' represents the arithmetic sum of emissions from iron and steel production.

$$Total\ CO_2 = CO_{2\ pig\ iron} + CO_{2\ crude\ steel}$$

GHG emissions from iron production can be estimated using the following equation:

$$CO_{2\ pig\ iron} = (EF_{\ reducing\ agent} \bullet Mass\ of\ Reducing\ Agent) + (Mass\ of\ Carbon\ in\ the\ Ore - Mass\ of\ Carbon\ in\ the\ Crude\ Iron) \bullet 44/12$$

Reducing agent can be coal, coke, petroleum coke and charcoal. The amount of carbon in ore is considered to be by default 'zero', while crude iron contains about four per cent (IPCC, 2000).

GHG emissions from steel production can be estimated using the following equation:

$$CO_{2\ crude\ steel} = (Mass\ of\ Carbon\ in\ the\ Crude\ Iron\ used\ for\ Crude\ Steel\ Production - Mass\ of\ Carbon\ in\ the\ Crude\ Steel) \bullet 44/12 + EF_{\ EAF} \bullet Mass\ of\ Steel\ Produced\ in\ EAF$$

In the Republic of Moldova, the content of carbon in crude iron represents an average of 4.3 per cent, while in crude steel – 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%[28], in general, following the GPG (IPCC, 2000), depending of steel type and quality, the content of carbon in crude steel varies between 0.5 and 2 per cent). In addition, for steel produced in electric arc furnaces it is good practice to add carbon mass released from consumed electrodes to the emissions, roughly 1.25 kg carbon per ton of steel and/or 4.583 kg CO_2 per ton of steel (IPCC, 2000).

AD related to steel (Table 4-55) and rolling mills production (Table 4-56) is available in the statistical publications of the Republic of Moldova and ATULBD.

Table 4-55: Activity Data on Steel Production within 1990-2013 periods, kt

	1990	1991	1992	1993	1994	1995	1996	1997
RM: right bank of Dniester River	0.370	0.350	0.340	0.320	0.300	0.299	0.199	0.114
RM: left bank of Dniester River	708.400	614.900	597.400	609.200	632.800	656.500	668.900	810.400
RM: total	708.770	615.250	597.740	609.520	633.100	656.799	669.099	810.514
	1998	1999	2000	2001	2002	2003	2004	2005
RM: right bank of Dniester River	0.050	0.026	0.047	0.076	0.151	0.161	0.191	0.173
RM: left bank of Dniester River	718.000	796.000	908.000	967.000	513.000	886.000	1013.000	1048.000
RM: total	718.050	796.026	908.047	967.076	513.151	886.161	1013.191	1048.173
	2006	2007	2008	2009	2010	2011	2012	2013
RM: right bank of Dniester River	0.222	0.125	0.109	0.031	0.059	0.073	0.077	0.085
RM: left bank of Dniester River	675.000	965.000	884.958	425.943	241.501	320.574	316.682	190.086
RM: total	675.222	965.125	885.067	425.974	241.560	320.647	316.759	190.171

Source: Statistical Yearbooks of the RM for 1994 (page 224), 1999 (page 302), 2003 (page 391), 2004 (page 441), 2010 (page 305), 2011 (page 306), 2012 (page 309), 2013 (page 307), 2014 (page 303); Statistical Yearbooks of the ATULBD for 1998 (page 178), 2000 (page 99), 2002 (page 103), 2006 (page 93), 2007 (page 92), 2010 (page 93), 2011 (page 94), 2012 (page 98), 2013 (page 99), 2014 (page 88).

Table 4-56: Activity Data on Rolling Mills Production within 1990-2013 periods, kt

	1990	1991	1992	1993	1994	1995	1996	1997
Production of Rolling Mills	614.000	561.300	547.600	487.200	438.000	357.000	341.000	407.000
	1998	1999	2000	2001	2002	2003	2004	2005
Production of Rolling Mills	589.200	592.100	635.000	790.400	381.000	695.400	789.300	889.300
	2006	2007	2008	2009	2010	2011	2012	2013
Production of Rolling Mills	633.000	914.000	818.035	437.515	237.710	302.162	360.402	173.146

Source: Statistical Yearbooks of the RM for 1994 (page 224), 1999 (page 302), 2003 (page 391), 2004 (page 441), 2010 (page 305), 2011 (page 306), 2012 (page 309), 2013 (page 307), 2014 (page 303); Statistical Yearbooks of the ATULBD for 1998 (page 178), 2000 (page 99), 2002 (page 103), 2006 (page 93), 2007 (page 92), 2010 (page 93), 2011 (page 94), 2012 (page 98), 2013 (page 99), 2014 (page 88).

Based on respective AD, as well as on the information available in the *Analysis of the Ukrainian Market of Scrap Metal, Strategic Aspects (Naziuta, 2010)*[29], it was estimated the carbon balance through the production process (Table 4-58).

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 year, 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 neighboring countries, especially from Ukraine. Since it was not possible to get from the producer the information regarding the amount of scrap metal used for steel production (these data are not available on the company website), the AD were generated by using the coefficient of 1078.3 kg of scrap metal per ton of steel, respectively 13.1 kg of iron per ton of steel (weighted average value of the Ukrainian plants with the same profile for 2004-2006 years)[30].

[28] Metal Integrated Works from Ribnita: <http://www.aommz.com/pls/webus/webus.main.show>.
[29] Ukrainian Association of Metallurgists, <http://uas.su/articles/steelmaking/00002.php>.
[30] Ukrainian Association of Metallurgists, <http://uas.su/articles/steelmaking/00002.php>.

Table 4-57: AD on Steel Production at the Metal Integrated Works in Ribnita within 1990-2013 periods, kt

	1990	1991	1992	1993	1994	1995	1996	1997
Scrap metal used in steel production, kt	764.2667	663.4241	644.5430	657.2454	682.6717	708.2264	721.4895	873.9772
Content of carbon in scrap metal used, %	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25
Mass of carbon in scrap metal used, kt	1.9107	1.6586	1.6114	1.6431	1.7067	1.7706	1.8037	2.1849
Iron used in steel production, kt	9.2849	8.0598	7.8304	7.9847	8.2936	8.6041	8.7652	10.6177
Content of carbon in iron used, %	4.3	4.3	4.3	4.3	4.3	4.3	4.3	4.3
Mass of carbon in iron used, kt	0.3993	0.3466	0.3367	0.3433	0.3566	0.3700	0.3769	0.4566
Carbon consumption in electrodes, kg C/t	1.25	1.25	1.25	1.25	1.25	1.25	1.25	1.25
Mass of carbon in electrodes, burnt in the production process, kt	0.8860	0.7691	0.7472	0.7619	0.7914	0.8210	0.8364	1.0131
Total carbon emissions from steel production, kt	3.1959	2.7742	2.6952	2.7484	2.8547	2.9615	3.0170	3.6546
	1998	1999	2000	2001	2002	2003	2004	2005
Scrap metal used in steel production, kt	774.2733	858.3548	979.1471	1042.7981	553.3307	955.5472	1092.5234	1130.2453
Content of carbon in scrap metal used, %	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25
Mass of carbon in scrap metal used, kt	1.9357	2.1459	2.4479	2.6070	1.3833	2.3889	2.7313	2.8256
Iron used in steel production, kt	9.4065	10.4279	11.8954	12.6687	6.7223	11.6087	13.2728	13.7311
Content of carbon in iron used, %	4.3	4.3	4.3	4.3	4.3	4.3	4.3	4.3
Mass of carbon in iron used, kt	0.4045	0.4484	0.5115	0.5448	0.2891	0.4992	0.5707	0.5904
Carbon consumption in electrodes, kg C/t	1.25	1.25	1.25	1.25	1.25	1.25	1.25	1.25
Mass of carbon in electrodes, burnt in the production process, kt	0.8976	0.9950	1.1351	1.2088	0.6414	1.1077	1.2665	1.3102
Total carbon emissions from steel production, kt	3.2377	3.5893	4.0944	4.3606	2.3138	3.9957	4.5685	4.7263
	2006	2007	2008	2009	2010	2011	2012	2013
Scrap metal used in steel production, kt	728.0921	1040.6939	954.3672	459.3273	260.4743	345.7540	341.5613	205.0617
Content of carbon in scrap metal used, %	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25
Mass of carbon in scrap metal used, kt	1.8202	2.6017	2.3859	1.1483	0.6512	0.8644	0.8539	0.5127
Iron used in steel production, kt	8.8454	12.6431	11.5944	5.5803	3.1644	4.2005	4.1495	2.4912
Content of carbon in iron used, %	4.3	4.3	4.3	4.3	4.3	4.3	4.3	4.3
Mass of carbon in iron used, kt	0.3804	0.5437	0.4986	0.2400	0.1361	0.1806	0.1784	0.1071
Carbon consumption in electrodes, kg C/t	1.25	1.25	1.25	1.25	1.25	1.25	1.25	1.25
Mass of carbon in electrodes, burnt in the production process, kt	0.8440	1.2064	1.1063	0.5325	0.3020	0.4008	0.3959	0.2377
Total carbon emissions from steel production, kt	3.0446	4.3518	3.9908	1.9207	1.0892	1.4458	1.4283	0.8575

Table 4-58 shows the default emission factors used in the Republic of Moldova, as well as in some Annex I Parties. The results are within the EFs margin values for 2C1 'Steel Production' used by the Annex I Parties under the UNFCCC in compiling their national GHG inventories.

Table 4-58: EFs used in the RM and some Annex I Parties in compiling their national GHG inventories for 2011 year, within the 2C1 „Steel Production" category

	Netherlands	Great Britain	Republic of Moldova	Italy	Portugal	Canada	Norway
Default EF, kg CO_2/t steel	3.2	7.6	16.5	22.9	36.9	40.1	42.7
	Luxembourg	Spain	Greece	Belgium	Slovenia	France	Romania
Default EF, kg CO_2/t steel	49.0	50.5	63.0	65.5	69.1	69.7	71.1

Source: UNFCCC database - GHG Locator v3.4 (2013).

The emission factors used to calculate non-CO_2 emissions from steel production in EAF rely on default values available in EMEP/EEA Atmospheric Emissions Inventory Guidebook (2013)[31] (Table 4-59).

Table 4-59: Default EFs Used to Estimate Non-CO_2 Emissions from Steel and Rolling Mills Production in Electric Arc Furnace (EAF)

Source	Description	NO_x	CO	NMVOC	SO_2
		g / t			
EAF Steel Production	Steel Production [1]	130	1700	46	60
	Rolling Mills Production [2]	NA	NA	7	NA

Source: [1] EMEP/EEA Atmospheric Emissions Inventory Guidebook (2013), 2.C.1 Steel Production, 040207 – Steel Production in EAF; [2] EMEP/EEA Atmospheric Emissions Inventory Guidebook (2013), 2.C.1 Steel Production, 040208 – Rolling Mills Production in EAF.

4.4.3 Uncertainties Assessment and Time-Series Consistency

The primary uncertainties related factors pertain to methodology, emission factors used to estimate GHG emissions covered by the 2C1 'Iron and Steel Production' category, and quality of activity data available.

Uncertainties associated with EFs used to estimate CO_2 emissions from this source category, were estimated at ±5 per cent. Uncertainties associated with statistical data on steel production in the Republic of Moldova can be considered low (±3 per cent). Combined uncertainties pertaining to GHG emissions

[31] European Environment Agency: <http://www.eea.europa.eu//publications/emep-eea-guidebook-2013>.

from the 2C1 'Iron and Steel Production' source category were considered low for CO_2 emissions (±5.83 per cent). At the same time, combined uncertainties, presented as a per cent of total sectoral emissions were estimated at ±0.027 per cent. Uncertainties introduced in trend in sectoral emissions were estimated at ±0.008 per cent for CO_2 emissions (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 GPG (IPCC, 2000).

4.4.4 Quality Assurance and Quality Control

Standard verification and quality control forms and checklists were filled in for the respective category under the Industrial Processes Sector, following the Tier 1 approach (IPCC, 2000). Verification was focused on correct use of the default EFs available in the Revised 1996 IPCC Guidelines (IPCC, 1997), GPG (IPCC, 2000), EMEP/EEA Air Pollutant Emission Inventory Guidebook 2013 and other relevant sources; correct use of AD obtained from different sources of reference, including official sources (NBS, Statistical Yearbooks of the RM and those of ATULBD, Steel Statistical Yearbooks, published by the International Institute of Iron and Steel, as well as the information available on the websites of different steel plants, e.g. <http://www.aommz.com/pls/webus/webus.main.show> and other relevant sources (Naziuta, 2010). 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 1997-2010 time series, due to updated AD available in the Statistical Yearbooks of the Republic of Moldova and ATULBD. In comparison with emissions estimates included into the TNC, the changes performed resulted in an insignificant variation of CO_2 emissions from steel production (Table 4-60). For the period 2011-2013, CO_2 emissions resulting from steel production were estimated for the first time. The results allow assert that between 1990 and 2013 the respective emissions decreased by 73 per cent.

Table 4-60: Comparative Results of CO_2 Emissions from 2C1 'Iron and Steel Production' included into the TNC and the BUR of the RM under the UNFCCC, Gg

	1990	1991	1992	1993	1994	1995	1996	1997
TNC	11.7182	10.1720	9.8825	10.0773	10.4672	10.8590	11.0623	13.4027
BUR	11.7182	10.1720	9.8825	10.0773	10.4672	10.8590	11.0623	13.4004
Difference, %	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-0.02
	1998	1999	2000	2001	2002	2003	2004	2005
TNC	11.8761	13.1665	15.0154	15.9881	8.4939	14.6507	16.7442	17.3341
BUR	11.8717	13.1608	15.0129	15.9888	8.4840	14.6511	16.7513	17.3296
Difference, %	-0.04	-0.04	-0.02	0.00	-0.12	0.00	0.04	-0.03
	2006	2007	2008	2009	2010	2011	2012	2013
TNC	11.1999	15.9599	14.6328	7.0427	3.9938			
BUR	11.1636	15.9566	14.6330	7.0427	3.9938	5.3013	5.2370	3.1441
Difference, %	-0.32	-0.02	0.00	0.00	0.00			

Abbreviations: TNC – Third National Communication; BUR – Biennial Update Report.

The non-CO_2 emissions from the 2C1 'Iron and Steel Production' source category were recalculated as well, in particular due to use of new emissions factors available in the EMEP/EEA Atmospheric Emissions Inventory Guidebook (2013) (NO_x – 130 g/t; CO – 1700 g/t, NMVOC – 46 g/t, SO_2 – 60 g/t, for steel production, respectively NMVOC – 7 g/t, for rolling mills production) to the detriment of those available in the CORINAIR Atmospheric Emissions Inventory Guidebook (CORINAIR, 1996, 1999) (NO_x – 200 g/t; CO – 10000 g/t, NMVOC – 90 g/t, SO_2 – 130 g/t, for steel production, respectively NO_x – 40 g/t; CO – 1 g/t, NMVOC – 30 g/t, SO_2 – 45 g/t, for rolling mills production).

The impact of these recalculations was a significant decrease of non-CO_2 emissions from steel production in the Republic of Moldova (Table 4-61). For the 2011-2013 periods, non-CO_2 emissions from steel and rolling mills production were estimated for the first time. The results allow assert that within the 1990-2013 time series, non-CO_2 emissions from 2C1 'Iron and Steel Production' source category decreased by circa 73 per cent.

Table 4-61: Non-CO_2 Emissions from the 2C1 'Iron and Steel Production' in the Republic of Moldova within 1990-2013 periods, Gg

	1990	1991	1992	1993	1994	1995	1996	1997
NO_x	0.0921	0.0800	0.0777	0.0792	0.0823	0.0854	0.0870	0.1054
CO	1.2049	1.0459	1.0162	1.0362	1.0763	1.1166	1.1375	1.3779
NMVOC	0.0369	0.0322	0.0313	0.0314	0.0322	0.0327	0.0332	0.0401
SO_2	0.0425	0.0369	0.0359	0.0366	0.0380	0.0394	0.0401	0.0486
	1998	1999	2000	2001	2002	2003	2004	2005
NO_x	0.0933	0.1035	0.1180	0.1257	0.0667	0.1152	0.1317	0.1363
CO	1.2207	1.3532	1.5437	1.6440	0.8724	1.5065	1.7224	1.7819
NMVOC	0.0371	0.0408	0.0462	0.0500	0.0263	0.0456	0.0521	0.0544
SO_2	0.0431	0.0478	0.0545	0.0580	0.0308	0.0532	0.0608	0.0629
	2006	2007	2008	2009	2010	2011	2012	2013
NO_x	0.0878	0.1255	0.1151	0.0554	0.0314	0.0417	0.0412	0.0247
CO	1.1479	1.6407	1.5046	0.7242	0.4107	0.5451	0.5385	0.3233
NMVOC	0.0355	0.0508	0.0464	0.0227	0.0128	0.0169	0.0171	0.0100
SO_2	0.0405	0.0579	0.0531	0.0256	0.0145	0.0192	0.0190	0.0114

4.4.6 Planned Improvements

Further improvements under the 2C 'Metal Production' might be possible by considering the possibility to update the activity data set used to estimate GHG emissions.

4.5 Other Production (Category 2D)

4.5.1 Source Category Description

Category 2D 'Other Production' covers GHG emissions generated from the following sources: 2D1 'Pulp and Paper' and 2D2 'Food and Drink'. As no pulp and paper production is registered in the Republic of Moldova, respectively no emissions are reported for this category ('Not Occurring'). The NMVOC emissions are monitored under the 2D2 'Food and Drink' (despite the fact that an estimating methodology for CO_2 emissions from alcoholic beverages exist, these emissions are not reported in the total national GHG emissions, as they are considered to have a biogenic origin, and according to the Revised 1996 Guidelines, only non-biogenic CO_2 emissions will be estimated).

NMVOC emissions from the 2D2 'Food and Drink' have decreased by 51 per cent over the 1990-2013 periods: from 9.52 to 4.75 Gg (Table 4-62).

Table 4-62: NMVOC Emissions from 2D2 'Food and Drink' within 1990-2013 periods, Gg

	1990	1991	1992	1993	1994	1995	1996	1997
2D2a „Bread Making and Other Food"	8.4750	5.9996	5.1181	4.6262	3.5660	3.8191	4.1996	3.4138
2D2b „Alcoholic Beverages"	1.0413	1.0254	0.8446	1.3841	2.3360	3.5282	2.7795	2.1125
2D2 „Food and Drink"	9.5163	7.0250	5.9627	6.0103	5.9020	7.3473	6.9791	5.5263
	1998	1999	2000	2001	2002	2003	2004	2005
2D2a „Bread Making and Other Food"	3.0234	1.8152	1.7768	2.0162	2.3784	1.8342	1.9058	2.1175
2D2b „Alcoholic Beverages"	1.5661	0.8739	0.6937	0.8837	1.0485	1.6503	2.3245	2.6381
2D2 „Food and Drink"	4.5895	2.6891	2.4705	2.8999	3.4269	3.4844	4.2303	4.7556
	2006	2007	2008	2009	2010	2011	2012	2013
2D2a „Bread Making and Other Food"	2.2926	1.5681	2.2483	1.2585	1.9220	1.7846	1.7519	2.3479
2D2b „Alcoholic Beverages"	1.8979	1.6919	1.4565	1.1797	1.3764	1.5970	1.9597	2.4051
2D2 „Food and Drink"	4.1905	3.2601	3.7048	2.4382	3.2984	3.3816	3.7115	4.7530

In comparison with the 2012 year level, in 2013 the NMVOC emissions from 2D2 'Food and Drink' increased by 28 per cent (Figure 4-5).

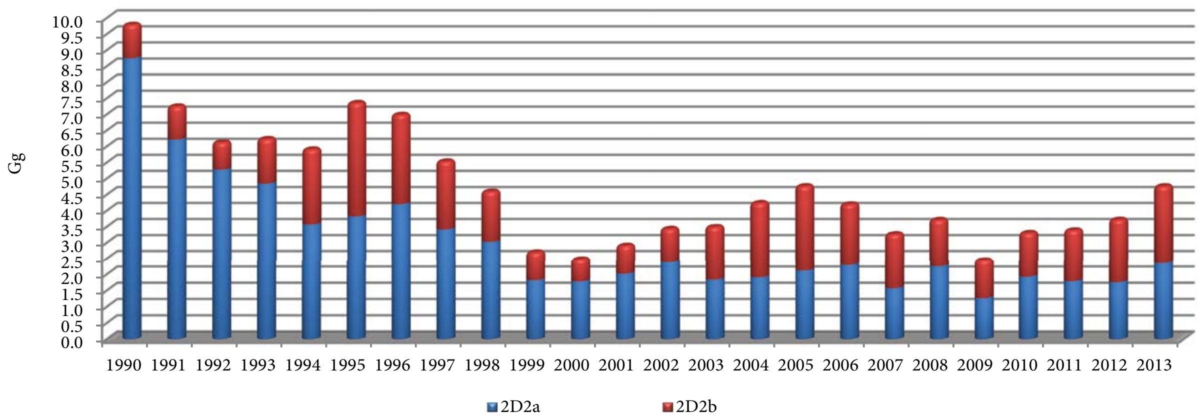


Figure 4-5: NMVOC Emissions from 2D2 'Food and Drink' within 1990-2013 periods, Gg

4. INDUSTRIAL PROCESSES SECTOR

To be noted that in the reference year, around 89.1 per cent of the total NMVOC emissions from the 2D2 'Food and Drink' were generated by the 2D2a 'Bread Making and Other Food'. By 2013, the share of this category in the total NMVOC emissions decreased to 49.4 per cent.

4.5.2 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 CORINAIR Atmospheric Emissions Inventory Guidebook. The estimation method used implies multiplication of default EF values (Table 4-63) by activity data on bread making and other food available in the national statistics (Table 4-64).

Table 4-63: 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	Meat, Fish and Poultry	0.3
	Sugar	10
	Margarine and Solid Cooking Fats	10
	Cakes, Biscuits and Breakfast Cereals	1
	White Bread	4.5
	Rye Bread	3
	Animal Feed	1

Source: EMEP CORINAIR Atmospheric Emissions Inventory Guidebook, 3rd edition, February, 15, 1996, B465-5, pr040605, Bread Making and Other Food.

Table 4-64: Activity Data on Bread Making and Other Food in the Republic of Moldova within1990-2013 periods, kt

	1990	1991	1992	1993	1994	1995	1996	1997
Meat	257.9	218.5	136.0	114.2	85.9	58.4	52.6	50.8
Sugar	435.8	236.9	192.2	209.0	166.7	218.7	264.5	213.3
Margarine and Butter	27.0	21.8	16.7	10.9	9.5	6.8	4.7	3.0
Confectionary Products	24.3	23.5	12.1	10.1	5.0	5.2	5.2	5.6
Bread	601.9	528.3	468.6	431.7	325.2	268.4	252.5	221.9
Animal Feed	1037.3	946.2	867.5	440.2	309.8	333.6	350.4	231.9
	1998	1999	2000	2001	2002	2003	2004	2005
Meat	27.3	25.7	13.4	7.3	11.3	14.9	10.2	6.7
Sugar	194.5	100.5	105.4	132.6	167.6	107.1	110.9	133.5
Margarine and Butter	2.9	2.4	2.9	4.4	5.3	6.2	7.4	7.0
Confectionary Products	9.2	8.4	8.7	12.8	15.9	18.0	17.9	20.7
Bread	180.2	147.0	138.1	133.3	130.8	144.7	145.8	142.0
Animal Feed	221.2	108.6	59.8	31.4	41.4	28.1	46.1	50.8
	2006	2007	2008	2009	2010	2011	2012	2013
Meat	10.2	16.1	12.8	16.3	24.7	28.5	31.3	35.4
Sugar	149.0	74.0	134.0	38.4	103.2	88.4	83.4	140.3
Margarine and Butter	6.1	5.8	6.6	5.9	5.9	5.4	5.2	6.5
Confectionary Products	21.7	22.3	22.9	23.6	27.7	29.4	31.3	34.6
Bread	145.3	154.8	169.8	161.6	160.4	162.9	161.8	164.1
Animal Feed	62.6	46.4	51.0	60.1	74.4	75.4	96.3	95.9

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 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).

b) 'Alcoholic Beverages'

Methodological issues related to calculation of NMVOC emissions from production of alcoholic beverages are addressed in the Atmospheric Emissions Inventory Guidebook (CORINAIR, 1996). The estimation method is based on multiplying default values of emission factors (Table 4-65) by activity data on production of alcoholic beverages available in national statistics (Table 4-66).

Table 4-65: Default EFs Used to Calculate NMVOC Emissions from Alcoholic Beverages

Source	Alcoholic beverages	NMVOC, kg / hl
Alcoholic Beverages	Red Wine	0.080
	White Wine, Sparkling Wine, Beer	0.035
	Spirits (unspecified)	15.0
	Vodka/Grain Whisky	7.5
	Brandy	3.5

Source: EMEP CORINAIR Atmospheric Emissions Inventory Guidebook, 3rd edition, February 15, 1996, B466-5, pr040606, Alcoholic beverages.

As at the time of inventory compilation there were no statistical data on the share of different types of wine in the total production reported in the RM, the breakdown percentage of different types of wines (i.e., red and white) was inferred based on a data survey covering 14 winemaking enterprises[32].

[32] The survey results covering 14 winemaking enterprises in the RM (S.A. „Vinuri Ialoveni", Ialoveni; S.A. „Zubreşti", Zubreşti, Străşeni; „Vitis Hînceşti" S.A., Hînceşti; „Deus Vin" SRL, Ulmu, Ialoveni; C.V. „Naţional Vin", Chişinău; S.A. „Migdal-P", mun. Chişinău; S.A. "Prut" Winery, Brînza, Cahul; ÎM „Grape Valley" SRL, Borceag, Cahul; ÎM „Vinăria-Bardar" S.A. Winery; „Cricova" S.A., Cricova, mun. Chişinău; S.A. „Bravicea-Vin", Bravicea, Călăraşi; ÎS CVC „Mileştii Mici", Mileştii Mici, Ialoveni; „Nectar-S" SRL, Străşeni; "Ţiganca" Winery, Plopi, Cantemir) revealed the share of white and red wines in the total wine production.

Table 4-66: Activity Data on Alcoholic Beverages Production within 1990-2013 periods

	1990	1991	1992	1993	1994	1995	1996	1997
Wine, thousand hl	1630.0	1430.0	920.0	1030.0	977.8	996.9	1458.0	1941.5
White wine, thousand hl	570.5	500.5	368.0	412.0	391.1	448.6	656.1	873.7
Red wine, thousand hl	1059.5	929.5	552.0	618.0	586.7	548.3	801.9	1067.8
Sparkling wine, thousand hl	80.4	78.3	85.4	88.8	74.2	94.8	141.9	134.5
Brandy, thousand hl	139.4	140.2	75.0	74.0	79.3	102.7	45.7	58.6
Vodka and Liqueurs, thousand hl	55.9	55.6	67.6	139.4	264.7	412.7	335.8	237.0
Beer, thousand hl	760.0	660.0	430.0	360.0	285.0	302.9	256.0	262.7
	1998	1999	2000	2001	2002	2003	2004	2005
Wine, thousand hl	1239.6	690.1	1092.2	1564.2	1494.0	1921.8	3351.4	3643.5
White wine, thousand hl	557.8	310.5	491.5	782.1	821.7	1153.1	1508.1	1639.6
Red wine, thousand hl	681.8	379.6	600.7	782.1	672.3	768.7	1843.3	2003.9
Sparkling wine, thousand hl	51.9	67.5	41.6	58.4	61.3	73.9	93.8	105.1
Brandy, thousand hl	49.7	48.6	71.8	95.6	103.8	136.1	142.8	171.1
Vodka and Liqueurs, thousand hl	174.1	87.0	48.9	59.4	77.9	139.8	212.9	238.8
Beer, thousand hl	300.1	220.9	257.9	336.2	462.4	599.1	695.7	777.8
	2006	2007	2008	2009	2010	2011	2012	2013
Wine, thousand hl	1936.0	1258.1	1553.0	1263.1	1285.5	1260.6	1426.4	1418.7
White wine, thousand hl	871.2	566.2	698.8	568.4	578.5	567.3	641.9	638.4
Red wine, thousand hl	1064.8	692.0	854.1	694.7	707.0	693.3	784.5	780.3
Sparkling wine, thousand hl	40.2	54.1	57.2	50.0	55.6	68.6	65.4	60.0
Brandy, thousand hl	79.1	82.4	103.7	69.8	74.6	91.2	109.4	118.0
Vodka and Liqueurs, thousand hl	196.3	172.2	129.1	110.8	133.8	155.1	193.4	249.2
Beer, thousand hl	912.4	1011.6	866.4	778.8	948.0	1051.1	1095.9	1029.3

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 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).

4.5.3 Uncertainty Assessment and Time-Series Consistency

The primary uncertainties related factors pertain to methodology, EFs used to estimate GHG emissions covered by the 2D2 'Food and Drink' 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 (CORINAIR, 1996). Uncertainties related to activity data on food and drink 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 GPG (IPCC, 2000).

4.5.4 Quality Assurance and Quality Control

Standard verification and quality control forms and checklists were filled in for the respective category under the 'Industrial Processes' Sector, following a Tier 1 approach (IPCC, 2000). Verification was focused on correct use of emission factors including the default EFs used as reference source according to the EMEP CORINAIR Atmospheric Emissions Inventory Guidebook (CORINAIR, 1996); 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) and other relevant sources (e.g. data surveys applied to the main wine producers), etc. To be noted that the AD and methods used for estimating GHG emissions under the Category 2D were documented and archived both in hard copies and electronically.

4.5.5 Recalculations

NMVOC emissions from the 2D2 'Food and Drink' were recalculated for the 1990-2010 periods, in particular due to updating activity data on bread making and other food and alcoholic beverages based on new editions of the Statistical Yearbooks of the Republic of Moldova and ATULBD.

'Bread Making and Other Food'

In comparison with values included in the TNC, the changes made resulted in an increase of NMVOC emission estimates between 1990 and 1993, 2004 and 2008 and in 2010, but also an insignificant decreasing trend in 1999-2003 time series (Table 4-67).

Table 4-67: Comparative Results of NMVOC Emissions from 2D2a 'Bread Making and Other Food' included into the TNC and the BUR of the Republic of Moldova under the UNFCCC, Gg

	1990	1991	1992	1993	1994	1995	1996	1997
TNC	8.4750	5.9996	5.1181	4.6262	3.5660	3.8191	4.1996	3.4138
BUR	8.7440	6.2136	5.2761	4.8382	3.5660	3.8191	4.1996	3.4138
Difference, %	3.17	3.57	3.09	4.58	0.00	0.00	0.00	0.00

	1998	1999	2000	2001	2002	2003	2004	2005
TNC	3.0234	1.8167	1.7777	2.0169	2.3838	1.8384	1.9032	2.1174
BUR	3.0234	1.8152	1.7768	2.0162	2.3784	1.8342	1.9058	2.1175
Difference, %	0.00	-0.08	-0.05	-0.04	-0.22	-0.23	0.14	0.01
	2006	2007	2008	2009	2010	2011	2012	2013
TNC	2.2922	1.5651	2.2474	1.2945	1.5928			
BUR	2.2926	1.5681	2.2483	1.2585	1.9220	1.7846	1.7519	2.3479
Difference, %	0.02	0.19	0.04	-2.78	20.66			

Abbreviations: TNC – Third National Communication; BUR – Biennial Update Report.

For the 2011-2013 time periods, 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 2013, NMVOC emissions from bread making and other food decreased by 73.1 per cent.

'Alcoholic Beverages'

In comparison with the values included in the TNC, the changes made (updating activity data for 1999-2001, 2003 and 2005-2010 years) resulted in an insignificant variation in NMVOC emission estimates from 'alcoholic beverages', with the exception of 2001, 2003 and 2010, when the recalculated values were significant, varying from -4.30 per cent in 2001 and -20.54 per cent in 2003, to +8.60 per cent in 2010 (Table 4-68).

Table 4-68: Comparative Results of NMVOC Emissions from 2D2b 'Alcoholic Beverages' included into the TNC and the BUR of the Republic of Moldova under the UNFCCC, Gg

	1990	1991	1992	1993	1994	1995	1996	1997
TNC	1.0413	1.0254	0.8446	1.3841	2.3360	3.5282	2.7795	2.1125
BUR	1.0413	1.0254	0.8446	1.3841	2.3360	3.5282	2.7795	2.1125
Difference, %	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	1998	1999	2000	2001	2002	2003	2004	2005
TNC	1.5661	0.8740	0.6935	0.9235	1.0485	2.0768	2.3245	2.6383
BUR	1.5661	0.8739	0.6937	0.8837	1.0485	1.6503	2.3245	2.6381
Difference, %	0.00	-0.01	0.02	-4.30	0.00	-20.54	0.00	-0.01
	2006	2007	2008	2009	2010	2011	2012	2013
TNC	1.8981	1.6912	1.4646	1.1761	1.2674			
BUR	1.8979	1.6919	1.4565	1.1797	1.3764	1.5970	1.9597	2.4051
Difference, %	-0.01	0.04	-0.55	0.31	8.60			

Abbreviations: TNC – Third National Communication; BUR – Biennial Update Report.

For the 2011-2013 time periods, the NMVOC emissions from alcoholic beverages were estimated for the first time. The results allow assert that over the period since 1990 to 2013, NMVOC emissions from 'alcoholic beverages' increased by circa 131 per cent, which is explained by a substantial growth of winemaking industry's output in the Republic of Moldova over the period under review (vodka and liquor – by 345.9 per cent, beer – by 35.4 per cent), despite the fact that the production of grape wine decreased by 13.0 per cent, sparkling wine – by 25.4 per cent and brandy – by 15.4 per cent.

4.5.6 Planned Improvements

Further improvements under the 2D 'Other Products' category might be possible by considering the possibility to update the activity data set used to estimate GHG emissions.

4.6 Consumption of Halocarbons and Sulphur Hexafluoride (Category 2F)

4.6.1 Source Category Description

The group of halocarbons comprises partially fluorinated hydrocarbons (HFC-23; HFC-32; HFC-41; HFC-43-10mee; HFC-125; HFC-134; HFC-134a; HFC-143, HFC-143a; HFC-152a; HFC-227ea; HFC-236fa; HFC-245ca) and perfluorinated hydrocarbons (perfluoromethane – CF_4, perfluoroethane – C_2F_6, pefluoropropane – C_3F_8, perfluorobutane – C_4F_{10}, perfluorociclobutane – c-C_4F_8, perfluoropentane – C_5F_{12}, perfluorohexane – C_6F_{14}) (Table 4-69).

Table 4-69: Global Warming Potentials and Atmospheric Lifetimes

GHG	Chemical formula	Atmospheric lifetime, years	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

GHG	Chemical formula	Atmospheric lifetime, years	SAR	TAR	AR4	AR5
Hydrofluorocarbons						
HFC-23	CHF_3	222	11700	12000	14800	12140
HFC-32	CH_2F_3	5.2	650	550	675	677
HFC-125	C_2HF_5	28.2	2800	3400	3500	3170
HFC-134a	$C_2H_2F_2$ (CH_2FCF_3)	13.4	1300	1300	1430	1300
HFC-143a	$C_2H_3F_3$ (CF_3CH_3)	47.1	3800	4300	4470	4800
HFC-152a	C_2H4F_2 (CH_3CHF_2)	1.5	140	120	124	138
HFC-227ea	CF_3CHFCF_3	38.9	2900	3500	3220	3350
HFC-236fa	$CF_3CH_2CF_3$	242	6300	9400	9810	8060
HFC-245fa	$CHF_2CH_2CF_3$	7.7	NA	950	1030	858
HFC-365mfc	$CH_3CF_2CH_2CF_3$	8.7	NA	890	794	804
HFC-43-10mee	$CF_3CHFCHFCF_2CF_3$	16.1	1300	1500	1640	1650
Fully fluorinates species						
Sulphur hexafluoride	SF_6	3200	23900	22200	22800	23500
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
Perfluorobutane	C_4F_{10}	2600	7000	8600	8860	9200
Perfluorociclobutan	c-C_4F_8	3200	8700	10000	10300	9540
Perfluoropentane	C_5F_{12}	4100	7500	8900	9160	8550
Perfluorohexane	C_6F_{14}	3100	7400	9000	9300	7910
Others						
Nitrogene trifluoride	NF_3	500	NA	10800	17200	16100

Source: SAR (IPCC, 1996), TAR (IPCC, 2001), AR4 (IPCC, 2007) and AR5 (IPCC, 2013).

Globally, wide scale production of halocarbons started in 1991, as alternative substances to chlorofluorocarbons (CFC), ozone layer depleting substances (ODS). According the Montreal Protocol, the Parties to this treaty committed to phase out the import and consumption of chemical substances that deplete the ozone layer, with further complete elimination starting 2008 (because halocarbons do not contain atoms of chlorine, they do not have any impact on ozone layer).

The 2F 'Consumption of Halocarbons and Sulphur hexafluoride' includes GHG emissions from the following sources: 2F1 'Refrigeration and Air Conditioning Equipment', 2F2 'Foam Blowing', 2F3 'Fire Extinguishers', 2F4 'Aerosols', 2F5 'Solvents', 2F6 'Other Applications with ODS', 2F7 'Semiconductors Production', 2F8 'Electrical Equipment' and 2F9 'Other'.

Under the current inventory cycle the Republic of Moldova monitored emissions generated by the consumption of HFCs, PFCs and SF_6 from source categories 2F1, 2F2, 2F4 and 2F8. Emissions from source categories 2F3, 2F5, 2F6, 2F7 and 2F9 were reported as 'Not Occurring' (NO) and 'Not Estimated' (NE) due to lack of activity data and information on their use.

To be noted that the process of collecting activity data on consumption of halocarbons and sulphur hexafluoride is extremely difficult in the Republic of Moldova. The primary difficulty is due to the fact that import, export, re-export and circulation of halocarbons and equipment charged with halocarbons on the market is not regulated at the national level (like, for example, the ODS). Import of halocarbons 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. 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, GHGs emissions from the category 2F 'Consumption of halocarbons and sulphur hexafluoride' were estimated based on data on import and consumption of halocarbons provided by the National Bureau of Statistics, Customs Service, the Republican Association of Refrigeration Technicians and based on Annual Reports submitted by enterprises to the Ozone Office of the Ministry of Environment: between 2004-2013, there were 4 enterprises ('Frigoinds' Ltd, 'Ecolux' Ltd, 'Frigo-Dins' Ltd and 'York Refrigerant' Ltd) licensed to import, export, re-export, transit and placing ODS and equipment containing ODS on the market, including alternative substances (HFCs). It should be noted that the Republic of Moldova does not produce halocarbons and SF_6, and before 1995 these substances had a relatively narrow use, being imported in insignificant amounts.

2F1. 'Refrigeration and Air Conditioning Equipment'

Refrigeration equipment (household refrigerators, freezers, AC window units) 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 Republic of Moldova uses R-22 and R-600a refrigerants as transit substances, and R-134a, R-404a, R-407c, R-410a, R-507, as alternative refrigerants to chlorofluorocarbons (Table 4-70).

Table 4-70: Composition of Refrigerants Preponderantly Used in the Republic of Moldova

Commercial Name	Sector of Use	Composition
R-134a	Transport refrigerant	HFC-134a (100%)
R-404a	Commercial refrigerant	HFC-125 (44%)/HFC-143a (52%)/HFC-134a (4%)
R-407a	Commercial 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	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	Transport refrigerant	HFC-32 (50%)/HFC-125 (50%)
R-507	Transport refrigerant	HFC-125 (50%)/HFC-143a (50%)

The breakdown of refrigerants used in the Republic of Moldova in different types of refrigeration and air conditioning equipment varied in different years (Table 4-71).

Table 4-71: Breakdown of Different Refrigerants Incorporated in Refrigeration and Air Conditioning Equipment Imported in the RM, 1995-2014, %

Refrigeration equipment	Refrigerant	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
Refrigerators	R-134a	50	55	60	65	70	75	90	85	85	85
	R-143a	0	0	0	0	0	0	0	0	0	0
	R-600a	0	0	0	0	0	0	0	15	15	15
	R-22	50	45	40	35	30	25	10	0	0	0
Ice machines	R-134a	45	45	45	45	45	45	45	50	40	35
	R-404a	55	55	55	55	55	55	55	50	60	65
	R-507a	0	0	0	0	0	0	0	0	0	0
	R-12	0	0	0	0	0	0	0	0	0	0
AC window units	R-134a	90	90	90	90	90	90	90	85	85	80
	R-404a	0	0	0	0	0	0	0	0	0	0
	R-407c	10	10	10	10	10	10	10	15	15	20
	R-507	0	0	0	0	0	0	0	0	0	0
Air Conditioning Equipment	R-410a	5	5	5	10	10	15	30	45	60	55
	R-407c	0	5	5	5	5	5	10	15	20	25
	R-22	95	90	90	85	85	80	60	40	20	20
Refrigeration equipment	**Refrigerant**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**
Refrigerators	R-134a	85	80	90	40	50	5	20	13	10	8
	R-143a	0	0	0	0	15	20	0	0	0	0
	R-600a	15	20	4	0	30	75	80	85	90	92
	R-22	0	0	6	60	5	0	0	0	0	0
Ice machines	R-134a	40	45	0	0	0	0	5	4	4	3
	R-404a	60	55	100	85	55	70	95	96	96	97
	R-507a	0	0	0	0	45	30	0	0	0	0
	R-12	0	0	0	15	0	0	0	0	0	0
AC window units	R-134a	80	75	0	0	0	0	5	5	3	2
	R-404a	0	0	60	100	60	70	65	60	50	50
	R-407c	20	25	0	0	0	0	30	35	47	48
	R-507	0	0	40	0	40	30	0	0	0	0
Air Conditioning Equipment	R-410a	50	30	40	50	80	55	60	65	70	75
	R-407c	30	50	35	30	15	45	32	30	25	20
	R-22	20	20	25	20	5	0	3	5	5	5

Source: Republican Association of Refrigeration Technicians in the Republic of Moldova through Official Letter No. 17/14 dated 19.03.2014, as a response to the request of the Climate Change Office of the Ministry of Environment No. 320/2014-01-01, as of 03.01.2014.

2F2. 'Foam Blowing'

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, and HFC-152a.

There is no foam blowing production in the Republic of Moldova, while imported foams are preponderantly closed cell foams (emissions generated by closed cell foams have a longer time period, by default, about 20 years).

2F3. 'Fire Extinguishers'

There are two types of fire extinguishers: fixed flooding fire extinguishing systems and portable streaming fire extinguishers. At the international level, halon based extinguishers (halon-1211 or bromoclorodifluoromethane; halon-1301 or bromotrifluoromethane and halon-2402 or dibromotetrafluoroethane) tend to be replaced by HFCs based extinguishers (HFC-227ea and HFC-236fa).

According to the information received from the Civil Protection and Emergency Situations Service of the Ministry of Intern Affaire (Official Letter No. 19/5-393 from 04.04.2008), 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 4-72).

Table 4-72: Import of Carbon Dioxide Based Portable Fire Extinguishers in the Republic of Moldova within 2000-2013 periods

	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
Portable fire extinguishers, units	7572	4178	9247	13806	20913	18494	26666	41232	46428	154462	43347	29374	42465	51143

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.

2F4. 'Aerosols'

In most aerosol products HFCs or CFCs are used as propellants (in insignificant quantities). 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 (US EPA, 1992). 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 (including CFC-12) 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).

2F8. 'Electrical Equipment'

Sulphur hexafluoride (SF_6) and perfluorinated hydrocarbons 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 is 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 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 Ministry of Health for the time period since 1990 to 2013;
- In the case of 'Moldelectrica' S.O.E. and Red Union Fenosa J.S.C., in 2014 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 (mostly in GL-315 type, 330 kV).

To be noted that 'potential' total direct greenhouse gas emissions covered by the source category 2F 'Consumption of Halocarbons and Sulphur Hexafluoride' increased between 1995 and 2013 by circa 4378.1 per cent, from 41.3029 up to 1849.5668 Gg CO_2 eq.

At the same time 'actual' total direct GHG covered by the source category 2F 'Consumption of Halocarbons and Sulphur Hexafluoride' increased by 7436.3 per cent over the period since 1995 to 2013, from 1.8961 up to 142.8948 Gg CO_2 eq. Share of SF_6 and CF_4 emissions in the total GHG emissions generated from the source category 2F 'Consumption of Halocarbons and Sulphur Hexafluoride' is insignificant, such emissions being reported only since 2003, and respectively since 2006 (Table 4-73).

Table 4-73: GHG Emissions from the 2F 'Consumption of Halocarbons and Sulphur Hexafluoride' in the Republic of Moldova within 1995-2013 periods, Gg CO_2 equivalent

Year	HFC		PFC		SF_6		Total	
	Potential	Actual	Potential	Actual	Potential	Actual	Potential	Actual
1995	41.3029	1.8961	NO	NO	NO	NO	41.3029	1.8961
1996	72.7763	4.0738	NO	NO	NO	NO	72.7763	4.0738
1997	101.7038	6.6059	NO	NO	NO	NO	101.7038	6.6059
1998	131.2891	9.4575	NO	NO	NO	NO	131.2891	9.4575
1999	154.9716	11.4564	NO	NO	NO	NO	154.9716	11.4564
2000	183.1792	13.3755	NO	NO	NO	NO	183.1792	13.3755
2001	221.1297	16.4898	NO	NO	NO	NO	221.1297	16.4898
2002	272.5667	19.5171	NO	NO	NO	NO	272.5667	19.5171
2003	362.2020	25.8543	NO	NO	0.2868	0.0057	362.4888	25.8600
2004	459.5423	32.0282	NO	NO	0.2868	0.0057	459.8291	32.0340
2005	570.8933	39.4124	NO	NO	2.2944	0.0459	573.1877	39.4583
2006	703.6394	47.0741	0.7800	0.0156	13.5991	0.2720	718.0185	47.3617
2007	909.1773	60.3620	0.7800	0.0156	17.6143	0.3523	927.5716	60.7298
2008	1146.3041	76.3309	0.9750	0.0195	21.1515	0.4230	1168.4306	76.7734
2009	1243.4062	87.1207	0.9750	0.0195	22.8723	0.4574	1267.2535	87.5976
2010	1382.5065	102.4171	1.3650	0.0273	27.6882	0.5538	1411.5596	102.9981
2011	1557.1979	112.3917	1.3650	0.0273	29.0720	0.5814	1587.6349	113.0005
2012	1647.2641	126.0156	1.3650	0.0273	31.4237	0.6285	1680.0528	126.6714
2013	1814.1873	142.1872	1.3650	0.0273	34.0145	0.6803	1849.5668	142.8948

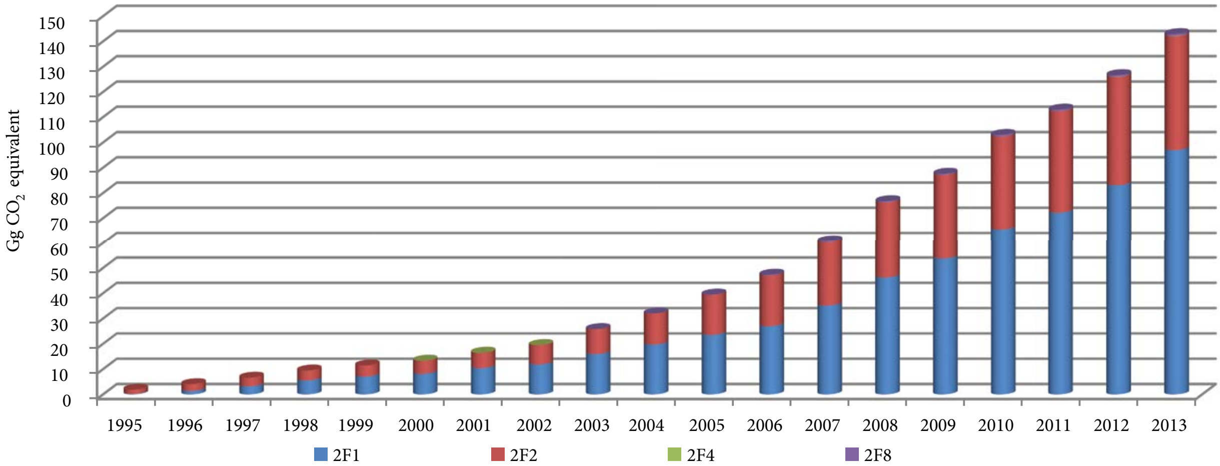


Figure 4-6: Direct GHG Emissions from the 2F 'Consumption of Halocarbons and Sulphur Hexafluoride' in the Republic of Moldova, by Source, within 1995-2013 periods

4.6.2 Methodological Issues, Emission Factors and Data Sources

2F1. 'Refrigeration and Air Conditioning Equipment'

Refrigeration equipment (refrigerators, ice machines, AC window units) and air conditioning equipment (stationary and mobile air conditioners) are a primary source of HFC emissions in the Republic of Moldova.

Greenhouse gas emissions generated from consumption of halocarbons in 2F1 'Refrigeration and Air Conditioning Equipment' source category were estimated using both Tier 1b (potential emissions) and Tier 2 estimation method (actual emissions).

Potential emissions are equal to the amount of virgin chemical substances consumed in the country minus the amount of chemical substances recovered to be destroyed or exported within one calendar year.

Potential Emissions = Production + Imports (Bulk Chemicals + Chemical Contained in Products) – Exports (Bulk Chemicals + Chemical Contained in Products) – Destruction

If not destroyed, over time the entire amount of chemical substances consumed is emitted in the atmosphere, so that in the long run (for example, 50 years) potential emissions become equal to actual emissions. However, it should be noted that this approach overlooks the accumulation of possible leakages of chemical substances from different products and equipment, entailing estimation uncertainties, in particular, for shorter periods of time (for example, 10-15 years). Since such an accumulation is a dominant process, potential emissions will be much more overestimated than the actual emissions.

The Tier 2 estimation method (bottom-up approach) is based on estimation of HFCs emissions from assembly, operation, and disposal of equipment.

Total Emissions = Assembly Emissions + Operation Emissions + Disposal Emissions

Where:

- Assembly Emissions include the emissions associated with product manufacturing, even if the products are eventually exported;
- Operation Emissions include annual leakage from equipment stock in use as well as servicing emissions; this calculation should include all equipment units in the country, regardless of where they were manufactured;
- Disposal Emissions include the amount of refrigerant released from scrapped systems; as with operation emissions, they should include all equipment units in the country where they were scraped, regardless of where they were manufactured;

The estimation process implies three consecutive stages using the equations below.

Assembly Emissions = (Total HFC and PFC Charged in year t) • (k /100)

Where:

k = Emission factor that represents the percentage of initial charge that is released during assembly.

Operation Emissions = (Amount of HFC and PFC Stock in year t) • (x /100)

Where:

x = Emission factor that represents the annual leak rate as a percentage of total charge; since different types of refrigeration equipment will leak at different rates, data were disaggregate into homogeneous classes in order to develop values of x specific to different types of equipment.

Disposal Emissions = (HFC and PFC Charged in year) • (y /100) • (100 – z /100) – (Amount of Intentional Destruction)

Where:

y = Percentage of the initial charge remaining in the equipment at the time of disposal;

z = Recovery efficiency at the time of disposal.

A) 'Stationary Refrigeration and Air Conditioning Equipment'

The information about the average charge for each type of equipment is based on data provided by the Customs Service, Republican Association of Refrigeration Technicians and annual reports submitted by companies to the Ozone Office of the Ministry of Environment (Table 4-74). Default values were used for other parameters and factors (IPCC, 2000).

Table 4-74: Estimates for Charge, Lifetime and Emission Factors for Stationary Refrigeration and Air Conditioning Equipment in the Republic of Moldova

Equipment Type	Charge, kg (Ei_{charge})[1]	Lifetime, years (n)[1]	EF, % of the initial charge/ year		% of Initial Charge Remaining at Disposal (y)[2]	End-of-Life Emissions (Recovery efficiency), (z)[1]
			Initial Emissions (k)[2]	Lifetime Emissions (x)[2]		
Domestic refrigeration	0.10	12	0.6	0.3	95	0
Chest freezers	0.20	12	0.6	5.0	90	0
Upright freezers	0.18	12	0.6	5.0	90	0
AC window units	0.40	10	0.6	10.0	60	0
Industrial AC window units	0.60	10	0.6	10.0	60	0
Air conditioning equipment	0.80	12	0.6	5.0	60	0

Source: [1] Republican Association of Refrigeration Technicians in the Republic of Moldova, Personal Communication of the Association Director, Mr. Ion Jicul dated 18.08.2011 to Mr. Anatol Tarata, Manager of Ozone Office of the MoEN; [2] Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories (IPCC, 2000), Chapter 3 „Industrial Processes", Table 3.22, page 3.106.

Activity data used to estimate HFC emissions from consumption of hydrofluorocarbons charged into refrigeration and air conditioning equipment (stationary air conditioning equipment) are provided below (Table 4-75).

Table 4-75: Activity Data on Refrigeration and Air Conditioning Equipment Imported in the Republic of Moldova within 1995-2014 periods, units

Equipment	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
Household refrigerators	18958	8376	11597	15230	8498	12092	19937	30689	42524	52694
Chest freezers	36	243	100	148	96	242	428	97	442	457
Upright freezers	43	337	22	320	200	393	558	995	2033	1481
Chillers	2696	1037	1411	2714	913	1195	1696	3153	1803	2465
Cold storage warehouses	102	583	558	2286	622	822	977	1122	1605	1260
Air conditioning equipment	2245	424	1247	1177	794	1677	1213	2205	5778	5753
Equipment	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
Household refrigerators	70412	87034	112982	78880	65306	72824	66900	63433	55638	60963
Chest freezers	1265	1713	1549	2834	2529	2492	3395	2107	2870	3151
Upright freezers	1965	5180	9574	3169	4323	8825	9239	7994	6164	8242
Chillers	2830	3621	8978	8692	4908	4296	4997	4000	5333	3961
Cold storage warehouses	1173	1246	1436	478	422	403	441	224	343	252
Air conditioning equipment	7879	11308	38291	36172	8287	17607	28055	25871	32607	17177

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.

The information on the composition of refrigerants preponderantly used in the Republic of Moldova (Table 4-70), the share of refrigerants charged into the refrigeration and air conditioning equipment imported in the country over the period from 1995 through 2014 (Table 4-71), the average charge of equipment with refrigerant (Table 4-74) and statistical data on import of refrigeration and air conditioning equipment (Table 4-75) (the respective equipment is not produced in the Republic of Moldova) was used to estimate the total amount of HFCs imported in the country (Table 4-76), as well as the actual HFCs emissions from the freons used in the refrigeration and air conditioning equipment in the Republic of Moldova within the period since 1995 to 2014 (Table 4-77).

Table 4-76: Activity Data on Imported HFCs Charged into 'Refrigeration and Air Conditioning Equipment' in the Republic of Moldova within 1995-2014 periods, tons/year

	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
HFC-32	0.0677	0.0277	0.0544	0.1071	0.0538	0.1355	0.1932	0.5158	1.6499	1.6000
HFC-125	0.0941	0.0697	0.0792	0.1782	0.0826	0.1851	0.2654	0.6228	1.8388	1.7951
HFC-134a	2.0262	1.2398	1.5783	3.3654	1.3315	1.9109	3.1213	4.6097	5.8205	6.7449
HFC-143a	0.0043	0.0312	0.0069	0.0249	0.0158	0.0341	0.0532	0.0516	0.1418	0.1210
Total HFCs	2.1922	1.3685	1.7187	3.6756	1.4837	2.2656	3.6331	5.7999	9.4510	10.2609
	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
HFC-32	2.0842	2.5071	8.5925	9.2311	2.8806	5.3314	8.5209	8.2759	10.8497	5.9518
HFC-125	2.3556	3.0159	11.7676	11.4860	4.5285	7.3117	10.4266	9.7652	12.4257	7.4574
HFC-134a	8.8411	11.7832	15.9317	7.8587	3.8638	3.7735	5.7224	4.5703	4.6362	2.4649
HFC-143a	0.1893	0.3647	3.3371	2.4597	2.7705	3.5367	1.9220	1.4698	1.4486	1.5174
Total HFCs	13.4701	17.6708	39.6289	31.0355	14.0434	19.9533	26.5919	24.0813	29.3602	17.3916

Table 4-77: Actual HFC Emissions from Freons Charged into 'Refrigeration and Air Conditioning Equipment' in the Republic of Moldova within 1995-2014 periods, tons

	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
HFC-32	0.0049	0.0068	0.0106	0.0187	0.0219	0.0301	0.0414	0.0720	0.1638	0.2470
HFC-125	0.0075	0.0124	0.0182	0.0327	0.0377	0.0495	0.0658	0.1049	0.2092	0.3056
HFC-134a	0.1225	0.1940	0.2845	0.5325	0.5936	0.6957	0.8341	1.0389	1.2440	1.4529
HFC-143a	0.0002	0.0020	0.0022	0.0035	0.0042	0.0061	0.0088	0.0114	0.0190	0.0250
Total HFCs	0.1352	0.2153	0.3155	0.5874	0.6574	0.7813	0.9501	1.2272	1.6360	2.0304
	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
HFC-32	0.3715	0.5003	0.9950	1.4596	1.5593	1.8563	2.3005	2.7847	3.3802	3.8422
HFC-125	0.4615	0.6182	1.3958	2.0898	2.2809	2.7403	3.3149	3.9340	4.6560	5.2325
HFC-134a	2.3497	2.5111	3.8428	4.5077	3.7542	4.3646	4.3935	5.2725	6.2506	7.1979
HFC-143a	0.0348	0.0541	0.3566	0.5965	0.7256	0.9053	1.0217	1.1360	1.2559	1.3533
Total HFCs	3.2175	3.6838	6.5903	8.6537	8.3200	9.8665	11.0305	13.1272	15.5427	17.6259

B). 'Mobile Air Conditioning Equipment'

Default values were used for average charge with freons (mainly, HFC-134a) of mobile sources of air conditioning equipment (passenger cars, trucks, buses, minibuses and refrigeration vehicles), as well as for other parameters and emission factors (IPCC, 2000) (Table 4-78). Estimation of the amount of

HFCs used in mobile air conditioning equipment was based on information on the total number of transportation means units registered in the Republic of Moldova, in conformity with data available in the Statistical Yearbooks (Table 4-79), as well as data recorded in the State Transport Register, data provided by the State Enterprise "State Information Resources Center "Register" (SE "CRIS "Register") (Table 4-80 and Table 4-81) (to be noted that the share of transportation means produced after 1993, in particular Euro-1, Euro-2, Euro-3, Euro-4 and Euro-5 was essential for estimating the share of transportation units charged with air conditioning equipment).

Table 4-78: Estimates for Charge, Lifetime and Emission Factors for Mobile Air Conditioning and Transport Refrigeration Equipment in the Republic of Moldova

Equipment type	Charge with HFC-134a, kg (Ei_{charge})[1]	Lifetime, years (n)[2]	Emission factor, % of initial charge/year		% of Initial charge remaining at disposal (y)[2]	End-of-Life emissions (recovery efficiency), (z)
			Initial (k)[2]	Operational (x)[2]		
Passenger Cars	0.75	12	0.5	15	40	0
Buses	9.00	12	0.5	15	40	0
Trucks	1.50	12	0.5	15	40	0
Refrigerators	8.00	9	0.6	15	40	0

Source: [1] Environmental Protection Agency, part of the Danish Ministry of Environment (2010), <http://www2.mst.dk/udgiv/publications/2010/978-87-92617-66-8/pdf/978-87-92617-67-5.pdf>; [2] Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories (IPCC, 2000), Chapter 3 „Industrial Processes", Table 3.23, page 3.110 and Table 3-24, page 3.112.

Table 4-79: Number of Transportation Units Registered in the Republic of Moldova between 1996 and 2013 (standing for the end of the calendar year), units

	1996	1997	1998	1999	2000	2001	2002	2003	2004
Passenger car	173618	205973	222769	232278	238380	256459	268882	265841	269551
Buses and Minibuses	9798	11169	12917	13582	12769	14703	15777	15723	19741
Trucks	57138	56924	57404	52430	46351	45809	46277	46905	73774
	2005	2006	2007	2008	2009	2010	2011	2012	2013
Passenger car	292994	319311	338944	366351	386365	404290	426973	456379	487418
Buses and Minibuses	19825	21056	21095	21491	21346	21395	21349	21433	21344
Trucks	81798	84087	94828	115967	120174	131243	141696	151830	154163

Source: Statistical Yearbooks for 1999 (page 390), 2003 (pages 515-516), 2005 (page 407), 2008 (page 399), 2010 (page 399), 2013 (page 401), 2014 (page 399).

Table 4-80: Transportation Units Charged with Air Conditioning Equipment in the RM between 1996 and 2013 (by the end of calendar year), units

	1996	1997	1998	1999	2000	2001	2002	2003	2004
Passenger car	4156	9928	14402	18709	22809	28497	30705	48998	52552
Buses and Minibuses	125	436	939	1138	1137	1417	1622	1679	2168
Trucks	632	1390	2318	3126	4174	5933	6214	7081	11381
Refrigeration Vehicles	21	50	106	166	155	236	415	623	864
	2005	2006	2007	2008	2009	2010	2011	2012	2013
Passenger car	59115	67856	75398	85706	93504	102384	113942	128792	280485
Buses and Minibuses	2258	2596	2698	2894	3214	3389	3491	3637	8910
Trucks	13252	14198	16993	22649	26122	30522	34662	38696	100291
Refrigeration Vehicles	1042	1229	1412	1753	1965	2329	608	777	1061

Table 4-81: Transportation Units Charged with Air Conditioning Equipment in the Republic of Moldova between 1996 and 2013 (by the end of calendar year), % of the total

	1996	1997	1998	1999	2000	2001	2002	2003	2004
Passenger car	2.4	4.8	6.5	8.1	9.6	11.1	11.4	18.4	19.5
Buses and Minibuses	1.3	3.9	7.3	8.4	8.9	9.6	10.3	10.7	11.0
Trucks	1.1	2.4	4.0	6.0	9.0	13.0	13.4	15.1	15.4
	2005	2006	2007	2008	2009	2010	2011	2012	2013
Passenger car	20.2	21.3	22.2	23.4	24.2	25.3	26.7	28.2	29.6
Buses and Minibuses	11.4	12.3	12.8	13.5	15.1	15.8	16.4	17.0	17.3
Trucks	16.2	16.9	17.9	19.5	21.7	23.3	24.5	25.5	27.0

Source: Ministry of Information and Communication Technology of the RM, Official Letter No. 01/337 din 02.03.2011, as a response to the request from the Ministry of Environment No. 03-07/175 dated 02.02.2011, regarding the period 1995-2010; SE "State Information Resources Center "Register" (SE „CRIS „Register"), through the Delivery and Acceptance Act of the Services provided under the Contract No. 97-ST dated 24.02.2014 from 14.03.2014, regarding the period 2011-2013.

Table 4-82: Activity Data on the Annual Import of HFC-134a Charged into the Air Conditioning Equipment of Transportation Units in the Republic of Moldova within 1996-2013 periods, tons

	1996	1997	1998	1999	2000	2001	2002	2003	2004
HFC-134a in passenger cars	0.9480	2.0850	3.4770	4.6890	6.2610	8.8995	9.3209	10.6208	17.0712
HFC-134a in buses	1.1250	3.9240	8.4510	10.2420	10.2303	12.7530	14.5962	15.1092	19.5098
HFC-134a in trucks	3.1170	7.4460	10.8015	14.0318	17.1068	21.3728	23.0286	36.7487	39.4139
HFC-134a in refrigeration vehicles	0.1680	0.4000	0.8480	1.3280	1.2400	1.8880	3.3200	4.9840	6.9120
Total HFC-134a	5.3580	13.8550	23.5775	30.2908	34.8381	44.9133	50.2657	67.4626	82.9068

	2005	2006	2007	2008	2009	2010	2011	2012	2013
HFC-134a in passenger cars	19.8773	21.2973	25.4894	33.9736	39.1826	45.7830	51.9924	58.0444	62.4311
HFC-134a in buses	20.3245	23.3604	24.2798	26.0433	28.9276	30.5037	31.4188	32.7335	33.2789
HFC-134a in trucks	44.3364	50.8922	56.5485	64.2793	70.1283	76.7880	85.4563	96.5938	108.3373
HFC-134a in refrigeration vehicles	8.3360	9.8320	11.2960	14.0240	15.7200	18.6320	4.8640	6.2160	8.4880
Total HFC-134a	92.8742	105.3820	117.6136	138.3202	153.9585	171.7068	173.7315	193.5877	212.5353

Based on the information on the average freon charge (HFC-134a) of air conditioning equipment in mobile sources (Table 4-78), information on total number of transportation units registered in the Republic of Moldova (Table 4-79) and information on the share of vehicles manufactured from 1993 onwards equipped with air conditioning equipment (Table 4-81), in conformity with data recorded in the State Transport Register, data provided by the State Enterprise “State Information Resources Center “Register” (SE “CRIS “Register”) (Table 4-80), was used to estimate the total amount of HFC-134a charged into the air conditioning equipment used in transportation units in the Republic of Moldova (Table 4-82), 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).

Table 4-83: Actual HFC-134a Emissions from Freon Charged into the Air Conditioning Equipment of Transportation Units in the Republic of Moldova within 1996-2013 periods, tons

	1996	1997	1998	1999	2000	2001	2002	2003	2004
HFC-134a in passenger cars	0.1469	0.3232	0.5389	0.7268	0.9705	1.3794	1.4447	1.6462	2.6460
HFC-134a in buses	0.1744	0.6082	1.3099	1.5875	1.5857	1.9767	2.2624	2.3419	3.0240
HFC-134a in trucks	0.4831	1.1541	1.6742	2.1749	2.6515	3.3128	3.5694	5.6960	6.1092
HFC-134a in refrigeration vehicles	0.0262	0.0624	0.1323	0.2072	0.1934	0.2945	0.5179	0.7775	1.0783
Total HFC-134a	0.8307	2.1479	3.6554	4.6964	5.4011	6.9634	7.7945	10.4617	12.8575
	2005	2006	2007	2008	2009	2010	2011	2012	2013
HFC-134a in passenger cars	3.0810	3.3011	3.9550	5.6451	6.9073	8.4872	9.9344	11.5013	13.2366
HFC-134a in buses	3.1503	3.6209	3.7778	4.4867	6.0534	8.1085	8.9667	9.1658	10.2594
HFC-134a in trucks	6.8721	7.8883	8.8103	11.2101	13.8483	16.2227	18.8584	21.8147	25.3414
HFC-134a in refrigeration vehicles	1.3676	1.6938	2.1014	2.7189	2.9483	3.6618	2.0868	2.9633	4.0889
Total HFC-134a	14.4710	16.5040	18.6445	24.0608	29.7573	36.4802	39.8464	45.4451	52.9264

C). ‘Import of Hydrofluorocarbons in Bulk’

The information about import of HFCs in bulk (Table 4-84) was provided by companies licensed to import freons in bulk and equipment containing freons. At the time of inventory compilation, this information was available only for the time period from 2003 through 2013, so, in order to fill the gap regarding the period from 1995 through 2002, it was used one of the methodologies available in the GPG (IPCC, 2000, Chapter 7, Table 7-5, page 7.19) – the trend extrapolation approach based on the regression analysis.

Table 4-84: Activity Data on Import of HFC in Bulk in the Republic of Moldova within 1996-2013 periods, tons

	1996	1997	1998	1999	2000	2001	2002	2003	2004
HFC-32	0.0202	0.0238	0.0280	0.0329	0.0387	0.0455	0.0536	0.0630	0.0720
HFC-125	0.1046	0.1312	0.1596	0.2029	0.2477	0.3044	0.4411	0.6871	2.4079
HFC-134a	0.2229	0.3248	0.4785	0.7112	1.0647	1.6034	2.4261	3.6846	0.7384
HFC-143a	0.1115	0.1565	0.1819	0.2641	0.3047	0.3565	0.4873	0.8115	2.5822
Total HFCs	0.4592	0.6362	0.8479	1.2110	1.6559	2.3099	3.4080	5.2462	5.8005
	2005	2006	2007	2008	2009	2010	2011	2012	2013
HFC-32	0.3333	0.1196	0.1040	0.5129	0.7017	0.1040	0.8769	0.9289	2.3549
HFC-125	1.8678	1.6997	1.4242	6.8617	4.2243	3.4554	9.3264	4.3428	9.4092
HFC-134a	3.2930	0.9386	4.7249	10.7280	5.2969	2.7528	12.7766	9.4814	15.2501
HFC-143a	1.7964	1.7451	1.6805	6.9974	3.9368	3.8689	9.5068	3.7802	7.8003
Total HFCs	7.2904	4.5031	7.9335	25.1000	14.1597	10.1810	32.4867	18.5332	34.8146

Source: Republican Association of Refrigeration Technicians of the Republic of Moldova; ‘Frigoinds’ Ltd.: Official Letter No. 34/2011 dated 19.08.2011, as a response to the request from the Ministry of Environment No. 03-07/1337 dated 08.08.2011; Official Letter No. 03/2014 dated 14.01.2014, 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. 06/2015 dated 03.02.2015, 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; ECOLUX Ltd.: Official Letter dated 17.08.2011, as a response to the request from the Ministry of Environment No. 03-07/1337 dated 08.08.2011; Official Letter dated 21.01.2014, 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 dated 03.02.2015, 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; FRIGO-DINS Ltd.: Official Letter No. 02/2014 dated 14.01.2014, 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. 04/2015 dated 10.02.2015, 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; York Refrigerant Ltd.: Official Letter dated 25.02.2015, 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.

2F2. ‘Foam Blowing’

HFCs emissions from foam blowing consumption (in particular, closed-cell foam) used in insulating, cushioning and packaging, the blowing agents that may be used are HFC-245f, HFC-365mfc, HFC-134a and HFC-152a, were estimated using a Tier 2 approach. The IPCC Guidelines (IPCC, 2000) suggest calculating HFCs emissions from open-cell foam separately from emissions from closed-cell foam. HFCs used for open-cell foam blowing are released immediately, all of the emissions will occur in the country of manufacture. Since there is no open-cell foam blowing production in the Republic of Moldova, there are no emissions from this category respectively.

Emissions from closed-cell foam occur at three distinct points:

- First year losses from foam manufacture and installation, these emissions occur where the product is manufactured;
- Annual losses (in situ losses from foam use); closed-cell foam will lose a fraction of their initial charge each year until decommissioning;
- Decommissioning losses: emissions upon decommissioning also occur where the product is used.

Emissions from closed-cell foam blowing are estimated in conformity with this equation:

Emissions from Closed-cell Foam = [(Total HFCs and PFCs Used in Manufacturing New Closed-cell Foam in year t) • (first-year Loss emission Factor)] + [(Original HFC or PFC Charge Blown into Closed-cell Foam Manufacturing between year t and year t-n) • (Annual Loss Emission Factor)] + [(Decommissioning losses in year n) – (HFC or PFC Destroyed)]

Where:

n – Product lifetime of closed-cell foam;

Decommissioning losses – the remaining chemical at the end of service life that occurs when the losses equipment is scrapped

This equation should be applied to each chemical and major foam application individually. Total CO_2 equivalent emissions 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 4-85).

Table 4-85: Default EFs for 2F2 'Foam Blowing'

Emission Factor	Default Values
Product Lifetime	n = 20 years
First Year Losses	10% of the original HFC or PFC charge/year
Annual Losses	4.5% of the original HFC or PFC charge/year

Source: IPCC Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories (IPCC, 2000), Chapter 3 „Industrial Processes", Table 3.17, page 3.96.

AD regarding the amount of foam blowing imported in the RM, in particular on polystyrene and polyurethane, has been provided by the Custom Service of the RM (Table 4-86). To be noted that the main use of polystyrene and polyurethane consist in foam manufacturing, of different types: flexible, elastomeric, semi-rigid, rigid and structurally rigid.

Table 4-86: Imported Foam Blowing products in the Republic of Moldova within 1995-2013, tons

	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
Polystyrene in primary forms, t (product code: 3903 11)	553.628	221.936	156.613	169.902	166.368	398.903	294.657	504.124	894.583	896.594
Polyurethane in primary forms, t (product code: 3909 50)	216.307	140.084	66.012	29.043	40.761	39.431	22.152	14.191	67.895	181.531
Cellular products of polystyrene, t (product code: 3921 11)	17.780	8.997	49.364	46.196	21.015	11.225	95.867	245.559	395.658	491.292
Cellular products of polyurethane, t (product code: 3921 13)	135.951	146.324	112.796	86.862	112.978	147.227	202.375	424.281	528.558	573.396
Total foam blowing products, t	923.666	517.341	384.785	332.003	341.122	596.786	615.051	1188.155	1886.694	2142.813
	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
Polystyrene in primary forms, t (product code: 3903 11)	1816.783	2475.656	2748.797	3017.817	2525.455	3097.145	3136.816	3297.834	3300.718	3639.104
Polyurethane in primary forms, t (product code: 3909 50)	364.711	306.105	540.386	769.626	598.859	684.052	704.837	363.320	163.015	164.232
Cellular products of polystyrene, t (product code: 3921 11)	605.544	612.300	597.861	712.092	627.675	638.795	544.450	687.852	715.263	848.389
Cellular products of polyurethane, t (product code: 3921 13)	681.616	1006.080	1527.649	1246.598	645.537	860.186	833.159	846.787	943.023	813.322
Total foam blowing products, t	3468.654	4400.141	5414.693	5746.133	4397.526	5280.178	5219.262	5195.793	5122.019	5465.047

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.

According to the literature in the field, the most frequently used blowing agents in polyurethane and polystyrene foam manufacturing can be water, CO_2 resulted from the interaction of excessive isocyanate groups with water and a large diversity of freons, including HFC-245f, HFC-365mfc, HFC-134a and HFC-152a.

The most frequently used blowing agent remain HFC-134a (IPCC, 2000), but since the share of HFC-134a-based foam blowing products in total imports is unknown, it has been decided to determine it considering the expert opinions (Table 4-87), taking into consideration, as well, 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[33].

Table 4-87: Share of HFC-134a-based Foam Blowing Products in Total Imports in the Republic of Moldova, %

	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
Share of HFC-134a-based Foam Blowing Products in Total Imports, %	37.5	36.0	34.5	33.0	31.5	30.0	28.5	27.0	25.5	24.0
	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
Share of HFC-134a-based Foam Blowing Products in Total Imports, %	22.5	21.0	19.5	18.0	16.5	15.0	13.5	12.0	10.5	9.0

Considering the AD provided in Tables 4-85, 4-86 and 4-87, as well as the assumption that the blowing agent (HFC-134a) volume in polyurethane products represents about 12 per cent, while in polystyrene products – circa 6 per cent[34], the amount of HFC-134a contained in imported foam blowing products was estimated (Table 4-88), as well as the actual HFC-134a emissions from the blowing agent charged into the foam blowing products (Table 4-89).

Table 4-88: AD on Import of HFC-134a Charged into the Foam Blowing Products in the Republic of Moldova within 1995-2014, tons

	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
HFC-134a in polystyrene in primary forms	12.4566	4.7938	3.2419	3.3641	3.1444	7.1803	5.0386	8.1668	13.6871	12.9110
HFC-134a in polyurethane in primary forms	9.7338	6.0516	2.7329	1.1501	1.5408	1.4195	0.7576	0.4598	2.0776	5.2281
HFC-134a in cellular products of polystyrene	0.4001	0.1943	1.0218	0.9147	0.3972	0.2021	1.6393	3.9781	6.0536	7.0746
HFC-134a in cellular products of polyurethane	6.1178	6.3212	4.6698	3.4397	4.2706	5.3002	6.9212	13.7467	16.1739	16.5138
Total HFC-134a in foam blowing products	28.7083	17.3610	11.6664	8.8686	9.3529	14.1020	14.3568	26.3514	37.9921	41.7275
	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
HFC-134a in polystyrene in primary forms	24.5266	31.1933	32.1609	32.5924	25.0020	27.8743	25.4082	23.7444	20.7945	19.6512
HFC-134a in polyurethane in primary forms	9.8472	7.7138	12.6450	16.6239	11.8574	12.3129	11.4184	5.2318	2.0540	1.7737
HFC-134a in cellular products of polystyrene	8.1748	7.7150	6.9950	7.6906	6.2140	5.7492	4.4100	4.9525	4.5062	4.5813
HFC-134a in cellular products of polyurethane	18.4036	25.3532	35.7470	26.9265	12.7816	15.4833	13.4972	12.1937	11.8821	8.7839
Total HFC-134a in foam blowing products	60.9522	71.9753	87.5479	83.8335	55.8550	61.4197	54.7338	46.1225	39.2368	34.7900

Table 4-89: Actual HFC-134a Emissions from the Blowing Agent Charged into the Foam Blowing Products in the Republic of Moldova within 1995-2014 periods, tons

	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
HFC-134a in polystyrene in primary forms	0.5605	0.7763	0.9222	1.0735	1.2150	1.5381	1.7649	2.1324	2.7483	3.3293
HFC-134a in polyurethane in primary forms	0.4380	0.7103	0.8333	0.8851	0.9544	1.0183	1.0524	1.0731	1.1666	1.4018
HFC-134a in cellular products of polystyrene	0.0180	0.0267	0.0727	0.1139	0.1318	0.1409	0.2146	0.3936	0.6660	0.9844
HFC-134a in cellular products of polyurethane	0.2753	0.5598	0.7699	0.9247	1.1169	1.3554	1.6668	2.2854	3.0132	3.7564
Total HFC-134a in foam blowing products	1.2919	2.0731	2.5981	2.9972	3.4181	4.0527	4.6987	5.8845	7.5942	9.4719
	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
HFC-134a in polystyrene in primary forms	4.4330	5.8367	7.2839	8.7506	9.8757	11.1300	12.2734	13.3419	14.2777	15.1620
HFC-134a in polyurethane in primary forms	1.8450	2.1921	2.7611	3.5092	4.0428	4.5968	5.1107	5.3461	5.4385	5.5183
HFC-134a in cellular products of polystyrene	1.3523	1.6994	2.0142	2.3603	2.6399	2.8986	3.0971	3.3200	3.5227	3.7289
HFC-134a in cellular products of polyurethane	4.5845	5.7254	7.3340	8.5457	9.1209	9.8177	10.4250	10.9737	11.5084	11.9037
Total HFC-134a in foam blowing products	12.2148	15.4536	19.3933	23.1658	25.6793	28.4432	30.9062	32.9817	34.7474	36.3129

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 (US EPA, 1992). The respective emissions occur within 1-2 years after sales and should be estimated using the equation below.

[33] Danish Ministry of the Environment, Environment Protection Agency (2010), Greenhouse Gases HFCs, PFCs and SF6, Danish Consumption and Emissions, 2008, Environmental Project No. 1323 2010, <http://www2.mst.dk/udgiv/publications/2010/978-87-92617-66-8/pdf/978-87-92617-67-5.pdf>.
[34] 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', see on page 17.

Emissions of HFC = 50% of HFC Quantity Contained in Aerosol Products Sold in year t +

50% HFC Quantity Contained in Aerosol Products Sold in year t-1

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 Ministry of Health (Table 4-90). 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.

Table 4-90: Import of Metered Dose Inhalers Using HFC-134a as Propellant in the RM, 2003-2014, flacons

	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
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
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	6568	5712
Fluticasone propionate - Flixotide 50 Evohaler 50 µg /dose 120 doses	-	500	1630	1690	1160	1200	300	1150	1896	3116	2400	2930
Fluticasone propionate - Flixotide 125 Evohaler 125 µg /dose 60 doses	-	-	-	-	-	612	800	250	-	300	496	820
Fluticasone propionate - Flixotide 125 Evohaler 125 µg /dose 120 doses	-	282	3170	2650	1370	-	1933	1400	1650	600	3108	4739
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	-	-	-	-
Totals Metered Dose Inhalers using HFC-134a as propellant	3014	12080	17993	108800	75651	90579	143943	135564	152075	140789	131339	156917

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.

Based on activity data presented above, the amount of HFC-134a contained in metered dose aerosols was estimated (Table 4-91).

Table 4-91: Activity Data on HFC-134a Incorporated in Metered Dose Aerosols Imported in the Republic of Moldova within 2000-2014, kg

	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
HFC-134a	0.0075	0.0151	0.0301	0.0603	0.2319	0.3164	4.1284	6.4691	7.6003	15.7534	19.8872	45.4319	53.6220	68.1190	60.0683

Since at the time of inventory compilation, the respective information was available only for 2003-2014 time series, the activity data for the time period from 2000 through 2002 was extrapolated based on modelling using regression type trend, using an exponential equation (IPCC, 2000, Chapter 7, Table 7-5, page 7.19). To be noted that according the Ministry of Health, the use of metered dose aerosols using HFC-134a as propellant, started only in 2000 in the Republic of Moldova.

2F8. 'Electrical Equipment'

SF_6 emissions from use of sulphur hexafluoride as insulation medium in high tension electrical circuit breakers were estimated based on Tier 2b estimation methodology using default emission factors (IPCC, 2000), based on the equation below.

Emissions of SF_6 in year t = (2% of the Total Charge of SF_6 Contained in the Existing Stock of Equipment of Operation in year t) + (95% of the Nameplate Capacity of SF_6 in Retiring Equipment)

Starting with 2003, the Moldavian companies initiated the use of high-tension electrical circuit breakers (35 kV, 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 25 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 4-92, respectively in Table 4-93.

Table 4-92: The dynamic of high-tension electrical circuit breakers installation process using SF_6 and CF_4 within 2003-2014 periods, units installed per year

Enterprises	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
Moldelectrica S.O.E.	1	0	5	28	8	2	0	8	1	3	4	0
Red Union Fenosa J.S.C.	0	0	2	6	6	8	6	5	5	4	11	9
Total	1	0	7	34	14	10	6	13	6	7	15	9

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.

Table 4-93: Total high-tension electrical circuit breakers available in bulk at the end of calendar year within 2003-2014 periods, units

	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
Circuit breaker THO 36 / 0.98 kg SF_6, 35 kV	0	0	0	0	0	0	0	0	0	0	0	2
Circuit breaker VOX 36 / 2.29 kg SF_6, 35 kV	0	0	0	0	0	0	0	0	0	0	0	2
Circuit breaker GL-107X (2012) / 2.4 kg SF_6, 35 kV	0	0	0	0	0	0	0	0	0	1	1	1
Circuit breaker GL-107X (2005) / 2.6 kg SF_6 35 kV	0	0	0	5	5	5	5	5	5	5	4	4
Circuit breaker LTB 145D/1B/ 6 kg SF_6 110 kV	0	0	0	0	0	0	0	0	2	4	4	6
Circuit breaker GL-312F1/4031 P /VR/7.8 kg SF_6 110 kV	0	0	0	0	0	0	0	1	1	1	6	6
Circuit breaker GL-311 F1 P / 9.9 kg SF_6 110 kV	0	0	0	0	0	0	0	3	4	4	4	4
Circuit breaker GL-311 F1 / 12 kg SF_6 110 kV	1	1	8	27	41	49	55	60	63	65	71	71
Circuit breaker LTB / 12 kg SF_6 110 kV	0	0	0	2	2	2	2	2	2	2	2	2
Circuit breaker Hypact / 45 kg SF_6 110 kV	0	0	0	0	0	0	0	0	0	0	5	8
Circuit breaker GL-315 F3 / 26 kg SF_6 and 15 kg CF_4 330 kV	0	0	0	8	8	10	10	14	14	14	14	14
Circuit breaker LTB 420 E2/ 30 kg SF_6 400 kV	0	0	0	0	0	0	0	0	0	2	2	2
Total	1	1	8	42	56	66	72	85	91	98	113	122

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 of the 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 dated 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.

The amount of insulating gas (SF_6 and CF_4) in bulk charged in the high-tension electrical circuit breakers in the Republic of Moldova is provided in Table 4-94 and 4-95, respectively.

Table 4-94: Total amount of insulating gas - SF_6 available in bulk, charged in the high-tension electrical circuit breakers in the Republic of Moldova, kg

	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
Circuit breaker THO 36 / 0.98 kg SF_6, 35kV	0.0	0.0	0.0	13.0	13.0	13.0	13.0	13.0	13.0	13.0	10.4	10.4
Circuit breaker VOX 36 / 2.29 kg SF_6, 35kV	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.4	2.4	2.4
Circuit breaker GL-107X (2012) / 2.4 kg SF_6, 35kV	12.0	12.0	96.0	324.0	492.0	588.0	660.0	720.0	756.0	780.0	852.0	852.0
Circuit breaker GL-107X (2005) / 2.6 kg SF_6, 35kV	0.0	0.0	0.0	0.0	0.0	0.0	0.0	29.7	39.6	39.6	39.6	39.6
Circuit breaker LTB 145D/1B/ 6 kg SF_6 110kV	0.0	0.0	0.0	0.0	0.0	0.0	0.0	7.8	7.8	7.8	46.8	46.8
Circuit breaker GL-312F1/4031 P /VR/7.8 kg SF_6 110kV	0.0	0.0	0.0	208.0	208.0	260.0	260.0	364.0	364.0	364.0	364.0	364.0
Circuit breaker GL-311 F1 P / 9.9 kg SF_6 110kV	0.0	0.0	0.0	24.0	24.0	24.0	24.0	24.0	24.0	24.0	24.0	24.0
Circuit breaker GL-311 F1 / 12 kg SF_6 110kV	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	12.0	24.0	24.0	36.0
Circuit breaker LTB / 12 kg SF_6 110 kV	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	60.0	60.0	60.0
Circuit breaker Hypact / 45 kg SF_6 110 kV	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	225.0	360.0
Circuit breaker GL-315 F3 / 26 kg SF_6 and 15 kg CF_4 330 kV	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4.6
Circuit breaker LTB 420 E2/ 30 kg SF_6 400kV	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.0
Total SF_6 in bulk	12.0	12.0	96.0	569.0	737.0	885.0	957.0	1158.5	1216.4	1314.8	1423.2	1435.2

Table 4-95: Total amount of insulating gas - CF_4 available in bulk, charged in the high-tension electrical circuit breakers in the Republic of Moldova, kg

	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
Total in circuit breakers GL-315, 330 kV	0	0	0	120	120	150	150	210	210	210	210	210

4.6.3 Uncertainty Assessment and Time-Series Consistency

The primary uncertainties related factors pertain to methodology, emission factors used to estimate GHG emissions from the 2F 'Consumption of halocarbons and SF_6' source category, and quality of activity data available. Uncertainties associated with default emission factors used to estimate halocarbons and SF_6 emissions covered by this source category reach up to ±50 per cent.

Uncertainties associated with activity data on import of halocarbons (in stock and incorporated in different types of equipment) are low for 2F1 'Refrigeration and Air Conditioning Equipment' (±8 per cent), 2F4 ‚Aerosols' (±5 per cent) and 2F8 'Electrical Equipment' and medium for 2F2 'Foam Blowing' (±25 per cent). Combined uncertainties related to HFC emissions covered by the source category 2F1 'Refrigeration and Air Conditioning Equipment', 2F2 'Foam Blowing', 2F4 'Aerosols' and 2F8 'Electrical Equipment' are considered medium (±50.6 per cent, ±55.9 per cent, ±50.2 per cent and ±50.1 per cent, respectively). At the same time, combined uncertainties, presented as a per cent of total sectoral emissions were estimated at ±7.2979 per cent for HFCs emissions from the 2F1 'Refrigeration and Air Conditioning Equipment' source category, ±3.7544 per cent for HFCs emissions from the 2F2 'Foam Blowing' source category, ±0.0059 per cent for HFCs emissions from the 2F4 'Aerosols' source category and only ±0.0020 per cent for CF_4 emissions and, respectively ±0.0507 per cent for SF_6 emissions from the 2F8 'Electrical Equipment' source category. Uncertainties introduced in trend in sectoral emissions were estimated at ±2.6977 per cent for HFCs emissions from the 2F1 'Refrigeration and Air Conditioning Equipment' source category, ±1.5017 per cent for HFCs emissions from the 2F2 'Foam Blowing', ±0.0022 per cent for HFCs emissions from the 2F4 'Aerosols' and for only ±0.0007 per cent for CF_4 emissions and, respectively ±0.0185 per cent for SF_6 emissions from the 2F8 'Electrical Equipment' (see 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 GPG (IPCC, 2000).

4.6.4 Quality Assurance and Quality Control

Standard verification and quality control forms and checklists were filled in for the respective category under the Industrial Processes Sector, following the Tier 1 approach (IPCC, 2000).

Verification was focused on ensuring correct use of the default emission factors available in the Revised 1996 IPCC Guidelines (IPCC, 1997) and GPG (IPCC, 2000); on correct use of AD obtained from different sources of reference (i.e., National Bureau of Statistics, Customs Service, Ministry of Health, Ministry 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 Environment), etc.

To be noted that the AD and methods used for estimating GHG emissions under the category 2F 'Consumption of halocarbons and SF_6' were documented and archived both in hard copies and electronically.

4.6.5 Recalculations

No recalculations were made for the potential and actual GHG emissions from the 2F 'Consumption of halocarbons and SF_6' source category regarding the 1995-2010 time periods. Potential and actual F-gas emissions from 2F 'Consumption of Halocarbons and Sulphur Hexafluoride' source category within 1996-2013 time series are provided below. The obtained results allow assert that over the period under review the potential F-gas emissions in the Republic of Moldova increased by 3362.2 per cent (Table 4-97), while the actual F-gas emissions increased by 5332.2 per cent (Table 4-98).

Table 4-97: Potential F-gas Emissions from the 2F 'Consumption of Halocarbons and Sulphur Hexafluoride' in the Republic of Moldova within 1996-2013 periods

	1996	1997	1998	1999	2000	2001	2002	2003	2004
2F1 'Refrigeration and Air Conditioning Equipment'									
HFC-32, t	0.1156	0.1735	0.2848	0.3436	0.4848	0.6848	1.2087	2.8680	4.4769
HFC-125, t	0.2685	0.3742	0.5808	0.7067	0.9367	1.2588	2.0182	4.1030	7.6189
HFC-134a, t	8.8469	19.0241	32.2656	40.5431	47.3549	61.0901	71.8749	96.1509	115.3938
HFC-143a, t	0.1470	0.1988	0.2492	0.3472	0.4219	0.5269	0.7093	1.1752	3.0669
2F1, Gg CO_2 eq.	**12.8863**	**26.6475**	**44.7037**	**56.2273**	**66.1023**	**85.3891**	**102.5692**	**142.8147**	**185.9091**
2F2 'Foam Blowing'									
HFC-134a, t	46.0693	57.7356	66.6042	75.9571	90.0591	104.4159	130.7672	168.7594	210.4868
2F2, Gg CO_2 eq.	**59.8900**	**75.0563**	**86.5855**	**98.7442**	**117.0768**	**135.7406**	**169.9974**	**219.3872**	**273.6329**
2F4 'Aerosols'									
HFC-134a, t	NO	NO	NO	NO	0.00001	0.00002	0.00003	0.00006	0.00023
2F4, Gg CO_2 eq.	**NO**	**NO**	**NO**	**NO**	**0.00001**	**0.00002**	**0.00004**	**0.0001**	**0.00030**
2F8 'Electrical Equipment'									
CF_4, t	NO	NO	NO	NO	NO	NO	NO	NO	NO
SF_6, t	NO	NO	NO	NO	NO	NO	NO	0.0120	0.0120
2F8, Gg CO_2 eq.	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**0.2868**	**0.2868**
2F 'Consumption of Halocarbons and SF_6'									
2F, Gg CO_2 eq.	72.7763	101.7038	131.2891	154.9716	183.1792	221.1297	272.5667	362.4888	459.8291
	2005	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**
2F1 'Refrigeration and Air Conditioning Equipment'									
HFC-32, t	6.8224	9.1158	17.6926	27.3327	30.4021	35.1357	44.4295	52.7574	65.0332
HFC-125, t	9.4343	12.2822	23.7743	40.6978	42.5889	49.1317	65.4294	70.2110	87.7031
HFC-134a, t	136.7568	158.6934	190.6430	225.2114	239.2825	258.2601	276.0310	297.1624	326.5149
HFC-143a, t	2.4704	2.7838	6.0562	13.8329	13.5427	17.0116	24.5714	20.3146	25.7833
2F1, Gg CO_2 eq.	**218.0221**	**257.1953**	**348.9179**	**477.0597**	**501.5397**	**560.7889**	**664.2932**	**694.3896**	**810.2861**
2F2 'Foam Blowing'									
HFC-134a, t	271.4391	343.4144	430.9623	514.7958	570.6508	632.0705	686.8043	732.9268	772.1636
2F2, Gg CO_2 eq.	**352.8708**	**446.4387**	**560.2510**	**669.2345**	**741.8460**	**821.6917**	**892.8456**	**952.8048**	**1003.8126**
2F4 'Aerosols'									
HFC-134a, t	0.00032	0.00413	0.00647	0.00760	0.01575	0.01989	0.04543	0.05362	0.06812
2F4, Gg CO_2 eq.	**0.00041**	**0.00537**	**0.00841**	**0.00988**	**0.02048**	**0.02585**	**0.05906**	**0.06971**	**0.08855**
2F8 'Electrical Equipment'									
CF_4, t	NO	0.1200	0.1200	0.1500	0.1500	0.2100	0.2100	0.2100	0.2100
SF_6, t	0.0960	0.5690	0.7370	0.8850	0.9570	1.1585	1.2164	1.3148	1.4232
2F8, Gg CO_2 eq.	**2.2944**	**14.3791**	**18.3943**	**22.1265**	**23.8473**	**29.0532**	**30.4370**	**32.7887**	**35.3795**
2F 'Consumption of Halocarbons and SF_6'									
2F, Gg CO_2 eq.	**573.1877**	**718.0185**	**927.5716**	**1168.4306**	**1267.2535**	**1411.5596**	**1587.6349**	**1680.0528**	**1849.5668**

Table 4-98: Actual F-gas Emissions from 2F 'Consumption of Halocarbons and Sulphur Hexafluoride' in the Republic of Moldova within 1996-2013 periods

	1996	1997	1998	1999	2000	2001	2002	2003	2004
2F1 'Refrigeration and Air Conditioning Equipment'									
HFC-32, t	0.0068	0.0106	0.0187	0.0219	0.0301	0.0414	0.0720	0.1638	0.2470
HFC-125, t	0.0124	0.0182	0.0327	0.0377	0.0495	0.0658	0.1049	0.2092	0.3056
HFC-134a, t	1.0247	2.4325	4.1878	5.2900	6.0968	7.7975	8.8334	11.7056	14.3103
HFC-143a, t	0.0020	0.0022	0.0035	0.0042	0.0061	0.0088	0.0114	0.0190	0.0250
2F1, Gg CO_2 eq.	**1.3788**	**3.2284**	**5.5612**	**7.0129**	**8.1070**	**10.3814**	**11.8672**	**15.9818**	**19.7146**
2F2 'Foam Blowing'									
HFC-134a, t	2.0731	2.5981	2.9972	3.4181	4.0527	4.6987	5.8845	7.5942	9.4719
2F2, Gg CO_2 eq.	**2.6951**	**3.3775**	**3.8963**	**4.4435**	**5.2685**	**6.1083**	**7.6499**	**9.8724**	**12.3135**
2F4 'Aerosols'									
HFC-134a, t	NO	NO	NO	NO	0.000004	0.00001	0.00002	0.00005	0.00015
2F4, Gg CO_2 eq.	**NO**	**NO**	**NO**	**NO**	**0.000005**	**0.00001**	**0.00003**	**0.00006**	**0.0002**
2F8 'Electrical Equipment'									
CF_4, t	NO	NO	NO	NO	NO	NO	NO	NO	NO
SF_6, t	NO	NO	NO	NO	NO	NO	NO	0.0002	0.0002
2F8, Gg CO_2 eq.	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**0.0057**	**0.0057**
2F 'Consumption of Halocarbons and SF_6'									
2F, Gg CO_2 eq.	4.0738	6.6059	9.4575	11.4564	13.3755	16.4898	19.5171	25.8600	32.0340
	2005	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**
2F1 'Refrigeration and Air Conditioning Equipment'									
HFC-32, t	0.3715	0.5003	0.9950	1.4596	1.5593	1.8563	2.3005	2.7847	3.3802
HFC-125, t	0.4615	0.6182	1.3958	2.0898	2.2809	2.7403	3.3149	3.9340	4.6560
HFC-134a, t	16.8208	19.0152	22.4873	28.5686	33.5115	40.8448	44.2399	50.7176	59.1770
HFC-143a, t	0.0348	0.0541	0.3566	0.5965	0.7256	0.9053	1.0217	1.1360	1.2559
2F1, Gg CO_2 eq.	**23.5329**	**26.9815**	**35.1438**	**46.2062**	**53.7224**	**65.4178**	**72.1712**	**83.0750**	**96.9365**
2F2 'Foam Blowing'									
HFC-134a, t	12.2148	15.4536	19.3933	23.1658	25.6793	28.4432	30.9062	32.9817	34.7474
2F2, Gg CO_2 eq.	**15.8792**	**20.0897**	**25.2113**	**30.1156**	**33.3831**	**36.9761**	**40.1781**	**42.8762**	**45.1716**
2F4 'Aerosols'									
HFC-134a, t	0.00027	0.00222	0.00530	0.00703	0.01168	0.01782	0.03266	0.04953	0.06087
2F4, Gg CO_2 eq.	**0.0004**	**0.0029**	**0.0069**	**0.0091**	**0.0152**	**0.0232**	**0.0425**	**0.0644**	**0.0791**

	2005	2006	2007	2008	2009	2010	2011	2012	2013
2F8 'Electrical Equipment'									
CF_4, t	NO	0.0024	0.0024	0.0030	0.0030	0.0042	0.0042	0.0042	0.0042
SF_6, t	0.0019	0.0114	0.0147	0.0177	0.0191	0.0232	0.0243	0.0263	0.0285
2F8, Gg CO_2 eq.	**0.0459**	**0.2876**	**0.3679**	**0.4425**	**0.4769**	**0.5811**	**0.6087**	**0.6558**	**0.7076**
2F 'Consumption of Halocarbons and SF_6'									
2F, Gg CO_2 eq.	**39.4583**	**47.3617**	**60.7298**	**76.7734**	**87.5976**	**102.9981**	**113.0005**	**126.6714**	**142.8948**

The ratio between potential and actual F-gas emissions in the RM varied between 1995 and 2013 from a maximum of 21.8 per cent in 1995 to a minimum of 12.9 per cent in 2013.

4.6.6 Planned Improvements

Activities focused on updating data used to estimate GHG emissions from 2F 'Consumption of Halocarbons and Sulphur Hexafluoride' source category in the Republic of Moldova, as well as on précising certain EFs values are planned for the next inventory cycle.

5. SOLVENTS AND OTHER PRODUCT USE SECTOR

5.1 Overview

The 'Solvents and Other Product Use' Sector includes emissions of non-methane volatile organic compounds (NMVOC) which are also regarded as CO_2 emissions source, since the majority of solvents are obtained from fossil fuels.

Most solvents are part of the final product and sooner or later will evaporate. In most countries this process is an important source of NMVOC emissions. On a European scale its contribution is approximately one quarter of the total national anthropogenic NMVOC emissions (in different countries, NMVOC emissions from this sector account for 15-40 per cent of total national NMVOC emissions).

This sector also includes nitrous oxide emissions from the use of N_2O in medicine, in particular, in anesthesia. The entire quantity of N_2O used in anesthesia is considered emitted in atmosphere.

5.1.1 Summary of Emission Trends

In 2013, the 'Solvents and Other Product Use' Sector accounted for 0.5 per cent of total national GHG in the Republic of Moldova (without LULUCF). To be noted that this sector is a major source of national NMVOC emissions, accounting for around 17.7 per cent of the total.

Between 1990 and 2013, total GHG emissions originated from 'Solvents and Other Product Use' Sector tended to decrease (Figure 5-1), reducing by 47.2 per cent: from 126.12 to 66.59 Gg CO_2 equivalent (Table 5-1).

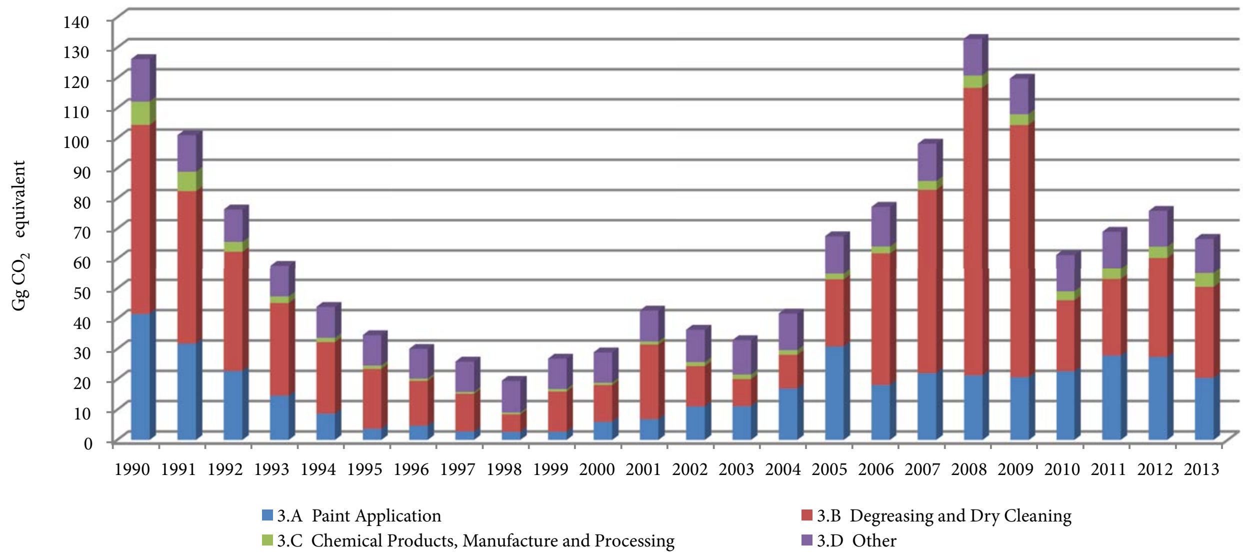


Figure 5-1: Total Direct GHG Emissions from 'Solvents and Other Product Use', by Category within 1990-2013 periods

In the time series since 1990 through 2013, the main sources of direct GHG emissions originated from 'Solvents and Other Product Use' Sector were represented by 3B 'Degreasing and Dry Cleaning' (with a share of 49.8 per cent of the total in 1990, respectively 45.0 per cent in 2013), 3A 'Paint Application' (33 per cent of the total in 1990, respectively 30.7 per cent in 2013) and 3D 'Other Solvent Use' (11.1 per cent of the total in 1990, respectively 17.3 per cent in 2013).

Table 5-1: Direct GHG Emissions from 'Solvents and Other Product Use' Sector in the Republic of Moldova within 1990-2013 periods, Gg CO_2 equivalent

Source Categories	1990	1991	1992	1993	1994	1995	1996	1997
3.A Paint Application	41.5890	31.7348	22.7133	14.5491	8.6638	3.6747	4.7121	2.8186
3.B Degreasing and Dry Cleaning	62.7662	50.6769	39.6170	30.5940	23.5984	19.7212	14.7570	12.3617
3.C Chemical Products, Manufacture and Processing	7.7278	6.4597	3.2844	2.1458	1.3950	1.1668	0.7431	0.6224
3.D Other	14.0339	12.0684	10.7724	10.3328	10.1653	9.9883	9.7619	9.9880
3.A-D Total	126.1169	100.9398	76.3870	57.6217	43.8224	34.5510	29.9741	25.7906

Source Categories	1998	1999	2000	2001	2002	2003	2004	2005
3.A Paint Application	2.6482	2.6741	5.9608	6.8371	11.0747	11.1597	16.9337	30.7948
3.B Degreasing and Dry Cleaning	5.7877	13.2599	12.1101	24.5923	13.2547	8.9405	11.0979	22.1430
3.C Chemical Products, Manufacture and Processing	0.5993	0.8116	0.7944	0.9895	1.3341	1.4329	1.5288	1.9194
3.D Other	10.4522	10.0210	9.9843	10.2183	10.6542	11.3573	12.1024	12.5996
3.A-D Total	19.4874	26.7666	28.8497	42.6372	36.3177	32.8904	41.6628	67.4568
Source Categories	2006	2007	2008	2009	2010	2011	2012	2013
3.A Paint Application	18.0925	22.0367	21.3190	20.6959	22.6684	27.7636	27.3124	20.4569
3.B Degreasing and Dry Cleaning	43.7278	60.8085	95.3015	83.5825	23.3968	25.3493	32.9493	29.9961
3.C Chemical Products, Manufacture and Processing	2.2602	2.9440	4.0929	3.5978	2.9304	3.5084	3.7528	4.6492
3.D Other	13.1165	12.3432	12.0922	11.7855	12.2475	12.2957	11.8515	11.4896
3.A-D Total	77.1970	98.1325	132.8057	119.6617	61.2431	68.9171	75.8660	66.5917

At the same time, between 1990 and 2013, NMVOC emissions from the 'Solvents and Other Product Use' Sector decreased by 47.1 per cent, from 42.96 to 22.74 Gg (Table 5-2). In the 1990-2013 periods, the main sources of NMVOC emissions were represented by 3B 'Degreasing and Dry Cleaning' (with a share of 49.8 per cent of the total in 1990, respectively 45.0 per cent in 2013), 3A 'Paint Application' (33.0 per cent of the total in 1990, respectively 30.7 per cent in 2013) and 3D 'Other Solvent Use' (11.1 per cent of the total in 1990, respectively 17.3 per cent in 2013).

Table 5-2: NMVOC Emissions from 'Solvents and Other Product Use' Sector in the Republic of Moldova within 1990-2013 periods, Gg

Source Categories	1990	1991	1992	1993	1994	1995	1996	1997
3.A Paint Application	14.2010	10.8094	7.7276	4.9457	2.9354	1.2377	1.5856	0.9522
3.B Degreasing and Dry Cleaning	20.9780	16.9375	13.2410	10.2253	7.8872	6.5913	4.9321	4.1316
3.C Chemical Products, Manufacture and Processing	2.5828	2.1590	1.0977	0.7172	0.4662	0.3900	0.2484	0.2080
3.D Other	5.1952	4.2970	3.7394	3.5449	3.4804	3.4163	3.3148	3.4350
3.A-D Total	42.9570	34.2029	25.8057	19.4331	14.7692	11.6353	10.0808	8.7268
Source Categories	1998	1999	2000	2001	2002	2003	2004	2005
3.A Paint Application	0.8966	0.9077	2.0221	2.3340	3.7799	3.8187	5.7473	10.4001
3.B Degreasing and Dry Cleaning	1.9344	4.4318	4.0475	8.2194	4.4301	2.9881	3.7092	7.4007
3.C Chemical Products, Manufacture and Processing	0.2003	0.2713	0.2655	0.3307	0.4459	0.4789	0.5110	0.6415
3.D Other	3.6637	3.4636	3.4468	3.5467	3.7486	4.0665	4.4186	4.6453
3.A-D Total	6.6950	9.0744	9.7819	14.4307	12.4044	11.3523	14.3861	23.0876
Source Categories	2006	2007	2008	2009	2010	2011	2012	2013
3.A Paint Application	6.1584	7.5034	7.2719	7.0526	7.7238	9.4737	9.3061	6.9751
3.B Degreasing and Dry Cleaning	14.6149	20.3237	31.8521	27.9353	7.8198	8.4724	11.0125	10.0254
3.C Chemical Products, Manufacture and Processing	0.7554	0.9840	1.3679	1.2025	0.9794	1.1726	1.2543	1.5539
3.D Other	4.9179	4.5557	4.4430	4.3096	4.5276	4.5574	4.3526	4.1854
3.A-D Total	26.4466	33.3668	44.9350	40.5000	21.0506	23.6761	25.9254	22.7398

5.1.2 Key Categories

The results of key category assessment carried out following a Tier 1 approach (IPCC, 2000), are provided in Chapter 1.5, as well as in the Annex 1-2. No key categories were identified under 'Solvents and Other Product Use' Sector in the Republic of Moldova (Table 5-3).

Table 5-3: Results of Key Category Analysis for 'Solvents and Other Product Use' Sector

Category Code	GHG	Source Categories	Key Categories
3.A	CO_2	Paint Application	No
3.B	CO_2	Degreasing and Dry Cleaning	No
3.C	CO_2	Chemical Products, Manufacture and Processing	No
3.D	CO_2	Other Solvent Use	No
3.D	N_2O	Other Solvent Use (N_2O Use in Anesthesia)	No

5.1.3 Methodological Issues

All source categories covered by 'Solvents and Other Product Use' Sector were estimated based on the EMEP/EEA Air Pollutant Emission Inventory Guidebook 2013, and default and/or country specific emission factors (Table 5-4).

Table 5-4: Assessment Methodologies Used to Estimate GHG Emissions from 'Solvents and Other Product Use' Sector

Category Code	Source Categories	GHG Emissions	
		Assessment Methodology	Emission Factors
3.A	Paint Application	T3 (EMEP/EEA, 2013)	CS, D
3.B	Degreasing and Dry Cleaning	T3 (EMEP/EEA, 2013)	CS, D
3.C	Chemical Products, Manufacture and Processing	T2 (EMEP/EEA, 2013)	D
3.D	Other Solvent Use	T1 and T2 (EMEP/EEA, 2013)	D

Abbreviations: T1 – Tier 1; T2 – Tier 2; T3 – Tier 3; CS – Country Specific; D – Default.

To be noted that the EMEP/EEA Air Pollutant Emission Inventory Guidebook 2013 provides information on how to convert the SNAP nomenclature classification of source categories into the IPCC's nomenclature classification (IPCC, 1997) (Table 5-5).

Table 5-5: Converting the SNAP Classification into the IPCC Classification

SNAP	Solvents and Other Products Use	IPCC	Solvents and Other Products Use
0601	Paint Application	3A	Paint Application
0602	Degreasing and Dry Cleaning	3B	Degreasing and Dry Cleaning
0603	Chemical Products, Manufacture and Processing	3C	Chemical Products, Manufacture and Processing
0604	Other Solvent Use	3D	Other Solvent Use
0605	N_2O Use	3D	Other Solvent Use

In general, GHG emissions (NMVOC, CO, NO_x, CO_2 and N_2O) reported under 'Solvents and Other Product Use' Sector are emitted in the process of manufacturing, using and storage solvents. Estimating GHG emissions from 'Solvent and Other Product Use' Sector can follow two basic ways: (1) either by estimating the amount of pure solvents consumed, or (2) by estimating the amount of solvent containing products consumed, considering their solvent content. The first approach implies an inventory of the most relevant categories of solvents used in the country, representing more than 90 per cent of the total GHG emissions. It is assumed that the total amount of solvents used in the country shall be equal to the total amount of national GHG emissions. As for the second approach, the inventory covers all source categories identified under this sector (SNAP EMEP/EEA defines the categories 0601-0605).

GHG emissions covered by these source categories can be estimated based on the information collected at the national level on total consumption of solvents, or by using default emission factors for the average per capita values in the European countries multiplied by the number of population in the respective country (this approach shall be applied only in cases when no AD on total consumption of solvents and other products is available on the national level). A more detailed description of estimation methodologies and emission factors used in this inventory cycle is available in sub-chapters 5.2-5.5 of the NIR.

5.1.4 Uncertainties Assessment and Time-Series Consistency

The uncertainty analysis of the GHG emissions from the 'Solvents and Other Product Use' Sector (by source categories) is described in detail in sub-chapters 5.2-5.5 of the NIR, as well as in the Annex 5-3.3. Combined uncertainties as a percentage of total direct sectoral emissions were estimated at circa ±13.67 per cent. The uncertainties introduced in trend in sectoral emissions were estimated at circa ±2.67 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 (IPCC, 2000).

5.1.5 Quality Assurance and Quality Control

Standard verification and quality control forms and check-lists by individual source categories were filled in for each source category under the 'Solvents and Other Product Use' Sector, following a Tier 1 approach (IPCC, 2000). The AD and methods used for estimating GHG emissions under the 'Solvents and Other Product Use' Sector were documented and archived both in hard copies and electronically. To identify the data entry, as well GHG emissions estimation related errors there were applied AD and EFs verifications and quality control procedures. Following the recommendations included into the GPG (IPCC, 2000), GHG emissions under the 'Solvents and Other Product Use' Sector were estimated based on national AD and EFs from official sources of reference. Quality assurance and quality control procedures include activities such as: comparison and verification of the correct application of emission factors, including default EFs (EMEP/EEA Air Pollutant Emission Inventory Guidebook 2013 serve as a reference source); verification of activity data obtained from different reference sources (Customs Service and the National Bureau of Statistics) and their correct application, including the conversion to mass units consistent with the assessment of GHG emissions, etc.

5.1.6 Recalculations

In comparison with the results obtained in the TNC of the Republic of Moldova under the UNFCCC (2013), GHG emissions from the 'Solvents and Other Product Use' Sector were recalculated. The recalculations are due to use of an updated set of activity data, as well as a result of changing the methodological approach used in the TNC of the RM under the UNFCCC (EMEP CORINAIR Inventory Guidebook, 1996, 1999) and EMEP/EEA Air Pollutant Emission Inventory Guidebook 2009 with those available in the EMEP/EEA Air Pollutant Emission Inventory Guidebook 2013. The performed changes resulted in an increase of the direct GHG emissions for the 1990-1994 time series, as well as for 2006-2010, varying from a minimum of 5.0 per cent in 1994, up to a maximum of 147.9

per cent in 2008; respectively in a decrease between 1995 and 2005, varying from a minimum of 1.1 per cent in 2005 to a maximum of 18.3 per cent in 1998 (Table 5-6).

Table 5-6: Recalculated Direct GHG Emissions under the 'Solvent and Other Product Use' Sector, for 1990-2010 time series, included into the TNC of the RM under the UNFCCC

	1990	1991	1992	1993	1994	1995	1996
TNC	90.7560	78.2139	62.4785	50.7831	41.7033	38.1975	33.8813
BUR	126.0964	100.9228	76.3715	57.6031	43.8069	34.5507	29.9734
Difference, %	38.9	29.0	22.2	13.4	5.0	-9.5	-11.5
	1997	1998	1999	2000	2001	2002	2003
TNC	29.8558	23.8423	30.9306	31.6119	45.2813	38.4944	35.6498
BUR	25.7897	19.4859	26.7533	28.8361	42.6236	36.3041	32.8768
Difference, %	-13.6	-18.3	-13.5	-8.8	-5.9	-5.7	-7.8
	2004	2005	2006	2007	2008	2009	2010
TNC	43.7358	68.1640	48.1765	52.2152	53.5824	48.5216	53.8690
BUR	41.6473	67.4379	77.1787	98.1325	132.8057	119.6617	61.2431
Difference, %	-4.8	-1.1	60.2	87.9	147.9	146.6	13.7

Abbreviations: TNC – Third National Communication; BUR – Bienniel Update Report.

As for the NMVOC emissions, the performed recalculation resulted in an increase for the 1990-1994 and 2006-2010 time series, varying from a minimum of 4.4 per cent in 1994, up to a maximum of 140.7 per cent in 2008; respectively in a decrease of NMVOC emissions between 1995 and 2005, varying from a minimum of 2.0 per cent in 2005, up to a maximum of 18.7 per cent in 1998 (Table 5-7). The results of recalculations performed at the category level are also presented in the sub-chapters 5.2-5.5 of the NIR.

Tabelul 5-7: Recalculated NMVOC Emissions under the 'Solvent and Other Product Use' Sector, for 1990-2010 time series, included into the TNC of the RM under the UNFCCC

	1990	1991	1992	1993	1994	1995	1996
TNC	31.2223	26.8078	21.3579	17.2917	14.1431	12.8927	11.4128
BUR	42.9570	34.2029	25.8057	19.4331	14.7692	11.6353	10.0808
Difference, %	37.6	27.6	20.8	12.4	4.4	-9.8	-11.7
	1997	1998	1999	2000	2001	2002	2003
TNC	10.1338	8.2354	10.5293	10.7662	15.3862	13.2315	12.4151
BUR	8.7268	6.6950	9.0744	9.7819	14.4307	12.4044	11.3523
Difference, %	-13.9	-18.7	-13.8	-9.1	-6.2	-6.3	-8.6
	2004	2005	2006	2007	2008	2009	2010
TNC	15.2714	23.5480	17.0229	18.2408	18.6653	16.9166	18.8146
BUR	14.3861	23.0876	26.4466	33.3668	44.9350	40.5000	21.0506
Difference, %	-5.8	-2.0	55.4	82.9	140.7	139.4	11.9

Abbreviations: TNC – Third National Communication; BUR – Bienniel Update Report.

5.1.7 Assessment of Completeness

Table 5-8 includes those source categories within which GHG emissions were estimated under the 'Solvent and Other Product Use' Sector.

Tabelul 5-8: Assessment of Completeness under the 'Solvents and Other Product Use' Sector in the Republic of Moldova

IPCC Category	Source Categories	CO_2	N_2O	NO_x	CO	NMVOC
3.A.1	Decorative Coating Application	X	NO	NO	NO	X
3.A.2	Industrial Coating Application	IE	NO	NO	NO	IE
3.A.3	Other Coating Application (Non-industrial)	IE	NO	NO	NO	IE
3.B.1	Chemical Degreasing	X	NO	NO	NO	X
3.B.2	Dry Cleaning	IE, NE	NO	NO	NO	IE, NE
3.C	Processing Polyurethane Products	X	NO	NO	NO	X
3.C	Processing Polystyrene Products	X	NO	NO	NO	X
3.C	Processing Rubber Products	X	NO	NO	NO	X
3.C	Processing Pharmaceutical Products	X	NO	NO	NO	X
3.C	Production of Paints and Varnishes	X	NO	NO	NO	X
3.C	Tanning Hides	X	NO	NO	NO	X
3.C	Tyre Manufacture and Restoration	X	NO	NO	NO	X
3.C	Shoes Manufacturing	X	NO	NO	NO	X
3.D.1	Paper Printing (printing ink use)	X	NO	NO	NO	X
3.D.2	Domestic Solvents Use	X	NO	NO	NO	X
3.D.3	Seed Oil Extraction and Seed Drying	X	NO	NO	NO	X
3.D.3	Adhesive Use	X	NO	NO	NO	X
3.D.3	Vehicles Dewaxing	X	NO	NO	NO	X
3.D.3	Tobacco Burning	X	NO	X	X	X
3.D.3	Use of N_2O in Anesthesia	NO	X	NO	NO	NO

Abbreviations: X – Source Categories included in the Inventory; IE – Included Elsewhere; NE – Not Estimated; .NO – Not Occurring.

5.1.8 Planned Improvements

For the next inventory cycle, planned improvements within this sector could include updating and précising activity data used in order to estimate the GHG emissions, including through their breakdown by categories, as well as collecting activity data related to other source categories, as 3C 'Chemical Products, Manufacturing and Processing' for wich, currently, there is no information available.

5.2 Paint Application (Category 3A)

5.2.1 Source Category Description

Under the 3A 'Paint Application' source category there were reported NMVOC emissions from the source categories 3A1 'Decorative Coating Application', in particular in constructions (SNAP 060103) and domestic paint application (SNAP 060104); 3A2 'Industrial Coating Application', in particular for 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); and from 3A3 '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 emissions were reported only for the 3A1 'Decorative Coating Application' source category. As for 3A2 'Industrial Coating Application' and 3A3 'Other Non-industrial Paint Application', the emissions within these source categories were reported as 'Included Elsewhere' (within the 3A1 category). Between 1990 and 2013, CO2 emissions from the 3A1 'Decorative Coating Application' decreased by 50.8 per cent (Table 5-9). The share of 'Conventional Solvent Paints Application' sub-category varied between 1990 and 2013 time series from a minimum of 95.0 per cent (in 2003) up to a maximum of 99.0 per cent (in 1996) of the total. To be noted that starting with 2006 it was observed an increasing trend for the share of 'Waterborne Paints Application' in the total CO2 emissions originated from the 3A1 'Decorative Coating Application' source category.

Table 5-9: CO_2 Emissions from the 3A1 'Decorative Coating Application' within 1990-2013 periods, Gg

	1990	1991	1992	1993	1994	1995	1996	1997
CO_2 emissions from conventional solvent paints	39.7292	30.5023	21.8934	14.0537	8.4363	3.6291	4.6647	2.7642
CO_2 emissions from waterborne paints	1.8598	1.2326	0.8199	0.4954	0.2275	0.0456	0.0474	0.0543
Total CO_2 emissions from paints application	41.5890	31.7348	22.7133	14.5491	8.6638	3.6747	4.7121	2.8186
	1998	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**
CO_2 emissions from conventional solvent paints	2.5830	2.5917	5.7867	6.5355	10.5913	10.6037	16.4194	30.2199
CO_2 emissions from waterborne paints	0.0652	0.0823	0.1741	0.3016	0.4834	0.5560	0.5143	0.5749
Total CO_2 emissions from paints application	2.6482	2.6741	5.9608	6.8371	11.0747	11.1597	16.9337	30.7948
	2006	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**
CO_2 emissions from conventional solvent paints	17.4192	21.1995	20.4190	19.8699	21.7703	26.5668	26.2306	19.6123
CO_2 emissions from waterborne paints	0.6733	0.8372	0.9000	0.8261	0.8981	1.1968	1.0818	0.8445
Total CO_2 emissions from paints application	18.0925	22.0367	21.3190	20.6959	22.6684	27.7636	27.3124	20.4569

In comparison with the 2005 year level of CO_2 emissions, between 2006 and 2013 the CO_2 emissions decreased. Compared with the 2012 year level, the CO_2 emissions decreased in 2013 by 25.1 per cent (Figure 5-2).

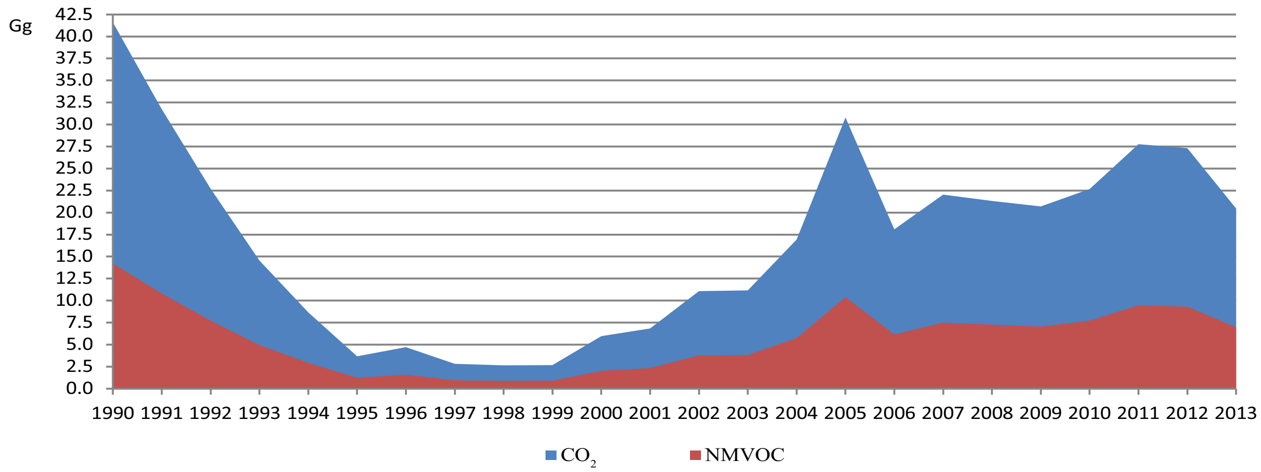


Figure 5-2: NMVOC and CO_2 Emissions from the 3A 'Paint Application' within 1990-2013 periods, Gg

A similar trend was revealed for the NMVOC emissions from this category, which decreased by 50.9 per cent within 1990-2013 time series (Table 5-10).

Table 5-10: NMVOC Emissions from 'Decorative Coating Application' within 1990-2013, Gg

	1990	1991	1992	1993	1994	1995	1996	1997
NMVOC emissions from conventional solvent paints	13.3111	10.2197	7.3353	4.7086	2.8265	1.2159	1.5629	0.9261
NMVOC emissions from waterborne paints	0.8899	0.5897	0.3923	0.2370	0.1088	0.0218	0.0227	0.0260
Total NMVOC emissions from paints application	14.2010	10.8094	7.7276	4.9457	2.9354	1.2377	1.5856	0.9522
	1998	1999	2000	2001	2002	2003	2004	2005
NMVOC emissions from conventional solvent paints	0.8654	0.8684	1.9388	2.1897	3.5486	3.5527	5.5013	10.1251
NMVOC emissions from waterborne paints	0.0312	0.0394	0.0833	0.1443	0.2313	0.2660	0.2461	0.2751
Total NMVOC emissions from paints application	0.8966	0.9077	2.0221	2.3340	3.7799	3.8187	5.7473	10.4001
	2006	2007	2008	2009	2010	2011	2012	2013
NMVOC emissions from conventional solvent paints	5.8362	7.1028	6.8413	6.6573	7.2941	8.9011	8.7884	6.5710
NMVOC emissions from waterborne paints	0.3222	0.4006	0.4306	0.3952	0.4297	0.5726	0.5176	0.4041
Total NMVOC emissions from paints application	6.1584	7.5034	7.2719	7.0526	7.7238	9.4737	9.3061	6.9751

The share of 'Waterborne Paints Application' sub-category varied between 1990 and 2013 time series from a minimum of 1.4 per cent (in 1996) to a maximum of 7.0 per cent (in 2003) of the total, showing since 2006 a relatively constant value of 5-6 per cent. In comparison with the 2005 year level, between 2006 and 2013 the NMVOC emissions have a decreasing trend. Compared with the 2012 year level, the respective emissions decreased in 2013 by 25.0 per cent.

5.2.2 Methodological Issues, Emission Factors and Data Sources

The methodology used to estimate NMVOC emissions from paint application is available in the EMEP/EEA Air Pollutant Emission Inventory Guidebook 2013[35], and is represented by the following formula:

$$E_{pollutant} = (AR_{product} \bullet EF_{pollutant\ technology}) / 10^3$$

Where:

$E_{pollutant}$ – the emission of the specified pollutant, t/yr;

$AR_{product}$ – the activity rate for the paint application (consumption of paint), t/yr;

$EF_{pollutant\ technology}$ – the emission factor for this technology and this pollutant, kg/t

The EMEP/EEA Air Pollutant Emission Inventory Guidebook 2013 provides default EFs for Tier 1 (Table 5-11) and/or Tier 2 (Table 5-12) approaches. To be noted that while determining the EFs values there were taken into consideration also typical mitigation actions for NMVOC emission.

Table 5-11: NMVOC Default Tier 1 EFs for the 3A 'Paint Application' Source Category

IPCC Source Category	NMVOC EF	Unit
3A1 Decorative Coating Application	150	g/kg paint
3A2 Industrial Coating Application	400	g/kg paint
3A3 Other Coating Application	200	g/kg paint

Source: EMEP/EEA Air Pollutant Emission Inventory Guidebook 2013, Source Category 2.D.3.d 'Paint Application' (according to the nomenclature NFR), Tables 3-1, 3-2 and 3-3, page 17.

Table 5-12: NMVOC Default Tier 2 EFs for the 3A 'Paint Application' Source Category

IPCC Source Category	NMVOC EF	Unit
3A1 Decorative Coating Application (SNAP 060103 and 060104, in construction and domestic use)	230	g/kg paint
3A2 Industrial Coating Application (SNAP 060101, manufacture of automobiles)	8	kg/automobiles
3A2 Industrial Coating Application (SNAP 060102, car repairing)	720	g/kg paint
3A2 Industrial Coating Application (SNAP 060105, coil coating)	480	g/kg paint
3A2 Industrial Coating Application (SNAP 060107, wood coating)	800	g/kg paint
3A2 Industrial Coating Application (SNAP 060108, other industrial coating application: truck/van coating)	28	kg/automobiles
3A2 Industrial Coating Application (SNAP 060108, other industrial coating application: truck cabin application)	8	kg/automobiles
3A2 Industrial Coating Application (SNAP 060108, other industrial coating application: bus coating)	150	kg/bus
3A2 Industrial Coating Application (SNAP 060108, other industrial coating application: wire coating)	17	g/kg wire
3A2 Industrial Coating Application (SNAP 060108, other industrial coating application: leather coating)	200	g/kg leather
3A2 Industrial Coating Application (SNAP 060108, other industrial coating application: boat building)	125	g/m^2
3A3 Industrial Coating Application (SNAP 060109, other coating application)	740	g/kg paint

Source: EMEP/EEA Air Pollutant Emission Inventory Guidebook 2013, Source Category 2.D.3.d 'Paint Application' (according to the nomenclature NFR), Tables 3-4, 3-5, 3-6, 3-7, 3-8, 3-9, 3-10, 3-11, 3-12, 3-13, 3-14, 3-15 and 3-16, pages 19-25.

As in the Republic of Moldova, no AD breakdown on paint and varnishes consumption within the different sectors of the national economy is available, an alternative methodology, consistent with the Tier 3 approach, was used, expressed by the following equation:

[35] European Environment Agency: <http://www.eea.europa.eu//publications/emep-eea-guidebook-2013>.

$$E_{pollutant} = AR_{product} \bullet EF_{pollutant}$$

Where:

$E_{pollutant}$ – the emission of the specified pollutant, t/yr;

$AR_{product}$ – the activity rate for the paint application (consumption of paint), t/yr;

$EF_{pollutant}$ – the emission factor for this pollutant

According to the reference literature, the content of solvents in various types of paint varies depending on the technology used to produce it (Table 5-13).

Table 5-13: Carbon and Solvents Content in Various Products

Product containing solvents	Carbon content, %[1]	Solvent content, %[1]	Solvent content, %[2]
Conventional solvent paints	81.4	50	40-70
Waterborne paints	57.0	6-8	<20
Other Paints and Varnishes	80.0	25	<30
Adhesive products	57.0	8	<10
Solvents and diluents	81.6	100	100

Source:[1] National Inventory Report for 1985-2009, Hungary, Annex A3.3, Table A3-2, pag. A39; [2] EMEP/EEA Air Pollutant Emission Inventory Guidebook 2013, Source Category 2.D.3.d 'Paint Application' (according to the nomenclature NFR), Table 2-1, page 9.

Under the current inventory cycle, there were used data on the content of solvents in various products, including conventional solvent paint (solvent-borne), alternative paints (waterborne), as well as for other types of products containing solvents used within the national GHG inventory of Hungary.

For most activities involving paint application, no statistics is available for activity data. Under such circumstances, 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.

$$Consumption_{paint} = Production_{paints} + Import_{paints} - Export_{paints}$$

Where:

$Consumption_{paints}$ = total consumption of paints, kt/year;

$Production_{paints}$ = produced amount of paints, kt/year;

$Import_{paints}$ = imported amount of paints, kt/year;

$Export_{paints}$ = exported amount of paints, kt/an.

Statistical Yearbooks of the RM contain aggregated data on total production of varnishes and paints in the country (Table 5-14).

Table 5-14: Activity Data on Production of Varnishes and Paints in the Republic of Moldova within 1990-2013 periods, kt

	1990	1991	1992	1993	1994	1995	1996	1997
Production of conventional solvent paints	10.100	8.250	5.549	2.714	1.131	0.738	0.664	0.451
Production of waterborne paints	1.600	0.550	0.451	0.386	0.069	0.062	0.036	0.058
Total paints production	11.700	8.800	6.000	3.100	1.200	0.800	0.700	0.509
	1998	1999	2000	2001	2002	2003	2004	2005
Production of conventional solvent paints	0.350	0.674	2.025	2.701	3.379	2.417	3.872	4.608
Production of waterborne paints	0.020	0.000	0.029	0.169	0.716	1.026	1.264	1.661
Total paints production	0.370	0.674	2.054	2.870	4.095	3.443	5.136	6.269
	2006	2007	2008	2009	2010	2011	2012	2013
Production of conventional solvent paints	6.091	7.941	8.486	8.681	9.446	12.915	13.685	9.474
Production of waterborne paints	2.200	2.869	3.065	3.136	3.412	5.097	4.222	2.744
Total paints production	8.295	10.815	11.557	11.822	12.864	18.011	17.907	12.219

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.

The National Bureau of Statistics also provides disaggregated activity data on production of different types of varnishes and paints.

The Customs Service 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 5-15). To be noted that the information on import-export operations for the 1990-1994 time series is not available in the Customs Service database. To fill this gap, following the GPG recommendations (IPCC, 2000, Chapter 7, Table 7-5, page 7.19), the trend extrapolation method was used.

Table 5-15: Activity Data on Import of Varnishes and Paints in the RM within 1990-2013, kt

	1990	1991	1992	1993	1994	1995	1996	1997
Imports of conventional solvent paints	16.522	12.189	9.122	6.703	4.522	1.694	2.462	1.401
Imports of waterborne paints	11.112	7.875	5.153	3.000	1.486	0.250	0.288	0.313
Total paints import	27.635	20.064	14.275	9.703	6.008	1.943	2.750	1.715
	1998	1999	2000	2001	2002	2003	2004	2005
Imports of conventional solvent paints	1.381	1.063	1.853	1.678	3.718	4.688	7.131	15.642
Imports of waterborne paints	0.426	0.563	1.161	1.892	2.588	2.774	2.251	2.268
Total paints import	1.807	1.625	3.014	3.571	6.306	7.463	9.382	17.911
	2006	2007	2008	2009	2010	2011	2012	2013
Imports of conventional solvent paints	5.582	6.264	5.197	4.634	5.142	4.888	3.892	3.668
Imports of waterborne paints	2.402	2.854	3.087	2.511	2.726	3.084	3.172	3.028
Total paints import	7.984	9.118	8.283	7.145	7.869	7.972	7.064	6.696

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.

AD on national consumption of varnishes and paints (Table 5-16) was inferred from information on national production (Table 5-14) and import (Table 5-15) of these products in the Republic of Moldova (within the period of reference no exports of these products were registered).

Table 5-16: Activity Data on Consumption of Varnishes and Paints in the Republic of Moldova within 1990-2013 periods, kt

	1990	1991	1992	1993	1994	1995	1996	1997
Consumption of conventional solvent paints	26.622	20.439	14.671	9.417	5.653	2.432	3.126	1.852
Consumption of waterborne paints	12.712	8.425	5.604	3.386	1.555	0.312	0.324	0.371
Total paints consumption	39.335	28.864	20.275	12.803	7.208	2.743	3.450	2.224
	1998	1999	2000	2001	2002	2003	2004	2005
Consumption of conventional solvent paints	1.731	1.737	3.878	4.379	7.097	7.105	11.003	20.250
Consumption of waterborne paints	0.446	0.563	1.190	2.061	3.304	3.800	3.515	3.930
Total paints consumption	2.177	2.299	5.068	6.441	10.401	10.906	14.518	24.180
	2006	2007	2008	2009	2010	2011	2012	2013
Consumption of conventional solvent paints	11.672	14.206	13.683	13.315	14.588	17.802	17.577	13.142
Consumption of waterborne paints	4.602	5.723	6.152	5.646	6.139	8.181	7.394	5.773
Total paints consumption	16.275	19.928	19.835	18.961	20.727	25.983	24.971	18.915

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; 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. 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; 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.

CO_2 emissions were estimated taking into consideration the content of carbon in NMVOC emissions (Table 5-13). Further, by oxidizing this carbon is converted in carbon dioxide in the atmosphere (it is assumed that all solvents from varnishes and paints are of fossil origin).

CO_2 emissions from paint application were estimated using the following formula:

$$CO_2\ emissions = NMVOC \bullet CC \bullet 44/12$$

Where:

CO_2 emissions – carbon dioxide emissions resulting from paint application, kt/yr;

CC – total NMVOC emissions within the respective category (see Table 5-13);

44/12 – stoichiometric ratio of carbon in CO_2 and NMVOC.

5.2.3 Uncertainties Assessment and Time-Series Consistency

Uncertainties related to the AD on production, import and export of paints in the Republic of Moldova are considered to be low (about ±5 per cent). At the same time, uncertainties related to content of solvents in different types of paints, as well as those related to carbon content in NMVOC are considered to be moderate. Uncertainties related to content of organic solvents in paints dissolved in conventional solvent medium are estimated to be at around ±25 per cent, while uncertainties related to content of organic solvents in alternative paints, inclusive in waterborne medium, reach to around ±50 per cent.

Combined uncertainties related to GHG emissions from the 3A 'Paint Application' source category can be considered moderate for emissions which origins from application of conventional solvent paints (±25.50 per cent), and medium for emissions from application of waterborne paints (±50.25 per cent).

At the same time, combined uncertainties, presented as percentage of total sectoral emissions were estimated at ±7.51 per cent for CO_2 emissions from conventional solvent paints, and at ±0.64 per cent for CO_2 emissions from waterborne paints. Uncertainties introduced in trend in sectoral emissions were estimated at ±1.13 per cent for CO_2 emissions from conventional solvent paints and at ±0.07 per cent for CO_2 emissions from waterborne paints.

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 GPG (IPCC, 2000).

5.2.4 Recalculations

GHG emissions from the source category 3.A 'Paint Application' were recalculated for the period from 1990 through 2010, in particular, due to updating AD regarding the production and imports of paint and varnishes. In comparison with results recorded in the TNC, the changes made in the process of compiling the current inventory resulted in an increase of NMVOC emissions over the period 1990 through 1995, respectively 2006-2010, varying from a minimum of 0.7 per cent in 2006, to a maximum of 31.8 per cent in 1990. At the same time, between 1996 through 2003, NMVOC emissions tended to decrease insignificantly (Table 5-17).

Table 5-17: Comparative Results of NMVOC Emissions from 3A 'Paint Application' included into the TNC and the BUR of the Republic of Moldova under the UNFCCC, Gg

	1990	1991	1992	1993	1994	1995	1996
TNC	10.7760	8.6135	6.1516	3.9602	2.3402	1.2183	1.5886
BUR	14.2010	10.8094	7.7276	4.9457	2.9354	1.2377	1.5856
Difference, %	31.8	25.5	25.6	24.9	25.4	1.6	-0.2
	1997	1998	1999	2000	2001	2002	2003
TNC	0.9522	0.8966	0.9077	2.0221	2.3398	3.7898	3.8244
BUR	0.9522	0.8966	0.9077	2.0221	2.3340	3.7799	3.8187
Difference, %	0.0	0.0	0.0	0.0	-0.2	-0.3	-0.1
	2004	2005	2006	2007	2008	2009	2010
TNC	5.7471	10.4001	6.1169	7.4535	7.0524	6.5691	7.0886
BUR	5.7473	10.4001	6.1584	7.5034	7.2719	7.0526	7.7238
Difference, %	0.0	0.0	0.7	0.7	3.1	7.4	9.0

Abbreviations: TNC – Third National Communication; BUR – Bienniel Update Report.

In order to highlight the trend, the table below provides the implied emission factors (g NMVOC per one kg of paint, respectively kg of NMVOC per capita) calculated for the source category 3A 'Paint Application' in the Republic of Moldova (Table 5-18). The changes of the default EF values between 1990 through 2013 is due to the changing share of conventional solvent paint in national total consumption.

Table 5-18: Default EFs estimated for the 3A 'Paint Application' in the RM, 1990-2013

	1990	1991	1992	1993	1994	1995	1996	1997
Default EF, g NMVOC/kg paint	361.0	374.5	381.1	386.3	407.2	451.2	459.6	428.2
Default EF, kg NMVOC/per capita	3.3	2.5	1.8	1.1	0.7	0.3	0.4	0.2
	1998	1999	2000	2001	2002	2003	2004	2005
Default EF, g NMVOC/kg paint	411.9	394.8	399.0	362.4	363.4	350.2	395.9	430.1
Default EF, kg NMVOC/per capita	0.2	0.2	0.5	0.5	0.9	0.9	1.4	2.5
	2006	2007	2008	2009	2010	2011	2012	2013
Default EF, g NMVOC/kg paint	378.4	376.5	366.6	372.0	372.6	364.6	372.7	368.8
Default EF, kg NMVOC/per capita	1.5	1.8	1.8	1.7	1.9	2.3	2.3	1.7

As for the CO_2 emissions, comparing with the TNC, the recalculations resulted in increased values between 1990 and 1995, as well as for the 2006-2010 time series, varying from a minimum of 0.7 per cent in 2006, up to a maximum of 30.5 per cent in 1990. At the same time, over the period 1996 through 2003, CO_2 emissions decreased insignificantly (Table 5-19). For the 2011-2013 time series, the GHG emissions resulting from the paint application were estimated for the first time.

Table 5-19: Comparative Results of CO_2 Emissions from 3A 'Paint Application' included into the TNC and the BUR of the RM under the UNFCCC, Gg

	1990	1991	1992	1993	1994	1995	1996
TNC	31.8675	25.5359	18.2380	11.7329	6.9474	3.6168	4.7210
BUR	41.5890	31.7348	22.7133	14.5491	8.6638	3.6747	4.7121
Difference, %	30.5	24.3	24.5	24.0	24.7	1.6	-0.2
	1997	1998	1999	2000	2001	2002	2003
TNC	2.8186	2.6482	2.6741	5.9608	6.8544	11.1043	11.1766
BUR	2.8186	2.6482	2.6741	5.9608	6.8371	11.0747	11.1597
Difference, %	0.0	0.0	0.0	0.0	-0.3	-0.3	-0.2

	2004	2005	2006	2007	2008	2009	2010
TNC	16.9331	30.7948	17.9607	21.8636	20.6314	19.2190	20.7260
BUR	16.9337	30.7948	18.0925	22.0367	21.3190	20.6959	22.6684
Difference, %	0.0	0.0	0.7	0.8	3.3	7.7	9.4

Abbreviations: TNC – Third National Communication; BUR – Biennial Update Report

The results allow assert that between 1990 and 2013, GHG emissions within this source category decreased by 51 per cent: from 14.2010 to 6.9751 Gg in case of NMVOC emissions, respectively from 41.5890 to 20.4569 Gg in case of CO_2 emissions.

5.3 Degreasing and Dry Cleaning (Category 3B)

5.3.1 Source Category Description

Within the source category 3B 'Degreasing and Dry Cleaning' there are monitored the GHG emissions from 3B1 'Chemical Degreasing' category (solvent use in industry, especially for metal degreasing - SNAP 060201; electronic components manufacturing - SNAP 060203, as well as other industrial cleaning - SNAP 060204), respectively from 3B2 'Dry Cleaning' category (dry cleaning of clothes and other textiles from animal grease, oils, wax, resin, etc. - SNAP 060202).

Typically, the solvents used for degreasing are obtained by distillation of fossil fuels, representing substances such as chlorinated hydrocarbons, ketones and quinones, alcohols and phenols, etc. Thus, for example, chlorinated solvents, including trichloroethylene, tetrachloroethylene and dichloromethane are widely used in the industrial sector for cleaning metal and plastic surfaces, including for degreasing in vaporized solvents. Hydrocarbons and oxygenated solvents are used as cleaning solvents. Dry cleaning involves, for example, the use of tetrachloroethylene to clean clothes and other textiles.

In general, solvents used are recovered and recycled; in particular, if new equipment is used, however, fugitive NMVOC emissions occur especially in old, open-circuit machines when the final drying implies venting of drying air to atmosphere.

Between 1990 and 2013, GHG emissions from 3B 'Degreasing and Dry Cleaning' source category decreased by 52.2 per cent (Table 5-20).

Table 5-20: GHG Emissions from 3B 'Degreasing and Dry Cleaning' Source Category by Gas, within 1990-2013 periods, Gg

	1990	1991	1992	1993	1994	1995	1996	1997
CO_2	62.7662	50.6769	39.6170	30.5940	23.5984	19.7212	14.7570	12.3617
NMVOC	20.9780	16.9375	13.2410	10.2253	7.8872	6.5913	4.9321	4.1316
	1998	1999	2000	2001	2002	2003	2004	2005
CO_2	5.7877	13.2599	12.1101	24.5923	13.2547	8.9405	11.0979	22.1430
NMVOC	1.9344	4.4318	4.0475	8.2194	4.4301	2.9881	3.7092	7.4007
	2006	2007	2008	2009	2010	2011	2012	2013
CO_2	43.7278	60.8085	95.3015	83.5825	23.3968	25.3493	32.9493	29.9961
NMVOC	14.6149	20.3237	31.8521	27.9353	7.8198	8.4724	11.0125	10.0254

In comparison with 2012 year level, in 2013 these emissions decreased by 9.0 per cent (Figure 5-3).

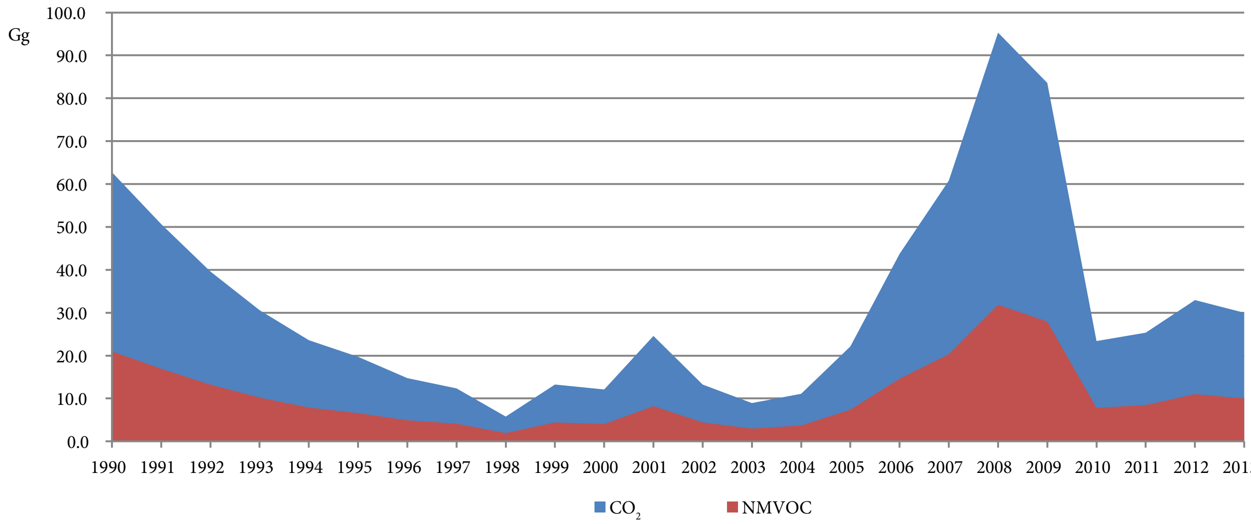


Figure 5-3: GHG Emissions from 3B 'Degreasing and Dry Cleaning' Source Category by Gas, within 1990-2013 periods, Gg

5.3.2 Methodological Issues, Emission Factors and Activity Data

The methodology used to estimate NMVOC emissions from the use of solvents for degreasing and dry cleaning is available in the EMEP/EEA Air Pollutant Emission Inventory Guidebook 2013[36], and is represented by the following formula:

$$E_{pollutant} = (AR_{product} \bullet EF_{pollutant\ technology}) / 10^3$$

Where:

$E_{pollutant}$ – pollutant gas emissions from the use of solvents for degreasing and dry cleaning, t/yr;

$AR_{product}$ – activity rate for the use of solvents for degreasing and dry cleaning (consumption), t/yr;

$EF_{pollutant\ technology}$ – the emission factor for this pollutant technology, kg/t

EMEP/EEA Air Pollutant Emission Inventory Guidebook 2013 provides default EFs used by different estimation methodologies, such as the Tier 1 (Table 5-21) and/or the Tier 2 approaches (Table 5-22).

Table 5-21: Tier 1 Default EFs for Source Category 3B 'Degreasing and Dry Cleaning'

Source Categories	NMVOC Emission Factor	Unit
3B1 Degreasing	460	g/kg solvents
3B2 Dry Cleaning	40	g/kg treated textiles

Source: EMEP/EEA Air Pollutant Emission Inventory Guidebook 2013, Source Category 2.D.3.e „Degreasing" (according to the nomenclature NFR), Table 3-1, page 8. Source Category 2.D.3.f „Dry Cleaning" (according to the nomenclature NFR), Table 3-1, page 6.

To be noted that, while estimating the EFs values, the NMVOC emissions mitigation technics within the respective sectors and/or industrial applications were taken into consideration as well.

Table 5-22: Tier 2 Default EFs for Source Category 3B 'Degreasing and Dry Cleaning'

Source Categories	NMVOC Emission Factor	Unit
3B1 Degreasing (SNAP 060201, metal degreasing)	710	g/kg solvents
3B1 Dry Cleaning (SNAP 060201, electronic components degreasing)	740	kg/t plastids
3B2 Dry Cleaning (SNAP 060202, dry cleaning)	177	g/kg treated textiles

Source: EMEP/EEA Air Pollutant Emission Inventory Guidebook 2013, Source Category 2.D.3.e „Degreasing" (according to the nomenclature NFR), Tables 3-2 and 3-3, page 10. Source Category 2.D.3.f „Dry Cleaning" (according to the nomenclature NFR), Table 3-2, page 8.

Since no AD breakdown on solvents consumption within various sectors of national economy and/or industrial applications is available in the Republic of Moldova, it was used an alternative approach, equivalent with the Tier 3 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 and dry cleaning, t/yr;

$AR_{product}$ – activity rate for the use of solvents for degreasing and dry cleaning (consumption), t/yr;

$EF_{pollutant}$ – the emission factor for this pollutant technology (the content of organic solvents in substances used in degreasing and dry cleaning is assumed to be 100 per cent, see in EMEP/EEA Air Pollutant Emission Inventory Guidebook 2013, Source Category 3B „Degreasing and Dry Cleaning", Table 3-5, page 12).

According to the available methodology (EMEP/EEA Air Pollutant Emission Inventory Guidebook 2013), the content of organic solvents in substances used in degreasing and dry cleaning is considered to be 100 per cent.

It is considered that the total amount of solvents for degreasing and dry cleaning 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 and degreasing (Table 5-23) is estimated following the equation:

$$Consumption_{solvents} = Production_{solvents} + Import_{solvents} - Export_{solvents}$$

[36] European Environment Agency:<http://www.eea.europa.eu//publications/emep-eea-guidebook-2013>.

Where:

Consumption $_{solvents}$ = total consumption of solvents in the RM, kt/yr;

Production $_{solvents}$ = quantity of solvents produced in the country, kt/yr;

Import $_{solvents}$ = quantity of solvents imported in the country, kt/yr;

Export $_{solvents}$ = quantity of solvents exported from the country, kt/yr.

To be noted that for most activities involving use of organic solvents for dry cleaning and degreasing in the RM there are no veridical statistic data. Under such circumstances, the total consumption of solvents used in dry cleaning and 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 including: (1) Oils and other products from coal tar distillation at high temperature (code 2707), including: 2707 10 900 „benzene for other use" (other than fuels); 2707 20 900 „toluene for other use" (other than fuels); 2707 30 900 „xylene for other use" (other than fuels), etc.; (2) acyclic hydrocarbons (codul 2901); (3) cyclic hydrocarbons (code 2902), including 2902 11 „cicloxehexanol"; 2902 20 „benzene"; 2902 30 „toluene"; 2902 40 „xylene"; 2902 50 „styrene"; 2902 60 „ethylbenzene"; 2902 70 „cumene" etc.; (4) halogenated derivatives of hydrocarbons (code 2903), including 2903 11 „chloromethane"; 2903 12 „dichloromethane"; 2903 13 „trichloromethane" (chloroform); 2903 14 „carbon tetrachloride"; 2903 15 „"ethylene chloride"; 2903 19 100 „1,1,1-trichlorethane" (methyl chloroform); 2903 21 „vinyl chloride" (chloroethylene); 2903 22 „trichloroethylene"; 2903 23 „tetrachloroethylene"; 2903 30 „fluorinated, brominated or iodinated derivatives of acyclic hydrocarbons"; 2903 40 „halogenated derivatives of acyclic hydrocarbons containing at least two different halogens" (trichlorofluoromethane, dichlorodifluoromethane, trichlorotrifluoroethane, etc.); 2903 50 „halogenated derivatives of cyclanes, cyclenic or cycloterpenes hydrocarbons"; 2903 60 „halogenated derivatives aromatic hydrocarbons"; (5) sulphonated, nitrated or nitrosated derivatives of hydrocarbons, wheather or not halogenated (code 2904); (6) acyclic alcohols and their halogenated, sulfonated, nitrated or nitrosated derivatives (code 2905), including 2905 11 „methanol", 2905 12 „propyl and isopropyl alcohol", 2905 13 „n-butyl alcohol", 2905 14 „third butanol", 2905 16 „octyl alcohol", 2905 17 „lauryl, cetyl and stearyl alcohols" etc.; (7) cyclic alcohols and their halogenated, sulfonated, nitrated or nitrosated derivatives (code 2906); (8) phenols and alcohols (code 2907); (9) halogenated, sulfonated, nitrated or nitrosated derivatives of phenols or phenol-alcohols (code 2908); (10) ethers, ether-alcohols, ether-phenols, ether-alcohol-phenols, alcohol peroxides, ether peroxides, ketone peroxides (whether or not chemically defined) and their halogenated sulfonated, nitrated or nitrosated derivatives (code 2909); (11) epoxides, epoxyalcohol, epoxyphenols and epoxyethers with three atoms and their halogenated, sulfonated, nitrated or nitrosated derivatives (code 2910); (12) acetals and semiacetals, whether or not containing other oxygenated functions and their halogenated, sulfonated, nitrated or nitrosated derivatives (code 2911); (13) aldehydes, whether or not containing other oxygenated functions; cyclic polymers of aldehydes; paraformaldehyde (code 2912); (14) halogenated, sulfonated, nitrated or nitrosated derivatives of products under heading 2912 (code 2913); (15) ketones and quinones, whether or not containing other oxygenated functions and their halogenated, sulfonated, nitrated or nitrosated derivatives (code 2914), including 2914 11 „acetone", 2914 12 „butanone", 2914 13 „methylisobutylacetone", 2914 22 „ciclohexanone", 2914 31 „phenilacetone" etc.; (16) saturated acyclic monocarboxylic acids and their anhydrides, halides, peroxides and peroxyacids; their halogenated, sulfonated, nitrated or nitrosated derivatives (code 2915); (17) unsaturated acyclic monocarboxylic acids and cyclic monocarboxylic acids, anhydrides, halides, peroxides and peroxyacids; their halogenated, sulfonated, nitrated or nitrosated derivatives (code 2916); (18) polycarboxylic acids, anhydrides, halides, peroxides and peroxyacids; their halogenated, sulfonated, nitrated or nitrosated derivatives (code 2917); (19) carboxylic acids with additional oxygenated function and their anhydrides, halides, peroxides and peroxyacids; their halogenated, sulfonated, nitrated or nitrosated derivatives (code 2918); (20) phosphoric esters and their salts, including lactophosphates; their halogenated, sulfonated, nitrated or nitrosated derivatives (code 2919); (21) esters of other inorganic acids of non-methals (excluding esters of hydrogen halides) and their salts, their halogenated, sulfonated, nitrated or nitrosated derivatives (code 2920); (22) amine function compounds (code 2921); (23) amino compounds with oxygenated functions (code 2922); (24) quaternary ammonium salts and hydroxides; lecithins and other phosphoaminolipids, whether or not chemically (code 2923); (25) carboxamide function compounds; carbonic acid compounds with amide function (code 2924); (26) organic solvents and diluents not included elsewhere, created for paint or varnish removal (code 3814).

To be noted that the information on import-export activities related to solvents used for degreasing and dry cleaning for 1990-1994 time series is not available in the Customs Service database. Thus, in order to fill this gap, following the GPG recommendations (IPCC, 2000, Chapter 7, Table 7-5, page 7.19), the trend extrapolation method was used (using the regression analysis).

CO_2 emissions were estimated based on the carbon content in NMVOC emissions. By oxidizing, this carbon converts into CO_2 in atmosphere (it is assumed that all solvents are of fossil origin). CO_2 emissions from degreasing and dry cleaning were estimated by the following equation:

$$CO_2\ Emissions = NMVOC \bullet CC \bullet 44/12$$

Where:

CO_2 emissions – carbon dioxide emissions from degreasing and dry cleaning, kt/yr;

NMVOC – total NMVOC emissions within the respective category, kt/yr;

CC – carbon content in NMVOC (81.6 per cent, see in Table 5-12);

44/12 – stoichiometric ratio of carbon content in CO_2 and NMVOC.

Table 5-23: Activity Data on Consumption of Solvents Used in Degreasing and Dry Cleaning in the Republic of Moldova within 1990-2013 periods

	1990	1991	1992	1993	1994	1995	1996	1997
Benzene, toluene, xylene and other oils from coal tar distillation, kt	6.8500	6.1521	5.1535	4.2022	3.3516	3.1696	3.2040	0.4377
Cyclic and Acyclic Hydrocarbons, kt	1.2254	0.7601	0.4932	0.3530	0.2559	0.2852	0.0586	0.1109
Alcohols, kt	0.5952	0.2761	0.0930	0.0304	0.0304	0.0383	0.0494	0.0441
Phenols and Phenol-Alcohols, kt	0.4023	0.3124	0.2167	0.1365	0.0784	0.0171	0.1262	0.0036
Ethers, kt	2.1297	1.0190	0.5100	0.3353	0.3551	0.1981	0.0739	1.6681
Aldehydes, kt	5.1014	4.3929	3.5886	2.7538	2.0326	1.8466	0.4646	0.5664
Ketones and Quinones, kt	0.2826	0.1874	0.1290	0.0983	0.0816	0.0208	0.0618	0.1228
Carboxylic Acids, kt	2.3127	2.0672	1.6486	1.2436	0.8924	0.5795	0.2847	0.5773
Esters, kt	0.0713	0.0586	0.0468	0.0372	0.0284	0.0000	0.0062	0.0136
Nitrogen-function Compounds, kt	0.2923	0.2200	0.1686	0.1213	0.0885	0.0255	0.0283	0.0835
Organic Solvents and Diluents for Paint or Varnish Removal, kt	1.7153	1.4917	1.1930	0.9137	0.6924	0.4106	0.5745	0.5035
Total solvents, kt	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Benzene, toluene, xylene and other oils from coal tar distillation, kt	20.9780	16.9375	13.2410	10.2253	7.8872	6.5913	4.9321	4.1316
	1998	1999	2000	2001	2002	2003	2004	2005
Benzene, toluene, xylene and other oils from coal tar distillation, kt	0.4221	3.0555	2.3602	6.0146	1.4684	0.1207	0.0804	0.0816
Cyclic and Acyclic Hydrocarbons, kt	0.1241	0.0282	0.1537	0.0604	0.1700	0.1197	0.1907	0.1089
Alcohols, kt	0.1956	0.2495	0.1247	0.2251	0.2401	0.1131	0.1158	0.1838
Phenols and Phenol-Alcohols, kt	0.0060	0.0200	0.0081	0.0000	0.0214	0.0293	0.0342	0.0015
Ethers, kt	0.1097	0.0598	0.0025	0.3738	0.0033	0.0690	0.0730	0.0044
Aldehydes, kt	0.3661	0.2049	0.2270	0.1983	0.3195	0.1119	0.1954	0.2074
Ketones and Quinones, kt	0.0332	0.0785	0.0349	0.0409	0.1247	0.0899	0.0894	0.0931
Carboxylic Acids, kt	0.3781	0.5055	0.3985	0.5145	0.9614	1.2754	1.2809	1.5213
Esters, kt	0.0003	0.0024	0.0002	0.0000	0.0000	0.0000	0.0000	0.0002
Nitrogen-function Compounds, kt	0.0207	0.0143	0.0248	0.0351	0.0786	0.0987	0.0784	0.0866
Organic Solvents and Diluents for Paint or Varnish Removal, kt	0.2784	0.2132	0.2506	0.2253	0.2716	0.2653	0.5127	3.5011
Total solvents, kt	0.0000	0.0000	0.4622	0.5315	0.7712	0.6952	1.0583	1.6109
Benzene, toluene, xylene and other oils from coal tar distillation, kt	1.9344	4.4318	4.0475	8.2194	4.4301	2.9881	3.7092	7.4007
	2006	2007	2008	2009	2010	2011	2012	2013
Benzene, toluene, xylene and other oils from coal tar distillation, kt	0.2007	0.0003	0.0004	0.0004	0.1812	0.1305	0.7132	0.1531
Cyclic and Acyclic Hydrocarbons, kt	0.1259	0.1273	0.1115	0.1165	0.1752	0.2036	0.9318	0.3641
Alcohols, kt	0.2837	0.2495	0.2649	0.2325	0.2534	0.2746	0.4277	0.5214
Phenols and Phenol-Alcohols, kt	0.0005	0.0217	0.0010	0.0236	0.3267	0.2538	0.3052	0.0709
Ethers, kt	0.0146	0.0040	0.0094	0.0035	0.0141	0.0276	0.0250	0.0258
Aldehydes, kt	0.1693	0.1554	0.1236	0.0630	0.1134	0.0964	0.1232	0.6369
Ketones and Quinones, kt	0.1455	0.1076	0.0484	0.0718	0.0363	0.0903	0.1261	0.0847
Carboxylic Acids, kt	1.5518	1.6585	1.6692	1.1298	1.3117	1.3875	1.7112	1.8960
Esters, kt	0.0002	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0003
Nitrogen-function Compounds, kt	0.0921	0.1271	0.1765	0.1939	0.1565	0.1772	0.2115	0.1948
Organic Solvents and Diluents for Paint or Varnish Removal, kt	0.3847	0.6958	1.3536	1.0018	1.5736	1.4425	0.4634	0.3680
Total solvents, kt	11.6459	17.1764	28.0935	25.0986	3.6777	4.3884	5.9739	5.7093
Benzene, toluene, xylene and other oils from coal tar distillation, kt	14.6149	20.3237	31.8521	27.9353	7.8198	8.4724	11.0125	10.0254

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.

5.3.3 Uncertainties Assessment and Time-Series Consistency

Uncertainties related to activity data on import and export of solvents in the RM are considered to be low (±5%). Uncertainties related to content of organic solvents in substances used in dry cleaning and degreasing are deemed to be low (±15 per cent), as well as the amount of organic solvents evaporated in atmosphere in the process of dry cleaning and degreasing (±20 per cent). Thus, combined uncertainties associated with GHG emissions from the 3B 'Degreasing and Dry Cleaning' source category may be considered moderate (±20.62 per cent). At the same time, combined uncertainties, presented as a percentage of total sectoral emissions were estimated at ±9.29 per cent. Uncertainties introduced in trend in sectoral emissions were estimated at ±1.75 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 GPG (IPCC, 2000).

5.3.4 Recalculations

GHG emissions from the source category 3.B 'Degreasing and Dry Cleaning' were recalculated for 1990-2010 time series, in particular, due to updated activity data set on import of solvents in the RM. In comparison with results recorded in the TNC of the RM under the UNFCCC, the changes made in the process of compiling the current inventory resulted in a significant increase of NMVOC emissions over the period since 1990 to 1994, respectively for the 2000-2010 time series, varying from a minimum of 6.9 per cent in 2001, to a maximum of 884.8 per cent in 2009 (Table 5-24).

Table 5-24: Comparative Results of NMVOC Emissions from 3B 'Degreasing and Dry Cleaning' included into the TNC and the BUR of the RM under the UNFCCC, Gg

	1990	1991	1992	1993	1994	1995	1996
TNC	11.0950	9.7089	8.4529	7.3807	6.3644	6.5913	4.9321
BUR	20.9780	16.9375	13.2410	10.2253	7.8872	6.5913	4.9321
Difference, %	89.1	74.5	56.6	38.5	23.9	0.0	0.0
	1997	1998	1999	2000	2001	2002	2003
TNC	4.1316	1.9344	4.4318	3.5853	7.6878	3.6589	2.2929
BUR	4.1316	1.9344	4.4318	4.0475	8.2194	4.4301	2.9881
Difference, %	0.0	0.0	0.0	12.9	6.9	21.1	30.3
	2004	2005	2006	2007	2008	2009	2010
TNC	2.6509	5.7899	2.9690	3.1472	3.7586	2.8367	4.1420
BUR	3.7092	7.4007	14.6149	20.3237	31.8521	27.9353	7.8198
Difference, %	39.9	27.8	392.3	545.8	747.4	884.8	88.8

Abbreviations: TNC – Third National Communication; BUR – Bienniel Update Report.

In order to highlight the trend, Table 5-25 provide the default emission factors (kg of NMVOC per capita) estimated for the source category 3B 'Degreasing and Dry Cleaning' in the RM.

Table 5-25: Default Emission Factors Estimated for the 3B 'Degreasing and Dry Cleaning' Source Category in the RM, 1990-2013

	1990	1991	1992	1993	1994	1995	1996	1997
Default EF, kg NMVOC/per capita	4.8	3.9	3.0	2.4	1.8	1.5	1.1	1.0
	1998	1999	2000	2001	2002	2003	2004	2005
Default EF, kg NMVOC/per capita	0.4	1.0	0.9	1.9	1.0	0.7	0.9	1.8
	2006	2007	2008	2009	2010	2011	2012	2013
Default EF, kg NMVOC/per capita	3.5	4.9	7.8	6.8	1.9	2.1	2.7	2.5

As for the CO_2 emissions, compared to the results included in the TNC of the RM under the UNFCCC, the recalculations performed resulted in significantly increased values for the 1990-1994, respectively 2000-2010 time series, varying from a minimum of 6.9 per cent in 2001, up to a maximum of 884.8 per cent in 2009 (Table 5-26).

Table 5-26: Comparative Results of CO_2 Emissions from 3B 'Degreasing and Dry Cleaning' Source Category Included into the TNC and the BUR of the RM under the UNFCCC, Gg

	1990	1991	1992	1993	1994	1995	1996
TNC	33.1963	29.0489	25.2910	22.0829	19.0422	19.7212	14.7570
BUR	62.7662	50.6769	39.6170	30.5940	23.5984	19.7212	14.7570
Difference, %	89.1	74.5	56.6	38.5	23.9	0.0	0.0
	1997	1998	1999	2000	2001	2002	2003
TNC	12.3617	5.7877	13.2599	10.7271	23.0020	10.9474	6.8605
BUR	12.3617	5.7877	13.2599	12.1101	24.5923	13.2547	8.9405
Difference, %	0.0	0.0	0.0	12.9	6.9	21.1	30.3
	2004	2005	2006	2007	2008	2009	2010
TNC	7.9314	17.3232	8.8832	9.4166	11.2457	8.4875	12.3930
BUR	11.0979	22.1430	43.7278	60.8085	95.3015	83.5825	23.3968
Difference, %	39.9	27.8	392.3	545.8	747.4	884.8	88.8

Abbreviations: TNC – Third National Communication; BUR – Bienniel Update Report..

For the 2011-2013 time series, the GHG emissions resulting from solvents use for degreasing and dry cleaning were estimated for the first time. The results obtained allow assert that over the period since 1990 to 2013, the GHG emissions resulting from 3B 'Degreasing and Dry Cleaning' decreased by 52.2 per cent: from 20.9780 to 10.0254 Gg in case of NMVOC emissions; respectively from 62.7662 to 29.9961 Gg in case of CO_2 emissions.

5.4 Chemical Products, Manufacture and Processing (Category 3C)

5.4.1 Source Category Description

Under the 3C 'Chemical Products, Manufacture and Processing' source category there were reported GHG 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 060313); leather tanning (SNAP 060314).

In 1990, the emission sources with the largest share in the structure of total CO_2 emissions from 3C 'Chemical Products, Manufacture and Processing' category were as following: 40.4 per cent - 'Shoes Manufacture', 18.5 per cent - 'Polyurethane Foam Processing', 14.5 per cent - 'Rubber Processing', 13.9 per cent - 'Polystyrene Processing', 5.8 per cent - 'Pharmaceutical Products Manufacturing', 5.0 per cent - 'Paints Manufacturing'. By 2013, the share of major emission sources changes as follows: 'Pharmaceutical Products Manufacturing'- 57.7 per cent, 'Polystyrene Processing'- 15.5 per cent, 'Polyurethane Foam Processing' – 8.8 per cent, 'Paints Manufacturing' – 8.6 per cent, 'Shoes Manufacture' – 8.5 per cent (Figure 5-4, Table 5-27).

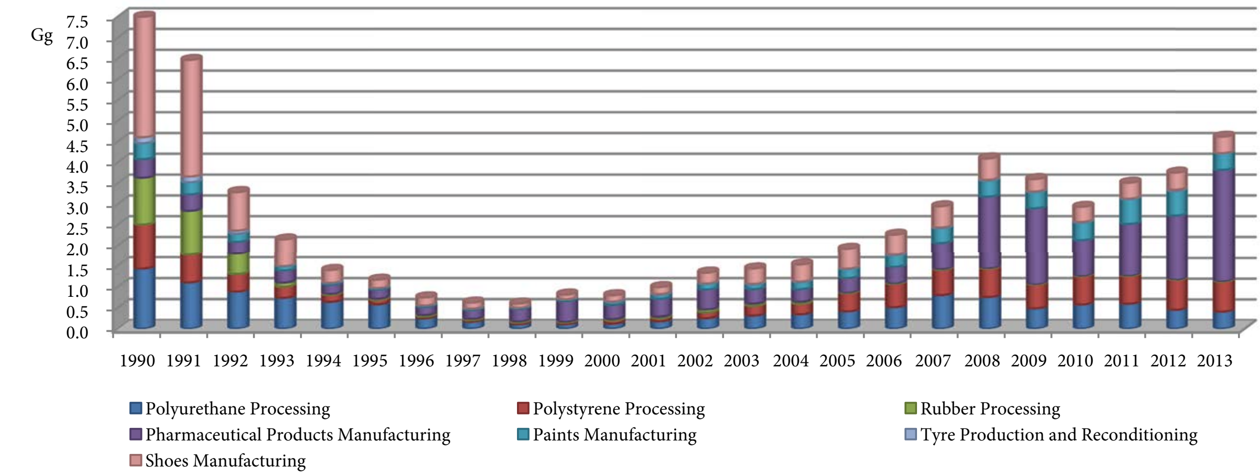


Figure 5-4: CO_2 Emissions from 3C 'Chemical Products, Manufacture and Processing' by Source, 1990-2013, Gg

Table 5-27: CO_2 Emissions from 3C 'Chemical Products, Manufacture and Processing' by Source, within 1990-2013 periods, Gg

	1990	1991	1992	1993	1994	1995	1996	1997
Polyurethane Processing	1.4311	1.1008	0.8806	0.7339	0.6382	0.5801	0.2468	0.1653
Polystyrene Processing	1.0756	0.6723	0.4202	0.2626	0.1641	0.1026	0.0415	0.0370
Rubber Processing	1.1226	1.0604	0.4955	0.1005	0.0215	0.0335	0.0362	0.0326
Pharmaceutical Products Manufacturing	0.4454	0.3959	0.2891	0.2846	0.2178	0.2088	0.1879	0.2048
Paints Manufacturing	0.3851	0.2896	0.1975	0.1020	0.0395	0.0263	0.0230	0.0168
Tyre Production and Reconditioning	0.1444	0.1402	0.0769	0.0029	0.0086	0.0127	0.0153	0.0188
Shoes Manufacturing	3.1236	2.8005	0.9247	0.6593	0.3052	0.2028	0.1924	0.1472
Total	7.7278	6.4597	3.2844	2.1458	1.3950	1.1668	0.7431	0.6224
	1998	1999	2000	2001	2002	2003	2004	2005
Polyurethane Processing	0.1055	0.1070	0.1188	0.1764	0.2504	0.3099	0.3406	0.4106
Polystyrene Processing	0.0388	0.0336	0.0736	0.0701	0.1346	0.2316	0.2492	0.4349
Rubber Processing	0.0295	0.0204	0.0383	0.0431	0.0735	0.0580	0.0541	0.0022
Pharmaceutical Products Manufacturing	0.2931	0.4948	0.3330	0.4202	0.4728	0.3399	0.2940	0.3580
Paints Manufacturing	0.0122	0.0222	0.0676	0.0945	0.1348	0.1133	0.1690	0.2063
Tyre Production and Reconditioning	0.0136	0.0196	0.0134	0.0176	0.0088	0.0115	0.0137	0.0161
Shoes Manufacturing	0.1065	0.1140	0.1497	0.1675	0.2592	0.3686	0.4083	0.4915
Total	0.5993	0.8116	0.7944	0.9895	1.3341	1.4329	1.5288	1.9194

	2006	2007	2008	2009	2010	2011	2012	2013
Polyurethane Processing	0.5109	0.7982	0.7534	0.4813	0.5752	0.5923	0.4521	0.4113
Polystyrene Processing	0.5543	0.6008	0.6696	0.5660	0.6707	0.6609	0.7155	0.7209
Rubber Processing	0.0076	0.0137	0.0051	0.0010	0.0011	0.0015	0.0016	0.0016
Pharmaceutical Products Manufacturing	0.3999	0.6434	1.7474	1.8459	0.8788	1.2643	1.5481	2.6841
Paints Manufacturing	0.2730	0.3559	0.3804	0.3891	0.4234	0.5928	0.5894	0.4021
Tyre Production and Reconditioning	0.0200	0.0209	0.0211	0.0154	0.0155	0.0131	0.0352	0.0332
Shoes Manufacturing	0.4945	0.5111	0.5159	0.2991	0.3658	0.3836	0.4111	0.3958
Total	2.2602	2.9440	4.0929	3.5978	2.9304	3.5084	3.7528	4.6492

Between 1990 and 2013, CO_2 emissions from 3C 'Chemical Products, Manufacture and Processing' source category decreased by 39.8 per cent. In comparison with the 2012 year level, in 2013 year the CO_2 emissions decreased by 23.9 per cent. A similar trend was characteristic also to NMVOC emissions (Table 5-28).

Table 5-28: NMVOC Emissions from 3C 'Chemical Products, Manufacture and Processing' by Source within 1990-2013 periods, Gg

	1990	1991	1992	1993	1994	1995	1996	1997
Polyurethane Processing	0.4783	0.3679	0.2943	0.2453	0.2133	0.1939	0.0825	0.0553
Polystyrene Processing	0.3595	0.2247	0.1404	0.0878	0.0549	0.0343	0.0139	0.0124
Rubber Processing	0.3752	0.3544	0.1656	0.0336	0.0072	0.0112	0.0121	0.0109
Pharmaceutical Products Manufacturing	0.1489	0.1323	0.0966	0.0951	0.0728	0.0698	0.0628	0.0685
Paints Manufacturing	0.1287	0.0968	0.0660	0.0341	0.0132	0.0088	0.0077	0.0056
Tyre Production and Reconditioning	0.0483	0.0469	0.0257	0.0010	0.0029	0.0042	0.0051	0.0063
Shoes Manufacturing	1.0440	0.9360	0.3091	0.2204	0.1020	0.0678	0.0643	0.0492
Total	2.5828	2.1590	1.0977	0.7172	0.4662	0.3900	0.2484	0.2080
	1998	1999	2000	2001	2002	2003	2004	2005
Polyurethane Processing	0.0353	0.0358	0.0397	0.0590	0.0837	0.1036	0.1138	0.1372
Polystyrene Processing	0.0130	0.0112	0.0246	0.0234	0.0450	0.0774	0.0833	0.1453
Rubber Processing	0.0099	0.0068	0.0128	0.0144	0.0246	0.0194	0.0181	0.0007
Pharmaceutical Products Manufacturing	0.0980	0.1654	0.1113	0.1405	0.1580	0.1136	0.0983	0.1196
Paints Manufacturing	0.0041	0.0074	0.0226	0.0316	0.0450	0.0379	0.0565	0.0690
Tyre Production and Reconditioning	0.0046	0.0065	0.0045	0.0059	0.0029	0.0038	0.0046	0.0054
Shoes Manufacturing	0.0356	0.0381	0.0500	0.0560	0.0866	0.1232	0.1365	0.1643
Total	0.2003	0.2713	0.2655	0.3307	0.4459	0.4789	0.5110	0.6415
	2006	2007	2008	2009	2010	2011	2012	2013
Polyurethane Processing	0.1708	0.2668	0.2518	0.1609	0.1923	0.1980	0.1511	0.1375
Polystyrene Processing	0.1853	0.2008	0.2238	0.1892	0.2242	0.2209	0.2391	0.2410
Rubber Processing	0.0025	0.0046	0.0017	0.0004	0.0004	0.0005	0.0005	0.0006
Pharmaceutical Products Manufacturing	0.1337	0.2150	0.5840	0.6170	0.2937	0.4225	0.5174	0.8971
Paints Manufacturing	0.0912	0.1190	0.1271	0.1300	0.1415	0.1981	0.1970	0.1344
Tyre Production and Reconditioning	0.0067	0.0070	0.0071	0.0051	0.0052	0.0044	0.0118	0.0111
Shoes Manufacturing	0.1653	0.1708	0.1724	0.1000	0.1223	0.1282	0.1374	0.1323
Total	0.7554	0.9840	1.3679	1.2025	0.9794	1.1726	1.2543	1.5539

5.4.2 Methodological Issues, Emission Factors and Data Sources

The methodology used to estimate NMVOC emissions from 'Manufacture and Processing of Chemical Products' is available in the EMEP/EEA Air Pollutant Emission Inventory Guidebook 2013, and is represented by the following equation:

$$E_{pollutant} = (AR_{product} \bullet EF_{technology\ pollutant}) / 10^3$$

Where:

$E_{pollutant}$ – pollutant gas emissions from solvents use for the manufacture and processing of chemical products, t/yr;

$AR_{product}$ – activity rate for manufacture and processing of chemical products, t/yr;

$EF_{pollutant\ technology}$ – the emission factor for this pollutant technology, kg/t

The EMEP/EEA Air Pollutant Emission Inventory Guidebook 2013 provides default EFs and alternative calculation methodologies: Tier 1 (Table 5-29) and/or Tier 2 approaches (Table 5-30).

Table 5-29: Tier 1 Default Emission Factors for Source Category 3C 'Chemical Products, Manufacture and Processing'

Source Category	EF_{NMVOC}	Unit
3C Chemical Products, Manufacture and Processing	10	g/kg of product

Source: EMEP/EEA Air Pollutant Emission Inventory Guidebook 2013, Source Category 2.D.3.g ‚Chemical Products, Manufacture and Processing' (according to the nomenclature NFR), Table 3-1, page 15.

Table 5-30: Tier 2 Default Emission Factors for Source Category 3C 'Chemical Products, Manufacture and Processing'

Source Category	EF_{NMVOC}	Unit
3C Chemical Products, Manufacture and Processing (SNAP 060301, polyester processing)	50	g/kg monomer
3C Chemical Products, Manufacture and Processing (SNAP 060303, polyurethane processing)	120	g/kg foam
3C Chemical Products, Manufacture and Processing (SNAP 060304, polystyrene foam processing)	60	g/kg foam
3C Chemical Products, Manufacture and Processing (SNAP 060305, rubber processing)	8	g/kg rubber

Source Category	EF_{NMVOC}	Unit
3C Chemical Products, Manufacture and Processing (SNAP 060306,pharmaceutical products manufacturing)	300	g/kg solvent
3C Chemical Products, Manufacture and Processing (SNAP 060307, paints, inks and glues manufacturing)	11	g/kg product
3C Chemical Products, Manufacture and Processing (SNAP 060314, tyre production)	10	g/kg tyre
3C Chemical Products, Manufacture and Processing (glues and adhesive products manufacturing)	3	g/m^2
3C Chemical Products, Manufacture and Processing (shoes manufacture)	0.045	kg/pair of shoes

Source: EMEP/EEA Air Pollutant Emission Inventory Guidebook 2013, Source Category 2.D.3.g ‚Chemical Products, Manufacture and Processing' (according to the nomenclature NFR), Tables 3-2, 3-3, 3-4, 3-5, 3-6, 3-7, 3-8, 3-9, 3-10, 3-11, 3-12 and 3-13, pages 17-22.

Statistical publications of the RM provide activity data on manufacturing different industrial commodities, including: leather items, shoes, as well as data on refurbished tires, other rubber products and paints manufacturing (Table 5-31).

Table 5-31: Activity Data on Manufacturing Industrial Commodities in the Republic of Moldova, within 1990-2013 periods

	1990	1991	1992	1993	1994	1995	1996	1997
Polyurethane Processing, kt	3.452	2.656	2.124	1.770	1.539	1.399	0.547	0.394
Polystyrene Processing, kt	5.992	3.745	2.340	1.463	0.914	0.571	0.231	0.206
Rubber Processing, kt	46.900	44.300	20.700	4.200	0.900	1.400	1.512	1.361
Pharmaceutical Products Manufacturing, kt	0.496	0.441	0.322	0.317	0.243	0.233	0.209	0.228
Paints Manufacturing, kt	11.700	8.800	6.000	3.100	1.200	0.800	0.700	0.509
Refurbished Tyres, thousand pieces	75.300	73.100	40.100	1.500	4.500	6.600	8.000	9.800
Shoes, thousand pairs	23.200	20.800	6.868	4.897	2.267	1.506	1.429	1.093
	1998	1999	2000	2001	2002	2003	2004	2005
Polyurethane Processing, kt	0.265	0.257	0.291	0.469	0.683	0.795	0.767	0.779
Polystyrene Processing, kt	0.216	0.187	0.410	0.391	0.750	1.290	1.388	2.422
Rubber Processing, kt	1.234	0.853	1.598	1.801	3.071	2.425	2.259	0.090
Pharmaceutical Products Manufacturing, kt	0.327	0.551	0.371	0.468	0.527	0.379	0.328	0.399
Paints Manufacturing, kt	0.370	0.674	2.054	2.870	4.095	3.443	5.136	6.269
Refurbished Tyres, thousand pieces	7.100	10.200	7.000	9.200	4.600	6.000	7.128	8.383
Shoes, thousand pairs	0.791	0.847	1.112	1.244	1.925	2.738	3.033	3.650
	2006	2007	2008	2009	2010	2011	2012	2013
Polyurethane Processing, kt	1.117	1.683	1.329	0.742	0.918	0.945	0.896	0.983
Polystyrene Processing, kt	3.088	3.347	3.730	3.153	3.736	3.681	3.986	4.016
Rubber Processing, kt	0.316	0.573	0.214	0.044	0.044	0.063	0.065	0.064
Pharmaceutical Products Manufacturing, kt	0.446	0.717	1.947	2.057	0.979	1.408	1.725	1.567
Paints Manufacturing, kt	8.295	10.815	11.557	11.822	12.864	18.011	17.925	12.060
Refurbished Tyres, thousand pieces	10.428	10.897	11.006	8.012	8.093	6.852	18.361	6.952
Shoes, thousand pairs	3.673	3.796	3.832	2.221	2.717	2.849	3.053	2.940

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 2012 and 2013"; 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 of 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; 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.

In order to convert AD in mass metric units (tonne), the following conversion coefficient was used: (1) 15.6 tyres per tone[37] (*the value represent an weighted average, considering that a car tyre weight about 7.1 kg; a land vehicles tyre – 13.0 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*). 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).

To be noted that the information on import-export activities for 1990-1994 time series is not available in the Customs Service database, thus in order to fill this gap, following the GPG recommendations (IPCC, 2000, Chapter 7, Table 7-5, page 7.19), the trend extrapolation method was used (using the regression analysis).

CO_2 emissions were estimated based on the carbon content in NMVOC emissions. By oxidizing, this carbon converts into CO_2 in atmosphere (it is assumed that all solvents from chemical products produced and processed, are of fossil origin). CO_2 emissions were estimated using the following formula:

$$CO_2 = NMVOC \bullet CC \bullet 44/12$$

Where:

CO_2 emissions – carbon dioxide emissions from solvents used for manufacturing and processing of chemical products, kt/yr;

[37] <http://www.wastexchange.co.uk/documenti/tyres/UK_Used_Tyre_Market_Report_2004_Report.pdf>.

NMVOC – total NMVOC emissions within the respective category, kt/yr;

CC – carbon content in NMVOC (81.6 per cent, see in Table 5-12);

44/12 – stoichiometric ratio of carbon content in CO_2 and NMVOC.

5.4.3 Uncertainties Assessment and Time-Series Consistency

Uncertainties related to activity data on manufacturing and processing of chemical products in the RM are considered to be relatively low, ±5 per cent for paints and varnishes, rubber products and shoes, respectively ±10 per cent for tanned leather and ±20 per cent for refurbished tyre production, in particular due to use of conversion coefficients, that bring additional uncertainties to initial AD from the statistical publications of the RM. Uncertainties related to NMVOC content fraction are considered relatively low (±10 per cent), while uncertainties related to the emission factors are considered to be medium (±25 per cent). The combined uncertainties associated with GHG emissions from the 3C 'Chemical Products, Manufacture and Processing' source category may be considered medium, varying from ±25.49 per cent for varnishes and paints production, rubber products and shoes, up to ±32.02 per cent for refurbished tyre, leather products, polyurethane and polystyrene processing. At the same time, combined uncertainties, presented as a per cent of total sectoral emissions were estimated at ±0.1977 per cent for polyurethane processing, ±0.3466 per cent for polystyrene processing, ±0.0006 per cent for rubber processing, ±1.0276 per cent for pharmaceutical products manufacturing, ±0.1540 per cent for varnishes and paint production, ±0.0160 per cent for refurbished tyre, respectively ±0.1515 per cent for shoes manufacture. Uncertainties introduced in trend in sectoral emissions are considered extremely low, varying from a minimum of ±0.0113 per cent for refurbished tyre, up to a maximum of ±0.5082 per cent for pharmaceutical products manufacturing (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 GPG (IPCC, 2000).

5.4.4 Recalculations

GHG emissions from the source category 3.C 'Chemical Products, Manufacture and Processing' were recalculated for the 1990 through 2010 time period, in particular due to using an updated data set on chemical products manufacture in the Republic of Moldova. In comparison with the results recorded in the TNC, the changes made in the process of compiling the current inventory resulted in increased NMVOC emissions over the period 1990 through 2005, varying from a minimum of 0.1 per cent in 2005, up to a maximum of 65.5 per cent in 1995, and respectively in decresed NMVOC emissions between 2006 and 2010, varying from a minimum of 0.7 per cent in 2009, up to a maximum of 3.1 per cent in 2006 (Table 5-32).

Table 5-32: Comparative Results of NMVOC Emissions from 3C 'Chemical Products, Manufacture and Processing' included in TNC and BUR of the RM under the UNFCCC, Gg

	1990	1991	1992	1993	1994	1995	1996
TNC	1.8704	1.6726	0.7646	0.4881	0.2853	0.2356	0.1976
BUR	2.5828	2.1590	1.0977	0.7172	0.4662	0.3900	0.2484
Difference, %	38.1	29.1	43.6	46.9	63.4	65.5	25.7
	1997	1998	1999	2000	2001	2002	2003
TNC	0.1708	0.1762	0.2493	0.2451	0.2947	0.4135	0.4469
BUR	0.2080	0.2003	0.2713	0.2655	0.3307	0.4459	0.4789
Difference, %	21.8	13.7	8.8	8.3	12.2	7.8	7.2
	2004	2005	2006	2007	2008	2009	2010
TNC	0.4888	0.6411	0.7799	1.0110	1.3865	1.2113	1.0052
BUR	0.5110	0.6415	0.7554	0.9840	1.3679	1.2025	0.9794
Difference, %	4.5	0.1	-3.1	-2.7	-1.3	-0.7	-2.6

Abbreviations: TNC – Third National Communication; BUR – Bienniel Update Report.

As for the CO_2 emissions, comparing with the TNC, the performed recalculations resulted showed a similar trend, Between 1990 and 2005, CO_2 emissions increased, varying from a minimum of 0.1 per cent in 2005, up to a maximum of 65.5 per cent in 1995. For the 2006-2010 time series, these emissions decreased, varying from a minimum of 0.7 per cent in 2009, up to a maximum of 3.1 per cent in 2006 (Table 5-33). For the 2011-2013 time series, the GHG emissions resulting from solvents use for manufacturing and processing of chemical products were estimated for the first time. The results allow assert that over the period from 1990 through 2013, GHG emissions resulting from 3C 'Chemical Products, Manufacturing and Processing' category decreased by 39.8 per cent: from 2.5828 to 1.5539 Gg in case of NMVOC emissions; respectively from 7.7278 to 4.6492 Gg in case of CO_2 emissions.

Table 5-33: Comparative Results of CO_2 Emissions from 3C 'Chemical Products, Manufacture and Processing', included in TNC and BUR of the Republic of Moldova under the UNFCCC, Gg

	1990	1991	1992	1993	1994	1995	1996
TNC	5.5962	5.0043	2.2878	1.4603	0.8537	0.7051	0.5912
BUR	7.7278	6.4597	3.2844	2.1458	1.3950	1.1668	0.7431
Difference, %	38.1	29.1	43.6	46.9	63.4	65.5	25.7
	1997	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**
TNC	0.5110	0.5273	0.7459	0.7333	0.8817	1.2371	1.3371
BUR	0.6224	0.5993	0.8116	0.7944	0.9895	1.3341	1.4329
Difference, %	21.8	13.7	8.8	8.3	12.2	7.8	7.2
	2004	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**
TNC	1.4625	1.9181	2.3334	3.0250	4.1484	3.6242	3.0075
BUR	1.5288	1.9194	2.2602	2.9440	4.0929	3.5978	2.9304
Difference, %	4.5	0.1	-3.1	-2.7	-1.3	-0.7	-2.6

Abbreviations: TNC – Third National Communication; BUR – Bienniel Update Report.

5.5 Other Solvent Use (Category 3D)

5.5.1 Source Category Description

Under the 3D 'Other Solvent Use' source category there were reported non-CO_2 emissions (in particular NMVOC, but also NO_x and CO), as well as direct GHG emissions (in particular CO_2, but also N_2O) from the following sources: 3D1 'Printing' (SNAP 060403) (use of solvents in printing process); 3D2 'Domestic Solvent Use' (SNAP 060408) (other than paints application; e.g. cosmetics and perfumes; car care products (antifreeze, car waxes and polishes, engine degreasers, etc.; households products like aerosols; glass and furniture cleaning, air freshener, disinfectants, waxes and polishes etc.); 3D3 'Other Product Use' (SNAP 060402 – use of hexane in seed oil extraction; SNAP 060405 – industrial application of glues and adhesives in industries like: construction, shoes manufacture, adhesive substances and furniture manufacture; SNAP 060406 – preservation of wood; SNAP 060407 – underseal treatment and conservation of vehicles; SNAP 060409 – vehicle dewaxing; SNAP 060411 – domestic use of pharmaceutical products, SNAP 060412 – preservation of seeds; SNAP 060508 – N_2O use in anesthesia; SNAP 060602 – tobacco combustion, SNAP 060603 – use of shoes, etc.).

In 1990, the sources with the largest share in the structure of total CO_2 emissions within this category were: 3D2 'Domestic Solvent Use' (65.4 per cent), 3D3 'Other Product Use' (29.4 per cent), respectively 3D1 'Printing' (5.2 per cent). By 2013, the trend changed as it follows: 3D2 'Domestic Solvent Use' (74.4 per cent), 3D3 'Other Product Use' (22.2 per cent), respectively 3D1 'Printing' (3.4 per cent).

Between 1990 and 2013, direct GHG emissions from 3D 'Other Solvent Use' source category decreased by circa 18.1 per cent; at the same time, in comparison with the 2012 year level, in 2013 CO_2 emissions decreased by3.1 per cent (Figure 5-5, Table 5-34).

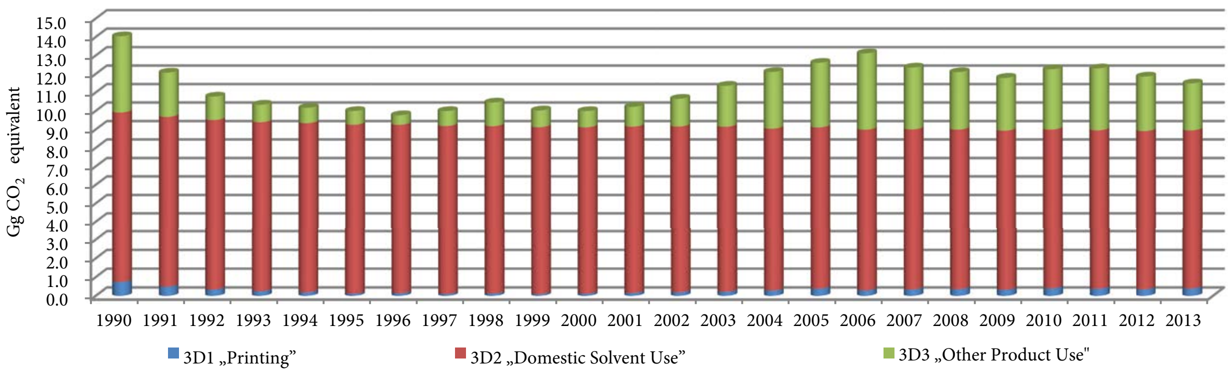


Figure 5-5: Direct GHG Emissions from 3D 'Other Solvent Use' by Source within 1990-2013 periods

Table 5-34: Direct GHG Emissions from Category 3D 'Other Solvent Use' by Source, within 1990-2013 periods, Gg CO_2 equivalent

	1990	1991	1992	1993	1994	1995	1996	1997
3D1 'Printing'	0.7352	0.4938	0.3385	0.2442	0.1834	0.1063	0.1307	0.0956
3D2 'Domestic Solvent Use'	9.1741	9.1840	9.1688	9.1451	9.1554	9.1453	9.1169	9.0866
3D3 'Other Product Use'	4.1247	2.3906	1.2651	0.9435	0.8265	0.7367	0.5143	0.8057
3D 'Other Solvent Use'	14.0339	12.0684	10.7724	10.3328	10.1653	9.9883	9.7619	9.9880
	1998	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**
3D1 'Printing'	0.1186	0.0877	0.1056	0.1500	0.1920	0.2174	0.2839	0.3839
3D2 'Domestic Solvent Use'	9.0544	9.0298	9.0056	8.9974	8.9633	8.9227	8.7538	8.7246
3D3 'Other Product Use'	1.2792	0.9034	0.8732	1.0709	1.4989	2.2171	3.0646	3.4911
3D 'Other Solvent Use'	10.4522	10.0210	9.9843	10.2183	10.6542	11.3573	12.1024	12.5996

	2006	2007	2008	2009	2010	2011	2012	2013
3D1 'Printing'	0.2937	0.3413	0.3607	0.3234	0.4021	0.3789	0.3494	0.3936
3D2 'Domestic Solvent Use'	8.6880	8.6546	8.6243	8.6028	8.5853	8.5687	8.5585	8.5495
3D3 'Other Product Use'	4.1348	3.3474	3.1073	2.8593	3.2600	3.3480	2.9436	2.5465
3D 'Other Solvent Use'	13.1165	12.3432	12.0922	11.7855	12.2475	12.2957	11.8515	11.4896

A similar trend was established for non-CO_2 emissions from this category, which, between 1990 and 2013 time series decreased by 19.4 per cent in case of NMVOC emissions (Table 5-35), respectively by 77.8 per cent for CO and NO_x emissions (N_2O emissions are not registered since 2007) (Tables 5-36).

Table 5-35: NMVOC Emissions from Category 3D 'Other Solvents Use' by Source, within 1990-2013 periods, Gg

	1990	1991	1992	1993	1994	1995	1996	1997
3D1 'Printing'	0.2457	0.1650	0.1131	0.0816	0.0613	0.0355	0.0437	0.0320
3D2 'Domestic Solvent Use'	3.0662	3.0695	3.0644	3.0565	3.0599	3.0566	3.0471	3.0370
3D3 'Other Product Use'	1.8833	1.0625	0.5618	0.4068	0.3592	0.3242	0.2240	0.3661
3D 'Other Solvent Use'	5.1952	4.2970	3.7394	3.5449	3.4804	3.4163	3.3148	3.4350
	1998	1999	2000	2001	2002	2003	2004	2005
3D1 'Printing'	0.0396	0.0293	0.0353	0.0501	0.0642	0.0727	0.0949	0.1283
3D2 'Domestic Solvent Use'	3.0262	3.0180	3.0099	3.0072	2.9958	2.9822	2.9257	2.9160
3D3 'Other Product Use'	0.5978	0.4163	0.4016	0.4894	0.6887	1.0116	1.3979	1.6010
3D 'Other Solvent Use'	3.6637	3.4636	3.4468	3.5467	3.7486	4.0665	4.4186	4.6453
	2006	2007	2008	2009	2010	2011	2012	2013
3D1 'Printing'	0.0982	0.1141	0.1205	0.1081	0.1344	0.1266	0.1168	0.1316
3D2 'Domestic Solvent Use'	2.9037	2.8926	2.8824	2.8753	2.8694	2.8639	2.8605	2.8574
3D3 'Other Product Use'	1.9160	1.5491	1.4400	1.3263	1.5238	1.5669	1.3754	1.1964
3D 'Other Solvent Use'	4.9179	4.5557	4.4430	4.3096	4.5276	4.5574	4.3526	4.1854

Table 5-36: Non-CO_2 Emissions (other than NMVOC) from 3D3 'Other Product Use' by Source, within 1990-2013 periods, Gg

	1990	1991	1992	1993	1994	1995	1996	1997
N_2O	0.000066	0.000055	0.000050	0.000060	0.000050	0.000001	0.000002	0.000003
NO_x	0.000029	0.000029	0.000027	0.000028	0.000025	0.000022	0.000031	0.000030
CO	0.000876	0.000886	0.000828	0.000847	0.000770	0.000684	0.000934	0.000915
	1998	1999	2000	2001	2002	2003	2004	2005
N_2O	0.000005	0.000043	0.000044	0.000044	0.000044	0.000044	0.000050	0.000061
NO_x	0.000039	0.000045	0.000037	0.000035	0.000022	0.000015	0.000014	0.000015
CO	0.001196	0.001366	0.001126	0.001062	0.000676	0.000461	0.000417	0.000452
	2006	2007	2008	2009	2010	2011	2012	2013
N_2O	0.000059	NO	NO	NO	NO	NO	NO	NO
NO_x	0.000009	0.000008	0.000011	0.000009	0.000013	0.000012	0.000010	0.000006
CO	0.000286	0.000239	0.000345	0.000270	0.000401	0.000372	0.000314	0.000195

Abbreviations: NO – Not Occurring.

5.5.2 Methodological Issues, Emission Factors and Data Sources

3.D.1 'Printing'

The methodology used to estimate NMVOC emissions from source category 3D1 'Printing' is available in the EMEP/EEA Air Pollutant Emission Inventory Guidebook 2013[38], and is represented by the following formula:

$$E_{pollutant} = (AR_{product} \bullet EF_{technology\ pollutant}) / 10^3$$

Where:

- $E_{pollutant}$ – pollutant gas emissions from inks used in printing, t/yr;
- $AR_{product}$ – activity rate for inks used in printing, t/yr;
- $EF_{pollutant\ technology}$ – the emission factor for this pollutant technology, kg/t

The EMEP/EEA Air Pollutant Emission Inventory Guidebook 2013 provides default EFs and a Tier 1 methodological approach (Table 5-37).

Table 5-37: Tier 1 Default Emission Factors for Source Category 3D1 'Printing'

Source Category	EF_{NMVOC}	Unit
3D1 Printing	500	kg/t inks

Source: EMEP/EEA Air Pollutant Emission Inventory Guidebook 2013, Source Category 2.D.3.h 'Printing' (according to the nomenclature NFR), 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,

[38] European Environment Agency: <http://www.eea.europa.eu//publications/emep-eea-guidebook-2013>.

import and export (in the Republic of Moldova, inks are not produced and there were no records on inks export) (Table 5-38).

Table 5-38: Activity Data on Inks Import in the Republic of Moldova within 1990-2013 periods

	1990	1991	1992	1993	1994	1995	1996	1997
Inks for printing, writing and drawing, as well as other inks, kt	0.3557	0.2214	0.1427	0.1026	0.0788	0.0405	0.0577	0.0604
Paints for artistic painting, for educational use, firms painting, amusement as well as similar paints, kt	0.1358	0.1086	0.0836	0.0607	0.0438	0.0306	0.0297	0.0035
Total inks, kt	0.4914	0.3301	0.2262	0.1633	0.1226	0.0711	0.0874	0.0639
	1998	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**
Inks for printing, writing and drawing, as well as other inks, kt	0.0596	0.0444	0.0553	0.0838	0.1024	0.1175	0.1568	0.2260
Paints for artistic painting, for educational use, firms painting, amusement as well as similar paints, kt	0.0197	0.0142	0.0152	0.0164	0.0259	0.0278	0.0330	0.0306
Total inks, kt	0.0793	0.0586	0.0706	0.1002	0.1284	0.1453	0.1898	0.2566
	2006	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**
Inks for printing, writing and drawing, as well as other inks, kt	0.1502	0.1925	0.1906	0.1721	0.2209	0.2009	0.1789	0.2008
Paints for artistic painting, for educational use, firms painting, amusement as well as similar paints, kt	0.0462	0.0356	0.0505	0.0441	0.0479	0.0524	0.0546	0.0623
Total inks, kt	0.1964	0.2281	0.2411	0.2162	0.2688	0.2533	0.2335	0.2631

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.

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*).

$$Consumption_{ink} = Production_{ink} + Import_{ink} - Export_{ink}$$

Where:

$Consumption_{ink}$ – Total consumption of inks, kt/yr;

$Production_{ink}$ – the amount of inks produced, kt/yr;

$Import_{ink}$ – the amount of inks imported, kt/yr;

$Export_{ink}$ – the amount of inks exported, kt/yr.

To be noted that the information on import-export activities for 1990-1994 time series is not available in the Customs Service database, thus, in order to fill this gap, following the GPG recommendations (IPCC, 2000, Chapter 7, Table 7-5, page 7.19), the trend extrapolation method was used (using the regression analysis).

CO_2 emissions were estimated based on the carbon content in NMVOC emissions (Table 5-13). By oxidizing, this carbon converts into CO_2 in atmosphere (it is assumed that all solvents from chemical products produced and processed, are of fossil origin).

CO_2 emissions were estimated by the following formula:

$$CO_2 = NMVOC \bullet CC \bullet 44/12$$

Where:

CO_2 emissions – carbon dioxide emissions from inks use for printing, kt/yr;

NMVOC – total NMVOC emissions within the respective category, kt/yr;

CC – carbon content in NMVOC (81.6 per cent, see in Table 5-11);

44/12 – stoichiometric ratio of carbon content in CO_2 and NMVOC.

3.D.2 'Domestic Solvent Use'

No statistical data are available in the Republic of Moldova related to 'domestic solvents use' (other than for decorative paint application), in particular, regarding cosmetics and toiletries, as well as on household products. AD on certain categories can be generated indirectly, considering statistical data on production, import and export, by the following formula:

$$Consumption_{dsu} = production_{dsu} + import_{dsu} - export_{dsu}$$

Where:

$Consumption_{dsu.}$ – total consumption of domestic solvents, kt/yr;

$Production_{dsu}$ – amount of domestic solvents produced, kt/yr;

$Import_{dsu}$ – amount of domestic solvents imported, kt/yr;

$Export_{dsu.}$ – amount of domestic solvents exported, kt/yr

To be noted that the production of domestic solvents in the Republic of Moldova is insignificant and the Statistical Yearbooks do not specify it, as well as domestic solvents exports. Customs Service of the Republic of Moldova is a primary source of information on national import operations (Table 5-39).

Table 5-39: Activity Data on Domestic Solvents Import in the Republic of Moldova within 1990-2013 periods

	1990	1991	1992	1993	1994	1995	1996	1997
Mixtures of odoriferous substances and mixtures based on one or more of these substances, kt	0.3980	0.3956	0.3393	0.2646	0.1879	0.1547	0.0712	0.0725
Parfumes and eau de toilette, kt	0.4903	0.2841	0.1804	0.1403	0.1256	0.0925	0.1429	0.1454
Beauty or make-up products and skin care, manicure or pedicure products, kt	1.2031	0.8108	0.5272	0.3542	0.2135	0.0667	0.0713	0.1068
Hair care products, kt	4.1210	2.5315	1.4654	0.7984	0.4046	0.2130	0.3283	0.3816
Oral or dental hygiene products, kt	0.9651	0.6180	0.3862	0.2214	0.1309	0.1006	0.1131	0.0831
Pre-shave, shave or after-shave products, deodorants, bath products, depilatories, other perfumery or toiletries and other cosmetics, air freshener , kt	2.7637	1.4024	0.6734	0.3428	0.1938	0.0399	0.0397	0.0807
	1998	1999	2000	2001	2002	2003	2004	2005
Mixtures of odoriferous substances and mixtures based on one or more of these substances, kt	0.0681	0.0808	0.0641	0.1758	0.9351	0.1789	0.2038	0.2532
Parfumes and eau de toilette, kt	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, kt	0.0580	0.0532	0.0800	0.1974	0.3326	0.5557	0.5567	0.7338
Hair care products, kt	0.3358	0.5573	1.0675	1.2892	1.5030	1.8767	1.9802	2.3080
Oral or dental hygiene products, kt	0.1041	0.4581	0.3640	0.3424	0.3902	0.5015	0.4623	0.5381
Pre-shave, shave or after-shave products, deodorants, bath products, depilatories, other perfumery or toiletries and other cosmetics, air freshener , kt	0.0687	0.0478	0.0864	0.1897	0.4108	0.6529	0.7696	1.2069
	2006	2007	2008	2009	2010	2011	2012	2013
Mixtures of odoriferous substances and mixtures based on one or more of these substances, kt	0.1875	0.2009	0.1696	0.1371	0.2009	0.2523	0.2873	0.2817
Parfumes and eau de toilette, kt	0.2858	0.4660	0.2012	0.1323	0.1114	0.0918	0.1441	0.1502
Beauty or make-up products and skin care, manicure or pedicure products, kt	0.8086	0.9913	1.0283	0.8313	0.8856	0.9429	0.9405	1.0121
Hair care products, kt	2.4143	2.8395	2.6788	2.6876	2.7463	2.8667	3.0558	2.9765
Oral or dental hygiene products, kt	0.5588	0.5750	0.6192	0.5212	0.6211	0.6229	0.6996	0.7023
Pre-shave, shave or after-shave products, deodorants, bath products, depilatories, other perfumery or toiletries and other cosmetics, air freshener , kt	1.3931	1.6538	1.8950	1.5354	1.6036	1.8711	2.1028	2.2754

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.

Information on import activities for 1990-1994 time series is not available in the Customs Service database, so, in order to fill this gap, following the GPG recommendations (IPCC, 2000, Chapter 7, Table 7-5, page 7.19), the trend extrapolation method was used (using the regression analysis). Considering the above mentioned, it is necessary to specify that although AD on certain consumer products consumption have been collected, since the solvents share in these products is unknown, it has not been possible yet to apply a higher estimation methodology.

For now, the methodology used to estimate NMVOC emissions from source category 3D2 'Domestic Solvents Use' is the one available in the EMEP/EEA Air Pollutant Emission Inventory Guidebook 2013 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 5-41);
- $EF_{pollutant}$ – the emission factor for this pollutant gas, kg/person/yr.

The EMEP/EEA Air Pollutant Emission Inventory Guidebook 2013 provides default EFs and a Tier 1 methodological approach (Table 5-40).

Table 5-40: Tier 1 Default Emission Factors for Source Category 3D2 'Domestic Solvents Use'

Source Category	EF_{NMVOC} for Eastern European Countries	Unit
3D2 Domestic Solvents Use	0.703	kg/person/yr

Source: EMEP/EEA Air Pollutant Emission Inventory Guidebook 2013, Source Category 2.D.3.a 'Domestic Solvents Use' Sub-Chapter 3.24, page 9.

CO_2 emissions were estimated based on the carbon content in NMVOC emissions (Table 5-13). By oxidizing, this carbon converts into CO_2 in atmosphere (it is assumed that all solvents from household waste products are of fossil origin).

Table 5-41: Republic of Moldova's Population within 1990-2013 periods

	1990	1991	1992	1993	1994	1995	1996	1997
Total Population (including ATULBD), thousand inhabitants	4361.6	4366.3	4359.1	4347.8	4352.7	4347.9	4334.4	4320.0
	1998	1999	2000	2001	2002	2003	2004	2005
Total Population (including ATULBD), thousand inhabitants	4304.7	4293.0	4281.5	4277.6	4261.4	4242.1	4161.8	4147.9
	2006	2007	2008	2009	2010	2011	2012	2013
Total Population (including ATULBD), thousand inhabitants	4130.5	4114.6	4100.2	4090.0	4081.7	4073.8	4068.9	4064.7

Source: Statistical Yearbooks of the RM for 1990 (page 20), 1993 (page 60), 1995 (page 49), 1997 (page 59), 1999 (page 42), 2003 (page 45), 2006 (page 37), 2007 (page 33), 2009 (page 32), 2011 (page 32), 2013 (page 32), 2014 (page 32); Statistical Yearbooks of the ATULBD for 2000 (page 27), 2006 (page 27), 2009 (page 28), 2013 (page 28); Socio-economic development of the Transnistrian Moldovan Republic, 2013 (final data). / State Statistical Service of the Ministry of Economy of the Transnistrian Moldovan Republic - Tiraspol, 2014 – 88 pages (page 3).

CO_2 emissions were estimated using the following equation:

$$CO_2 = NMVOC \bullet CC \bullet 44/12$$

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 (81.6 per cent, see in Table 5-13);

44/12 – stoichiometric ratio of carbon content in CO_2 and NMVOC.

3.D.3 'Other 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 3D3 'Other Product Use' (seed oil extraction) is available in the EMEP/EEA Air Pollutant Emission Inventory Guidebook 2013, and is represented by the following equation:

$$E_{pollutant} = (AR_{product} \bullet EF_{technology\ pollutant}) / 10^3$$

Where:

$E_{pollutant}$ – pollutant gas emissions from solvents use in seed oil extraction, t/yr;

$AR_{product}$ – activity rate for solvents consumption in seed oil extraction, t/yr;

$EF_{pollutant\ technology}$ – the emission factor for this pollutant technology, kg/t

The EMEP/EEA Air Pollutant Emission Inventory Guidebook 2013 provides default EFs and a Tier 2 methodological approach (Table 5-42). In order to estimate NMVOC emissions, statistical data on the amount of oil extracted at the Moldovan enterprises are used.

Table 5-42: Tier 1 Default EF for Source Category 3D3 'Other Product Use' (seed oil extraction)

Source Category	EF_{NMVOC}	Unit
3D3 Seed Oil Extraction	1.57	kg/t seeds

Source: EMEP/EEA Air Pollutant Emission Inventory Guidebook 2013, Source Category 2.D.3.i 'Other Product Use' (according to the nomenclature NFR), SNAP 060404, Table 3-4, page 15.

In 2013, at the national level, there were over 92 enterprises specialized in oil production [39], the largest being 'Floarea-Soarelui' J.S.C. in Balti[40]. 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 5-43).

[39] <http://md.kompass.com/a/ulei-de-floarea-soarelui-comestibil/0388015/>.
[40] <http://www.fsoil.info/>.

Table 5-43: Activity Data on Oil Production and Quantity of Seeds Used for Oil Extraction in the Republic of Moldova within 1990-2013 periods, kt

	1990	1991	1992	1993	1994	1995	1996	1997
Total oil produced, including:	125.600	117.900	57.317	60.271	50.439	50.715	39.374	35.168
refined oil obtained by extraction with hexane	47.728	44.213	21.207	21.999	18.158	18.004	13.781	12.023
Seeds used for oil extraction	106.062	98.250	47.127	48.886	40.351	40.009	30.624	26.717
	1998	1999	2000	2001	2002	2003	2004	2005
Total oil produced, including:	28.747	24.264	31.343	43.486	53.632	77.007	96.092	83.394
refined oil obtained by extraction with hexane	8.388	5.399	6.061	10.404	13.574	25.920	38.253	37.204
Seeds used for oil extraction	18.640	11.998	13.468	23.119	30.164	57.601	85.006	82.676
	2006	2007	2008	2009	2010	2011	2012	2013
Total oil produced, including:	81.471	84.967	79.307	83.881	80.705	89.787	96.828	49.951
refined oil obtained by extraction with hexane	33.452	31.870	26.930	25.503	21.671	20.916	19.898	11.810
Seeds used for oil extraction	74.338	70.821	59.844	56.674	48.158	46.480	44.218	26.244

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 Enivironment; 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 of 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 Moldov, by product type, for 2012 and 2013"; Statistical Yearbooks of the ATULBD for 1998 (page 183), 2000 (page 100), 2003 (page 99), 2006 (page 94), 2009 (page 93), 2011 (page 95), 2014 (page 89).

'Use of Glues and Other Adhesives'

The methodology used to estimate NMVOC emissions from source category 3D3 'Other Product Use' (use of glues and other adhesives) is available in the EMEP/EEA Air Pollutant Emission Inventory Guidebook 2013, The methodology used to estimate NMVOC emissions from source category 3D3 'Other Product Use' (use of glues and other adhesives) is available in the EMEP/EEA Air Pollutant Emission Inventory Guidebook 2013 (Table 5-44).

The EMEP/EEA Air Pollutant Emission Inventory Guidebook 2013 provides default EFs and a Tier 2 methodological approach.

Table 5-44: Tier 2 Default Emission Factors for Category 3D3 'Use of Glues and Other Adhesives'

Source Category	EF_{NMVOC}	Unit
3D3 Use of Glues and Other Adhesives	522	kg/t glue

Source: EMEP/EEA Air Pollutant Emission Inventory Guidebook 2013, Source Category 2.D.3.i 'Other Product Use' (according to the nomenclature NFR), SNAP 060405, Table 3-11, page 19.

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, following the equation:

$$Consumption_{glue} = Production_{glue} + Import_{glue} - Export_{glue}$$

Where:

$Consumption_{glue}$ – total consumption of glues and other adhesives, kt/yr;

$Production_{glue}$ – amount of glues and other adhesives produced, kt/yr;

$Import_{glue}$ – amount of glues and other adhesives imported, kt/yr;

$Export_{glue.}$ – amount of glues and other adhesives exported, kt/yr.

To be noted that production of glues and other adhesives in the Republic of Moldova is insignificant and is recorded starting only with 2003 (Table 5-45).

Table 5-45: AD on Glues and Other Adhesives Production, Import and Consumption in the Republic of Moldova within 1990-2013 periods

	1990	1991	1992	1993	1994	1995	1996	1997
Glues and Other Adhesives Production, kt	NO	NO	NO	NO	NO	NO	NO	NO
Glues and Other Adhesives Import, kt	3.2508	1.7106	0.9162	0.6208	0.5598	0.4962	0.3323	0.6172
Glues and Other Adhesives Consumption, kt	3.2508	1.7106	0.9162	0.6208	0.5598	0.4962	0.3323	0.6172
	1998	1999	2000	2001	2002	2003	2004	2005
Glues and Other Adhesives Production, kt	NO	NO	NO	NO	NO	0.3611	0.6552	0.8533
Glues and Other Adhesives Import, kt	1.0852	0.7549	0.7264	0.8643	1.2217	1.3874	1.7522	1.9457
Glues and Other Adhesives Consumption, kt	1.0852	0.7549	0.7264	0.8643	1.2217	1.7485	2.4074	2.7990
	2006	2007	2008	2009	2010	2011	2012	2013
Glues and Other Adhesives Production, kt	1.4646	0.7735	0.5797	0.9211	0.9586	1.3234	1.0774	0.9397
Glues and Other Adhesives Import, kt	1.9679	1.9609	1.9713	1.4342	1.8004	1.5226	1.4106	1.2544
Glues and Other Adhesives Consumption, kt	3.4325	2.7344	2.5510	2.3553	2.7590	2.8460	2.4880	2.1940

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; 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; 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. 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 2012 and 2013".

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). Information on import activities for 1990-1994 time series is not available in the Customs Service database, thus in order to fill the gap, following the GPG recommendations (IPCC, 2000, Chapter 7, Table 7-5, page 7.19), the trend extrapolation method was used (using the regression analysis).

'Vehicles Dewaxing'

The methodology used to estimate NMVOC emissions from source category 3D3 'Other Product Use' (vehicles dewaxing after long storage and long-distance transport) is available in the EMEP/EEA Air Pollutant Emission Inventory Guidebook 2013, and is represented by the following equation:

$$E_{pollutant} = (AR_{product} \bullet EF_{technology\ pollutant}) / 10^3$$

Where:

$E_{pollutant}$ – pollutant gas emissions from vehicles dewaxing, t/yr;

$AR_{product}$ – activity rate for new vehicles import, units/yr;

$EF_{pollutant\ technology}$ – the emission factor for this pollutant technology, kg/t

The EMEP/EEA Air Pollutant Emission Inventory Guidebook 2013 provides default EFs and a Tier 2 methodological approach (Table 5-46).

Table 5-46: Tier 2 Default Emission Factors for Category 3D3 'Vehicles Dewaxing'

Source Category	EF_{NMVOC}	Unit
3D3 'Vehicles Dewaxing'	1.0	kg/car

Source: EMEP/EEA Air Pollutant Emission Inventory Guidebook 2013, Source Category 2.D.3.i 'Other Product Use' (according to the nomenclature NFR), SNAP 060409, Table 3-9, page 18.

No vehicles are produced in the Republic of Moldova. Customs Service is a primary source of information on national import operations (Table 5-47).

Table 5-47: AD on New Cars Import in the Republic of Moldova within 1990-2013 periods

	1990	1991	1992	1993	1994	1995	1996	1997
Imported vehicles – total, units	19790	15223	9515	5947	3498	2332	2334	1922
	1998	1999	2000	2001	2002	2003	2004	2005
Imported vehicles – total, units	1947	3281	1161	1841	3503	8431	7768	10030
	2006	2007	2008	2009	2010	2011	2012	2013
Imported vehicles – total, units	7477	10523	14368	7832	7923	8237	7171	9869

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.

Information on import activities for 1990-1994 time series is not available in the Customs Service database, thus in order to fill this gap, following the GPG recommendations (IPCC, 2000, Chapter 7, Table 7-5, page 7.19), the trend extrapolation method was used (using the regression analysis).

'Tobacco Combustion'

The methodology used to estimate NMVOC emissions from source category 3D3 'Other Product Use' (tobacco combustion) is available in the EMEP/EEA Air Pollutant Emission Inventory Guidebook 2013, and is represented by the following formula:

$$E_{pollutant} = (AR_{product} \bullet EF_{technology\ pollutant}) / 10^3$$

Where:

$E_{pollutant}$ – pollutant gas emissions from tobacco combustion, t/yr;

$AR_{product}$ – activity rate for tobacco products combusted, t/yr;

$EF_{pollutant\ technology}$ – the emission factor for this pollutant technology, kg/t

The EMEP/EEA Air Pollutant Emission Inventory Guidebook 2013 provides default EFs and a Tier 2 methodological approach (Table 5-48).

Table 5-48: Tier 2 Default Emission Factors for Category 3D3 'Tobacco Combustion'

Source Category	Gas	EF	Unit
3D3 Tobacco Combustion	NOx	1.80	g/ton of tobacco
	CO	55.10	
	NMVOC	4.84	

Source: EMEP/EEA Air Pollutant Emission Inventory Guidebook 2013, Source Category 2.D.3.i 'Other Product Use' (according to the nomenclature NFR), SNAP 060602, Table 3-14, page 21.

Statistical data regarding fermented tobacco, cigars and cigarettes production (Table 5-50) are available in the Statistical Yearbooks of the RM, as well as in the statistical database which can be accessed on-line on the NBS website[41].

Table 5-49: AD on Fermented Tobacco, Cigars and Cigarettes production in the Republic of Moldova within 1990-2013 periods

	1990	1991	1992	1993	1994	1995	1996	1997
Cigars and Cigarettes, billion units	9.100	9.200	8.600	8.800	8.000	7.100	9.700	9.500
Fermented Tobacco, kt	15.901	16.076	15.027	15.377	13.979	12.406	16.949	16.600
	1998	1999	2000	2001	2002	2003	2004	2005
Cigars and Cigarettes, billion units	7.512	8.731	9.262	9.421	6.310	7.126	7.050	6.195
Fermented Tobacco, kt	21.700	24.795	20.442	19.273	12.269	8.372	7.562	8.207
	2006	2007	2008	2009	2010	2011	2012	2013
Cigars and Cigarettes, billion units	5.031	4.913	7.088	5.551	8.252	7.654	6.448	3.472
Fermented Tobacco, kt	5.191	4.338	6.259	4.901	7.287	6.759	5.694	3.536

Source: NBS, Statistical Yearbooks for 1994 (page 290), 1999 (page 305), 2003 (page 395), 2006 (page 311), 2007 (page 310), 2009 (page 303), 2011 (page 304), 2013 (page 305), 2014 (page 301); 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 of 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 2012 and 2013".

Use of N_2O in Anesthesia

The methodology used to estimate N_2O emissions from source category 3D3 'Other Product Use' (use of N_2O in anesthesia) is represented by the following formula:

$$E_{pollutant} = (AR_{product} \bullet EF_{technology\ pollutant}) / 10^3$$

Where:

$E_{pollutant}$ – pollutant gas emissions from N_2O use in anesthesia, t/yr;

$AR_{product}$ – activity rate for N_2O consumption in anesthesia, t/yr;

$EF_{pollutant\ technology}$ – the emission factor for this pollutant technology, t/t (by default, 100 per cent of the whole amount of N_2O used in anesthesia is deemed to be emitted into the atmosphere).

Estimation of nitrous oxide emissions from use of N_2O in anesthesia was based on activity data provided by the Ministry of Health, as a response to the Official Letters of the Ministry of Environment (Table 5-50).

Table 5-50: Amount of Nitrous Oxide Used in Anesthesia in the Republic of Moldova within 1990-2006 periods, kg

	1990	1991	1992	1993	1994	1995	1996	1997
N_2O consumption in anesthesia	66	55	50	60	50	1	2	3
	1998	1999	2000	2001	2002	2003	2004	2005
N_2O consumption in anesthesia	5	43	44	44	44	44	50	61
	2006	2007	2008	2009	2010	2011	2012	2013
N_2O consumption in anesthesia	59	NO	NO	NO	NO	NO	NO	NO

Source: Ministry of Health, Official Letter No. 01-9/2513 dated 9.11.2007, as a response to Official Letter No. 01-07/1608 dated 15.10.2007 from the Ministry of Environment and Natural Resources; Official Letter No. 01-9/550 dated 01.03.2011, as a response to Official Letter No. 03-07/175 dated 02.02.2011 from the Ministry of Environment.

In conformity with the response to the last Letter dated 1st of March 2011, since 2007 in the Republic of Moldova N_2O is not used in anesthesia anymore.

5.5.3 Uncertainties Assessment and Time-Series Consistency

Uncertainties related to the AD on other solvents use in the Republic of Moldova vary from low for 'ink use for printing', 'domestic solvent use', 'use of glues and other adhesives', 'vehicles dewaxing', 'tobacco combustion' and 'use of N_2O in anesthesia' (about ±5 per cent), to moderate for 'hexane use in seed oil extraction' (circa ±20 per cent), in particular due to the use of conversion coefficients, that bring additional uncertainties to the initial AD provided by the statistical publications of the Republic of Moldova.

Uncertainties related to EFs are considered to be low for 'use of N_2O in anesthesia' (±1 per cent), rather moderate for 'tobacco combustion' (±20 per cent), moderate for 'ink use for printing', 'use of glues and other adhesives', 'vehicles dewaxing' (±25 per cent), and average for 'domestic solvent use'(±50 per cent).

[41] National Bureau of Statistics of the Republic of Moldova, Statistical Database: <http://statbank.statistica.md/pxweb/Dialog/varval.asp?ma=IND0301&ti=Productia+principalelor+produse+industriale%2C+1997-2009&path= ../ Database/RO/14%20IND/IND03/&lang=1>.

Thus, combined uncertainties related to GHG emissions from the 3D 'Other Solvent Use' source category can be considered low for those from the 'Use of N_2O in Anesthesia' (±5.10 per cent), rather moderate for 'tobacco combustion' (±20.62 per cent), moderate for 'ink use for printing', 'use of glues and other adhesives', 'vehicles dewaxing' (±25.50 per cent), respectively for 'seed oil extraction' (±32.02 per cent) and high for 'domestic solvent use' (±50.25 per cent).

At the same time, combined uncertainties, presented as a per cent of total sectoral emissions were estimated at circa ±6.4513 per cent for 'domestic solvent use', ±0.9164 per cent for 'use of glues and other adhesives', ±0.1507 per cent for 'ink use for printing', respectively ±0.0593 per cent for'seed oil extraction'. Uncertainties introduced in trend in sectoral emissions are rather low, the maximum value of ±1.5443 per cent being registered for domestic solvent use (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 GPG (IPCC, 2000).

5.5.4 Recalculations

3.D.1 'Printing'

The GHG emissions from the source category 3D1 'Printing' were recalculated for the period 1991 through 1994, in particular, due to the use of an updated activity data set on ink import. In comparison with results recorded in the TNC, the changes made in the process of compiling the current inventory resulted in decreased NMVOC emissions over the period between 1991 and 1993, which varied from a minimum of 3.5 per cent in 1993, to a maximum of 14.7 per cent in 1992, respectively increasing by 12.9 per cent in 1994 (Table 5-51).

Table 5-51: Comparative Results of NMVOC Emissions from 3D1 'Printing' included into the TNC and the BUR of the Republic of Moldova under the UNFCCC, Gg

	1990	1991	1992	1993	1994	1995	1996
TNC	0.2457	0.1860	0.1326	0.0846	0.0543	0.0355	0.0437
BUR	0.2457	0.1650	0.1131	0.0816	0.0613	0.0355	0.0437
Difference, %	0.0	-11.3	-14.7	-3.5	12.9	0.0	0.0
	1997	1998	1999	2000	2001	2002	2003
TNC	0.0320	0.0396	0.0293	0.0353	0.0501	0.0642	0.0727
BUR	0.0320	0.0396	0.0293	0.0353	0.0501	0.0642	0.0727
Difference, %	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	2004	2005	2006	2007	2008	2009	2010
TNC	0.0949	0.1283	0.0982	0.1141	0.1205	0.1081	0.1344
BUR	0.0949	0.1283	0.0982	0.1141	0.1205	0.1081	0.1344
Difference, %	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Abbreviations: TNC – Third National Communication; BUR – Bienniel Update Report.

As for the CO_2 emissions, in comparison with results recorded in the TNC, the changes made revealed a similar trend with decreased emissions between 1991 and 1993, varying from a minimum of 14.7 per cent in 1992, up to a maximum of 12.9 per cent in 1994 (Table 5-52).

Table 5-52: Comparative Results of CO_2 Emissions from 3D1 'Printing' included into the TNC and the BUR of the Republic of Moldova under the UNFCCC, Gg

	1990	1991	1992	1993	1994	1995	1996
TNC	0.7352	0.5566	0.3968	0.2532	0.1625	0.1063	0.1307
BUR	0.7352	0.4938	0.3385	0.2442	0.1834	0.1063	0.1307
Difference, %	0.0	-11.3	-14.7	-3.5	12.9	0.0	0.0
	1997	1998	1999	2000	2001	2002	2003
TNC	0.0956	0.1186	0.0877	0.1056	0.1500	0.1920	0.2174
BUR	0.0956	0.1186	0.0877	0.1056	0.1500	0.1920	0.2174
Difference, %	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	2004	2005	2006	2007	2008	2009	2010
TNC	0.2839	0.3839	0.2937	0.3413	0.3607	0.3234	0.4021
BUR	0.2839	0.3839	0.2937	0.3413	0.3607	0.3234	0.4021
Difference, %	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Abbreviations: TNC – Third National Communication; BUR – Bienniel Update Report.

For the 2011-2013 time series, the GHG emissions resulting from inks use for printing were estimated for the first time. The results allow assert that over the period 1990 through 2013, the NMVOC and CO_2

emissions resulting from 3D1 'Printing" decreased by 46.5 per cent: from 0.2457 Gg NMVOC in 1990, to 0.1409 Gg NMVOC in 2013; respectively from 0.7352 Gg CO_2 in 1990, to 0.4215 Gg CO_2 in 2013.

3.D.2 'Domestic Solvent Use'

The GHG emissions from the source category 3D2 'Domestic Solvents Use' were recalculated for the period 1990 through 2010, in particular, due to employing a new EF (0.703 kg NMVOC/per capita, characteristic for Eastern European countries) within this source category, available in the EMEP/EEA Air Pollutant Emission Inventory Guidebook 2013, in the detriment of the previously used (1.0 kg NMVOC/per capita), available in the EMEP/EEA Air Pollutant Emission Inventory Guidebook 2009.

In comparison with results recorded in the TNC, the changes made in the process of compiling the current inventory resulted in decreased NMVOC and CO_2 emissions, by 29.7 per cent, between 1990 and 2010 (Tables 5-53 and 5-54).

Table 5-53: Comparative Results of NMVOC Emissions from 3D1 'Domestic Solvents Use' included into the TNC and the BUR of the Republic of Moldova under the UNFCCC, Gg

	1990	1991	1992	1993	1994	1995	1996
TNC	4.3616	4.3663	4.3591	4.3478	4.3527	4.3479	4.3344
BUR	3.0662	3.0695	3.0644	3.0565	3.0599	3.0566	3.0471
Difference, %	-29.7	-29.7	-29.7	-29.7	-29.7	-29.7	-29.7
	1997	1998	1999	2000	2001	2002	2003
TNC	4.3200	4.3047	4.2930	4.2815	4.2776	4.2614	4.2421
BUR	3.0370	3.0262	3.0180	3.0099	3.0072	2.9958	2.9822
Difference, %	-29.7	-29.7	-29.7	-29.7	-29.7	-29.7	-29.7
	2004	2005	2006	2007	2008	2009	2010
TNC	4.1618	4.1479	4.1305	4.1146	4.1002	4.0900	4.0817
BUR	2.9257	2.9160	2.9037	2.8926	2.8824	2.8753	2.8694
Difference, %	-29.7	-29.7	-29.7	-29.7	-29.7	-29.7	-29.7

Abbreviations: TNC – Third National Communication; BUR – Bienniel Update Report.

Table 5-54: Comparative Results of CO_2 Emissions from 3D2 'Domestic Solvents Use' included into the TNC and the BUR of the Republic of Moldova under the UNFCCC, Gg

	1990	1991	1992	1993	1994	1995	1996
TNC	13.0499	13.0640	13.0424	13.0086	13.0233	13.0089	12.9685
BUR	9.1741	9.1840	9.1688	9.1451	9.1554	9.1453	9.1169
Difference, %	-29.7	-29.7	-29.7	-29.7	-29.7	-29.7	-29.7
	1997	1998	1999	2000	2001	2002	2003
TNC	12.9254	12.8797	12.8447	12.8102	12.7986	12.7501	12.6924
BUR	9.0866	9.0544	9.0298	9.0056	8.9974	8.9633	8.9227
Difference, %	-29.7	-29.7	-29.7	-29.7	-29.7	-29.7	-29.7
	2004	2005	2006	2007	2008	2009	2010
TNC	12.4521	12.4105	12.3585	12.3109	12.2678	12.2373	12.2124
BUR	8.7538	8.7246	8.6880	8.6546	8.6243	8.6028	8.5853
Difference, %	-29.7	-29.7	-29.7	-29.7	-29.7	-29.7	-29.7

Abbreviations: TNC – Third National Communication; BUR – Bienniel Update Report.

For the 2011-2013 time series, the GHG emissions resulting from 'domestic solvents use' were estimated for the first time. The results allow assert that during the 1990-2013 time series, the NMVOC and CO_2 emissions resulting from this category decreased by 6.8 per cent: from 3.0662 to 2.8574 Gg in case of NMVOC emissions; respectively from 9.1741 to 8.5495 Gg in case of CO_2 emissions.

3.D.3 'Other Product Use'

'Seed Oil Extraction'

The GHG emissions from the source category 3D3 'Seed Oil Extraction' were recalculated for the period 1990 through 2010, in particular, due to employing a new EF (1.57 kg NMVOC/t of seeds), available in the EMEP/EEA Air Pollutant Emission Inventory Guidebook 2013, in the detriment of the previously used (3.0 kg NMVOC/t of seeds), available in the EMEP/EEA Air Pollutant Emission Inventory Guidebook 2009, as well due to the use of an updated AD set on total oil produced in the country (including the ATULBD), respectively on the share of refined vegetable oil.

In comparison with results recorded in the TNC, the changes made in the process of compiling the current inventory resulted in decreased emissions over the period 1990 through 2010, varying from a minimum of 4.5 per cent in 1997, to a maximum of 65.3 per cent in 2009 (Table 5-55).

Table 5-55: Comparative Results of NMVOC Emissions from 3D3 'Seed Oil Extraction' included into the TNC and the BUR of the Republic of Moldova under the UNFCCC, Gg

	1990	1991	1992	1993	1994	1995	1996
TNC	0.3182	0.2948	0.0943	0.0956	0.1235	0.0746	0.0548
BUR	0.1665	0.1543	0.0740	0.0768	0.0634	0.0628	0.0481
Difference, %	-47.7	-47.7	-21.5	-19.7	-48.7	-15.8	-12.2
	1997	1998	1999	2000	2001	2002	2003
TNC	0.0439	0.0353	0.0259	0.0291	0.0601	0.0873	0.1638
BUR	0.0419	0.0293	0.0188	0.0211	0.0363	0.0474	0.0904
Difference, %	-4.5	-17.1	-27.3	-27.2	-39.6	-45.7	-44.8
	2004	2005	2006	2007	2008	2009	2010
TNC	0.2423	0.2474	0.2436	0.2569	0.2429	0.2564	0.2027
BUR	0.1335	0.1298	0.1167	0.1112	0.0940	0.0890	0.0756
Difference, %	-44.9	-47.5	-52.1	-56.7	-61.3	-65.3	-62.7

Abbreviations: TNC – Third National Communication; BUR – Bienniel Update Report.

As for the CO_2 emissions, in comparison with results recorded in the TNC, the changes made showed a similar trend with decreased emissions, varying from a minimum of 4.5 per cent in 1997, up to a maximum of 65.3 per cent in 2009 (Table 5-56).

Table 5-56: Comparative Results of CO_2 Emissions from 3D3 'Seed Oil Extraction' included into the TNC and the BUR of the Republic of Moldova under the UNFCCC, Gg

	1990	1991	1992	1993	1994	1995	1996
TNC	0.9520	0.8819	0.2821	0.2859	0.3694	0.2232	0.1639
BUR	0.4982	0.4615	0.2214	0.2296	0.1895	0.1879	0.1439
Difference, %	-47.7	-47.7	-21.5	-19.7	-48.7	-15.8	-12.2
	1997	1998	1999	2000	2001	2002	2003
TNC	0.1314	0.1056	0.0775	0.0869	0.1798	0.2612	0.4902
BUR	0.1255	0.0876	0.0564	0.0633	0.1086	0.1417	0.2706
Difference, %	-4.5	-17.1	-27.3	-27.2	-39.6	-45.7	-44.8
	2004	2005	2006	2007	2008	2009	2010
TNC	0.7249	0.7403	0.7289	0.7687	0.7267	0.7671	0.6066
BUR	0.3993	0.3884	0.3492	0.3327	0.2811	0.2662	0.2262
Difference, %	-44.9	-47.5	-52.1	-56.7	-61.3	-65.3	-62.7

Abbreviations: TNC – Third National Communication; BUR – Bienniel Update Report.

For the 2011-2013 time series, the GHG emissions resulting from solvents use for seed oil extraction were estimated for the first time. The results allow assert that between 1990 and 2013, the NMVOC and CO_2 emissions resulting from this category decreased by 75.3 per cent: from 0.1665 to 0.0412 Gg in case of NMVOC emissions; respectively from 0.4982 to 0.1233 Gg in case of CO_2 emissions.

'Use of Glues and Other Adhesives'

GHG emissions from the source category 3D3 'Use of Glues and Other Adhesives' were recalculated for the period 1990 through 2010, in particular due to employing a new EF (522 kg NMVOC/t of product) within this source category, available in the EMEP/EEA Air Pollutant Emission Inventory Guidebook 2013, in the detriment of the previously used (780 kg NMVOC/t of product), available in the EMEP/EEA Air Pollutant Emission Inventory Guidebook 2009, as well as due to the use of an updated activity data set on glues and other adhesives import in the country, between 1991 and 1994.

In comparison with results recorded in the TNC, the changes made in the process of compiling the current inventory resulted in increased NMVOC emissions over the period 1990 through 2010 (Table 5-57), varying from a minimum of 33.1 per cent in 1990, respectively for 1995-2010 time series, to a maximum of 65.7 per cent in 1992.

Table 5-57: Comparative Results of NMVOC Emissions from 3D3 'Use of Glues and Other Adhesives' included in the TNC and the BUR of the Republic of Moldova under the UNFCCC, Gg

	1990	1991	1992	1993	1994	1995	1996
TNC	2.5356	1.9505	1.3932	0.9288	0.6192	0.3870	0.2592
BUR	1.6969	0.8929	0.4782	0.3240	0.2922	0.2590	0.1735
Difference, %	-33.1	-54.2	-65.7	-65.1	-52.8	-33.1	-33.1
	1997	1998	1999	2000	2001	2002	2003
TNC	0.4814	0.8465	0.5888	0.5666	0.6741	0.9529	1.3638
BUR	0.3222	0.5665	0.3940	0.3792	0.4512	0.6377	0.9127
Difference, %	-33.1	-33.1	-33.1	-33.1	-33.1	-33.1	-33.1
	2004	2005	2006	2007	2008	2009	2010
TNC	1.8778	2.1832	2.6774	2.1329	1.9898	1.8371	2.1520
BUR	1.2567	1.4611	1.7918	1.4274	1.3316	1.2295	1.4402
Difference, %	-33.1	-33.1	-33.1	-33.1	-33.1	-33.1	-33.1

Abbreviations: TNC – Third National Communication; BUR – Bienniel Update Report.

As for the CO_2 emissions, the changes made resulted in a similar trend with decreased emissions, varying from a minimum of 33.1 per cent in 1990, respectively for 1995-2010 time series, to a maximum of 65.7 per cent in 1992 (Table 5-58).

Table 5-58: Comparative Results of CO_2 Emissions from 3D3 'Use of Glues and Other Adhesives' included into the TNC and the BUR of the Republic of Moldova under the UNFCCC, Gg

	1990	1991	1992	1993	1994	1995	1996
TNC	5.2995	4.0765	2.9118	1.9412	1.2941	0.8088	0.5418
BUR	3.5466	1.8663	0.9995	0.6772	0.6108	0.5413	0.3626
Difference, %	-33.1	-54.2	-65.7	-65.1	-52.8	-33.1	-33.1
	1997	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**
TNC	1.0061	1.7691	1.2306	1.1842	1.4090	1.9917	2.8504
BUR	0.6733	1.1840	0.8236	0.7925	0.9429	1.3329	1.9076
Difference, %	-33.1	-33.1	-33.1	-33.1	-33.1	-33.1	-33.1
	2004	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**
TNC	3.9246	4.5630	5.5957	4.4577	4.1586	3.8396	4.4977
BUR	2.6265	3.0537	3.7448	2.9832	2.7831	2.5696	3.0100
Difference, %	-33.1	-33.1	-33.1	-33.1	-33.1	-33.1	-33.1

Abbreviations: TNC – Third National Communication; BUR – Bienniel Update Report.

For the 2011-2013 time series, the GHG emissions resulting from use of glues and other adhesives were estimated for the first time. The results allow assert that over the period 1990 through 2013, the NMVOC and CO_2 emissions resulting from this category decreased by 32.5 per cent: from 1.6969 to 1.1453 Gg in case of NMVOC emissions; respectively from 3.5466 to 2.3936 Gg in cas of CO_2 emissions.

'Vehicles Dewaxing'

No recalculations were made for the GHG emissions from the 3D3 'Vehicles Dewaxing' category. The results allow assert that between 1990 and 2013, the respective emissions decreased by 50.1 per cent (Table 5-59).

Table 5-59: GHG Emissions from 3D3 'Vehicles Dewaxing' within 1990-2013 periods, Gg

	1990	1991	1992	1993	1994	1995	1996	1997
NMVOC	0.0198	0.0152	0.0095	0.0059	0.0035	0.0023	0.0023	0.0019
CO_2	0.0592	0.0455	0.0285	0.0178	0.0105	0.0070	0.0070	0.0058
	1998	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**
NMVOC	0.0019	0.0033	0.0012	0.0018	0.0035	0.0084	0.0078	0.0100
CO_2	0.0058	0.0098	0.0035	0.0055	0.0105	0.0252	0.0232	0.0300
	2006	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**
NMVOC	0.0075	0.0105	0.0144	0.0078	0.0079	0.0082	0.0072	0.0099
CO_2	0.0224	0.0315	0.0430	0.0234	0.0237	0.0246	0.0215	0.0295

'Tobacco Combustion'

GHG emissions from the source category 3D3 'Tobacco Combustion' were recalculated for the period 1990 through 2010, in particular due to employing a new EF (4.84 g NMVOC/t of tobacco, 1.8 g NO_x/t tobacco and 55.1 g CO/t tobacco) within this source category, available in the EMEP/EEA Air Pollutant Emission Inventory Guidebook 2013, in the detriment of the previously used (4.8 g NMVOC/t of tobacco, 3.5 g NO_x/t tobacco and 122 g CO/t tobacco), available in the EMEP/EEA Air Pollutant Emission Inventory Guidebook 2009.

In comparison with results recorded in the TNC, the changes made in the process of compiling the current inventory resulted in an insignificant increase of NMVOC and CO_2 emissions over the 1990-2010, respectively a decrease by 48.8 per cent of NO_x emissions and by 54.8 per cent of CO emissions. For the 2011-2013 time series, the GHG emissions resulting from tobacco combustion were estimated for the first time. The results allow assert that over the period 1990 through 2013, the respective emissions resulting from this category decreased by 77.8 per cent (Table 5-60).

Table 5-60: GHG Emissions from 3D3 'Tobacco Combustion' within 1990-2013 periods, Gg

	1990	1991	1992	1993	1994	1995	1996	1997
NMVOC	0.00008	0.00008	0.00007	0.00007	0.00007	0.00006	0.00008	0.00008
NO_x	0.00003	0.00003	0.00003	0.00003	0.00003	0.00002	0.00003	0.00003
CO	0.00088	0.00089	0.00083	0.00085	0.00077	0.00068	0.00093	0.00091
CO_2	0.00023	0.00023	0.00022	0.00022	0.00020	0.00018	0.00025	0.00024

	1998	1999	2000	2001	2002	2003	2004	2005
NMVOC	0.00011	0.00012	0.00010	0.00009	0.00006	0.00004	0.00004	0.00004
NO_x	0.00004	0.00004	0.00004	0.00003	0.00002	0.00002	0.00001	0.00001
CO	0.00120	0.00137	0.00113	0.00106	0.00068	0.00046	0.00042	0.00045
CO_2	0.00031	0.00036	0.00030	0.00028	0.00018	0.00012	0.00011	0.00012
	2006	2007	2008	2009	2010	2011	2012	2013
NMVOC	0.00003	0.00002	0.00003	0.00002	0.00004	0.00003	0.00003	0.00002
NO_x	0.00001	0.00001	0.00001	0.00001	0.00001	0.00001	0.00001	0.00001
CO	0.00029	0.00024	0.00034	0.00027	0.00040	0.00037	0.00031	0.00019
CO_2	0.00008	0.00006	0.00009	0.00007	0.00011	0.00010	0.00008	0.00005

'Use of N_2O in Anesthesia'

Within the current inventory cycle, no recalculations were performed for the N_2O emissions from the 'Use of N_2O in Anesthesia'. The results allow assert that over the 1990-2006, the respective emissions decreased by 10.6 per cent (Table 5-61). According to the information provided by the Ministry of Health, since 2007 N_2O is not longer used in anesthesia ("NO" – not occurring).

Table 5-61: N_2O Emissions from 'Use of N_2O in Anesthesia' within 1990-2006 periods, Gg

	1990	1991	1992	1993	1994	1995	1996	1997	1998
N_2O	0.000066	0.000055	0.00005	0.00006	0.00005	0.000001	0.000002	0.000003	0.000005
	1999	2000	2001	2002	2003	2004	2005	2006	2007-2013
N_2O	0.000043	0.000044	0.000044	0.000044	0.000044	0.00005	0.000061	0.000059	NO

6. AGRICULTURE SECTOR

Agriculture sector plays a significant role in the national economy of the Republic of Moldova, contributing with 12.5 per cent to its GDP (NBS, 2014). In 2013, under the agriculture sector the plant production accounted for a relatively large share – 65.0 per cent, animal breeding – for 33.3 per cent, while the services – for circa 1.7 per cent (NBS, 2014). More than 28.8 per cent of active population is employed in this sector (NBS, 2014). The overwhelming majority of agricultural workers represent small and medium agricultural production enterprises.

On January 1, 2014 the total area of the country represented 3384.6 thousand ha, including 2500.1 thousand ha (73.9 per cent) – agricultural lands; of which 1816.1 thousand ha (53.7 per cent) – arable lands; 295.3 thousand ha (8.7 per cent) – perennial plantations; 350.1 thousand ha (10.4 per cent) – hayfields and pastures; 38.4 thousand ha (1.1 per cent) – fallow lands; 465.2 thousand ha (13.7 per cent) – forests and lands covered with forest vegetation; 96.9 thousand ha (2.9 per cent) – rivers, lakes, water basins and bogs, and 322.4 thousand ha (9.5 per cent) – other lands (NBS, 2014).

According to the Land Cadaster of the Republic of Moldova, in 2013 the use of agricultural land by different agribusiness entities was as it follows: 74 state agribusiness enterprises with a total area of 270.9 thousand ha (13.4 per cent); 75 scientific research and education institutions with a total area of 22.4 thousand ha (1.1 per cent); 132 of other enterprises and auxiliary households in state ownership – 70.8 thousand ha (3.5 per cent); 52.7 thousand lands in the public property of the administrative-territorial units with a total area of 56.4 thousand ha (2.8 per cent); 185 production cooperatives with a total area of 97.8 thousand ha (4.8 per cent); 152 joint stock companies with a total area of 36.6 thousand ha (1.8 per cent); 40.0 thousand limited liability companies – 724.9 thousand ha (35.8 per cent); 381.6 thousand peasant farms – 537.2 thousand ha (26.5 per cent); 822.3 thousand lands used individually by private owners with a total area of 233.8 thousand ha (11.6 per cent); 35.4 thousand of orchard farms – 2.5 thousand ha (0.1 per cent) and 56.3 thousand of other lands with a total area of 63.6 thousand ha (3.1 per cent).

6.1 Overview

The main sources covered by 'Agriculture' sector in the Republic of Moldova include methane emissions from animal breeding, in particular from 4A 'Enteric Fermentation', 4B 'Manure Management' and nitrous oxide emissions from 4B 'Manure Management', as well as 4D 'Agricultural Soils'.

As in the Republic of Moldova rice is not cultivated and there are no savannas, no GHG emissions covered by 4C 'Rice Cultivation' and 4E 'Prescribed Burning of Savannas' were reported. GHG emissions covered by the 4F 'Field Burning of Agricultural Residues' were reported under 'Land Use, Land-Use Change and Forestry' sector (i.e., under the 5B 'Cropland'), following the recommendations set forth in the Good Practice Guidance for Land Use, Land-Use Change and Forestry (IPCC, 2003).

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.

6.1.1 Summary of Emission Trends

In 2013, 'Agriculture' sector accounted for circa 16.6 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 22.1 per cent and respectively 91.4 per cent of total emissions reported at national level.

Between 1990 and 2013, the total GHG emissions originated from the 'Agriculture' sector tended to lower values, decreasing by 58.0 per cent, from 5063.90 to 2126.73 Gg CO_2 equivalent (Table 6-1), 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 6-1: Direct GHG Emissions from 'Agriculture' Sector in the Republic of Moldova within 1990-2013 periods, Gg CO_2 equivalent

	1990	1991	1992	1993	1994	1995	1996	1997
CH_4	2148.9459	1980.4867	1923.7725	1770.4550	1722.9347	1512.0916	1389.7614	1192.0713
N_2O	2914.9531	2710.1052	2166.1256	2156.3772	1639.7445	1772.3274	1650.4940	1793.1804
Total	5063.8990	4690.5918	4089.8981	3926.8322	3362.6793	3284.4190	3040.2554	2985.2517
	1998	1999	2000	2001	2002	2003	2004	2005
CH_4	1155.1474	1064.6608	988.0274	1005.2768	1023.5898	936.4623	872.7490	846.5055
N_2O	1596.2981	1454.5548	1301.8272	1449.6586	1484.9255	1259.1527	1506.2917	1512.2939
Total	2751.4456	2519.2156	2289.8545	2454.9353	2508.5153	2195.6150	2379.0408	2358.7994
	2006	2007	2008	2009	2010	2011	2012	2013
CH_4	822.3557	658.6681	628.8797	658.7728	659.0039	620.6487	588.3672	595.7331
N_2O	1443.2063	853.7327	1471.6913	1259.2813	1441.6509	1465.8461	1051.6201	1530.9923
Total	2265.5620	1512.4009	2100.5711	1918.0542	2100.6548	2086.4947	1639.9873	2126.7254

To be noted that in 1990, CH_4 and N_2O emissions accounted for 42.4 per cent and respectively 57.6 per cent of total GHG emissions originated from the 'Agriculture' sector. By 2013, the share of CH_4 emissions decreased to 28.0 per cent, while that of N_2O emissions, on the contrary, increased up to 72.0 per cent.

Over the period under review, total GHG emissions from the 'Agriculture' sector decreased by 58.0 per cent, while CH_4 and N_2O emissions decreased respectively, by 72.3 per cent and 47.5 per cent (Figure 6-1, Table 6-2).

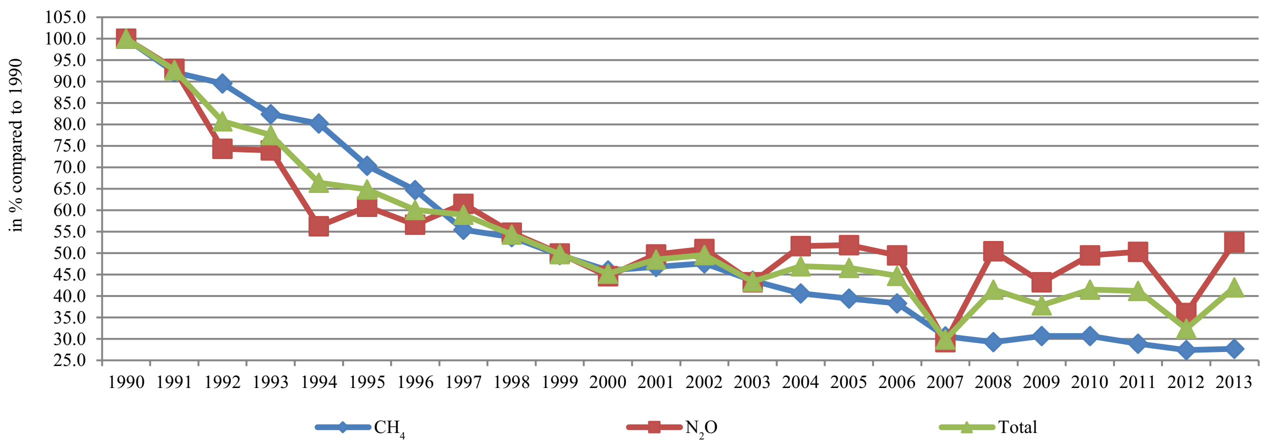


Figure 6-1: Direct GHG Emissions from 'Agriculture' sector in the Republic of Moldova within 1990-2013

Table 6-2: Total Methane and Nitrous Oxide Emissions from 'Agriculture' sector by Category, within 1990-2013 periods, Gg

	1990	1991	1992	1993	1994	1995	1996	1997
4A Enteric Fermentation	87.6290	81.2261	79.7791	75.0063	73.0080	64.8174	59.6366	51.3958
4B Manure management	14.7018	13.0828	11.8291	9.3011	9.0365	7.1870	6.5425	5.3695
Total CH_4 Emissions from Agriculture Sector	**102.3308**	**94.3089**	**91.6082**	**84.3074**	**82.0445**	**72.0044**	**66.1791**	**56.7653**
4B Manure management	4.4577	4.0464	3.5193	2.9555	2.8481	2.7252	2.6624	2.2291
4D Agricultural soils	4.9454	4.6959	3.4682	4.0005	2.4414	2.9920	2.6618	3.5553
Total N_2O Emissions from Agriculture Sector	**9.4031**	**8.7423**	**6.9875**	**6.9561**	**5.2895**	**5.7172**	**5.3242**	**5.7845**
	1998	1999	2000	2001	2002	2003	2004	2005
4A Enteric Fermentation	49.8940	46.1613	43.4216	44.2080	45.1402	41.2406	38.4878	37.0710
4B Manure management	5.1130	4.5368	3.6273	3.6623	3.6021	3.3528	3.0717	3.2388
Total CH_4 Emissions from Agriculture Sector	**55.0070**	**50.6981**	**47.0489**	**47.8703**	**48.7424**	**44.5934**	**41.5595**	**40.3098**
4B Manure management	2.0630	1.8491	1.6121	1.6352	1.6709	1.5941	1.5693	1.7119
4D Agricultural soils	3.0864	2.8430	2.5873	3.0411	3.1191	2.4677	3.2897	3.1665
Total N_2O Emissions from Agriculture Sector	**5.1493**	**4.6921**	**4.1994**	**4.6763**	**4.7901**	**4.0618**	**4.8590**	**4.8784**
	2006	2007	2008	2009	2010	2011	2012	2013
4A Enteric Fermentation	35.8772	28.9864	27.5975	28.7081	28.5037	26.8515	25.3644	25.7746
4B Manure management	3.2826	2.3788	2.3492	2.6620	2.8774	2.7032	2.6531	2.5936
Total CH_4 Emissions from Agriculture Sector	**39.1598**	**31.3651**	**29.9467**	**31.3701**	**31.3811**	**29.5547**	**28.0175**	**28.3682**
4B Manure management	1.7802	1.3455	1.3457	1.5352	1.6089	1.5356	1.3743	1.2761
4D Agricultural soils	2.8753	1.4084	3.4017	2.5270	3.0416	3.1930	2.0180	3.6626
Total N_2O Emissions from Agriculture Sector	**4.6555**	**2.7540**	**4.7474**	**4.0622**	**4.6505**	**4.7285**	**3.3923**	**4.9387**

Table 6-3 allow to assert that 4A 'Enteric Fermentation' was the largest source of CH_4 emissions in the time periods from 1990 through 2013 (with a share varying between 85.6 and 92.6 per cent of the total), while 4D 'Agricultural Soils', was the most relevant source of N_2O emissions (with a share varying between 46.2 and 74.2 per cent of the total).

Table 6-3: Breakdown of the Republic of Moldova's 'Agriculture' sector Methane and Nitrous Oxide Emissions by Category within 1990-2013 periods

	1990	1991	1992	1993	1994	1995	1996	1997
CH_4 from 4A Enteric Fermentation, % of the total	85.6	86.1	87.1	89.0	89.0	90.0	90.1	90.5
CH_4 from 4B Manure Management, % of the total	14.4	13.9	12.9	11.0	11.0	10.0	9.9	9.5
N_2O from 4B Manure Management, % of the total	47.4	46.3	50.4	42.5	53.8	47.7	50.0	38.5
N_2O from 4D Agricultural Soils, % of the total	52.6	53.7	49.6	57.5	46.2	52.3	50.0	61.5
	1998	1999	2000	2001	2002	2003	2004	2005
CH_4 from 4A Enteric Fermentation, % of the total	90.7	91.1	92.3	92.3	92.6	92.5	92.6	92.0
CH_4 from 4B Manure Management, % of the total	9.3	8.9	7.7	7.7	7.4	7.5	7.4	8.0
N_2O from 4B Manure Management, % of the total	40.1	39.4	38.4	35.0	34.9	39.2	32.3	35.1
N_2O from 4D Agricultural Soils, % of the total	59.9	60.6	61.6	65.0	65.1	60.8	67.7	64.9
	2006	2007	2008	2009	2010	2011	2012	2013
CH_4 from 4A Enteric Fermentation, % of the total	91.6	92.4	92.2	91.5	90.8	90.9	90.5	90.9
CH_4 from 4B Manure Management, % of the total	8.4	7.6	7.8	8.5	9.2	9.1	9.5	9.1
N_2O from 4B Manure Management, % of the total	38.2	48.9	28.3	37.8	34.6	32.5	40.5	25.8
N_2O from 4D Agricultural Soils, % of the total	61.8	51.1	71.7	62.2	65.4	67.5	59.5	74.2

6.1.2 Key Categories

The results of key category analysis (including LULUCF) carried out following a Tier 1 approach (IPCC, 2000), are provided in Chapter 1.5, as well as in the Annex 1. Table 6-4 provides information on identified key categories under the 'Agriculture' sector (Table 6-4).

Table 6-4: Key Categories Identified under the 'Agriculture' sector

IPCC Category	GHG	Source Category	Key Categories
4A	CH_4	CH_4 emissions from enteric fermentation	Yes (L, T)
4B	CH_4	CH_4 emissions from manure management	No
4B	N2O	Direct N_2O emissions from manure management	Yes (L, T)
4B	N_2O	Indirect N_2O emissions from manure management	No
4D	N2O	Direct N_2O emissions from agricultural soils	Yes (L, T)
4D	N_2O	Indirect N_2O emissions from agricultural soils	Yes (L, T)

Abbreviations: L – Level Assessment; T – Trend Assessment.

6.1.3 Methodological Issues

Emissions covered by 4A 'Enteric Fermentation', 4B 'Manure Management' and 4D 'Agriculture Soils' were estimated using both, the Tier 1 methodological approach and default EFs values (IPCC, 2006), as well as the Tier 2 methodological approach (IPCC, 2006) 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 6-5, while a more detailed description is available in sub-chapters 6.2-6.4 of the NIR.

Table 6-5: Summary of Methods Used to Estimate GHG Emissions for the 'Agriculture' sector

IPCC Category	Source Category	CH_4		N_2O	
		Method	EF	Method	EF
4A	Enteric Fermentation	T2, T1	CS, D		
4B	Manure management	T2, T1	CS, D	T2, T1	CS, D
4D	Agricultural soils			T3, T1	CS, D

Abbreviations: T1 – Tier 1 Method; T2 – Tier 2 Method; T3 – Tier 3 Method; CS – Country Specific; D – Default; EF – Emission Factors

6.1.4 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 6.2-6.4 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 ±17.91 per cent. The uncertainties introduced in trend in sectoral emissions were estimated at ±5.99 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 (IPCC, 2000).

6.1.5 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 (IPCC, 2000). 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 GPG (IPCC, 2000), GHG emissions were estimated using AD and national factors and parameters from official sources of reference.

6.1.6 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), as well as due to précising/updating country specific EFs.

In comparison with the results included into the TNC, the performed recalculations resulted in decreased values of direct GHG emissions within 1990-1997 and 2002-2010, varying from a minimum of 0.1 per cent in 1997, up to a maximum of 7.1 per cent in 1991, with the exception of 1998-2001 time series when an insignificant increase was recorded (Table 6-6). The results of recalculations performed at the category level are presented in sub-chapters 6.2-6.4 of the NIR.

Table 6-6: Recalculated GHG Emissions under the 'Agriculture' sector for 1990-2010, included in the TNC and the BUR of the RM under the UNFCCC, Gg CO_2 equivalent

	1990	1991	1992	1993	1994	1995	1996
TNC	5120.2	5049.3	4154.2	4003.3	3409.9	3359.1	3071.8
BUR	5063.9	4690.6	4089.9	3926.8	3362.7	3284.4	3040.3
Difference, %	-1.1	-7.1	-1.5	-1.9	-1.4	-2.2	-1.0
	1997	1998	1999	2000	2001	2002	2003
TNC	2987.3	2731.8	2488.5	2277.0	2454.1	2524.6	2196.9
BUR	2985.3	2751.4	2519.2	2289.9	2454.9	2508.5	2195.6
Difference, %	-0.1	0.7	1.2	0.6	0.0	-0.6	-0.1
	2004	2005	2006	2007	2008	2009	2010
TNC	2401.2	2373.4	2268.2	1515.1	2117.7	1924.9	2132.4
BUR	2379.0	2358.8	2265.6	1512.4	2100.6	1918.1	2100.7
Difference, %	-0.9	-0.6	-0.1	-0.2	-0.8	-0.4	-1.5

Abbreviations: TNC – Third National Communication; BUR – Biennial Update Report.

6.1.7 Assessment of Completeness

The current inventory covers greenhouse gas emissions from 3 categories: 4A 'Enteric Fermentation', 4B 'Manure Management' and 4D 'Agricultural Soils' (Table 6-7).

Table 6-7: Assessment of Completeness of GHG Emissions under the 'Agriculture' sector

IPCC Category	Source Category	CH_4	N_2O
4A	Enteric Fermentation	X	NO
4B	Manure Management	X	X
4C	Rice Cultivation	NO	NO
4D	Agricultural Soils	NE	X
4E	Prescribed Burning of Savannas	NO	NO
4F	Field Burning of Agricultural Residues	IE	IE

Abbreviations: X – source categories included in the inventory; NO – Not Occurring; NE – Not Estimated; IE – Included Elsewhere.

As in the RM there are no savannas and rice is not cultivated, respectively no GHG emissions have been registered from the 4C 'Rice Cultivation' and 4E 'Prescribed Burning of Savannas'. GHG emissions from the 4F 'Field Burning of Agricultural Residues' were reported under LULUCF Sector, specifically under the 5B 'Cropland'. CH_4 emissions from 4D 'Agricultural Soils' were not estimated due to lack of estimation methodology.

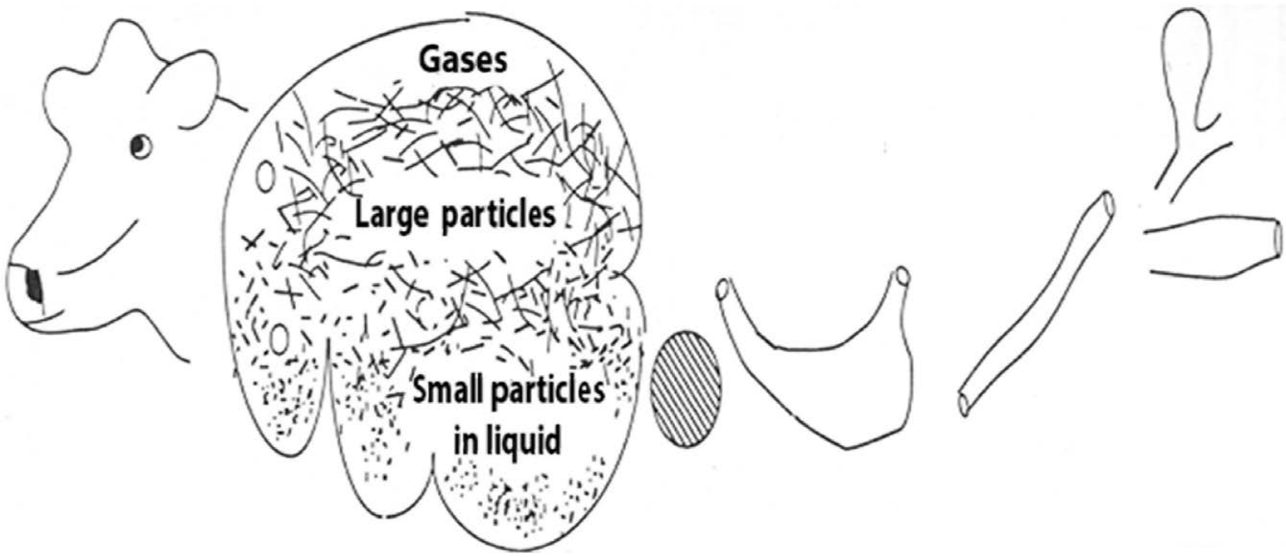
6.1.8 Planned Improvements

Planned improvements at the source categories level within the Agriculture sector are described in detail in respective sub-chapters (6.2-6.4) of the NIR.

6.2 Enteric Fermentation (Category 4A)

6.2.1 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 6-2), 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[42].



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 6-2: Organs, processes and timing for forage digestion by ruminant livestock

About 5 per cent of ingested feed gross energy is lost through gaseous emissions (Figure 6-3). Thus the problem of reducing the gas emissions within the feed fermentation process is important not only in terms of environmental protection, but also from economic point of view.

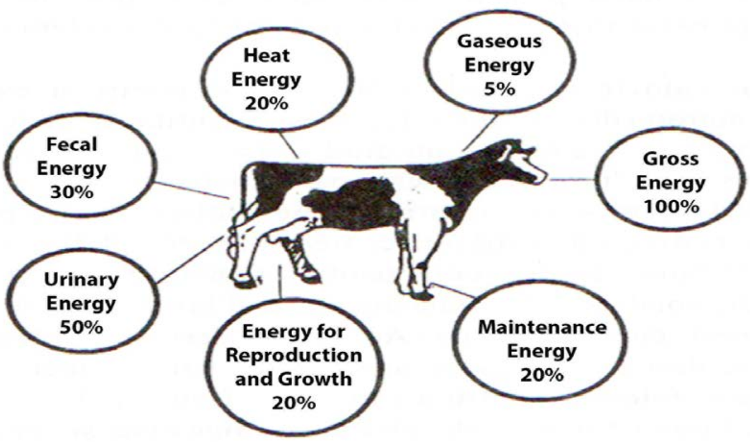


Figure 6-3: Intake Energy for Dairy Cows [43]

[42] „Technical Guideline for Milk Production", Babcock International Institute for Dairy Research and Development, USA, 1996 (<www.animals-feed.info>)
[43] Pârvu Gh, Costea Mihaela, Pirvu M., Nicolae B. 'Treaty on Animal Nutrition' Bucharest, 2003, page 368.

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 4A '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.

6.2.2 Activity Data, Methodological Issues and Emission Factors

Estimation of methane emissions covered by the 4A '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 Republic of Moldova 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 4A '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 (IPCC, 2006). While following the Tier 1 methodology, CH_4 emissions from the 4A 'Enteric Fermentation' were estimated on the basis of equations 10.19 and 10.20 from 2006 IPCC Guidelines:

$$Total\ CH_{4\ enteric} = \Sigma_i\ E_i\ [EF_{(T)} \bullet (N_{(T)}/10^6)]$$

Where:

Total $CH_{4\ enteric}$ – total CH_4 emissions from Enteric Fermentation, Gg 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 6-8) multiplied by national AD on the animal population data (Table 6-9).

Table 6-8: Default EFs for Western Europe (WE) and Eastern Europe (EE) used to estimate CH_4 emissions from 4A 'Enteric Fermentation' Source Category

	EF, kg CH_4/head/year		Comments
	WE	EE	
Dairy cows	109	89	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 4A 'Enteric Fermentation').

Divide livestock population into subgroups. Following IPCC GPG (2000) and 2006 IPCC Guidelines recommendation, it is *good practice* to divide the livestock population into sub-categories (Table 6-9).

Table 6-9: Animal Population Data in the Republic of Moldova within 1990-2013, thousand heads

	1990	1991	1992	1993	1994	1995	1996	1997
Cattle	1060.7	1000.5	970.1	882.6	832.0	729.5	646.3	549.7
...Dairy Cows	395.2	397.1	403.2	401.8	402.6	380.8	355.4	323.7
…Other Cattle	665.5	603.4	566.9	480.7	429.4	348.7	290.9	226.0
Sheep and Goats	1281.9	1288.8	1357.2	1437.3	1501.9	1423.0	1372.4	1235.3
Sheep	1244.8	1239.3	1294.3	1362.5	1410.4	1328.2	1273.7	1139.3
Goats	37.1	49.5	62.9	74.7	91.5	94.7	98.7	95.9
Horses	47.2	48.4	51.4	54.5	58.2	61.6	63.3	65.4
Asses and Mules	1.7	1.8	2.1	2.2	2.9	3.2	3.1	3.0
Swine	1850.1	1753.0	1487.4	1082.3	1046.8	1014.6	950.1	797.5
Poultry	24625.0	23715.0	17128.0	12809.2	13448.3	13744.9	12364.9	12363.9
…Chickens	20234.4	19607.1	13271.0	9516.6	9957.4	10199.5	9137.4	9112.0
…Geese	1335.5	1321.8	1300.4	1378.9	1457.0	1487.2	1357.9	1372.3
…Ducks	2165.7	1914.7	1736.5	1198.9	1284.8	1293.1	1166.6	1169.5
…Turkeys	889.3	871.3	820.2	714.8	749.0	765.1	703.0	710.1
Rabbits	283.0	250.8	298.5	262.4	237.2	209.3	189.8	176.8
	1998	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**
Cattle	532.4	482.4	445.4	453.6	454.7	409.1	359.5	339.8
...Dairy Cows	318.4	306.9	298.5	300.1	304.8	277.7	249.0	233.1
…Other Cattle	214.0	175.5	146.9	153.5	149.9	131.5	110.5	106.7
Sheep and Goats	1147.2	1055.5	962.1	971.7	978.4	958.4	959.8	954.3
Sheep	1050.5	953.2	850.7	857.0	849.1	834.8	838.1	832.8
Goats	96.7	102.4	111.4	114.6	129.2	123.6	121.7	121.5
Horses	68.5	72.0	76.0	81.6	82.6	81.4	75.8	72.0
Asses and Mules	3.2	3.4	3.8	4.3	4.0	4.3	4.0	3.7
Swine	928.0	751.3	492.7	489.2	550.1	476.4	422.3	493.0
Poultry	13046.0	13730.1	13624.9	14730.4	15525.5	16194.2	17881.6	22771.6
…Chickens	9557.0	9992.5	9952.9	10947.5	11474.7	12182.9	13556.7	17193.3
…Geese	1470.0	1581.6	1550.6	1589.2	1777.4	1780.2	1828.0	2120.3
…Ducks	1264.8	1349.4	1325.3	1367.5	1423.3	1461.9	1592.6	2394.1
…Turkeys	754.2	806.6	796.2	826.2	850.1	769.3	904.4	1063.9
Rabbits	185.9	182.6	161.3	191.4	190.7	205.4	239.1	278.9
	2006	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**
Cattle	326.9	253.7	238.4	243.0	236.4	224.4	210.6	208.0
...Dairy Cows	222.0	180.8	171.8	173.2	166.1	156.0	145.5	141.6
…Other Cattle	104.9	72.9	66.6	69.8	70.3	68.4	65.1	66.4
Sheep and Goats	962.5	866.4	879.6	929.7	920.6	846.2	836.9	861.9
Sheep	848.7	765.5	774.0	816.7	801.2	722.0	706.4	724.9
Goats	113.8	100.9	105.6	112.9	119.4	124.2	130.4	137.1
Horses	69.3	60.5	57.4	56.1	53.6	50.9	47.5	46.0
Asses and Mules	3.6	3.1	3.2	2.9	2.8	2.5	2.4	2.1
Swine	568.3	320.8	302.9	403.6	511.7	471.7	438.4	444.5
Poultry	23014.6	17500.6	18652.1	22880.2	23671.7	19669.2	15766.3	11931.9
…Chickens	17318.1	14118.4	15285.5	18729.6	19338.4	16096.5	13121.2	10080.5
…Geese	2111.5	1342.2	1277.2	1497.4	1600.2	1351.6	1028.5	718.6
…Ducks	2551.0	1435.5	1501.7	1981.8	2013.6	1622.1	1166.9	822.3
…Turkeys	1034.0	604.5	587.8	671.4	719.5	599.0	449.6	310.6
Rabbits	326.0	263.4	248.5	274.5	277.0	277.4	267.0	296.2

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 1990-2013); Statistical Yearbooks of ATULBD for 1998 (page 224), 2000 (page 114), 2002 (page 118), 2006 (page 109), 2010 (page 110), 2014 (page 104).

Average daily feed intake per day. For each representative animal categories defined, is required the information on average daily feed intake (IPCC, 2006). 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 6-10), as well as by the scientific literature.

Table 6-10: Livestock and Poultry Weight, by species and sub-categories, in the Republic of Moldova within 1990-2013 periods, kg

	1990	1991	1992	1993	1994	1995	1996	1997
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
Dairy Cows	476	443	430	415	413	412	411	452
Breeding Males	580	562	550	545	540	539	537	551
Swine from all sub-categories, including:	145	143	132	140	118	109	100	55
Female sows	189	186	181	185	176	169	162	144
Sheep and Goats	43	44	43	43	44	39	39	35

	1990	1991	1992	1993	1994	1995	1996	1997
Horses, including:	376	326	341	344	369	356	340	276
Female horses older than 3 years and Stallions	433	381	396	399	414	401	382	308
Poultry of all species and ages	1.74	1.69	1.54	1.49	1.5	1.43	1.28	1.38
Average weight per head sold to population, kg:								
Cattles, including	81	92	107	100	139	167	182	196
Dairy Cows	475	430	425	414	398	396	392	387
Swine	10	10	10	11	11	11	12	14
Sheep and Goats	20	21	22	21	23	27	27	27
Horses	161	167	179	171	170	213	220	227
Poultry of all species and ages	0.15	0.11	0.14	0.20	0.24	0.21	0.18	0.15
Average weight per head bought from population, kg:								
Cattles, including	403	380	391	370	323	271	245	219
Dairy Cows	526	443	396	405	397	393	391	389
Swine	145	143	132	140	110	105	107	109
Sheep and Goats	43	44	43	43	44	44	44	44
Horses	391	316	297	344	352	329	318	306
Poultry of all species and ages	1.61	1.59	1.54	1.49	1.50	0.96	0.68	0.41
Average weight per head sold for slaughter, kg:								
Cattles, including	NA	NA	NA	NA	288	266	264	248
Dairy Cows	NA	NA	NA	NA	400	395	391	385
Swine	NA	NA	NA	NA	119	98	100	102
Sheep and Goats	NA	NA	NA	NA	31	29	29	25
Horses	NA	NA	NA	NA	358	355	340	306
Poultry of all species and ages	NA	NA	NA	NA	1.67	1.58	1.65	1.39
	1998	1999	2000	2001	2002	2003	2004	2005
Average Weight per head at the end of the year, kg:								
Cattles from all sub-categories, including:	308	303	294	297	294	290	300	293
Dairy Cows	443	439	435	434	434	431	435	429
Breeding Males	542	539	533	535	534	532	535	531
Swine from all sub-categories, including:	51	46	56	49	47	54	51	50
Female sows	141	137	145	139	137	145	141	138
Sheep and Goats	35	35	35	33	33	33	33	33
Horses, including:	282	279	285	283	277	277	282	275
Female horses older than 3 years and Stallions	314	311	317	315	309	309	314	307
Poultry of all species and ages	1.62	1.65	1.62	1.57	1.6	1.29	1.35	1.39
Average weight per head sold to population, kg:								
Cattles, including	187	239	258	193	176	246	183	161
Dairy Cows	395	392	394	338	391	384	365	346
Swine	13	23	27	18	17	32	23	13
Sheep and Goats	29	29	29	28	26	29	25	29
Horses	257	270	282	285	270	256	254	246
Poultry of all species and ages	0.14	0.16	0.14	0.17	0.21	0.21	0.20	0.27
Average weight per head bought from population, kg:								
Cattles, including	236	308	283	293	286	283	276	253
Dairy Cows	391	392	393	383	414	402	397	400
Swine	85	62	83	51	47	62	51	45
Sheep and Goats	37	34	31	30	30	31	26	32
Horses	304	281	284	278	285	290	254	296
Poultry of all species and ages	0.47	0.10	0.39	0.10	0.12	0.30	0.06	0.14
Average weight per head sold for slaughter, kg:								
Cattles, including	245	257	244	241	261	252	247	264
Dairy Cows	375	381	384	372	387	374	382	386
Swine	92	68	62	63	77	71	73	82
Sheep and Goats	24	26	24	25	26	24	26	25
Horses	269	250	307	267	365	285	261	273
Poultry of all species and ages	1.44	1.51	1.35	1.69	1.61	1.65	1.67	1.80
	2006	2007	2008	2009	2010	2011	2012	2013
Average Weight per head at the end of the year, kg:								
Cattles from all sub-categories, including:	297	284	286	289	291	322	318	310
Dairy Cows	427	425	405	409	420	421	427	430
Breeding Males	529	475	480	478	480	467	474	431
Swine from all sub-categories, including:	51	51	56	56	55	57	59	54
Female sows	140	137	141	137	141	155	167	176
Sheep and Goats	34	33	33	35	35	35	36	38
Horses, including:	297	297	308	302	307	304	320	326
Female horses older than 3 years and Stallions	322	339	342	346	345	343	342	343
Poultry of all species and ages	1.5	1.36	1.26	1.28	1.28	1.28	1.23	1.31
Average weight per head sold to population, kg:								
Cattles, including	163	229	170	209	176	137	169	200
Dairy Cows	373	398	364	423	410	394	356	408
Swine	30	33	22	19	27	45	32	56
Sheep and Goats	27	28	30	26	29	25	26	16
Horses	274	272	290	303	269	311	257	339
Poultry of all species and ages	0.35	0.41	0.39	0.34	0.30	0.37	0.45	0.69
Average weight per head bought from population, kg:								

	2006	2007	2008	2009	2010	2011	2012	2013
Cattles, including	282	303	268	265	275	280	294	307
Dairy Cows	406	408	375	390	417	427	426	440
Swine	57	69	38	33	34	38	33	31
Sheep and Goats	36	32	32	32	30	30	43	45
Horses	332	293	310	265	298	312	381	347
Poultry of all species and ages	0.78	0.12	0.15	0.16	0.17	0.18	0.26	0.21
Average weight per head sold for slaughter, kg:								
Cattles, including	285	297	273	306	292	322	317	309
Dairy Cows	361	372	395	412	386	392	420	413
Swine	87	92	89	95	94	108	103	98
Sheep and Goats	24	26	24	26	28	25	43	28
Horses	309	244	255	316	297	264	381	343
Poultry of all species and ages	1.92	1.91	2.02	1.88	1.91	2.3	2.14	2.10

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 1990-2013).

As for cattle[44], 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 6-11. 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 6-11: 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) [45]*, g/day.* The information on daily actual weight gain reported in Republic of Moldova within 1990-2013 periods for cattle and swine is presented in Table 6-12.

Table 6-12: Average Daily Weight Gain Characteristic for Cattle and Swine in the Republic of Moldova within 1990-2013 periods

		1990	1991	1992	1993	1994	1995	1996	1997
Daily weight gain, g	cattle	515	421	425	376	363	223	203	181
	swine	304	117	110	89	94	148	171	189
		1998	1999	2000	2001	2002	2003	2004	2005
Daily weight gain, g	cattle	230	192	217	260	287	262	275	321
	swine	222	117	107	134	147	136	166	187
		2006	2007	2008	2009	2010	2011	2012	2013
Daily weight gain, g	cattle	323	297	325	378	345	366	379	355
	swine	200	218	268	311	317	339	398	402

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 1990-2013).

Average Annual Milk Production per One Cow. In the past 20 years, the average productivity of dairy cows in the Republic of Moldova varied between the maximum of 3735 kg of milk per year in 1990 and a minimum of 1957 kg of milk per year in 1997 (Table 6-13) although the potential is much higher (Annex 3-3).

Table 6-13 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).

[44] 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).
[45] 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 6-13: Average Annual Milk Production per one Cow in the Republic of Moldova within1990-2013 periods, kg/head/year

	1990	1991	1992	1993	1994	1995	1996	1997
Total national average annual milk production per one cow	3735	3248	2841	2398	2189	2043	2021	1957
Average annual milk production per one cow at agricultural enterprises and farm households	3975	3394	3026	2413	2245	2207	2051	1687
Average annual milk production per one cow at individual farms	2940	2815	2421	2100	2097	2125	2029	2038
	1998	1999	2000	2001	2002	2003	2004	2005
Total national average annual milk production per one cow	2040	2030	2039	2072	2111	2126	2480	2800
Average annual milk production per one cow at agricultural enterprises and farm households	2001	2036	2179	2447	2710	2493	2561	3018
Average annual milk production per one cow at individual farms	2048	2038	2028	2052	2081	2110	2477	2792
	2006	2007	2008	2009	2010	2011	2012	2013
Total national average annual milk production per one cow	2807	2871	3011	3316	3435	3438	3425	3607
Average annual milk production per one cow at agricultural enterprises and farm households	2913	2710	2743	3098	2993	3224	3380	3225
Average annual milk production per one cow at individual farms	2803	2877	3020	3323	3449	3444	3426	3621

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 1990-2013)

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 Republic of Moldova (Table 6-14).

Table 6-14: Average Daily Milk Production per one Cow in the Republic of Moldova within 1990-2013 periods, kg/head/day

	1990	1991	1992	1993	1994	1995	1996	1997
Total national average daily milk production per one cow	10.2	8.9	7.8	6.6	6.0	5.6	5.5	5.4
Average daily milk production per one cow at agricultural enterprises and farm households	10.9	9.3	8.3	6.6	6.2	6.0	5.6	4.6
Average daily milk production per one cow at individual farms	8.1	7.7	6.6	5.8	5.7	5.8	5.5	5.6
	1998	1999	2000	2001	2002	2003	2004	2005
Total national average daily milk production per one cow	5.6	5.6	5.6	5.7	5.8	5.8	6.8	7.7
Average daily milk production per one cow at agricultural enterprises and farm households	5.5	5.6	6.0	6.7	7.4	6.8	7.0	8.3
Average daily milk production per one cow at individual farms	5.6	5.6	5.5	5.6	5.7	5.8	6.8	7.6
	2006	2007	2008	2009	2010	2011	2012	2013
Total national average daily milk production per one cow	7.7	7.9	8.2	9.1	9.4	9.4	9.4	9.9
Average daily milk production per one cow at agricultural enterprises and farm households	8.0	7.4	7.5	8.5	8.2	8.8	9.2	8.8
Average daily milk production per one cow at individual farms	7.7	7.9	8.3	9.1	9.4	9.4	9.4	9.9

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 1990-2013).

Further, once the big collective farms collapsed and the livestock concentrated in private sector (at present, according to the NBS, circa 94 per cent of total cattle of the Republic of Moldova is in the private sector[46]), 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 recent years the protein deficit in the cattle diet exceeds 20 per cent (Bucataru, Cosman, Holban, 2006), being the main reason of poor productivity indicators, in particular during the 1993-2003 period. Over the 2003-2013 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

[46] NBS on-line database: <http://statbank.statistica.md/pxweb/Database/RO/16%20AGR/AGR03/AGR03.asp>.

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 6-15 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 2013.

Table 6-15: Average Milk Production per Sheep and Goats at the Individual Farms in the Republic of Moldova within 1990-2013 periods, kg/head/year

	1990	1991	1992	1993	1994	1995	1996	1997
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
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
	1998	1999	2000	2001	2002	2003	2004	2005
Total national average annual milk production per one goat	125.0	106.0	57.0	57.0	59.0	58.0	65.0	112.0
Total national average annual milk production per one sheet	18.9	20.0	20.0	20.0	24.0	26.0	21.0	32.0
	2006	2007	2008	2009	2010	2011	2012	2013
Total national average annual milk production per one goat	137.0	143.0	139.0	147.0	149.0	136.9	168.8	201.3
Total national average annual milk production per one sheet	30.0	33.0	35.0	36.0	36.0	34.6	32.7	37.1

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 1990-2013)

Average Wool Production per Sheep. The default value used is 4 kg/year/head (*IPCC, 2000*). According the statistical data, in the Republic of Moldova the value of this indicator varied over the period from 1990 through 2013 between 1.8 and 2.3 kg of wool collected per year from one sheep (Table 6-16). Local goats can yield 1-2 kilograms of wool per year.

Table 6-16: Average Wool Production from Sheep at the Individual Farms in the Republic of Moldova within 1990-2013 periods, kg/head/year

	1990	1991	1992	1993	1994	1995	1996	1997
Average annual amount of wool sheared per sheep	2.30	2.30	2.10	1.90	2.00	2.00	1.90	2.00
	1998	1999	2000	2001	2002	2003	2004	2005
Average annual amount of wool sheared per sheep	2.00	1.90	1.80	2.30	2.20	2.00	2.10	2.20
	2006	2007	2008	2009	2010	2011	2012	2013
Average annual amount of wool sheared per sheep	2.00	1.80	1.70	1.80	1.76	1.66	1.25	1.64

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 1990-2013)

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 <15ºC are defined as cold climate areas; areas with average annual temperatures between 15ºC and 25ºC inclusively are defined as moderate climate areas, and areas with average annual temperatures >25ºC 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 6-17).

Table 6-17: Average Annual Temperature in Different Regions of the Republic of Moldova within 1990-2013 periods, in ºC

Geographic areas	1990	1991	1992	1993	1994	1995	1996	1997
North	9.5	8.0	8.5	7.8	9.5	8.4	7.1	7.7
Centre	11.3	9.4	10.1	9.4	11.3	10.0	9.1	9.4
South	11.4	9.3	10.2	9.3	11.3	10.0	9.1	9.1
Geographic areas	1998	1999	2000	2001	2002	2003	2004	2005
North	8.2	9.2	9.7	8.8	9.5	8.6	9.0	8.7
Centre	10.3	11.0	11.2	10.3	10.8	9.8	10.3	10.5
South	10.1	10.9	11.2	10.4	11.0	10.3	10.9	10.8
Geographic areas	2006	2007	2008	2009	2010	2011	2012	2013
North	9.7	9.6	8.9	9.1	9.3	9.4	9.7	9.6
Centre	11.3	11.4	10.6	10.5	11.2	11.1	11.3	11.4
South	11.8	11.8	11.2	10.6	11.7	11.5	11.8	11.8

Source: NBS, Statistical Yearbooks of the RM for 1991 (page 207), 1994 (page 31), 1999 (page 13), 2006 (page 15), 2011 (page 15), 2013 (page 15), 2014 (page 15).

Percentage of females that give birth in a year (%)[47]. Table 6-18 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 2013.

[47] 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 10.73-74.

Table 6-18: Live Products Produced by 100 Females at Publicly Owned Agricultural Enterprises in the Republic of Moldova within 1990-2013 periods

	1990	1991	1992	1993	1994	1995	1996	1997
Calves from cows	86	80	79	75	72	66	65	58
Pigs from sows	1466	1317	1569	1223	989	983	1019	892
Lambs from sheep giving birth	91	84	80	79	78	76	75	73
Young equines	25	24	23	23	23	21	19	19
	1998	1999	2000	2001	2002	2003	2004	2005
Calves from cows	61	55	58	65	69	63	60	72
Pigs from sows	1187	772	434	869	967	558	689	997
Lambs from sheep giving birth	75	68	71	79	81	75	79	84
Young equines	20	17	18	23	22	21	18	23
	2006	2007	2008	2009	2010	2011	2012	2013
Calves from cows	66	63	62	67	63	71	63	53
Pigs from sows	949	782	1015	1222	1040	1136	1069	1158
Lambs from sheep giving birth	80	73	81	83	73	82	88	94
Young equines	19	17	18	19	18	19	17	13

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 1990-2013).

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)[48]. 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 67 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 and for the period 2009 through 2013 the average value of DE was accepted at the level of 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 GPG (IPCC, 2000) and 2006 IPCC Guidelines (IPCC, 2006) provide equations (Table 6-19) that were used to calculate the average amount of gross energy required for animal maintenance and other relevant vital activities.

6. AGRICULTURE SECTOR

Table 6-19: Summary of Equations Used to Estimate Daily Gross Energy Intake for Cattle, Sheep and Goats for maintenance and other relevant vital activities

Metabolic Function	Equations for cattle		Equations for sheep and goats	
	IPCC, 2000	IPCC, 2006	IPCC, 2000	IPCC, 2006
Maintenance (NE_m)	4.1	10.3	4.1	10.3
Activity (NE_a)	4.2a	10.4	4.2b	10.5
Growth (NE_g)	4.3a	10.6	4.3b	10.7
Weight loss ($NE_{mobilised}$)	4.4a and 4.4b	NA	NA	NA
Lactation (NE_l)	4.5a	10.8	4.5b and 4.5c	10.9 and 10.10
Draft Power (NE_w)	4.6	10.11	NA	NA
Wool Production (NE_{wool})	NA	NA	4.7	10.12
Pregnancy (NE_p)	4.8	10.13	4.8	10.13
REM {NE_{ma}/DE}	4.9	10.14	4.9	10.14
REG {NE_{ga}/DE}	4.10	10.15	4.10	10.15
Gross Energy (GE)	4.11	10.16	4.11	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 IPCC 2006 Guidelines.

$$NE_m = Cf_i \bullet (Weight)^{0.75}$$

Where:

NE_m – net energy required by the animal for maintenance, MJ/day

[48] Default values available in 2006 IPCC Guidelines, Vol. 4, Ch. 10, Table 10.2, Page 10.14.

Cf_i – a coefficient which varies for each animal category[49], 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 IPCC 2006 Guidelines.

$$NE_a = C_a \bullet NE_m$$

Where:

NE_a – net energy for animal (cattle) activity, MJ/day;

C_a – coefficient corresponding to animal's feeding situation[50], 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 1992-2013;

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[51], 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[52];

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;

[49] Default values available in IPCC 2006 Guidelines, Volume 4, Chapter 10, Table 10.4, Page 10.16
[50] Default values available in 2006 IPCC Guidelines, Volume 4, Chapter 10, Table 10.5, Page 10.17.
[51] Default values available in IPCC 2006 Guidelines, Volume 4, Chapter 10, Table 10.5, Page 10.17.
[52] Default values available in 2006 IPCC Guidelines, Volume 4, Chapter 10, Equation 10.6, Page 10.17.

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[53].

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 10.7 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 IPCC 2006 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[54]; this inventory cycle used 2 hours of work per day regarding the 1990-1991 time period and 3 hours of work per day for 1992-2013.

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[55] 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[56].

[53] Default values available in 2006 IPCC Guidelines, Volume 4, Chapter 10, Table 10.6, Page 10.18.
[54] Default value available in 2006 IPCC Guidelines, Volume 4, Chapter 10, Table 10A-2, Page 10.73.
[55] Default value available in 2006 IPCC Guidelines, Volume 4, Chapter 10, Table 10A-7, Page 10.20.
[56] Cpregnancy default values were estimated regarding average prolificacy of the local breeds in the RM: Cpregnancy – 0.087 for sheep, respectively Cpregnancy – 0.109 for goats.

$$NE_p = C_{pregnancy} \bullet NE_m$$

Where:

NE_p – net energy required for pregnancy, MJ/day;

$C_{pregnancy}$ – pregnancy coefficient;

NE_m – net energy required by the animal for maintenance (Equation 10.3), MJ/day.

Ratio of net energy available in diet for maintenance to digestible energy consumed (REM). REM was calculated in conformity with Equation 10.14 in the IPCC 2006 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 IPCC 2006 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 6-20.

Table 6-20: 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
Dairy cows	245.8	229.0	227.5	219.8	217.8	213.2	211.9	211.4
Other cattle (average)	118.4	116.1	116.8	122.4	125.9	123.3	129.4	124.6
…Calves and heifers up to 1 year	100.2	94.6	95.0	95.4	96.7	78.5	75.4	69.9
…Heifers between 12 and 18 months	131.0	131.0	126.7	127.2	127.4	127.4	125.7	120.8
…Heifers between 18 and 24 months	156.8	152.3	147.2	142.7	146.4	146.4	146.4	142.7
…Heifers between 24 months and more	167.2	165.0	158.8	158.8	160.2	160.2	164.4	158.7
…Breeding males	207.9	204.9	191.9	194.2	190.4	188.3	184.2	178.2
…Work bullocks	182.5	182.4	172.9	176.2	178.0	178.0	178.0	174.2
Sheep (average)	16.9	16.9	16.3	16.2	16.3	15.6	15.6	15.2
…Mature ewes and Ewe lambs ≥ 1 year	17.4	17.3	16.7	16.7	17.0	16.0	15.9	15.6
…Breeding rams	24.9	24.3	23.9	23.8	23.9	23.1	23.1	22.9
…Growing lambs up to 1 year	13.2	12.9	12.4	12.4	12.7	12.4	12.3	11.4
Goats (average)	15.4	15.6	15.3	15.3	14.8	14.8	14.8	14.6
…Mature females ≥ 1 year	16.6	16.9	16.4	17.0	16.5	16.8	17.0	16.3
…Breeding males	16.6	16.5	15.9	15.6	14.7	14.7	14.7	13.9
…Growing kids up to 1 year	9.5	9.3	9.0	9.0	8.1	8.1	8.1	7.8

	1998	1999	2000	2001	2002	2003	2004	2005
Dairy cows	212.1	212.5	213.7	216.2	218.9	219.4	227.3	229.8
Other cattle (average)	123.2	123.5	128.8	124.5	127.3	126.3	131.6	129.3
…Calves and heifers up to 1 year	77.4	71.6	75.5	81.5	85.0	81.7	83.5	86.7
…Heifers between 12 and 18 months	114.8	114.8	114.8	120.8	129.4	129.4	128.3	130.1
…Heifers between 18 and 24 months	136.1	136.1	136.1	142.7	147.9	147.9	151.5	149.2
…Heifers between 24 months and more	152.0	152.0	152.0	160.1	161.5	161.5	166.8	166.3
…Breeding males	178.2	178.2	178.2	178.2	180.3	180.3	182.3	178.5
…Work bullocks	172.1	170.1	168.0	170.1	172.1	174.2	176.2	174.5
Sheep (average)	15.1	15.2	15.1	15.2	15.3	14.9	15.3	15.7
…Mature ewes and Ewe lambs ≥ 1 year	15.6	15.6	15.6	15.6	15.8	15.5	15.7	16.4
…Breeding rams	22.4	22.3	22.3	21.9	21.9	21.3	22.4	21.4
…Growing lambs up to 1 year	10.6	11.4	10.6	11.1	11.5	10.5	11.8	10.9
Goats (average)	14.3	14.3	14.1	14.1	14.4	14.2	14.4	14.2
…Mature females ≥ 1 year	15.8	15.9	15.3	15.0	15.5	15.4	15.5	15.6
…Breeding males	14.1	14.8	16.2	16.2	16.9	16.0	16.7	15.3
…Growing kids up to 1 year	8.0	8.3	9.0	9.0	9.2	9.2	9.4	8.5
	2006	2007	2008	2009	2010	2011	2012	2013
Dairy cows	228.7	230.1	231.0	232.2	237.6	238.8	239.3	242.3
Other cattle (average)	130.1	127.6	120.5	120.6	121.7	123.6	124.1	121.7
…Calves and heifers up to 1 year	87.0	83.9	87.2	90.5	87.1	89.3	90.7	88.1
…Heifers between 12 and 18 months	132.5	130.1	119.4	114.9	120.5	122.9	123.7	121.3
…Heifers between 18 and 24 months	154.1	152.1	142.1	143.3	144.6	146.6	147.6	145.1
…Heifers between 24 months and more	170.3	166.3	151.9	150.3	153.6	154.6	155.1	154.1
…Breeding males	180.4	180.4	182.4	180.6	180.6	180.6	180.6	180.6
…Work bullocks	174.5	174.5	176.5	174.8	174.8	174.8	174.8	174.8
Sheep (average)	15.5	15.6	15.5	16.2	16.2	16.0	15.8	17.1
…Mature ewes and Ewe lambs ≥ 1 year	16.3	16.3	16.2	16.9	16.8	16.7	16.7	18.4
…Breeding rams	21.6	21.5	20.7	21.3	21.2	21.2	21.2	21.2
…Growing lambs up to 1 year	10.5	11.1	10.2	10.9	11.5	10.5	10.9	10.9
Goats (average)	14.7	14.7	14.6	15.3	15.5	15.1	14.8	15.9
…Mature females ≥ 1 year	16.3	16.1	16.0	16.8	17.2	16.8	16.6	18.3
…Breeding males	15.1	14.8	14.8	15.5	15.8	15.8	13.8	14.3
…Growing kids up to 1 year	8.3	8.1	8.1	8.3	8.4	8.4	7.5	7.9

For animal categories "other cattle"[57], "sheep" and "goats"[58] 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 6-21).

Table 6-21: Distribution of Animal Population by Sub-Categories in the Republic of Moldova within 1990-2013 periods

	1990	1991	1992	1993	1994	1995	1996	1997
Other cattle, including:	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
…Heifers between 12 and 18 months	17.3	19.8	21.0	25.5	27.0	26.8	31.1	18.0
…Heifers between 18 and 24 months	8.7	10.2	12.4	17.3	16.2	18.5	20.1	24.2
…Heifers between 24 months and more	11.4	11.4	12.9	14.8	17.5	20.7	23.5	27.5
…Breeding males	0.2	0.3	0.4	1.1	1.4	1.4	1.9	2.3
…Work bullocks	0.0	0.0	0.1	0.4	0.5	0.7	1.0	0.9
Sheep, including:	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
…Breeding rams	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
Goats, including:	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
…Breeding males	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
	1998	1999	2000	2001	2002	2003	2004	2005
Other cattle, including:	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
…Calves and heifers up to 1 year	27.1	24.2	16.8	32.2	34.7	33.7	29.5	34.2
…Heifers between 12 and 18 months	14.2	13.2	13.4	15.9	14.7	16.3	17.9	15.0
…Heifers between 18 and 24 months	26.4	32.3	40.0	26.6	25.8	27.0	27.4	27.0
…Heifers between 24 months and more	28.6	26.0	25.4	21.4	21.0	19.4	21.9	20.7
…Breeding males	2.6	3.1	3.0	2.8	2.7	2.6	2.4	2.2
…Work bullocks	1.1	1.3	1.3	1.1	1.0	0.9	0.8	0.9
Sheep, including:	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
…Mature ewes and Ewe lambs ≥ 1 year	82.5	81.8	82.0	82.9	81.7	81.5	81.5	81.9
…Breeding rams	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
…Growing lambs up to 1 year	14.5	15.2	15.0	14.1	15.3	15.5	15.5	15.1
Goats, including:	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
…Mature females ≥ 1 year	79.1	77.0	77.5	80.4	77.6	76.3	77.8	77.8
…Breeding males	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
…Growing kids up to 1 year	17.9	20.0	19.5	16.6	19.4	20.7	19.2	19.2

[57] 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).
[58] According to the literature in the field (Bucătaru et al., 2003), the reproduction structure at local sheep and goats is: breeding males – circa 3%, mature females – circa 75%, breeding youngsters – circa 22%.

	2006	2007	2008	2009	2010	2011	2012	2013
Other cattle, including:	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
…Calves and heifers up to 1 year	34.2	34.8	37.0	35.9	35.5	34.6	36.2	35.7
…Heifers between 12 and 18 months	20.4	18.3	17.2	19.6	19.1	21.2	20.2	22.0
…Heifers between 18 and 24 months	25.7	26.2	25.9	25.5	26.9	26.4	25.4	24.5
…Heifers between 24 months and more	17.3	18.3	17.6	17.0	16.7	16.3	15.7	15.2
…Breeding males	1.8	1.7	1.6	1.4	1.4	0.4	0.4	0.5
…Work bullocks	0.5	0.7	0.7	0.4	0.3	1.2	2.1	2.2
Sheep, including:	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
…Mature ewes and Ewe lambs ≥ 1 year	79.6	80.7	82.5	82.1	82.7	83.0	79.7	79.2
…Breeding rams	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
…Growing lambs up to 1 year	17.4	16.3	14.5	14.9	14.3	14.0	17.3	17.8
Goats, including:	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
…Mature females ≥ 1 year	77.3	80.3	79.8	79.8	77.5	77.9	77.3	75.2
…Breeding males	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
…Growing kids up to 1 year	19.7	16.7	17.2	17.2	19.5	19.1	19.7	21.8

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 1990-2013).

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[59]: 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[60]: 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 4A '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 6-22 features country specific emission factor for cattle bred in the RM, developed by using a Tier 2 simplified methodology.

Table 6-22: 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
Dairy cows	104.8	97.6	97.0	93.7	92.8	90.9	90.3	90.1
Other cattle (average)	50.5	49.5	49.8	52.2	53.7	52.6	55.2	53.1
…Calves and heifers up to 1 year	42.7	40.3	40.5	40.7	41.2	33.5	32.1	29.8
…Heifers between 12 and 18 months	55.9	55.8	54.0	54.2	54.3	54.3	53.6	51.5
…Heifers between 18 and 24 months	66.8	64.9	62.8	60.8	62.4	62.4	62.4	60.8
…Heifers between 24 months and more	71.3	70.4	67.7	67.7	68.3	68.3	70.1	67.7
…Breeding males	88.6	87.3	81.8	82.8	81.2	80.3	78.5	76.0
…Work bullocks	77.8	77.8	73.7	75.1	75.9	75.9	75.9	74.3
	1998	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**
Dairy cows	90.4	90.6	91.1	92.2	93.3	93.5	96.9	98.0
Other cattle (average)	52.5	52.7	54.9	53.1	54.3	53.8	56.1	55.1
…Calves and heifers up to 1 year	33.0	30.5	32.2	34.8	36.3	34.8	35.6	37.0
…Heifers between 12 and 18 months	49.0	49.0	49.0	51.5	55.1	55.1	54.7	55.5
…Heifers between 18 and 24 months	58.0	58.0	58.0	60.8	63.0	63.0	64.6	63.6
…Heifers between 24 months and more	64.8	64.8	64.8	68.3	68.8	68.8	71.1	70.9
…Breeding males	76.0	76.0	76.0	76.0	76.9	76.9	77.7	76.1
…Work bullocks	73.4	72.5	71.6	72.5	73.4	74.3	75.1	74.4
	2006	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**
Dairy cows	97.5	98.1	98.5	99.0	101.3	101.8	102.0	103.3
Other cattle (average)	55.5	54.4	51.4	51.4	51.9	52.7	52.9	51.9
…Calves and heifers up to 1 year	37.1	35.8	37.2	38.6	37.1	38.1	38.7	37.6
…Heifers between 12 and 18 months	56.5	55.5	50.9	49.0	51.4	52.4	52.8	51.7
…Heifers between 18 and 24 months	65.7	64.9	60.6	61.1	61.7	62.5	62.9	61.9
…Heifers between 24 months and more	72.6	70.9	64.8	64.1	65.5	65.9	66.1	65.7
…Breeding males	76.9	76.9	77.8	77.0	77.0	77.0	77.0	77.0
…Work bullocks	74.4	74.4	75.2	74.5	74.5	74.5	74.5	74.5

[59] Default values used for cattle available in IPCC 2006 Guidelines, Volume 4, Chapter 10, Table 10.12, Tables 10A-1 and 10A-2, Pages 10.30, 10.72-10.73;
[60] Default values used for sheep and goats available in IPCC 2006 Guidelines, Volume 4, Chapter 10, Table 10.13, Page 10.31.

Table 6-23 features country specific emission factors calculated for sheep and goats in the Republic of Moldova.

Table 6-23: 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
Sheep, including:	6.9	6.9	6.7	6.6	6.5	6.4	6.4	6.3
…Mature ewes and Ewe lambs ≥ 1 year	7.4	7.4	7.1	7.1	7.3	6.8	6.8	6.6
…Breeding rams	10.6	10.4	10.2	10.2	10.2	9.9	9.8	9.8
…Growing lambs up to 1 year	3.9	3.8	3.7	3.7	3.7	3.6	3.6	3.4
Goats, including:	6.4	6.4	6.3	6.3	6.1	6.1	6.0	6.0
…Mature females ≥ 1 year	7.1	7.2	7.0	7.3	7.0	7.2	7.2	7.0
…Breeding males	7.1	7.0	6.8	6.6	6.3	6.3	6.3	5.9
…Growing kids up to 1 year	2.8	2.8	2.6	2.6	2.4	2.4	2.4	2.3
	1998	1999	2000	2001	2002	2003	2004	2005
Sheep, including:	6.2	6.2	6.2	6.3	6.3	6.1	6.3	6.5
…Mature ewes and Ewe lambs ≥ 1 year	6.6	6.7	6.7	6.7	6.7	6.6	6.7	7.0
…Breeding rams	9.5	9.5	9.5	9.3	9.3	9.1	9.5	9.1
…Growing lambs up to 1 year	3.1	3.4	3.1	3.3	3.4	3.1	3.5	3.2
Goats, including:	5.9	5.9	5.8	5.8	5.9	5.8	5.9	5.9
…Mature females ≥ 1 year	6.7	6.8	6.5	6.4	6.6	6.6	6.6	6.7
…Breeding males	6.0	6.3	6.9	6.9	7.2	6.8	7.1	6.5
…Growing kids up to 1 year	2.3	2.4	2.7	2.7	2.7	2.7	2.8	2.5
	2006	2007	2008	2009	2010	2011	2012	2013
Sheep, including:	6.4	6.4	6.4	6.7	6.7	6.6	6.5	7.1
…Mature ewes and Ewe lambs ≥ 1 year	7.0	6.9	6.9	7.2	7.2	7.1	7.1	7.8
…Breeding rams	9.2	9.2	8.8	9.1	9.1	9.1	9.1	9.1
…Growing lambs up to 1 year	3.1	3.3	3.0	3.2	3.4	3.1	3.2	3.2
Goats, including:	6.0	6.1	6.0	6.3	6.4	6.2	6.1	6.6
…Mature females ≥ 1 year	6.9	6.9	6.8	7.2	7.3	7.1	7.1	7.8
…Breeding males	6.5	6.3	6.3	6.6	6.7	6.7	5.9	6.1
…Growing kids up to 1 year	2.4	2.4	2.4	2.5	2.5	2.5	2.2	2.3

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) (IPCC, 2006).

6.2.3 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 Republic of Moldova are higher than it is officially acknowledged (circa 10 per cent). It is quite likely that the reported data collected from current statistical reports are erroneous; in particular keeping in mind that seasonal variation in total animal population is not fully taken into account. To be noted that the accuracy of default EFs estimated by using a Tier 1 method is around ±30 per cent (IPCC, 2006). 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 (IPCC, 2006). 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. The accuracy of EFs estimated by using a Tier 2 methodology are likely to be in the order of ±20 per cent (IPCC, 2006).

The combined uncertainties associated with methane emissions from enteric fermentation can be considered moderate for cattle, sheep and goats (±18.03 per cent) and medium for other animal categories (±31.62 per cent for swine, horses, asses and mules, ±36.06 per cent for rabbits). At the same time, combined uncertainties, presented as a per cent of total sectoral emissions were estimated at ±3.22 per cent for cattle, ±0.91 per cent for sheep, ±0.16 per cent for goats, ±0.26 per cent for horses, ±0.01 per cent for asses and mules, ±0.21 per cent for swine and ±0.06 per cent for rabbits. Uncertainties introduced in trend in sectoral emissions were estimated at ±1.35 per cent for cattle, ±0.31 per cent for sheep, ±0.07 per cent for goats and swine, ±0.08 per cent for horses, ±0.002 per cent for asses and mules and ±0.02 per cent for rabbits.

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 GPG (IPCC, 2000).

6.2.4 Quality Assurance and Quality Control

Standard verification and quality control forms and check-lists were filled in for 4A 'Enteric Fermentation' source category, following a Tier 1 approach (IPCC, 2000). 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 (IPCC, 2000), GHG emissions were estimated using AD and country specific factors and parameters from official sources of reference.

6.2.5 Recalculations

Methane emissions from the 4A 'Enteric Fermentation' were recalculated for the 1990 through 2010 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). In comparison with emissions estimates included into the TNC, the changes performed resulted in insignificant variations (not exceeding 0.43 per cent) of methane emissions over the period 1990 through 2010 (Table 6-24).

For the period 2011-2013, methane emissions resulting from enteric fermentation were estimated for the first time. The results allow assert that within the 1990-2013 time series methane emissions from 4A 'Enteric Fermentation' decreased by 70.6 per cent, in particular due to reduced animal population, but also due to the evolution of the main productivity indicators in the livestock sector of the Republic of Moldova.

Table 6-24: Comparative Results of CH_4 Emissions from 4A 'Enteric Fermentation' included into the TNC and the BUR of the Republic of Moldova under the UNFCCC, Gg

	1990	1991	1992	1993	1994	1995	1996	1997
TNC	87.3513	81.2128	79.7688	74.9883	73.2244	64.8018	59.6262	51.2098
BUR	87.6290	81.2261	79.7791	75.0063	73.0080	64.8174	59.6366	51.3958
Difference, %	0.32	0.02	0.01	0.02	-0.30	0.02	0.02	0.36
	1998	1999	2000	2001	2002	2003	2004	2005
TNC	49.8919	46.1429	43.3896	44.1737	45.0836	41.3224	38.3224	37.0653
BUR	49.8940	46.1613	43.4216	44.2080	45.1402	41.2406	38.4878	37.0710
Difference, %	0.00	0.04	0.07	0.08	0.13	-0.20	0.43	0.02
	2006	2007	2008	2009	2010	2011	2012	2013
TNC	35.8562	28.9918	27.6051	28.7010	28.4934			
BUR	35.8772	28.9864	27.5975	28.7081	28.5037	26.8515	25.3644	25.7746
Difference, %	0.06	-0.02	-0.03	0.02	0.04			

Abbreviations: TNC – Third National Communication; BUR – Biennial Update Report.

Over the period under review, the share of different livestock categories in the overall methane emissions from the 4A 'Enteric Fermentation' has changed significantly. By 2013, 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', 'rabbits' increased (Table 6-25).

Table 6-25: Breakdown of the Methane Emissions from 4A 'Enteric Fermentation' by Livestock Category within 1990-2013 periods, %

	1990	1991	1992	1993	1994	1995	1996	1997
Dairy cows	47.3	47.7	49.0	50.2	51.2	53.4	53.8	56.8
Other cattle	38.3	36.8	35.4	33.5	31.6	28.3	26.9	23.4
Sheep	9.8	10.6	10.9	12.0	12.7	13.1	13.7	13.9
Goats	0.3	0.4	0.5	0.6	0.8	0.9	1.0	1.1
Horses	1.0	1.1	1.2	1.3	1.4	1.7	1.9	2.3
Asses and mules	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1
Swine	3.2	3.2	2.8	2.2	2.2	2.3	2.4	2.3
Rabbits	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
	1998	1999	2000	2001	2002	2003	2004	2005
Dairy cows	57.7	60.2	62.6	62.6	63.0	63.0	62.7	61.6
Other cattle	22.5	20.0	18.6	18.4	18.0	17.2	16.1	15.9
Sheep	13.1	12.9	12.2	12.2	11.8	12.4	13.7	14.6
Goats	1.1	1.3	1.5	1.5	1.7	1.7	1.9	1.9
Horses	2.5	2.8	3.2	3.3	3.3	3.6	3.5	3.5
Asses and mules	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Swine	2.8	2.4	1.7	1.7	1.8	1.7	1.6	2.0
Rabbits	0.2	0.2	0.2	0.3	0.2	0.3	0.4	0.4

	2006	2007	2008	2009	2010	2011	2012	2013
Dairy cows	60.3	61.2	61.3	59.7	59.0	59.2	58.5	56.7
Other cattle	16.2	13.7	12.4	12.5	12.8	13.4	13.6	13.4
Sheep	15.0	16.9	17.9	19.0	18.8	17.8	18.1	19.8
Goats	1.9	2.1	2.3	2.5	2.7	2.9	3.1	3.5
Horses	3.5	3.8	3.7	3.5	3.4	3.4	3.4	3.2
Asses and mules	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Swine	2.4	1.7	1.6	2.1	2.7	2.6	2.6	2.6
Rabbits	0.5	0.5	0.5	0.6	0.6	0.6	0.6	0.7

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 source category 4A "Enteric fermentation", this reduction varying from a minimum of 7.7 per cent in 1990 to a maximum of 14.8 per cent in 1999 (Table 6-26).

Table 6-26: Comparative Results of CH_4 Emissions from 4A 'Enteric Fermentation', estimated using Tier 1 and Tier 2 Methodologies, Gg

	1990	1991	1992	1993	1994	1995	1996	1997
Tier 1	94.9625	91.5052	90.2826	85.2558	82.8881	75.2674	68.7138	60.2710
Tier 2	87.6290	81.2261	79.7791	75.0063	73.0080	64.8174	59.6366	51.3958
Difference, %	-7.7	-11.2	-11.6	-12.0	-11.9	-13.9	-13.2	-14.7
	1998	1999	2000	2001	2002	2003	2004	2005
Tier 1	58.5543	54.1593	50.5151	51.2459	51.6685	47.4008	42.9314	40.9976
Tier 2	49.8940	46.1613	43.4216	44.2080	45.1402	41.2406	38.4878	37.0710
Difference, %	-14.8	-14.8	-14.0	-13.7	-12.6	-13.0	-10.4	-9.6
	2006	2007	2008	2009	2010	2011	2012	2013
Tier 1	39.8649	32.2473	30.9083	31.7614	31.0382	29.1144	27.5645	27.3885
Tier 2	35.8772	28.9864	27.5975	28.7081	28.5037	26.8515	25.3644	25.7746
Difference, %	-10.0	-10.1	-10.7	-9.6	-8.2	-7.8	-8.0	-5.9

6.2.6 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 4A 'Enteric Fermentation'.

6.3 Manure Management (Category 4B)

The 4B 'Manure Management' source 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.

6.3.1 Methane Emissions

6.3.1.1 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. 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.

6.3.1.2 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 4A 'Enteric Fermentation') and climate region or temperature (Republic of Moldova corresponds to countries with cold climate - the average annual temperature being less than 15^{0}C), in combination with IPCC default emission factors to estimate emissions (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, Gg 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 4B "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 GPG (IPCC, 2000) 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 4B 'Manure Management' source 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 6-27);

$B_{0(T)}$ – maximum methane producing capacity for manure produced by livestock category *T*, m^3 CH_4/kg of VS excreted;

0.67 – conversion factor 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*, %;

Table 6-27: Daily Volatile Solid Excreted (VS) Calculated for 1990-2013 time series, kg dry matter/day

	1990	1991	1992	1993	1994	1995	1996	1997
Dairy cows	4.15	3.98	3.95	4.03	4.10	4.01	3.99	3.87
Other cattle	1.99	2.00	2.02	2.23	2.36	2.31	2.42	2.27
Market swine	0.85	0.83	0.81	0.83	0.79	0.76	0.73	0.65
Fattening swine	0.54	0.54	0.52	0.53	0.51	0.49	0.47	0.42
	1998	1999	2000	2001	2002	2003	2004	2005
Dairy cows	3.89	3.89	3.92	3.96	4.01	4.02	4.17	4.21
Other cattle	2.25	2.25	2.35	2.27	2.32	2.30	2.40	2.36
Market swine	0.63	0.61	0.65	0.62	0.61	0.65	0.63	0.62
Fattening swine	0.41	0.40	0.42	0.40	0.40	0.42	0.41	0.40
	2006	2007	2008	2009	2010	2011	2012	2013
Dairy cows	4.08	4.11	4.01	4.03	4.13	4.15	4.15	4.21
Other cattle	2.31	2.26	2.08	2.08	2.10	2.13	2.14	2.10
Market swine	0.63	0.61	0.63	0.61	0.63	0.70	0.75	0.79
Fattening swine	0.40	0.40	0.41	0.40	0.41	0.45	0.48	0.51

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 [61] (see country specific values in Table 6-27).

GE – gross energy intake, MJ/day; the same values as those used under the 4.A 'Enteric Fermentation' source category;

DE – digestibility of the feed in per cent; for cattle the same values were used as under the 4A 'Enteric Fermentation'; for fattening swine, *DE* – 75 per cent, while for market swine, accounting for 15 per cent of the total population of swine, *DE* – 60 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 1990-2012 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 (IPCC, 2006);

18.45 – conversion factor 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.

Table 6-28: Coefficients and Default Emission Factors Used Under the 4B '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	B0, m^3 CH_4 / kg VS	FE, 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 6-29: Coefficients and Default Emission Factors Used Under the 4B '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	FC CH_4, %	FE, 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.

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 6-28 and 6-29).

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, to replace those proposed in the GPG (IPCC, 2000) and Revised 1996 IPCC Guidelines (IPCC, 1997) (Tables 6-30 and 6-31).

Table 6-30: Default Values of Methane Conversion Factor for Manure Management Systems non-specified in the Revised 1996 IPCC Guidelines

Additional Animal Waste Management Systems		MCF, %	
		IPCC, 2000	IPCC, 2006
Pit storage below animal confinements (cattle and swine): collection and storage of manure with little or no added water typically below a slatted floor in an enclosed animal confinement facility, usually for periods less than one year	< 30 days	0	3
	> 30 days	39	17
Composting - Intensive Windrow: composting in windrows with regular (at least daily) turning for mixing and aeration		0.5	0.5
Composting - Passive Windrow: composting in windrows with infrequent turning for mixing and aeration		0.5	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	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	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		0.1	0

[61] 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 6-31: Default Values of Methane Conversion Factor (MCF) for Manure Management Systems, (IPCC, 1997, 2000, 2006)

Manure Management System		MCF, %		
		IPCC, 1997	IPCC, 2000	IPCC, 2006
Pasture/Range/Paddock: the manure from pasture and range grazing animals is allowed to lie as deposited, and is not managed		1	1	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	0.1	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		1	1	2
Dry lot: a paved or unpaved open confinement area without any significant vegetative cover where accumulating manure may be removed periodically		1	1	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	39	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		90	0-100	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	5	0	3
	> I month	10	39	17
Anaerobic Digester: the dung and urine in liquid/slurry are collected and anaerobically digested; methane may be burned flared or vented.		5-15	0-100	0-100
Burned for Fuel: the dung and urine are excreted on fields; the sun dried dung cakes are burned for fuel		5-10	10	10

Methane conversion factor (MCF) represents the extent to which maximum methane producing capacity (B_0) is attained. So, 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.

The default values of methane conversion factor for cattle and swine are presented in the Table 6-32, while the percentage of using different manure management systems in EE Countries, respectively in the Table 6-33 below.

Table 6-32: Manure Management Systems MCFs for Different Animal Categories

Manure Management Systems	MCF for different animal categories , %			
	Revised 1996 IPCC Guidelines		2006 IPCC Guidelines	
	Cattle	Swine	Cattle	Swine
Anaerobic Lagoon	47	19	66	66
Liquid/Slurry	39	39	17	17
Solid Storage	1	1	2	2
Dry lot	1	1	1	1
Pasture/Range/Paddock	1	0	1	0
Pit Storage below animal confinements < 1 month	0	0	0	3
Pit Storage below animal confinements > 1 month	0	39	0	17
Daily Spread	0.1	0.1	0.1	0.1
Anaerobic Digester	0	0	10	10
Burning for fuel	10	0	10	0
Other Systems	1	1	1	1

Source: *Revised 1996 IPCC Guidelines* (1997), Vol. 3, Tab. B-3, Page 4.43, Tab. B-4 and Tab. B-6; *2006 IPCC Guidelines*, Vol. 4, Chap. 10, Tab. 10A-4, 10A-5, Tab. 10A-7 and Tab. 10A-8.

Table 6-33: 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	Pasture	Daily Spread	Other
Dairy cows	3	0	42	24.7	24.7	5.7
Other cattle	3	0	42	24.7	24.7	5.7

Source: *IPCC 2006 Guidelines*, Vol. 4, Chap. 10, Tab. 10A-4, 10A-5, Tab. 10A-7 and Tab. 10A-8.

Based on country specific information (identical to that used for the enteric fermentation), as well as on default EFs and coefficients, there were developed country specific CH_4 EFs for 4B '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

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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 calculate CH_4 emissions from the 4B 'Manure Management' source category (for cattle and swine), country specific values were used on the manure management systems usage in the Republic of Moldova (specialist from the Scientific-Practical Institute of Biotechnology in Animal Breeding and Veterinary Medicine were consulted) (Table 6-34).

Table 6-34: Manure Management Systems Usage (MS%) in the RM within 1990-2013 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
	$MS_{(T,S)}$ values											
Dairy cows	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**
Pasture/Range/Paddock	12	14	18	22	24	24	24	24	23	23	24	24
Liquid/Slurry	18	16	12	7	5	3	2	2	2	2	2	3
Solid Storage	70	70	70	71	71	73	74	74	75	75	74	73
Other cattle	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**
Pasture/Range/Paddock	10	12	16	18	20	21	22	22	22	22	22	22
Liquid/Slurry	20	18	13	10	7	5	3	2	2	2	2	3
Solid Storage	70	70	71	72	73	74	75	76	76	76	76	75
Swine	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**
Liquid/Slurry	24	22	20	18	16	14	12	10	10	12	12	14
Solid Storage	76	78	80	82	84	86	88	90	90	88	88	86
Sheep and Goats	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**
Pasture/Range/Paddock	26	26	22	24	22	22	22	22	22	22	22	22
Solid Storage	74	74	78	76	78	78	78	78	78	78	78	78
Horses, Asses and Mules	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**
Pasture/Range/Paddock	24	22	20	20	18	18	18	18	18	18	18	18
Solid Storage	76	78	80	80	82	82	82	82	82	82	82	82
Rabbits	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**
Solid Storage	100	100	100	100	100	100	100	100	100	100	100	100
Poultry	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**
Pasture/Range/Paddock	2	2	2	2	3	3	3	3	3	3	3	3
Liquid/Slurry	20	15	13	10	8	7	7	7	7	7	7	8
Solid Storage	78	83	85	88	89	90	90	90	90	90	90	89

Table 6-35: Country Specific Methane EFs for the 4B '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
Dairy cows	11.15	9.94	9.88	8.56	8.70	6.66	6.62	6.44
Other cattle (average)	4.05	3.82	3.84	3.52	3.71	3.18	3.34	3.13
Swine (average)	3.52	3.29	3.21	3.14	2.99	2.69	2.59	2.31
Market swine	5.22	4.87	4.74	4.57	4.34	3.92	3.76	3.34
Fattening piglets	3.36	3.13	3.04	2.94	2.79	2.52	2.42	2.15
	1998	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**
Dairy cows	5.73	5.74	5.08	5.14	4.85	4.86	5.04	5.09
Other cattle (average)	2.66	2.67	2.48	2.40	2.15	2.13	2.07	2.04
Swine (average)	2.13	2.07	2.05	1.98	1.80	1.89	1.70	1.66
Market swine	3.06	2.98	2.93	2.81	2.57	2.72	2.44	2.38
Fattening piglets	1.97	1.91	1.89	1.81	1.65	1.75	1.57	1.53
	2006	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**
Dairy cows	4.96	4.99	4.87	4.90	4.99	5.01	5.39	5.46
Other cattle (average)	2.00	1.96	1.80	1.80	1.82	1.84	1.99	1.95
Swine (average)	1.68	1.63	1.82	1.77	1.81	2.00	2.31	2.42
Market swine	2.42	2.37	2.64	2.57	2.64	2.91	3.39	3.56
Fattening piglets	1.55	1.52	1.70	1.65	1.70	1.87	2.18	2.29

Country specific EFs, calculated following a simplified Tier 2 approach (Equation 10.23 from the 2006 IPCC Guidelines) are provided below (Table 6-35).

For cattle and swine population, the share of animal population by sub-categories was taking into account for estimating average national EFs (see Table 6-21 for 'other cattle' and Table 6-36 for 'swine').

Table 6-36: Swine population distribution by sub-categories in the Republic of Moldova within 1990-2013 periods, %

	1990	1991	1992	1993	1994	1995	1996	1997
Swine, total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
…Market swine	8.4	9.1	9.9	12.3	12.5	12.1	12.8	13.6
…Piglets	91.6	90.9	90.1	87.7	87.5	87.9	87.2	86.4
	1998	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**
Swine, total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
…Market swine	14.6	14.5	15.3	16.6	16.3	14.7	14.9	15.5
…Piglets	85.4	85.5	84.7	83.4	83.7	85.3	85.1	84.5
	2006	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**
Swine, total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
…Market swine	14.2	13.2	13.0	12.9	12.1	12.2	11.0	10.6
…Piglets	85.8	86.8	87.0	87.1	87.9	87.8	89.0	89.4

Source: NBS, Statistical Annual Report No. 24-agr „Animal Breeding Sector", the Number of Livestock and Poultry in all Households Categories as of 1st of January (annually for 1990-2013).

6.3.1.3 Uncertainties Assessment and Time-Series Consistency

Uncertainties related to estimation of methane emissions from 4B '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 higher than it is officially acknowledged (circa 10 per cent). It is quite likely that the reported data collected from current statistical reports are erroneous; in particular keeping in mind that seasonal variation in total animal population is not taken into account.

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 (IPCC, 2006). 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 (IPCC, 2006). 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 two manure management systems (pasture/range/paddock and solid storage), 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).

Combined uncertainties associated with methane emissions from manure management can be considered moderate for cattle and swine (±22.36 per cent) and medium for other animal categories (±31.62 per cent for sheep, goats, horses, rabbits, asses and mules and respectively ±33.54 per cent for poultry). At the same time, combined uncertainties, presented as a per cent of total sectoral emissions were estimated at ±0.20 per cent for cattle, ±0.04 per cent for sheep, ±0.01 per cent for goats, ±0.02 per cent for horses, ±0.0005 per cent for asses and mules, ±0.24 per cent for swine, ±0.12 per cent for poultry and ±0.0007 per cent for rabbits. Uncertainties introduced in trend in sectoral emissions were estimated at ±0.18 per cent for cattle, ±0.01 per cent for sheep, ±0.002 per cent for goats, ±0.007 per cent for horses, ±0.0002 per cent for asses and mules, ±0.15 per cent for swine, ±0.03 per cent for poultry and ±0.002 per cent for rabbits.

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 GPG (IPCC, 2000).

6.3.1.4 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 (IPCC, 2000). 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.

6.3.1.5 Recalculations

Methane emissions from the 4B 'Manure Management' were recalculated for the 1990 through 2010 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), as well as a result of using a Tier 2 methodology and country specific EFs for cattle and swine). In comparison with emissions estimates included into the TNC, the changes performed resulted in increased CH_4 emissions from 4B 'Manure Management' over the 1990-2010 period, with a variation from a minimum increase of 2.4 per cent in 2008 to a maximum of 21.1 per cent in 1990 (Table 6-37).

Table 6-37: Comparative Results of CH_4 Emissions from 4B 'Manure Management' included into the TNC and the BUR of the Republic of Moldova under the UNFCCC, Gg

	1990	1991	1992	1993	1994	1995	1996	1997
TNC	12.1384	10.8795	10.0671	8.0186	7.9323	6.2651	5.7862	4.9870
BUR	14.7018	13.0828	11.8291	9.3011	9.0365	7.1870	6.5425	5.3695
Difference, %	21.12	20.25	17.50	15.99	13.92	14.71	13.07	7.67
	1998	1999	2000	2001	2002	2003	2004	2005
TNC	4.7643	4.2933	3.4319	3.5221	3.4761	3.1873	2.9603	3.0965
BUR	5.1130	4.5368	3.6273	3.6623	3.6021	3.3528	3.0717	3.2388
Difference, %	7.32	5.67	5.69	3.98	3.63	5.19	3.76	4.60
	2006	2007	2008	2009	2010	2011	2012	2013
TNC	3.1418	2.3099	2.2931	2.5702	2.7336			
BUR	3.2826	2.3788	2.3492	2.6620	2.8774	2.7032	2.6531	2.5936
Difference, %	4.48	2.98	2.45	3.58	5.26			

Abbreviations: TNC – Third National Communication; BUR – Biennial Update Report.

For the 2011-2013 time periods, methane emissions resulting from manure management were estimated for the first time. The obtained results allow assert that within the 1990-2013 time series methane emissions from 4B 'Manure Management' source category decreased by 82.4 per cent, in particular due to reduced animal population, to negative changes in the productivity of this sector. To be noted that over the period under review the share of different animals in the structure of methane emissions from the 4.B 'Manure Management' source category has changed significantly. By 2013, 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 6-38).

Table 6-38: Breakdown of the Methane Emissions from 4B 'Manure Management' by Livestock and Poultry Category within 1990-2013 periods, %

	1990	1991	1992	1993	1994	1995	1996	1997
Cattle	48.3	47.8	52.1	55.2	56.4	50.7	50.8	52.0
Sheep	1.6	1.8	2.1	2.8	3.0	3.5	3.7	4.0
Goats	0.0	0.0	0.1	0.1	0.1	0.2	0.2	0.2
Horses	0.5	0.6	0.7	0.9	1.0	1.3	1.5	1.9
Asses and mules	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Swine	44.2	44.0	40.4	36.5	34.6	38.0	37.6	34.3
Poultry	5.1	5.6	4.5	4.3	4.7	6.0	5.9	7.2
Rabbits	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.3
	1998	1999	2000	2001	2002	2003	2004	2005
Cattle	46.8	49.1	51.8	52.2	50.0	48.6	48.3	43.4
Sheep	3.9	4.0	4.5	4.4	4.5	4.7	5.2	4.9
Goats	0.2	0.3	0.4	0.4	0.5	0.5	0.5	0.5
Horses	2.1	2.5	3.3	3.5	3.6	3.8	3.9	3.5
Asses and mules	0.0	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Swine	38.6	34.2	27.8	26.4	27.5	26.9	23.3	25.3
Poultry	8.0	9.5	11.8	12.6	13.5	14.9	18.1	21.7
Rabbits	0.3	0.3	0.4	0.4	0.4	0.5	0.6	0.7
	2006	2007	2008	2009	2010	2011	2012	2013
Cattle	39.9	43.9	40.7	36.6	33.2	33.6	34.4	34.8
Sheep	4.9	6.1	6.3	5.8	5.3	5.1	5.1	5.3
Goats	0.5	0.6	0.6	0.6	0.5	0.6	0.6	0.7
Horses	3.3	4.0	3.8	3.3	2.9	2.9	2.8	2.8
Asses and mules	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Swine	29.0	22.0	23.5	26.8	32.3	34.8	38.2	41.6
Poultry	21.5	22.4	24.1	26.0	24.9	22.1	18.0	13.9
Rabbits	0.8	0.9	0.8	0.8	0.8	0.8	0.8	0.9

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 the 4B 'Manure Management', varying between a minimum of 1.90 per cent in 1990 to a maximum of 46.34 per cent in 2002 (Table 6-39).

Table 6-39: Comparative Results of CH_4 Emissions from 4B 'Manure Management', estimated using Tier 1 and Tier 2 Methodologies, Gg

	1990	1991	1992	1993	1994	1995	1996	1997
Tier 1	14.9864	14.3176	13.1911	11.3291	10.9584	10.1351	9.2644	8.0451
Tier 2	14.7018	13.0828	11.8291	9.3011	9.0365	7.1870	6.5425	5.3695
Difference, %	-1.90	-8.62	-10.33	-17.90	-17.54	-29.09	-29.38	-33.26

	1998	1999	2000	2001	2002	2003	2004	2005
Tier 1	8.3158	7.4380	6.3814	6.4749	6.7124	6.0934	5.5409	5.6966
Tier 2	5.1130	4.5368	3.6273	3.6623	3.6021	3.3528	3.0717	3.2388
Difference, %	-38.51	-39.00	-43.16	-43.44	-46.34	-44.98	-44.56	-43.14
	2006	2007	2008	2009	2010	2011	2012	2013
Tier 1	5.7951	4.1984	4.0379	4.5082	4.7763	4.3949	4.0324	3.9027
Tier 2	3.2826	2.3788	2.3492	2.6620	2.8774	2.7032	2.6531	2.5936
Difference, %	-43.36	-43.34	-41.82	-40.95	-39.76	-38.49	-34.21	-33.54

6.3.1.6 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 4B '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 updating the AD set for the livestock breeding sector.

6.3.2 Nitrous Oxide Emissions

6.3.2.1 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[62] 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.

6.3.2.2 Activity Data, Assessment Methodologies and Emission Factors

N_2O emissions from the 4B '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 4.A '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 4B 'Manure Management':

[62] Leaching – the loss of mineral and organic solutes due to water or other liquids percolation from soil.

(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):

$$N_2O_{\ D(mm)} = [\ \Sigma_{(S)}\ [\Sigma_{(T)}\ (N_{(T)} \bullet Nex_{(T)} \bullet MS_{(T, S)})] \bullet FE_{3(S)}] \bullet 44/28$$

Where:

$N_2O_{D(mm)}$ – direct N_2O emissions from Manure Management in the country (kg N_2O/yr);

$N_{(T)}$ – number of head of livestock species/category *T* in the country;

$Nex_{(T)}$ – annual average N excretion per head of species/category *T* in the country (kg N/animal/yr);

$MS_{(T, S)}$ – fraction of total annual nitrogen excretion for each livestock species/category *T* that is managed in manure management system *S* in the country, dimensionless;

$FE_{3(S)}$ – emission factor for direct N_2O emissions from manure management system *S* in the country, (kg N_2O-N/kg N in manure management system *S*);

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.

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 6-40).

Table 6-40: Average Annual N Excretion by Main Livestock and Poultry Categories in EE

	$N_{rate\ (T),}$ kg N/1000 kg/day	TAM, weigh, kg	$N_{ex\ (T)\ ANIMAL,}$ kg N/head/year
Dairy cows	0.35	550	70.3
Other cattle	0.35	395	50.5
Sheep	0.90	28	9.2
Goats	1.28	30	14.0
Horses	0.30	238	26.1
Asses and mules	0.30	130	14.2
Swine	0.74	70	18.8
Fattening swine	0.55	50	10.0
Market swine	0.46	180	30.2
Rabbits	7.40	3.0	8.1
Chicken	0.82	1.8	0.5
Geese	0.83	4.0	1.2
Ducks	0.83	3.0	0.9
Turkeys	0.74	7.0	1.9

Source: *IPCC 2006 Guidelines*, Volume 4, Chapter 10, Table 10.19, Page 10.59, Table 10A-9, Page 10.82.

The $Nex_{(T)}$ country specific values (Table 6-41) were estimated using this approach, default values for N excretion values for EE countries, as well as country specific information on the typical animal mass (TAM) in the Republic of Moldova during the period under review (see Table 6-10).

Table 6-41: Average Annual $Nex_{(T)}$ Excretion by Main Livestock and Poultry Categories in the Republic of Moldova within 1990-2013 periods, kg N/head/year

	1990	1991	1992	1993	1994	1995	1996	1997
Dairy cows	60.8	56.6	55.1	53.0	52.8	52.6	52.6	57.7
Other cattle	49.9	46.7	43.7	42.0	40.4	40.6	42.0	40.6
Sheep	14.1	14.5	14.2	14.1	14.5	12.8	12.8	11.5
Goats	17.8	18.2	17.8	17.8	18.2	15.9	15.9	14.0
Horses	42.8	34.6	37.4	37.7	40.4	39.0	37.3	33.5
Asses and mules	14.3	13.8	13.6	13.7	13.5	13.1	12.5	12.3
Swine	26.5	24.4	22.4	21.3	20.3	22.4	26.0	23.0
Rabbits	8.1	8.0	7.9	7.7	7.6	7.4	7.3	7.3
Chicken	0.6	0.6	0.6	0.5	0.5	0.5	0.5	0.5
Geese	1.2	1.2	1.2	1.1	1.1	1.0	1.1	1.0
Ducks	0.8	0.8	0.8	0.8	0.7	0.7	0.8	0.8
Turkeys	1.8	1.8	1.8	1.7	1.6	1.5	1.6	1.5
	1998	1999	2000	2001	2002	2003	2004	2005
Dairy cows	56.6	56.1	55.7	55.4	55.4	55.1	55.7	54.8
Other cattle	39.3	38.7	37.7	37.9	37.6	37.0	38.4	37.4
Sheep	11.5	11.5	11.5	10.8	10.8	10.8	10.9	10.8
Goats	14.0	14.0	14.1	13.1	13.1	13.1	13.1	13.1
Horses	33.3	30.8	31.3	31.0	31.2	31.8	31.0	32.4
Asses and mules	12.2	11.4	11.6	11.5	11.6	11.7	11.5	12.0
Swine	16.7	15.4	14.1	13.4	12.7	13.2	13.8	13.5
Rabbits	7.3	7.5	7.4	7.3	7.4	7.4	7.3	7.4
Chicken	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Geese	1.0	1.1	1.0	1.1	1.1	1.1	1.1	1.2
Ducks	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8
Turkeys	1.6	1.6	1.6	1.6	1.5	1.6	1.6	1.7
	2006	2007	2008	2009	2010	2011	2012	2013
Dairy cows	54.5	54.3	51.9	52.2	53.7	53.8	54.7	54.9
Other cattle	37.9	36.3	36.6	36.9	37.2	41.1	40.7	39.6
Sheep	11.2	10.8	10.9	11.5	11.5	11.5	11.9	12.5
Goats	13.5	13.1	13.1	14.0	14.0	14.0	14.5	15.4
Horses	36.4	32.5	33.8	33.1	33.6	33.3	35.1	35.7
Asses and mules	12.2	12.1	12.4	12.2	12.4	12.5	12.8	13.0
Swine	13.8	13.8	15.2	15.1	14.9	15.4	16.0	14.6
Rabbits	7.4	7.3	7.4	7.6	7.7	8.0	8.1	8.2
Chicken	0.5	0.6	0.6	0.6	0.6	0.7	0.6	0.6
Geese	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2
Ducks	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8
Turkeys	1.7	1.8	1.8	1.8	1.8	1.8	1.8	1.8

To be noted that where organic forms of bedding material (straw, sawdust, chippings, etc.) are used, the additional N from the bedding should also be considered as part of the managed manure N applied to soils. 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 6-42).

Table 6-42: Average annual nitrogen excretion for a typical animal Nex $_{(T)}$ calculated based on country specific information

	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.

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 6-42 are not available for all animal categories, Nex $_{(T)}$ values set forth in Table 6-41 were used to calculate the direct N_2O emissions from manure management in the Republic of Moldova.

Information on manure management systems usage is identical to that used earlier in sub-chapter 6.3.1. 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 Revised 1996 Guidelines (IPCC, 1997)[63], so their use was deemed to be inappropriate.

To estimate direct N_2O emissions from the 4B 'Manure Management' source category there were used country specific information (identified following experts opinions – the experts from the specialist from the Scientific-Practical Institute of Biotechnology in Animal Breeding and Veterinary Medicine were consulted) on the manure management systems usage in the Republic of Moldova (see Table 6-34). 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 6-43).

Table 6-43: 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
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 'N_2O from agricultural soils'	cattle, swine, poultry	0.020	0.007-0.06
	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
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
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
	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
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
	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
Composting - Static Pile: Composting in piles with forced aeration but no mixing		0.006	Factor of 2
Composting – Intensive Windrow: Composting in windrows with regular turning for mixing and aeration		0.100	Factor of 2
Composting – Passive Windrow: Composting in windrows with infrequent turning for mixing and aeration		0.010	Factor of 2
Poultry manure with litter: Manure is excreted on floor with bedding, birds walk on manure		0.001	Factor of 2
Poultry manure without bedding: Manure is excreted on floor without bedding, birds do not walk on manure		0.001	Factor of 2
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
	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 4B 'Manure Management' were estimated by using a Tier 1 methodology (IPCC, 2006). Indirect N_2O emissions ($N_2O_{G(mm)}$) from volatilization of N in forms of NH_3 and NO_x were estimated by using the following equation (2006 IPCC Guidelines, Volume 4, Chapter 10, Equations 10.26 and 10.27):

$$N_2O_{G(mm)} = [\Sigma_{(S)}\ [\Sigma_{(T)} (N_{(T)} \bullet Nex_{(T)} \bullet MS_{(T,S)}) \bullet (Frac_{GasMS}/100)_{(T,S)}] \bullet FE_4 \bullet 44/28$$

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;

[63] Revised 1996 Guidelines, Volume 3, Table 4-21, Page 4.101.

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 6-44);

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 6-44: Default Values for Total Nitrogen Loss, that Volatilize in NH_3 and NO_x from Manure Management *S*, %

	Manure Management System (MMS)	Total N loss from MMS due to volatilization of N-NH_3 and N-NO_x (%), Frac $_{GasMS}$ (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	Deep bedding	25% (10-30)
	Solid storage	12% (5-20)
Poultry	Poultry without litter	55% (40-70)
	Anaerobic lagoon	40% (25-75)
	Poultry with litter	40% (10-60)

Indirect N_2O emissions (N_2O $_{L(mm)}$) from leaching and runoff were estimated by using the following equation (2006 IPCC Guidelines, Volume 4, Chapter 10, Equations 10.28 and 10.29):

$$N_2O_{L(mm)} = [\Sigma_{(S)} [\Sigma_{(T)} (N_{(T)} \bullet Nex_{(T)} \bullet MS_{(T,S)}) \bullet (Frac_{leach\,MS}/100)_{(T,S)}] \bullet FE_5 \bullet 44/28$$

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 (IPCC, 2006).

Table 6-45 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 6-45: Default Values (IPCC, 2006) for Total Nitrogen Loss from Manure Management *S*, %

	Manure Management System (MMS)	Total N loss from MMS (%), $Frac_{LossMS}$ (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	Deep bedding	35% (15-40)
	Solid storage	15% (5-20)
Poultry	Poultry without litter	55% (40-70)
	Anaerobic lagoon	77% (50-99)
	Poultry with litter	50% (20-80)

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 4D 'Agricultural Soils'.

The estimate of managed manure N available for application to managed soils was based on the following equation (2006 IPCC Guidelines, Volume 4, Chapter 10, Equation 10.34):

$$N_{MMS\_Avb} = \Sigma_{(S)} \{\Sigma_{(T)} [(N_{(T)} \bullet Nex_{(T)} \bullet MS_{(T,S)}) \bullet (1-Frac_{Loss\ MS}/100)] + [N_{(T)} \bullet Nex_{(T)} \bullet N_{bending\ MS}]\}$$

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; limited data from scientific literature indicates the amount of nitrogen contained in organic bedding material applied for dairy cows and heifers is usually around 7 kg N/animal/year, for other cattle is 4 kg N/animal/year, for market and breeding swine is around 0.8 and 5.5 kg N/animal/year, respectively; for deep bedding systems, the amount of N in litter is approximately double these amounts (Webb, 2001; Döhler *et al.*, 2002); cited from 2006 IPCC Guidelines);

S – manure management system;

T – species/category of livestock.

6.3.2.3 Uncertainties Assessment and Time-Series Consistency

Uncertainties related to estimation of N_2O emissions from 4B 'Manure Management' source category, depend on the accuracy of the livestock characterization (±10%), 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 by ±25 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.

The combined uncertainties associated with direct N_2O emissions from manure management can be considered medium for 'cattle', 'sheep', 'goats', 'horses', 'asses and mules' and 'swine' (±31.62 per cent), as well as for 'poultry' and 'rabbits' (±33.54 per cent). At the same time, combined uncertainties, presented as a per cent of total sectoral emissions were estimated at ±1.12 per cent for cattle, ±1.02 per cent for 'sheep', ±0.24 per cent for 'goats', ±0.19 per cent for 'horses', ±0.003 per cent for 'asses and mules', ±0.84 per cent for 'swine', ±1.18 per cent for 'poultry' and ±0.37 per cent for 'rabbits'. Uncertainties introduced in trend in sectoral emissions were estimated at ±0.63 per cent for 'cattle', ±0.21 per cent for 'sheep', ±0.09 per cent for 'goats', ±0.05 per cent for 'horses', ±0.001 per cent for 'asses and mules', ±0.66 per cent for 'swine', ±0.33 per cent for 'poultry' and ±0.13 per cent for 'rabbits'.

Combined uncertainties associated with indirect N_2O emissions from manure management can be considered high for 'cattle', 'sheep' and 'swine' (±75.66 per cent), as well as for 'poultry' (±76.49 per cent), and very high for other animal categories: ±100.50 per cent for 'goats', 'horses', and 'asses and mules' respectively ±101.12 per cent for 'rabbits'. At the same time, combined uncertainties, presented as a per cent of total sectoral emissions were estimated at ±0.52 per cent for 'cattle', ±0.40 per cent for 'sheep', ±0.12 per cent for 'goats', ±0.10 per cent for 'horses', ±0.002 per cent for 'asses and mules', ±0.50 per cent for 'swine', ±0.67 per cent for 'poultry' and ±0.18 per cent for 'rabbits'. Uncertainties introduced in trend in sectoral emissions were estimated at ±0.37 per cent for 'cattle', ±0.05 per cent for 'sheep', 'goats' and 'rabbits'; ±0.02 per cent for 'horses', ±0.0005 per cent for 'asses and mules', ±0.46 per cent for 'swine', ±0.09 per cent for 'poultry'.

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 GPG (IPCC, 2000).

6.3.2.4 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 (IPCC, 2000). Also, the AD and methods used for estimating N_2O emissions under the category 4B '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.

6.3.2.5 Recalculations

N_2O emissions from the 4B 'Manure Management' source category were recalculated for the following leap years – 1992, 1996, 2000, 2008 and 2012 (using 366 days within the estimation equations), as well as for the 2002-2010 time series, in particular due to précising AD on poultry livestock in the Republic of the RM under the UNFCCC, within the current inventory cycle, the direct N_2O emissions increased insignificantly during the leap years, and respectively decreased between 2002-2010 time series (Table 6-46).

Table 6-46: Comparative Results of $N_2O_{TOTAL(mm)}$ Emissions from 4B 'Manure Management' included into the TNC and the BUR of the RM under the UNFCCC, Gg

	1990	1991	1992	1993	1994	1995	1996	1997
TNC	4.4577	4.0464	3.5097	2.9555	2.8481	2.7252	2.6551	2.2291
BUR	4.4577	4.0464	3.5193	2.9555	2.8481	2.7252	2.6624	2.2291
Difference, %	0.00	0.00	0.27	0.00	0.00	0.00	0.27	0.00
	1998	1999	2000	2001	2002	2003	2004	2005
TNC	2.0630	1.8491	1.6077	1.6352	1.6711	1.5941	1.5650	1.7119
BUR	2.0630	1.8491	1.6121	1.6352	1.6709	1.5941	1.5693	1.7119
Difference, %	0.00	0.00	0.27	0.00	-0.01	0.00	0.27	0.00
	2006	2007	2008	2009	2010	2011	2012	2013
TNC	1.7803	1.3464	1.3457	1.5374	1.6095			
BUR	1.7802	1.3455	1.3457	1.5352	1.6089	1.5356	1.3743	1.2761
Difference, %	0.00	-0.07	0.00	-0.14	-0.04			

Abbreviations: TNC – Third National Communication; BUR – Biennial Update Report.

6. AGRICULTURE SECTOR

Direct $N_2O_{D(mm)}$ (Table 6-47) and indirect $N_2O_{IND(mm)}$ (Table 6-48) emissions from the 4B 'Manure Management' source category were recalculated for the period included in the TNC. For the period 2011-2013, $N_2O_{TOTAL(mm)}$, direct $N_2O_{D(mm)}$ and indirect $N_2O_{IND(mm)}$ emissions resulting from manure management were estimated for the first time.

Table 6-47: Comparative Results of Direct $N_2O_{D(mm)}$ Emissions from 4B 'Manure Management' included into the TNC and the BUR of the RM under the UNFCCC, Gg

	1990	1991	1992	1993	1994	1995	1996	1997
TNC	3.6011	3.2827	2.8580	2.4284	2.3436	2.2452	2.1846	1.8360
BUR	3.6011	3.2827	2.8659	2.4284	2.3436	2.2452	2.1906	1.8360
Difference, %	0.00	0.00	0.27	0.00	0.00	0.00	0.27	0.00
	1998	1999	2000	2001	2002	2003	2004	2005
TNC	1.7051	1.5302	1.3367	1.3589	1.3902	1.3258	1.3012	1.4185
BUR	1.7051	1.5302	1.3404	1.3589	1.3900	1.3258	1.3047	1.4184
Difference, %	0.00	0.00	0.27	0.00	-0.01	0.00	0.27	0.00
	2006	2007	2008	2009	2010	2011	2012	2013
TNC	1.4748	1.1177	1.1155	1.2721	1.3297			
BUR	1.4747	1.1170	1.1156	1.2703	1.3292	1.2685	1.1371	1.0602
Difference, %	0.00	-0.06	0.01	-0.14	-0.04			

Abbreviations: TNC – Third National Communication; BUR – Biennial Update Report.

The obtained results allow assert that within the 1990-2013 time series $N_2O_{TOTAL(mm)}$ emissions from 4B 'Manure Management' decreased by 71.4 per cent, respectively direct $N_2O_{D(mm)}$ emissions decreased by 70.6 per cent, while indirect $N_2O_{IND(mm}$ emissions decreased by 74.8 per cent.

Table 6-48: Comparative Results of Indirect $N_2O_{IND(mm)}$ Emissions from 4B 'Manure Management' included into the TNC and the BUR of the RM under the UNFCCC, Gg

	1990	1991	1992	1993	1994	1995	1996	1997
TNC	0.8566	0.7637	0.6517	0.5271	0.5045	0.4800	0.4705	0.3931
BUR	0.8566	0.7637	0.6535	0.5271	0.5045	0.4800	0.4718	0.3931
Difference, %	0.00	0.00	0.27	0.00	0.00	0.00	0.27	0.00
	1998	1999	2000	2001	2002	2003	2004	2005
TNC	0.3579	0.3189	0.2710	0.2763	0.2809	0.2683	0.2639	0.2934
BUR	0.3579	0.3189	0.2717	0.2763	0.2809	0.2683	0.2646	0.2934
Difference, %	0.00	0.00	0.27	0.00	-0.01	0.00	0.27	0.00
	2006	2007	2008	2009	2010	2011	2012	2013
TNC	0.3055	0.2287	0.2302	0.2653	0.2798			
BUR	0.3055	0.2286	0.2301	0.2649	0.2797	0.2671	0.2372	0.2160
Difference, %	0.00	-0.08	-0.05	-0.16	-0.05			

Abbreviations: TNC – Third National Communication; BUR – 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 76.0 per cent within this period, while $N_2O_{L(mm)}$ emissions from leaching and runoff of nitrogen have decreased by 66.0 per cent (Table 6-49). 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 Republic of Moldova.

Table 6-49: Indirect N_2O Emissions from Volatilization of Ammonia and Nitrogen Oxides, as well as from Leaching and Runoff of Nitrogen, under 4B 'Manure Management' within 1990-2013 periods, Gg

	1990	1991	1992	1993	1994	1995	1996	1997
Indirect $N_2O_{(G)}$	0.7510	0.6662	0.5662	0.4500	0.4295	0.4098	0.4046	0.3356
Indirect $N_2O_{(L)}$	0.1056	0.0975	0.0872	0.0771	0.0750	0.0702	0.0671	0.0576
$N_2O_{IND(mm)}$	0.8566	0.7637	0.6535	0.5271	0.5045	0.4800	0.4718	0.3931
	1998	1999	2000	2001	2002	2003	2004	2005
Indirect $N_2O_{(G)}$	0.3029	0.2684	0.2256	0.2293	0.2329	0.2224	0.2192	0.2443
Indirect $N_2O_{(L)}$	0.0549	0.0506	0.0461	0.0470	0.0480	0.0459	0.0454	0.0491
$N_2O_{IND(mm)}$	0.3579	0.3189	0.2717	0.2763	0.2809	0.2683	0.2646	0.2934
	2006	2007	2008	2009	2010	2011	2012	2013
Indirect $N_2O_{(G)}$	0.2549	0.1894	0.1911	0.2209	0.2344	0.2239	0.1987	0.1800
Indirect $N_2O_{(L)}$	0.0506	0.0391	0.0390	0.0439	0.0453	0.0432	0.0385	0.0359
$N_2O_{IND(mm)}$	0.3055	0.2286	0.2301	0.2649	0.2797	0.2671	0.2372	0.2160

Table 6-50 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 Republic of Moldova, estimated in conformity with the methodology set forth in the IPCC 2006 Guidelines.

Table 6-50: Amount of Managed Manure N Available for Application to Managed Soils within 1990-2013 periods, kt N

	1990	1991	1992	1993	1994	1995	1996	1997
$Nex_{(T)}$	145.7	131.8	115.7	98.0	94.7	89.3	86.8	73.0
N_{MMS_Avb}	87.9	79.8	71.1	60.2	58.3	54.5	52.4	44.5

	1998	1999	2000	2001	2002	2003	2004	2005
$Nex_{(T)}$	69.6	62.6	52.8	53.4	54.3	51.6	50.3	53.9
N_{MMS_Avb}	41.7	37.8	33.3	33.9	34.6	32.9	32.0	34.1
	2006	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**
$Nex_{(T)}$	55.7	42.4	42.3	47.9	50.0	47.6	43.3	40.6
N_{MMS_Avb}	35.3	27.0	26.9	30.2	31.3	32.7	32.7	32.5

6.3.2.6 Planned Improvements

Regarding N_2O emissions from the 4B 'Manure Management' source category, planned improvements could include collecting additional data, in particular on country specific manure management systems, as well as those related to country specific N excreted rates for different categories (kg N/head/year).

6.4 Agricultural Soils (Category 4D)

Direct and indirect N_2O emissions are monitored under the 4D '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.

$$N_2O_{direct} = N_2O_{(SN)} + N_2O_{(ON)} + N_2O_{(PRP)} + N_2O_{(CR)} + N_2O_{(SOM)}$$

Where:

$N_2O_{(SN)}$ – annual N_2O emissions from the amount of synthetic fertilizer N applied to soils; Gg/yr;

$N_2O_{(ON)}$ – annual N_2O emissions from the amount of animal manure, compost, sewage sludge and other organic N additions applied to soils, Gg/yr;

$N_2O_{(PRP)}$ – annual N_2O emissions from urine and dung inputs to grazed soils, Gg/yr;

$N_2O_{(CR)}$ – annual 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, Gg/yr;

$N_2O_{(SOM)}$ – annual 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), Gg/yr

To be noted, that within the 1990-2013 time series, direct N_2O emissions from 4D 'Agriculture Soils' decreased by 22.3 per cent, from 3.8 to 2.9 Gg (Figure 6-4).

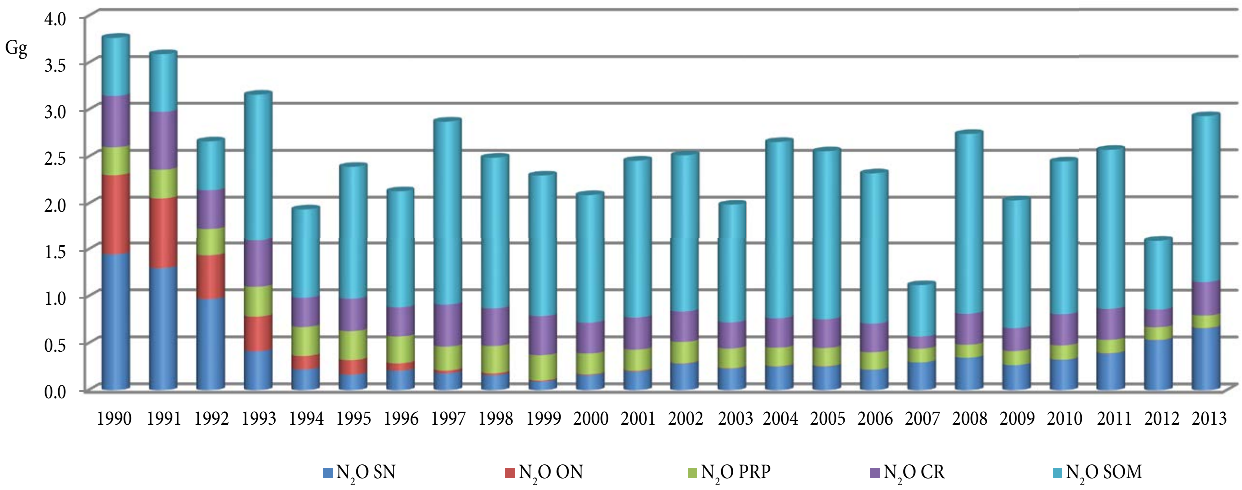

Figure 6-4: Direct N_2O emissions from the 4D 'Agricultural Soils' within 1990-2013 periods, Gg

The contribution of different emission sources in the structure of total direct N_2O emissions has changed significantly (Table 6-51). The share of $N_2O_{(SN)}$, $N_2O_{(ON)}$, $N_2O_{(PRP)}$ and $N_2O_{(CR)}$ emissions decreased by 41.2 per cent, 99.4 per cent, 42.9 per cent and, respectively 15.4 per cent, while the share of $N_2O_{(SOM)}$ emissions increased by 267.8 per cent.

Table 6-51: Breakdown of Direct N_2O Emissions from 4D 'Agriculture Soils' by Source within 1990-2013 periods, %

	1990	1991	1992	1993	1994	1995	1996	1997
N_2O_{SN}	38.4	36.2	36.5	13.1	11.4	6.9	9.7	6.2
N_2O_{ON}	22.7	21.1	17.5	11.7	7.4	6.5	3.7	1.1
N_2O_{PRP}	7.9	8.5	11.0	10.1	16.0	12.9	13.3	8.8
N_2O_{CR}	14.5	17.1	15.5	15.7	16.1	14.4	14.5	15.6
N_2O_{SOM}	16.5	17.1	19.6	49.4	49.2	59.3	58.6	68.3
	1998	1999	2000	2001	2002	2003	2004	2005
N_2O_{SN}	6.4	4.0	7.7	8.1	11.2	11.5	9.5	9.9
N_2O_{ON}	0.8	0.5	0.4	0.4	0.2	0.2	0.1	0.2
N_2O_{PRP}	11.7	11.7	10.6	9.1	9.0	10.5	7.4	7.5
N_2O_{CR}	16.1	18.1	15.8	13.9	12.8	14.0	11.8	12.0
N_2O_{SOM}	65.0	65.7	65.6	68.5	66.7	63.7	71.2	70.5
	2006	2007	2008	2009	2010	2011	2012	2013
N_2O_{SN}	9.3	26.4	12.6	13.1	13.2	15.3	33.5	22.6
N_2O_{ON}	0.0	0.1	0.0	0.0	0.1	0.1	0.1	0.1
N_2O_{PRP}	8.0	13.0	5.1	7.3	6.2	5.6	8.4	4.5
N_2O_{CR}	13.2	11.5	12.0	12.1	13.5	12.9	11.8	12.3
N_2O_{SOM}	69.5	49.0	70.3	67.5	67.0	66.1	46.1	60.5

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 (2006 IPCC Guidelines, Volume 4, Chapter 11, Equations 11.09, 11.10 and 11.11):

$$N_2O_{\ indirect} = N_2O_{\ (ATD)} + N_2O_{\ (L)}$$

Where:

$N_2O_{\ (ATD)}$ – indirect N_2O emissions, produced from atmospheric deposition of nitrogen as ammonia (NH_3), oxides of N (NO_x), and their products NH_4^+ and NH_3^- onto soils and the surface of lakes and other waters; deposition of agriculturally derived NH_3 and NO_x, following the application of synthetic and organic N fertilizers and/or urine and dung deposition from grazing animals;

$N_2O_{\ (L)}$ – from leaching and runoff from land of N from synthetic and organic fertilizer additions, crop residues returned to soils, mineralization of N associated with loss of soil C in mineral and drained/managed organic soils through land-use change or management practices and urine and dung deposition from grazing animals.

Within the 1990-2013 time series, indirect N_2O emissions from the 4D 'Agricultural Soils' decreased by circa 37.7 per cent, from 1.2 to 0.7 Gg (Figure 6-5).

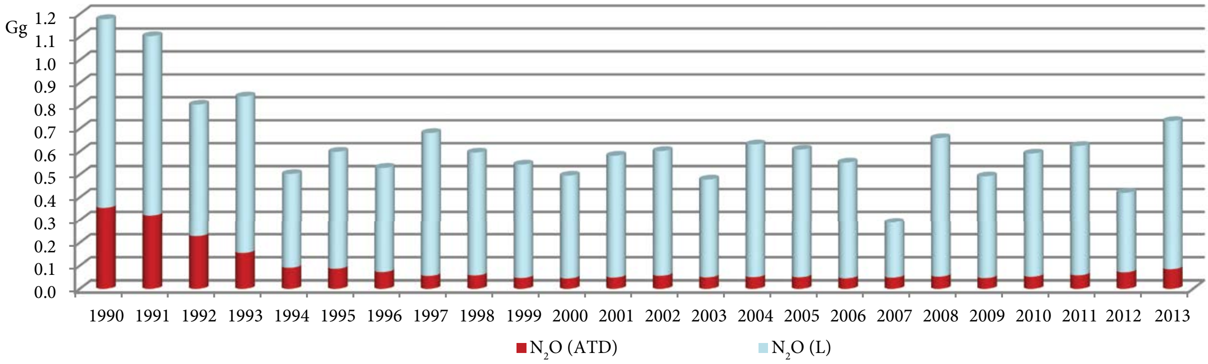

Figure 6-5: Indirect N_2O emissions from the 4D 'Agricultural Soils' within 1990-2013 periods, Gg

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 61.7 per cent, while the share of $N_2O_{(L)}$ emissions has decreased by 26.5 per cent (Table 6-52).

Table 6-52: Breakdown of Indirect N_2O Emissions from 4D 'Agriculture Soils' by Source within 1990-2013 periods, %

	1990	1991	1992	1993	1994	1995	1996	1997
$N_2O_{(ATD)}$	30.1	29.0	28.4	18.5	18.1	14.4	13.7	8.2
$N_2O_{(L)}$	69.9	71.0	71.6	81.5	81.9	85.6	86.3	91.8
	1998	1999	2000	2001	2002	2003	2004	2005
$N_2O_{(ATD)}$	9.7	8.6	9.0	8.3	9.4	10.3	7.9	8.1
$N_2O_{(L)}$	90.3	91.4	91.0	91.7	90.6	89.7	92.1	91.9
	2006	2007	2008	2009	2010	2011	2012	2013
$N_2O_{(ATD)}$	8.1	16.7	8.0	9.4	8.8	9.3	17.0	11.5
$N_2O_{(L)}$	91.9	83.3	92.0	90.6	91.2	90.7	83.0	88.5

6.4.1 Direct N_2O Emissions from Managed Soils

6.4.1.1 Applied Synthetic Nitrogen Fertilizer

Source Category Description

Considerable amounts of nitrogen are applied to soils with synthetic N fertilizer. 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 fertilizer vary a lot over a year.

Methodological Issues, Emission Factors and Data Sources

Direct N_2O emissions from applied synthetic fertilizer were estimated by using a Tier 1 methodology (IPCC, 2006). The following equation was used to calculate N_2O emissions:

$$N_2O_{SN} = F_{SN} \bullet EF_1 \bullet 44/28$$

Where:

N_2O_{SN} – N_2O emissions from applied synthetic fertilizer (Gg/yr);

F_{SN} – annual amount of synthetic fertilizer N 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 6-53 provides a short overview of synthetic N fertilizers, including complex fertilizers most commonly used in the Republic of Moldova.

Table 6-53: Overview of Synthetic N Fertilizers Most Commonly Used in the Republic of Moldova

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 fiecare	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 synthetic N fertilizers (active substance) 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 1993-2013 time series).

Table 6-54 indicates that between 1990 and 2013, there was a significant decrease by 4.2 times of the amounts of synthetic fertilizers used in the agriculture sector of the Republic of Moldova. The amounts of synthetic fertilizers used per one ha decreased by 2.5 times, from 136.0 kg a.s./ha in 1990, to 53.6 kg a.s./ha in 2013.

Table 6-54: Applied Synthetic Fertilizers in the Republic of Moldova within 1990-2013 periods, kt of nitrogen active substance

	1990	1991	1992	1993	1994	1995	1996	1997
Applied Synthetic N Fertilizer, F_{SN}	92.1	82.7	61.8	26.4	14.1	10.5	13.2	11.4
Total Applied Synthetic Fertilizer	232.4	191.4	127.6	44.9	20.0	12.5	14.3	12.1
kg applied for 1 sown ha	136.0	124.0	86.0	27.4	11.0	8.8	10.3	9.2
	1998	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**
Applied Synthetic N Fertilizer, F_{SN}	10.2	5.9	10.2	12.7	18.0	14.6	16.1	16.1
Total Applied Synthetic Fertilizer	10.3	6.1	10.3	12.8	18.4	15.4	17.5	18.1
kg applied for 1 sown ha	8.1	5.3	10.5	14.5	18.3	18.5	18.9	20.7
	2006	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**
Applied Synthetic N Fertilizer, F_{SN}	13.8	18.8	21.9	17.0	20.6	25.0	34.1	42.1
Total Applied Synthetic Fertilizer	16.6	22.4	24.7	19.9	25.5	30.9	43.9	54.8
kg applied for 1 sown ha	19.8	26.7	29.1	23.5	26.0	31.5	45.4	53.6

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) and 2014 (page 345). Statistical Yearbooks of the ATULBD for 1998 (page 230), 2000 (page 107), 2002 (page 111), 2006 (page 108), 2009 (page 107), 2012 (page 114) and 2014 (page 103).

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 Republic of Moldova, 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 fertilizer 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 synthetic N fertilizer 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 fertilizer are considered to be low (±7.81 per cent). At the same time, combined uncertainties, presented as a per cent of total sectoral emissions were estimated at ±0.75 per cent while uncertainties introduced in trend in total GHG sectoral emissions were estimated at ±0.29 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 GPG (IPCC, 2000).

Quality Assurance and Quality Control

Standard verification and quality control forms and check-lists were filled in for 4D 'Agriculture Soils' source category, following a Tier 1 approach (IPCC, 2000). The AD and methods used for estimating N_2O emissions originated from this source under the 4D 'Agriculture Soils' 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 GPG (IPCC, 2000), GHG emissions were estimated using AD and national EF from official sources of reference.

Recalculations

No recalculations were made for 1990-2013 time series regarding direct N_2O emissions from applied synthetic N fertilizer on managed lands in the Republic of Moldova. For the period 2011-2013, the respective emissions were estimated for the first time. The results allow assert that within the 1990-2013 time series, direct N_2O emissions from applied synthetic N fertilizer on managed lands under 4D 'Agriculture Soils' decreased by circa 54.3 per cent (Table 6-55).

Table 6-55: Direct N_2O Emissions from Applied Synthetic Nitrogen Fertilizer within the 4D 'Agriculture Soils' Category included into the BUR of the RM under the UNFCCC, Gg

	1990	1991	1992	1993	1994	1995	1996	1997
$N_2O_{(SN)}$	1.4473	1.2996	0.9711	0.4145	0.2217	0.1652	0.2077	0.1795
	1998	1999	2000	2001	2002	2003	2004	2005
$N_2O_{(SN)}$	0.1600	0.0929	0.1609	0.1994	0.2823	0.2298	0.2524	0.2530
	2006	2007	2008	2009	2010	2011	2012	2013
$N_2O_{(SN)}$	0.2168	0.2959	0.3446	0.2674	0.3241	0.3927	0.5351	0.6617

Planned Improvements

No activities for improving the estimation process regarding the direct N_2O emissions from applied synthetic N fertilizers under the 4D 'Agriculture Soils' are planned for the future inventory cycle.

6.4.1.2 Applied Organic Nitrogen Fertilizers

Source Category Description

Applied organic nitrogen fertilizer 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 fertilizer were estimated using a Tier 1 methodology. The following equation was applied:

$$N_2O_{ON} = F_{ON} \bullet EF_1 \bullet 44/28$$

Where:

N_2O_{ON} – N_2O emissions from applied organic N fertilizer (Gg/yr);

$F_{ON} = (F_{AM} + F_{SEW} + F_{COMP} + F_{OOA})$, total annual amount of organic N fertilizer 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 fertilizer (preponderantly, manure with bedding[64]) applied on managed lands are available in the Statistical Yearbooks of the Republic of Moldova and those of the ATULBD (Table 6-56).

Table 6-56: Applied Organic Fertilizers in the Republic of Moldova within 1990-2013 periods

	1990	1991	1992	1993	1994	1995	1996	1997
Applied organic N fertilizer, kt	9740.0	8600.0	5300.0	4200.0	1620.0	1779.2	905.7	352.9
tones/sown ha	5.60	5.10	3.40	3.11	1.19	1.21	0.61	0.23
	1998	1999	2000	2001	2002	2003	2004	2005
Applied organic N fertilizer, kt	227.3	122.1	83.3	98.2	54.2	47.3	42.2	44.2
tones/sown ha	0.13	0.12	0.07	0.10	0.04	0.05	0.04	0.05
	2006	2007	2008	2009	2010	2011	2012	2013
Applied organic N fertilizer, kt	10.5	7.9	8.0	6.9	17.7	31.5	22.9	42.6
tones/sown ha	0.01	0.01	0.01	0.01	0.02	0.04	0.03	0.05

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) and 2014 (page 345). Statistical Yearbooks of the ATULBD for 1998 (page 230), 2000 (page 107), 2002 (page 111), 2006 (page 108), 2009 (page 107), 2012 (page 114) and 2014 (page 103).

[64] 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).

As the table indicates, from 1990 through 2013 there was a significant reduction, by circa 112 times, of the amounts of organic N fertilizers applied per hectare of sown fields: from circa 5.6 t/ha in 1990, to circa 50 kg/ha in 2013, while 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 3.5 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.

The scientific literature[65] shows that 1 tone of cattle manure with bedding contain circa 5.6 kg of nitrogen (sheep manure with bedding – 9.5 kg of nitrogen, horse manure with bedding – 6.0 kg nitrogen, swine manure with bedding – 8.2 kg of nitrogen, poultry manure with bedding – 16.3 kg of nitrogen), 1 tone of slurry – circa 3 kg of nitrogen, and 1 tone of sewage sludge – 20 kg of nitrogen.

In order to calculate the F_{ON} values (Table 6-57), the applied amount of organic fertilizer was multiplied by the conversion factor from bedding manure to nitrogen – 5.6 kg N/t of manure with bedding (Banaru, 2003).

Table 6-57: Annual Amount of Organic Nitrogen Applied to Soils in the Republic of Moldova within 1990-2013 periods, thousand tons

	1990	1991	1992	1993	1994	1995	1996	1997
F_{ON}	54.5440	48.1600	29.6800	23.5200	9.0720	9.9635	5.0719	1.9762
	1998	1999	2000	2001	2002	2003	2004	2005
F_{ON}	1.2729	0.6838	0.4665	0.5499	0.3035	0.2649	0.2363	0.2475
	2006	2007	2008	2009	2010	2011	2012	2013
F_{ON}	0.0588	0.0442	0.0448	0.0386	0.0991	0.1764	0.1282	0.2386

Uncertainties Assessment and Time-series Consistency

Uncertainties related to activity data on applied organic N fertilizer in the RM are considered to be medium (±25 per cent). Uncertainties associated with the default emission factor (EF_1 for F_{ON}) may reach up to ±6 per cent. The combined uncertainties associated with direct N_2O emissions from applied organic N fertilizer are considered to be large (±25.71 per cent). At the same time, combined uncertainties, presented as a per cent of total sectoral emissions were estimated at ±0.0140 per cent, while uncertainties introduced in trend in sectoral emissions were estimated at ±0.1310 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 GPG (IPCC, 2000).

Quality Assurance and Quality Control

Standard verification and quality control forms and check-lists were filled in for 4D 'Agriculture Soils' source category, following a Tier 1 approach (IPCC, 2000). 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. Following the recommendations included into the GPG (IPCC, 2000), GHG emissions were estimated using AD and national EF from official sources of reference.

Recalculations

No recalculations were made for 1990-2010 time series regarding direct N_2O emissions from applied organic fertilizer on managed lands in the Republic of Moldova. For the period 2011-2013, the respective emissions were estimated for the first time. The results allow assert that within the 1990-2013 time series, direct N_2O emissions from applied organic fertilizer on managed lands under 4D 'Agriculture Soils' decreased by circa 99.6 per cent (Table 6-58).

[65] 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.

Table 6-58: Direct N_2O Emissions from Applied Organic Fertilizer within the 4D 'Agriculture Soils' Category included into the BUR of the RM under the UNFCCC, Gg

	1990	1991	1992	1993	1994	1995	1996	1997
$N_2O_{(ON)}$	0.8571	0.7568	0.4664	0.3696	0.1426	0.1566	0.0797	0.0311
	1998	1999	2000	2001	2002	2003	2004	2005
$N_2O_{(ON)}$	0.0200	0.0107	0.0073	0.0086	0.0048	0.0042	0.0037	0.0039
	2006	2007	2008	2009	2010	2011	2012	2013
$N_2O_{(ON)}$	0.0009	0.0007	0.0007	0.0006	0.0016	0.0028	0.0020	0.0037

The significant decrease in emissions is due to a drastic drop in amount of organic fertilizers applied to soils, in particular, as a result of the collapse of the animal breeding sector during the period of transition to the market economy. To be noted also, in early 1990' the collective farms were regularly collecting the manure from big feeding lots and applying it to soil, while private farmers (in 2013, circa 93 per cent of the total livestock, the principal source of manure was concentrated in the private sector) are more reluctant to do the same due to high transportation costs.

Planned Improvements

No activities for improving the estimation process regarding the direct N_2O emissions from applied organic N fertilizers under the 4D 'Agriculture Soils' are planned for the future inventory cycle.

6.4.1.3 Urine and Dung Inputs to Grazed Soils

Source Category Description

By 2014, hayfields and pastures occupied circa 350.0 thousand ha (10.4 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 Republic of Moldova however this surface is 5 times smaller (Table 6-59).

Table 6-59: Available Lands by Use in the Republic of Moldova within 1992-2014, thousand ha

	1992	1995	2000	2005	2010	2011	2012	2013	2014
Total lands:	3376.0	3385.1	3384.4	3384.6	3384.4	3384.4	3384.6	3384.6	3384.6
Agricultural lands	2565.9	2556.7	2550.3	2521.6	2501.1	2498.3	2498.0	2497.8	2500.1
including:									
arable land	1736.3	1758.7	1813.8	1840.2	1816.7	1812.7	1810.5	1814.1	1816.1
perennial plantations:	474.8	430.7	352.3	297.8	301.0	298.8	298.7	295.3	295.3
including:									
orchards	224.5	208.3	170.8	131.9	132.5	133.3	134.5	135.1	135.8
vineyards	215.8	202.6	168.9	155.5	153.5	149.6	147.3	142.6	141.2
pastures	350.5	365.2	373.9	370.8	352.1	350.4	350.3	348.9	348.0
hayfields	4.3	2.1	2.5	2.7	2.2	2.2	2.0	2.1	2.0
fallow lands	0.0	0.0	7.8	10.1	29.1	34.2	36.5	37.4	38.7
Forests and forest lands	421.7	425.3	422.7	439.5	462.8	463.1	462.7	464.2	465.2
Rivers, lakes and bogs	88.7	92.6	95.5	96.8	96.4	99.6	99.5	99.2	96.9
Other lands	299.7	310.5	315.9	326.7	324.3	323.6	324.4	323.4	322.4

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

N_2O emissions from urine and dung inputs to grazed soils were estimated by using a Tier 1 methodology (IPCC, 2006). The following equation was applied:

$$N_2O_{PRP} = F_{PRP} \bullet EF_{3\,(PRP)} \bullet 44/28$$

Where:

N_2O_{PRP} – N_2O emissions from urine and dung inputs to grazed soils;

F_{PRP} – annual amount of urine and dung N deposited by grazing animals on pasture, range and paddock (kg N/yr);

$F_{PRP} = \Sigma_{(s)} [(N_{(T)} \bullet Nex_{(T)}) \bullet MS_{(T, PRP)}]$;

$N_{(T)}$ – number of head of livestock species/category T in the country (see 4A source category);

$Nex_{(T)}$ – annual average N excretion per animal of species/category T in the country (kg N/animal/yr) (see 4B 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 4B 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.

To calculate the amount of nitrogen from urine and dung inputs to grazed soils (Table 6-60), 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" (annual for 1990-2013 time periods), Statistical Yearbooks of the ATULBD (identical AD to those used under the 4A 'Enteric Fermentation' and 4B '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 4B 'Manure Management').

Table 6-60: Annual Amount of Urine and Dung Nitrogen Deposited by Grazing Animals on Pasture, Range and Paddock in the Republic of Moldova within 1990-2013 periods, thousand tons

	1990	1991	1992	1993	1994	1995	1996	1997
F_{PRP}	12.0528	12.3633	12.0327	12.7915	12.7413	12.2641	11.4464	10.0176
	1998	1999	2000	2001	2002	2003	2004	2005
F_{PRP}	12.0370	11.1315	8.5381	8.5374	8.6659	8.0813	7.6202	7.4764
	2006	2007	2008	2009	2010	2011	2012	2013
F_{PRP}	7.3354	5.8729	5.6761	6.0988	6.1716	5.8196	5.5624	5.5640

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 inputs to grazed soils (±50%) and uncertainties associated with the default emission factor (EF_3 for F_{PRP}) also may reach up to ±50 per cent. The combined uncertainties associated with direct N_2O emissions from N urine and dung inputs to grazed soils are considered to be quite high (±70.71 per cent). At the same time, combined uncertainties, presented as a per cent of total sectoral emissions were estimated at ±1.36 per cent while uncertainties introduced in trend in sectoral emissions were estimated at ±0.57 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 GPG (IPCC, 2000).

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 (IPCC, 2000). The AD and methods used for estimating N_2O emissions from N urine and dung inputs to grazed soils 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 GPG (IPCC, 2000), N_2O emissions from urine and dung inputs to grazed soils were estimated using AD and national EF from official sources of reference.

Recalculations

No recalculations were made for 1990-2010 time series regarding N_2O emissions from urine and dung inputs to grazed soils in the Republic of Moldova. For the period 2011-2013, the respective emissions were estimated for the first time (Table 6-61).

Table 6-61: Direct N_2O Emissions from Urine and Dung Inputs to Grazed Soils within the 4D 'Agriculture Soils' Category included into the BUR of the RM under the UNFCCC, Gg

	1990	1991	1992	1993	1994	1995	1996	1997
$N_2O_{(PRP)}$	0.2965	0.3058	0.2919	0.3179	0.3098	0.3079	0.2846	0.2534
	1998	1999	2000	2001	2002	2003	2004	2005
$N_2O_{(PRP)}$	0.2902	0.2684	0.2222	0.2237	0.2273	0.2097	0.1957	0.1915
	2006	2007	2008	2009	2010	2011	2012	2013
$N_2O_{(PRP)}$	0.1852	0.1456	0.1389	0.1484	0.1511	0.1433	0.1345	0.1316

The results allow assert that within the 1990-2013 time series, N_2O emissions from urine and dung inputs to grazed soils under 4D 'Agriculture Soils' decreased by circa 55.6 per cent. The decrease in emissions is due to a significant reduction in total population of livestock over the period under review. Despite the fact that the share of this type of manure management system (grazing) increased in comparison to 1990's level, it did not have any major impact on the trend of N_2O emissions from urine and dung inputs to grazed soils.

Planned Improvements

No activities for improving the estimation process regarding the direct N_2O emissions from urine and dung inputs to grazed soils under the 4D 'Agriculture Soils' are planned for the future inventory cycle.

6.4.1.4 Nitrogen in 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 A3-4.5)[66].

The following equation 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:

$$F_{CR} = (Crop_{(T)} \bullet R_{AG(T)} \bullet (1-Frac_{Remove(T)}) + Crop_{(T)} \bullet R_{BG(T)}) \bullet (P_{CR}/10^2) \bullet (k_6/10^2)$$

Where:

$Crop_{(T)}$ – harvested annual dry matter yield for crop *T* t.d.m./ha;

$$Crop_{(T)} = Yield\ Fresh_{(T)}\ x\ DRY;$$

$Yield\ Fresh_{(T)}$ – harvested fresh yield for crop *T*, t/ha;

DRY – dry matter fraction of harvested crop *T*, kg dm/t of yield[67] (see Table 6-62);

$R_{AG(T)}$ – ratio of above-ground residues dry matter to harvested yield for crop *T* (Crop(*T*)), $t.d.m_{AG}/t.d.m$[68] (see Table 6-62);

$R_{BG(T)}$ – ratio of below-ground residues to harvested yield for crop *T*, $t.d.m_{BG}/t$ dm[69] (see Table 6-62);

[66] Banaru, Anatol (2000), Methodology to Calculate CO2 Emissions from Agricultural Soils, In the collection of papers "Climate Change: Research, Studies, Solutions", Ministry of Environment / UNDP Moldova. „Bons Offices" S.R.L. Chişinău, 2000, pp. 115-123

[67] 2006, IPCC Guidelines, Volume 4, Chapter 11, Table 11.2, Page 11.17.

[68] 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.

[69] 2006 IPCC Guidelines, Volume 4, Chapter 11, Table 11.2, Page 11.17.

Frac $_{Remove\ (T)}$ – fraction of above-ground residues of crop *T* removed and used for other purposes[70] (see Table 6-62);

P_{CR} = amount of Nitrogen in crop residues (% a.s.) (Table 6-63);

k_6 = coefficient reflecting the N in crop residues (Banaru, 2002)[71] (Table 6-63).

Indices used to estimate N_2O emissions from crop residues returned to soils come from different sources of reference, including the 2006 IPCC Guidelines.

Table 6-62: 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 6-63: 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 6-64, 6-65 and 6-66).

Table 6-64: Areas Sown with Crops within 1990-2013 periods, thousand hectares

	1990	1991	1992	1993	1994	1995	1996	1997
Sown Areas – total	**1733.1**	**1717.0**	**1711.1**	**1779.5**	**1715.5**	**1725.4**	**1717.4**	**1726.3**
Cereals and leguminous crops – total	**745.7**	**837.0**	**746.6**	**910.7**	**830.1**	**920.5**	**902.4**	**1055.5**
...Wheat (Winter and Spring)	286.7	303.0	281.7	345.9	300.4	394.1	380.9	410.3
…Winter rye	0.9	0.8	0.7	1.1	1.7	2.7	4.7	3.9
...Barley (Winter and Spring)	120.4	134.0	123.0	139.0	147.0	135.1	108.7	129.5
...Oat	2.1	3.0	3.0	4.0	5.0	5.9	3.7	6.5
…Millet	0.1	0.1	0.1	0.1	0.1	0.2	0.3	0.3
...Buckwheat	3.6	6.0	7.0	7.0	8.0	5.5	7.4	7.3
...Leguminous crops	72.6	77.0	71.2	70.7	65.5	53.6	44.6	46.2

[70] Expert opinion, Prof. Valerian Cerbari, Institute of Pedology, Agrochemistry and Soil Protection „Nicolae Dimo"

[71] 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, page 23

	1990	1991	1992	1993	1994	1995	1996	1997
...Grain maize	258.0	310.0	259.4	342.6	283.4	321.3	350.0	450.7
…Grain sorghum	1.2	3.1	0.5	0.3	1.2	1.1	0.3	0.3
...Other cereal crops	0.1	0.0	0.0	0.0	17.8	1.0	1.8	0.5
Industrial crops – total	**295.3**	**277.0**	**275.3**	**291.5**	**293.3**	**283.6**	**333.7**	**300.0**
...Sugar beet	81.5	79.9	82.6	91.0	91.2	90.4	83.9	76.3
...Sun flower	134.1	126.9	130.9	146.1	160.9	163.2	225.1	199.0
...Soybeans	26.5	24.1	16.6	9.3	5.6	3.4	2.4	2.4
...Tobacco	32.1	32.5	28.1	31.4	28.6	20.1	16.4	17.3
…Grain rapeseed	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
…Other industrial crops	21.1	13.6	17.1	13.7	7.0	6.6	6.0	5.1
Potatoes, vegetables and melons & gourds – total	**131.8**	**141.0**	**143.1**	**175.3**	**157.6**	**140.3**	**130.3**	**135.4**
...Potatoes	41.2	46.9	55.3	72.8	64.4	57.1	59.6	62.3
…Vegetables	71.1	78.0	73.7	89.2	83.3	72.3	61.4	63.5
…Melons and gourds	9.2	8.0	7.0	6.7	5.4	7.6	6.7	7.9
…Other	10.3	8.1	7.1	6.6	4.5	3.3	2.6	1.7
Forage crops – total	**560.3**	**462.0**	**546.1**	**505.1**	**551.2**	**381.0**	**351.0**	**235.4**
...Forage roots	26.4	30.0	29.0	30.3	26.2	24.5	17.6	16.3
... Maize for silo and green fodder	292.3	200.0	299.3	243.8	305.2	181.2	181.0	98.7
…Perennial grasses for green fodder, silage and fodder	206.3	205.2	182.9	198.4	180.5	144.7	124.0	102.6
…Annual grasses for green fodder	31.4	26.8	35.0	32.6	39.3	29.3	27.0	16.8
…Other	3.9	0.0	0.0	0.0	0.0	1.3	1.4	1.0
	1998	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**
Sown Areas – total	**1717.6**	**1663.8**	**1701.4**	**1713.1**	**1736.2**	**1593.1**	**1682.5**	**1625.5**
Cereals and leguminous crops – total	**1039.0**	**1024.7**	**1077.4**	**1160.4**	**1165.7**	**940.6**	**1144.6**	**1084.9**
...Wheat (Winter and Spring)	405.8	392.1	423.8	485.2	502.8	213.2	342.4	433.7
…Winter rye	3.7	3.9	3.8	5.3	3.6	1.3	2.6	2.1
...Barley (Winter and Spring)	134.0	128.5	125.0	113.9	133.7	96.1	140.8	133.5
...Oat	6.1	4.9	4.2	4.8	4.3	4.6	5.9	6.2
…Millet	0.3	0.2	0.4	0.0	0.1	0.2	0.5	0.2
...Buckwheat	11.1	16.8	12.1	13.3	5.1	4.9	4.1	2.9
...Leguminous crops	58.8	64.7	53.6	52.1	59.9	48.3	37.9	42.7
...Grain maize	416.7	411.7	454.1	483.8	454.7	567.9	604.1	461.0
…Grain sorghum	0.2	0.1	0.4	1.0	0.5	3.1	3.8	0.7
...Other cereal crops	2.2	1.7	0.0	0.8	0.7	0.8	2.5	1.8
Industrial crops – total	**344.7**	**355.1**	**364.9**	**332.3**	**358.6**	**447.9**	**367.2**	**373.9**
...Sugar beet	76.4	65.5	66.6	63.1	52.0	39.7	34.9	34.4
...Sun flower	234.5	246.0	256.9	234.3	280.7	381.3	293.0	291.0
...Soybeans	6.5	17.2	11.8	9.6	10.3	18.3	28.6	36.2
...Tobacco	22.0	18.8	23.7	17.1	9.3	5.6	5.8	4.7
…Grain rapeseed	0.0	1.0	1.0	1.0	1.0	1.0	0.9	2.3
…Other industrial crops	5.2	5.9	3.9	5.8	4.2	2.0	4.1	4.9
Potatoes, vegetables and melons & gourds – total	**127.9**	**131.0**	**132.3**	**119.8**	**112.6**	**92.5**	**81.4**	**82.5**
...Potatoes	62.0	66.6	65.4	42.8	45.1	38.6	34.8	36.6
…Vegetables	58.6	56.3	56.8	67.2	58.7	43.7	38.2	38.6
…Melons and gourds	5.2	6.0	7.9	7.4	6.5	8.7	7.3	5.1
…Other	2.1	2.1	2.2	2.4	2.3	1.5	1.1	2.2
Forage crops – total	**206.0**	**153.0**	**126.8**	**100.6**	**99.3**	**112.1**	**89.3**	**84.2**
...Forage roots	15.5	14.3	11.5	4.7	4.1	4.5	3.7	2.5
... Maize for silo and green fodder	97.1	62.8	49.7	39.2	35.1	44.5	24.6	16.0
…Perennial grasses for green fodder, silage and fodder	75.2	58.3	53.1	48.1	49.8	50.9	53.6	57.4
…Annual grasses for green fodder	17.3	16.9	11.3	8.0	8.9	11.3	6.1	7.4
…Other	0.9	0.7	1.1	0.6	1.1	0.9	1.2	0.9
	2006	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**
Sown Areas – total	**1546.9**	**1552.4**	**1552.0**	**1593.0**	**1601.7**	**1597.3**	**1624.1**	**1660.9**
Cereals and leguminous crops – total	**953.9**	**989.2**	**1034.8**	**1033.8**	**1002.5**	**975.1**	**1019.1**	**1063.2**
...Wheat (Winter and Spring)	316.1	333.6	429.6	395.8	374.6	347.8	367.5	425.5
…Winter rye	0.7	0.8	1.0	1.9	1.6	0.6	1.3	1.9
...Barley (Winter and Spring)	123.2	138.1	139.4	184.7	156.1	120.9	107.5	121.3
...Oat	4.5	4.4	2.8	2.4	2.8	2.2	2.3	2.5
…Millet	0.1	0.4	0.3	0.3	0.3	0.3	0.3	0.3
...Buckwheat	3.8	1.3	0.8	1.0	0.2	0.6	0.9	0.3
...Leguminous crops	42.2	40.1	28.3	36.1	39.0	29.9	25.2	23.5
...Grain maize	461.4	469.2	429.5	407.3	423.6	470.6	512.2	485.4
…Grain sorghum	0.4	0.2	0.2	0.2	0.2	0.2	0.2	0.2
...Other cereal crops	1.4	1.3	2.8	3.8	3.8	2.0	1.4	1.7
Industrial crops – total	**413.3**	**376.7**	**355.9**	**401.0**	**435.1**	**469.8**	**454.7**	**457.2**
...Sugar beet	42.4	34.3	24.7	23.4	26.5	25.4	31.2	28.7
...Sun flower	299.7	241.1	239.1	249.5	283.3	314.7	340.8	342.7
...Soybeans	55.7	50.5	30.5	48.8	59.0	58.9	62.3	42.8
...Tobacco	3.5	3.1	2.7	2.5	4.4	3.8	2.4	1.5
…Grain rapeseed	7.1	41.3	53.5	67.4	48.7	53.4	8.2	35.7
…Other industrial crops	4.7	6.0	4.9	7.2	10.2	12.0	9.7	5.7
Potatoes, vegetables and melons & gourds – total	**90.1**	**84.0**	**83.2**	**78.7**	**79.8**	**76.0**	**68.0**	**69.4**
...Potatoes	34.8	35.8	31.3	28.5	27.9	29.7	25.0	24.1
…Vegetables	44.4	39.7	41.7	37.0	40.1	37.2	34.7	36.7
…Melons and gourds	9.1	7.1	8.8	11.9	10.4	8.0	7.2	7.6
…Other	1.8	1.4	1.4	1.3	1.4	1.1	1.1	1.0
Forage crops – total	**89.6**	**102.4**	**78.1**	**79.5**	**84.3**	**76.5**	**82.4**	**71.1**
...Forage roots	3.0	1.9	1.9	1.5	1.7	1.2	1.4	1.2
... Maize for silo and green fodder	16.1	24.9	10.3	11.3	9.8	9.8	21.8	8.5
…Perennial grasses for green fodder, silage and fodder	63.5	68.4	60.2	61.5	65.3	60.1	55.2	56.0
…Annual grasses for green fodder	5.8	5.6	4.6	3.5	5.9	3.9	3.3	4.2
…Other	1.1	1.6	1.1	1.7	1.6	1.4	0.7	1.1

Source: 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>; Statistical Yearbooks for ATULBD: 1998 (page 218), 2002 (page 113), 2005 (page 101), 2009 (page 97), 2011 (page 100), 2014 (page 94).

Table 6-65: Gross Harvest of Agricultural Crops in the Republic of Moldova within 1990-2013, kt

	1990	1991	1992	1993	1994	1995	1996	1997
Cereals and leguminous crops – total	**2538.6**	**3105.9**	**2099.8**	**3340.2**	**1753.8**	**2638.6**	**1981.2**	**3512.3**
... Wheat (Winter and Spring)	1129.0	1056.5	925.8	1392.6	658.8	1126.4	673.7	1152.6
…Winter rye	1.9	1.6	1.4	2.8	2.7	5.9	9.9	10.9
... Barley (Winter and Spring)	417.9	427.0	405.0	481.0	324.9	311.3	136.7	256.9
... Oat	3.8	5.0	6.8	10.7	7.1	9.8	4.2	10.3
… Millet	0.1	0.1	0.0	0.1	0.1	0.3	0.2	0.5
... Buckwheat	1.8	5.0	2.3	5.5	3.5	2.2	3.0	4.8
... Leguminous crops	97.1	105.7	121.8	121.6	70.2	55.5	31.6	63.2
... Grain maize	885.5	1501.2	635.6	1324.5	629.3	948.6	1006.6	1788.0
…Grain sorghum	1.2	3.1	1.1	1.4	1.1	0.8	0.1	0.5
...Other cereal crops	0.3	0.7	0.0	0.0	56.1	0.3	0.2	0.0
Industrial crops – total								
...Sugar beet	2374.5	1988.6	1783.4	2048.3	1526.7	1877.9	1682.1	1674.8
...Sun flower	252.2	151.4	176.2	173.7	149.2	208.1	284.0	174.3
...Soybeans	23.8	33.4	7.9	9.3	4.0	3.1	2.5	2.7
...Tobacco	66.2	62.8	42.4	50.2	41.5	39.7	51.3	168.8
…Grain rapeseed	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
…Vegetables	1177.3	989.2	787.5	777.2	598.5	529.3	362.4	393.6
…Melons and gourds	34.4	35.6	9.3	18.6	12.6	21.6	23.3	30.4
Forage plants – total								
...Forage roots	1171.8	1416.4	922.5	988.6	547.0	545.6	336.5	310.2
...Maize for silo and green fodder	4509.0	4979.1	3025.9	3358.7	2285.7	1766.0	1212.0	1065.0
…Perennial grasses for green fodder, silage and fodder	4456.1	6053.5	3401.4	3514.6	2013.8	1704.7	1027.2	855.6
…Annual grasses for green fodder	288.9	420.7	339.0	339.1	190.7	222.3	143.4	96.7
	1998	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**
Cereals and leguminous crops – total	**2751.9**	**2375.0**	**2070.2**	**2823.6**	**2791.2**	**1654.4**	**3178.0**	**2954.3**
... Wheat (Winter and Spring)	951.9	797.8	725.0	1180.8	1113.1	102.4	861.2	1047.7
…Winter rye	7.0	6.3	5.0	9.1	5.9	0.8	5.1	3.6
... Barley (Winter and Spring)	242.2	203.1	152.3	246.9	241.7	74.4	284.1	226.7
... Oat	9.5	5.9	3.5	6.4	4.7	4.0	10.3	7.4
… Millet	0.1	0.0	0.1	0.0	0.1	0.1	0.3	0.2
... Buckwheat	4.3	6.1	8.0	5.6	1.4	1.6	1.2	1.0
... Leguminous crops	76.9	61.6	30.8	79.1	50.2	30.2	51.0	66.4
... Grain maize	1272.7	1151.3	1050.4	1134.3	1206.3	1440.2	1845.1	1502.7
…Grain sorghum	0.2	0.3	0.5	1.1	0.5	4.4	3.4	0.3
...Other cereal crops	4.7	6.0	3.2	5.7	4.2	0.7	3.7	12.3
Industrial crops – total								
...Sugar beet	1356.8	956.4	982.5	1117.8	1157.4	660.3	911.3	996.2
...Sun flower	196.4	291.6	305.1	275.6	340.9	421.4	354.8	347.7
...Soybeans	6.0	13.7	11.6	9.5	12.6	19.4	40.2	66.1
...Tobacco	169.6	196.8	121.4	105.7	69.0	36.5	7.9	6.7
…Grain rapeseed	0.0	1.2	1.1	1.0	1.0	1.2	1.1	3.3
Potatoes, vegetables and melons & gourds – total								
... Potatoes	372.5	330.6	330.4	385.3	326.0	303.2	321.8	388.9
…Vegetables	570.8	535.8	396.1	472.9	408.4	371.7	328.7	405.9
…Melons and gourds	25.9	33.9	31.7	38.8	29.0	72.7	57.3	48.7
Forage plants – total								
...Forage roots	286.4	170.1	125.0	63.4	67.9	55.7	52.7	40.9
...Maize for silo and green fodder	856.5	428.6	350.7	306.7	322.8	327.9	219.4	178.6
…Perennial grasses for green fodder, silage and fodder	498.5	506.8	317.4	201.5	173.4	145.4	206.7	183.8
…Annual grasses for green fodder	106.6	53.7	28.8	19.3	16.0	12.6	12.6	16.3
	2006	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**
Cereals and leguminous crops – total	**2371.2**	**932.5**	**3261.6**	**2375.5**	**2641.4**	**2761.5**	**1346.6**	**3075.2**
... Wheat (Winter and Spring)	682.3	406.5	1286.5	738.9	749.0	797.0	496.9	1009.2
…Winter rye	1.1	0.8	2.0	3.4	2.4	1.0	2.6	5.4
... Barley (Winter and Spring)	214.6	125.7	362.3	290.5	231.9	211.5	132.7	236.0
... Oat	6.1	1.4	3.9	1.6	2.9	3.6	2.0	3.7
… Millet	0.0	0.1	0.5	0.7	0.3	0.1	0.1	0.1
... Buckwheat	0.5	0.4	0.5	0.6	0.5	0.4	0.3	0.5
... Leguminous crops	68.4	14.4	38.0	32.0	39.7	33.0	17.2	24.0
... Grain maize	1327.6	363.2	1484.1	1159.6	1456.7	1539.6	586.0	1530.3
…Grain sorghum	0.5	0.1	0.1	0.2	0.2	0.1	0.1	0.1
...Other cereal crops	15.2	1.1	8.1	5.3	7.7	4.8	2.1	5.7
Industrial crops – total								
...Sugar beet	1177.3	612.3	960.7	337.4	837.6	588.6	587.0	1009.0
...Sun flower	396.1	158.7	387.2	310.2	434.3	489.9	335.1	592.1
...Soybeans	80.2	40.0	58.8	50.1	112.9	80.2	48.8	67.5
...Tobacco	4.9	3.6	3.9	4.4	7.6	5.4	2.9	2.2
…Grain rapeseed	6.9	34.9	100.1	81.6	50.9	67.5	8.1	58.1
Potatoes, vegetables and melons & gourds – total								
... Potatoes	384.1	200.9	273.7	264.8	286.4	362.7	191.0	243.4
…Vegetables	490.6	226.6	389.4	322.8	361.5	394.8	250.7	317.0
…Melons and gourds	92.6	41.2	69.9	102.4	104.5	84.8	52.1	55.7
Forage plants – total								
...Forage roots	34.9	13.8	26.4	20.0	31.7	23.1	10.6	22.2
...Maize for silo and green fodder	153.3	104.6	113.0	106.4	140.7	120.6	109.4	165.6
…Perennial grasses for green fodder, silage and fodder	194.9	177.0	364.2	213.4	323.9	238.5	97.6	198.6
…Annual grasses for green fodder	13.6	7.4	15.3	7.9	10.9	11.3	6.3	9.6

Source: 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>; Statistical Yearbooks for ATULBD: 1998 (page 218), 2002 (page 113), 2005 (page 101), 2009 (page 98), 2011 (page 101), 2014 (page 95).

Table 6-66: Average Yield per Hectare of Agricultural Crops in within 1990-2013 periods, t/ha

	1990	1991	1992	1993	1994	1995	1996	1997
Cereals and leguminous corps – total	**3.4**	**3.7**	**2.8**	**3.7**	**2.1**	**2.9**	**2.2**	**3.3**
...Wheat (Winter and Spring)	3.9	3.5	3.3	4.0	2.2	2.9	1.8	2.8
…Winter rye	2.1	2.0	2.0	2.6	1.6	2.2	2.1	2.8
...Barley (Winter and Spring)	3.5	3.2	3.3	3.5	2.2	2.3	1.3	2.0
...Oat	1.8	1.7	2.3	2.7	1.4	1.7	1.1	1.6
…Millet	1.0	1.0	0.4	1.0	0.6	1.4	0.7	1.6
...Buckwheat	0.5	0.8	0.3	0.8	0.4	0.4	0.4	0.7
...Leguminous crops	1.3	1.4	1.7	1.7	1.1	1.0	0.7	1.4
...Grain maize	3.4	4.8	2.5	3.9	2.2	3.0	2.9	4.0
…Grain sorghum	1.0	1.0	2.2	4.6	0.9	0.8	0.3	1.7
...Other cereal crops	3.0	3.1	2.6	2.8	2.1	0.3	1.4	0.0
Industrial crops – total								
...Sugar beet	29.1	24.9	21.6	22.5	16.7	20.8	20.0	22.0
...Sun flower	1.9	1.2	1.3	1.2	0.9	1.3	1.3	0.9
...Soybeans	0.9	1.4	0.5	1.0	0.7	0.9	1.0	1.1
...Tobacco	2.1	1.9	1.5	1.6	1.5	2.0	3.1	9.8
…Grain rapeseed	2.0	2.0	1.6	1.2	1.0	0.8	0.7	1.0
Potatoes, vegetables and melons & gourds – total								
...Potatoes	7.2	6.2	5.6	10.0	7.4	6.7	5.8	6.3
…Vegetables	16.6	12.7	10.7	8.7	7.2	7.3	5.9	6.2
…Melons and gourds	3.7	4.5	1.3	2.8	2.3	2.8	3.5	3.8
Forage plants – total								
...Forage roots	44.4	47.2	31.8	32.6	20.9	22.3	19.1	19.0
...Maize for silo and green fodder	15.4	24.9	10.1	13.8	7.5	9.7	6.7	10.8
…Perennial grasses for green fodder, silage and fodder	21.6	29.5	18.6	17.7	11.2	11.8	8.3	8.3
…Annual grasses for green fodder	9.2	15.7	9.7	10.4	4.9	7.6	5.3	5.8
	1998	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**
Cereals and leguminous corps – total	**2.6**	**2.3**	**1.9**	**2.4**	**2.4**	**1.8**	**2.8**	**2.7**
...Wheat (Winter and Spring)	2.3	2.0	1.7	2.4	2.2	0.5	2.5	2.4
…Winter rye	1.9	1.6	1.3	1.7	1.6	0.6	2.0	1.7
...Barley (Winter and Spring)	1.8	1.6	1.2	2.2	1.8	0.8	2.0	1.7
...Oat	1.6	1.2	0.8	1.3	1.1	0.9	1.7	1.2
…Millet	0.4	0.1	0.2	0.8	0.5	0.5	0.7	0.9
...Buckwheat	0.4	0.4	0.7	0.4	0.3	0.3	0.3	0.3
...Leguminous crops	1.3	1.0	0.6	1.5	0.8	0.6	1.3	1.6
...Grain maize	3.1	2.8	2.3	2.3	2.7	2.5	3.1	3.3
…Grain sorghum	0.9	3.1	1.3	1.1	0.9	1.4	0.9	0.4
...Other cereal crops	2.1	3.6	161.2	7.5	6.0	0.9	1.5	2.0
Industrial crops – total								
...Sugar beet	17.8	14.6	14.8	17.7	22.3	16.6	26.1	29.0
...Sun flower	0.8	1.2	1.2	1.2	1.2	1.1	1.2	1.2
...Soybeans	0.9	0.8	1.0	1.0	1.2	1.1	1.4	1.8
...Tobacco	7.7	10.5	5.1	6.2	7.4	6.5	1.4	1.4
…Grain rapeseed	0.9	1.2	1.0	1.0	1.0	1.0	1.2	1.4
Potatoes, vegetables and melons & gourds – total								
...Potatoes	6.0	5.0	5.1	9.0	7.2	7.9	9.2	10.6
…Vegetables	9.7	9.5	7.0	7.0	7.0	8.5	8.6	10.5
…Melons and gourds	5.0	5.7	4.0	5.2	4.5	8.4	7.8	9.5
Forage plants – total								
...Forage roots	18.5	11.9	10.9	13.5	16.6	12.3	14.2	16.3
...Maize for silo and green fodder	8.8	6.8	7.1	7.8	9.2	7.4	8.9	11.2
…Perennial grasses for green fodder, silage and fodder	6.6	8.7	6.0	4.2	3.5	2.9	3.9	3.2
…Annual grasses for green fodder	6.2	3.2	2.6	2.4	1.8	1.1	2.1	2.2
	2006	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**
Cereals and leguminous corps – total	**2.5**	**0.9**	**3.2**	**2.3**	**2.6**	**2.8**	**1.3**	**2.9**
...Wheat (Winter and Spring)	2.2	1.2	3.0	1.9	2.0	2.3	1.4	2.4
…Winter rye	1.6	1.1	1.9	1.8	1.5	1.8	2.0	2.8
...Barley (Winter and Spring)	1.7	0.9	2.6	1.6	1.5	1.7	1.2	1.9
...Oat	1.3	0.3	1.4	0.7	1.0	1.6	0.9	1.5
…Millet	0.5	0.1	1.7	2.5	0.9	0.4	0.4	0.3
...Buckwheat	0.1	0.3	0.6	0.6	3.2	0.8	0.3	1.6
...Leguminous crops	1.6	0.4	1.3	0.9	1.0	1.1	0.7	1.0
...Grain maize	2.9	0.8	3.5	2.8	3.4	3.3	1.1	3.2
…Grain sorghum	1.1	0.5	0.5	0.8	1.0	0.3	0.3	0.5
...Other cereal crops	2.0	0.8	2.1	1.7	1.8	1.9	1.9	2.0
Industrial crops – total								
...Sugar beet	27.8	17.9	38.9	14.4	31.6	23.2	18.8	35.2
...Sun flower	1.3	0.7	1.6	1.2	1.5	1.6	1.0	1.7
...Soybeans	1.4	0.8	1.9	1.0	1.9	1.4	0.8	1.6
...Tobacco	1.4	1.2	1.4	1.8	1.7	1.4	1.2	1.5
…Grain rapeseed	1.0	0.8	1.9	1.2	1.0	1.3	1.0	1.6
Potatoes, vegetables and melons & gourds – total								
...Potatoes	11.0	5.6	8.7	9.3	10.3	12.2	7.6	10.1
…Vegetables	11.0	5.7	9.3	8.7	9.0	10.6	7.2	8.6
…Melons and gourds	10.2	5.8	7.9	8.6	10.0	10.5	7.3	7.3
Forage plants – total								
...Forage roots	11.6	7.4	14.1	13.7	18.5	19.0	7.4	18.5
...Maize for silo and green fodder	9.6	4.2	11.0	9.4	14.4	12.3	5.0	19.4
…Perennial grasses for green fodder, silage and fodder	3.1	2.6	6.0	3.5	5.0	4.0	1.8	3.5
…Annual grasses for green fodder	2.3	1.3	3.3	2.2	1.8	2.9	1.9	2.3

Source: 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>; Statistical Yearbooks for ATULBD: 1998 (page 218), 2002 (page 113), 2005 (page 101), 2009 (page 99), 2011 (page 102), 2014 (page 96).

Based on information provided in Tables 6-62 and 6-63, and activity data included into Tables 6-64, 6-65 and 6-66, the total amount of nitrogen in crop residues returned to soils was calculated. The results allow assert that over the period from to 1990 through 2013, the total amount of nitrogen in crop residues returned to soils decreased by 34.2 per cent (Table 6-67).

Table 6-67: Amount of N in Crop Residues Returned to Soils within 1990-2013, thousand tons

	1990	1991	1992	1993	1994	1995	1996	1997
F_{CR}	34.8062	39.1856	26.3070	31.5533	19.8322	21.9505	19.7444	28.5108
	1998	1999	2000	2001	2002	2003	2004	2005
F_{CR}	25.5077	26.5647	21.0021	21.7577	20.5532	17.7709	19.9839	19.5407
	2006	2007	2008	2009	2010	2011	2012	2013
F_{CR}	19.4949	8.2302	21.0310	15.6403	21.1198	21.0686	12.0211	22.8976

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 6-6) will allow to obtain the necessary amount of grain needed to ensure the food security of population, fodder for the animal breeding sector, industrial and leguminous crops to meet the needs of population and the processing industry. At the same time this structure will allow to use soil protective crop rotation, contributing to stabilizing the humus balance in soil and soil fertility conservation.

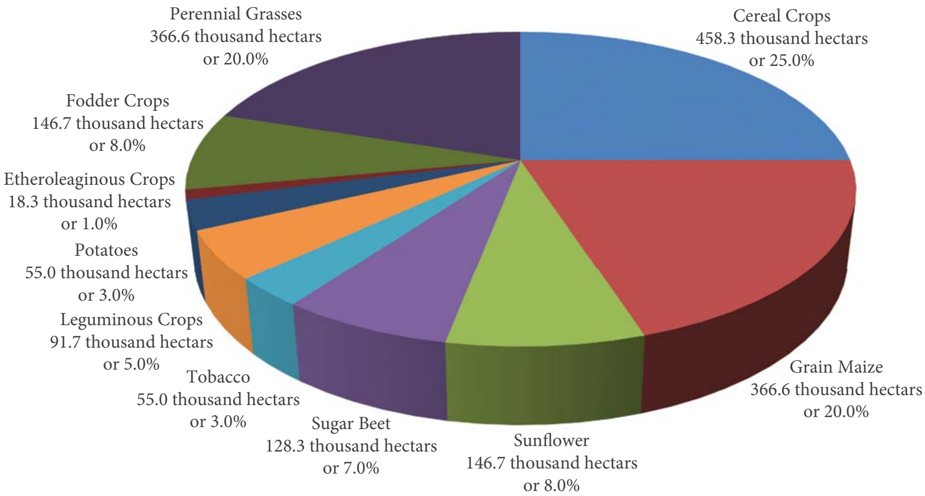

Figure 6-6: Recommended Crops Structure on Agricultural Lands in the RM[72].

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 ±25.49 per cent. At the same time, combined uncertainties, presented as a per cent of total sectoral emissions were estimated at circa ±1.34 per cent, while uncertainties introduced in trend in sectoral emissions were estimated at ±0.25 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 GPG (IPCC, 2000).

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 (IPCC, 2000). 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 GPG (IPCC, 2000), N_2O emissions from crop residues returned to soil were estimated using AD and national EF from official sources of reference.

[72] 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.

Recalculations

Direct N_2O emissions from crop residues returned to soil were recalculated for the 1990 through 2010 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[73] as well as into the Statistical Yearbooks of the ATULBD, and in the FAO database – UN Food and Agriculture Organization[74]), due to the use of country specific revised values (for example, the dry matter fraction of harvested crops was revised for maize for silo and green fodder, perennial grasses for green fodder, silage and fodder and annual grasses for green fodder) since the values used in the previous inventory cycle referred to the yield expressed in dry matter, while the statistical data refer to the yield fresh in green mass; also, for the same crops, the last available data in the literature in the field were considered regarding the ratio of below-ground residues to harvested yield for crop. It should also be noted that these recalculations were due to use of revised values for the fraction of above-ground residues of crop removed annually for other purposes, as well as due to use of revised values regarding the nitrogen in crop residues for various crops (wheat, oat, barley, sugar beet, potatoes, perennial grasses for green fodder, silage and fodder and annual grasses for green fodder), based on the literature in the field.

The obtained results allow assert that compared with the TNC, within the current inventory cycle, the direct N_2O emissions from crop residues returned to soils decreased between 1990-2010, varying from a minimum of 0.3 per cent in 1998 to a maximum of 50.2 per cent in 1992; except for 1999 when an increase by 6.5 per cent was recorded. For the 2011-2013 time series, the respective emissions were estimated for the first time (Table 6-68). The results allow assert that within the 1990-2013, direct N_2O emissions from this source category decreased by circa 34.2 per cent.

Table 6-68: Comparative Results of Direct N_2O_{CR} Emissions from Crop Residues Returned to Soils, included into the TNC and the BUR of the Republic of Moldova under the UNFCCC, Gg

	1990	1991	1992	1993	1994	1995	1996	1997
TNC	1.0908	1.1440	0.8296	0.9513	0.5757	0.6378	0.4819	0.5311
BUR	0.5470	0.6158	0.4134	0.4958	0.3116	0.3449	0.3103	0.4480
Difference, %	-49.9	-46.2	-50.2	-47.9	-45.9	-45.9	-35.6	-15.6
	1998	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**
TNC	0.4021	0.3918	0.3387	0.4048	0.4078	0.3301	0.4329	0.4403
BUR	0.4008	0.4174	0.3300	0.3419	0.3230	0.2793	0.3140	0.3071
Difference, %	-0.3	6.5	-2.6	-15.5	-20.8	-15.4	-27.5	-30.3
	2006	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**
TNC	0.4244	0.1936	0.4822	0.3286	0.3935			
BUR	0.3063	0.1293	0.3305	0.2458	0.3319	0.3311	0.1889	0.3598
Difference, %	-27.8	-33.2	-31.5	-25.2	-15.7			

Abbreviations: TNC – Third National Communication; BUR – Biennial Update Report.

The decrease in emissions is due to both less area being sown with crops over the period under review (for example, from 1990 through 2013 areas sown with tobacco decreased by 95.3 per cent, with fodder plants – by 87.3 per cent, with leguminous crops – by 67.7 per cent, with sugar beets – by 64.8 per cent, with vegetables – by 48.4 per cent, with potatoes – by 41.6 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 83.6 per cent, for annual grasses for green fodder – by 75.2 per cent, for forage roots – by 58.3 per cent, for vegetables – by 47.8 per cent, for barley – by 43.9 per cent, for winter wheat – by 39.8 per cent, for tobacco – by 28.9 per cent, sugar beet – by 27.4 per cent, leguminous crops – by 23.6 per cent, grain rapeseed – by 18.5 per cent, oat – by 18.2 per cent, grain maize and sun flower – by 8.1 per cent etc.).

Despite the fact that over the 1990-2013 time periods the areas sown with some crops increased: sun flower – by 155.5 per cent, grain maize – by 88.1 per cent, soybeans – by 61.5 per cent and winter wheat – by 48.4 per cent; and there was also recorded an increase in yield per hectare in other crops, such as melons and gourds – by 95.1 per cent, soybeans – by 75.7 per cent, potatoes – by 41.1 per cent, maize for silo and green fodder – by 25.8 per cent and sugar beets – by 20.7, it did not considerable affect the decreasing trend in N_2O emissions from crop residues returned to soils.

[73] 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>.
[74] <http://faostat.fao.org/site/567/DesktopDefault.aspx?PageID=567#ancor>.

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 4D 'Agriculture Soils' category.

6.4.1.5 Nitrogen Mineralization Associated with Loss of Soil Carbon

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 carbon as a result of land-use or management change were estimated by using a Tier 1 methodology (IPCC, 2006) and the following equation:

$$N_2O_{SOM} = F_{SOM} \bullet EF_1 \bullet 44/28$$

Where:

[44/28] – stoichiometric ratio between the content of nitrogen in N_2O-N and N_2O;

EF_1 – default 0.01 kg N_2O-N/kg N applied (range: 0.003-0.03 kg N_2O-N/kg N);

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);

Where:

$$F_{SOM} = \Sigma\ [(\Delta C_{mineral} \bullet 1/R)]$$

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 6-69) was estimated using the "Methodology for determining the carbon balance in agricultural lands for estimating GHG emissions" (see Annex A3-4.5)[75].

Table 6-69: Annual Loss of Soil Carbon in the Republic of Moldova within 1990-2013, kt C

	1990	1991	1992	1993	1994	1995	1996	1997
ΔC mineral	422.0282	418.4393	354.6712	1063.8451	649.1336	965.8785	851.5091	1336.3323
	1998	1999	2000	2001	2002	2003	2004	2005
ΔC mineral	1102.8997	1028.5867	933.9223	1147.8457	1143.6669	862.4515	1288.8346	1227.3418
	2006	2007	2008	2009	2010	2011	2012	2013
ΔC mineral	1099.0331	373.5846	1313.1182	934.7483	1117.8058	1156.6674	501.9482	1206.7532

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 6-70.

Table 6-70: The Net Annual Amount of Nitrogen Mineralized in Mineral Soils as a Result of Loss of Soil Carbon in the Republic of Moldova within 1990-2013 periods, thousand tons

	1990	1991	1992	1993	1994	1995	1996	1997
F_{SOM}	39.4419	39.1065	33.1468	99.4248	60.6667	90.2690	79.5803	124.8909
	1998	1999	2000	2001	2002	2003	2004	2005
F_{SOM}	103.0747	96.1296	87.2825	107.2753	106.8848	80.6029	120.4518	114.7048
	2006	2007	2008	2009	2010	2011	2012	2013
F_{SOM}	102.7134	34.9144	122.7213	87.3597	104.4678	108.0998	46.9111	112.7807

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})

[75] Banaru Anatol (2000), Methodology to Calculate CO2 Emissions from Agricultural Soils, In the collection of papers „Climate Change: Research, Studies, Solutions, Ministry of Environment / UNDP Moldova. „Bons Offices" S.R.L. Chisinau, 2000. P. 115-123.

may reach up to ±6 per cent. Combined uncertainties associated with direct N_2O emissions from nitrogen 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). At the same time, combined uncertainties, presented as percentage of total sectoral emissions were estimated at ±6.59 per cent, while uncertainties introduced in trend in sectoral emissions were estimated at ±2.44 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 GPG (IPCC, 2000).

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 (IPCC, 2000). 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 4D '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 (IPCC, 2000), N_2O emissions originated from the 4D '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 2010 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[76] as well as into the Statistical Yearbooks of the ATULBD[77], and in the FAO database – UN Food and Agriculture Organization[78]), due to the use of country specific revised values (for example, the dry matter fraction of harvested crop was revised for maize for silo and green fodder, perennial grasses for green fodder, silage and fodder and annual grasses for green fodder) since the values used in the previous inventory cycle referred to the yield expressed in dry matter, while the statistical data refer to the yield fresh in green mass; also, for the same crops, the last available data in the literature in the field were considered regarding the ratio of below-ground residues to harvested yield for crop. It should also be noted that these recalculations were due to use of revised values for the fraction of above-ground residues of crop removed annually for other purposes, as well as due to use of revised values regarding the nitrogen in crop residues for various crops (wheat, oat, barley, sugar beet, potatoes, perennial grasses for green fodder, silage and fodder and annual grasses for green fodder), based on the literature in the field.

The obtained results allow assert that compared with the TNC, within the current inventory cycle, the direct N_2O emissions from nitrogen mineralization associated with loss of soil carbon as a result of land-use or management change increased between 1990-2009, varying from a minimum of 1.9 per cent in 2000 to a maximum of 62.5 per cent in 1990; except for 1991 and 2010 when an decrease by 40.4 per cent and respectively 1.8 per cent was recorded (Table 6-71).

Table 6-71: Comparative Results of Direct N_2O_{SOM} Emissions from Nitrogen Mineralization Associated with Loss of Soil Carbon from Croplands, included into the TNC and the BUR of the Republic of Moldova under the UNFCCC, Gg

	1990	1991	1992	1993	1994	1995	1996	1997
TNC	0.3814	1.0310	0.3805	1.3803	0.8628	1.3741	1.2111	1.9164
BUR	0.6198	0.6145	0.5209	1.5624	0.9533	1.4185	1.2505	1.9626
Difference, %	62.5	-40.4	36.9	13.2	10.5	3.2	3.3	2.4
	1998	1999	2000	2001	2002	2003	2004	2005
TNC	1.5861	1.4697	1.3460	1.6304	1.6472	1.2237	1.8515	1.7158
BUR	1.6197	1.5106	1.3716	1.6858	1.6796	1.2666	1.8928	1.8025
Difference, %	2.1	2.8	1.9	3.4	2.0	3.5	2.2	5.1
	2006	2007	2008	2009	2010	2011	2012	2013
TNC	1.5118	0.4942	1.8247	1.3115	1.6717			
BUR	1.6141	0.5487	1.9285	1.3728	1.6416	1.6987	0.7372	1.7723
Difference, %	6.8	11.0	5.7	4.7	-1.8			

Abbreviations: TNC – Third National Communication; BUR – Biennial Update Report.

For the 2011-2013 time series, the respective emissions were estimated for the first time. The results allow assert that within the 1990-2013 time series, direct N_2O emissions from this source category increased by 2.9 times.

[76] 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>.
[77] <http://www.mepmr.org/gosudarstvennaya-statistika/informacziya>, <http://www.mepmr.org/pechatnye-izdaniya/statisticheskij-ezhegodnik-pmr>.
[78] <http://faostat.fao.org/site/567/DesktopDefault.aspx?PageID=567#ancor>.

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 4D 'Agriculture Soils' category.

6.4.2 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.

6.4.2.1 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 (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 synthetic N fertilizer applied to soils (t N/yr);

$Frac_{GASF}$ – fraction of synthetic fertilizer 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 synthetic N fertilizer applied to soils) (range from 0.03-0.3 t NH_3-N + NO_x-N/t N in synthetic N fertilizer 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 fertilizer 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 synthetic and organic fertilizers, urine and dung of grazing animals applied to soils are available in Tables 6-54, 6-57 and respectively in Table 6-60.

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 GPG (IPCC, 2000) 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). Combined uncertainties presented as a per cent of total sectoral emissions were estimated at ±2.04 per cent, while uncertainties introduced in trend in sectoral emissions were estimated at ±0.78 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 GPG (IPCC, 2000).

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 (IPCC, 2000). 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

No recalculations were made for 1990-2010 time series regarding indirect $N_2O_{(ATD)}$ emissions from atmospheric deposition of nitrogen oxides (NO_x) and ammonia (NH_4). For the period 2011-2013, the respective emissions were estimated for the first time (Table 6-72). The results allow assert that within the 1990-2013 time series, indirect $N_2O_{(ATD)}$ emissions under 4D 'Agriculture Soils' decreased by circa 76.2 per cent.

Table 6-72: Indirect $N_2O_{(ATD)}$ Emissions from Atmospheric Deposition of Nitrogen Oxides (NO_x) and Ammonia (NH_4), within the 4D 'Agriculture Soils' Category included into the BUR of the RM under the UNFCCC, Gg

	1990	1991	1992	1993	1994	1995	1996	1997
$N_2O_{(ATD)}$	0.3540	0.3202	0.2282	0.1556	0.0907	0.0864	0.0727	0.0556
	1998	1999	2000	2001	2002	2003	2004	2005
$N_2O_{(ATD)}$	0.0578	0.0464	0.0444	0.0485	0.0564	0.0492	0.0499	0.0496
	2006	2007	2008	2009	2010	2011	2012	2013
$N_2O_{(ATD)}$	0.0449	0.0482	0.0524	0.0460	0.0521	0.0581	0.0714	0.0844

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 4D 'Agriculture Soils' category are planned for the future inventory cycle.

6.4.2.2 Nitrogen Leaching and Runoff

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 runoff. 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; 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 runoff were estimated by using a Tier 1 methodology (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 synthetic nitrogen fertilizer 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 runoff, 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 runoff (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 runoff);

[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 synthetic 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 6-54, 6-57, 6-60, 6-67 and 6-70.

Uncertainties Assessment and Time-Series Consistency

The uncertainties associated with the estimation of indirect N_2O emissions from leaching and runoff are very high, being caused by uncertainties related to natural variability and to the emission and leaching factors, activity data and lack of measurements. Additional uncertainty is introduced in the inventory, as values of emission factors might be not representative of all condition of the Republic of Moldova. According the GPG (IPCC, 2000), uncertainties associated with estimation of indirect N_2O emissions from leaching and runoff may vary up to factor of 2. In the RM, combined uncertainties associated with indirect N_2O emissions from leaching and runoff are considered to be very high (±167.71 per cent). At the same time, combined uncertainties, presented as a per cent of total sectoral emissions were estimated at ±15.87 per cent, while uncertainties introduced in trend in sectoral emissions were estimated at ±5.05 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 GPG (IPCC, 2000).

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 (IPCC, 2000). 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 quality control procedures were applied.

Recalculations

Indirect N_2O emissions from soil nitrogen leaching and runoff through synthetic (F_{SN}) and organic (F_{ON}) nitrogen fertilizer applied, urine and dung N deposited by grazing animals on pasture, range and paddock (F_{PRP}), crop residues returned to soils (F_{CR}), nitrogen mineralized in mineral soils associated to loss of soil carbon (F_{SOM}) were recalculated for 1990-2010 time series. In case of F_{CR} and F_{SOM} the recalculations are due to an updated set of activity data on areas sown with crops, gross harvest of agricultural crops, average yield per hectare of agricultural crops (available in the NBS on-line database, in the revised versions of the Statistical Yearbooks of the ATULBD, as well as in the FAO database – UN Food and Agriculture Organization), respectively due to use of country specific values (for example, the dry matter fraction of harvested crop was revised for maize for silo and green fodder, perennial grasses for green fodder, silage and fodder and annual grasses for green fodder) since the values used in the previous inventory cycle referred to the yield expressed in dry matter, while the statistical data refer to the yield fresh in green mass; also, for the same crops, the last available data in the literature in the field were considered regarding the ratio of below-ground residues to harvested yield for crop. It should also be noted that these recalculations were due to use of revised values for the fraction of above-ground residues of crop removed annually for other purposes, as well as due to use of revised values regarding the nitrogen in crop residues for various crops (wheat, oat, barley, sugar beet, potatoes, perennial grasses for green fodder, silage and fodder and annual grasses for green fodder), based on the literature in the field.

The obtained results allow assert that compared with the TNC, within the current inventory cycle, the indirect N_2O emissions from soil nitrogen leaching and runoff decreased between 1990-2010, varying from a minimum of 0.3 per cent in 2001 to a maximum of 21.3 per cent in 1991; respectively, increased between 1998 and 2000, varying from a minimum of 0.9 per cent in 2000 to a maximum of 3.1 per cent in 1999. For the 2011-2013 time series, the respective emissions were estimated for the first time (Table 6-73). The results allow assert that within the 1990-2013 time series, indirect $N_2O_{(L)}$ emissions from this source category decreased by 21.2 per cent.

Table 6-73: Comparative Results of Indirect $N_2O_{(L)}$ Emissions from Soil Nitrogen Leaching and Runoff, included into the TNC and the BUR of the Republic of Moldova under the UNFCCC, Gg

	1990	1991	1992	1993	1994	1995	1996	1997
TNC	0.8923	0.9958	0.6382	0.7463	0.4507	0.5684	0.4860	0.6335
BUR	0.8236	0.7832	0.5762	0.6847	0.4116	0.5125	0.4563	0.6252
Difference, %	-7.7	-21.3	-9.7	-8.2	-8.7	-9.8	-6.1	-1.3
	1998	1999	2000	2001	2002	2003	2004	2005
TNC	0.5304	0.4815	0.4470	0.5349	0.5576	0.4308	0.5985	0.5694
BUR	0.5377	0.4965	0.4509	0.5332	0.5458	0.4290	0.5811	0.5589
Difference, %	1.4	3.1	0.9	-0.3	-2.1	-0.4	-2.9	-1.8
	2006	2007	2008	2009	2010	2011	2012	2013
TNC	0.5106	0.2423	0.6168	0.4509	0.5598			
BUR	0.5070	0.2400	0.6060	0.4460	0.5391	0.5663	0.3489	0.6491
Difference, %	-0.7	-0.9	-1.7	-1.1	-3.7			

Abbreviations: TNC – Third National Communication; BUR – Biennial Update Report.

This decrease can be explained by a drastic drop in amounts of synthetic and organic fertilizers applied to soils, a significant reduction of the total population of livestock over the period under review, as well as 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 emissions from soil N leaching and runoff under the 4D 'Agriculture Soils' category are planned for the future inventory cycle.

7. LAND USE, LAND-USE CHANGE AND FORESTRY SECTOR

7.1 Overview

Estimation of CO_2 removals/emissions covered by the Land Use, Land-Use Change and Forestry Sector are described below in the respective chapter.

CO_2 removals/emissions within this sector were estimated following the Good Practice Guidance for Land Use, Land-Use Change and Forestry (IPCC, 2003), 2006 IPCC Guidelines for National Greenhouse Gas Inventories (IPCC, 2006) and other relevant methodological publications.

The evolution of removals/emissions reported for the time period from 1990 through 2013 was greatly affected, in addition to the state of forests and other vegetation types, by the social-political and economic changes that occurred over the period in the RM (transition to market economy, land parceling as result of land reform, a sharp decrease in industrial 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 years. The forest area was growing steadily. According to data provided by the General Land Cadaster, by 01.01.2013, forest lands accounted for 372.8 thousand ha or 11.1 per cent of the country's territory. The respective indicator is much lower than the European average (about 30 per cent), but it is close to the medium-term target, established in a series of national and sectoral policies (15.0 per cent by 2020).

Most forest lands (87.2 per cent) are under state ownership, while the rest belongs to local public authorities (12.2 per cent) and 0.6 per cent are in private property.

The total standing volume of wood mass in the forests of the RM is circa 47 million m^3, on average 124 m^3 per hectare. The average growth of forests is 3.3m^3/ha/year and the total average growth is circa 1240 thousand m^3/year.

7.1.1 Summary of CO_2 Removals Trends

Over the period from 1990 through 2013, CO_2 removals from LULUCF Sector tended to decrease significantly. (Figure 7-1, Table 7-1).

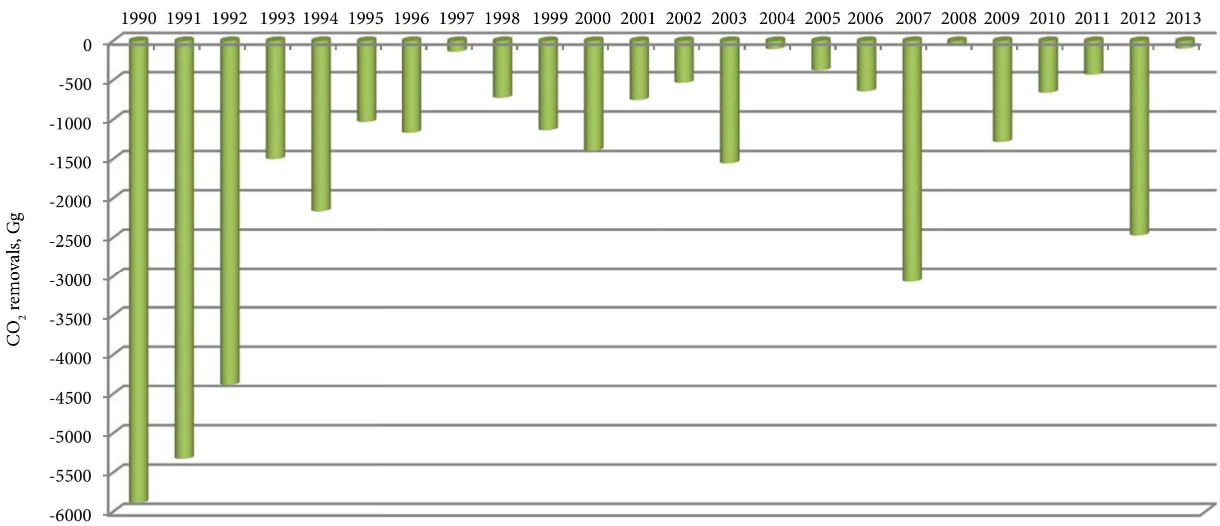

Figure 7-1: CO_2 removals within the LULUCF Sector in the Republic of Moldova within 1990-2013 periods

Table 7-1: Net CO_2 Emissions/Removals within the LULUCF Sector in the Republic of Moldova, by Source and Sink Categories within 1990-2013 periods

Year	5A, Gg CO_2	5B1.1, Gg CO_2	5B1.2, Gg CO_2	5C1.1, Gg CO_2	5C1.2, Gg CO_2	Total LULUCF, Gg CO_2	LULUCF, non-CO_2, Gg CO_2 eq.	Net LULUCF, Gg CO_2 eq.	Compared with 1990, %
1990	-2197.5790	-725.2315	-1490.8146	-1469.8567	-6.3800	-5889.8617	3.2675	-5886.5942	100.0
1991	-1924.1010	-613.0622	-1440.6633	-1475.5767	125.6200	-5327.7832	2.8184	-5324.9648	-9.5
1992	-1766.5038	-613.9635	-728.7402	-1479.9033	202.1360	-4386.9748	2.5861	-4384.3888	-25.5
1993	-1491.3852	-611.8682	1780.9854	-1481.7733	299.8160	-1504.2253	3.4249	-1500.8004	-74.5
1994	-1743.7096	-590.3010	1471.6489	-1502.1233	198.4400	-2166.0450	1.9746	-2164.0704	-63.2
1995	-1620.7949	-598.6205	2517.1205	-1518.2200	188.5180	-1031.9969	2.5679	-1029.4289	-82.5
1996	-1705.1295	-551.0146	2381.3224	-1528.8533	235.2240	-1168.4510	1.8072	-1166.6439	-80.2
1997	-2132.2121	-573.4484	4013.0993	-1536.9567	89.4740	-140.0438	3.1273	-136.9165	-97.7
1998	-2027.8925	-550.9832	3280.1637	-1546.4533	119.6140	-725.5513	2.9233	-722.6280	-87.7
1999	-2111.2238	-533.4373	3025.1199	-1548.9833	30.8220	-1137.7025	2.8136	-1134.8889	-80.7
2000	-2140.3185	-523.3924	2827.3964	-1559.5067	2.5520	-1393.2691	1.0610	-1392.2082	-76.3
2001	-2195.4199	-507.7310	3545.3117	-1589.5000	-4.2240	-751.5632	1.5750	-749.9882	-87.3
2002	-2134.8652	-477.5706	3573.3887	-1494.7167	0.7480	-533.0158	0.3561	-532.6596	-91.0
2003	-2135.8765	-473.9941	2681.0372	-1598.5200	-27.4560	-1554.8094	0.1229	-1554.6866	-73.6
2004	-2183.7322	-466.3503	4110.5280	-1566.2900	2.2440	-103.6005	0.3693	-103.2311	-98.2
2005	-2246.2332	-465.3288	3883.3090	-1549.7167	2.2440	-375.7257	0.3140	-375.4117	-93.6
2006	-2087.8823	-472.0698	3450.6090	-1537.8733	7.7044	-639.5120	0.4314	-639.0807	-89.1
2007	-2192.3574	-477.0847	1113.5737	-1515.5067	2.3936	-3068.9814	2.9864	-3065.9950	-47.9
2008	-2223.0019	-479.9904	4137.7822	-1498.2000	2.9172	-60.4929	0.9795	-59.5134	-99.0
2009	-2251.7423	-483.5731	2931.2323	-1485.2200	3.8148	-1285.4883	0.5728	-1284.9156	-78.2
2010	-2193.2612	-470.5183	3458.1723	-1473.5600	21.8416	-657.3257	0.2351	-657.0905	-88.8
2011	-2082.9771	-483.1691	3597.8304	-1466.2633	5.1612	-429.4180	0.2832	-429.1348	-92.7
2012	-2007.9512	-484.2581	1481.5276	-1466.5567	4.4880	-2472.7503	2.3957	-2470.3546	-58.0
2013	-1887.6165	-483.4705	3728.9563	-1461.3867	4.1664	-99.3510	1.7362	-97.6148	-98.3

This trend is due, first of all, to changes in forest management and forest land use (Category 5B 'Cropland'), which contributed to the significant decrease of organic carbon stocks in croplands[79], thus changing the balance of humus, from a positive one, specific to the period 1990-1992, in a negative and/or profoundly negative one, specific to 1993-2013 time periods. The respective process was also influenced by some changes in forest management and forest land use (Category 5A 'Forest Land'), such as increasing authorized harvesting of wood mass, significant increase of illegal logging, increased conversion of forest land to agricultural lands, etc.

With respect to Category 5B 'Cropland', the situation described above continues for already two decades and could be solved only with the implementation of certain actions concerning: (a) restoration of the livestock sector and the broader manure use as organic fertilizer[80]; (b) rational distribution of soil resources following the recommended structure for crops rotation, including the allocation of 15-20 per cent of cropland for perennial grasses, green fodder, silage and forage[81]; (c) given the lack of needed manure as an alternative source of organic fertilizer, it is necessary to use on a larger scale sidereal crops as green manure[82]. These actions will help stabilize the humus balance in soil and its fertility preservation, ensuring the conversion from a carbon emission source category to a carbon emission sink category.

With regard to the Category 5A 'Forest Land', the most serious situation was reported for forests and other types of forest vegetation managed by local public authorities. In particular due to the population's need to get fuel wood and construction materials, the total volume of illegal logging over the period from 1990 through 2013 was circa 1500 thousand m^3 (Figure 7-2).

In these terms, the forest areas managed by the state forest authorities lost circa 1 percent through illegal logging, while forests managed by other owners were destroyed at circa 13 per cent. Since 1997, the situation started to gradually improve, reaching the carbon removal level of 1990 (see also Table 7-1). The above mentioned improvement was due to both gradual increase of forests (in comparison with 1990 there was a 15 per cent increase), as well as due to a significant decrease of illegal logging.

[79] 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).

[80] For the neutral balance of humus, a fully compensation of humus loss in crop rotation, it is necessary to apply an average dose of organic fertilizer of circa 10 t/ha/year, while for a positive balance – circa 15 t/ha/yr.

[81] From 1990 through 2013, areas sown with perennial grasses decreased by 74.5 per cent in the RM.

[82] Research carried out by a group of authors (Cerbari, Scorpan, Taranu, 2012), have established that the use of a single crop harvest in a sidereal cycle as green manure increases the soil organic content by 0.2 per cent, contributing to improved physical quality of degraded arable layers of soils, but also to increased agricultural output by 20-30 per cent.

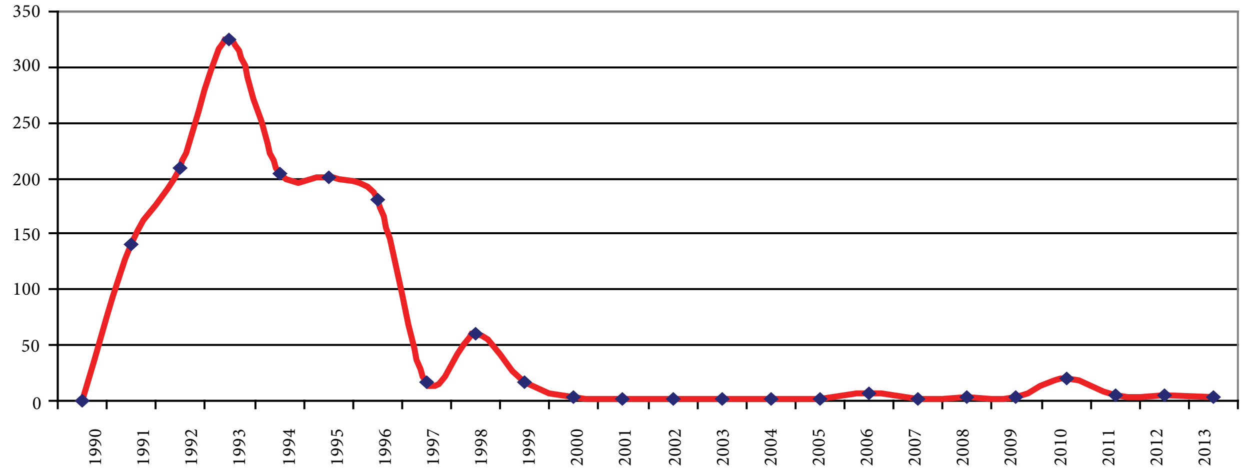

Figure 7-2: Forests and Other Forest Vegetation Illegal Logging within 1990-2013, thousand m^3

To be noted that in the base year 1990, the main source of CO_2 removals under the LULUCF Sector was the 5B 'Cropland' category (land covered with woody vegetation – perennial plantations, as well as soils with agricultural destination) with a share of about 37.6 per cent of the total, followed by 5A 'Forest Land' category (forest vegetation - forests, protection forest belts, etc.) with a share of 37.3 per cent, respectively 5C 'Grassland' category, with a share of 25.1 per cent (Figure 7-3).

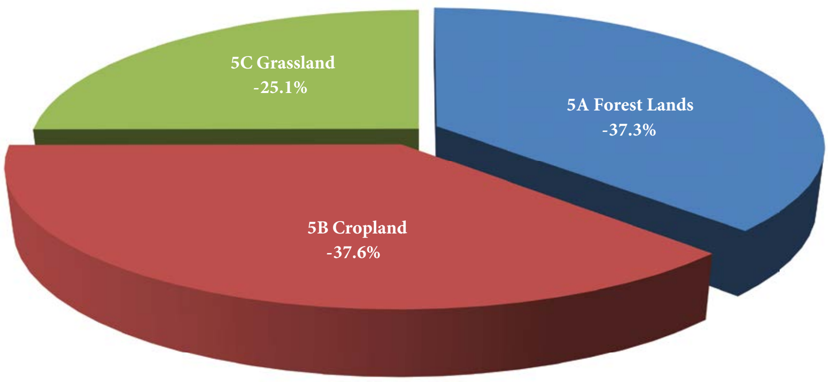

Figure 7-3: Breakdown of CO_2 Removals under LULUCF Sector in 1990, %

Since 1993, 5B 'Cropland' category becomes a source of CO_2 emissions as a result of a deeply negative balance of humus in the soils with agricultural destination[83], and due to the decrease of perennial plantations areas[84].

In some particular years (1997-1998, 2001-2002, 2004-2005, 2008, 2010-2011 and 2013) the total emissions recorded within the category 5B 'Cropland' induced a significant reduction of the net carbon removals within the LULUCF sector and this despite the fact that contribution of areas covered by forest ecosystems in the process of carbon removals is constantly growing, in particular due to the expansion of areas covered with forest vegetation. In future, this growth may be enhanced at the expense of increased productivity of existing forests by a wider reconstruction of damaged and low productivity stands. Improved management of the national forestry resources will implicitly generate and enhance the climatic and oxical functions of forests in the Republic of Moldova.

Given the biological features, productivity and areas occupied, the forest species within the national forest fund have different contribution to carbon dioxide removals. Thus, considering the occupied area, the largest share in the process of CO_2 removal rests with *Quercus genus* (41.5 per cent) and *Robinia pseudoacacia* (39.5 per cent), the remaining species accounting together for as much as circa 19.7 per cent[85] percent of the total amount of CO_2 sequestrated (Figure 7-4).

[83] In particular, due to the severe decrease between 1990 and 2013 of the amount of synthetic and organic fertilizers applied to soil, by 76.4 per cent and respectively 99.6 per cent; irrational distribution of soil resources and improper crops structure: for example, areas sown with tobacco decreased by 95.3 per cent, areas sown with fodder plants – by 87.3 per cent, leguminous crops – by 67.7 per cent, with sugar beet – by 64.8 per cent, with vegetables – by 48.4 per cent, potatoes – by 41.6 per cent, etc.; while areas sown with sunflower increased by 155.5 per cent, grain maize - by 88.1 per cent, soybeans – by 61.5 per cent, winter barley - by 48.4 per cent, etc.

[84] Between 1990 and 2013 the total areas of perennial plantations decreased by 38.5 per cent, including: orchards decreased by 45.4 per cent, vineyards, respectively by 30.4 per cent.

[85] [1]Including:, Fraxinus spp. - 5.6 per cent, Populus spp./Salix spp. - 2.4 per cent, Carpinus spp. – 3.2 per cent, Tilia spp. – 0.9 per cent and Other species – 6.7 per cent.

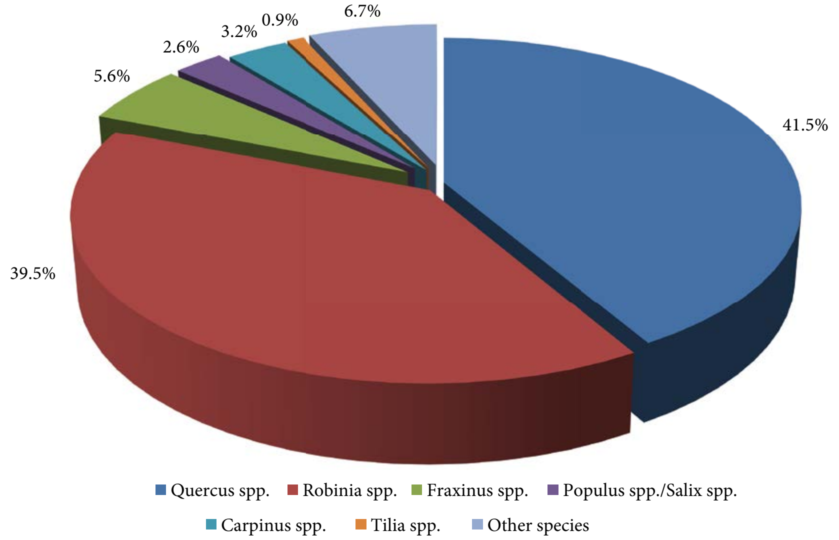

Figure 7-4: Share of Forest Species in CO_2 removals within the 5A 'Forest Land' category in the Republic of Moldova

7.1.2 Key Categories

The results of key category analysis carried out following a Tier 1 approach (IPCC, 2000), by level and trend, are provided in Table 7-2 under the LULUCF Sector.

Table 7-2: Key Source Categories under the LULUCF Sector

IPCC Category	Gases	Source and Sink Categories	Key Categories
5A1	CO_2	Forest Lands remaining Forest Lands	Yes (L, T)
5A1	non-CO_2	Forest Lands Remaining Forest Lands	No
5A2	CO_2	Lands Converted to Forest Lands	No
5B1	CO_2	Cropland Remaining Cropland	Yes (L, T)
5B1	non-CO_2	Cropland Remaining Cropland	No
5B2	CO_2	Land Converted to Cropland	No
5C1	CO_2	Grassland Remaining Grassland	Yes (L, T)
5C2	CO_2	Land Converted to Grassland	No
5D1	CO_2	Wetlands Remaining Wetlands	No
5D2	CO_2	Lands Converted to Wetlands	No
5E1	CO_2	Settlements Remaining Settlements	No
5E2	CO_2	Lands Converted to Settlements	No
5F1	CO_2	Other Lands Remaining Other Lands	No
5F2	CO_2	Lands Converted to Other Lands	No

7.1.3 Methodological Issues and Data Sources

Tier 1 and Tier 2 methodologies (IPCC, 2003, 2006), 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, etc.) were employed to estimate emissions/removals under LULUCF Sector. The summary of estimation methods used to calculate emissions by source and sink categories are presented in Table 7-3, and a more detailed description is provided in sub-chapters 7.2-7.4 of the NIR.

Table 7-3: Summary of Methods Used to Estimate CO_2 Emissions/Removals from the LULUCF Sector

IPCC Categories	Subcategories	Methodology Used	EF	Notes
5A Forest Land	A1. Forest Lands Remaining Forest Lands	T1, T2	D, CS	Above-ground biomass (biomass increment in forests, carbon losses due to authorized commercial fellings, illegal logging and fuel wood gathering)
	A2. Lands Converted to Forest Lands	T2	D, CS	There was included in the category 'Forest Land Remaining Forest Land'
5B Cropland	B1. Cropland Remaining Cropland	T1, T2	D, CS	
	B1.1. Cropland Covered with Woody Vegetation	T1, T2	CS	Above-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	Cropland: annual change in carbon stocks in mineral soils
	B2.Land Converted to Cropland	T2	CS	Included in the category 'Cropland Remaining Cropland'
5C Grassland	C1. Grassland Remaining Grassland	T2	CS	Change in carbon stocks in living biomass from grassland covered with grasses (lands included in 'pastures' and 'hayfields')
	C2. Land Converted to Grassland	T2	CS	Change in carbon stocks in living biomass from area of land converted to grassland from some initial use (protection forest strips, other types of forest vegetation and degraded arable lands)

IPCC Categories	Subcategories	Methodology Used	EF	Notes
5D Wetlands	D1. Wetlands Remaining Wetlands	NE, IE		Part of wetlands were included in grassland category
	D2. Lands Converted to Wetlands	NE		
5E Settlements	E1. Settlements Remaining Settlements	NE, IE		Depending on the type of vegetation a part of settlement lands were included in the following categories: 5A 'Forest Land' (urban forests), 5B 'Cropland' (parks, squares, green spaces), 5C 'Grassland' (pastures and hayfields)
	E2. Lands Converted to Settlements	IE		
5F Other Lands	F1. Other Lands Remaining Other Lands	NE, IE		Part of other lands (landslides) were included in grassland category
	F2. Lands Converted to Other Lands Category	NE		

Abbreviations: T1, T2 – Tier 1 and Tier 2 Methods; CS – country specific emission/removal factors; D –default emission/ removal factors; NE – Not Estimated; IE – Included Elsewhere.

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 Cadasters*: 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); *Statistical Reports of "Moldsilva" Agency*: 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; *Reports of the State Ecological Inspectorate*: 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.

7.1.4 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 7.2-7.4 of the NIR, as well as in the Annex 5-3.5. Combined uncertainties as a percentage of net sectoral emissions/removals were estimated at circa ±790.9 per cent. The uncertainties introduced in trend in total sectoral emissions/removals were estimated at ±17.2 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 (IPCC, 2000).

7.1.5 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, 2000). 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 recommendations included into the Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories (IPCC, 2000), GHG emissions/removals under the LULUCF Sector were estimated based on AD and EFs from official sources of reference.

7.1.6 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 5B 'Cropland' and 5C 'Grassland'. In comparison to the results included into the TNC of the RM under the UNFCCC, the performed recalculation resulted in a decrease of total CO_2 removals for 1990, 1992-1995, 1997, 2004, 2008 and 2010 years, varying from a minimum of 9.0 per cent in 1994, up to a maximum of -2613.2 per cent in 2010, respectively in an increase of CO_2 removals in 1991, 1996, 1998-2003, 2005-2007 and 2009, varying from a minimum of 4.8 per cent in 1991, up to a maximum of 642.1 per cent in 2002 (Table 7-4). The results of recalculations performed at the category level are presented in sub-chapters 7.2-7.4 of the NIR.

Table 7-4: Recalculated CO_2 Emissions/Removals included into the TNC and BUR of the Republic of Moldova under the UNFCCC within the LULUCF Sector, Gg

	1990	1991	1992	1993	1994	1995	1996	1997
TNC	-7180.2643	-5080.1241	-5111.5226	-2416.7596	-2379.2647	-1160.8385	-1008.5757	172.8643
BUR	-5886.5942	-5324.9648	-4384.3888	-1500.8004	-2164.0704	-1029.4289	-1166.6439	-136.9165
Difference, %	-18.0	4.8	-14.2	-37.9	-9.0	-11.3	15.7	-179.2
	1998	1999	2000	2001	2002	2003	2004	2005
TNC	-190.1995	-560.7042	-783.2114	-280.8032	-71.7804	-1046.5861	309.5755	-104.5728
BUR	-722.6280	-1134.8889	-1392.2082	-749.9882	-532.6596	-1554.6866	-103.2311	-375.4117
Difference, %	279.9	102.4	77.8	167.1	642.1	48.5	-133.3	259.0
	2006	2007	2008	2009	2010	2011	2012	2013
TNC	-403.2242	-2612.7710	129.9309	-872.0809	26.1460			
BUR	-639.0807	-3065.9950	-59.5134	-1284.9156	-657.0905	-429.1348	-2470.3546	-97.6148
Difference, %	58.5	17.3	-145.8	47.3	-2613.2			

Abbreviations: TNC – Third National Communication; BUR – Biennial Update Report.

7.1.7 Assessment of Completeness

The current inventory covers CO_2 emissions/removals from 4 source categories: 5A1 'Forest Lands Remaining Forest Lands', 5B1 'Cropland Remaining Cropland', 5C1 'Grassland Remaining Grassland' and 5C2 'Land Converted to Grassland'. CO_2 emissions/removals from the source category 5A2 'Land Converted to Forest Land' were included in the source category 5A1 'Forest Land Remaining Forest Land', while CO_2 emissions/removals from the source category 5B2 'Land Converted to Cropland', were included in category 5B1 'Cropland Remaining Cropland'. To be noted that CO_2 emissions/removals from the 5E1 'Settlements Remaining Settlements' and 5E2 'Land Converted to Settlements' categories were included in 5B1 'Cropland Remaining Cropland' category (Table 7-5).

Table 7-5: Assessment of Completeness under the LULUCF Sector in the RM

IPCC Category	Source Category	CO_2	CH_4	N_2O	NO_x	CO
5A1	Forest Land Remaining Forest Land	X	X	X	X	X
5A2	Land Converted to Forest Land	IE	NE	NE	NE	NE
5B1	Cropland Remaining Cropland	X	X	X	X	X
5B2	Land Converted to Cropland	IE	NE	NE	NE	NE
5C1	Grassland Remaining Grassland	X	NE	NE	NE	NE
5C2	Land Converted to Grasslands	X	NE	NE	NE	NE
5D1	Wetlands Remaining Wetlands	NE, IE	NE	NE	NE	NE
5D2	Land Converted to Wetlands	NE	NE	NE	NE	NE
5E1	Settlements Remaining Settlements	NE, IE	NE	NE	NE	NE
5E2	Land Converted to Settlements	IE	NE	NE	NE	NE
5F1	Other Land Remaining Other Land	NE, IE	NE	NE	NE	NE
5F2	Land converted to Other Land	NE	NE	NE	NE	NE

Abbreviations: X – source categories included in inventory; IE – Included Elsewhere; NE – Not Estimated.

Non-CO_2 emissions from forest fires were estimated under the 5A1 'Forest Lands Remaining Forest Lands', while non-CO_2 emissions from agricultural residues burning on field were estimated under the 5B1 'Cropland Remaining Cropland' categories, however these emissions being quite insignificant in the Republic of Moldova.

7.1.8 Planned Improvements

Planned improvements at the source and sink category level within the LULUCF Sector are described in detail in sub-chapters 7.2-7.4 of the NIR.

7.2 Forest Land (Category 5A)

7.2.1 Source Category Description

The 5A '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 of fuel wood, forest damage by forest defoliating insects, etc.).

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, recovering to 372.8 thousand ha in 2013 or circa 11.1 per cent of the country's territory[86] (Figure 7-5).

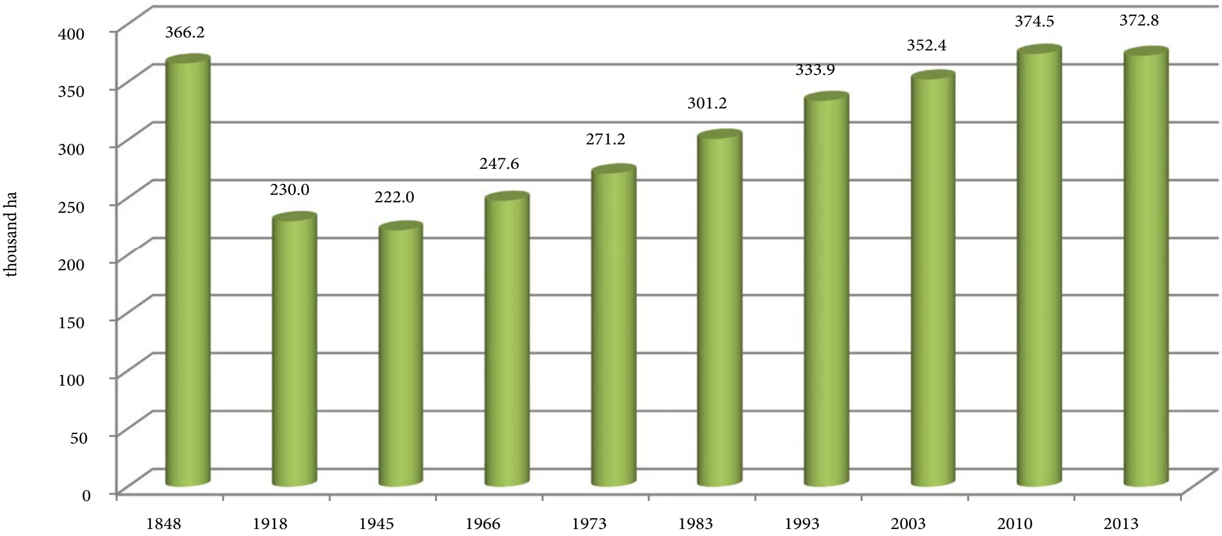

Figure 7-5: Evolution of Areas Covered with Forests in the RM, 1848-2013, thousand ha

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 46 million m^3, on average 124 m^3 per hectare. The average forest increment is 3.3 m^3/ha/year, and the total average increment is circa 1240 thousand m^3/year. The average production class is 2.3 (see Annex 3-4.1). The structure by age in all forest species is misbalanced, in particular in those of low productivity.

In conformity with Article 14 of the Forest Code, the forests in the Republic of Moldova are included in the functional group I, having exclusively environment protection functions.

In terms of functions, there are 5 functional sub-groups:

- forests with water protection functions – 1.6 per cent;
- forests with lands and soils protection functions – 6.7 per cent;
- forests with protection functions against harmful climatic and industrial factors – 48.6 per cent;
- forests with recreational functions – 29.5 per cent;
- forests presenting scientific interest and for protection of forestry genetic and ecological pool – 13.6 per cent

In spring-summer 2007, a catastrophic drought was reported in the RM, affecting over 80 per cent of the country territory. This phenomenon has substantially damaged the national forests over an area

[86] Gh. Vdovîi, 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.

of circa 19 thousand ha or 5.5 per cent of the forests, in particular in the southern and central regions of the country.

The drought affected about 20 forest species, both indigenous and non-native, such as: *Quercus robur L., Quercus petraea (Matt) Liebl., Quercus pubescens Willd, Fraxinus exelsior L., Acer platanoides L., Acer pseudoplatanus L., Robinia pseudoacacia L., Betula verrucosa Ehrh., Pinus sylvestris L., Pinus pallasiana [Lamb] Holmboe*. The most affected species was *Robinia spp,* representing 71.3 percent (13 thousand ha) of the total.

The 2007 year drought has long-lasting consequences, and these are visible over several years. According to air-visual forest pathology research data, in 2009 year the total area of damaged and dried rammels represented 17.9 thousand ha, in 2010 year – 13.1 thousand ha, in 2011 – 8.9 thousand ha, while in 2012 – 9.0 thousand ha.

7.2.2 Methodological Issues, Emission Factors and Data Sources

To estimate CO_2 emissions/removals from the category 5A1 '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), losses from authorized and illegal harvesting of fuel wood, as well as from forest damage by forest defoliating insects.

The estimation process followed two steps:

1. Annual increase in carbon stocks due to biomass increment in forest land remaining forest land (in stem, branches, leaves, roots), using the following equation:

$$\Delta_{CFFG} = A \bullet G_{total} \bullet CF$$

Where:

A – area of forest land remaining forest land;

G_{total} – annual biomass increment above and belowground (t.d.m.[87]/ha/yr), calculated using the following equation:

$$G_{total} = G_w \bullet (1+R)$$

Where:

R – root-to-shoot ratio appropriate to increments, dimensionless;

G_w – average annual aboveground biomass increment, calculated using the following equation:

$$G_w = I_v \bullet D \bullet BEF_I$$

Where:

I_v – average annual net increment in volume suitable for industrial processing, m^3/ha/yr;

D – basic wood density, t.d.m./m^3;

BEF_I – biomass expansion factor for conversion of annual net increment to aboveground tree biomass increment, dimensionless;

CF – carbon fraction of dry matter

2. Annual decrease in carbon stocks due to biomass loss in forest land remaining forest land (from authorized fellings and illegal logging), estimated by the following formula:

$$\Delta C_{FFL} = L_{fellings} + L_{fuel\ wood} + L_{other\ losses}$$

Where:

$L_{fellings}$ – annual carbon loss due to commercial fellings, calculated using the following equation:

$$L_{fellings} = H \bullet D \bullet BEF_{II} \bullet (1\text{-}f_{BL}) \bullet CF$$

Where:

H – annually extracted volume, round wood, m^3;

D – basic wood density, t.d.m./m^3;

BEF_{II} – biomass expansion factor for converting volumes of extracted round wood to total aboveground biomass, dimensionless;

f_{BL} – fraction of biomass left to decay in forest (transferred to dead organic matter);

[87] Constant mass (dry matter – d.m.)

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$L_{fuelwood}$ – annual carbon loss due to fuel wood gathering, calculated using the following equation:

$$L_{fuel\ wood} = FG \bullet D \bullet BEF_{II} \bullet CF$$

Where:

FG – annual volume of fuel wood gathering, m^3;

$L_{other\ losses}$ – annual other losses of carbon (diseases and pests, natural disasters, drying, etc.)

These volumes 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.).

Methodologies described in the Revised 1996 Guidelines (IPCC, 1996), GPG LULUCF (IPCC, 2003) and 2006 IPCC Guidelines were used in the Republic of Moldova in the inventory development process. Country specific removals factors on average annual net increment in volume suitable for industrial processing; basic wood density; carbon fraction of dry matter and others, were used, as well as sectoral activity data (forest land by species/categories of species, forest land areas, annual extracted volume of round wood, annual volume of fuel wood, 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 7-6).

Table 7-6: 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		
1.	*Quercus spp.*	Oak tree	Ilex, durmast, oak, red oak	QU
2.	*Carpinus ssp.*	Hornbeam	Hornbeam (*Carpinus betulus*)	CA
3.	*Fraxinus spp.*	Ash tree	Ash tree	FR
4.	*Acer spp.*	Sycamore maple	Field maple, Common maple, Mountain maple	AC
5.	*Ulmus spp.*	Elm	Field elm, Elm tree, Turkestan elm, etc.	UL
6.	*Tilia spp.*	Linden tree	Foul lime, Silver lime, big leaf linden tree	TI
7.	*Salix spp.*	Willow	Willow, Osier, etc.	SA
8.	*Pinus spp.*	Pine	Pine silvestre, Black pine, Spruce fir, Fir tree	PI
9.	*Populus spp.*	Poplar	Trembling poplar, Black poplar, Aspen tree	PO
10.	*Robinia spp.*	Acacia	Acacia, Honey locust, Sofora	RB
11.	*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

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 2013, available into the National Report on Forestry Resources of the Republic of Moldova and General Land Cadasters of the Republic of Moldova (Table 7-7).

Table 7-7: Forest Land Areas in the Republic of Moldova within 1990-2013 periods, thousand ha

Year	Total	Forest Land Areas by Species										
		OU	CA	FS	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	6.5
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

Year	Total	Forest Land Areas by Species										
		OU	CA	FS	AC	UL	TI	SA	PI	PO	RB	OS
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

Source: National Report on Forestry Resources of the Republic of Moldova (2011), General Land Cadasters for 1990-2013 periods; Statistical Records and Reports of „Moldsilva" Agency on afforestation over the 1990-2013 periods.

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. 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.

Table 7-8: Trends in Fuel Wood Harvests in the Republic of Moldova, 1990-2013

	1990	1991	1992	1993	1994	1995	1996	1997
Commercial fellings, thousand m^3	39.4	27.0	27.4	31.5	39.8	68.5	51.7	52.7
Fuel wood gathering, thousand m^3	184.2	260.7	314.7	402.9	347.7	420.0	402.4	280.2
Illegal fuel wood logging, thousand m^3	0.6	140.8	213.4	328.2	210.7	205.7	187.5	21.4
Total fuel wood harvested, thousand m^3	184.8	401.5	528.1	731.1	558.4	625.7	589.9	301.6
	1998	1999	2000	2001	2002	2003	2004	2005
Commercial fellings, thousand m^3	38.0	38.8	39.7	37.3	50.4	47.0	43.5	39.0
Fuel wood gathering, thousand m^3	332.4	326.1	330.5	307.1	343.9	372.4	371.7	352.2
Illegal fuel wood logging, thousand m^3	64.2	22.0	7.5	6.0	5.4	5.9	4.4	4.2
Total fuel wood harvested, thousand m^3	396.6	348.1	338.0	313.1	349.3	378.3	376.1	356.4
	2006	2007	2008	2009	2010	2011	2012	2013
Commercial fellings, thousand m^3	46.5	44.4	42.8	37.3	40.6	33.9	31.7	29.9
Fuel wood gathering, thousand m^3	419.8	388.7	400.3	394.8	415.4	471.3	524.2	567.4
Illegal fuel wood logging, thousand m^3	7.2	2.2	2.7	3.6	20.5	5.7	4.8	3.9
Total fuel wood harvested, thousand m^3	427.0	390.9	403.0	398.4	435.9	477.0	529.0	571.3

Source: Statistical Records/Reports of "Moldsilva" Agency and of the State Ecological Inspectorate for the 1990-2013 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, Centrul editorial al UASM, 2005, 116 pages; Statistical Yearbooks of the ATULBD (2013); 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 volume of commercial timber, as well as the quantity of fuel wood gathered in the Republic of Moldova, there 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 7-8).

Between 1990 and 2013, through different types of forest fellings a total wood mass of circa 11 million m^3 was harvested, including commercial wood – circa 980 thousand m^3 and fuel wood – circa 10 million m^3. 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 7-9 and 7-10 and refers to the 1990-2013 time series.

Table 7-9: Trends in Commercial Fellings Harvest in the Republic of Moldova, 1990-2013, thousand m^3

Species	1990	1991	1992	1993	1994	1995	1996	1997
Quercus spp.	7.16	4.32	4.09	4.41	6.88	9.59	10.05	10.26
Carpinus spp.	1.05	0.71	0.72	0.83	1.04	1.79	1.35	1.39
Fraxinus spp.	3.65	2.99	3.24	3.94	4.03	8.56	4.47	4.47
Acer spp.	0.31	0.23	0.23	0.27	0.34	0.58	0.45	0.44
Ulmus spp.	0.17	0.10	0.10	0.12	0.15	0.26	0.19	0.21
Tilia spp.	3.78	2.48	2.52	2.90	3.66	6.31	4.70	4.91
Salix spp.	0.26	0.19	0.19	0.22	0.28	0.48	0.37	0.36
Pinus spp.	0.28	0.17	0.18	0.20	0.26	0.44	0.32	0.35
Populus spp.	4.87	3.20	3.26	3.74	4.73	8.14	6.07	6.33
Robinia spp.	16.74	12.02	12.26	14.18	17.54	30.83	22.66	22.70
Other species	1.15	0.59	0.60	0.69	0.89	1.51	1.06	1.28
Total	39.40	27.00	27.40	31.50	39.80	68.50	51.70	52.70

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Species	1998	1999	2000	2001	2002	2003	2004	2005
Quercus spp.	7.40	7.51	7.77	5.18	10.12	10.31	9.34	7.63
Carpinus spp.	1.00	0.99	1.07	1.09	1.85	1.00	0.92	1.05
Fraxinus spp.	3.23	3.49	3.17	2.96	4.45	3.41	3.03	3.12
Acer spp.	0.32	0.37	0.28	0.30	0.42	0.26	0.19	0.28
Ulmus spp.	0.15	0.13	0.18	0.19	0.24	0.22	0.22	0.18
Tilia spp.	3.54	3.34	3.97	4.86	4.82	4.22	4.47	3.90
Salix spp.	0.26	0.30	0.24	0.32	0.29	0.20	0.21	0.24
Pinus spp.	0.25	0.22	0.30	0.33	0.00	0.00	1.10	0.30
Populus spp.	4.56	4.32	5.11	2.89	5.82	8.28	6.62	5.02
Robinia spp.	16.37	17.67	16.13	18.19	19.94	16.43	15.93	15.85
Other species	0.92	0.45	1.46	0.97	2.46	2.66	1.44	1.44
Total	38.00	38.80	39.70	37.30	50.40	47.00	43.50	39.00
Species	2006	2007	2008	2009	2010	2011	2012	2013
Quercus spp.	9.26	7.49	7.17	5.84	7.16	5.68	4.77	6.28
Carpinus spp.	1.28	0.92	1.13	0.77	0.87	0.74	0.49	0.52
Fraxinus spp.	5.57	5.94	6.02	5.70	5.83	4.03	4.52	4.76
Acer spp.	0.28	0.28	0.25	0.15	0.20	0.14	0.11	0.15
Ulmus spp.	0.27	0.31	0.20	0.17	0.19	0.24	0.12	0.17
Tilia spp.	4.06	3.45	3.84	3.24	3.42	3.17	2.67	2.21
Salix spp.	0.31	0.42	0.38	0.38	0.14	0.19	0.24	0.25
Pinus spp.	0.79	1.60	0.60	0.89	1.19	1.95	1.35	0.73
Populus spp.	7.81	6.44	6.09	4.87	6.32	5.61	5.26	5.06
Robinia spp.	15.68	16.58	16.01	14.34	14.41	11.47	11.69	9.43
Other species	1.22	1.01	1.10	0.98	0.89	0.69	0.47	0.36
Total	46.50	44.40	42.80	37.30	40.60	33.90	31.70	29.90

Source: Statistical Records/Reports of "Moldsilva" Agency and of the State Ecological Inspectorate for the 1990-2013 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 7-10: Trends in Fuel Wood Harvest in the Republic of Moldova, 1990-2013, thousand m^3

Species	1990	1991	1992	1993	1994	1995	1996	1997
Quercus spp.	30.10	50.35	49.29	51.15	39.07	63.60	58.99	49.12
Carpinus spp.	12.50	17.96	13.24	13.15	10.05	11.30	15.45	20.41
Fraxinus spp.	15.80	38.99	56.52	73.07	55.81	71.97	73.74	25.80
Acer spp.	8.70	11.39	6.65	6.19	4.73	5.30	5.00	14.12
Ulmus spp.	3.50	6.19	6.54	10.23	7.81	8.76	2.26	5.72
Tilia spp.	10.60	18.97	20.40	29.23	22.32	20.10	19.50	17.29
Salix spp.	3.40	6.68	7.95	12.42	9.49	10.64	4.14	5.57
Pinus spp.	0.40	2.10	4.09	6.58	5.02	5.63	3.80	0.70
Populus spp.	11.80	34.34	55.04	73.07	55.81	74.35	70.09	19.21
Robinia spp.	76.80	197.60	294.55	439.88	335.98	340.30	323.90	125.34
Other species	11.20	16.91	13.82	16.08	12.28	13.77	12.98	18.32
Total	184.80	401.50	528.10	731.04	558.36	625.72	589.84	301.60
Species	1998	1999	2000	2001	2002	2003	2004	2005
Quercus spp.	64.60	55.32	53.71	48.34	56.93	65.45	64.16	56.64
Carpinus spp.	26.84	24.10	23.40	22.46	23.41	23.07	25.30	24.68
Fraxinus spp.	33.93	30.09	29.22	28.35	28.91	32.38	30.63	30.81
Acer spp.	18.57	16.64	16.16	14.17	17.49	16.50	17.13	17.04
Ulmus spp.	7.52	6.38	6.19	5.78	6.36	8.32	7.07	6.53
Tilia spp.	22.73	19.59	19.02	18.93	18.35	21.63	23.40	20.06
Salix spp.	7.33	6.32	6.13	5.48	6.55	6.28	8.22	6.47
Pinus spp.	0.92	0.74	0.72	1.41	0.00	0.00	2.09	0.76
Populus spp.	25.26	20.32	19.73	17.37	21.29	28.96	28.19	20.80
Robinia spp.	164.81	148.24	143.93	132.86	149.22	148.22	147.77	151.77
Other species	24.09	20.38	19.78	17.98	20.79	27.52	22.09	20.86
Total	396.60	348.10	338.00	313.11	349.30	378.34	376.05	356.40
Species	2006	2007	2008	2009	2010	2011	2012	2013
Quercus spp.	71.56	57.00	59.84	59.35	65.69	79.79	83.11	98.48
Carpinus spp.	27.49	23.70	27.73	26.27	30.17	34.93	40.30	43.30
Fraxinus spp.	48.42	47.74	49.05	52.75	62.33	51.65	63.42	71.72
Acer spp.	23.05	21.44	23.48	23.33	23.79	22.10	13.00	21.92
Ulmus spp.	10.45	10.47	8.55	9.90	12.74	20.60	21.51	20.27
Tilia spp.	27.66	24.71	25.19	22.43	22.98	22.22	28.75	29.88
Salix spp.	9.95	8.43	7.85	4.75	5.42	7.80	9.25	10.72
Pinus spp.	3.06	2.80	2.74	3.91	4.78	10.29	8.94	10.88
Populus spp.	27.11	23.26	25.04	23.82	26.00	30.97	33.76	39.41
Robinia spp.	161.18	155.21	154.83	149.54	162.77	173.10	188.06	192.53
Other species	17.08	16.17	18.74	22.32	19.20	23.55	38.90	32.19
Total	427.00	390.94	403.03	398.36	435.86	477.00	529.00	571.30

Source: Statistical Records/Reports of "Moldsilva" Agency and of the State Ecological Inspectorate for the 1990-2013 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 2000-2013.

In order to estimate annual biomass increments and losses, country specific emission factors were calculated/developed (Tables 7-11 and 7-12).

Table 7-11: Coefficients Used to Estimate CO_2 Emissions/Removals from the 5A1 'Forest Land Remaining Forest Land' Category

Species	Average annual net increments, m³/ha	Basic wood density, t.d.m./m³ fresh volume	Biomass expansion factor for conversion of annual net increment to aboveground tree increment, BEF_1	Biomass expansion factor for converting volumes of extracted round wood to total aboveground biomass, BEF_2
Quercus spp.	3.0	0.835	1.20	1.20
Carpinus spp.	3.5	0.85	1.20	1.10
Fraxinus spp.	3.5	0.72	1.20	1.20
Acer spp.	2.6	0.75	1.20	1.15
Ulmus spp.	3.2	0.70	1.20	1.15
Tilia spp.	3.7	0.55	1.20	1.15
Salix spp.	7.4	0.38	1.20	1.20
Pinus spp.	2.8	0.535	1.15	1.10
Populus spp.	7.9	0.51	1.20	1.20
Robinia spp.	3.9	0.78	1.20	1.20
Other species	2.1	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.

For estimating/developing these, production tables were used, as well as data on actual productivity of stands in the Republic of Moldova, according to the forest planning records. At the same time, to ensure an appropriate quality of the sectoral GHG inventory, it is necessary to keep records for all reductions and emissions. An important section is the biomass loss due to forest damage by defoliator pests. Most areas affected are concentrated in oak and ash tree stands.

Table 7-12: Coefficients Used to Estimate CO_2 Emissions/Removals from the 5A1 'Forest Land Remaining Forest Land' Category

Species	Root-shoot ratio appropriate to increments	Carbon fraction of dry matter	Fraction of biomass left to decay in forest	Average loss from current increments due to disturbances (forest pest), t/ha/yr
Quercus spp.	0.40	0.50	0.05	0.91
Carpinus ssp.	0.35	0.50	0.05	1.22
Fraxinus spp.	0.28	0.49	0.05	1.29
Acer spp.	0.28	0.49	0.05	0.67
Ulmus spp.	0.28	0.49	0.05	0.74
Tilia spp.	0.21	0.50	0.05	1.73
Salix spp.	0.21	0.49	0.05	1.70
Pinus spp.	0.46	0.51	0.05	0.46
Populus spp.	0.21	0.50	0.05	1.13
Robinia spp.	0.28	0.49	0.05	0.70
Other species	0.28	0.50	0.05	0.48

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); Annex 4 to the Order of the Federal Forestry Agency dated 29.12.2007 No. 523, "Technical guidance on localization and liquidations of pests outbreaks" (in Russian).

In order to complete the national GHG emissions inventory, a number of bibliographic sources have been studied in this section, resulting in the final development of coefficients/factors that highlight the losses from current stands increment, losses that are caused by forest pests. The main source of reference was "Technical guidance on localization and liquidations of pests outbreaks"[88].

For estimating loss from current increment caused by the forest pests the following formula was used:

$$P = L \bullet (X / 100),$$

Where,

P – loss from current increment volume;

X – extent of the canopy damage;

L – empirical coefficient calculated by phonological group[89].

Details regarding the area affected by defoliators as well as the coefficient reflecting the affected biomass reduction are provided by Annex 3-4.2, 3-4.3 şi 3-4.4.

Non-CO_2 emissions from the 5A1 'Forest Land Remaining Forest Land' category were estimated by using a Tier 1 methodology (IPCC, 2006).

[88] Annex 4 to the Order of the Federal Forestry Agency from 29.12.2007 Nr. 523, "Technical guidance on localization and liquidations of pests outbreaks".

[89] The main species of pests affecting forests in the RM are: Tortrix viridana L., Operophtera brumata, Erannis defoliaria L. (affect Quercus spp.) and Stereonicus fraxini (affects Fraxinus spp.) referring to the phenological group I, with an empirical coefficient (L) equal to 0.4.

$$L_{fire} = A \bullet M_B \bullet C_f \bullet G_{ef} \bullet 10^{-3}$$

Where:

L_{fire} – amount of non-CO_2 greenhouse gas emissions from fire, t GHG/yr;

A – area burnt, ha/yr;

M_B – mass of fuel available for combustion (biomass, ground litter and dead wood), t/ha;

C_f – combustion factor; IPCC default value is 0.45 (IPCC, 2006, vol. 4, Ch. 2, Tab. 2.6, p. 2.48);

$M_B \bullet C_f$ – amount of fuel actually burnt; IPCC default for 'Other temperate forests' under wildfire is 19.8 t.d.m./ha (IPCC, 2006, vol. 4, Ch. 2, Tab. 2.4, p. 2.45-2.46);

G_{ef} – default EF (kg/t.d.m.) (IPCC, 2006, vol. 4, Ch. 2, Tab. 2.4, p. 2.45-2.46) (Table 7-13).

Table 7-13: EFs for Various Types of Burning Vegetation, kg GHG / t.d.m.

Category	CO	CH_4	N_2O	NO_x
Temperate zone forests	107	4.7	0.26	3.0

Source: IPCC, 2006, vol. 4, Ch. 2, Tab. 2.5, p. 2.47.

Activity data on forest land affected by fires are available in Statistical Yearbooks of the Republic of Moldova and those of the ATULBD (Table 7-14).

Table 7-14: Forest Land Areas Affected by Fires in the Republic of Moldova, 1990-2013

	1990	1991	1992	1993	1994	1995	1996	1997
Right bank of Dniester river, ha	120.10	20.10	22.00	1.50	33.50	1.40	0.00	0.00
Left bank of Dniester river, ha	NA	NA	NA	NA	NA	0.53	11.20	3.40
Total, ha	120.10	20.10	22.00	1.50	33.50	1.93	11.20	3.40
	1998	1999	2000	2001	2002	2003	2004	2005
Right bank of Dniester river, ha	9.70	0.00	0.00	41.60	12.50	10.50	42.00	5.50
Left bank of Dniester river, ha	24.00	25.20	0.90	15.40	18.10	23.00	46.00	2.90
Total, ha	33.70	25.20	0.90	57.00	30.60	33.50	88.00	8.40
	2006	2007	2008	2009	2010	2011	2012	2013
Right bank of Dniester river, ha	32.60	683.30	31.00	126.00	20.00	25.90	636.60	460.00
Left bank of Dniester river, ha	58.20	108.00	24.00	8.20	26.90	36.90	35.80	7.10
Total, ha	90.80	791.30	55.00	134.20	46.90	62.80	672.40	467.10

Source: Statistical Yearbooks of the RM for 1994 (page 38), 1999 (page 20), 2007 (page 22), 2011 (page 22), 2014 (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).

7.2.3 Uncertainties Assessment and Time-Series Consistency

Uncertainties associated with the process of estimating the CO_2 emissions/removals from the 5A1 'Forest Land Remaining Forest Land' category at the beginning of the reference period, were rather low, circa ±5 per cent. Since 1991, due to social-political developments, the level of uncertainties increased significantly. For 2013, the level of precision of activity data related to the production processes reached circa ±25 per cent. Uncertainties related to emission/removals factors and coefficients in both cases are of circa ±5 per cent.

General uncertainties on CO_2 removals from the 5A 'Forest Land' category are affected by a number of factors. Thus, part of data needed to estimate CO_2 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 5A1 'Forest Land Remaining Forest Land' category represent circa ±25.5 per cent, while, the combined uncertainties as a percentage of total sectoral emissions/ removals were estimated at ±493.0 per cent. The uncertainties introduced in trend in total sectoral direct GHG emissions/ removals were estimated at ±11.4 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 5A1 'Forest Land Remaining Forest Land' category are considered relatively high (±31.6 per cent for CH_4 and ±51.0 per cent for N_2O), while combined uncertainties as a percentage of total direct sectoral emissions/removals are quite insignificant (Annex 5-3.5).

7.2.4 Quality Assurance and Quality Control

Following the recommendations included into the GPG (IPCC, 2000), CO_2 removals under the 5A 'Forest Land' category were estimated based on AD and EFs from official sources of reference. Data on total forest area was taken from the General Land Cadaster by years, annual forest lands balance drafted annually by the state forest authorities, periodical records (once in 5 years) of forests, forest planning materials, etc.

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.

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';
- 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 revealed by the State Ecological Inspectorate were provided by the study *Illegal logging of forest vegetation in the Republic of Moldova*[90].

Standard verification and quality control forms and checklists were filled in for 5A 'Forest Land' category, following a Tier 1 approach (IPCC, 2000). Verification was focused on various aspects such as: ensuring correct use of estimation methodologies following the Revised 1996 IPCC Guidelines (IPCC, 1997), GPG LULUCF (2003) and 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.

7.2.5 Recalculations

No recalculations were performed for CO_2 removals within the 5A 'Forest Land' sink category for 1990-2010 time series. Within the 1997-2010, CO_2 removals from 5A 'Forest Land' were relatively constant (Figure 7-6).

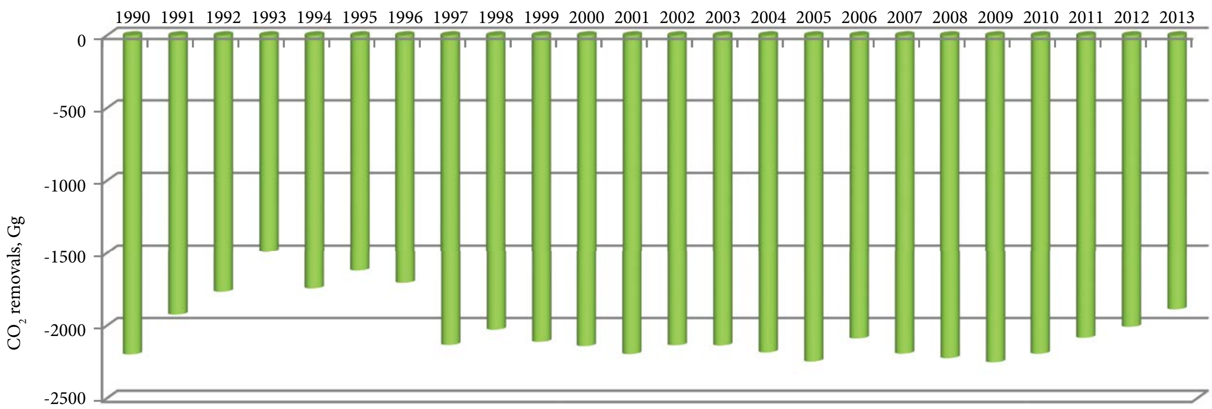

Figure 7-6: CO_2 Removals within the 5A 'Forest Land' in the Republic of Moldova, 1990-2013

[90] 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.

In the last four years, CO_2 removals within 5A 'Forest Land' have a decreasing trend, in 2013 constituting just 85.9 per cent of the reference year level (Table 7-15).

Table 7-15: CO_2 Removals within the 5A 'Forest Land' in the Republic of Moldova, 1990-2013

	1990	1991	1992	1993	1994	1995	1996	1997
CO_2 removals, Gg	-2197.5790	-1924.1010	-1766.5038	-1491.3852	-1743.7096	-1620.7949	-1705.1295	-2132.2121
	1998	1999	2000	2001	2002	2003	2004	2005
CO_2 removals, Gg	-2027.8925	-2111.2238	-2140.3185	-2195.4199	-2134.8652	-2135.8765	-2183.7322	-2246.2332
	2006	2007	2008	2009	2010	2011	2012	2013
CO_2 removals, Gg	-2087.8823	-2192.3574	-2223.0019	-2251.7423	-2193.2612	-2082.9771	-2007.9512	-1887.6165

No recalculations were performed also for non-CO_2 emissions from the 5A 'Forest Land' category. Within the 1997-2013 time series, non-CO_2 emissions (CH_4, CO, N_2O and NO_x) from 5A 'Forest Land' category, were relatively constant, excepting for 2007 and 2012, when, due to the severe drought, the forest areas affected by fires recorded an historical maximum of 791 ha and 672.4 ha or a 7 times increase compared to the reference year (1990) level.

At the same time, in comparison to reference year, by 2013 the non-CO_2 emissions from forest areas affected annually by fires within the category 5A 'Forest Land' increased by circa 3.9 times (Table 7-16).

Table 7-16: Non-CO_2 Emissions from Forest Areas Annually Affected by Fires in the Republic of Moldova within 1990-2013, Gg

	1990	1991	1992	1993	1994	1995	1996	1997
CH_4	0.0112	0.0019	0.0020	0.0001	0.0031	0.0002	0.0010	0.0003
N_2O	0.0006	0.0001	0.0001	0.0000	0.0002	0.0000	0.0001	0.0000
CO	0.2544	0.0426	0.0466	0.0032	0.0710	0.0041	0.0237	0.0072
NO_x	0.0071	0.0012	0.0013	0.0001	0.0020	0.0001	0.0007	0.0002
	1998	1999	2000	2001	2002	2003	2004	2005
CH_4	0.0031	0.0023	0.0001	0.0053	0.0028	0.0031	0.0082	0.0008
N_2O	0.0002	0.0001	0.0000	0.0003	0.0002	0.0002	0.0005	0.0000
CO	0.0714	0.0534	0.0019	0.1208	0.0648	0.0710	0.1864	0.0178
NO_x	0.0020	0.0015	0.0001	0.0034	0.0018	0.0020	0.0052	0.0005
	2006	2007	2008	2009	2010	2011	2012	2013
CH_4	0.0084	0.0736	0.0051	0.0125	0.0044	0.0058	0.0626	0.0435
N_2O	0.0005	0.0041	0.0003	0.0007	0.0002	0.0003	0.0035	0.0024
CO	0.1924	1.6764	0.1165	0.2843	0.0994	0.1330	1.4245	0.9896
NO_x	0.0054	0.0470	0.0033	0.0080	0.0028	0.0037	0.0399	0.0277

7.2.6 Planned Improvements

Possibilities 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 and undertake actions aimed at verification of C removals factors (annual net increment in volume suitable for industrial processing, basic wood density, biomass expansion factors, emission factors from forest fires etc.) will be considered for the next inventory cycles.

7.3 Cropland (Category 5B)

7.3.1 Source Category Description

In the Republic of Moldova, under the 5B1 'Cropland Remaining Cropland' category there are reported CO_2 emissions/removals estimates originated from two sub-categories: 5B1.1 'Cropland Covered with Woody Vegetation' and 5B1.2 'Annual Change in Carbon Stocks in Mineral Soils', as well as non-CO_2 emissions from post-harvest field burning of agricultural residues (stubble fields burning).

'Cropland Covered with Woody Vegetation'

The 5B1.1 'Cropland Covered with Woody Vegetation' sink category comprises CO_2 removals from cropland covered with woody vegetation, including aboveground and belowground 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.

Though having a smaller share in CO_2 removals in comparison with forests, the respective category is still quite important in the total balance per sector, as the quantitative share in the general land structure per country of these sources reach up to 10 per cent.

Thus, according to the General Land Cadaster of the Republic of Moldova (standing as of 01.01.2013), the areas with forest vegetation not regarded as forest resources covered 52.0 thousand ha or 1.5 per cent of the country's territory, including 30.7 thousand ha – protection forest strips (by the side of agricultural fields, roads, rivers and water pools, etc.), and 21.2 thousand ha – other types of forest vegetation (woody crops and shrubs plantations, green spaces, parks, squares, etc.), which also substantially contribute to maintaining the ecological balance.

In conformity with records available in the Republic of Moldova, forest vegetation not regarded as forest resources includes the following categories:

- protection forest strips by the side of agricultural fields;
- protection forest strips and 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. Depending on a number of indicators that determine the conditions for establishing protection forest strips (type, structure, composition etc.), their influence present the following benefits:

- improve the microclimate conditions (albedo change, reducing the amplitude of diurnal and annual air temperature, wind speed reduction, snow retention, evapotranspiration reduction, increasing air humidity);
- decrease the air temperature diurnal amplitude by 1-4°C and by 1-2°C – the annual amplitude, wind speed reduction by 31-55 per cent within the sheltered part and by 10-15 per cent within the exposed areas, the reduction of non-productive evapotranspiration up to 30 per cent, the increase of air humidity above ground by 3-5 per cent;
- improve growth and development conditions for adjacent crops situated at a distance equal to 20-30 times the height of the forest strips in the leeward (sheltered) and to 5-12 times in the wind (exposed);
- increase soil fertility and conservation conditions, reduce erosion and water leakage on slopes, reduce deflation to total halt, increase soil moisture, soil enrichment with humus and other nutrients, pH change due to a surplus of organic substances from leaves and roots;
- create favorable conditions for the development of local fauna;
- increase local biodiversity;
- improve the carbon stock, as well as
- landscape reconstruction and improvement.

The Republic of Moldova has a relatively wide experience in planting protection forest strips (in particular after the Second World War period). At the time of starting and along the entire process, the main emphasis was laid on anti-erosion component, and partially, on obtaining additional amounts of food products, etc. This focus determined the composition of protection forest strips (Paladiiciuk, 1986), comprising: *Juglans spp.* – 38 per cent; *Robinia spp.* – 36 per cent; *Quercus spp.* – 9 per cent; *Populus spp.* – 4 per cent; other species – 13 per cent. At the same time, in this sphere the Republic of Moldova has 295.3 thousand ha (8.7 per cent of the country's territory) of perennial plantations (orchards, plantations of walnut species, vineyards, etc.).

'Annual Change in Carbon Stocks in Mineral Soils'

Under the 5B1.2 'Annual Change in Carbon Stocks in Mineral Soils' category there are reported CO_2 emissions/removals from mineral soils. This source has a significant share in the total emissions from the LULUCF Sector, as according the Statistical Yearbooks of the Republic of Moldova (standing as of 01.01.2014), this source includes arable lands with a share of over 53 per cent of the total, which occupy 1816.1 thousand ha or 53.7 per cent of the country's territory). It should be mentioned that over the period from 1990 through 2013, the areas of arable lands remained relatively constant, increasing only by 4 per cent.

Cropland change and soil management change can considerably affect the organic carbon stocks in mineral soils[91]. 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 (IPCC, 2006).

Soil organic C stocks can change with management or disturbance if the net balance between C inputs and C losses from soil is altered. Management activities influence organic C inputs through changes in plant production (such as fertilization or irrigation to enhance crop growth), direct additions of C in organic amendments, and the amount of carbon left after biomass removal activities, such as crop harvest, timber harvest, fire, or grazing. Decomposition largely controls C outputs and can be influenced by changes in moisture and temperature regimes as well as the level of soil disturbance resulting from the management activities.

'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.

7.3.2 Methodological Issues, Emission Factors and Data Sources

'Cropland Covered with Woody Vegetation'

For estimating CO_2 emissions/removals within the source 5B1.1 'Cropland Covered with Woody Vegetation' under the 5B.1 'Cropland Remaining Cropland' category, it was necessary to determine annual biomass increments in woody vegetation not included in forestry resources and perennial plantations (according to production tables and forest planning).

The calculations was done based on annual change in carbon stocks in as a result of perennial woody crops growth (in stem, shoots, leaves and roots), by using the following equation:

$$\Delta C_{CC_{LB}} = A \bullet (G + L)$$

Where:

- A – area of cropland with perennial woody biomass;
- G – annual biomass increments in perennial woody crops, t C/ha/yr;
- L – annual volume of harvested biomass, t C/ha/yr.

Under the 5B.1 'Cropland Remaining Cropland' category there were used estimation methods available in the Revised 1996 Guidelines (IPCC, 1996), GBP LULUCF (IPCC, 2003) and 2006 IPCC Guidelines. At the same time, country specific emission/removal factors were used, pertaining to annual growth rate of perennial woody biomass and annual carbon stock in biomass etc., as well as sectoral AD (areas covered with forests strips, trees and shrubs plantations, orchards, vineyards, wood harvesting, etc.).

[91] 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.

Annual wood harvesting from orchards and vineyards occurs during the cleaning cuttings. Wood harvesting from forest strips and other types of vegetation, 95 per cent of which are managed by local public authorities, is not specified statistically, as the national records for this type of vegetation are insufficient.

The volume of commercial timber and illegal logging from forests and other types of woody vegetation were included in 5A.1 'Forest Land Remaining Forest Land' sink category. So, the total GHG balance reported under the LULUCF Sector is not affected.

Most industrial orchards follow the 4 x 3 m and 5 x 4 m planting schemes. In this case, the number of trees per 1 ha is respectively, 850 and 500. For estimating the number of trees growing in orchards, it was agreed to develop an average of the two schemes. Thus, the reference figure is 675 trees per 1 ha of orchards.

For estimating the participation level of trees growing in private rural orchards, there was used a conventional average number of 10 trees per household. For estimating removals, this vegetation was transformed, in conventional area, by considering the reference figure (675 trees per 1 ha of orchards).

In order to estimate the biomass increments in perennial woody crops on croplands, and implicitly, the resulting CO_2 removals, there were used activity data available in the General Land Cadaster of the Republic of Moldova on areas occupied by such crops over the period from 1990 through 2013 (Tables 7-17 and 7-18).

Table 7-17: Areas of Other Types of Woody Vegetation in the RM, 1990-2013, thousand ha

	1990	1991	1992	1993	1994	1995	1996	1997
Total woody vegetation not included in forest resources, including:	47.00	47.00	47.80	48.50	47.00	54.10	45.20	54.60
Protection forest strips	31.40	31.00	31.70	31.50	30.60	30.40	30.60	30.80
Other types of forest vegetation	15.60	16.00	16.10	17.00	16.40	23.70	14.60	23.80
	1998	1999	2000	2001	2002	2003	2004	2005
Total woody vegetation not included in forest resources, including:	51.50	49.40	50.90	50.50	50.00	50.50	49.10	49.30
Protection forest strips	30.60	31.00	30.70	31.10	30.70	30.60	30.50	30.80
Other types of forest vegetation	20.90	18.40	20.20	19.40	19.30	19.90	18.60	18.50
	2006	2007	2008	2009	2010	2011	2012	2013
Total woody vegetation not included in forest resources, including:	50.47	51.14	51.46	52.08	49.08	52.03	51.97	51.95
Protection forest strips	30.91	30.98	30.93	30.85	29.85	30.81	30.78	30.71
Other types of forest vegetation	19.56	20.16	20.53	21.23	19.23	21.22	21.19	21.24

Source: General Land Cadaster for 1990-2013.

According to recorded data, between 1990 and 2013 the area of other types of woody vegetation increased by 10.9 per cent.

Table 7-18: Area of Cropland with Perennial Woody Biomass in the RM, 1990-2013

	1990	1991	1992	1993	1994	1995	1996	1997
Area of vineyards, thousand ha	211.50	212.80	213.00	212.00	205.50	201.60	195.90	191.40
Area of orchards, thousand ha	262.60	260.70	257.80	254.00	242.90	229.10	216.70	207.70
Area of trees growing in private gardens, thousand ha	12.41	12.41	12.40	12.71	13.02	13.15	13.33	13.52
	1998	1999	2000	2001	2002	2003	2004	2005
Area of vineyards, thousand ha	185.80	176.90	168.70	162.20	153.60	152.80	153.00	155.50
Area of orchards, thousand ha	200.00	193.90	183.60	172.70	152.10	148.00	145.00	142.30
Area of trees growing in private gardens, thousand ha	13.46	13.44	13.43	13.41	12.26	11.94	12.63	12.31
	2006	2007	2008	2009	2010	2011	2012	2013
Area of vineyards, thousand ha	157.34	158.61	157.50	155.74	153.58	149.58	147.33	142.61
Area of orchards, thousand ha	141.68	143.21	145.26	147.29	147.41	149.21	151.33	152.72
Area of trees growing in private gardens, thousand ha	14.35	14.55	14.61	14.64	14.79	15.05	15.06	15.01

Source: General Land Cadaster of the Republic of Moldova for 1990-2013.

Between 1990 and 2013 perennial plantations constantly decreased. Thus, the area of orchards decreased by 41.8 per cent, while vineyards - by 32.6 per cents. At the same time, it should be mentioned that beginning with 2010 this negative trend stopped. For example, compared to 2009, in 2013 an increase by 5.4 thousand ha was recorded.

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 7-19).

Table 7-19: Emission/Removal Factors used under the 5B.1 'Cropland Remaining Cropland' Category

Category	Annual biomass increments, t C/yr/ha	Annual volume of harvested biomass, t C/yr/ha
Protection forest strips	1.42	-
Other types of forest vegetation	0.98	-
Vineyards	0.20	0.08
Orchards	0.50	0.20
Trees in private gardens	0.50	0.20

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 Rammels 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.

'Annual Change in Carbon Stocks in Mineral Soils'

In order to estimate emissions within the category 5B1.2 'Annual Change in Carbon Stocks in Mineral Soils' it was used the "Methodology for determining the carbon balance in agriculture soils for calculating GHG emissions" (see Annex A3-4.5)[92].

The following equation was used to calculate respective emissions:

$$CO_{2\ soils} = \pm B_C \bullet 44/12$$

Where:

$CO_{2\ soils}$ – CO_2 emissions from annual change in carbon stocks in soils due to land use change and soil management practices (Gg/yr);

$\pm B_C$ – carbon balance in arable soils (kt C/yr) (see Table 7-20; other relevant information is available in Annex A3-4.5, as well as in Chapter 6 "Agriculture Sector", see sub-chapters 6.4.1.1 'Applied Synthetic Nitrogen Fertilizer', 6.4.1.2 'Applied Organic Nitrogen Fertilizers', 6.4.1.4 'Crop Residues Returned to Soil', 6.4.1.5 'Nitrogen Mineralization Associated with Loss of Soil Carbon', including AD used for calculation exercise);

[44/12] – stoichiometric ratio of carbon fraction in CO_2 and C.

In the last two decades, in the Republic of Moldova, agriculture sector is based mainly on the exploitation of soils natural fertility (and/or existing content of humus in soil). As a result, any increase in harvest (such as, for example, in 1997, 2004, 2008 or 2013), caused particularly by favorable climatic conditions, if not followed by compensations for the losses of soil organic matter, used in crop formation, will lead to increased GHG emissions. Thus, the intensification of dehumification process (mineralization of soil organic matter) within the current subsistence agriculture leads to decreased carbon stocks in humus, respectively to increased CO_2 emissions in the atmosphere and reduced quality and fertility of agricultural soils.

The catastrophic decrease, between 1990 and 2013 of carbon return to soil through manure (by 99.6 per cent), respectively through above and belowground crop residues (by 34.2 per cent), led to the transition from a positive carbon balance (+0.24 t/ha in 1990, before the land reform was implemented in the RM) to a profoundly negative balance (-0.62 t/ha in 2013) (Table 7-20).

Table 7-20: Carbon Balance in Agriculture Soils of the Republic of Moldova,1990-2013

	1990	1991	1992	1993	1994	1995	1996	1997
Carbon returned to soil through organic fertilizer, kt	464.04	401.86	271.94	214.88	85.54	97.04	49.19	19.41
Carbon returned to soil through above and belowground crop residues, kt	364.58	409.49	281.48	363.24	162.23	182.35	152.87	222.44
Loss of soil carbon through the mineralization of humus, kt	-422.03	-418.44	-354.67	-1063.85	-649.13	-965.88	-851.51	-1336.33
Carbon balance in agriculture soils, kt	406.59	392.91	198.75	-485.72	-401.36	-686.49	-649.45	-1094.48
Carbon balance in agriculture soils, t/ha	0.24	0.23	0.12	-0.26	-0.22	-0.40	-0.38	-0.64
	1998	1999	2000	2001	2002	2003	2004	2005
Carbon returned to soil through organic fertilizer, kt	13.18	7.08	4.83	5.70	3.14	2.74	2.45	2.56
Carbon returned to soil through above and belowground crop residues, kt	195.13	196.47	157.98	175.25	165.96	128.52	165.33	165.69
Loss of soil carbon through the mineralization of humus, kt	-1102.90	-1028.59	-933.92	-1147.85	-1143.67	-862.45	-1288.83	-1227.34
Carbon balance in agriculture soils, kt	-894.59	-825.03	-771.11	-966.90	-974.56	-731.19	-1121.05	-1059.08
Carbon balance in agriculture soils, t/ha	-0.52	-0.50	-0.46	-0.57	-0.56	-0.46	-0.67	-0.65
	2006	2007	2008	2009	2010	2011	2012	2013
Carbon returned to soil through organic fertilizer, kt	0.61	0.46	0.46	0.40	1.03	1.83	1.33	2.47
Carbon returned to soil through above and belowground crop residues, kt	157.35	69.42	184.17	134.92	173.64	173.61	96.57	187.29
Loss of soil carbon through the mineralization of humus, kt	-1099.03	-373.58	-1313.12	-934.75	-1117.81	-1156.67	-501.95	-1206.75
Carbon balance in agriculture soils, kt	-941.08	-303.70	-1128.49	-799.43	-943.14	-981.23	-404.05	-1016.99
Carbon balance in agriculture soils, t/ha	-0.61	-0.20	-0.73	-0.51	-0.59	-0.62	-0.25	-0.62

To be noted that, if from 1990 through 2001, carbon balance in arable soils in the Republic of Moldova represented, on an average -0.28 t/ha per year, between 2002-2013, it was already circa -0.54 t/ha per year.

[92] Banaru, Anatol (2000), Methodology to Calculate CO2 Emissions from Agricultural Soils, In the collection of papers „Climate Change: Research, Studies, Solutions, Ministry of Environment / UNDP Moldova. „Bons Offices" S.R.L. Chisinau, 2000. P. 115-123.

'Non-CO_2 Emissions from Post-Harvest Field Burning of Crop Residues'

Non-CO_2 emissions from post-harvest field burning of crop residues (stubble fields burning) within the 5.B 'Cropland' were estimated by using a Tier 1 methodology (2006 IPCC Guidelines).

$$L_{fire} = A \bullet M_B \bullet C_f \bullet G_{ef} \bullet 10^{-3}$$

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 (IPCC, 2006, vol. 4, Ch. 2, Tab. 2.6, p. 2.49);

$M_B \bullet C_f$ – 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 (IPCC, 2006, vol. 4, Ch. 2, Tab. 2.4, p. 2.46);

G_{ef} – default EF (kg/t.d.m.) (Table 7-21).

Table 7-21: EFs for Field Burning of Crop Residues, g/kg d.m.

	CO	CH_4	N_2O	NO_x
Field Burning of Agricultural Residues	92	2.7	0.07	2.5

Source: IPCC, 2006, vol. 4, Ch. 2, Tab. 2.5, p. 2.47.

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 provided in Table 6-64, see Chapter 6 "Agriculture Sector" of the NIR).

The information on post-harvest field burning of crop residues (stubble fields burning) cases in the Republic of Moldova is reported annually by the State Ecological Inspectorate's territorial inspectors and it is provided in the Table 7-22.

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 7-22: Stubble Fields Burning in the Republic of Moldova, 1990-2013

	1990	1991	1992	1993	1994	1995	1996	1997
Burnt stubble fields, thousand ha	12.213	13.110	12.141	14.547	13.422	15.800	18.600	20.700
Burnt stubble fields, % from total	3.00	3.00	3.00	3.00	3.00	2.99	3.80	3.83
	1998	1999	2000	2001	2002	2003	2004	2005
Burnt stubble fields, thousand ha	21.500	24.000	11.500	9.500	1.960	0.100	0.400	2.200
Burnt stubble fields, % from total	3.98	4.61	2.10	1.59	0.31	0.03	0.08	0.39
	2006	2007	2008	2009	2010	2011	2012	2013
Burnt stubble fields, thousand ha	0.890	2.650	4.465	0.892	0.627	0.475	0.106	0.575
Burnt stubble fields, % from total	0.20	0.56	0.78	0.15	0.12	0.10	0.02	0.11

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).

The activity data on the amount of crop residues available to be combusted on field (Table 7-23) 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 7-23: Amount of Crop Residues Available for Combustion on Field in the Republic of Moldova within 1990-2013, t.d.m./ha

	1990	1991	1992	1993	1994	1995	1996	1997
Winter wheat	3.5047	3.1033	2.9248	3.5832	1.9518	2.5438	1.5741	2.5002
Barley	3.0891	2.8360	2.9305	3.0798	1.9671	2.0508	1.1193	1.7656
Average	3.2969	2.9696	2.9277	3.3315	1.9594	2.2973	1.3467	2.1329

	1998	1999	2000	2001	2002	2003	2004	2005
Winter wheat	2.0877	1.8109	1.5225	2.1659	1.9703	0.4274	2.2386	2.1500
Barley	1.6085	1.4064	1.0846	1.9296	1.6088	0.6894	1.7958	1.5110
Average	1.8481	1.6086	1.3036	2.0478	1.7895	0.5584	2.0172	1.8305
	2006	2007	2008	2009	2010	2011	2012	2013
Winter wheat	1.9211	1.0847	2.6653	1.6617	1.7796	2.0397	1.2033	2.1111
Barley	1.5503	0.8103	2.3134	1.3993	1.3223	1.5569	1.0984	1.7315
Average	1.7357	0.9475	2.4893	1.5305	1.5510	1.7983	1.1508	1.9213

7.3.3 Uncertainties Assessment and Time-Series Consistency

'Cropland Covered with Woody Vegetation'

Uncertainties related to CO_2 emissions/removals from the 5.B.1 'Cropland Covered with Woody Vegetation' may be considered relatively acceptable, however exceeding values reported for other categories under the LULUCF Sector. Thus, for production processes the uncertainties account for circa ±25 per cent, and uncertainties related to emission/removal factors are of 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 statistics on the volume of wood mass harvested during forest clearings. Some consolidated information in this field is available at the State Ecological Inspectorate, which is as an institution that authorizes fellings of any type of forest vegetation (based on Article 40 of the Law on Environment Protection and Article 22 of the Forest Code, on state control and state control data). For instance, over the period from 2000 through 2013, the IES authorized harvesting of 88.9 thousand m^3 of wood mass from the forestry resources and other types of forest vegetation managed by local public authorities. This volume was not separated by categories of woody vegetation. A considerable part of illicit logging is not even reported. As a consequence, it generates massive illegal logging on forest land managed by local public authorities. According to a recent study, circa 12 per cent (3.6 thousand ha) of areas of protection forest strips need partial reconstruction because of low consistency (of 0.3-0.5).

In this context, combined uncertainties for this source category were estimated at circa ±26.9 per cent, while the combined uncertainties as a percentage of total annual direct sectoral emissions/removals were estimated at ±133.4 per cent. The uncertainties introduced in trend in sectoral emissions/removals were estimated at ±3.0 per cent (Annex 5-3.5).

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.

'Annual Change in Carbon Stocks in Mineral Soils'

Uncertainties related to activity data used to estimate CO_2 emissions/removals from 5.B.1.2 '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' can be regarded as being moderate (±14.1 per cent), while the combined uncertainties as a percentage of total annual sectoral emissions/removals were estimated at ±540.2 per cent. The uncertainties introduced in trend in total sectoral emissions/removals were estimated at ±11.0 per cent (Annex 5-3.5).

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.

'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 (±31.6 per cent for CH_4 and ±51.0 per cent for N_2O), while the combined uncertainties as a percentage of total direct sectoral emissions/removals are quite insignificant (Annex 5-3.5).

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.

7.3.4 Quality Assurance and Quality Control

'Cropland Covered with Woody Vegetation'

The quality of assessment for 5.B.1.1 'Cropland covered with woody vegetation' category is provided by the fact that most of the AD used is taken from official records[93]. Standard verification and quality control forms and checklists were filled in for this category, following a Tier 1 approach (IPCC, 2000). Verification was focused on various aspects such as: ensuring correct use of estimation methodologies following the Revised 1996 IPCC Guidelines (IPCC, 1997) and GPG LULUCF (2003), correct use of national factors, their accuracy, as well as comparing them to the values used by other countries in the region.

'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 (IPCC, 2000). 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 GPG (IPCC, 2000), 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 Cadasters of the Republic of Moldova, etc.).

'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.

7.3.5 Recalculations

Cropland Covered with Woody Vegetation

No recalculations were performed for CO_2 removals within the 5B1.1 'Cropland Covered with Woody Vegetation' category in the Republic of Moldova, for the period 1990-2010. Within the 1990-2013 time series, CO_2 removals from the respective category decreased by 33.3 per cent (Table 7-24).

Table 7-24: CO_2 Removals from 'Cropland Covered with Woody Vegetation' in the Republic of Moldova, 1990-2013

	1990	1991	1992	1993	1994	1995	1996	1997
CO_2 removals, Gg	-725.2315	-613.0622	-613.9635	-611.8682	-590.3010	-598.6205	-551.0146	-573.4484
	1998	1999	2000	2001	2002	2003	2004	2005
CO_2 removals, Gg	-550.9832	-533.4373	-523.3924	-507.7310	-477.5706	-473.9941	-466.3503	-465.3288
	2006	2007	2008	2009	2010	2011	2012	2013
CO_2 removals, Gg	-472.0698	-477.0847	-479.9904	-483.5731	-470.5183	-483.1691	-484.2581	-483.4705

The graphical illustration of CO_2 removals evolution within the source category 5B1.1 'Cropland Covered with Woody Vegetation' is provided in Figure 7-7.

[93] 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.

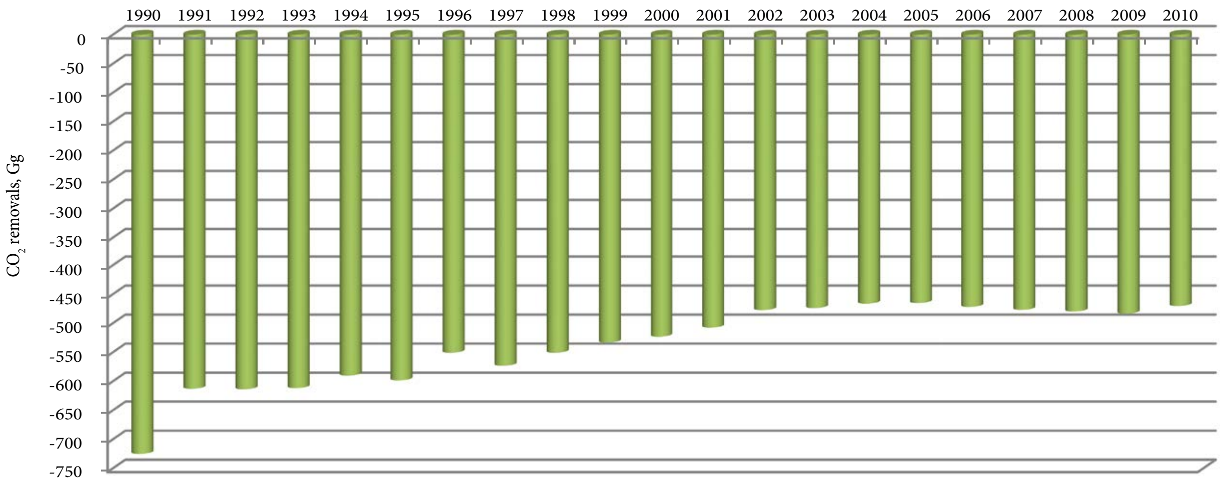

Figure 7-7: CO_2 Removals from 'Cropland Covered with Woody Vegetation' in the Republic of Moldova within 1990-2013 periods

'Annual Change in Carbon Stocks in Mineral Soils'

GHG emission recalculations under the 5B1.2 'Annual Change in Carbon Stocks in Mineral Soils' category were performed for the 1990-2010 time periods due to the use of an updated set of activity data regarding cropland areas, total crop yield, average crop yield/per hectare (available in the on-line database of the NBS[94], as well as in FAO database[95]), respectively due to use of revised country specific factors. For example, the dry matter fraction of crop yield was revised for the following categories: maize for silo and green fodder, perennial grasses for green fodder, silage and fodder, respectively for annual grasses for green fodder since the values used in the previous inventory cycle referred to the harvested crop yield expressed in dry matter, while the statistical data refer to gross harvested crop yield; also, for the same categories of crop, the latest data available within the literature in the field were taken into consideration regarding the ratio of above-ground residues to harvested crop yield, as well as the fraction of above-ground residues of crop removed and used for other purposes. At the same time, for a number of crops (wheat, oats, barley, sugar beet, potatoes, perennial grasses for green fodder, silage and fodder and annual grasses for green fodder) the values related to the amount of nitrogen in crop residues were revised considering the scientific literature in the field.

Compared to the results included into the TNC, the performed recalculation resulted in an increase of CO_2 emissions for the 1993-2010 time periods, varying from a minimum of 0.3 per cent in 2010, up to a maximum of 921.9 per cent in 1993, respectively in a decrease of CO_2 removals for the 1990-1992 time periods, varying from a minimum of 23.6 per cent in 1991, up to a maximum of 66.1 per cent in 1992 (Table 7-25). For 2011-2013 time series, CO_2 emissions within this category were estimated for the first time. The results allow assert that between 1990 and 2013, CO_2 emissions from the source category 5B1.2 'Annual Change in Carbon Stocks in Mineral Soils' increased by circa 350 per cent.

Table 7-25: Recalculated CO_2 Emissions/Removals from 5B1.2 'Annual Change in Carbon Stocks in Mineral Soils' included into the TNC and the BUR of the Republic of Moldova under the UNFCCC, Gg

	1990	1991	1992	1993	1994	1995	1996	1997
TNC	-3470.9538	-1885.3809	-2147.3512	174.2778	558.4259	1678.1188	1825.6843	3607.4508
BUR	-1490.8146	-1440.6633	-728.7402	1780.9854	1471.6489	2517.1205	2381.3224	4013.0993
Difference, %	-57.0	-23.6	-66.1	921.9	163.5	50.0	30.4	11.2
	1998	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**
TNC	3092.0822	2880.3349	2706.0275	3266.4584	3321.1274	2431.3604	3786.8140	3426.4452
BUR	3280.1637	3025.1199	2827.3964	3545.3117	3573.3887	2681.0372	4110.5280	3883.3090
Difference, %	6.1	5.0	4.5	8.5	7.6	10.3	8.5	13.3
	2006	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**
TNC	2963.4636	855.5174	3622.2260	2645.0396	3447.5439			
BUR	3450.6090	1113.5737	4137.7822	2931.2323	3458.1723	3597.8304	1481.5276	3728.9563
Difference, %	16.4	30.2	14.2	10.8	0.3			

Abbreviations: TNC – Third National Communication; BUR – Biennial Update Report.

The graphical illustration of CO_2 emissions/removals evolution within the source category 5B1.2 'Annual Change in Carbon Stocks in Mineral Soils' is provided in Figure 7-8. As it can be noted,

[94] NBS, on-line database, category „Cropland, crop yield and average production per crop, 1980-2013": <http://statbank.statistica.md/pxweb/Database/RO/16%20AGR/AGR02/AGR02.asp>.
[95] <http://faostat.fao.org/site/567/DesktopDefault.aspx?PageID=567#ancor>.

by 2013 an amount of CO_2 emissions larger by 2.5 times to 1990 year level removals was emitted in the atmosphere. 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.

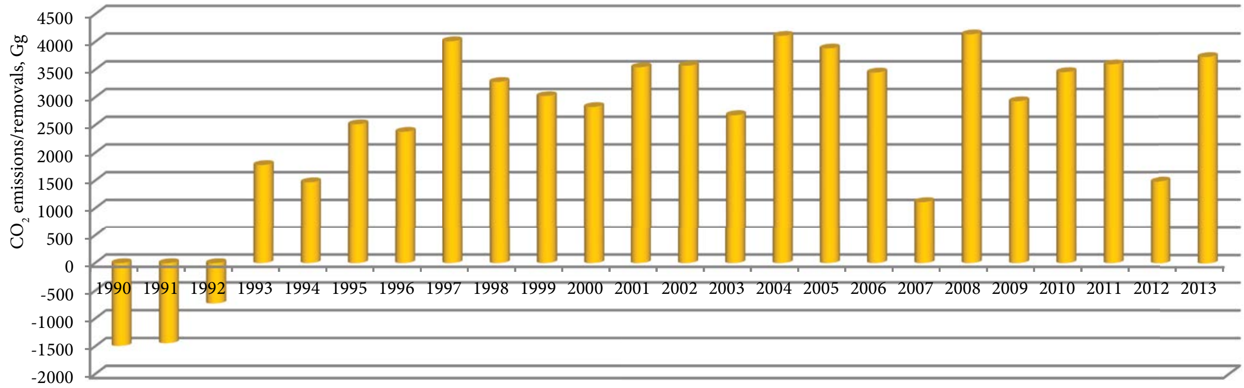

Figure 7-8: CO_2 Removals/Emissions from 'Annual Change in Carbon Stocks in Mineral Soils' category in the Republic of Moldova within 1990-2013 periods

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.

'Non-CO_2 Emissions from Post-Harvest Field Burning of Crop Residues'

No recalculations were performed for non-CO_2 emissions within this source category, for 1990-2010 time series. In comparison with the reference year level, by 2013, the non-CO_2 emissions from stubble fields burning decreased in the RM by circa 97.3 percent (Table 7-26). At the same time, from year to year, the volume fluctuates significantly due to adverse weather conditions and anthropogenic factors.

Table 7-26: Non-CO_2 Emissions from Stubble Fields Burning in the Republic of Moldova within 1990-2013, Gg

	1990	1991	1992	1993	1994	1995	1996	1997
CH_4	0.0978	0.0946	0.0864	0.1178	0.0639	0.0882	0.0609	0.1073
N_2O	0.0025	0.0025	0.0022	0.0031	0.0017	0.0023	0.0016	0.0028
CO	3.3340	3.2236	2.9431	4.0127	2.1776	3.0054	2.0740	3.6556
NO_x	0.0906	0.0876	0.0800	0.1090	0.0592	0.0817	0.0564	0.0993
	1998	1999	2000	2001	2002	2003	2004	2005
CH_4	0.0966	0.0938	0.0364	0.0473	0.0085	0.0001	0.0020	0.0098
N_2O	0.0025	0.0024	0.0009	0.0012	0.0002	0.0000	0.0001	0.0003
CO	3.2900	3.1967	1.2413	1.6108	0.2904	0.0046	0.0668	0.3334
NO_x	0.0894	0.0869	0.0337	0.0438	0.0079	0.0001	0.0018	0.0091
	2006	2007	2008	2009	2010	2011	2012	2013
CH_4	0.0038	0.0061	0.0270	0.0033	0.0024	0.0021	0.0003	0.0027
N_2O	0.0001	0.0002	0.0007	0.0001	0.0001	0.0001	0.0000	0.0001
CO	0.1279	0.2079	0.9203	0.1130	0.0805	0.0707	0.0101	0.0915
NO_x	0.0035	0.0056	0.0250	0.0031	0.0022	0.0019	0.0003	0.0025

7.3.6 Planned Improvements

'Cropland Covered with Woody Vegetation'

The possibility to improve records pertaining to actual consumption of fuel wood from forest strips and other types of woody vegetation, as well as pursue activities aimed at verification of the country specific emission/removal factors (annual biomass increments, biomass harvesting during the cleaning cuttings of perennial plantations, etc.), will be considered for the next inventory cycle.

'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'.

'Non-CO_2 Emissions from Post-Harvest Field Burning of Crop Residues'

It is planned to carry out activities aimed at updating activity data used to estimate non-CO_2 emissions from stubble fields burning in the next inventory cycle.

7.4 Grassland (Category 5C)

7.4.1 Source Category Description

5C 'Grassland' comprises GHG emissions/removals originated from two categories, 5C1 'Grassland Remaining Grassland' and 5C2 'Land Converted to Cropland'. 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 25 per cent of the total CO_2 removals, being an important sink category in the Republic of Moldova.

Current inventory comprised estimation of CO_2 removals from the 5C1 'Grasslands Remaining Grasslands' category, resulting from the growth of aboveground biomass included in "pastures" and "hayfields" categories, as well as CO_2 removals from the 5C2 'Lands Converted to Grassland' category resulting from growth of grassland vegetation after conversion of cropland to grassland, and from former forest land converted to grassland.

According to the General Land Cadaster (standing as of 01.01.2013, the grassland area (pastures and hayfields) was 350.9 thousand ha. At current productivity level, 1 ha of grassland can provide feed for an average of 0.3 cows or 2 sheep. In optimal conditions, 1 ha of grassland could support 1.5-2.0 cows or 10-14 sheep.

Conversion of cropland to grassland is a regular process over the past 20 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 1990 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 2013 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).

7.4.2 Methodological Issues, Emission Factors and Data Sources

5C1 'Grassland Remaining Grassland'

In order to estimate CO_2 removals from the 5C1 'Grassland Remaining Grassland' category, it was necessary to determine average annual biomass growth of grasses (from grassland, wetlands and landslides) according to national available data.

The calculation was done based on annual change in carbon stocks in living biomass, by using the following equations:

$$\Delta C\ GG_{LB} = (\Delta B_{perennial} + \Delta B_{grasses}) \bullet CF$$

Where:

$\Delta B_{perennial}$ – change in above and belowground perennial woody biomass (in case of the RM, the respective areas were included under category 5B1 'Cropland Remaining Cropland'), t.d.m./ha/yr;

CF – carbon fraction of dry matter (0.5);

$\Delta B_{grasses}$ – change in belowground biomass of grasses, t.d.m./ha/yr, calculated using the following equation:

$$\Delta B_{grasses} = A_{grasses} \bullet (G_{grasses} - L_{grasses})$$

Where:

$A_{grasses}$ – area of grasslands covered with grasses, thousand ha;

$G_{grasses}$ – average annual biomass growth of grasses, t.d.m./ha/yr;

$L_{grasses}$ – average annual biomass loss of grasses, t.d.m./ha/yr.

Under the 5C 'Grassland' category there were used estimation methods available in the Revised 1996 Guidelines (IPCC, 1996), GBP LULUCF (IPCC, 2003) which apply for the Republic of Moldova's specific conditions. At the same time, country specific emission/removal factors were used, pertaining to annual growth rate of perennial woody biomass and annual carbon stock in biomass, as well as sectoral AD.

The main source of reference for the activity data on area of grassland covered with grasses (including for wetlands and landslides) and, implicitly, on CO_2 resulting, is the General Land Cadaster of the Republic of Moldova for the period under review – 1990-2013 (Table 7-28).

Table 7-28: Grassland Area in the Republic of Moldova within 1990-2013 periods

	1990	1991	1992	1993	1994	1995	1996	1997
1. Grassland, total thousand ha	**354.6**	**356.0**	**357.2**	**358.0**	**364.6**	**367.3**	**369.7**	**372.0**
1.1. Meadows, thousand ha of which:	54.3	54.5	54.7	54.8	55.8	56.2	56.6	56.9
High productivity	10.1	10.2	10.2	10.3	10.4	10.5	10.6	10.6
Medium productivity	39.1	39.2	39.3	39.4	40.2	40.4	40.7	41.0
Low productivity	5.1	5.1	5.2	5.1	5.2	5.3	5.3	5.3
1.2. Grasslands on slopes, thousand ha of which:	300.3	301.5	302.5	303.2	308.8	311.1	313.1	315.1
High productivity	87.1	87.5	87.8	88.0	89.6	90.3	90.9	91.4
Medium productivity	193.0	193.8	194.4	194.8	198.4	199.9	201.2	202.5
Low productivity	20.2	20.2	20.3	20.4	20.8	20.9	21.0	21.2
2. Wetlands, thousand ha	**15.7**	**16.1**	**16.1**	**16.4**	**16.3**	**17.3**	**17.2**	**17.4**
3. Other Lands (landslides), thousand ha	**29.2**	**28.5**	**28.5**	**27.3**	**25.5**	**26.3**	**27.1**	**26.6**
	1998	1999	2000	2001	2002	2003	2004	2005
1. Grassland, total thousand ha	**374.1**	**376.0**	**376.4**	**381.6**	**355.1**	**382.1**	**376.9**	**373.5**
1.1. Meadows, thousand ha of which:	57.2	57.5	57.6	58.4	54.3	58.5	57.7	57.1
High productivity	10.7	10.7	10.8	10.9	10.1	10.9	10.8	10.7
Medium productivity	41.2	41.4	41.4	42.0	39.1	42.1	41.5	41.1
Low productivity	5.3	5.4	5.4	5.5	5.1	5.5	5.4	5.3
1.2. Grasslands on slopes, thousand ha of which:	316.9	318.5	318.8	323.2	300.8	323.5	319.2	316.4
High productivity	92.0	92.4	92.5	93.8	87.3	93.9	92.6	91.8
Medium productivity	203.6	204.7	204.9	207.7	193.3	207.9	205.1	203.3
Low productivity	21.3	21.4	21.4	21.7	20.2	21.7	21.5	21.3
2. Wetlands, thousand ha	**17.6**	**18.0**	**19.9**	**20.9**	**21.2**	**21.5**	**20.0**	**20.2**
3. Other Lands (landslides), thousand ha	**26.8**	**24.1**	**24.6**	**27.5**	**29.5**	**29.8**	**26.7**	**24.6**
	2006	2007	2008	2009	2010	2011	2012	2013
1. Grassland, total thousand ha	**370.2**	**364.2**	**360.1**	**357.1**	**354.3**	**352.5**	**352.3**	**350.9**
1.1. Meadows, thousand ha of which:	56.6	55.7	55.1	54.6	54.2	53.9	53.9	53.7
High productivity	10.6	10.4	10.3	10.2	10.1	10.1	10.1	10.1
Medium productivity	40.7	40.1	39.6	39.3	39.0	38.8	38.8	38.6
Low productivity	5.3	5.2	5.2	5.1	5.1	5.0	5.0	5.0
1.2. Grasslands on slopes, thousand ha of which:	313.6	308.5	305.0	302.5	300.1	298.6	298.4	297.2
High productivity	91.0	89.5	88.5	87.8	87.1	86.6	86.6	86.2
Medium productivity	201.5	198.2	196.0	194.4	192.8	191.9	191.8	191.0
Low productivity	21.1	20.8	20.5	20.3	20.2	20.1	20.0	20.0
2. Wetlands, thousand ha	**20.1**	**20.0**	**19.6**	**19.6**	**19.6**	**19.4**	**19.5**	**19.4**
3. Other Lands (landslides), thousand ha	**25.1**	**25.5**	**25.4**	**24.6**	**24.2**	**24.3**	**24.5**	**24.8**

Source: General Land Cadasters for 1990-2013.

Country specific emission factors were used in order to estimate annual biomass growth and loss rates on grasslands. Thus, the annual biomass growth rate was estimated taking into account the distribution of grasslands by categories (meadows, grasslands on slopes with high, medium or low productivity) and data from scientific literature in the Republic of Moldova (Table 7-29).

Table 7-29: Annual Biomass Growth Rates Used to Estimate Emissions/Removals within the 5C1 '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
Wetlands	medium	2.2
Other Lands (landslides)	low	1.2

Source: Forest Research and Management Institute Reports (2014) on Grassland Inventory within the Orhei National Park.

According to the respective sources of reference, the productivity rate for grasslands on slopes may vary between 1.2-3.2 t.d.m./ha/yr, while for meadows is 1.2-3.3 t.d.m./ha/yr. The distribution by productivity is as follows: grassland on slopes with high productivity (2.8 t.d.m./ha/yr) – 29 per cent, grassland on slopes with medium productivity (1.8 t.d.m./ha/yr) – 64 per cent, grassland on slopes with low productivity (1.2 t.d.m./ha/yr) – 7 per cent; meadows with high productivity (3.2 t.d.m./ha/yr) – 18.7 per cent, meadows with medium productivity (2 t.d.m./ha/yr) – 72.0 per cent, meadows with low productivity (1.2 t.d.m./ha/yr) – 9.3 per cent. The distribution of grasslands according to different forms of relief is as follows: meadows – 15.3 per cent, slopes – 84.7 per cent. The annual biomass growth within wetlands was estimated similar to medium productivity meadows – 2.2 t.d.m./ha/yr, while for landslides – similar to low productivity grassland on slopes (1.2 t.d.m./ha/yr). The carbon fraction of dry matter used was considered 0.5.

5C2 'Lands Converted to Grassland'

In order to estimate CO_2 removals from land converted to grassland, according to national available data, it was necessary to determine annual biomass increments in herbaceous vegetation on newly formed grasslands, as well as differences in initial biomass for land covered previously by forest.

The main source of reference for the activity data on lands converted to grassland is the General Land Cadaster of the RM, as well as the Reports of the "Moldsilva" Agency and the Reports of the State Ecological Inspectorate for the period under review. The respective areas were calculated as a difference between area of grassland in the period of years under review and similar values in the precedent years.

The calculation was done based on annual change in carbon stocks in living biomass, by using the following equations:

$$\Delta C_{CC_{LB}} = A \bullet (L_{Conversion} + \Delta C_{Growth})$$

Where:

A – area of lands converted to grasslands from some initial use, ha/yr;

$L_{Conversion}$ – carbon stock change per area for that type of conversion, when land is converted to grassland (t C/ha/yr), calculated using the following equation:

$$L_{Conversion} = C_{After} - C_{Before}$$

Where:

C_{After} – C stocks in biomass immediately after conversion to grassland, t C/ha;

C_{Before} – C stocks in biomass immediately before conversion to grassland, t C/ha;

ΔC_{Growth} – carbon stocks from one year of growth of grassland vegetation after conversion (t C/ha/yr).

In order to estimate CO_2 emissions/removals within this category, data on area of land converted to grassland and area of forest and other types of forest vegetation cleared through illegal logging were provided by the General Land Cadaster of the RM, as well as through Reports of the Agency "Moldsilva" and through Reports of the State Ecological Inspectorate (Table 7-30).

Table 7-30: Area of Lands Converted to Grassland in the Republic of Moldova, 1990-2013

	1990	1991	1992	1993	1994	1995	1996	1997
Area of cropland converted annually to grassland, thousand ha	5.800	1.400	1.200	0.800	6.600	2.700	2.400	2.300
Area of forest land converted annually to grassland, thousand ha	-	1.690	2.720	4.020	2.750	2.560	3.180	1.230
	1998	1999	2000	2001	2002	2003	2004	2005
Area of cropland converted annually to grassland, thousand ha	2.100	1.900	0.400	5.200	-26.500	27.000	-5.100	-3.500
Area of forest land converted annually to grassland, thousand ha	1.630	0.440	0.040	0.020	0.010	0.030	0.030	0.030
	2006	2007	2008	2009	2010	2011	2012	2013
Area of cropland converted annually to grassland, thousand ha	-3.300	-6.000	-4.100	-3.000	-2.800	-1.750	-0.210	-1.410
Area of forest land converted annually to grassland, thousand ha	0.103	0.032	0.039	0.051	0.292	0.069	0.060	0.056

Source: General Land Cadasters of the Republic of Moldova for 1990-2013, 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 1990-2013.

Country specific emission factors were used to estimate annual changes in carbon stocks in living biomass on land converted to grassland from some initial use. Thus, for forest land converted to grassland, the amount of biomass before conversion to grassland (70 m^3/ha or 51 t.d.m./ha) was provided in conformity with the results of controls performed by the state forest authorities to reveal illegal logging. The default value of 5 t.d.m./ha used for biomass remaining after conversion of forest land to grassland (roots, grasses, etc.) was taken from GBP LULUCF (IPCC, 2003). The annual rate of biomass accumulation on cropland converted to grassland was the same as the one used for grassland on degraded land, which is 0.6 t.d.m./ha/yr (see Table 7-31).

Table 7-31: EFs Used to Estimate Emissions/Removals from the 5C2 'Lands Converted to Grassland' Category

Categories	Carbon fraction in biomass	Carbon stocks in biomass after conversion to grassland, t C/ha/yr	Carbon stocks in biomass before conversion to grassland, t C/ha/yr	Carbon stocks from one year of growth of vegetation after conversion, t C/ha/yr
Cropland Converted to Grassland	0.5	-	-	0.3
Forest Land Converted to Grassland	0.5	5.0	26.0	0.6

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'; Postolache, Gh., Vegetation of the Republic of Moldova, 1995; Sabanova G. A., Bulat A., Tofan E., Report on Floral and Phytocenotical of the Herbaceous Stratum by Sectors under the "Soil Conservation Project in Moldova", 2005.

7.4.3 Uncertainties Assessment and Time-Series Consistency

5C1 'Grassland Remaining Grassland'

Uncertainties associated with the CO_2 emissions/removals from 5C1 '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. Thus, combined uncertainties related to CO_2 emissions/removals from the 5C1 'Grassland Remaining Grassland' can be regarded as being medium (±18 per cent), while the combined uncertainties as a percentage of total annual sectoral emissions/removals were estimated at ±269.9 per cent. The uncertainties introduced in trend in sectoral emissions/removals were estimated at ±5.8 per cent.

5C2 'Land Converted to Grassland'

Uncertainties associated with the CO_2 emissions/removals resulted from 5C2 'Land Converted to Grassland' are higher, however, within acceptable limits. To be noted that conversion of forest land to grassland started after 1990. At that moment, the uncertainty level was circa ±15 per cent for production processes, due the fact that the state forestry authorities were responsible for regular (twice a year, in spring and autumn) total control of forest land and other woody vegetation land managed by local the public authorities and agricultural enterprises. By the end of the reference period (2013), the uncertainties increased up to ±30 per cent, what is explained by lack of veridical records on evolution of land use of forest land damaged by illegal logging, as well as by grazing and cropping, etc. In both cases emission/removal factors have an uncertainty level of ±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 7^0, 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, etc.). Land cadasters 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. The reference year for this category is considered to be 1993.

Taking into account all these information, the deviation from actual indicators can generate high uncertainties, exceeding ±70 per cent for production processes and ±5 per cent for emission/removal factors. Thus, combined uncertainties related to CO_2 emissions/removals from the 5C2 'Land Converted to Grassland' can be regarded as medium (±31.6 per cent), while the combined uncertainties as a percentage of total annual sectoral emissions/removals were estimated as relatively low ±1.35 per cent. The uncertainties introduced in trend in total sectoral emissions/removals were estimated at ±0.03 per cent.

7.4.4 Quality Assurance and Quality Control

The quality of assessment for 5C 'Grassland' category is provided by the fact that most of the AD used is taken from official records. Thus, the total area of grassland is provided by the General Land Cadasters of the Republic of Moldova for each year. Data regarding area of forest land converted to grassland are provided by the Reports of the "Moldsilva" Agency (Statistical Report 5 "Statistic Report on volumes of illegal logging", as well as by the Reports of the State Ecological Inspectorate. 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 on various aspects such as: ensuring correct use of estimation methodologies following the Revised 1996 IPCC Guidelines (IPCC, 1997) and GPG LULUCF (2003), correct use of national factors, their accuracy, as well as comparing them to the values used by other Eastern and Central European countries.

Standard verification and quality control forms and checklists were filled in for this category, following a Tier 1 approach (IPCC, 2000). To be noted that according to the recommendations included into the GPG (IPCC, 2003), CO_2 emissions within this sector resulting from carbon loss in mineral soils due to changes in land-use and management practices in the Republic of Moldova were estimated based on AD from official sources of reference (General Land Cadasters of the Republic of Moldova and Statistical Yearbooks of the Republic of Moldova).

7.4.5 Recalculations

5C1 'Grassland Remaining Grassland'

In the current inventory cycle, there were performed recalculations of CO_2 removals from 5C1 'Grassland Remaining Grassland' for 1990-2010 time series. It has been used the same estimation approach, available in the Revised 1996 IPCC Guidelines (IPCC, 1997) and GPG LULUCF (IPCC, 2003), as well as the same AD set (total grassland area). However, unlike the previous inventory cycle, within the current inventory cycle the grassland area was disaggregated in meadows and grassland on slopes, additionally being considered grassland areas within wetlands, as well as those subject to landslides. Simultaneously, the annual growth of biomass on grasslands was estimated considering their distribution within subcategories – grassland with high, medium or low productivity.

In comparison with the results included into the TNC of the Republic of Moldova under the UNFCCC, the performed recalculations resulted in an increase of CO_2 removals, varying within the 1990-2010 time series from a minimum of 87.3 per cent in 1994 up to a maximum of 91.3 per cent in 2002 (Table 7-32).

Table 7-32: CO_2 Removals from 5C1 'Grassland Remaining Grassland' included into the TNC and the BUR of the RM under the UNFCCC, Gg

	1990	1991	1992	1993	1994	1995	1996	1997
TNC	-780.1200	-783.2000	-785.8400	-787.6000	-802.1200	-808.0600	-813.3400	-818.4000
BUR	-1469.8567	-1475.5767	-1479.9033	-1481.7733	-1502.1233	-1518.2200	-1528.8533	-1536.9567
Difference, %	88.4	88.4	88.3	88.1	87.3	87.9	88.0	87.8
	1998	1999	2000	2001	2002	2003	2004	2005
TNC	-823.0200	-827.2000	-828.0800	-839.5200	-781.2200	-840.6200	-829.4000	-821.7000
BUR	-1546.4533	-1548.9833	-1559.5067	-1589.5000	-1494.7167	-1598.5200	-1566.2900	-1549.7167
Difference, %	87.9	87.3	88.3	89.3	91.3	90.2	88.8	88.6
	2006	2007	2008	2009	2010	2011	2012	2013
TNC	-814.4400	-801.2400	-792.2200	-785.6200	-779.4600			
BUR	-1537.8733	-1515.5067	-1498.2000	-1485.2200	-1473.5600	-1466.2633	-1466.5567	-1461.3867
Difference, %	88.8	89.1	89.1	89.1	89.0			

Abbreviations: TNC – Third National Communication; BUR – Biennial Update Report.

For 2011-2013 time series, CO_2 removals within the 5C1 'Grassland Remaining Grassland' were estimated for the first time. The results allow assert that between 1990 and 2013, CO_2 removals from the respective category decreased by circa 0.6 per cent. To be noted that within 1990-2001 time periods, the removals presented an increasing trend; however, by the end of the reference period, due to converting degraded grassland in forests, were recorded approximately similar values as in 1990.

5C2 'Land Converted to Grassland'

No recalculations were performed for CO_2 removals within the 5C2 'Land Converted to Grassland' for the period 1990-2010. To be noted that, although CO_2 emissions increased significantly since 1991 to 1999 (Table 7-33), in particular due to reported problems encountered by the local public authorities and by the agricultural enterprises, in relation to the management of forest land and land covered with other type of forest vegetation, which resulted in a significant deforestation, after 2000, the situation returned to normal and the respective emissions gradually decreased. To be noted that CO_2 emissions/removals recorded within the 5C2 'Land Converted to Grassland' are insignificant at the sectoral level.

Table 7-33: CO_2 Emissions/Removals under the 5C2 'Land Converted to Grassland' in the Republic of Moldova within 1990-2013 time periods

	1990	1991	1992	1993	1994	1995	1996	1997
CO_2 emissions / removals, Gg	-6.3800	125.6200	202.1360	299.8160	198.4400	188.5180	235.2240	89.4740
	1998	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**
CO_2 emissions / removals, Gg	119.6140	30.8220	2.5520	-4.2240	0.7480	-27.4560	2.2440	2.2440
	2006	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**
CO_2 emissions / removals, Gg	7.7044	2.3936	2.9172	3.8148	21.8416	5.1612	4.4880	4.1664

7.4.6 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.

8. WASTE SECTOR

8.1 Overview

Within Waste Sector there are monitored the CH_4 emissions from the anaerobic decomposition of organic waste disposed in solid waste disposal sites (SWDS), CH_4 emission from handling domestic and industrial wastewater under anaerobic conditions, as well as N_2O emissions from human sewage. Direct GHG emissions resulted from waste sector have been estimated based on the Revised 1996 Guidelines (IPCC, 1997) and Good Practice Guidance and Uncertainty Management in National GHG Inventories (IPCC, 2000). The source categories covered by this sector are: 6A 'Solid Waste Disposal on Land' and 6B 'Wastewater Handling'. 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.

8.1.1 Summary of Emission Trends

In 2013, Waste Sector accounted for circa 12.2 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 and N_2O emissions, accounting for circa 54.9 per cent and respectively 5.1 per cent of total methane and nitrous oxide emissions reported at the national level.

Between 1990 and 2013, the total GHG emissions originated from the Waste Sector tended to lower values, decreasing from 1865.47 to 1565.80 Gg CO_2 equivalent (Table 8-1), in particular due to economic decline in the Republic of Moldova during the transition to a market economy. To be noted, however, that the economic growth recorded in the last decades (especially after 2000) resulted in a higher level of welfare, 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.

Table 8-1: Direct GHG Emissions from Waste Sector, by Gas, in the Republic of Moldova within 1990-2013 periods, Gg CO_2 equivalent

	1990	1991	1992	1993	1994	1995	1996	1997
CH_4	1759.8493	1882.3864	1973.6959	1939.1197	1878.1830	1822.8406	1740.5870	1666.5329
N_2O	105.6201	95.7965	88.4394	82.9720	80.5518	81.5515	80.3216	81.7779
Total	1865.4695	1978.1829	2062.1353	2022.0918	1958.7348	1904.3921	1820.9086	1748.3108
	1998	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**
CH_4	1586.0301	1474.7172	1386.3253	1308.7575	1238.5808	1208.8674	1194.0100	1208.3709
N_2O	82.6149	80.8026	82.7123	83.9202	86.1119	83.1151	85.4576	89.4708
Total	1668.6450	1555.5198	1469.0376	1392.6778	1324.6927	1291.9826	1279.4676	1297.8417
	2006	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**
CH_4	1223.1443	1280.4952	1374.8283	1432.9661	1485.5188	1476.1564	1471.6263	1480.3798
N_2O	87.7676	83.4615	84.0757	81.5430	85.1747	83.5727	85.0586	85.4174
Total	1310.9119	1363.9567	1458.9040	1514.5091	1570.6934	1559.7290	1556.6850	1565.7972

The 6A 'Solid Waste Disposal on Land' was the largest source of direct GHG emissions in the time period from 1990 through 2013 (with a share varying between 82.8 to 89.6 per cent of the total), while the 6B 'Wastewater Handling' is the only source of N_2O emissions (Table 8-2).

Table 8-2: Breakdown of CH_4 and N_2O Emissions by Category under the Waste Sector within 1990-2013 periods

Year	6A, CH_4, Gg CO_2 eq.	6B, CH_4, Gg CO_2 eq.	6B, N_2O, Gg CO_2 eq.	6, Total Emission, Gg CO_2 eq.	6A, CH_4, % from the total	6B, CH_4, % from the total	6B, N_2O, % from the total
1990	1544.2480	215.6014	105.6201	1865.4695	82.8	11.6	5.7
1991	1687.9308	194.4556	95.7965	1978.1829	85.3	9.8	4.8
1992	1818.2070	155.4889	88.4394	2062.1353	88.2	7.5	4.3
1993	1788.5075	150.6122	82.9720	2022.0918	88.4	7.4	4.1
1994	1745.1730	133.0100	80.5518	1958.7348	89.1	6.8	4.1
1995	1695.1973	127.6433	81.5515	1904.3921	89.0	6.7	4.3
1996	1621.7539	118.8331	80.3216	1820.9086	89.1	6.5	4.4
1997	1550.3166	116.2163	81.7779	1748.3108	88.7	6.6	4.7
1998	1487.9148	98.1153	82.6149	1668.6450	89.2	5.9	5.0
1999	1394.0708	80.6464	80.8026	1555.5198	89.6	5.2	5.2

Year	6A, CH_4, Gg CO_2 eq.	6B, CH_4, Gg CO_2 eq.	6B, N_2O, Gg CO_2 eq.	6, Total Emission, Gg CO_2 eq.	6A, CH_4, % from the total	6B, CH_4, % from the total	6B, N_2O, % from the total
2000	1309.3479	76.9773	82.7123	1469.0376	89.1	5.2	5.6
2001	1223.8706	84.8869	83.9202	1392.6778	87.9	6.1	6.0
2002	1155.2957	83.2851	86.1119	1324.6927	87.2	6.3	6.5
2003	1116.4467	92.4207	83.1151	1291.9826	86.4	7.2	6.4
2004	1089.3693	104.6407	85.4576	1279.4676	85.1	8.2	6.7
2005	1095.4870	112.8840	89.4708	1297.8417	84.4	8.7	6.9
2006	1112.5653	110.5789	87.7676	1310.9119	84.9	8.4	6.7
2007	1174.2231	106.2720	83.4615	1363.9567	86.1	7.8	6.1
2008	1263.0198	111.8084	84.0757	1458.9040	86.6	7.7	5.8
2009	1327.9083	105.0578	81.5430	1514.5091	87.7	6.9	5.4
2010	1371.3804	114.1384	85.1747	1570.6934	87.3	7.3	5.4
2011	1353.3765	122.7799	83.5727	1559.7290	86.8	7.9	5.4
2012	1341.4442	130.1822	85.0586	1556.6850	86.2	8.4	5.5
2013	1343.8942	136.4857	85.4174	1565.7972	85.8	8.7	5.5
1990-2013, %	-13.0	-36.7	-19.1	-16.1	3.7	-24.6	-3.6

In 1990, CH_4 and N_2O emissions accounted for circa 94.3 per cent and respectively 5.7 per cent of the total GHG emissions from the Waste Sector. By 2013, the share of CH_4 and N_2O emissions have not changed significantly, representing about 94.5 per cent, respectively 5.5 percent of the total sectoral emissions.

As stated above, between the 1990-2013 time series, the total direct GHG emissions originated from the Waste Sector decreased by circa 16.1 per cent, CH_4 emissions by 15.9 per cent while N_2O emissions respectively, by 19.1 per cent (Figure 8-1).

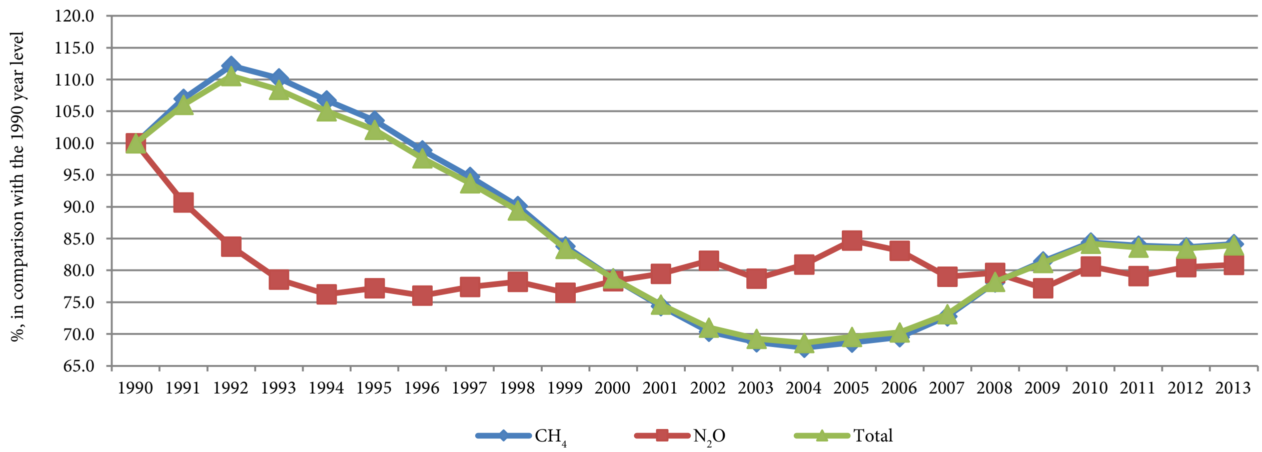

Figure 8-1: Direct GHG Emissions from Waste Sector by Gas in the Republic of Moldova within 1990-2013 time periods, where 1990 represent 100 per cent

8.1.2 Key Categories

The results of key category analysis (including LULUCF) carried out following a Tier 1 approach (IPCC, 2000), are provided in Chapter 1.5, as well as in the Annex 1. Table 8-3 provides information on identified key categories (by level and trend) under the Waste Sector.

Table 8-3: Key Categories identified under the Waste Sector

IPCC Category	GHG	Source Category	Key Categories
6A	CH_4	Solid Waste Disposal on Land	Yes (L, T)
6B	CH_4	Wastewater Handling	Yes (L)
6B	N_2O	Human Sewage	No

Abbreviations: L – Level Assessment; T – Trend Assessment

8.1.3 Methodological Issues

Emissions originated from the source categories 6A 'Solid Waste Disposal on Land' were estimated using both, the Tier 1 methodological approach and default EFs values (IPCC, 1997), as well as the Tier 2 methodological approach (IPCC, 2000) and country specific emission factors. Emissions originated from the source categories 6B 'Wastewater Handling' were estimated using the Tier 1 methodological approach (IPCC, 1997, 2000).

A summary description of methods used to estimate emissions by source categories is provided in Table 8-4, while a more detailed description is available in the sub-chapters 8.2-8.3 of the NIR.

Table 8-4: Assessment Methods Used to Estimate GHG Emissions from the Waste Sector

IPCC Category	Source Category	CH_4		N_2O	
		Method	EF	Method	EF
6A	Solid Waste Disposal on Land	T1, T2	D, CS	NA	NA
6B	Wastewater Handling	T1	D, CS	T1	D
6C	Waste Incineration	NO	NO	NO	NO

Abbreviations: T1 – Tier 1; T2 – Tier 2 2; CS – country specific; D – default; NA – Not Applicable; NO – Not Occurring.

8.1.4 Uncertainties Assessment and Time-Series Consistency

The uncertainty analysis of the GHG emissions from the Waste Sector (including by source categories) is described in detail in the sub-chapters 8.2-8.3 of the NIR, as well as in the Annex 5-3.6. Combined uncertainties as a percentage of total direct sectoral emissions were estimated at ±14.5 per cent. The uncertainties introduced in trend in total direct sectoral emissions were estimated at ±12.3 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 Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories (IPCC, 2000).

8.1.5 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 (IPCC, 2000). 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 Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories (IPCC, 2000), GHG emissions from the Waste Sector were estimated based on AD and EFs from official sources of reference.

8.1.6 Recalculations

GHG emission recalculations under the Waste Sector are due to the availability of an updated set of activity data regarding the process of solid waste generation within the ATULBD, available in the annual activity reports of the Ministry of Agriculture and Natural Resources of the ATULBD[96] as well as in the annual activity reports of the administrative units from the left bank of the Dniester River[97]; other relevant sectoral statistical data sources[98]; and also due to use of FAO database, in particular the indicator for protein consumption per capita.

In comparison with the results included into the TNC, the performed recalculation revealed an increasing trend of GHG emissions between 1990 and 1997, varying from a minimum of 0.3 per cent in 1997, up to maximum of 14.6 per cent in 1990, respectively in a decrease of direct GHG emissions in 1998-2010 time series, varying from a minimum of 0.5 per cent in 2010, to a maximum of 11.8 per cent in 2003 (Table 8-5).

Table 8-5: Recalculated GHG Emissions from the Waste Sector, included into the TNC of the Republic of Moldova under UNFCC for 1990-2010 periods, Gg CO_2 equivalent

	1990	1991	1992	1993	1994	1995	1996
TNC	1627.3829	1756.2989	1872.6894	1866.5467	1821.2994	1781.4913	1814.3442
BUR	1865.4695	1978.1829	2062.1353	2022.0918	1958.7348	1904.3921	1820.9086
Difference, %	14.6	12.6	10.1	8.3	7.5	6.9	0.4
	1997	1998	1999	2000	2001	2002	2003
TNC	1743.2010	1684.0719	1750.3457	1658.5649	1551.7223	1481.1731	1465.0002
BUR	1748.3108	1668.6450	1555.5198	1469.0376	1392.6778	1324.6927	1291.9826
Difference, %	0.3	-0.9	-11.1	-11.4	-10.2	-10.6	-11.8
	2004	2005	2006	2007	2008	2009	2010
TNC	1443.0074	1411.1196	1434.2799	1467.7908	1500.7458	1564.8796	1578.3041
BUR	1279.4676	1297.8417	1310.9119	1363.9567	1458.9040	1514.5091	1570.6934
Difference, %	-11.3	-8.0	-8.6	-7.1	-2.8	-3.2	-0.5

Abbreviations: TNC – Third National Communication; BUR – Biennial Updated Report.

[96] <http://ecology-pmr.org/inform/inform_otchet.shtml>.
[97] <http://rybnitsa.org/content/otchet-o-prodelannoy-rabote-gosadministracii-rybnickogo-rayona-i-g-rybnica-za-2013-god>; <http://grig-rsnd.idknet.com/news/informaciya-o-prodelannoj-rabote-gosudarstvennoj-administracii-grigoriopolskogo-rajona-i-g-grigoriopol-za-2012-god-po-vypolneniyu-reshenij-grigoriopolskogo-rajonnogo-soveta-narodnyx-deputatov.html>; <http://parcani.at.ua/news/otchet_gosudarstvennoj_administracii_slobodzejskogo_rajona_i_goroda_slobodzeja/2013-04-02-537>; <http://www.dubossary.ru/news.php?extend.3958; http://www.oblshkola.ru/obls/tverdih-bitovih-othodov-v-g-benderi/>;
[98] <http://mepmr.org/gosudarstvennaya-statistika/informacziya/77-sostoyanie-zhkx>.

The results of recalculations performed at the category level are presented in the sub-chapters 8.2-8.3 of the NIR.

8.1.7 Assessment of Completeness

The current inventory covers GHG emissions from two source categories under the Waste Sector (Table 8-6). As the waste incineration is not officially practiced in the Republic of Moldova, respectively no GHG emissions were reported under the 6C 'Waste Incineration' category.

Table 8-6: Assessment of Completeness under the Waste Sector in the Republic of Moldova

IPCC Category	Source Categories	CO_2	CH_4	N_2O
6A	Solid Waste Disposal on Land	NE	X	NE
6B	Wastewater Handling	NE	X	X
6C	Waste Incineration	NO, NE	NO, NE	NO, NE

Abbreviations: X – source categories included in the inventory; NO – Not Occurring; NE – Not Estimated.

8.1.8 Planned Improvements

Planned improvements at the source categories level within the Waste Sector are described in detail in sub-chapters 8.2-8.3 of the NIR.

8.2 Solid Waste Disposal on Land (Category 6A)

8.2.1 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 behavior, 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[99].

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 waste management systems at regional level. The following values were proposed: for rural areas – 0.5–0.7 kg/per capita/day, respectively 0.9 kg/per capita/day for small urban and district centers and between 1.3–1.5 kg/per capita/day for Balti and Chisinau municipalities. It should be mentioned that these calculations use AD on waste disposed provided by waste collection services.

Currently, the most used method of treating waste is waste disposal on sites, which often is a major source of soil pollution and groundwater contamination. In this context, sanitation and waste management services represent an important goal for local and governmental structures. According to the State Ecological Inspectorate Yearbook for 2013 – Environment Protection in the Republic of Moldova, the total area of SWDS in urban areas represent circa 1100 ha. In 2013, the area of authorized SWDS represented only 169.5 ha (NBS, 2014), therefore, circa 930 ha were occupied by the so called „dump sites" (unauthorized landfills) situated especially in the rural areas of the Republic

[99] <http://lex.justice.md/index.php?action=view&view=doc&lang=1&id=347341>.

of Moldova. From the existing 1110 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 2014 the construction of several landfills started in the country, in particular in district centers, serving the neighborhood villages. Thus, for example, new landfills became operational in 2013-2014 in Nisporeni, Telenesti and Hincesti. Within 2000-2013 time periods, through urban sanitation services, about 1144 and 2647 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 30-35 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 odors; lacking a strict control of disposed waste quality and quantity; there are no facilities to recover biogas produced or to recover/treat the filtrate; access road to and within the disposal sites are not maintained, vehicles are not washed on leaving the landfill; these sites do not have proper fences, an appropriate entry and warning signs.

In most district towns the dump sites are overfilled, the disposed waste layer being 7-8 m deep (ex., in Ungheni, Cahul, Ocnita, etc.), at some landfills the layer is circa 10-15 m deep (ex., in Briceni, Balti, Ialoveni, etc.) and even 25-30 m deep (Cretoaia and Orhei). Circa 3/4 of district town's landfills are being explored for circa 25-35 years at over 80 per cent of their capacity. In recent years there have been changes in waste management in Chisinau municipality. The landfill situated in Cretoaia village, Anenii Noi district that served until recently Chisinau municipality became operational by the end of 1990 (de facto exploitation began in 1991); this landfill has an area of about 24.95 ha, of which net area represents 20.89 ha. According to the project, it was designed to storage until the end of 2010 about 44 million m^3 of solid waste. By 2011, when 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 Cretoaia landfill is considered by the specialists as a populist action, without any relevant supporting arguments for stopping its use.

Meanwhile, starting with 2011 Chisinau municipality stores its waste near the waste transshipment station, located in the outskirts. The new location, though a temporary solution, is already a serious environmental problem since waste is disposed on an unmanaged land, lacking environment protection measures such as sealing foundation, rainwater deviation, etc.

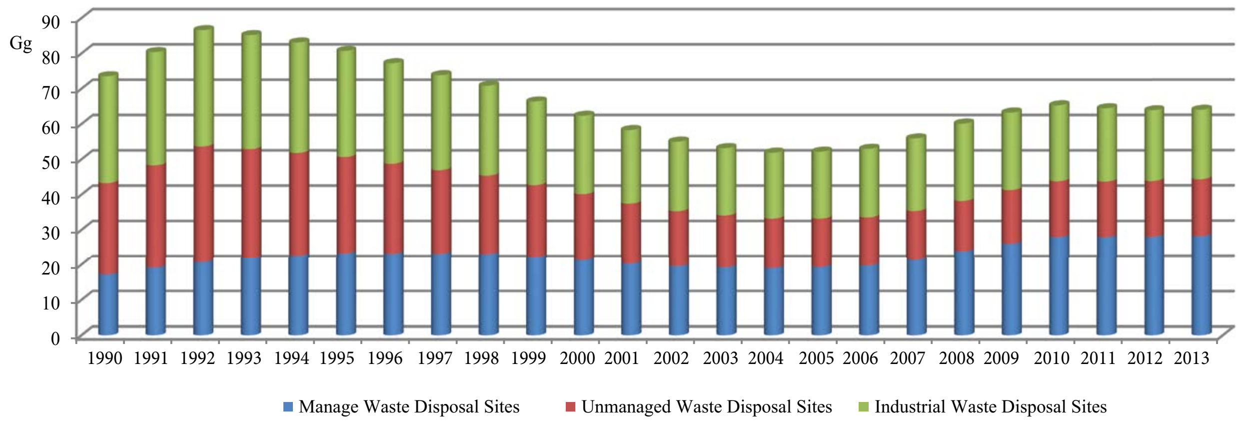

Figure 8-2: Methane Emissions from 6A 'Solid Waste Disposal on Land' in the Republic of Moldova within 1990-2013 periods, estimated using a Tier 2 Methodology

The impact of waste on the environment increased significantly in recent years, and inappropriate management entails soil and phreatic water contamination and emissions of GHG and other toxic gases, directly affecting the human health and the environment (Duca, Tugui, 2006).

Between 1990 and 2013, the methane emissions from the 6A 'Solid Waste Disposal on Land' source category decreased by 13 per cent, from 73.5 to 64.0 Gg (Figure 8-2).

8.2.2 Methodological Issues, Emission Factors and Data Sources

According to the IPCC Guidelines (1997, 2000), GHG emissions from solid waste disposal on land can be estimated using two alternative methodological approaches: the Default Method (Tier 1) and the First Order Decay Method (Tier 2).

The main difference between the two approaches is that the First Order Decay (FOD) method produces a time-dependent emission profile that better reflects the true pattern of the degradation process over time, whereas the default method is based on the assumption that all potential CH_4 is released in the year the waste is disposed of.

The default method will give a reasonable annual estimate of actual emissions if the amount and composition of deposited waste have been constant or slowly varying over a period of several decades. If the amount or composition of waste disposed at SWDS is changing more rapidly over time, however, the IPCC default method (Tier 1) will not provide an accurate trend. It is *good practice* to use the FOD method, because it more accurately reflects the emission trend.

8.2.2.1 First Order Decay Method

Republic of Moldova has used the FOD method to estimate the methane emissions from 6A 'Solid Waste Disposal on Land' source category for 30 years. Calculations have been performed by using the following equation:

$$CH_4 = \Sigma_x [(A \bullet k \bullet MSW_T(x) \bullet MSW_F(x) \bullet L_o(x)) \bullet e^{-k(t-k)}],$$

Where:

CH_4 – amount of methane generated in year t, Gg/yr;

Σ_x – amount of methane generated over a period of years x;

t – years of inventory;

x – years for which input data should be added;

A – $(1-e^{-k})/k$; normalization factor which corrects the summation;

k – methane generation rate constant, 1/yr;

$MSW_T(x)$ – total MSW generated in year t, Gg/an;

$MSW_F(x)$ – fraction of MSW disposed at solid waste disposal sites in year x;

$L_o(x)$ – methane generation potential, Gg CH_4/Gg MSW.

Methane generation potential L_o(x) depends on morphologic composition of municipal solid waste, disposal practices and landfill characteristics, being calculated by use the following equation:

$$L_o = [MCF \bullet DOC \bullet DOC_F \bullet F \bullet 16/12]$$

Where:

L_o – methane generation potential, Gg CH_4/Gg MSW;

$MCF_{(x)}$ – methane correction factor in year x (fraction);

DOC – degradable organic carbon (DOC) in year x (fraction), Gg C/Gg waste;

DOC_F – fraction DOC dissimilated;

F – fraction of CH_4 in landfill gas;

$16/12$ – conversion from C to CH_4.

Table 8-7: Methane Correction Factors Used to Estimate CH_4 Emissions from Solid Waste Disposal Sites in the Republic of Moldova within 1985-2013 periods

SWDS Classification	MCF	SWDS
Managed	1.0	Chisinau, 1991-2010
Unmanaged – deep (≥5 m waste)	0.8	Chisinau, up to 1990, 2011-2013
Unmanaged – shallow (<5 m waste)	0.4	
Uncategorized SWDS	0.6	Balti municipality and district towns

8.2.2.2 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. The following equation estimates DOC using carbon content values:

$$DOC = (0.4 \bullet A) + (0.17 \bullet B) + (0.15 \bullet C) + (0.3 \bullet D)$$

Where:

A – fraction of MSW that is paper and textiles (default value - 40 per cent DOC by weight);

B – fraction of MSW that is garden waste, park waste or other non-food organic putrescible (default value - 17 per cent DOC by weight),

C – fraction of MSW that is food waste (default value - 15 per cent DOC by weight);

D – fraction of MSW that is wood or straw (default value - 30 per cent DOC by weight).

Based on waste morphologic composition studies performed in the Republic of Moldova between 1986 and 2012 years, there were calculated the country specific DOC values. Bibliographical sources do not provide information on fraction of garden and park waste and other (non-food) putrescible disposed to sites. At the same time, under the current waste management practices applied in the Republic of Moldova, garden and park waste are not collected and consequently not disposed at the SWDS. In Chisinau, garden and park vegetal waste are disposed in special places meant for waste disposal, including the Purcel quarry. For these reasons, while estimating the DOC value, the product of (0.17 • B), characteristic to the fraction of MSW that is garden waste, was omitted from the equation presented above.

$$DOC = (0.4 \bullet A) + (0.15 \bullet C) + (0.3 \bullet D)$$

Figure 8-3 illustrates the shares of biodegradable fractions (food waste, paper, textiles and leather, wood and phytotechnical waste) in the waste stream in the Republic of Moldova, indicating a decrease from circa 71 per cent in 1993 to 56 per cent in 2001 with a further increase to 72 per cent in 2005.

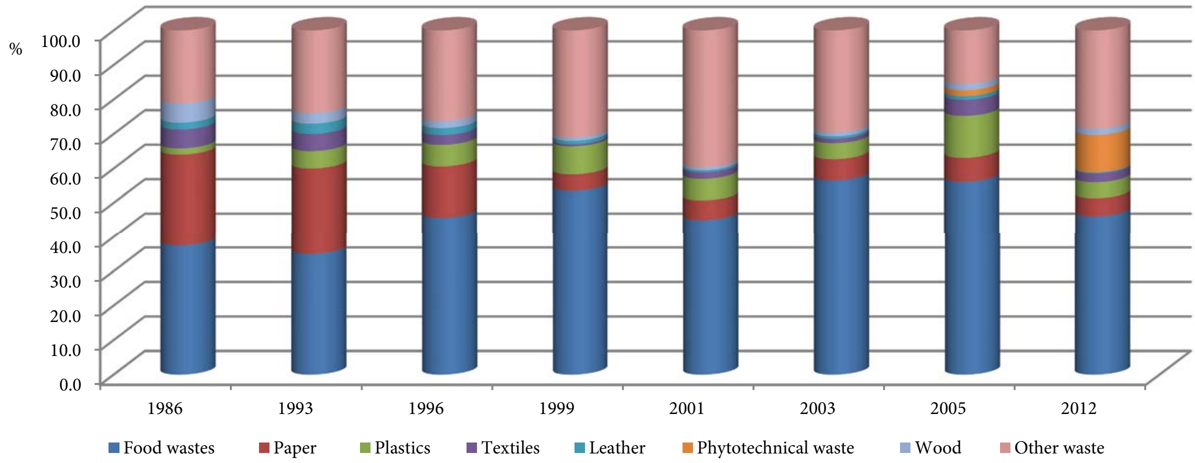

Figure 8-3: Biodegradable Waste in the Major Waste Streams in the Republic of Moldova

Within the current inventory cycle, a study was conducted on solid waste morphologic composition (Table 8-8). The technical team within the State Environmental Laboratory, previously trained in similar waste management analysis, in fully cooperation with project experts have determined the morphology of household waste generated in Chisinau, and respectively in Balti, Leova and Causeni municipalities.

Table 8-8: Average annual WDS Morphological Composition in 2012 year

Waste Type		Morphological Composition of Municipal Waste, %			
		Chisinau	Balti	Leova/Căuseni	Average
Recyclable Waste	Paper	7.98	2.83	5.02	5.28
	Glass	8.06	5.17	5.13	6.12
	Plastics	7.30	3.76	2.92	4.66
	Metals and non-metals	1.98	1.99	1.04	1.67
Organic Waste	Food waste	46.24	63.14	28.79	46.06
	Phytotechnical Waste	4.30	5.01	23.00	10.77
	Fabrics	3.28	2.66	1.84	2.59
	Leather products and shoes	0.57	0.20	0.29	0.35
Bulky Waste	Furniture	1.39	3.88	0.59	1.95
	Electronic and Electrical Equipment	1.66	1.01	0.97	1.21
Construction and Demolition Waste	Wood	1.87	1.85	1.55	1.76
	Other (construction waste)	15.37	8.50	28.86	17.58

Table 8-9: Country Specific Values for Degradable Organic Carbon (*DOC*) used to Estimate CH_4 Emissions from SWD sites, 1985-2012

Years	Degradable Fractions (A / C / D)	DOC
1986	0.320 / 0.375 / 0.029	0.2158
1993	0.300 / 0.350 / 0.030	0.1989
1996	0.179 / 0.456 / 0.021	0.1547
1999	0.054 / 0.535 / 0.010	0.1042
2001	0.077 / 0.449 / 0.008	0.1001
2003	0.075 / 0.565 / 0.011	0.1163
2005	0.117 / 0.561 / 0.035	0.1460
2012	0.079 / 0.108 / 0.461 / 0.037	0.1407

Note: The values of degradable fractions for 1996 year were calculated by interpolation, based on data available for 1993 and 1999. The value of degradable fractions for 2012 were estimated based on the degradable fractions for paper, textiles, phytotechnical waste (garden and park waste), other degradable non-food waste, food waste and wood waste.

In 2013, with the support of GIZ Project „Modernization of local public services" and relying on the Waste Management Strategy of the Republic of Moldova for 2013-2027, approved by Government Decision no. 248 dated 10.04.2013, several activities of waste management planning were initiated at regional level. As a result, in February 2014 sectoral regional programs in waste management were approved for Central and North Development Regions, which enabled further development of feasibility studies.

Given the fact that the feasibility studies foresee complete coverage with sanitation services of the entire population in the areas of waste management, it was necessary to carry out investigations regarding waste composition, an important tool in municipal waste management planning. Various options were examined for identifying a type-locality in order to determine the morphological composition. Several aspects of the existing waste management system were considered: operator status, the existent system for collection and transportation, the system's coverage, the frequency of waste collection, operator's technical capabilities, economic-financial condition etc.

According to the above mentioned criteria, in order to determine household waste composition it was selected an operator affiliated to the local authorities of Cupcini town, Edinet district. This town has an operational sanitation service, with a satisfactory financial situation and waste collection is carried out according to a predetermined schedule, though for now, the separate waste collection is not operational. Investigations were conducted within the territory of the sanitation service operator, using a method which implies the fraction separation of collected waste (in a container); a total of 680 kg of samples were taken within 4 measurements. The results obtained regarding waste composition in the urban area of Cupcini are reflected in Figures 8-4 and 8-5.

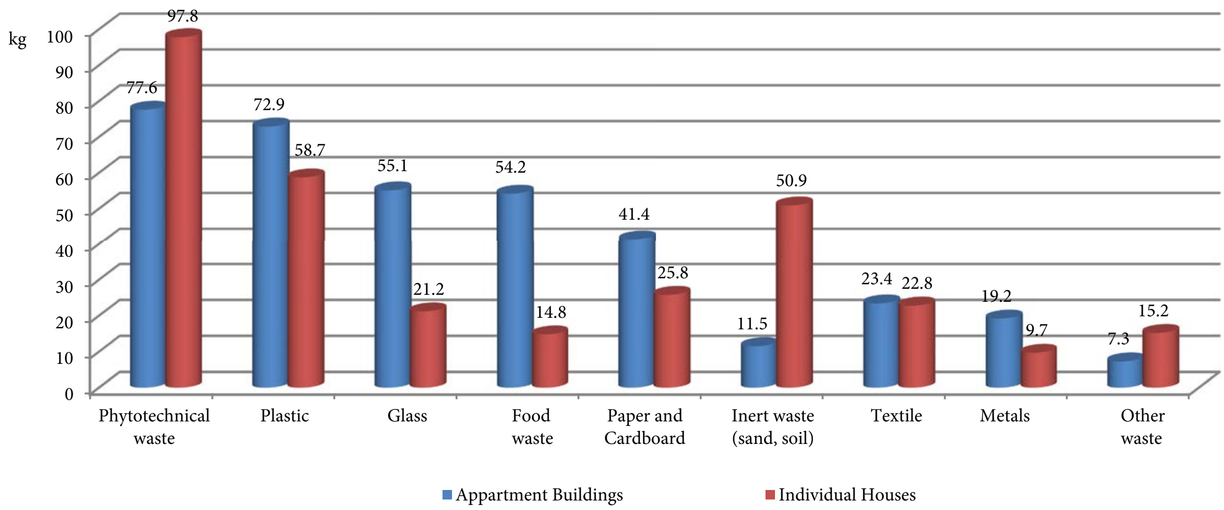

Figure 8-4: Morphological Analysis of Household Waste in the Urban Area of Cupcini Town

This study reveals the following conclusions:

- City containers are not provided with lids, so the collected waste can be wetted by rain. Since the study was conducted in May 2014, a month characterized by rainy weather conditions, the collected waste increased its water content, which influenced the results. Regarding waste composition, in Cupcini about 19.4 per cent is plastic waste (PETs, plastic items and bags).

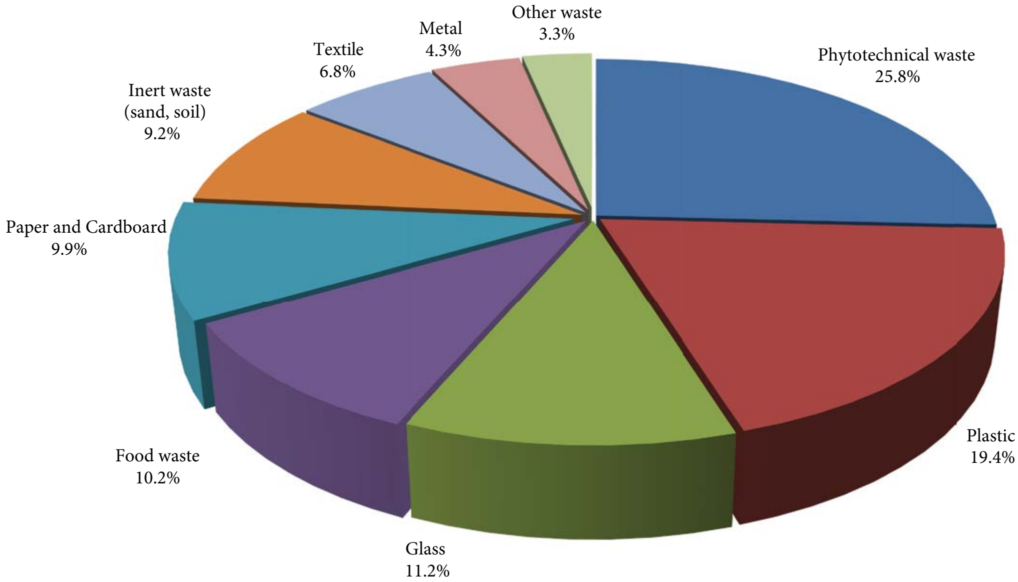

Figure 8-5: Morphological Waste Composition in Cupcini town, Edinet district

Compared to the situation in the country, in Cupcini the share of plastic waste is almost double. This can be explained by the moisture gained in collected materials (mainly bags), as well as the higher sales of packed water in PETs during the warm season.

- The share of phytotechnical waste represented about 25.8 per cent, higher than in Balti, Chisinau and Causeni municipalities, which can be explained by the fact that in larger cities, waste from green areas is collected directly in special vehicles, while in smaller cities, it is stored in containers. During the survey, actions such as trees cleaning as well as individual houses and apartment buildings courtyards cleaning were being carried out on the eve of May holidays (Mai 1st, May 9th and the city's day). Considering the above mentioned, it should be concluded that the share of phytotechnical waste could change significantly during the year.
- The share of glass waste (11.2 per cent) is close to the value recorded in Chisinau. This could be explained by the presence nearby the waste containers of grocery stores and pubs, which generate more glass waste. Increased share of glass waste also shows the lack of a separate waste collection system, including due to a lack of motivation from the economic agents to collect the waste separately. Additionally, glass producers impose strict rules regarding the collection of glass for reuse, making it difficult to collect it (they accept only a single color type glass).
- The share of paper and cardboard waste (9.9 per cent) exceeds the quota of this type of waste recorded in other cities. This trend can be explained by the presence nearby the waste containers of grocery stores and apartment buildings, which generate more paper and cardboard waste than individual houses, where there is the possibility of using the respective materials as fuel.
- The share of metal waste, including aluminium cans (4.3 per cent) also exceeds the quota recorded in other cities while the explanations refer to the presence nearby the waste containers of grocery stores which generate more metal waste (beer cans), in particular during the holidays.
- The share of food waste (10.2 per cent) is much lower compared to Chisinau (circa 50 per cent), Balti (61 per cent) and Causeni (circa 74 per cent). The larger amount of food waste was recorded in the area of apartment buildings immediately after the holidays (36 per cent), then it decreased during the measurements to about 10 per cent. By contrast, in the area of individual houses the share of food waste is lower since the population uses the food waste for pets.
- The share of inert waste (9.2 per cent) is approximately the same to other cities. In Cupcini, the share of this type of waste is significantly higher in the area of individual houses compared to the apartment buildings (about 5 times).
- „Other Waste" category (3.3 per cent) included samples from footwear, electrical and electronic equipment waste.
- Within the composition of urban waste no manure was identified (manure collection and depositing is not allowed in the cities).

Given the results of this study, it is intended to do several other morphological analysis of collected waste in urban areas in order to continue the analysis made during 2005 and 2012. This will also be continued periodically in Chisinau and Balti municipalities, as well as in those district centers (Causeni, Leova, Edinet, etc.) that have individual houses, making them similar to rural settlements.

8.2.2.3 Fraction of Degradable Organic Carbon Dissimilated

Fraction of degradable organic carbon dissimilated (DOC_F) is an estimate of the fraction of carbon that is ultimately degraded and released from SWDS, and reflects the fact that some organic carbon does not degrade, or degrades very slowly, when deposited in SWDS. It is assumed that fraction of DOC_f depends on the temperature in the anaerobic zone of the site, characterized by the relation: 0.014T + 0.28 (Tabasaran, 1981).

The Revised 1996 IPCC Guidelines (IPCC, 1997) provide a default value of 0.77 for DOC_f, while the BPG (IPCC, 2000) stipulates that only 50-60 per cent of DOC degrades and is converted into landfill gas ($DOC_f = 0.5\text{-}0.6$). Therefore, it appears that the default value may be an overestimate. To avoid this, it is good practice to use an average value of 0.55 as a default.

In the RM, country specific *DOC* and DOC_f values were developed using „MSW Learning Tool" developed by Florida University (1996) on the base of laboratory experiments carried out by Dr. Morton Barlaz (1987, 1997) and investigations made by Chandler, Van Soest (1980).

Table 8-10: Country Specific DOC and DOC_f Values Used to Estimate CH_4 Emissions from 6A'Solid Waste Disposal on Land' within 1985-2012 periods

	1986	1993	1996	1999	2001	2003	2005	2012
DOC_f	0.5176	0.5246	0.5617	0.6299	0.6130	0.6214	0.5854	0.4931
DOC	0.2158	0.1989	0.1547	0.1042	0.1001	0.1163	0.1460	0.1407

8.2.2.4 Fraction of CH_4 in Landfill Gas

The Revised 1996 IPCC Guidelines (IPCC, 1997) recommends using the CH_4 fraction *F* in SWD - 0.5, while the BPG (IPCC, 2000) states that F value can vary between 0.4 and 0.6, depending on several factors including waste composition (Bingemer, Crutyen, 1987).

The results of the measurements undertaken at the national level denote CH_4 concentrations in landfill gas varying between 53 and 66 per cent and CO_2 concentrations varying between 16 and 20 per cent (Tugui, Duca, Taranu et al., 2005). To be noted that composition of landfill gas can be calculated also based on extended Buswell equation using the results of the waste morphologic composition, which also served as basis to estimate *DOC* and DOC_f values (Figure 8-6).

The evolution of biogas composition emitted from the landfill situated in the proximity of Cretoaia village, Anenii Noi district is relatively constant, the ratio of CH_4 to CO_2 being 55/45. The results of the studies carried out in order to identify landfill gas composition at the SWDS in the Republic of Moldova revealed that the average ratio of CH_4 to CO_2 is 60/40.

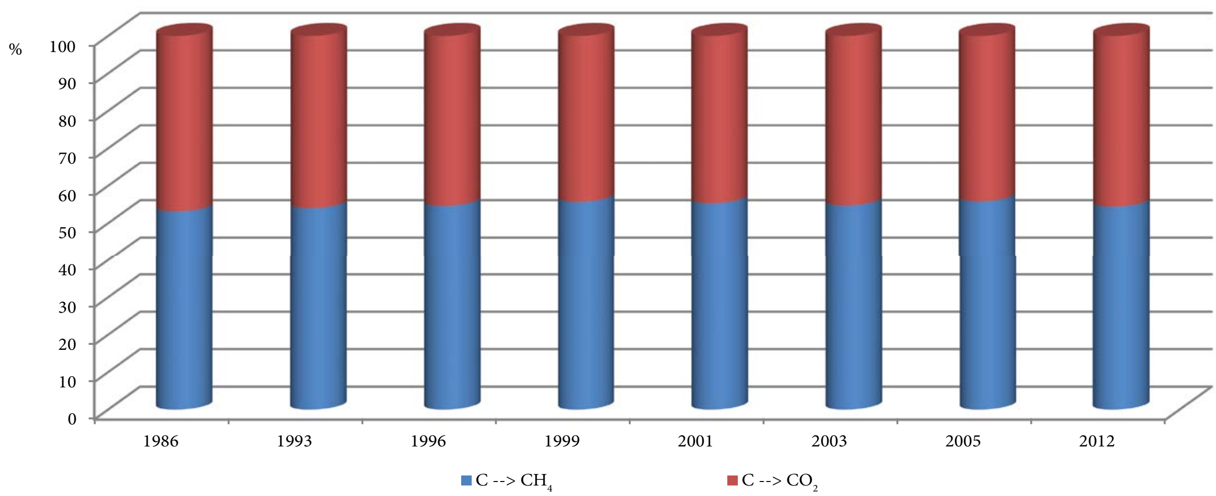

Figure 8-6: Biogas Composition in Landfill Gas Calculated Based on Extended Buswell Equation

In comparison with the results included in the first GHG Inventory of the Republic of Moldova reported in the Initial National Communication under the UNFCCC, calculated by using a default method (Tier 1), the use of the FOD method (Tier 2) and country specific values for the fraction of CH_4 in landfill gas ($F = 0.6$), methane correction factors (*MCF*), biodegradable organic carbon (*DOC*) and fraction of degradable organic carbon dissimilated (DOC_F) values, resulted in a significant increase in methane emissions within the Waste Sector.

Table 8-11: Fractions of Gases in the Landfill Gas Composition from Different SWDS in the Republic of Moldova and Other Countries

Gases	Landfill gas composition in developed countries, %	Landfill gas composition in developing countries, %	Landfill gas composition in Cretoaia, %	Landfill gas composition in Balti, %	Landfill gas composition in Straseni, %	Average landfill gas composition in the RM, %
CH_4	40-60	33-88	60-70[1]/ 63-65 [2]	75-85	23-43	53-66
CO_2	40-60	35-89	15-18[1]/ 32-34[2]	14-19	20-22	16-20
N_2	2.4-5.0	87	7-19	11-38	38-69	18-42
O_2	0.16	20.9	1-8[1]/ 0.5-1[2]	0.5-16	0.5-19	0.7-14

Note: [1] – results obtained by national experts; [2] – results obtained by DEPA (Danish Environment Protection Agency) experts.

8.2.2.5 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. The performed analyzes 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', approved by the Order of the Department of Statistics and Sociology, No. 83, from 01.08.2003.

Table 8-12 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.

Table 8-12: Activity Data on the Amount of Solid Waste Disposed on Land in the Republic of Moldova within 1985-2013 periods[100], thousand m^3

	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994
Managed SWDS	963.30	1012.25	1037.18	1061.65	1110.90	1126.00	1127.40	879.40	869.30	830.00
Unmanaged SWDS	1945.00	2094.03	2043.30	2143.75	2243.00	2273.30	2317.30	2714.40	699.60	641.20
Total	2908.30	3106.28	3080.48	3205.40	3353.90	3399.30	3444.70	3593.80	1568.90	1471.20
	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
Managed SWDS	833.10	806.90	822.90	815.80	780.50	734.20	691.00	741.00	745.80	766.70
Unmanaged SWDS	540.40	592.80	482.90	490.40	430.90	410.40	410.90	407.40	397.70	433.30
Total	1373.50	1399.70	1305.80	1306.20	1211.40	1144.60	1101.90	1148.40	1143.50	1200.00
	2005	2006	2007	2008	2009	2010	2011	2012	2013	%
Managed SWDS	785.50	819.00	1175.90	1487.10	1478.60	1494.00	1556.90	1591.30	1633.20	69.5
Unmanaged SWDS	483.00	534.60	614.70	643.70	731.60	808.60	793.10	829.80	1014.20	-47.9
Total	1268.50	1353.60	1790.60	2130.80	2210.20	2302.60	2350.00	2421.10	2647.40	-9.0

During the previous years, there were several attempts to estimate GHG emissions from the SWDS from the left bank of the Dniester River (ATULBD). In this region, the situation in the field is similar with the rest of the country, household and industrial waste being disposed together to the SWDS.

According to „The State Programme on Household and Industrial Waste Management Development", in 2006 year about 448.6 thousand m^3 of solid waste (a conversion coefficient of 0.25 tons/1m^3 of SWD is used in the region, due to the fact that the transportation services imply the use of old soviet trucks with a lower capacity) were disposed in the ATULBD to 8 authorized and about 90 unauthorized landfills.

At the same time, in the last few years an increasing trend of waste generation and disposal was recorded in the region, with a total of 643.2 thousand m^3 of disposed waste in 2014 (Table 8-13).

[100] Since1993, the information refers only to the Right Bank of the Dniester River.

Table 8-13: AD on the Amount of Solid Waste Disposed on Land in the ATULBD within 1993-2014, thousand m^3

	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
Total MSW	367.4	328.1	331.1	367.4	362.7	385.8	384.8	263.8	138.9	250.8	362.7
	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
Total MSW	381.7	380.4	448.6	524.5	600.5	644.9	594.8	606.3	598.0	621.0	643.2

To be noted that all active landfills were built between 1960 and 1990, do not comply with sanitary and environment protection requirements and should be considered landfills. Within the current inventory cycle, AD refer to the amount of solid waste disposed on land in Tiraspol, Bender as well as in other 5 district centers – Camenca, Rabnita, Dubasari, Grigoriopol and Slobozia. The main sources of information were the Annual Activity Reports of the Ministry of Agriculture and Natural Resources of the ATULBD[101], Annual Activity Reports of the Local Public Administrations on the left bank of the Dniester River[102]; as well as the sectoral statistical publications[103].

As for the industrial waste, statistical data reveal that the waste generation process is unstable in time and the uncertainty is quite high. At the same time, following the GPG recommendations, AD must be consistent over time.

Therefore, in order to estimate the amount of industrial waste for the right bank of Dniester river, after consulting the field experts, it was decided to use a share of 80 per cent of the biodegradable organic waste disposed to landfills between 1985 and 1989; 70 per cent for 1990; 60 per cent for 1991; 50 per cent of the biodegradable organic waste disposed to landfills between 1992 and 1999, a share of 60 per cent for the 2000-2008 time series, and a 40 per cent share for 2009-2013, based on the fact that the economic crisis strongly affected in 2009 year the industrial sector of the Republic of Moldova, reducing the amount of industrial waste generated.

As for the left bank of the Dniester River, different sources reveal AD for 2002 and 2007-2010 time series. For the 1993-2001 time period, respectively for 2003-2006 and 2010-2013, AD were generated using the extrapolation method.

Table 8-14 refer to AD on total industrial waste disposed on land in the Republic of Moldova within 1985-2013 time series.

Table 8-14: Activity Data on the Amount of Industrial Waste Disposed on Land in the Republic of Moldova within 1985-2013, thousand tons

	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994
Right bank of Dniester River	930.66	994.01	985.75	1025.73	1073.25	951.80	826.73	718.76	313.78	294.24
Left bank of Dniester River	NA	NA	NA	NA	NA	NA	NA	NA	246.12	196.90
Republic of Moldova, total	930.66	994.01	985.75	1025.73	1073.25	951.80	826.73	718.76	559.90	491.14
	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
Right bank of Dniester River	274.70	279.94	261.16	261.24	242.28	274.70	264.46	275.62	274.44	288.00
Left bank of Dniester River	164.08	142.68	129.71	123.53	124.78	126.04	127.31	128.60	153.28	177.96
Republic of Moldova, total	438.78	422.62	390.87	384.77	367.06	400.74	391.77	404.22	427.72	465.96
	2005	2006	2007	2008	2009	2010	2011	2012	2013	%
Right bank of Dniester River	304.44	324.86	429.74	511.39	353.63	368.42	376.00	387.38	423.58	-54.5
Left bank of Dniester River	202.64	227.32	252.00	245.60	184.00	88.10	86.70	85.51	88.80	-63.9
Republic of Moldova, total	507.08	552.18	681.74	756.99	537.63	456.52	462.70	472.89	512.39	-44.9

Table 8-15 provide AD on the total amount of solid municipal and industrial waste disposed at the landfills between 1985 and 2013; including AD on the disposal of solid municipal waste within the managed solid waste disposal sites (Chisinau municipality), the unmanaged solid waste disposal sites (the urban areas on both the right and left bank of the Dniester River were sanitation services exist and report the information to the regional and central statistical authorities), as well as AD on industrial waste disposal (for both the right and left bank of the Dniester River).

Table 8-15: Activity Data on the Amount of Solid Municipal and Industrial Waste Disposed at SWDS in the Republic of Moldova within 1985-2013 periods, thousand tons

	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994
Managed SWDS	385.3	404.9	414.9	424.7	444.4	450.4	451.0	351.8	347.7	332.0
Unmanaged SWDS	778.0	837.6	817.3	857.5	897.2	909.3	926.9	1085.8	371.7	338.5
Industrial SWDS	930.7	994.0	985.8	1025.7	1073.2	951.8	826.7	718.8	559.9	491.1
Total	2094.0	2236.5	2217.9	2307.9	2414.8	2311.5	2204.6	2156.3	1279.3	1161.7

101 <http://ecology-pmr.org/inform/inform_otchet.shtml>
102 <http://rybnitsa.org/content/otchet-o-prodelannoy-rabote-gosadministracii-rybnickogo-rayona-i-g-rybnica-za-2013-god>; <http://grig-rsnd.idknet.com/news/informaciya-o-prodelannoj-rabote-gosudarstvennoj-administracii-grigoriopolskogo-rajona-i-g-grigoriopol-za-2012-god-po-vypolneniyu-reshenij-grigoriopolskogo-rajonnogo-soveta-narodnyx-deputatov.html>; <http://parcani.at.ua/news/otchet_gosudarstvennoj_administracii_slobodzejskogo_rajona_i_goroda_slobodzeja/2013-04-02-537>; <http://www.dubossary.ru/news.php?extend.3958; http://www.oblshkola.ru/obls/tverdih-bitovih-othodov-v-g-benderi/>;
103 <http://mepmr.org/gosudarstvennaya-statistika/informacziya/77-sostoyanie-zhkx>.

	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
Managed SWDS	333.2	322.8	329.2	326.3	312.2	293.7	276.4	296.4	298.3	306.7
Unmanaged SWDS	298.9	329.0	283.8	292.6	268.5	230.1	199.1	225.7	249.8	268.8
Industrial SWDS	438.8	422.6	390.9	384.8	367.1	400.7	391.8	404.2	427.7	466.0
Total	1071.0	1074.3	1003.9	1003.7	947.8	924.5	867.3	926.3	975.8	1041.4
	2005	2006	2007	2008	2009	2010	2011	2012	2013	%
Managed SWDS	314.2	327.6	470.4	594.8	591.4	597.6	622.8	636.5	653.3	69.5
Unmanaged SWDS	288.3	326.0	377.0	408.6	522.8	477.5	468.8	481.4	560.9	-27.9
Industrial SWDS	507.1	552.2	681.7	757.0	537.6	456.5	462.7	472.9	512.4	-44.9
Total	1109.6	1205.8	1529.1	1760.4	1651.9	1531.6	1554.3	1590.8	1726.6	-17.5

Between 1985–2013, the amount of waste collected and disposed in urban landfills significantly decreased, in particular in 1992 and 1993 years.

The above mentioned allow assert:

- in 1985-1992 time period, the statistical system covered the entire territory of the country, while since 1993, it refers only to the right bank of the Dniester River (without ATULBD);
- data on the amount of solid waste disposed in the ATULBD became available only in recent years and are collected through multiple sources including the Annual Activity Reports of the Ministry of Agriculture and Natural Resources of the ATULBD and the Annual Activity Reports of the Local Public Administrations from the left bank of the Dniester River; the official statistical information became available starting with 2011[104];
- following the breakup of the Soviet Union, the country's economy was affected by a severe economic decline which continued till 2001; since the industry was one of the most affected sector of the national economy, as a result the amount of solid waste and industrial waste decreased dramatically;
- during the soviet period, raw material processing was extremely inefficient, therefore enormous amount of waste was generated, in particular industrial waste; another widespread phenomenon during the soviet era was „ inflating figures"; since the statistical form „Special auto transport" reflected fuel consumption, respectively the distance traveled, the number of routes with the purpose of transporting solid waste was often increased thus explaining a larger amount of fuel used;
- the decrease in the amount of industrial waste after 2009 is the result of the severe economic decline that affected the Republic of Moldova, as well as other countries in the region; it should be noted that some sectors of the national economy such as food industry are extremely dependent of the geo-political regional context; therefore the Russian embargo on Moldovan food and agricultural products, specifically starting with 2006 year, had an impact on the decreasing trend of the industrial waste disposed. At the same time, since 2010, the agriculture sector of the Republic of Moldova attracted increasingly more investment in modernizing the technological processes; waste from food and agricultural industry are often subjected to biological treatment and biomass is widely used for energy generation.

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 40 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 recultured and their number – drastically reduced.

8.2.3 Uncertainties Assessment and Time-Series Consistency

For countries with efficient statistical systems, the GPG (IPCC, 2000) recommends using values implying circa ±5-10 per cent of uncertainties associated with AD. For countries with poor quality

[104] <http://mepmr.org/gosudarstvennaya-statistika/informacziya/77-sostoyanie-zhkx>.

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 ±10 per cent for uncertainties related to 'Managed Waste Disposal on Land', respectively ±20 per cent for uncertainties related to 'Unmanaged Waste Disposal Sites'. To be noted 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 6A1 'Solid Waste Disposal on Land' source 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'. It should be also mentioned, that uncertainties associated with activity data on industrial waste are much higher than the uncertainties associated with the activity data on MSW. It was considered rational to use a value of ±30 per cent for the uncertainties associated with these data.

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 ±20 per cent for uncertainties related to emission factors.

Therefore, combined uncertainties related to CH_4 emissions from 6A1 'Managed Solid Waste Disposal on Land' source category can be considered moderate (±22.36 per cent), uncertainties related to the CH_4 emissions from 6A2 'Unmanaged Waste Disposal Sites' can be considered medium (±28.28 per cent), while the respective uncertainties related to the CH_4 emissions from 6A3 'Other' (Industrial Waste) are considered high (±36.06 per cent). At the same time, combined uncertainties presented as a per cent of total direct sectoral emissions were estimated at ±8.43 per cent for 6A1 'Managed Solid Waste Disposal on Land' source category, ±6.15 per cent for 6A2 'Unmanaged Waste Disposal Sites', and ±9.52 per cent for the 6A3 'Other' (Industrial Waste) source category. Uncertainties introduced in trend in sectoral emissions were estimated at ±5.42 per cent for 6A1 'Managed Solid Waste Disposal on Land' source category, ±5.31 for the 6A2 'Unmanaged Waste Disposal Sites' source category, and ±9.49 per cent for the 6A3 'Other' (Industrial Waste) source category.

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 (IPCC, 2000).

8.2.4 Quality Assurance and Quality Control

Standard verification and quality control forms and checklists were filled in for the category 6A1 'Solid Waste Disposal on Land' following a Tier 1 approach (IPCC, 2000). Verification was focused on various aspects such as: on ensuring correct use of the default emission factors available in the Revised 1996 IPCC Guidelines (IPCC, 1997) and GPG (IPCC, 2000); use of country specific factors; correct use of AD obtained from different sources of reference; comparing the results obtained by using different estimating methodologies (Tier 1 and Tier 2), and explaining the identified discrepancies, etc. The AD and methods used for estimating GHG emissions under the category 6A 'Solid Waste Disposal on Land' were documented and archived both in hard copies and electronically.

8.2.5 Recalculations

The CH_4 emissions from the category 6A1 'Solid Waste Disposal on Land' were recalculated for the 1990 through 2010 time series, in particular due to use of updated set of activity data regarding the generation of solid waste on the left bank of the Dniester River available in the Annual Activity Reports of the Ministry of Agriculture and Natural Resources of the ATULBD, in the Annual activity reports of the ATULBD local public administrations as well as in the sectoral statistics. Also, the AD regarding the amount of disposed industrial waste within the same period were revised. The obtained results allow assert that within the 1990-2013 time series CH_4 emissions from 6A1 'Solid Waste Disposal on Land' category, estimated using a Tier 1 approach, decreased by circa 50.9 per cent, from 131.98 to 64.78 Gg (Table 8-16).

Table 8-16: CH_4 Emissions from the 6A 'Solid Waste Disposal on Land' within the 1990-2013 periods, calculated by using a Tier 1 Approach, Gg

	1990	1991	1992	1993	1994	1995	1996	1997
Managed SWDS	32.1975	32.2376	31.4326	29.0254	27.7132	27.8167	22.4323	22.8771
Unmanaged SWDS	48.7531	49.6967	58.2129	18.6156	16.9542	14.9725	13.7182	11.8362
Industrial SWDS	51.0308	44.3249	38.5362	28.0423	24.5982	21.9760	17.6236	16.2996
Total	131.9814	126.2592	128.1817	75.6832	69.2657	64.7652	53.7740	51.0129
Compared to 1990, %	100	-4.3	-2.9	-42.7	-47.5	-50.9	-59.3	-61.3
Inter-annual fluctuations, %	100	-4.3	1.5	-41.0	-8.5	-6.5	-17.0	-5.1
	1998	1999	2000	2001	2002	2003	2004	2005
Managed SWDS	22.6797	16.3929	15.4205	13.5740	14.5562	17.2517	17.7352	21.4856
Unmanaged SWDS	12.2016	8.4605	7.2499	5.8665	6.6495	8.6660	9.3252	11.8288
Industrial SWDS	16.0453	11.5641	12.6253	11.5439	11.9107	14.8409	16.1678	20.8051
Total	50.9266	36.4176	35.2958	30.9845	33.1164	40.7587	43.2282	54.1196
Compared to 1990, %	-61.4	-72.4	-73.3	-76.5	-74.9	-69.1	-67.2	-59.0
Inter-annual fluctuations, %	-0.2	-28.5	-3.1	-12.2	6.9	23.1	6.1	25.2
	2006	2007	2008	2009	2010	2011	2012	2013
Managed SWDS	22.4020	32.1642	40.6764	40.4439	40.8651	27.6635	28.2747	29.0192
Unmanaged SWDS	13.3752	15.4686	16.7636	21.4517	19.5899	15.6188	16.0388	18.6877
Industrial SWDS	22.6557	27.9714	31.0588	22.0586	18.7305	15.4151	15.7546	17.0704
Total	58.4328	75.6043	88.4988	83.9542	79.1855	58.6974	60.0680	64.7773
Compared to 1990, %	-55.7	-42.7	-32.9	-36.4	-40.0	-55.5	-54.5	-50.9
Inter-annual fluctuations, %	8.0	29.4	17.1	-5.1	-5.7	-25.9	2.3	7.8

To be noted that some years were marked by large inter-annual fluctuations in CH_4 emissions: -41.0 per cent in 1993, -17.0 per cent in 1996, -28.5 per cent in 1999, +23.1 per cent in 2003 and +25.2 per cent in 2005, +29.4 per cent in 2007, respectively -25.9 per cent in 2011. The significant reduction of CH_4 emissions registered in 1993 is explained both, by smaller amounts of solid waste disposed on land within the country, as well as by the impact of not taking into consideration in full extent the statistical data for administrative territorial units on the left bank of the Dniester River (the related uncertainties to the official statistical data for this region are rather high). Further fluctuations are explained by the fact that the recycled fractions in waste stream for paper has dropped significantly within the period under review (for example, the fraction of paper in the waste stream constituted 25 per cent in 1993, 15 per cent in 1996, 4.8 per cent in 1999, 6.2 per cent in 2003, 7.0 per cent in 2005 and 5.3 per cent in 2012).

Between 1990 and 2013, CH_4 emissions from the respective source category, estimated using the FOD methodology, decreased by 13 per cent, from 73.5 to 64.0 Gg (Table 8-17).

Table 8-17: CH_4 Emissions from the 6A 'Solid Waste Disposal on Land' within the 1990-2013 periods, calculated by using the FOD methodology (Tier 2), Gg

	1990	1991	1992	1993	1994	1995	1996	1997
Managed SWDS	17.2237	19.1720	20.7631	21.8353	22.5981	23.2753	23.1659	23.1285
Unmanaged SWDS	26.0688	29.1350	32.9085	31.0537	29.2240	27.3745	25.6023	23.8159
Industrial SWDS	30.2432	32.0706	32.9096	32.2780	31.2814	30.0738	28.4581	26.8803
Total	73.5356	80.3777	86.5813	85.1670	83.1035	80.7237	77.2264	73.8246
Compared to 1990, %	100	9.3	17.7	15.8	13.0	9.8	5.0	0.4
Inter-annual fluctuations, %	100	9.3	7.7	-1.6	-2.4	-2.9	-4.3	-4.4
	1998	1999	2000	2001	2002	2003	2004	2005
Managed SWDS	23.0702	22.2037	21.3234	20.3178	19.5701	19.2692	19.0702	19.3836
Unmanaged SWDS	22.3087	20.5116	18.7906	17.1134	15.7555	14.8355	14.1204	13.8230
Industrial SWDS	25.4742	23.6691	22.2359	20.8484	19.6885	19.0594	18.6842	18.9594
Total	70.8531	66.3843	62.3499	58.2796	55.0141	53.1641	51.8747	52.1660
Compared to 1990, %	-3.6	-9.7	-15.2	-20.7	-25.2	-27.7	-29.5	-29.1
Inter-annual fluctuations, %	-4.0	-6.3	-6.1	-6.5	-5.6	-3.4	-2.4	0.6
	2006	2007	2008	2009	2010	2011	2012	2013
Managed SWDS	19.7753	21.3830	23.8868	26.0354	27.9599	27.9214	27.9673	28.1038
Unmanaged SWDS	13.7649	13.9860	14.3464	15.2685	15.8293	15.8020	15.8327	16.2032
Industrial SWDS	19.4391	20.5464	21.9106	21.9298	21.5146	20.7231	20.0783	19.6880
Total	52.9793	55.9154	60.1438	63.2337	65.3038	64.4465	63.8783	63.9950
Compared to 1990, %	-28.0	-24.0	-18.2	-14.0	-11.2	-12.4	-13.1	-13.0
Inter-annual fluctuations, %	1.6	5.5	7.6	5.1	3.3	-1.3	-0.9	0.2

In the time period from 1990 through 1992, as well as from 2005 through 2010, a clear increasing trend was recorded. The decreasing trend can be explained by the severe economic decline during the transition to a market economy. Starting with 2011, the decrease was due to the development of initiatives for waste separate collection, primarily biodegradable recyclable fractions. To be noted that in comparison with results obtained by using the default methodology (Tier 1), the CH_4 emission annual fluctuations are much smaller when using the FOD methodology (Tier 2). The analysis of obtained results reveal that the use of FOD methodology induces a slower evolution of emissions, avoiding thus the noted fluctuations in case of using the default methodology, reflecting thus the respective emissions in a more accurate way.

In comparison with the results reported in the TNC, the changes performed within the current greenhouse gas inventory resulted in an increase of CH_4 emissions originated from the 6A 'Solid Waste Disposal on Land' between 1990-1997, varying from a minimum of 0.3 per cent in 1996, to a maximum of 17.0 per cent in 1990, respectively in a decrease between 1997 and 2010, varying from a minimum of 0.01 per cent in 1997, to a maximum of 13.5 per cent in 2003 (Table 8-18).

Table 8-18: Comparative Results of CH_4 Emissions from 6A 'Solid Waste Disposal on Land' Category included into the TNC and the BUR of the Republic of Moldova under the UNFCCC, Gg

	1990	1991	1992	1993	1994	1995	1996
TNC	62.8611	70.1560	77.7145	77.8178	76.5442	75.0597	77.0144
BUR	73.5356	80.3777	86.5813	85.1670	83.1035	80.7237	77.2264
Difference, %	17.0	14.6	11.4	9.4	8.6	7.5	0.3
	1997	1998	1999	2000	2001	2002	2003
TNC	73.8295	71.9409	76.0378	71.8615	66.2014	62.8479	61.4577
BUR	73.8246	70.8531	66.3843	62.3499	58.2796	55.0141	53.1641
Difference, %	0.0	-1.5	-12.7	-13.2	-12.0	-12.5	-13.5
	2004	2005	2006	2007	2008	2009	2010
TNC	59.9037	57.7585	59.0444	61.1093	62.3186	65.7925	66.0980
BUR	51.8747	52.1660	52.9793	55.9154	60.1438	63.2337	65.3038
Difference, %	-13.4	-9.7	-10.3	-8.5	-3.5	-3.9	-1.2

Abbreviations: TNC – Third National Communication; BUR – Biennial Updated Report.

8.2.6 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.

8.3 Wastewater Handling (Category 6B)

Untreated or insufficiently treated wastewater from sewage plants directly into the natural 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 basins between 1990 and 2013 decreased by approximately 75 per cent, from 2731 million m^3 to 679 million m^3 (Table 8-19).

Table 8-19: Wastewater Discharged into Surface Basins within 1990-2013 periods, million m^3

	1990	1991	1992	1993	1994	1995	1996	1997
Discharged wastewater – total	2731	2486	2231	1993	1810	1381	1384	1239
Conventional pure water (untreated)	2424	2173	1935	1717	1547	1120	1133	1007
Polluted wastewater	90	69	41	21	16	15	12	11
..untreated	1.0	1.0	0.0	0.0	0.4	0.4	0.5	0.3
..insufficiently treated	89	68	41	21	15	14.6	11.5	10.7
Treated water according to normative requirements	216	244	255	255	247	245	238	222
Treated water according to normative, in % compared to the total volume of wastewater needing treatment	70	78	86	92	94	94	95	95
	1998	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**
Discharged wastewater – total	1030	794	740	708	696	685	688	690
Conventional pure water (untreated)	802	593	569	557	560	558	561	556
Polluted wastewater	12	10	9	13	19	48	42	9
..untreated	0.4	0.4	0.5	0.3	0.5	0.8	0.5	0.6
..insufficiently treated	11.6	9.6	8.2	12.6	18.9	47.5	41.4	8.3
Treated water according to normative requirements	215	191	162	138	116	79	85	124
Treated water according to normative, in % compared to the total volume of wastewater needing treatment	94	95	95	91	86	62	67	93
	2006	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**
Discharged wastewater – total	695	687	686	685	689	686	682	679
Conventional pure water (untreated)	562	551	550	552	555	555	553	551
Polluted wastewater	7	10	14	10	8	8	9	9
..untreated	0.5	0.7	0.8	0.8	0.9	1.0	1.5	1.0
..insufficiently treated	6.7	9.2	13.3	9.5	7.5	7.2	7.4	7.9
Treated water according to normative requirements	119	119	115	116	119	115	113	113
Treated water according to normative, in % compared to the total volume of wastewater needing treatment	89	88	85	87	89	88	87	88

Source: NBS, Statistical Yearbooks of the RM for 1994 (page 41), 1999 (page 23), 2006 (page 27), 2011 (page 24) and 2014 (page 24).

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 91.1 per cent, from 89 million m^3 in 1990, to 7.9 million m^3 in 2013. 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.

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[105]. In 2002, 106 WBTP[106] 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)[107]. In 2004, 252 WBTP existed, most of them presenting a high attrition rate regarding the buildings. In reality, only 93 plants functioned, of which 89 were bellow normative requirements (partial mechanical, partial biological treatment, with wastewater storage and/or discharge)[108]. 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[109]. 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[110]. In 2006, 131 WBTP existed, but functioned only 78 and just one was according to normative requirements; another 53 WBTP were closed[111]. 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[112]. Of the 103 plants that were

[105] 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).
[106] 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).
[107] 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).
[108] 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).
[109] State of the Environment in the Republic of Moldova in 2006: (National Report) – Ch.: S.n., 2007, - 103 pages (see page 50).
[110] 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).
[111] Environment Protection in the Republic of Moldova: (National Report for the Ministerial Conference in Belgrade, Serbia) – Chisinau, 2008, - 64 pages (see page 32).
[112] SEI Yearbook „Quality of the Environment and the State Ecological Inspectorate Activity – 2007" – Chisinau, 2008 – 202 pages (see page 8).

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[113]. 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[114]. 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[115]. In 2012, 73 wastewater treatment plants had project documentation, 30 units operated according to normative requirements, 116 units – performed insufficient treatment[116]. 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[117]. 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 quality of wastewater discharged in all urban areas except several towns such as Drochia, Edinet, Falesti, Floresti, Glodeni, Calarasi and Orhei, do not meet the existing norms regarding the discharge. There are a series of actions taken to maintain the wastewater treatment plants: Zaim, Baimaclia, Cricova, Ungheni, Nisporeni, Vulcanesti, Vasieni village in Ialoveni district and others.

The disastrous situation within this sector is determined primarily by divesting the wastewater plants to local public authorities, which lack the infrastructure, the professional staff with expertise and the financial resources needed to ensure proper operation; as well as by the essential decrease of wastewater volumes. Insufficient volume of wastewater and the excessive concentration of noxious substances received disturb the optimal functioning of the wastewater treatment plants.

In the last years, a clear trend of increasing the number of operational wastewater treatment plants was recorded. Between 2011 and 2013 new wastewater treatment plants were opened in: Ermoclia, Marianca and Festelita villages, Stefan Voda district; Siret and Lozova villages, Straseni district; District Hospital in Ocnita; Otaci, Soldanesti and Rezina towns, as well as in some villages such as Sarcova, Slobozia Horodiste and Ghiduleni of Rezina district; Nihoreni village, Rascani district; CWWT type in Orhei municipality; communitarian center in Fundurii Vechi and Ghindesti villages, Glodeni district; Sarata Galbena and Pascani villages, Hancesti district; Gangura and Horesti villages, Ialoveni district; Cosnita and Holercani villages, Dubasari district; Ecaterinovca village, Cimislia district; Hartopul Mic, Magdacesti villages, Criuleni district; Tiganca village, Cantemir district; Valcinet, Hirova villages, Calarasi district; Sadaclia village, Basarabeasca district. Construction works have started on new wastewater treatment plants: Tantareni, Speia, Salcia, Botnarești and Maximovca villages, Anenii Noi district; Marcauti village, Dubasari district; Nisporeni, Comrat and Vulcanesti towns.

Construction and reconstruction works have started on sewage and water supply systems nationwide including in the following districts: Stefan Voda, Calarasi, Causeni, Anenii Noi, Ialoveni, Straseni, Criuleni, Dubasari, Ungheni, Briceni, Rascani, Drochia, Donduseni, Sangerei, Edinet, Rezina, Orhei, Telenesti, Soldanesti, Nisporeni, Cahul, Cantemir, Taraclia, Basarabeasca, Leova, as well as in ATU Gagauzia and also in Balti and Chisinau municipalities.

[113] 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).
[114] 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).
[115] 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).
[116] 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).
[117] 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).

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)[118] 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 odor. 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 odor 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.

8.3.1 Source Category Description

The 6B 'Wastewater Handling' category, deals with CH_4 emission from 6B1 'Industrial Wastewater' and 6B2 'Domestic Wastewater' under anaerobic conditions, as well as with N_2O emissions from 'Human Sewage'.

6B1 'Industrial Wastewater'

In the Republic of Moldova the industrial wastewater are released into municipal sewer lines where it combines with domestic wastewater, the CH_4 emission generated being covered there. Under the 'Industry' Sector, the 'Food Processing Industry' generates most industrial wastewater with high content of biodegradable organic matter. In the Republic of Moldova wastewater (a mix of industrial and domestic wastewater) is treated by classical aerobic method (mechanic and biological), however due to incorrect operation of the existent treatment facilities, a portion of wastewater (around 20 per cent of the total) is treated anaerobically. Within this sector, another relevant source of CH_4 emissions is the sludge removed from wastewater which is treated aerobically and anaerobically, and applied to land.

6B2 'Domestic Wastewater'

Domestic wastewater is the product of using water for domestic purposes. The process of treating domestic wastewaters and sludge[119] from treatment facilities implies CH_4 generation. The amount of CH_4 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.

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

[118] <http://lex.justice.md/index.php?action=view&view=doc&lang=1&id=352311>.
[119] As mentioned above, domestic wastewater treatment is carried out jointly with industrial wastewater.

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. According to inventory results of existent wastewater treatment facilities it has been stated that due to small amounts of generated wastewater needed for adequate operation of domestic wastewater treatment facilities, "Apa-Canal" J.S.C. allowed to release wastewater produced by a number of industrial enterprises into the municipal sewage system, what entailed decreased amounts of industrial wastewaters being treated on-site.

Under the 6B "Wastewater Handling' category, the sludge resulting from human sewage treatment is a relevant source of N_2O emissions, being calculated based on activity data on the number of population and protein consumption per capita.

Between 1990 and 2013, the direct GHG emissions from 6B 'Wastewater Handling', expressed in CO_2 equivalent, decreased by circa 30.9 per cent, from 321.22 to 221.20 Gg CO_2 equivalent (Figure 8-7). The share of CH_4 emissions decreased from 67.1 per cent of the total in 1990 to 61.5 per cent in 2013, while the share of N_2O emissions increased, respectively from 32.9 per cent of the total in 1990, to 38.5 per cent in 2013.

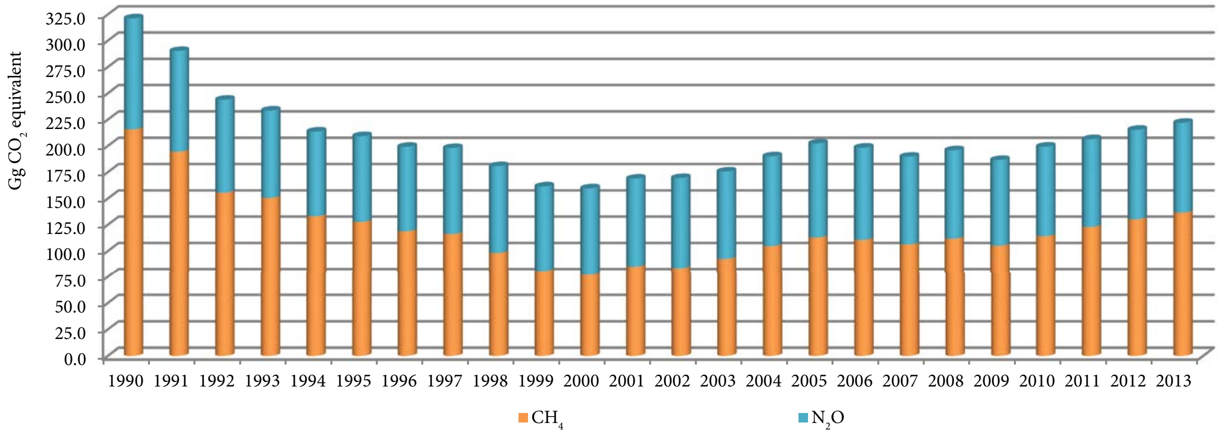

Figure 8-7: Direct GHG Emissions from 6B 'Wastewater Handling' Source Category in the Republic of Moldova within 1990-2013 periods

8.3.2 Methodological Issues, Emission Factors and Data Sources

6B1 'Industrial Wastewater'

Methane emissions from the 6B1 'Industrial Wastewater' were estimated by following recommendations set forth in the Revised 1996 Guidelines (IPCC, 1997) and GPG (IPCC, 2000), based on a IPCC default method (Tier 1). The respective approach implies substitution of the organic load value from industry sector, by the equivalent number of population connected to centralized sewage systems. For this purpose, there were used activity data on industrial wastewater generation (by industry branches) and their discharging into the sewage systems. Each industry branch was assigned a certain value for organic load in chemical oxygen demand (COD), expressed in kg COD_5/m^3 of industrial wastewater, amount of wastewater produced per industrial production output unit in m^3/t of product (Table 8-20), as well as the amount of annual output for each industry type (Table 8-21).

Table 8-20: EFs Used to Estimate CH_4 Emissions from the 6B1 'Industrial Wastewater'

Industry Production by Type	COD value, kg COD_2/m^3 wastewater	Wastewater Produced, m^3/t of product
Canned meat	2.0	20.5
Canned vegetables	1.7	15.0
Canned tomato	1.7	15.0
Canned fruit	1.7	15.0
Beer	1.5	7.6
Wine	13.0	4.0
Sparkling wine	13.0	4.0
Cognac	17.0	16.4
Brandy	11.0	24.0
Meat	2.0	20.5
Sausages	2.0	20.5
Butter	1.2	2.6
Cheese	3.0	4.3
Milk products	2.7	7.0
Sugar	5.0	3.4
Fish	2.5	8.0
Vegetable oil and fats	1.5	1.6
Soft drinks	1.0	3.8
Corrugated cardboard	4.0	23.8
Plastics and resins	3.7	0.6
Paint and varnishes	10.0	10.0
Detergents	1.2	5.0
Soap	1.2	5.0
Leather	7.0	4.2
Textiles	1.0	42.6

Source: 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. Revised 1996 Guidelines (IPCC, 1997); GPG (IPCC, 2000).

Table 8-21: Activity Data on Industrial Output Used to Estimate CH_4 Emissions from the 6B1 'Industrial Wastewater' within 1990-2013 periods, kt

	1990	1991	1992	1993	1994	1995	1996	1997
Canned meat	15.000	9.600	5.808	3.269	1.723	1.750	1.500	3.100
Canned vegetables and fruit	499.300	462.400	394.650	403.400	244.250	176.700	126.200	200.100
Fruit and vegetable juices	273.600	260.000	89.100	104.600	50.800	44.800	49.400	88.300
Canned vegetables	149.600	143.000	74.300	72.000	62.400	41.100	20.500	26.600
Processed and canned fruit	81.458	62.660	48.200	53.900	17.600	10.600	17.600	18.200
Beer	76.000	66.000	43.000	36.000	28.500	30.290	25.600	26.270
Grapes wine	163.000	143.000	92.000	103.000	97.780	99.690	145.800	194.150
Sparkling wine	8.040	7.830	8.540	8.880	7.420	9.480	14.190	13.450
Cognac	13.940	14.020	7.500	7.400	7.930	10.270	4.570	5.860
Brandy and liqueurs	5.590	5.560	6.760	13.940	26.470	41.270	33.580	23.700
Meat	257.900	218.500	136.000	114.200	85.900	58.400	52.600	50.800
Sausages	50.000	52.900	27.300	14.700	9.000	8.900	8.000	9.600
Butter	27.000	21.833	18.803	11.052	9.660	6.800	4.700	2.956
Cheese and cottage cheese	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Curd, curd cream, yogurt, kefir, sour cream	12.200	10.000	5.400	4.900	3.200	2.100	1.700	1.213
Ice cream	138.000	115.400	70.100	65.100	48.800	21.700	11.900	20.500
Milk and whipped cream with a fat content <6 %	11.520	9.600	6.400	2.900	2.500	2.400	3.000	3.251
Milk and whipped cream in solid form	454.800	382.600	180.500	175.100	86.700	39.500	36.100	26.600
Crude oil, not chemically modified	15.500	12.000	9.200	4.300	4.700	4.400	3.100	2.647
Granulated sugar	125.600	117.900	57.300	60.300	50.400	50.700	39.400	35.200
Fish and fish products	435.800	236.900	208.000	230.200	166.700	218.700	264.500	213.300
Mineral and aerated water	9.500	5.200	6.500	9.500	2.100	0.000	0.000	0.900
Other non-alcoholic drinks	51.924	34.616	19.774	13.749	11.382	10.003	10.120	9.772
Paper and corrugated cardboard	131.330	86.220	32.407	18.703	17.081	20.490	15.080	14.330
Synthetic resins	5.340	4.650	1.110	1.020	0.240	0.420	0.510	0.720
Paint and Varnishes	17.500	14.600	5.839	4.792	1.510	1.104	0.040	0.000
Soap	11.700	8.800	6.000	3.100	1.200	0.800	0.700	0.509
Washing and cleaning products	11.700	8.000	4.800	2.700	0.700	0.600	0.500	0.608
Rough leather goods	15.000	10.100	9.900	4.900	1.200	1.400	1.600	0.293
Leather boxing clothes	0.439	0.404	0.106	0.064	0.027	0.047	0.054	0.053
Cotton yarn	1.174	1.173	0.897	0.611	0.182	0.143	0.177	0.214
Fabrics	31.600	32.600	16.668	8.561	4.252	2.655	6.524	5.364
Polymer film	33.540	16.770	11.372	7.575	5.048	3.761	7.681	7.297

	1998	1999	2000	2001	2002	2003	2004	2005
Canned meat	2.350	1.860	2.845	2.071	2.213	3.192	2.200	0.739
Canned vegetables and fruit	135.400	98.592	93.852	113.875	80.861	111.194	80.406	86.264
Fruit and vegetable juices	67.400	32.100	46.700	59.700	31.300	56.900	36.900	30.000
Canned vegetables	27.200	44.527	22.119	28.876	22.724	25.534	22.739	33.010
Processed and canned fruit	6.600	5.216	6.116	5.423	5.231	16.076	18.596	18.332
Beer	30.010	22.090	25.790	33.620	46.240	59.910	69.570	77.780
Grapes wine	123.960	69.010	109.224	156.423	149.398	192.183	335.140	364.350
Sparkling wine	5.190	6.752	4.162	5.843	6.130	7.385	9.383	10.513
Cognac	4.970	4.859	7.177	9.556	10.381	13.611	14.280	17.108
Brandy and liqueurs	17.410	8.700	4.890	5.940	7.790	13.980	21.291	23.876
Meat	27.300	25.717	13.351	7.301	11.262	14.855	10.180	6.651
Sausages	8.000	9.434	10.168	11.655	13.842	15.026	15.566	17.241
Butter	2.895	2.374	2.844	3.360	2.717	2.863	3.840	3.593
Margarine	0.000	0.000	0.024	1.034	2.616	3.301	3.515	3.390
Cheese and cottage cheese	1.328	1.325	1.212	1.484	1.895	1.895	1.941	2.435
Curd, curd cream, yogurt, kefir, sour cream	26.800	20.700	17.100	21.900	16.839	22.262	20.958	26.532
Ice cream	4.389	4.264	4.395	5.182	6.321	8.073	7.287	8.105
Milk and whipped cream with a fat content <6 %	32.400	25.984	26.764	35.171	43.060	16.925	16.049	20.784
Milk and whipped cream in solid form	2.389	1.962	3.114	5.000	4.186	3.709	5.059	4.565
Crude oil, not chemically modified	28.700	24.264	31.343	43.486	53.632	77.007	96.092	83.394
Granulated sugar	194.500	100.500	105.400	132.600	167.600	107.100	110.900	133.500
Fish and fish products	0.800	1.000	1.900	2.300	2.700	2.700	2.700	3.000
Mineral and aerated water	18.578	24.585	30.917	39.039	54.222	62.804	75.273	97.310
Other non-alcoholic drinks	15.570	15.140	19.180	30.910	51.370	63.450	69.743	69.438
Paper and corrugated cardboard	0.390	0.180	0.168	0.385	0.189	0.185	0.471	0.605
Synthetic resins	0.000	0.000	0.000	0.000	0.776	0.708	0.910	1.048
Paint and Varnishes	0.370	0.674	2.054	2.870	4.095	3.443	5.136	6.269
Soap	0.301	0.231	0.231	0.280	0.232	0.339	0.386	0.317
Washing and cleaning products	0.172	0.258	0.386	0.821	0.255	0.243	0.493	0.533
Rough leather goods	0.055	0.018	0.013	0.012	0.004	0.002	0.000	0.000
Leather boxing clothes	0.095	0.040	0.043	0.060	0.135	0.042	0.000	0.000
Cotton yarn	10.552	8.131	13.030	12.400	12.501	13.300	16.200	18.000
Fabrics	13.644	11.486	17.064	16.342	16.837	19.292	20.625	23.823
Polymer film	1.238	0.684	1.723	2.091	3.348	4.236	3.595	4.464
	2006	2007	2008	2009	2010	2011	2012	2013
Canned meat	1.062	1.377	1.555	1.195	1.598	1.433	1.654	0.972
Canned vegetables and fruit	99.896	93.952	102.669	60.237	75.977	71.009	85.397	100.816
Fruit and vegetable juices	29.700	53.800	38.993	28.119	30.299	30.038	46.751	50.837
Canned vegetables	44.388	22.701	41.939	26.505	29.890	26.336	24.291	25.154
Processed and canned fruit	17.276	16.524	17.781	3.738	7.985	6.758	4.724	10.674
Beer	91.240	101.160	86.640	77.880	94.800	105.111	109.586	102.927
Grapes wine	193.598	125.812	155.297	126.305	128.550	126.057	142.640	141.873
Sparkling wine	4.016	5.407	5.720	4.997	5.561	6.864	6.539	5.955
Cognac	7.914	8.236	10.373	6.978	7.465	9.118	10.940	11.797
Brandy and liqueurs	19.625	17.216	12.911	11.080	13.376	15.511	19.345	24.925
Meat	10.228	16.122	12.809	16.260	24.699	28.509	31.308	35.441
Sausages	18.049	20.775	22.466	17.057	16.697	17.963	19.560	21.266
Butter	3.521	3.587	4.697	4.222	4.586	4.258	4.447	5.811
Margarine	2.624	2.225	1.944	1.658	1.274	1.119	0.788	0.706
Cheese and cottage cheese	2.081	2.311	2.609	1.463	1.828	2.153	2.250	2.525
Curd, curd cream, yogurt, kefir, sour cream	28.278	32.351	32.373	32.961	32.999	35.412	39.283	41.212
Ice cream	8.609	8.228	7.679	7.010	8.490	8.313	9.436	10.173
Milk and whipped cream with a fat content <6 %	50.349	55.271	66.640	61.398	65.056	62.921	62.397	65.313
Milk and whipped cream in solid form	3.806	2.676	2.693	1.821	1.217	0.625	0.536	0.439
Crude oil, not chemically modified	81.471	84.967	79.307	83.881	80.705	89.787	96.828	49.951
Granulated sugar	149.000	74.000	134.000	38.400	103.200	88.436	83.440	140.297
Fish and fish products	2.500	2.300	4.600	3.700	1.300	5.517	5.632	6.283
Mineral and aerated water	109.810	136.518	130.358	117.804	122.668	114.370	114.230	100.470
Other non-alcoholic drinks	80.677	101.594	87.526	67.617	73.043	80.746	78.931	70.545
Paper and corrugated cardboard	1.950	2.700	1.140	0.870	1.290	2.520	1.324	2.467
Synthetic resins	0.825	1.026	0.961	0.777	1.516	1.657	1.774	1.842
Paint and Varnishes	8.295	10.815	11.557	11.822	12.864	18.011	17.907	12.219
Soap	0.526	0.562	0.399	0.380	0.538	0.523	0.570	0.637
Washing and cleaning products	0.769	1.034	0.451	0.482	0.618	0.727	0.798	1.048
Cotton yarn	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.007
Fabrics	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.035
Polymer film	18.100	20.500	19.896	14.334	15.906	12.693	14.084	14.864

Source: NBS, Official Letter No. 06-39/08 dated 23.02.2011 (AD for 1992-2010 time series). Official Letter No. 15-03-05 dated 24.01.2014 (AD for 2011-2012); Official Letter No. 15-03-09 dated 13.02.2015 (AD for 2012-2013); 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) and 2014 (pages 89-90).

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[120];

TOS_{ind} – total industrial organic sludge, kg COD_5/year;

O – total annual industrial output, t[121]/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 8-22) 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 – 60 g COD/person/day (IPCC, 2000); in the RM a country specific value was used: 75 g COD/person/day (SNIP 2.04.03.85);

D – number of days in a calendar year (365 days in normal years and 366 days in leap years: 1992, 1996, 2000, 2004, 2008, 2012).

Table 8-22: Total Industrial Organic Wastewater in the Republic of Moldova within 1990-2013

	1990	1991	1992	1993	1994	1995	1996	1997
TOW_{ind}, kt CCO/year	79.2265	67.6727	43.1847	43.8755	34.9556	35.2822	33.2392	35.6069
	1998	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**
TOW_{ind}, kt CCO/year	26.5259	17.8500	19.4704	24.7513	24.7548	30.5594	39.3432	43.5677
	2006	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**
TOW_{ind}, kt CCO/year	32.8633	28.8353	31.0827	23.3057	26.9331	28.1221	31.4519	34.5674

The calculated population equivalent values (P_{EQ}) are added to the number of population connected to sewage systems (P_{WS}) (Table 8-23).

Table 8-23: Number of Population Connected to Sewage System in the Republic of Moldova

	1990	1991	1992	1993	1994	1995	1996	1997
P, inhabitants[1]	4361600	4366300	4359100	4347800	4352700	4347900	4334400	4320000
P_{WS} %[2]	68.0	64.4	60.9	57.3	53.7	50.2	46.6	43.0
P_{WS}, inhabitants	2965888	2813207	2652948	2490855	2338270	2180472	2018964	1858032
	1998	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**
P, inhabitants[1]	4304700	4293000	4281500	4277600	4261400	4242100	4161800	4147900
P_{WS} %[2]	39.4	35.9	32.3	32.8	31.9	32.9	33.9	35.6
P_{WS}, inhabitants	1697774	1539899	1382925	1403053	1359387	1395651	1410850	1476652
	2006	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**
P, inhabitants[1]	4130500	4114600	4100200	4090000	4081700	4073800	4068941	4064650
P_{WS} %[2]	43.7	44.6	46.5	49.0	51.9	56.7	58.8	60.2
P_{WS}, inhabitants	1805029	1835112	1906593	2004100	2118402	2309845	2392537	2446919

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), 2007 (page 33), 2008 (page 32), 2009 (page 32), 2010 (page 32), 2012 (page 32), 2014 (page 32); Statistical Yearbooks of the ATULBD for 2000 (page 27), 2006 (page 27), 2007 (page 27), 2009 (page 28), 2010 (page 28), 2011 (page 28), 2012 (page 28), 2013 (page 29); [2] For 1990-1999 time series, the source is: <http://www.ib-net.org/en/production/?action=country>; for 2000-2013 time series – NBS database, revised indicators of the Millennium Development Goals, 2000-2012; <http://statbank.statistica.md/pxweb/Dialog/varval.asp?ma=ODM0101&ti=Indicatorii+revizuiti+ai+Obiectivelor+Dezvoltarii+Mileniului%2C+2000-2013&path=../Database/RO/ODM/&lang=1>.

The sum obtained corresponds to the fictitious number of population (P) connected to sewage systems (Table 8-24). The respective figures were used to estimate CH_4 emissions from industrial and domestic wastewater handling.

Table 8-24: The Fictitious Number of Population Connected to Sewage Systems in the Republic of Moldova within 1990-2013 periods

	1990	1991	1992	1993	1994	1995	1996	1997
P_{WS}, inhabitants	2965888	2813207	2652948	2490855	2338270	2180472	2018964	1858032
P_{EQ}, inhabitants	2894119	2472062	1573212	1602759	1276917	1288849	1210899	1300707
P fictitious, inhabitants	5860007	5285269	4226160	4093614	3615188	3469321	3229863	3158739

[120] COD – Chemical Oxygen Demand;

[121] The following conversion factors were used: 1 jar equivalent = 0.5 kg; 1 m2 fabric = 0.2 kg; 1m2 of soft man made leather = 0.7 kg; 1 m2 of corrugated cardboard = 0.3 kg; 1 dal of alcoholic drinks (wine, sparkling wine, brandy, brandies and liqueurs, beer) = 10 kg.

	1998	1999	2000	2001	2002	2003	2004	2005
P_{WS}, inhabitants	1697774	1539899	1382925	1403053	1359387	1395651	1410850	1476652
P_{EQ}, inhabitants	968983	652056	709306	904159	904287	1116326	1433267	1591514
P fictitious, inhabitants	2666757	2191955	2092230	2307211	2263673	2511977	2844117	3068166
	2006	2007	2008	2009	2010	2011	2012	2013
P_{WS}, inhabitants	1805029	1835112	1906593	2004100	2118402	2309845	2392537	2446919
P_{EQ}, inhabitants	1200487	1053343	1132340	851351	983858	1027291	1145791	1262736
P fictitious, inhabitants	3005516	2888455	3038933	2855451	3102260	3337135	3538328	3709656

6B2 'Domestic Wastewater' (CH_4 Emissions)

Methane emissions from the 6B2 'Domestic Wastewater' source category were estimated by following recommendations set forth in the Revised 1996 Guidelines (IPCC, 1997) and GPG (IPCC, 2000), based on a IPCC default method (Tier 1).

Three basic steps are required for estimating CH4 emissions from wastewater handling.

Step 1:

Determine the total amount of organic matter in the wastewater produced under domestic wastewater handling system (TOW_{dom}) (Table 8-25).

Table 8-25: Activity Data Used to Estimate Methane Emissions from the 6B2 'Domestic Wastewater' for 1990-2013 periods

	1990	1991	1992	1993	1994	1995	1996	1997
TOW_{dom}, kt BOD_5	106.9451	96.4562	77.1274	74.7084	65.9772	63.3151	58.9450	57.6470
	1998	1999	2000	2001	2002	2003	2004	2005
TOW_{dom}, kt BOD_5	48.6683	40.0032	38.1832	42.1066	41.3120	45.8436	51.9051	55.9940
	2006	2007	2008	2009	2010	2011	2012	2013
TOW_{dom}, kt BOD_5	54.8507	52.7143	55.4605	52.1120	56.6163	60.9027	64.5745	67.7012

This value is influenced in particular, by the population (*P*) fictitious number connected to sewage system, and respectively by the domestic degradable organic component (*D*); the default value for European countries is 18250 kg BOD_5/1000 persons/year (IPCC, 1997).

$$TOW_{dom\ (wastewater)} = P \bullet D_{dom} \bullet (1 - DS_{dom}) \quad and \quad TOS_{dom\ (sludge)} = P \bullet D_{dom} \bullet DS_{dom}$$

Where:

TOW_{dom} – total domestic organic wastewater, kg BOD_5/year;

P – fictitious country population connected to sewage system: which is the actual number of country population connected to sewage systems (P_{WS}), plus population equivalent number (P_{eq}), calculated under the 6B1 'Industrial Wastewater', in 1000 persons/year;

D_{dom} – domestic degradable organic component, kg BOD/1000 persons/year;

DS_{dom} – fraction of domestic degradable organic component removed as sludge.

Step 2:

Estimate emissions factors values for domestic and industrial wastewater handling systems. The emission factors depend on the conditions characteristic to the wastewater handling processes (aerobic and/or anaerobic). The calculation refers only to anaerobic wastewater handling processes.

$$EF_i = B_{oi} \bullet \Sigma(WS_{ix} \bullet MCF_x) \quad and \quad EF_i = B_{oi} \bullet \Sigma(SS_{ix} \bullet MCF_x)$$

Where:

EF_i – emission factor for wastewater and sludge, kg CH_4/kg BOD;

B_{oi} – maximum methane producing capacity in wastewater and sludge, kg CH_4/kg BOD (default value is 0.6 kg CH_4/kg BOD);

MCF_x – methane conversion factor for wastewater and sludge handling systems (the value used in the Republic of Moldova is 0.8);

WS_{ix} – fraction of wastewater treatment using the anaerobic method (in the Republic of Moldova, the used value is 20 per cent);

SS_{ix} – fraction of sludge treatment using the anaerobic method.

Step 3:

Estimate the total CH_4 emissions from wastewater and sludge handling.

$$TM = WM + SM, \qquad WM = \Sigma\ (TOWi \bullet EF_i - MR_i), \qquad SM = \Sigma\ (TOSi \bullet EF_i - MR_i)$$

Where:

TM – total methane from wastewater and sludge handling, kg CH_4/year;

WM – total methane emissions from wastewater, kg CH_4/year;

SM – total methane emissions from sludge, kg CH_4/year;

TOW_i – total organic waste for wastewater type i, kg BOD/year;

TOS_i – total organic waste for sludge type j, kg BOD/year;

EFi – EF from wastewater type i and for sludge type j, kg CH_4/kg BOD;

MR_i – total amount of methane recovered or flared from wastewater type i or from sludge type j, if no data are available, the default value of zero is used.

6B2 Nitrous Oxide from Human Sewage

Nitrous oxide emissions from the 6B2 'Domestic Wastewater' (Nitrous Oxide from Human Sewage) were estimated by following recommendations set forth in the Revised 1996 Guidelines (IPCC, 1997), based on an IPCC default methodology.

$$N_2O = PROTEIN \bullet Frac_{NPR} \bullet NR_{PEOPLE} \bullet EF_6 \bullet 44/28$$

Where:

N_2O – N_2O emissions from human sewage, kg N_2O/year;

PROTEIN – annual per capita protein consumption, kg/per capita/year;

NR_{PEOPLE} – number of people in the Republic of Moldova;

EF_6 – emission factor; default value is 0.01 kg N_2O-N/kg N sewage-N produced;

$Frac_{NPR}$ – fraction of nitrogen in proteins, default value is 0.16 kg N/kg proteins;

[44/28] – stoichiometric ratio of N_2O-N and N_2O.

Table 8-26: Activity Data Used to Estimate N_2O Emissions from 'Nitrous Oxide from Human Sewage' in the RM

	1990	1991	1992	1993	1994	1995	1996	1997
P_{RM}, inhabitants[1]	4361600	4366300	4359100	4347800	4352700	4347900	4334400	4320000
Proteins, g/per capita/day	85.12	77.12	71.12	67.08	65.05	65.93	64.96	66.54
Proteins, kg/per capita/year	31.07	28.15	26.03	24.48	23.74	24.06	23.78	24.29
	1998	1999	2000	2001	2002	2003	2004	2005
P_{RM}, inhabitants[1]	4304700	4293000	4281500	4277600	4261400	4242100	4161800	4147900
Proteins, g/per capita/day	67.46	66.16	67.72	68.96	71.03	68.87	71.98	75.82
Proteins, kg/per capita/year	24.62	24.15	24.79	25.17	25.93	25.14	26.34	27.67
	2006	2007	2008	2009	2010	2011	2012	2013
P_{RM}, inhabitants[1]	4130500	4114600	4100200	4090000	4081700	4073800	4068941	4064650
Proteins, g/per capita/day	74.69	71.30	71.88	70.08	73.35	72.11	73.28	73.67
Proteins, kg/per capita/year	27.26	26.02	26.31	25.58	26.77	26.32	26.82	26.96

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); Statistical Yearbooks of the ATULBD for 2000 (page 27), 2006 (page 27), 2007 (page 27), 2009 (page 28), 2011 (page 28), 2013 (page 29); [2] FAO database, FAOSTAT, FAO Statistics Division 2014, 15 October 2014, <http://faostat3.fao.org/faostat-gateway/go/to/download/FB/CL/E>.

To be noted that AD regarding annual per capita protein consumption in the Republic of Moldova is available in the FAO database. For 1990-1991 and 2012-2013 years, activity data were extrapolated, since these are not available for the RM in the FAO database.

8.3.3 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 emissions under this source category and to the quality and availability of data used to derive these estimates.

Uncertainties associated with the default emission factors used to estimate CH_4 and N_2O emissions from the 6B 'Wastewater Handling' reach up to ±30 per cent. Uncertainties related to activity data vary from low (±5 per cent) for number of population and industrial output (even when considering the uncertainties associated with the use of conversion factors, for transferring certain measurement units to other units) to medium (±15 per cent) for annual per capita protein consumption. Combined uncertainties associated with direct GHG emissions from the 6B2 'Wastewater Handling' source category vary from ±31.6 per cent for methane emissions, to ±33.5 per cent for nitrous oxide emissions. At the same time, combined uncertainties presented as a per cent of total direct sectoral GHG emissions were estimated at ±2.76 per cent for methane emissions and at ±1.83 per cent for nitrous oxide emissions. Uncertainties introduced in trend in total sectoral direct emissions were estimated at ±1.26 per cent for CH_4 emissions and at ±0.97 per cent for N_2O emissions (Annex 5-3.6).

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 (IPCC, 2000).

8.3.4 Quality Assurance and Quality Control

Standard verification and quality control forms and checklists were filled in for this category following a Tier 1 approach (IPCC, 2000). Verification was focused on various aspects such as: 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; on ensuring correct use of the default emission factors available in the Revised 1996 IPCC Guidelines (IPCC, 1997) and GPG (IPCC, 2000), etc. The AD and methods used for estimating CH_4 emissions under the category 6B 'Wastewater Handling' were documented and archived both in hard copies and electronically.

8.3.5 Recalculations

The CH_4 emissions from the category 6B 'Wastewater Handling' were recalculated for the 1990-2010 time series, in particular due to use an updated set of activity data related to industrial output in the Republic of Moldova, available in the new editions of the Statistical Yearbooks of the Republic of Moldova and those of the ATULBD.

In comparison with the previously obtained results included in the TNC, the above mentioned changes resulted in an insignificant increase of CH_4 emissions from 6B 'Wastewater Handling', with a variation from a minimum of 0.001 per cent in 1997 to a maximum of 5.880 per cent in 2010. At the same time, within the 1995-1996, 1998 and 2002-2005 years CH_4 emissions slightly decreased, varying from a minimum of 0.004 per cent in 1998 up to a maximum of 2.196 per cent in 2003 (Table 8-27).

Table 8-27: Comparative Results of CH_4 Emissions from 6B 'Wastewater Handling' category included into the TNC and the BUR of the Republic of Moldova under the UNFCCC, Gg

	1990	1991	1992	1993	1994	1995	1996	1997
TNC	10.2667	9.2598	7.4042	7.1720	6.3338	6.0800	5.6601	5.5341
BUR	10.2667	9.2598	7.4042	7.1720	6.3338	6.0783	5.6587	5.5341
Difference, %	0.000	0.000	0.000	0.000	0.000	-0.029	-0.025	0.001
	1998	1999	2000	2001	2002	2003	2004	2005
TNC	4.6724	3.8283	3.6608	4.0393	3.9663	4.4998	5.0052	5.3974
BUR	4.6722	3.8403	3.6656	4.0422	3.9660	4.4010	4.9829	5.3754
Difference, %	-0.004	0.313	0.130	0.072	-0.009	-2.196	-0.446	-0.408
	2006	2007	2008	2009	2010	2011	2012	2013
TNC	5.2370	5.0063	5.2684	4.9024	5.1333			
BUR	5.2657	5.0606	5.3242	5.0028	5.4352	5.8467	6.1992	6.4993
Difference, %	0.548	1.085	1.060	2.047	5.880			

Abbreviations: TNC – Third National Communication; BUR – Biennial Updated Report.

The results allow assert that within the 1990-2013 time series CH_4 emissions from 6B 'Wastewater Handling' decreased by circa 36.7 per cent, from 10.2667 to 6.4993 Gg.

N_2O emissions from the 6B2 'Domestic Wastewater' (Human Sewage) were recalculated for the 1990 through 2010 time series, in particular due to reassessment of protein consumption (grams of protein/ per capita/per day) and also due to use of an updated set of activity data, available on FAO[122] webpage.

In comparison with the results reported in the TNC, the changes performed resulted in a decrease of N_2O emissions from the 6B2 'Domestic Wastewater' (Human Sewage), varying from a minimum of 1.5 per cent in 1993, up to a maximum of 15.2 per cent in 1990, except for 1994 when an insignificant decrease was recorded (Table 8-28).

Table 8-28: Comparative Results of N_2O Emissions from 6B2 'Domestic Wastewater: Human Sewage' included into the TNC and the BUR of the Republic of Moldova under the UNFCCC, Gg

	1990	1991	1992	1993	1994	1995	1996	1997
TNC	0.2958	0.2857	0.2756	0.2637	0.2608	0.2502	0.2529	0.2470
BUR	0.3407	0.3090	0.2853	0.2677	0.2598	0.2631	0.2591	0.2638
Difference, %	15.2	8.2	3.5	1.5	-0.4	5.2	2.5	6.8
	1998	1999	2000	2001	2002	2003	2004	2005
TNC	0.2426	0.2360	0.2348	0.2473	0.2519	0.2577	0.2585	0.2737
BUR	0.2665	0.2607	0.2668	0.2707	0.2778	0.2681	0.2757	0.2886
Difference, %	9.9	10.5	13.6	9.5	10.3	4.0	6.6	5.5

122 <http://faostat3.fao.org/faostat-gateway/go/to/download/FB/CL/E>.

	2006	2007	2008	2009	2010	2011	2012	2013
TNC	0.2722	0.2560	0.2626	0.2590	0.2660			
BUR	0.2831	0.2692	0.2712	0.2630	0.2748	0.2696	0.2744	0.2755
Difference, %	4.0	5.2	3.3	1.6	3.3			

Abbreviations: TNC – Third National Communication; BUR – Biennial Updated Report.

The results allow assert that within the 1990-2013 time series N_2O emissions from the respective source category decreased by circa 19.1 per cent, from 0.3407 to 0.2755 Gg.

8.3.6 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 the Government Decision No. 199 dated 20.03.2014 *Strategy on water supply and sanitation for* (2014–2028)[123], while at the regional level (Central, Southern and Northern Development Regions) there are ongoing efforts to develop *Regional Plans for Water and Sanitation*. 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 dated 23.12.2011, the draft *Law on municipal water supply and sanitation services*, the set of secondary legislation to the *Water Law*, Regional Plans drafts 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 Hancesti, Soroca, Floresti, Ceadar-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 (Rom. – ANRE; Eng. – NAER), 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 6B 'Wastewater handling'. 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 Republic of Moldova to fulfill 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 cycles it is planned to study the possibility of using country specific information on fraction of BOD removed with the sludge, maximum methane producing capacity, methane correction factor, fraction of wastewater and sludge treated by different handling systems and other relevant parameters used to estimate CH_4 emissions from the 6B 'Wastewater Handling' category.

[123] <http://lex.justice.md/index.php?action=view&view=doc&lang=1&id=352311>.

9. 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 1990-2010 time series, included in its TNC under the UNFCCC (2014), 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 3-8 of the NIR: 1990-2013.

9.1. Explanations and Justifications for Recalculations

The national inventory team revised and recalculated GHG emissions and removals for each calendar year covered by the inventory for the period from 1990 through 2010, a component part of the TNC of the Republic of Moldova under the UNFCCC. These activities were carried out during the on-going process of improving the quality of the National GHG Inventory (inclusive, by taking into account the updated activity data, new methodological approaches and 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, inclusion new emission sources, etc.), entailing the need to make recalculations of national GHG emissions for the time period from 1990 through 2010, reflected in the Chapter 2 'National GHG Inventory' of the TNC of the RM to the UNFCCC.

In comparison with the results reported under the TNC, the changes made during the development of the current inventory, resulted in insignificant increased values of total direct GHG emissions in 1990, 1992-1995, 1998, 2007 and 2009-2010, respectively revealed a decreasing trend in the following years: 1991, 1996-1997, 1999-2006 and 2008 (Table 9-1).

Table 9-1: Recalculations of Total Direct GHG Emissions included into the TNC of the Republic of Moldova under the UNFCCC, Mt CO_2 equivalent

	1990	1991	1992	1993	1994	1995	1996
TNC	43.2598	38.8643	28.6479	23.1660	20.9036	17.3809	17.2985
BUR	43.4188	38.7474	28.7545	23.2180	20.9914	17.4240	17.2640
Difference, %	0.4	-0.3	0.4	0.2	0.4	0.2	-0.2
	1997	1998	1999	2000	2001	2002	2003
TNC	16.0263	14.0435	11.9511	10.9108	11.5891	11.3244	11.8425
BUR	16.0256	14.0442	11.7718	10.7307	11.4210	11.1419	11.6173
Difference, %	0.0	0.0	-1.5	-1.7	-1.5	-1.6	-1.9
	2004	2005	2006	2007	2008	2009	2010
TNC	12.5511	12.9399	12.1180	11.3894	13.1216	13.1243	13.2761
BUR	12.3044	12.7530	11.9433	11.6586	13.0587	13.1368	13.9394
Difference, %	-2.0	-1.4	-1.4	2.4	-0.5	0.1	5.0

Abbreviations: TNC – Third National Communication; BUR – Biennial Update Report.

With reference to the net GHG emissions included into the TNC of the RM under the UNFCCC, changes made in the development of the current inventory, resulted in an increasing trend in GHG emissions in 1990 and during the 1992-1995 time periods, varying from a minimum of 1.1 per cent in 1995, up to 4.6 per cent in 1993, respectively in a decreasing trend in GHG emissions in 1991 and during the 1996-2010 time periods, varying from a minimum of 0.2 per cent in 2010 to 7.8 per cent in 2000 (Table 9-2).

Table 9-2: Recalculations of the Total Net Direct GHG Emissions included into the TNC of the Republic of Moldova under the UNFCCC, Mt CO_2 equivalent

	1990	1991	1992	1993	1994	1995	1996
TNC	36.0828	33.7870	23.5389	20.7527	18.5263	16.2228	16.2919
BUR	37.5322	33.4510	24.3701	21.7173	18.8274	16.3946	16.0973
Difference, %	4.0	-1.0	3.5	4.6	1.6	1.1	-1.2
	1997	1998	1999	2000	2001	2002	2003
TNC	16.2026	13.8565	11.3935	10.1287	11.3099	11.2530	10.7960
BUR	15.8886	13.3216	10.6370	9.3385	10.6710	10.6092	10.0626
Difference, %	-1.9	-3.9	-6.6	-7.8	-5.6	-5.7	-6.8
	2004	2005	2006	2007	2008	2009	2010
TNC	12.8611	12.8357	11.7152	8.7796	13.2525	12.2528	13.3025
BUR	12.2012	12.3776	11.3042	8.5926	12.9992	11.8519	13.2823
Difference, %	-5.1	-3.6	-3.5	-2.1	-1.9	-3.3	-0.2

Abbreviations: TNC – Third National Communication; BUR – Biennial Update Report.

9.1.1. Energy Sector

Recalculations of GHG emissions from the Energy Sector were performed based on the following considerations:

1) For the 1A1 'Energy Industry' category recalculations were performed for 1993 year as a result of some data entry errors correction, while for 2007 and 2010, due to the availability of an updated set of statistical data.

2) Regarding the 1A2 'Manufacturing Industry and Construction' category recalculations were performed for 2010 year, due to the availability of an updated set of statistical data.

3) For the 1A3 'Transport' category:

- GHG emissions originated from 1A3a 'Civil Aviation' source category were recalculated for 2001-2010 time period due to an updated set of activity data made available by the Civil Aviation Authority of the Republic of Moldova; also, to be noted that if previous activity data (expressed in thousands of tons) were included in the calculation model with an accuracy of 3 digits after the decimal point, within the current inventory cycle, AD were considered with an accuracy of 5 digits;
- GHG emission recalculations performed under the 1A3b 'Road Transportation' source category covering the 1990-2010 time period were due to the availability of an updated set of activity data, including for the ATULBD, as well as a result of separate estimation of liquefied petroleum gas, in particular regarding the calculation of non-CO_2 emissions. Previously, in the absence of a separate recording of the emissions from this particular fuel, the respective amount of fuel was accounted in common with gasoline.

4) With reference to the 1A4 'Other Sectors' category:

- GHG emission recalculations performed under the 1A4a 'Commercial / Institutional' source category covering the 1995-2004, 2007 and 2010 years were due to the availability of an updated set of activity data, including for the ATULBD, as well as due to the correction of activity data entry errors: the kerosene was incorrectly entered in the accounting files as liquefied petroleum gas;
- GHG emission recalculations performed under the 1A4b 'Residential Sector' source category covering the 1999-2000, 2006-2007 and 2009-2010 years were due to the availability of an updated set of activity data, including the ATULBD, as well as due to the identification of some mechanical errors related to data entry activities; also, in the previous inventory cycle, natural gas consumption for several years was recorded only for the territory on the Right Bank of Dniester River, without ATULBD;
- GHG emission recalculations performed under the 1A4c 'Agriculture / Forestry / Fishing' source category covering the 1997, 1999-2002, 2004, 2006-2007 and 2010 years were due to the availability of an updated set of activity data, including for the ATULBD, as well as due to the identification of some mechanical errors related to data entry activities.

5) For the 1A5 'Other' category recalculations of GHG emissions were performed for the 1990-2010 time periods due to the availability of an updated set of activity data for the Left Bank of Dniester River (ATULBD), as a result of adding AD related to military transport, as well as due to the identification of some mechanical errors related to data entry activities and use of emission factors.

6) GHG emissions from the 1B2 'Fugitive Emissions from Oil and Natural Gas' source category were recalculated covering the 1995-1999 and 2010 years, in particular due to the identification of some mechanical errors related to data entry activities.

Compared with the results recorded in the TNC, changes performed in the current inventory cycle (in the frame of the First Biennial Update Report of the Republic of Moldova under the UNFCCC) resulted in insignificant decrease of direct GHG emissions between 1992-1993, 2003-2006 and in 2008, respectively an insignificant increase in the following time series: 1990-1991, 1994-2002, 2007 and 2009-2010 (Table 9-3).

Table 9-3: Recalculations of Total Direct GHG Emissions within the Energy Sector included into the TNC of the RM under the UNFCCC, Mt CO_2 equivalent

	1990	1991	1992	1993	1994	1995	1996
TNC	34.5204	30.2204	21.3842	16.4752	15.0077	11.7107	11.9417
BUR	34.5213	30.2217	21.3789	16.4721	15.0185	11.7222	11.9472
Difference, %	0.0	0.0	0.0	0.0	0.1	0.1	0.0
	1997	1998	1999	2000	2001	2002	2003
TNC	10.7761	9.2605	7.3728	6.6623	7.2653	6.9497	7.7622
BUR	10.7884	9.2725	7.3733	6.6728	7.2688	6.9519	7.7253
Difference, %	0.1	0.1	0.0	0.2	0.0	0.0	-0.5
	2004	2005	2006	2007	2008	2009	2010
TNC	8.2344	8.5189	7.7036	7.4085	8.4274	9.0660	8.9465
BUR	8.1841	8.4684	7.6334	7.7455	8.3514	9.0709	9.6473
Difference, %	-0.6	-0.6	-0.9	4.5	-0.9	0.1	7.8

Abbreviations: TNC – Third National Communication; BUR – Biennial Update Report.

The results of recalculations performed by categories are presented also in the sub-chapters 3.2-3.9 of the NIR: 1990-2013.

9.1.2. Industrial Processes Sector

Recalculations of total direct GHG emissions from the 'Industrial Processes' Sector were performed based on the following considerations:

1) CO_2 emissions within the source category 2A3 'Limestone and Dolomite Use' were recalculated for the 2004-2010 time series, as a result of use of more accurate and precise activity data.

2) For the source category 2A7 'Other':

- Non-CO_2 emissions (NO_x, NMVOC and SO_2) from 'Glass Production' were recalculated only for 2010 years due to updated AD for glass bottles in wine making industry;
- CO_2 emissions from 'Brick and Expanded Clay Production' were recalculated for the 1990-2010 time series due to updating the AD on expanded clay production, and the amount of clay used for brick and expanded clay production, as well as due to use of a revised conversion ratio (kg of clay per one brick piece); SO_2 emissions from brick production were recalculated for the 1990-2010 time series due to updating the AD on brick production, including due to use of a revised conversion ratio (kg of clay per one conventional brick piece).

3) NMVOC emissions from the 2B5 'Other' (Polyethylene Production, Acrylonitrile Butadiene Styrene Resins (ABS) Production, Detergents Production) source category were recalculated due to updating/précising the AD on synthetic resins (ABS) production at the level of 2009 year, on polyethylene production in 2010 year, respectively on detergents production within 1992-1993, 1995-2003, and 2005-2010 years.

4) CO_2 emissions from the 2C1 'Iron and Steel Production' source category were recalculated for the 1997-2010 time series, due to updated AD, available in the Statistical Yearbooks of the RM and ATULBD; the non-CO_2 emissions from the 2C1 'Iron and Steel Production' source category were recalculated as well, in particular due to use of new emissions factors available in the EMEP/EEA Air Pollutant Emission Inventory Guidebook 2013 (NO_x – 130 g/t; CO – 1700 g/t, NMVOC – 46 g/t, SO_2 – 60 g/t, for steel production, respectively NMVOC – 7 g/t, for rolling mills production) to the detriment of those available in the CORINAIR Atmospheric Emissions Inventory Guidebook (CORINAIR, 1996, 1999) (NO_x – 200 g/t; CO – 10000 g/t, NMVOC – 90 g/t, SO_2 – 130 g/t, for steel production, respectively NO_x – 40 g/t; CO – 1 g/t, NMVOC – 30 g/t, SO_2 – 45 g/t, for rolling mills production).

5) NMVOC emissions from the 2D2 'Food and Drink' source category were recalculated for the period 1990-2010, in particular due to updating activity data on bread making and other food and alcoholic beverages based on new editions of the Statistical Yearbooks of the RM and ATULBD.

Compared with the results recorded in the TNC, changes performed in the current inventory cycle resulted in a decrease of direct GHG emissions, with a variation from a minimum of 0.7 per cent in 2008, up to a maximum of 4.0 per cent in 1993 (Table 9-4).

Table 9-4: Recalculations of Total Direct GHG Emissions within the Industrial Processes Sector included into the TNC of the RM under the UNFCCC, Mt CO_2 equivalent

	1990	1991	1992	1993	1994	1995	1996
TNC	1.9010	1.8067	1.1743	0.7701	0.6230	0.4915	0.4368
BUR	1.8420	1.7560	1.1472	0.7394	0.6077	0.4784	0.4256
Difference, %	-3.1	-2.8	-2.3	-4.0	-2.5	-2.7	-2.6
	1997	1998	1999	2000	2001	2002	2003
TNC	0.4898	0.3433	0.3086	0.2812	0.2727	0.3304	0.3828
BUR	0.4778	0.3321	0.2971	0.2702	0.2620	0.3204	0.3715
Difference, %	-2.5	-3.2	-3.7	-3.9	-3.9	-3.0	-3.0
	2004	2005	2006	2007	2008	2009	2010
TNC	0.4288	0.5684	0.6638	0.9458	1.0222	0.5201	0.5650
BUR	0.4201	0.5605	0.6563	0.9385	1.0150	0.5137	0.5594
Difference, %	-2.0	-1.4	-1.1	-0.8	-0.7	-1.2	-1.0

Abbreviations: TNC – Third National Communication; BUR – Biennial Update Report.

The results of recalculations performed by categories are presented also in the sub-chapters 4.2-4.6 of the NIR: 1990-2013.

9.1.3. Solvents and Other Products Use Sector

Recalculations of total direct GHG emissions from the 'Solvents and Other Products Use' Sector were performed based on the following considerations:

1) GHG emissions from the 3.A 'Paint Application' category were recalculated for the period from 1990 through 2010, in particular, due to updating AD regarding the production and imports of paints and varnishes.

2) GHG emissions from the 3.B 'Degreasing and Dry Cleaning' category were recalculated for 1990-2010 time series, in particular, due to updated activity data set on import of solvents in the RM.

3) GHG emissions from the 3.C 'Chemical Products, Manufacture and Processing' category were recalculated for the 1990 through 2010 time period, in particular due to using an updated data set on chemical products manufacture in the RM.

3) For the 3D 'Other' category:

- The GHG emissions from the source category 3D1 'Printing' were recalculated for the period 1991 through 1994, in particular, due to the use of an updated activity data set on ink import in the country;
- The GHG emissions from the source category 3D2 'Domestic Solvents Use' were recalculated for the period 1990 through 2010, in particular, due to employing a new EF (0.703 kg NMVOC/ per capita, characteristic for Eastern European countries) within this source category, available in the EMEP/EEA Air Pollutant Emission Inventory Guidebook 2013, in the detriment of the previously used (1.0 kg NMVOC/per capita), available in the EMEP/EEA Air Pollutant Emission Inventory Guidebook 2009;
- The GHG emissions from the source category 3D3 'Seed Oil Extraction' were recalculated for the period 1990 through 2010, in particular, due to employing a new EF (1.57 kg NMVOC/t of seeds) within this source category, available in the EMEP/EEA Air Pollutant Emission Inventory Guidebook 2013, in the detriment of the previously used (3.0 kg NMVOC/t of seeds), available in the EMEP/EEA Air Pollutant Emission Inventory Guidebook 2009; as well due to the use of an updated activity data set on total oil produced in the country (including the ATULBD), respectively on the share of refined vegetable oil;
- GHG emissions from the source category 3D3 'Use of Glues and Other Adhesives' were recalculated for the period 1990 through 2010, in particular due to employing a new EF (522 kg NMVOC/t of product) within this source category, available in the EMEP/EEA Air Pollutant Emission Inventory Guidebook 2013, in the detriment of the previously used (780 kg NMVOC/t of product), available in the EMEP/EEA Air Pollutant Emission Inventory Guidebook 2009; as well as due to the use of an updated activity data set on glues and other adhesives import in the country, between 1991 and 1994;

- GHG emissions from the source category 3D3 'Tobacco Combustion' were recalculated for the period 1990 through 2010, in particular due to employing a new EF (4.84 g NMVOC/t of tobacco, 1.8 g NO_x/t tobacco and 55.1 g CO/t tobacco) within this source category, available in the EMEP/EEA Air Pollutant Emission Inventory Guidebook 2013, in the detriment of the previously used (4.84 g NMVOC/t of tobacco, 3.5 g NO_x/t tobacco and 122 g CO/t tobacco), available in the EMEP/EEA Air Pollutant Emission Inventory Guidebook 2009.

Compared with the results recorded in the TNC, changes performed in the current inventory revealed an increasing trend of direct GHG emissions between 1990-1994 and 2006-2010 years, with a variation from a minimum of 5.0 per cent in 1994, to a maximum of 147.9 per cent in 2008; respectively a decrease between 1995 and 2005, varying from a minimum of 1.1 per cent in 2005, to a maximum of 18.3 per cent in 1998 (Table 9-5).

Table 9-5: Recalculations of Total Direct GHG Emissions within the Solvents and Other Products Use Sector included into the TNC of the RM under the UNFCCC, Mt CO_2 equivalent

	1990	1991	1992	1993	1994	1995	1996
TNC	0.0908	0.0782	0.0625	0.0508	0.0417	0.0382	0.0339
BUR	0.1261	0.1009	0.0764	0.0576	0.0438	0.0346	0.0300
Difference, %	38.9	29.0	22.2	13.4	5.0	-9.5	-11.5
	1997	1998	1999	2000	2001	2002	2003
TNC	0.0299	0.0238	0.0309	0.0316	0.0453	0.0385	0.0356
BUR	0.0258	0.0195	0.0268	0.0288	0.0426	0.0363	0.0329
Difference, %	-13.6	-18.3	-13.5	-8.8	-5.9	-5.7	-7.8
	2004	2005	2006	2007	2008	2009	2010
TNC	0.0437	0.0682	0.0482	0.0522	0.0536	0.0485	0.0539
BUR	0.0416	0.0674	0.0772	0.0981	0.1328	0.1197	0.0612
Difference, %	-4.8	-1.1	60.2	87.9	147.9	146.6	13.7

Abbreviations: TNC – Third National Communication; BUR – Biennial Update Report.

The results of recalculations performed by categories are presented also in the sub-chapters 5.2-5.5 of the NIR: 1990-2013.

9.1.4. Agriculture Sector

Recalculations of total direct GHG emissions from the 'Agriculture' Sector were performed based on the following considerations:

1) Methane emissions from the 4A 'Enteric Fermentation' category were recalculated for the 1990 through 2010 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).

2) Methane and nitrous oxide emissions from the 4B 'Manure Management' category were recalculated for the 1990 through 2010 time series, in particular due to use of an updated set of values for 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; as well as due to updating the daily ratio of volatile solid excretion on a dry-organic matter basis (kg d.m./day), as well as a result of using a Tier 2 methodology and country specific EFs for cattle and swine). N_2O emissions from the 4B 'Manure Management' source category were recalculated for the following leap years – 1992, 1996, 2000, 2008 and 2012 (using 366 days within the estimation equations), as well as for the 2002-2010 time series, in particular due to précising AD on poultry livestock in the RM.

3) For the 4D 'Agricultural Soils' category, direct N_2O emissions from crop residues returned to soil and from nitrogen mineralization associated with loss of soil carbon as a result of land-use or management practices change, respectively indirect N_2O emissions from managed soils that occur through the leaching and runoff from land of N were recalculated for the 1990 through 2010 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 as well as into the Statistical Yearbooks of the ATULBD, and in the FAO database – Food and Agriculture Organization of the United Nations), due to the use of country specific revised values (for example, the dry matter fraction of harvested crop was revised for maize for silo and green fodder,

perennial grasses for green fodder, silage and fodder and annual grasses for green fodder) since the values used in the previous inventory cycle referred to the fresh yield in dry matter, while the statistical data refer to the fresh yield in green mass; also, for the same crops, the last available data in the literature in the field were considered regarding the ratio of below-ground residues to harvested yield for crop; It should also be noted that these recalculations were due to use of revised values for the fraction of above-ground residues of crop removed annually for other purposes, as well as due to use of revised values regarding the nitrogen in crop residues for various crops (wheat, oat, barley, sugar beet, potatoes, perennial grasses for green fodder, silage and fodder and annual grasses for green fodder), based on the literature in the field.

Compared with the results recorded in the TNC, changes performed in the current inventory cycle revealed a decreasing trend of direct GHG emissions between 1990-1997 and 2002-2010, with a variation from a minimum of 0.1 per cent in 1997, to a maximum of 7.1 per cent in 1991; except for 1998-2001 years, when the direct GHG emissions increased insignificantly (Table 9-6).

Table 9-6: Recalculations of Direct GHG Emissions within the Agriculture Sector included into the TNC of the RM under the UNFCCC, Mt CO_2 equivalent

	1990	1991	1992	1993	1994	1995	1996
TNC	5.1202	5.0493	4.1542	4.0033	3.4099	3.3591	3.0718
BUR	5.0639	4.6906	4.0899	3.9268	3.3627	3.2844	3.0403
Difference, %	-1.1	-7.1	-1.5	-1.9	-1.4	-2.2	-1.0
	1997	1998	1999	2000	2001	2002	2003
TNC	2.9873	2.7318	2.4885	2.2770	2.4541	2.5246	2.1969
BUR	2.9853	2.7514	2.5192	2.2899	2.4549	2.5085	2.1956
Difference, %	-0.1	0.7	1.2	0.6	0.0	-0.6	-0.1
	2004	2005	2006	2007	2008	2009	2010
TNC	2.4012	2.3734	2.2682	1.5151	2.1177	1.9249	2.1324
BUR	2.3790	2.3588	2.2656	1.5124	2.1006	1.9181	2.1007
Difference, %	-0.9	-0.6	-0.1	-0.2	-0.8	-0.4	-1.5

Abbreviations: TNC – Third National Communication; BUR – Biennial Update Report.

The results of recalculations performed by categories are presented also in the sub-chapters 6.2-6.4 of the NIR: 1990-2013.

9.1.5. 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:

1) GHG emission recalculations under the 5.B.1.2 'Annual Change in Carbon Stocks in Mineral Soils' were performed during the 1990-2010 time periods due to the use of an updated set of activity data regarding cropland areas, total crop yield, average crop yield/per hectare (available in the database of the NBS, the Statistical Yearbooks of the ATULBD as well as in FAO database), respectively due to use of revised country specific factors. For example, the dry matter fraction of crop yield was revised for the following categories: maize for silo and green fodder, perennial grasses for green fodder, silage and fodder, respectively for annual grasses for green fodder since the values used in the previous inventory cycle referred to the dry matter of harvested crop while the statistical data refer to harvested fresh crop yield; also, for the same categories of crop, the latest data available within the literature in the field were taken into consideration regarding the ratio of above-ground residues to harvested yield for crop, as well as the fraction of above-ground residues of crop removed and used for other purposes. At the same time, for a number of crops (wheat, oats, barley, sugar beet, potatoes, perennial grasses for green fodder, silage and fodder and annual grasses for green fodder) the values related to the amount of nitrogen in crop residues were revised considering the scientific literature in the field.

2) For 1990-2010 time series recalculations for CO_2 removals within the 5C1 'Grassland Remaining Grassland' in the RM were performed. It has been used the same estimation approach, available in the Revised 1996 IPCC Guidelines (IPCC, 1997) and GPG LULUCF (IPCC, 2003), as well as the same AD set (total grassland area). However, unlike the previous cycle, within the current inventory cycle grassland area was divided in subcategories (meadows and grassland on slopes), while additionally were considered grassland areas within wetlands, as well as those subject to landslides. Simultaneously, the annual growth of biomass on grasslands was estimated considering their distribution within subcategories – grassland with high, medium or low productivity.

Compared with the results recorded in the TNC, changes performed in the current inventory cycle resulted in a decreasing trend of total CO_2 removals in 1990, 1992-1995, 1997, 2004, 2008 and 2010, with a variation from a minimum of 9.0 per cent in 1994, up to a maximum of 2613.2 per cent in 2010, respectively an increasing trend in the following time series: 1991, 1996, 1998-2003, 2005-2007 and 2009, varying from a minimum of 4.8 per cent in 1991, up to a maximum of 642.1 per cent in 2002 (Table 9-7).

Table 9-7: Recalculations of Net CO_2 Removals within the Land Use, Land-Use Change and Forestry Sector included into the TNC of the RM under the UNFCCC, Mt

	1990	1991	1992	1993	1994	1995	1996
TNC	-7.1803	-5.0801	-5.1115	-2.4168	-2.3793	-1.1608	-1.0086
BUR	-5.8866	-5.3250	-4.3844	-1.5008	-2.1641	-1.0294	-1.1666
Difference, %	-18.0	4.8	-14.2	-37.9	-9.0	-11.3	15.7
	1997	1998	1999	2000	2001	2002	2003
TNC	0.1729	-0.1902	-0.5607	-0.7832	-0.2808	-0.0718	-1.0466
BUR	-0.1369	-0.7226	-1.1349	-1.3922	-0.7500	-0.5327	-1.5547
Difference, %	-179.2	279.9	102.4	77.8	167.1	642.1	48.5
	2004	2005	2006	2007	2008	2009	2010
TNC	0.3096	-0.1046	-0.4032	-2.6128	0.1299	-0.8721	0.0261
BUR	-0.1032	-0.3754	-0.6391	-3.0660	-0.0595	-1.2849	-0.6571
Difference, %	-133.3	259.0	58.5	17.3	-145.8	47.3	-2613.2

Abbreviations: TNC – Third National Communication; BUR – Biennial Update Report.

The results of recalculations performed by categories are presented also in the sub-chapters 7.2-7.4 of the NIR: 1990-2013.

9.1.6. Waste Sector

Recalculations of total direct GHG emissions from the Waste Sector were performed based on the following considerations:

1) The CH_4 emissions from the 6A1 "Solid Waste Disposal on Land' source category were recalculated for the 1990 through 2010 time series, in particular due to use of updated set of activity data regarding the generation of solid waste on the left bank of the Dniester River available in the Annual Activity Reports of the Ministry of Agriculture and Natural Resources of the ATULBD, in the Annual Activity Reports of the ATULBD's local public authorities as well as in the sectoral statistics. Also, the AD regarding the amount of disposed industrial waste within the same period were revised.

2) For the 6B 'Wastewater Handling' category:

- The CH_4 emissions from the 6B 'Wastewater Handling' category were recalculated for the 1995 through 2010 time series, in particular due to use an updated set of activity data related to industrial output in the RM, available in the new editions of the Statistical Yearbooks of the RM and those of the ATULBD;
- N_2O emissions from the 6B2 'Domestic Wastewater' (Human Sewage) were recalculated for the 1990 through 2010 time series, in particular due to reassessment of protein consumption (grams of protein/per capita/per day) and also due to use of an updated set of activity data, available on FAO webpage.

Compared with the results recorded in the, changes performed in the current inventory cycle revealed an increasing trend of direct GHG emissions between 1990-1997 years, with a variation from a minimum of 0.3 per cent in 1997, to a maximum of 14.6 per cent in 1990; respectively a decrease between 1998 and 2010 years, varying from a minimum of 0.5 per cent in 2010, to a maximum of 11.8 per cent in 2003 (Table 9-8).

Table 9-8: Recalculations of Direct GHG Emissions within the Waste Sector included into the TNC of the RM under the UNFCCC, Mt CO_2 equivalent

	1990	1991	1992	1993	1994	1995	1996
TNC	1.6274	1.7563	1.8727	1.8665	1.8213	1.7815	1.8143
BUR	1.8655	1.9782	2.0621	2.0221	1.9587	1.9044	1.8209
Difference, %	14.6	12.6	10.1	8.3	7.5	6.9	0.4
	1997	1998	1999	2000	2001	2002	2003
TNC	1.7432	1.6841	1.7503	1.6586	1.5517	1.4812	1.4650
BUR	1.7483	1.6686	1.5555	1.4690	1.3927	1.3247	1.2920
Difference, %	0.3	-0.9	-11.1	-11.4	-10.2	-10.6	-11.8

	2004	2005	2006	2007	2008	2009	2010
TNC	1.4430	1.4111	1.4343	1.4678	1.5007	1.5649	1.5783
BUR	1.2795	1.2978	1.3109	1.3640	1.4589	1.5145	1.5707
Difference, %	-11.3	-8.0	-8.6	-7.1	-2.8	-3.2	-0.5

Abbreviations: TNC – Third National Communication; BUR – Biennial Update Report.

The results of recalculations performed by categories are presented also in the sub-chapters 8.2-8.3 of the NIR: 1990-2013.

9.2. 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.

9.2.1. 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 in 2016;
- 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 a „Report on the National GHG Inventory System of the Republic of Moldova" which would contain information according to six national system 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, in particular within the energy sector, as well as for the LULUCF sector (for example, the employees of the Institute of Power Engineering of the Academy of Sciences of Moldova, the Technical University of Moldova, National Bureau of Statistics, „Termoelectrica" J.S.C., „Moldovagaz" J.S.C., SE State Information Resources Center „REGISTRU" etc.; respectively the employees of the Forest Research and Management Institute, Agency „Moldsilva", Land Relations and Cadaster Agency, Institute of Pedology, Agrochemistry and Soil Protection „Nicolae Dimo", Agrarian University of Moldova, etc.), by organizing a series of seminars and thematic trainings by the end of 2015;
- Developing a data management system for tracking and archiving the inventory information used in each inventory cycle by the end of 2016 year;
- Gradual transition to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories in all sectors and 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.

9.2.2. Planned Improvements

Energy Sector

Potential improvements within the ‚Energy Sector' could be achieved once:

- new AD regarding the fuel consumption for heat generation in the ATULBD are available;
- new data related to fugitive leaks from oil and natural gas distribution networks are available (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.);

- switching to a higher level methodology (Tier 2 and Tier 3 replacing Tier 1) in order to estimate direct GHG emissions within the 1A1 'Energy Industries', 1A3 'Transport' and 'International Aviation' source categories; currently, the opportunities offered by respective methodologies were studied, the necessary AD as well as the gaps within these data were identified and it was revealed that the respective data do not permit the assessment of direct GHG emissions for the entire reference period (1990-2013), but only for the last few years (2009/2010-2013);
- collecting more accurate AD for the Right Bank of Dniester River, including for the period previous to 2010 (AD on biomass consumption were recently revised by the NBS using a new methodology, though it did not covered the entire period from 1990 to 2009, revealing thus a 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 Sector

Monitoring the GHG emissions from the Industrial Processes Sector is planned to be improved along with:

- updating/précising the activity data used to estimate GHG emissions within the source categories 2A 'Mineral Products', 2B 'Chemical Industry', 2C 'Metal Production', 2D 'Other Production' and 2F 'Consumption of Halocarbons and Sulphur Hexafluoride';
- specifying some EFs values used to estimate GHG emissions from the 2F 'Consumption of Halocarbons and Sulphur Hexafluoride' category in the Republic of Moldova (e.g. the volume and type of blowing agents used in foam blowing products imported in the country, etc.).

Solvents and Other Products Use Sector

Monitoring the GHG emissions from the Solvents and Other Product Use Sector is planned to be improved along with:

- updating and précising activity data used to estimate GHG emissions from all source categories within the Solvents and Other Products Use Sector;
- collecting AD for other source categories, for which, currently, there are no information available in the statistical publications.

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 for the livestock breeding sector of the RM for the entire period under review;
- précising AD and productivity indicators used to estimate the country specific emission factors following a Tier 2 methodology within the source categories 4A 'Enteric Fermentation' and 4B 'Manure Management';
- development of a nationwide study related to manure management in order to specify the share of different manure management systems (MS%), currently applied in the livestock sector of the Republic of Moldova;
- précising the country specific N excreted rates for different categories (kg N/head/year) in the RM;
- collecting higher quality activity information and country specific parameters and coefficients used to estimate direct N_2O emissions from crop residues returned to soils in the RM, as well as those from nitrogen mineralization associated with loss of soil carbon resulting from land-use or management change.

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:

- For 5A 'Forest Land' source category : improving record keeping pertaining to distribution of forests by species, actual consumption of fuel wood from the forests of the Republic of Moldova, as well as verification of country specific emission/removal factors and coefficients (annual net increment in volume suitable for industrial processing, basic wood density, biomass expansion factors, etc.);

- For 5B1.1 'Cropland Covered with Woody Vegetation' source category: improving record keeping pertaining to actual consumption of wood mass from forest belts and other types of forest vegetation, as well as verification of country specific emission/removal factors and coefficients (such as: annual biomass increments, biomass harvesting during the cleaning cuttings of perennial plantations, etc.);
- For 5B1.2 'Annual Change in Carbon Stocks in Mineral Soils' source category: improving the quality of activity data used to estimate CO_2 emissions/removals;
- improving the quality of activity data used to estimate non-CO_2 emissions from category 5B'Cropland' - 'Post-harvest field burning of agricultural residues' (stubble fields burning);
- For 5C 'Grassland' category: improving the cadastral records (as a main source of activity data) by specifying the land use categories to which converted lands are transferred to.

Waste Sector

Monitoring the direct GHG emissions from the Waste Sector is planned to be improved along with:

- the need to promote statistical accounting of the generated waste, focused on the main criterion of relevance and comparability among the EU member states, as well as to improve the quality of activity data pertaining to the amount of generated and disposed municipal solid waste and industrial waste;
- the essential restructuring of waste management in the RM through the transposition of the Resolution 2000/532/EC of the EU Commission regarding the 'Waste List';
- improving the national statistical records on waste generation and the quality of AD on the amount of generated and disposed municipal solid waste, industrial waste etc., used to estimate methane emissions within the source category 6A 'Solid Waste Disposal on Land';
- the adoption of the 'Waste List', and efficient reporting on its consistent implementation;
- proper implementation of *Waste Management Strategy of the Republic of Moldova for 2013-2027 years* and the development of integrated municipal waste management systems 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.);
- to promote and implement selective waste collection in all areas, both in domestic sector and in the production sector, as well as waste sorting, composting and recycling facilities;
- the development of waste disposal capacities by creating 7 new SWD landfills at a regional level and 2 new mechanical-biological treatment plants for Chisinau and Balti municipalities;
- proper implementation of the Strategy on Water Supply and Sanitation for 2014-2028, recently approved by the Government through Decision No. 199 dated 20.03.2014;
- developing, promoting and approving at a regional level of *Regional plans for water and sanitation* (Central, Southern and Northern Development Regions);
- improvements within the wastewater handling sector could be possible by applying clearly defined regulatory, institutional and economic instruments:
    - o *Regulatory instruments* will focus on a set of normative laws (the Water Law No. 272 dated 23.12.2011, the draft *Law on municipal water supply and sanitation services*, the set of secondary legislation to the *Water Law*, regional plans drafts 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;
    - o *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 Hancesti, Soroca, Floresti, Ceadar-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 (ANRE/NAER), which will exercise a major impact in regulating the functioning of the sector. These institutional instruments will determine the sustainability of sector management;

  - o *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.

- RM needs to fulfill 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 cycles it is planned to study the possibility of using country specific information on fraction of BOD removed with the sludge, maximum methane producing capacity, methane correction factor, fraction of wastewater and sludge treated by different handling systems and other relevant parameters used to estimate methane emissions from the 6B 'Wastewater Handling' category.

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ANNEXES

Annex 1. Key Categories

Annex 1-1: Key Categories - Methodology

Both the IPCC Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories (IPCC, 2000) and the IPCC Good Practice Guidance for Land Use, Land-Use Change and Forestry (IPCC, 2003) recommend as 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 "one that is prioritize within the national inventory system because its estimates 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" (IPCC, 2000).

This annex describes the category analysis conducted for the Republic of Moldova's inventory (covering the 1990-2013 periods), according to IPCC approaches.

Good Practice first requires that inventories be disaggregated into categories from which key sources and sinks may be identified. Source and sink categories are defined according to the following guidelines:

- IPCC categories should be used with emissions specified in CO_2 equivalent units according to standard GWPs;
- 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 categories for key sources and sinks proceeds according to the Tier 1 Good Practice Guidance approaches of IPCC (2000, 2003). Using the Tier 1 method, key categories were identified by quantitative methods using a predetermined cumulative emission threshold.

The quantitative approach identifies key categories from two perspectives. The first analyses the emission contribution that each category makes to the national total (with and without LULUCF). 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 (with and without LULUCF categories). 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. IPCC 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 method of determining key categories (IPCC, 2000). 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.

Level contribution of each source is calculated according to Equation A1– 1, which follows IPCC (2000), whereas Equation A1– 2 is used to calculate the level contribution from both sources and sinks following IPCC (2003):

Equation A1-1.1 for source category level assessment:

$$L_{x,t} = E_{x,t}/E_t$$

Where:

$L_{x,t}$ – the level assessment for source x in year t;

$E_{x,t}$ – the emission estimate (CO_2 eq.) estimate of source category x in year t

E_t – the total inventory estimate (CO_2 eq.) in year *t*

Equation A1-1.2 for source/sink category level assessment:

$$L_{x,t}^* = E_{x,t}^* / E_t^*$$

Where:

$L_{x,t}^*$ – level assessment for source or sink x in year t. The asterisk (*) indicates that contributions from all categories (including LULUCF) are entered as absolute values (i.e. negative values are always recorded as the equivalent positive values);

$E_{x,t}^*$ – $E_{x,t}|$ the absolute value of the emission or removal estimate of source or sink category x in year t;

E_t^* – $\Sigma |E_t|$ total contribution, which is the sum of the absolute values of all emissions and removals in year t.

Trend contribution of each source is calculated according to Equation A1– 3, which follows IPCC (2000), whereas Equation A1– 4 is used to calculate the trend contribution from both sources and sinks following IPCC (2003):

Equation A1-1.3 for source category trend assessment:

$$T_{x,t} = L_{x,t} \bullet |\{[(E_{x,t} - E_{x,0})/E_{x,t}] - [(E_t - E_0) / E_t]\}|$$

Where:

$T_{x,t}$ – the contribution of the source category trend to the overall inventory trend (i.e. the trend assessment); the contribution is always recorded as an absolute value;

$L_{x,t}$ – the level assessment for source x in year t (derived in Equation A1-1.1);

$E_{x,t}$ and $E_{x,0}$ – the emissions estimates of source category x in years t and 0, respectively;

E_t and E_0 – the total inventory estimates in years t and 0, respectively.

Equation A1-1.4 for source and sink category trend assessment:

$$T_{x,t} = E_{x,t}^*/E_t \bullet |\{[(E_{x,t} - E_{x,0})/E_{x,t}] - [(E_t - E_0) / E_t]\}|$$

Where:

$T_{x,t}$ – trend assessment, which is the contribution of the source or sink category trend to the overall inventory trend (i.e. the trend assessment); the trend assessment is always recorded as an absolute value (i.e. the trend assessment); the contribution is always recorded as an absolute value);

$E_{x,t}^*$ – $|E_{x,t}|$: absolute value of the emission or removal estimate of source or sink category x in year t;

$E_{x,t}$ and $E_{x,0}$ – real values of estimates of source or sink category x in years t and 0, respectively;

E_t and E_0 – ΣE_t and ΣE_0 total inventory estimates in years t and 0, respectively; E_t differs from E_t^* in Equation A1-1.2 in that the removals are not entered as absolute values.

The key category analysis was performed using the Key Categories Estimation Tool developed by the United States Environment Protection Agency (US EPA).

Annex 1-2: 1990 year Key Category Tier 1 Analysis – Level Assessment, without LULUCF

Inventory Categories	Inventory Sector	Base Year Estimate (Gg CO2 eq.)	Total	Cumulative Sum	Status
CO2 Emissions from Energy Industries - Oil	Energy	6785.7360	15.63%	15.63%	key category
CO2 Emissions from Energy Industries - Coal	Energy	6394.4000	14.73%	30.36%	key category
CO2 Emissions from Energy Industries - Gas	Energy	6152.6295	14.17%	44.53%	key category
CO2 Other Sectors: Residential	Energy	4407.6336	10.15%	54.68%	key category
CO2 Mobile Combustion: Road Vehicles	Energy	3364.2178	7.75%	62.43%	key category
CO2 Emissions from Manufacturing Industries and Construction	Energy	2188.7285	5.04%	67.47%	key category
CO2 Other Sectors: Agriculture/Forestry/Fishing	Energy	1942.3629	4.47%	71.94%	key category
CH4 Emissions from Enteric Fermentation in Domestic Livestock	Agriculture	1840.2088	4.24%	76.18%	key category
CH4 Emissions from Solid Waste Disposal Sites	Waste	1544.2480	3.56%	79.74%	key category
CO2 Other Sectors: Commercial/Institutional	Energy	1412.4933	3.25%	82.99%	key category
N2O Direct Emissions from Agriculutural Soils	Agriculture	1167.9904	2.69%	85.68%	key category
N2O Direct Emissions from Manure Management	Agriculture	1116.3560	2.57%	88.25%	key category
CO2 Emissions from Cement Production	Industrial Processes	971.7056	2.24%	90.49%	key category
CH4 Fugitive Emissions from Oil and Gas Operations	Energy	682.2942	1.57%	92.06%	key category
CO2 Emissions from Limestone and Dolomite Use	Industrial Processes	619.4733	1.43%	93.49%	key category
CO2 Mobile Combustion: Railways	Energy	452.3598	1.04%	94.53%	key category
N2O Indirect Emissions from Agriculutural Soils	Agriculture	365.0744	0.84%	95.37%	key category
CH4 Emissions from Manure Management	Agriculture	308.7371	0.71%	96.08%	non key category
N2O Indirect Emissions from Manure Management	Agriculture	265.5323	0.61%	96.69%	non key category
CH4 Other Sectors: Residential	Energy	230.2856	0.53%	97.22%	non key category
CH4 Emissions from Wastewater Handling	Waste	215.6014	0.50%	97.72%	non key category
CO2 Other (Energy)	Energy	154.2715	0.36%	98.07%	non key category
CO2 Emissions from Lime Production	Industrial Processes	148.6611	0.34%	98.42%	non key category
N2O Emissions from Wastewater Handling	Waste	105.6201	0.24%	98.66%	non key category
CO2 Mobile Combustion: Other (Pipeline Transport)	Energy	91.1782	0.21%	98.87%	non key category
CO2 Emissions from Degreasing and Dry Cleaning	SOPU	62.7662	0.14%	99.01%	non key category
N2O Mobile Combustion: Railways	Energy	54.1488	0.12%	99.14%	non key category
N2O (Non-CO2) Emissions from Energy Industries	Energy	51.2316	0.12%	99.26%	non key category
N2O Mobile Combustion: Road Vehicles	Energy	50.1981	0.12%	99.37%	non key category
CO2 Emissions from Brick Production	Industrial Processes	49.4409	0.11%	99.49%	non key category
CO2 Emissions from Paint Application	SOPU	41.5890	0.10%	99.58%	non key category
CO2 Emissions from Soda Ash Production and Use	Industrial Processes	32.9560	0.08%	99.66%	non key category
CH4 Mobile Combustion: Road Vehicles	Energy	24.8796	0.06%	99.71%	non key category
N2O Other Sectors: Residential	Energy	19.4047	0.04%	99.76%	non key category
CO2 Mobile Combustion Water Borne Navigation	Energy	18.9048	0.04%	99.80%	non key category
CO2 Emissions from Other Products	SOPU	14.0135	0.03%	99.84%	non key category
CO2 Emissions from the Iron and Steel Industry	Industrial Processes	11.7182	0.03%	99.86%	non key category
CH4 (Non-CO2) Emissions from Energy Industries	Energy	9.2887	0.02%	99.88%	non key category
CH4 Other Sectors: Agriculture/Forestry/Fishing	Energy	8.9856	0.02%	99.90%	non key category
CO2 Emissions from Mineral Wool Production	Industrial Processes	8.0816	0.02%	99.92%	non key category
CO2 Emissions from Chemical Products, Manufacture and Processing	SOPU	7.7278	0.02%	99.94%	non key category
N2O Other Sectors: Commercial/Institutional	Energy	6.3499	0.01%	99.96%	non key category
CH4 Other Sectors: Commercial/Institutional	Energy	5.2253	0.01%	99.97%	non key category
N2O Emissions from Manufacturing Industries and Construction	Energy	5.1641	0.01%	99.98%	non key category
N2O Other Sectors: Agriculture/Forestry/Fishing	Energy	5.0378	0.01%	99.99%	non key category
CH4 Emissions from Manufacturing Industries and Construction	Energy	2.0005	0.00%	100.00%	non key category
CO2 Fugitive Emissions from Oil and Gas Operation	Energy	0.6377	0.00%	100.00%	non key category
CH4 Mobile Combustion: Railways	Energy	0.5323	0.00%	100.00%	non key category
N2O Other (Energy)	Energy	0.4911	0.00%	100.00%	non key category
N2O Mobile Combustion Water Borne Navigation	Energy	0.1582	0.00%	100.00%	non key category
CH4 Other (Energy)	Energy	0.0484	0.00%	100.00%	non key category
CH4 Mobile Combustion Water Borne Navigation	Energy	0.0375	0.00%	100.00%	non key category
N2O Emissions from Use of N2O for Anaesthesia	SOPU	0.0205	0.00%	100.00%	non key category
N2O Fugitive Emissions from Oil and Gas Operation	Energy	0.0002	0.00%	100.00%	non key category
Total			100.00%		

Annex 1-3: 1990 year Key Category Tier 1 Analysis – Level Assessment, with LULUCF

Inventory Categories	Inventory Sector	Base Year Estimate (Gg CO2 eq.)	Total	Cumulative Sum	Status
CO2 Emissions from Energy Industries - Oil	Energy	6785.7360	13.76%	13.76%	key category
CO2 Emissions from Energy Industries - Coal	Energy	6394.4000	12.97%	26.73%	key category
CO2 Emissions from Energy Industries - Gas	Energy	6152.6295	12.48%	39.21%	key category
CO2 Other Sectors: Residential	Energy	4407.6336	8.94%	48.14%	key category
CO2 Mobile Combustion: Road Vehicles	Energy	3364.2178	6.82%	54.97%	key category
CO2 from Croplands remaining Croplands	LULUCF	-2216.0460	4.49%	59.46%	key category
CO2 from Forest Land remaining Forest Land	LULUCF	-2197.5790	4.46%	63.92%	key category
CO2 Emissions from Manufacturing Industries and Construction	Energy	2188.7285	4.44%	68.35%	key category
CO2 Other Sectors: Agriculture/Forestry/Fishing	Energy	1942.3629	3.94%	72.29%	key category
CH4 Emissions from Enteric Fermentation in Domestic Livestock	Agriculture	1840.2088	3.73%	76.03%	key category
CH4 Emissions from Solid Waste Disposal Sites	Waste	1544.2480	3.13%	79.16%	key category
CO2 from Grassland remaining Grassland	LULUCF	-1469.8567	2.98%	82.14%	key category
CO2 Other Sectors: Commercial/Institutional	Energy	1412.4933	2.86%	85.00%	key category
N2O Direct Emissions from Agriculutural Soils	Agriculture	1167.9904	2.37%	87.37%	key category
N2O Direct Emissions from Manure Management	Agriculture	1116.3560	2.26%	89.63%	key category
CO2 Emissions from Cement Production	IP	971.7056	1.97%	91.60%	key category
CH4 Fugitive Emissions from Oil and Gas Operations	Energy	682.2942	1.38%	92.99%	key category
CO2 Emissions from Limestone and Dolomite Use	IP	619.4733	1.26%	94.24%	key category
CO2 Mobile Combustion: Railways	Energy	452.3598	0.92%	95.16%	key category
N2O Indirect Emissions from Agriculutural Soils	Agriculture	365.0744	0.74%	95.90%	non key category
CH4 Emissions from Manure Management	Agriculture	308.7371	0.63%	96.53%	non key category
N2O Indirect Emissions from Manure Management	Agriculture	265.5323	0.54%	97.07%	non key category
CH4 Other Sectors: Residential	Energy	230.2856	0.47%	97.53%	non key category
CH4 Emissions from Wastewater Handling	Waste	215.6014	0.44%	97.97%	non key category
CO2 Other (Energy)	Energy	154.2715	0.31%	98.28%	non key category
CO2 Emissions from Lime Production	IP	148.6611	0.30%	98.59%	non key category
N2O Emissions from Wastewater Handling	Waste	105.6201	0.21%	98.80%	non key category
CO2 Mobile Combustion: Other (Pipeline Transport)	Energy	91.1782	0.18%	98.98%	non key category
CO2 Emissions from Degreasing and Dry Cleaning	SOPU	62.7662	0.13%	99.11%	non key category
N2O Mobile Combustion: Railways	Energy	54.1488	0.11%	99.22%	non key category
N2O Emissions from Energy Industries	Energy	51.2316	0.10%	99.33%	non key category
N2O Mobile Combustion: Road Vehicles	Energy	50.1981	0.10%	99.43%	non key category
CO2 Emissions from Brick Production	IP	49.4409	0.10%	99.53%	non key category
CO2 Emissions from Paint Application	SOPU	41.5890	0.08%	99.61%	non key category
CH4 Emissions from Soda Ash Production and Use	IP	32.9560	0.07%	99.68%	non key category
CH4 Mobile Combustion: Road Vehicles	Energy	24.8796	0.05%	99.73%	non key category
N2O Other Sectors: Residential	Energy	19.4047	0.04%	99.77%	non key category
CO2 Mobile Combustion Water Borne Navigation	Energy	18.9048	0.04%	99.81%	non key category
CO2 Emissions from Other Products	SOPU	14.0135	0.03%	99.84%	non key category
CO2 Emissions from the Iron and Steel Industry	IP	11.7182	0.02%	99.86%	non key category
CH4 Emissions from Energy Industries	Energy	9.2887	0.02%	99.88%	non key category
CH4 Other Sectors: Agriculture/Forestry/Fishing	Energy	8.9856	0.02%	99.90%	non key category
CO2 Emissions from Mineral Wool Production	IP	8.0816	0.02%	99.91%	non key category
CO2 Emissions from Chemical Products, Manufacture and Processing	SOPU	7.7278	0.02%	99.93%	non key category
CO2 from Wetland remaining Wetland	LULUCF	-6.3800	0.01%	99.94%	non key category
N2O Other Sectors: Commercial/Institutional	Energy	6.3499	0.01%	99.95%	non key category
CH4 Other Sectors: Commercial/Institutional	Energy	5.2253	0.01%	99.96%	non key category
N2O Emissions from Manufacturing Industries and Construction	Energy	5.1641	0.01%	99.98%	non key category
N2O Other Sectors: Agriculture/Forestry/Fishing	Energy	5.0378	0.01%	99.99%	non key category
CH4 from Croplands remaining Croplands	LULUCF	2.0547	0.00%	99.99%	non key category
CH4 Emissions from Manufacturing Industries and Construction	Energy	2.0005	0.00%	99.99%	non key category
N2O from Croplands remaining Croplands	LULUCF	0.7864	0.00%	100.00%	non key category
CO2 Fugitive Emissions from Oil and Gas Operation	Energy	0.6377	0.00%	100.00%	non key category
CH4 Mobile Combustion: Railways	Energy	0.5323	0.00%	100.00%	non key category
N2O Other (Energy)	Energy	0.4911	0.00%	100.00%	non key category
CH4 from Forest Land remaining Forest Land	LULUCF	0.2347	0.00%	100.00%	non key category
N2O from Forest Land remaining Forest Land	LULUCF	0.1917	0.00%	100.00%	non key category
N2O Mobile Combustion Water Borne Navigation	Energy	0.1582	0.00%	100.00%	non key category
CH4 Other (Energy)	Energy	0.0484	0.00%	100.00%	non key category
CH4 Mobile Combustion Water Borne Navigation	Energy	0.0375	0.00%	100.00%	non key category
N2O Emissions from Use of N2O for Anaesthesia	SOPU	0.0205	0.00%	100.00%	non key category
N2O Fugitive Emissions from Oil and Gas Operation	Energy	0.0002	0.00%	100.00%	non key category
Total			100.00%		

Annex 1-4: 2013 year Key Category Tier 1 Analysis – Level Assessment, without LULUCF

Inventory Categories	Inventory Sector	2013 Year Estimate (Gg CO2 eq.)	Total	Cumulative Sum	Status	Inventory Categories
CO2 Emissions from Energy Industries - Gas	Energy	6152.6295	2753.2020	21.45%	21.45%	key category
CO2 Mobile Combustion: Road Vehicles	Energy	3364.2178	1759.1150	13.70%	35.15%	key category
CH4 Emissions from Solid Waste Disposal Sites	Waste	1544.2480	1343.8942	10.47%	45.62%	key category
CO2 Other Sectors: Residential	Energy	4407.6336	1309.0059	10.20%	55.82%	key category
N2O Direct Emissions from Agricultural Soils	Agriculture	1167.9904	908.0039	7.07%	62.89%	key category
CO2 Emissions from Manufacturing Industries and Construction	Energy	2188.7285	607.6708	4.73%	67.63%	key category
CH4 Emissions from Enteric Fermentation in Domestic Livestock	Agriculture	1840.2088	541.2669	4.22%	71.84%	key category
CH4 Fugitive Emissions from Oil and Gas Operations	Energy	682.2942	520.6450	4.06%	75.90%	key category
CO2 Emissions from Cement Production	IP	971.7056	476.9147	3.72%	79.62%	key category
CO2 Other Sectors: Commercial/Institutional	Energy	1412.4933	471.6212	3.67%	83.29%	key category
CO2 Emissions from Energy Industries - Coal	Energy	6394.4000	470.1322	3.66%	86.95%	key category
N2O Direct Emissions from Manure Management	Agriculture	1116.3560	328.6530	2.56%	89.51%	key category
N2O Indirect Emissions from Agricultural Soils	Agriculture	365.0744	227.3876	1.77%	91.28%	key category
CO2 Other Sectors: Agriculture/Forestry/Fishing	Energy	1942.3629	164.9499	1.29%	92.57%	key category
CH4 Emissions from Wastewater Handling	Waste	215.6014	136.4857	1.06%	93.63%	key category
HFCs Emissions from Refrigeration and Air Conditioning Equipment	IP	0.0000	96.9365	0.76%	94.39%	key category
N2O Emissions from Wastewater Handling	Waste	105.6201	85.4174	0.67%	95.05%	key category
CO2 Emissions from Energy Industries - Oil	Energy	6785.7360	84.8480	0.66%	95.71%	non key category
CH4 Other Sectors: Residential	Energy	230.2856	84.5901	0.66%	96.37%	non key category
N2O Indirect Emissions from Manure Management	Agriculture	265.5323	66.9478	0.52%	96.89%	non key category
CO2 Mobile Combustion: Railways	Energy	452.3598	62.3858	0.49%	97.38%	non key category
CH4 Emissions from Manure Management	Agriculture	308.7371	54.4662	0.42%	97.80%	non key category
HFCs Emissions from Foam Blowing	IP	0.0000	45.1716	0.35%	98.16%	non key category
CO2 Other (Energy)	Energy	154.2715	30.3317	0.24%	98.39%	non key category
CO2 Emissions from Degreasing and Dry Cleaning	SOPU	62.7662	29.9961	0.23%	98.63%	non key category
N2O Mobile Combustion: Road Vehicles	Energy	50.1981	27.7130	0.22%	98.84%	non key category
CO2 Emissions from Paint Application	SOPU	41.5890	20.4569	0.16%	99.00%	non key category
CO2 Emissions from Soda Ash Production and Use	IP	32.9560	15.5217	0.12%	99.12%	non key category
N2O Other Sectors: Residential	Energy	19.4047	15.2511	0.12%	99.24%	non key category
CO2 Emissions from Limestone and Dolomite Use	IP	619.4733	14.3708	0.11%	99.35%	non key category
CO2 Emissions from Brick Production	IP	49.4409	13.4504	0.10%	99.46%	non key category
CO2 Mobile Combustion: Other (Pipeline Transport)	Energy	91.1782	13.2968	0.10%	99.56%	non key category
CO2 Emissions from Other Products	SOPU	14.0135	11.4896	0.09%	99.65%	non key category
N2O Mobile Combustion: Railways	Energy	54.1488	7.4678	0.06%	99.71%	non key category
CH4 Mobile Combustion: Road Vehicles	Energy	24.8796	6.6527	0.05%	99.76%	non key category
CO2 Emissions from Chemical Products, Manufacture and Processing	SOPU	7.7278	4.6492	0.04%	99.80%	non key category
N2O Emissions from Energy Industries	Energy	51.2316	4.3651	0.03%	99.83%	non key category
CO2 Emissions from Lime Production	IP	148.6611	4.0523	0.03%	99.86%	non key category
CO2 Emissions from the Iron and Steel Industry	IP	11.7182	3.1441	0.02%	99.89%	non key category
CH4 Other Sectors: Commercial/Institutional	Energy	5.2253	2.7585	0.02%	99.91%	non key category
CO2 Emissions from Expanded Clay Production	IP	0.0000	2.2411	0.02%	99.93%	non key category
CO2 Fugitive Emissions from Oil and Gas Operation	Energy	0.6377	2.1589	0.02%	99.94%	non key category
N2O Emissions from Manufacturing Industries and Construction	Energy	5.1641	1.4119	0.01%	99.95%	non key category
CH4 Emissions from Energy Industries	Energy	9.2887	1.3734	0.01%	99.97%	non key category
N2O Other Sectors: Commercial/Institutional	Energy	6.3499	1.0959	0.01%	99.97%	non key category
CH4 Other Sectors: Agriculture/Forestry/Fishing	Energy	8.9856	0.8209	0.01%	99.98%	non key category
SF6 Emissions from Electrical Equipment	IP	0.0000	0.6803	0.01%	99.99%	non key category
CH4 Emissions from Manufacturing Industries and Construction	Energy	2.0005	0.6760	0.01%	99.99%	non key category
N2O Other Sectors: Agriculture/Forestry/Fishing	Energy	5.0378	0.4452	0.00%	99.99%	non key category
CO2 Mobile Combustion Water Borne Navigation	Energy	18.9048	0.2710	0.00%	100.00%	non key category
CO2 Mobile Combustion: Civil Aviation	Energy	0.0000	0.1966	0.00%	100.00%	non key category
N2O Other (Energy)	Energy	0.4911	0.0862	0.00%	100.00%	non key category
HFCs Emissions from Aerosols	IP	0.0000	0.0791	0.00%	100.00%	non key category
CH4 Mobile Combustion: Railways	Energy	0.5323	0.0734	0.00%	100.00%	non key category
PFCs Emissions from Electrical Equipment	IP	0.0000	0.0273	0.00%	100.00%	non key category
N2O Fugitive Emissions from Oil and Gas Operation	Energy	0.0002	0.0053	0.00%	100.00%	non key category
N2O Mobile Combustion Water Borne Navigation	Energy	0.1582	0.0023	0.00%	100.00%	non key category
N2O Mobile Combustion: Civil Aviation	Energy	0.0000	0.0017	0.00%	100.00%	non key category
CH4 Other (Energy)	Energy	0.0484	0.0009	0.00%	100.00%	non key category
CH4 Mobile Combustion Water Borne Navigation	Energy	0.0375	0.0005	0.00%	100.00%	non key category
CH4 Mobile Combustion: Civil Aviation	Energy	0.0000	0.0000	0.00%	100.00%	non key category
N2O Emissions from Use of N2O for Anaesthesia	SOPU	8.0816	0.0000	0.00%	100.00%	non key category
CO2 Emissions from Mineral Wool Production	IP	0.0205	0.0000	0.00%	100.00%	non key category
Total				100.00%		

Annex 1-5: 2013 year Key Category Tier 1 Analysis – Level Assessment, with LULUCF

Inventory Categories	Inventory Sector	2013 year Estimate (Gg CO2 eq.)	Total	Cumulative Sum	Status	Inventory Categories
CO2 from Croplands remaining Croplands	LULUCF	-2216.0460	3245.4858	16.70%	16.70%	key category
CO2 Emissions from Energy Industries - Gas	Energy	6152.6295	2753.2020	14.16%	30.86%	key category
CO2 from Forest Land remaining Forest Land	LULUCF	-2197.5790	-1887.6165	9.71%	40.57%	key category
CO2 Mobile Combustion: Road Vehicles	Energy	3364.2178	1759.1150	9.05%	49.62%	key category
CO2 from Grassland remaining Grassland	LULUCF	-1469.8567	-1461.3867	7.52%	57.14%	key category
CH4 Emissions from Solid Waste Disposal Sites	Waste	1544.2480	1343.8942	6.91%	64.06%	key category
CO2 Other Sectors: Residential	Energy	4407.6336	1309.0059	6.73%	70.79%	key category
N2O Direct Emissions from Agriculutural Soils	Agriculture	1167.9904	908.0039	4.67%	75.46%	key category
CO2 Emissions from Manufacturing Industries and Construction	Energy	2188.7285	607.6708	3.13%	78.59%	key category
CH4 Emissions from Enteric Fermentation in Domestic Livestock	Agriculture	1840.2088	541.2669	2.78%	81.38%	key category
CH4 Fugitive Emissions from Oil and Gas Operations	Energy	682.2942	520.6450	2.68%	84.05%	key category
CO2 Emissions from Cement Production	IP	971.7056	476.9147	2.45%	86.51%	key category
CO2 Other Sectors: Commercial/Institutional	Energy	1412.4933	471.6212	2.43%	88.93%	key category
CO2 Emissions from Energy Industries - Coal	Energy	6394.4000	470.1322	2.42%	91.35%	key category
N2O Direct Emissions from Manure Management	Agriculture	1116.3560	328.6530	1.69%	93.04%	key category
N2O Indirect Emissions from Agriculutural Soils	Agriculture	365.0744	227.3876	1.17%	94.21%	key category
CO2 Other Sectors: Agriculture/Forestry/Fishing	Energy	1942.3629	164.9499	0.85%	95.06%	key category
CH4 Emissions from Wastewater Handling	Waste	215.6014	136.4857	0.70%	95.76%	non key category
HFCs Emissions from Refrigeration and Air Conditioning Equipment	IP	0.0000	96.9365	0.50%	96.26%	non key category
N2O Emissions from Wastewater Handling	Waste	105.6201	85.4174	0.44%	96.70%	non key category
CO2 Emissions from Energy Industries - Oil	Energy	6785.7360	84.8480	0.44%	97.14%	non key category
CH4 Other Sectors: Residential	Energy	230.2856	84.5901	0.44%	97.57%	non key category
N2O Indirect Emissions from Manure Management	Agriculture	265.5323	66.9478	0.34%	97.92%	non key category
CO2 Mobile Combustion: Railways	Energy	452.3598	62.3858	0.32%	98.24%	non key category
CH4 Emissions from Manure Management	Agriculture	308.7371	54.4662	0.28%	98.52%	non key category
HFCs Emissions from Foam Blowing	IP	0.0000	45.1716	0.23%	98.75%	non key category
CO2 Other (Energy)	Energy	154.2715	30.3317	0.16%	98.91%	non key category
CO2 Emissions from Degreasing and Dry Cleaning	SOPU	62.7662	29.9961	0.15%	99.06%	non key category
N2O Mobile Combustion: Road Vehicles	Energy	50.1981	27.7130	0.14%	99.21%	non key category
CO2 Emissions from Paint Application	SOPU	41.5890	20.4569	0.11%	99.31%	non key category
CO2 Emissions from Soda Ash Production and Use	IP	32.9560	15.5217	0.08%	99.39%	non key category
N2O Other Sectors: Residential	Energy	19.4047	15.2511	0.08%	99.47%	non key category
CO2 Emissions from Limestone and Dolomite Use	IP	619.4733	14.3708	0.07%	99.54%	non key category
CO2 Emissions from Brick Production	IP	49.4409	13.4504	0.07%	99.61%	non key category
CO2 Mobile Combustion: Other (Pipeline Transport)	Energy	91.1782	13.2968	0.07%	99.68%	non key category
CO2 Emissions from Other Products	SOPU	14.0135	11.4896	0.06%	99.74%	non key category
N2O Mobile Combustion: Railways	Energy	54.1488	7.4678	0.04%	99.78%	non key category
CH4 Mobile Combustion: Road Vehicles	Energy	24.8796	6.6527	0.03%	99.81%	non key category
CO2 Emissions from Chemical Products, Manufacture and Processing	SOPU	7.7278	4.6492	0.02%	99.84%	non key category
N2O Emissions from Energy Industries	Energy	51.2316	4.3651	0.02%	99.86%	non key category
CO2 from Wetland remaining Wetland	LULUCF	-6.3800	4.1664	0.02%	99.88%	non key category
CO2 Emissions from Lime Production	IP	148.6611	4.0523	0.02%	99.90%	non key category
CO2 Emissions from the Iron and Steel Industry	IP	11.7182	3.1441	0.02%	99.92%	non key category
CH4 Other Sectors: Commercial/Institutional	Energy	5.2253	2.7585	0.01%	99.93%	non key category
CO2 Emissions from Expanded Clay Production	IP	0.0000	2.2411	0.01%	99.94%	non key category
CO2 Fugitive Emissions from Oil and Gas Operation	Energy	0.6377	2.1589	0.01%	99.95%	non key category
N2O Emissions from Manufacturing Industries and Construction	Energy	5.1641	1.4119	0.01%	99.96%	non key category
CH4 Emissions from Energy Industries	Energy	9.2887	1.3734	0.01%	99.97%	non key category
N2O Other Sectors: Commercial/Institutional	Energy	6.3499	1.0959	0.01%	99.97%	non key category
CH4 from Forest Land remaining Forest Land	LULUCF	0.2347	0.9128	0.00%	99.98%	non key category
CH4 Other Sectors: Agriculture/Forestry/Fishing	Energy	8.9856	0.8209	0.00%	99.98%	non key category
N2O from Forest Land remaining Forest Land	LULUCF	0.1917	0.7454	0.00%	99.99%	non key category
SF6 Emissions from Electrical Equipment	IP	0.0000	0.6803	0.00%	99.99%	non key category
CH4 Emissions from Manufacturing Industries and Construction	Energy	2.0005	0.6760	0.00%	99.99%	non key category
N2O Other Sectors: Agriculture/Forestry/Fishing	Energy	5.0378	0.4452	0.00%	100.00%	non key category
CO2 Mobile Combustion Water Borne Navigation	Energy	18.9048	0.2710	0.00%	100.00%	non key category
CO2 Mobile Combustion: Civil Aviation	Energy	0.0000	0.1966	0.00%	100.00%	non key category
N2O Other (Energy)	Energy	0.4911	0.0862	0.00%	100.00%	non key category
HFCs Emissions from Aerosols	IP	0.0000	0.0791	0.00%	100.00%	non key category
CH4 Mobile Combustion: Railways	Energy	0.5323	0.0734	0.00%	100.00%	non key category
CH4 from Croplands remaining Croplands	LULUCF	2.0547	0.0564	0.00%	100.00%	non key category
PFCs Emissions from Electrical Equipment	IP	0.0000	0.0273	0.00%	100.00%	non key category
N2O from Croplands remaining Croplands	LULUCF	0.7864	0.0216	0.00%	100.00%	non key category
N2O Fugitive Emissions from Oil and Gas Operation	Energy	0.0002	0.0053	0.00%	100.00%	non key category
N2O Mobile Combustion Water Borne Navigation	Energy	0.1582	0.0023	0.00%	100.00%	non key category
N2O Mobile Combustion: Civil Aviation	Energy	0.0000	0.0017	0.00%	100.00%	non key category
CH4 Other (Energy)	Energy	0.0484	0.0009	0.00%	100.00%	non key category
CH4 Mobile Combustion Water Borne Navigation	Energy	0.0375	0.0005	0.00%	100.00%	non key category
CH4 Mobile Combustion: Civil Aviation	Energy	0.0000	0.0000	0.00%	100.00%	non key category
CO2 Emissions from Mineral Wool Production	IP	8.0816	0.0000	0.00%	100.00%	non key category
N2O Emissions from Use of N2O for Anaesthesia	SOPU	0.0205	0.0000	0.00%	100.00%	non key category
Total				100.00%		

Annex 1-6: 2013 year Key Category Tier 1 Analysis – Trend Assessment, without LULUCF

Inventory Categories	Inventory Sector	Base Year Estimate (Gg CO2 eq.)	Total	Cumulative Sum	Status	Inventory Categories
CO2 Emissions from Energy Industries - Oil	Energy	6785.7360	84.8480	23.35%	23.35%	key category
CO2 Emissions from Energy Industries - Coal	Energy	6394.4000	470.1322	17.26%	40.62%	key category
CO2 Emissions from Energy Industries - Gas	Energy	6152.6295	2753.2020	11.36%	51.97%	key category
CH4 Emissions from Solid Waste Disposal Sites	Waste	1544.2480	1343.8942	10.79%	62.76%	key category
CO2 Mobile Combustion: Road Vehicles	Energy	3364.2178	1759.1150	9.29%	72.05%	key category
N2O Direct Emissions from Agriculutural Soils	Agriculture	1167.9904	908.0039	6.84%	78.89%	key category
CO2 Other Sectors: Agriculture/Forestry/Fishing	Energy	1942.3629	164.9499	4.97%	83.86%	key category
CH4 Fugitive Emissions from Oil and Gas Operations	Energy	682.2942	520.6450	3.88%	87.74%	key category
CO2 Emissions from Cement Production	IP	971.7056	476.9147	2.30%	90.04%	key category
CO2 Emissions from Limestone and Dolomite Use	IP	619.4733	14.3708	2.05%	92.10%	key category
N2O Indirect Emissions from Agriculutural Soils	Agriculture	365.0744	227.3876	1.45%	93.55%	key category
CH4 Emissions from Wastewater Handling	Waste	215.6014	136.4857	0.88%	94.43%	key category
CO2 Mobile Combustion: Railways	Energy	452.3598	62.3858	0.87%	95.30%	key category
N2O Emissions from Wastewater Handling	Waste	105.6201	85.4174	0.66%	95.96%	non key category
CO2 Other Sectors: Commercial/Institutional	Energy	1412.4933	471.6212	0.66%	96.61%	non key category
CO2 Emissions from Lime Production	IP	148.6611	4.0523	0.48%	97.10%	non key category
CO2 Emissions from Manufacturing Industries and Construction	Energy	2188.7285	607.6708	0.48%	97.58%	non key category
CH4 Emissions from Manure Management	Agriculture	308.7371	54.4662	0.45%	98.03%	non key category
CH4 Other Sectors: Residential	Energy	230.2856	84.5901	0.20%	98.23%	non key category
CO2 Other (Energy)	Energy	154.2715	30.3317	0.19%	98.41%	non key category
CO2 Mobile Combustion: Other (Pipeline Transport)	Energy	91.1782	13.2968	0.17%	98.58%	non key category
N2O Mobile Combustion: Road Vehicles	Energy	50.1981	27.7130	0.16%	98.73%	non key category
N2O Indirect Emissions from Manure Management	Agriculture	265.5323	66.9478	0.14%	98.88%	non key category
CO2 Emissions from Degreasing and Dry Cleaning	SOPU	62.7662	29.9961	0.14%	99.01%	non key category
N2O Emissions from Energy Industries	Energy	51.2316	4.3651	0.13%	99.15%	non key category
N2O Other Sectors: Residential	Energy	19.4047	15.2511	0.12%	99.26%	non key category
N2O Mobile Combustion: Railways	Energy	54.1488	7.4678	0.10%	99.36%	non key category
CO2 Emissions from Paint Application	SOPU	41.5890	20.4569	0.10%	99.46%	non key category
CO2 Emissions from Other Products	SOPU	14.0135	11.4896	0.09%	99.55%	non key category
CO2 Other Sectors: Residential	Energy	4407.6336	1309.0059	0.07%	99.63%	non key category
CO2 Emissions from Soda Ash Production and Use	IP	32.9560	15.5217	0.07%	99.70%	non key category
CO2 Mobile Combustion Water Borne Navigation	Energy	18.9048	0.2710	0.06%	99.76%	non key category
CH4 Emissions from Enteric Fermentation in Domestic Livestock	Agriculture	1840.2088	541.2669	0.03%	99.79%	non key category
CO2 Emissions from Mineral Wool Production	IP	8.0816	0.0000	0.03%	99.82%	non key category
CO2 Emissions from Chemical Products, Manufacture and Processing	SOPU	7.7278	4.6492	0.03%	99.85%	non key category
CO2 Fugitive Emissions from Oil and Gas Operation	Energy	0.6377	2.1589	0.02%	99.88%	non key category
CH4 Other Sectors: Agriculture/Forestry/Fishing	Energy	8.9856	0.8209	0.02%	99.90%	non key category
N2O Direct Emissions from Manure Management	Agriculture	1116.3560	328.6530	0.02%	99.91%	non key category
CH4 Emissions from Energy Industries	Energy	9.2887	1.3734	0.02%	99.93%	non key category
CH4 Other Sectors: Commercial/Institutional	Energy	5.2253	2.7585	0.01%	99.95%	non key category
CO2 Emissions from Brick Production	IP	49.4409	13.4504	0.01%	99.96%	non key category
N2O Other Sectors: Agriculture/Forestry/Fishing	Energy	5.0378	0.4452	0.01%	99.97%	non key category
N2O Other Sectors: Commercial/Institutional	Energy	6.3499	1.0959	0.01%	99.98%	non key category
CH4 Mobile Combustion: Road Vehicles	Energy	24.8796	6.6527	0.01%	99.99%	non key category
CO2 Emissions from the Iron and Steel Industry	IP	11.7182	3.1441	0.00%	99.99%	non key category
N2O Emissions from Manufacturing Industries and Construction	Energy	5.1641	1.4119	0.00%	100.00%	non key category
CH4 Emissions from Manufacturing Industries and Construction	Energy	2.0005	0.6760	0.00%	100.00%	non key category
CH4 Mobile Combustion: Railways	Energy	0.5323	0.0734	0.00%	100.00%	non key category
N2O Other (Energy)	Energy	0.4911	0.0862	0.00%	100.00%	non key category
N2O Mobile Combustion Water Borne Navigation	Energy	0.1582	0.0023	0.00%	100.00%	non key category
CH4 Other (Energy)	Energy	0.0484	0.0009	0.00%	100.00%	non key category
CH4 Mobile Combustion Water Borne Navigation	Energy	0.0375	0.0005	0.00%	100.00%	non key category
N2O Emissions from Use of N2O for Anaesthesia	SOPU	0.0205	0.0000	0.00%	100.00%	non key category
N2O Fugitive Emissions from Oil and Gas Operation	Energy	0.0002	0.0053	0.00%	100.00%	non key category
HFCs Emissions from Aerosols	IP	0.0000	0.0791	0.00%	100.00%	non key category
SF6 Emissions from Electrical Equipment	IP	0.0000	0.6803	0.00%	100.00%	non key category
HFCs Emissions from Refrigeration and Air Conditioning Equipment	IP	0.0000	96.9365	0.00%	100.00%	non key category
CO2 Emissions from Expanded Clay Production	IP	0.0000	2.2411	0.00%	100.00%	non key category
N2O Mobile Combustion: Civil Aviation	Energy	0.0000	0.0017	0.00%	100.00%	non key category
HFCs Emissions from Foam Blowing	IP	0.0000	45.1716	0.00%	100.00%	non key category
PFCs Emissions from Electrical Equipment	IP	0.0000	0.0273	0.00%	100.00%	non key category
CO2 Mobile Combustion: Civil Aviation	Energy	0.0000	0.1966	0.00%	100.00%	non key category
CH4 Mobile Combustion: Civil Aviation	Energy	0.0000	0.0000	0.00%	100.00%	non key category
Total				100.00%		

Annex 1-7: 2013 year Key Category Tier 1 Analysis – Trend Assessment, with LULUCF

Inventory Categories	Inventory Sector	2013 Year Estimate (Gg CO2 eq.)	Total	Cumulative Sum	Status	Inventory Categories
CO2 Emissions from Energy Industries - Oil	Energy	6785.7360	84.8480	16.82%	16.82%	key category
CO2 from Croplands remaining Croplands	LULUCF	-2216.0460	3245.4858	14.62%	31.44%	key category
CO2 Emissions from Energy Industries - Coal	Energy	6394.4000	470.1322	14.10%	45.54%	key category
CO2 from Forest Land remaining Forest Land	LULUCF	-2197.5790	-1887.6165	8.50%	54.04%	key category
CO2 from Grassland remaining Grassland	LULUCF	-1469.8567	-1461.3867	6.58%	60.62%	key category
CH4 Emissions from Solid Waste Disposal Sites	Waste	1544.2480	1343.8942	6.05%	66.67%	key category
CO2 Other Sectors: Residential	Energy	4407.6336	1309.0059	5.28%	71.95%	key category
CO2 Other Sectors: Agriculture/Forestry/Fishing	Energy	1942.3629	164.9499	4.18%	76.14%	key category
N2O Direct Emissions from Agriculutural Soils	Agriculture	1167.9904	908.0039	4.09%	80.23%	key category
CO2 Emissions from Energy Industries - Gas	Energy	6152.6295	2753.2020	3.20%	83.43%	key category
CO2 Emissions from Manufacturing Industries and Construction	Energy	2188.7285	607.6708	2.81%	86.24%	key category
CH4 Emissions from Enteric Fermentation in Domestic Livestock	Agriculture	1840.2088	541.2669	2.44%	88.68%	key category
CO2 Emissions from Cement Production	IP	971.7056	476.9147	2.15%	90.83%	key category
N2O Direct Emissions from Manure Management	Agriculture	1116.3560	328.6530	1.48%	92.31%	key category
CO2 Other Sectors: Commercial/Institutional	Energy	1412.4933	471.6212	1.46%	93.76%	key category
N2O Indirect Emissions from Agriculutural Soils	Agriculture	365.0744	227.3876	1.02%	94.79%	key category
CO2 Mobile Combustion: Railways	Energy	452.3598	62.3858	0.87%	95.65%	key category
CH4 Fugitive Emissions from Oil and Gas Operations	Energy	682.2942	520.6450	0.61%	96.27%	non key category
CH4 Emissions from Wastewater Handling	Waste	215.6014	136.4857	0.61%	96.88%	non key category
CO2 Mobile Combustion: Road Vehicles	Energy	3364.2178	1759.1150	0.61%	97.49%	non key category
N2O Emissions from Wastewater Handling	Waste	105.6201	85.4174	0.38%	97.88%	non key category
N2O Indirect Emissions from Manure Management	Agriculture	265.5323	66.9478	0.30%	98.18%	non key category
CO2 Other (Energy)	Energy	154.2715	30.3317	0.25%	98.43%	non key category
CH4 Emissions from Manure Management	Agriculture	308.7371	54.4662	0.25%	98.68%	non key category
CH4 Other Sectors: Residential	Energy	230.2856	84.5901	0.20%	98.88%	non key category
CO2 Mobile Combustion: Other (Pipeline Transport)	Energy	91.1782	13.2968	0.17%	99.05%	non key category
CO2 Emissions from Degreasing and Dry Cleaning	SOPU	62.7662	29.9961	0.14%	99.19%	non key category
N2O Emissions from Energy Industries	Energy	51.2316	4.3651	0.11%	99.30%	non key category
N2O Mobile Combustion: Railways	Energy	54.1488	7.4678	0.10%	99.40%	non key category
CO2 Emissions from Paint Application	SOPU	41.5890	20.4569	0.09%	99.49%	non key category
CO2 Emissions from Soda Ash Production and Use	IP	32.9560	15.5217	0.07%	99.56%	non key category
CO2 Emissions from Limestone and Dolomite Use	IP	619.4733	14.3708	0.06%	99.63%	non key category
CO2 Emissions from Brick Production	IP	49.4409	13.4504	0.06%	99.69%	non key category
CO2 Emissions from Other Products	SOPU	14.0135	11.4896	0.05%	99.74%	non key category
CO2 Mobile Combustion Water Borne Navigation	Energy	18.9048	0.2710	0.05%	99.79%	non key category
CH4 Mobile Combustion: Road Vehicles	Energy	24.8796	6.6527	0.03%	99.82%	non key category
CO2 Emissions from Chemical Products, Manufacture and Processing	SOPU	7.7278	4.6492	0.02%	99.84%	non key category
N2O Other Sectors: Residential	Energy	19.4047	15.2511	0.02%	99.86%	non key category
CH4 Other Sectors: Agriculture/Forestry/Fishing	Energy	8.9856	0.8209	0.02%	99.88%	non key category
CO2 from Wetland remaining Wetland	LULUCF	-6.3800	4.1664	0.02%	99.90%	non key category
CO2 Emissions from Lime Production	IP	148.6611	4.0523	0.02%	99.92%	non key category
CH4 Emissions from Energy Industries	Energy	9.2887	1.3734	0.02%	99.93%	non key category
CO2 Emissions from the Iron and Steel Industry	IP	11.7182	3.1441	0.01%	99.95%	non key category
N2O Other Sectors: Commercial/Institutional	Energy	6.3499	1.0959	0.01%	99.96%	non key category
N2O Other Sectors: Agriculture/Forestry/Fishing	Energy	5.0378	0.4452	0.01%	99.97%	non key category
CO2 Fugitive Emissions from Oil and Gas Operation	Energy	0.6377	2.1589	0.01%	99.98%	non key category
N2O Emissions from Manufacturing Industries and Construction	Energy	5.1641	1.4119	0.01%	99.98%	non key category
CH4 from Forest Land remaining Forest Land	LULUCF	0.2347	0.9128	0.00%	99.99%	non key category
N2O from Forest Land remaining Forest Land	LULUCF	0.1917	0.7454	0.00%	99.99%	non key category
N2O Mobile Combustion: Road Vehicles	Energy	50.1981	27.7130	0.00%	99.99%	non key category
CH4 Emissions from Manufacturing Industries and Construction	Energy	2.0005	0.6760	0.00%	100.00%	non key category
CH4 Mobile Combustion: Railways	Energy	0.5323	0.0734	0.00%	100.00%	non key category
N2O Other (Energy)	Energy	0.4911	0.0862	0.00%	100.00%	non key category
CH4 Other Sectors: Commercial/Institutional	Energy	5.2253	2.7585	0.00%	100.00%	non key category
N2O Mobile Combustion Water Borne Navigation	Energy	0.1582	0.0023	0.00%	100.00%	non key category
CH4 from Croplands remaining Croplands	LULUCF	2.0547	0.0564	0.00%	100.00%	non key category
CH4 Other (Energy)	Energy	0.0484	0.0009	0.00%	100.00%	non key category
N2O from Croplands remaining Croplands	LULUCF	0.7864	0.0216	0.00%	100.00%	non key category
CH4 Mobile Combustion Water Borne Navigation	Energy	0.0375	0.0005	0.00%	100.00%	non key category
N2O Fugitive Emissions from Oil and Gas Operation	Energy	0.0002	0.0053	0.00%	100.00%	non key category
CO2 Emissions from Mineral Wool Production	IP	8.0816	0.0000	0.00%	100.00%	non key category
N2O Emissions from Use of N2O for Anaesthesia	SOPU	0.0205	0.0000	0.00%	100.00%	non key category
HFCs Emissions from Aerosols	IP	0.0000	0.0791	0.00%	100.00%	non key category
SF6 Emissions from Electrical Equipment	IP	0.0000	0.6803	0.00%	100.00%	non key category
HFCs Emissions from Refrigeration and Air Conditioning Equipment	IP	0.0000	96.9365	0.00%	100.00%	non key category
CO2 Emissions from Expanded Clay Production	IP	0.0000	2.2411	0.00%	100.00%	non key category
HFCs Emissions from Foam Blowing	IP	0.0000	45.1716	0.00%	100.00%	non key category
CH4 Mobile Combustion: Civil Aviation	Energy	0.0000	0.0000	0.00%	100.00%	non key category
PFCs Emissions from Electrical Equipment	IP	0.0000	0.0273	0.00%	100.00%	non key category
N2O Mobile Combustion: Civil Aviation	Energy	0.0000	0.0017	0.00%	100.00%	non key category
CO2 Mobile Combustion: Civil Aviation	Energy	0.0000	0.1966	0.00%	100.00%	non key category
Total				100.00%		

Annex 2. Energy Balances of the Republic of Moldova for 1990, 1993-2013 (without ATULBD)

Annex 2-1: Energy Balances for 1990, 1993-2013

Energy Balance 1990 (natural units)

Type of Fuel and Energy	TOTAL	Resources				Distribution				
		Stock at the Start of the Year	Production	Inputs from Other National Sources	Import	Gross Domestic Consumption	Export	Losses	Other Distribution Items	Stock at the End of the Year
Coal – total, kt	5380	804			4576	4623	1	7	173	749
anthracite	5201	799			4402	4449		6		746
brown coal	179	5			174	174		1		2
Brown Coal Briquettes, kt	33	2			31	31		2		
Ukraine Brown Coal, kt	33	2			31	31		2		
Coking Coal, kt	65	18			47	41				24
Diesel Oil, kt	1250	129			1121	1120				130
Oven Fuel, kt	104	17			87	93				11
Residual Fuel Oil, kt	2867	234			2633	2501				366
Jet Fuel, kt	7	6			1					7
Fuel for Diesel Engines, kt	76	14			62	61				15
Aviation Fuel, kt	2	1			1	2				
Gasoline, kt	841	48			793	796		1		44
Kerosene for Tractors, kt	31	5			26	26				5
Kerosene for Lighting, kt	12	3			9	11				1
Aviation Kerosene, kt	68	1			67	67				1
Lubricants, kt										
Natural Gas, million standard m^3	4077	73			4004	3908		97		72
Liquefied Petroleum Gas, kt	148	4			144	146				2
Fuel wood, thousand m^3 comp.	253	57	194		2	216				17
Wood and Agricultural Waste, kt c.e.	16		16			16				
Other Fuels, kt c.e.										
Electricity, million kWh	20161		156725		4489	11349	55	1221		7536
Heat, thousand Gcal	22213		22212		1	20983	16	1214		

Energy Balance 1993 (natural units)

Type of Fuel and Energy	TOTAL	Resources				Distribution				
		Stock at the Start of the Year	Production	Inputs from Other National Sources	Import	Gross Domestic Consumption	Export	Losses	Other Distribution Items	Stock at the End of the Year
Coal – total, kt	2281.5	343.6			1937.9	2138.7		1.5		141.3
anthracite	225.5	79.1			146.4	185.1		0.5		39.9
brown coal	103.3	49.6			53.7	84.1		0.2		19.0
Coking Coal, kt	22.7	16.7			6.0	17.3			0.1	5.3
Diesel Oil, kt	535.1	40.7			494.4	468.4		1.2	11.1	54.4
Oven Fuel, kt	20.4	6.0			14.4	11.5			6.3	2.6
Residual Fuel Oil, kt	1401.6	356.5			1045.1	1296.9	2.6	1.5		100.6
Residual Fuel Oil for Ships, kt	0.2	0.2								0.2
Fuel for Engines, kt	3.6	1.7			1.9	2.8				0.8
Aviation Fuel, kt	0.5	0.2			0.3	0.4				
Gasoline, kt	242.5	19.6			222.9	219.6	0.1	1.1	0.1	21.7
Kerosene Oil, kt	53.8	2.7			51.1	41.5			5.5	6.8
Lubricants, kt										
Natural Gas, million standard m^3	3194.1	6.7			3187.4	2224.8		89.0	851.4	41.8
Liquefied Petroleum Gas, kt	41.5	1.8			39.7	39.9		0.4	0.1	1.1
Fuel wood, thousand m^3 comp.	148.2	9.5	137.1		1.6	130.1			1.9	16.2
Wood and Agricultural Waste, kt c.e.	12.7	0.2	12.5			10.6		0.5	0.3	1.3
Other Fuels, kt c.e.	1.1				1.1	1.0				0.1
Electricity, million kWh	15381.2		10368.7		5012.5	6122.2	5776.5	1359.0	2123.5	
Heat, thousand Gcal	10208.1		10208.1			8703.4		917.3	587.4	

Energy Balance 1994 (natural units)

Type of Fuel and Energy	TOTAL	Resources				Distribution				
		Stock at the Start of the Year	Production	Inputs from Other National Sources	Import	Gross Domestic Consumption	Export	Losses	Other Distribution Items	Stock at the End of the Year
Coal – total, kt	918	131			787	476		2	333	107
anthracite	200	38			162	174				26
brown coal	57	21			36	44				13
Coking Coal, kt	21	5			16	12				8
Diesel Oil, kt	429	56			373	390		1		38
Oven Fuel, kt	6	3			3	4			1	1
Residual Fuel Oil, kt	590	104			486	363			102	125
Fuel for Engines, kt	2	1			1	1			1	
Gasoline, kt	236	22			214	211		2		23
Kerosene Oil, kt	20	6			14	16				4
Lubricants, kt	29	4			25	17				12
Natural Gas, million standard m^3	1882	41			1841	1213		112	555	2
Liquefied Petroleum Gas, kt	21	1			20	19			1	1
Fuel wood, thousand m^3 comp.	160	17	143			134			4	22
Wood and Agricultural Waste, kt c.e.	16	1	15			14			1	1
Other Fuels, kt c.e.	10				10	1			8	1
Electricity, million kWh	5820		1236	3967	617	4347	265	1208		
Heat, thousand Gcal	7507		7507			6658		849		

Energy Balance 1995 (natural units)

Type of Fuel and Energy	TOTAL	Resources				Distribution				
		Stock at the Start of the Year	Production	Inputs from Other National Sources	Import	Gross Domestic Consumption	Export	Losses	Other Distribution Items	Stock at the End of the Year
Coal – total, kt	1026	109			917	269		1	647	109
anthracite	761	22			739	78		1	646	36
brown coal	46	12			34	34			1	11
Coking Coal, kt	30	8			22	14				16
Diesel Oil, kt	420	38			382	379	3	1		37
Oven Fuel, kt	2	1			1	1			1	
Residual Fuel Oil, kt	517	126			391	347		1	17	152
Gasoline, kt	283	26			257	223		2		58
Kerosene Oil, kt	16	5			11	13			2	1
Lubricants, kt	27	13			14	17			1	9
Natural Gas, million standard m^3	1876	2			1874	1227		169	477	3
Liquefied Petroleum Gas, kt	21	1			20	19			1	1
Fuel wood, thousand m^3 comp.	283	23	260			228				55
Wood and Agricultural Waste, kt c.e.	15	1	14			11			1	3
Other Fuels, kt c.e.	1	1							1	
Electricity, million kWh	5500		1176	2327	1997	4138	127	1235		
Heat, thousand Gcal	7097		7097			6126		971		

Energy Balance 1996 (natural units)

Type of Fuel and Energy	TOTAL	Resources				Distribution				
		Stock at the Start of the Year	Production	Inputs from Other National Sources	Import	Gross Domestic Consumption	Export	Losses	Other Distribution Items	Stock at the End of the Year
Coal – total, kt	983	119			864	372		1	536	74
anthracite	642	43			599	84			536	22
brown coal	46	12			34	35				11
Coking Coal, kt	25	16			9	15			1	9
Diesel Oil, kt	341	39			302	323		1	1	16
Oven Fuel, kt	9	–			9	7			1	1
Residual Fuel Oil, kt	424	152			272	311		1	31	81
Gasoline, kt	241	60			181	214		3	1	23
Kerosene Oil, kt	21	1			20	20				1
Lubricants, kt	24	10			14	16			1	7
Natural Gas, million standard m^3	2052	3			2049	1349		204	484	15
Liquefied Petroleum Gas, kt	23	1			22	22				1
Fuel wood, thousand m^3 comp.	332	58	274			276				56
Wood and Agricultural Waste, kt c.e.	15	3	12			15				
Other Fuels, kt c.e.	6				6	2			1	3
Electricity, million kWh	5335		1398	2368	1569	4094	4	1237		
Heat, thousand Gcal	7077		7077			6027		1050		

Energy Balance 1997 (natural units)

Type of Fuel and Energy	TOTAL	Resources				Distribution				
		Stock at the Start of the Year	Production	Inputs from Other National Sources	Import	Gross Domestic Consumption	Export	Losses	Other Distribution Items	Stock at the End of the Year
Coal – total, kt	627	75			552	265		1	236	125
anthracite	124	22			102	90				34
brown coal	35	8			27	25				10
Coking Coal, kt	17	9			8	12			1	4
Diesel Oil, kt	347	19			328	305		6	1	35
Oven Fuel, kt	11	1			10	6			1	4
Residual Fuel Oil, kt	356	81			275	224			18	114
Gasoline, kt	286	24			262	244		5		37
Kerosene Oil, kt	27	2			25	22			1	4
Lubricants, kt	24	8			16	15			1	8
Natural Gas, million standard m^3	2094	15			2079	1461		162	448	23
Liquefied Petroleum Gas, kt	31	3			28	26		1		4
Fuel wood, thousand m^3 comp.	355	57	298			274		1	1	79
Wood and Agricultural Waste, kt c.e.	18	1	17			13			1	4
Other Fuels, kt c.e.	12	3			9	9			1	2
Electricity, million kWh	4972		1450	1772	1750	3767		1178		
Heat, thousand Gcal	6590		6590			5552		1038		

Energy Balance 1998 (natural units)

Type of Fuel and Energy	TOTAL	Resources				Distribution				
		Stock at the Start of the Year	Production	Inputs from Other National Sources	Import	Gross Domestic Consumption	Export	Losses	Other Distribution Items	Stock at the End of the Year
Coal – total, kt	478	150			328	197			173	108
anthracite	82	28			54	34			16	32
brown coal	25	11			14	20				5
Coking Coal, kt	11	4			7	10				1
Diesel Oil, kt	271	36			235	246		1	1	23
Oven Fuel, kt	13	4			9	10			1	2
Residual Fuel Oil, kt	262	123			139	172			23	67
Gasoline, kt	230	38			192	207		4		19
Kerosene Oil, kt	24	3			21	21				3
Lubricants, kt	17	8			9	11				6
Natural Gas, million standard m^3	1887	23			1864	1355		139	369	24
Liquefied Petroleum Gas, kt	30	6			24	25		2	1	2
Fuel wood, thousand m^3 comp.	344	79	265			280		2		62
Wood and Agricultural Waste, kt c.e.	13	4	9			7		1	2	3
Other Fuels, kt c.e.	6	2			4	4			1	1
Electricity, million kWh	4609		1246	1447	1916	3213		1396		
Heat, thousand Gcal	6120		6120			5173		947		

Energy Balance 1999 (natural units)

Type of Fuel and Energy	TOTAL	Resources				Distribution				
		Stock at the Start of the Year	Production	Inputs from Other National Sources	Import	Gross Domestic Consumption	Export	Losses	Other Distribution Items	Stock at the End of the Year
Coal – total, kt	245	112			133	151			8	86
anthracite	80	33			47	51			7	22
brown coal	12	4			8	10				2
Coking Coal, kt	8	1			7	7				1
Diesel Oil, kt	192	25			167	178		1	1	12
Oven Fuel, kt	11	2			9	9			1	1
Residual Fuel Oil, kt	136	72			64	104		1	1	30
Gasoline, kt	139	19			120	119		1	1	18
Kerosene Oil, kt	24	3			21	22			1	1
Lubricants, kt	12	6			6	8				4
Natural Gas, million m^3 stand.	1561	24			1537	1150		126	271	14
Liquefied Petroleum Gas, kt	34	2			32	31	1	1		1
Fuel wood, thousand m^3 comp.	298	62	236			257				41
Wood and Agricultural Waste, kt c.e.	19	2	17			13		1		5
Other Fuels, kt c.e.	17	1			16	14			1	2
Electricity, million kWh	3752		1134	840	1778	2566		1186		
Heat, thousand Gcal	4647		4647			3899		748		

Energy Balance 2000 (natural units)

Type of Fuel and Energy	TOTAL	Resources				Distribution				
		Stock at the Start of the Year	Production	Inputs from Other National Sources	Import	Gross Domestic Consumption	Export	Losses	Other Distribution Items	Stock at the End of the Year
Coal – total, kt	194	87			107	125			1	68
anthracite	87	20			67	70			1	16
brown coal	12	3			9	8				4
Coking Coal, kt	7	1			6	7				
Diesel Oil, kt	213	12			201	192		1		20
Oven Fuel, kt	20	1			19	14	1		1	4
Residual Fuel Oil, kt	67	30			37	47	1	2		17
Gasoline, kt	139	18			121	117		1		21
Kerosene Oil, kt	22	1			21	21				1
Lubricants, kt	9	4			5	7				2
Natural Gas, million standard m^3	1058	14			1044	928		102	16	12
Liquefied Petroleum Gas, kt	44	1			43	35	2	1	1	5
Fuel wood, thousand m^3 comp.	287	44	243			240			1	46
Wood and Agricultural Waste, kt c.e.	24	5	19			19		1		4
Other Fuels, kt c.e.	5	2			3	3			1	1
Electricity, million kWh	3379		904	690	1785	2244		1135		
Heat, thousand Gcal	3057		3057			2673		383	1	

Energy Balance 2001 (natural units)

Type of Fuel and Energy	TOTAL	Resources				Distribution				
		Stock at the Start of the Year	Production	Inputs from Other National Sources	Import	Gross Domestic Consumption	Export	Losses	Other Distribution Items	Stock at the End of the Year
Coal – total, kt	209	69			140	108			34	67
anthracite	104	17			87	40			34	30
brown coal	9	5			4	5				4
Coking Coal, kt	9	1			8	8				1
Diesel Oil, kt	241	20			221	210		1		30
Oven Fuel, kt	19	4			15	15			1	3
Residual Fuel Oil, kt	65	17			48	45				20
Gasoline, kt	153	22			131	128		1		24
Kerosene Oil, kt	19	1			18	16			1	2
Lubricants, kt	11	3			8	7			1	3
Natural Gas, million standard m^3	1160	12			1148	1044		82	20	14
Liquefied Petroleum Gas, kt	56	6			50	47		1	1	7
Fuel wood, thousand m^3 comp.	296	46	250			222				74
Wood and Agricultural Waste, kt c.e.	33	2	31			26		1		6
Other Fuels, kt c.e.	3				3	1			1	1
Electricity, million kWh	3390		1263	1441	686	2208		1181	1	
Heat, thousand Gcal	3298		3298			2809		489		

Energy Balance 2002 (natural units)

Type of Fuel and Energy	Resources	Distribution				Distribuţii				
		Stock at the Start of the Year	Production	Inputs from Other National Sources	Import	Gross Domestic Consumption	Export	Losses	Other Distribution Items	Stock at the End of the Year
Coal – total, kt	217	67			150	151		1		65
anthracite	114	29			85	88				26
brown coal	5	4			1	3				2
Coking Coal, kt	9	1			8	8				1
Diesel Oil, kt	282	30			252	255		1	2	24
Oven Fuel, kt	7	3			4	6				1
Residual Fuel Oil, kt	50	20		7	23	33			1	16
Gasoline, kt	192	24			168	162		2		28
Kerosene Oil, kt	20	2			18	19				1
Lubricants, kt	10	3			7	7				3
Natural Gas, million standard m^3	1159	14			1145	1066		75	4	14
Liquefied Petroleum Gas, kt	56	7			49	48	1	2		5
Fuel wood, thousand m^3 comp.	320	74	246			270				50
Wood and Agricultural Waste, kt c.e.	32	4	27		1	26			1	5
Other Fuels, kt c.e.	2	1			1	1			1	
Electricity, million kWh	3781		1179	1615	987	2451		1045	285	
Heat, thousand Gcal	3217		3217			2699		518		

Energy Balance 2003 (natural units)

Type of Fuel and Energy	TOTAL	Resources				Distribution				
		Stock at the Start of the Year	Production	Inputs from Other National Sources	Import	Gross Domestic Consumption	Export	Losses	Other Distribution Items	Stock at the End of the Year
Coal – total, kt	332	65			267	219		1		112
anthracite	236	31			205	160		1		75
brown coal	2	2				1				1
Coking Coal, kt	8	2			6	5			1	2
Diesel Oil, kt	323	25			298	287		1		35
Oven Fuel, kt	4	1			3	3				1
Residual Fuel Oil, kt	39	16	1		22	26		1		12
Gasoline – total, kt	230	27			203	192		2		36
including, Lead Free Gasoline	230	27			203	192		2		36
Kerosene Oil, kt	16	1			15	13				3
Lubricants, kt	14	3	1		10	11				3
Bitumen, kt	13				13	12				1
White Spirit, kt	1				1	1				
Other Petroleum Products, kt c.e.	2			1	1	2				
Natural Gas, million standard m^3	1252	14			1238	1143		91		18
Liquefied Petroleum Gas, kt	62	6			56	50	1	2		9
Fuel wood, thousand m^3 comp.	358	50	308			311				47
Wood Waste, kt c.e.	24	4	20			21				3
Agricultural Waste, kt c.e.	11		11			11				
Electricity, million kWh	4629		1046	1826	1757	2529	131	1047	922	
Heat, thousand Gcal	3347		3347			2799		548		

Energy Balance 2004 (natural units)

Type of Fuel and Energy	TOTAL	Resources				Distribution				
		Stock at the Start of the Year	Production	Inputs from Other National Sources	Import	Gross Domestic Consumption	Export	Losses	Other Distribution Items	Stock at the End of the Year
Coal – total, kt	297	112			185	185		1		111
anthracite	216	74			142	144		1		71
brown coal										
Coking Coal, kt	2	2				2				
Oil, kt	8		8				5		1	2
Diesel Oil, kt	359	35			324	325		1	1	32
Oven Fuel, kt	3	1			2	3				
Residual Fuel Oil, kt	34	12		3	19	24				10
Jet Fuel, kt	15	2			13	14				1
Gasoline – total, kt	246	36			210	210		2		34
including, Lead Free Gasoline	246	36			210	210		2		34
Kerosene Oil, kt	1			1		1				
Lubricants, kt	15	4			11	11				4
Bitumen, kt	19	1			18	17			1	1
White Spirit, kt										
Paraffin Waxes, kt										
Processed Oils, kt c.e.										
Other Petroleum Products, kt c.e.	1				1	1				
Natural Gas, million standard m^3	1281	18			1263	1167		96		18
Liquefied Petroleum Gas, kt	63	6			57	52	1	1	1	8
Fuel wood, thousand m^3 comp.	317	47	270			251		1	1	64
Wood Waste, kt c.e.	19	3	15		1	16		1		2
Agricultural Waste, kt c.e.	16		16			16				
Electricity, million kWh	4383		1022		3361	2634	424	831	494	
Heat, thousand Gcal	3147		3147			2686		461		

Energy Balance 2005 (natural units)

Type of Fuel and Energy	TOTAL	Resources				Distribution				
		Stock at the Start of the Year	Production	Inputs from Other National Sources	Import	Gross Domestic Consumption	Export	Losses	Other Distribution Items	Stock at the End of the Year
Coal – total, kt	276	110			166	180		2	1	93
anthracite	206	70			136	142		1	1	62
brown coal										
Coking Coal, kt										
Oil, kt	7	2	5			6				1
Diesel Oil, kt	366	32	1		333	331				35
Oven Fuel, kt	2				2	1				1
Residual Fuel Oil, kt	29	10	3	3	13	21	1			7
Jet Fuel, kt	16	1			15	15				1
Gasoline – total, kt	251	35			216	215		2	1	33
including, Lead Free Gasoline	251	35			216	215		2	1	33
Kerosene Oil, kt	1				1	1				
Lubricants, kt	17	4	1		12	11	1		1	4
Bitumen, kt	18	1		1	16	16				2
White Spirit, kt										
Paraffin Waxes, kt										
Processed Oils, kt c.e.										
Other Petroleum Products, kt c.e..	2				2	2				
Natural Gas, million standard m^3	1437	18			1419	1339		81		17
Liquefied Petroleum Gas, kt	62	8			54	53		1		8
Fuel wood, thousand m^3 comp.	330	64	266			253			1	76
Wood Waste, kt c.e.	17	2	14		1	13				4
Agricultural Waste, kt c.e.	16		16			16				
Electricity, million kWh	4196		1229		2967	2921	14	783	478	
Heat, thousand Gcal	3591		3591			3084		507		

Energy Balance 2006 (natural units)

Type of Fuel and Energy	TOTAL	Resources				Distribution				
		Stock at the Start of the Year	Production	Inputs from Other National Sources	Import	Gross Domestic Consumption	Export	Losses	Other Distribution Items	Stock at the End of the Year
Coal – total, kt	266	94			172	189		1		76
anthracite	196	62			134	143		1		52
brown coal										
Coking Coal, kt										
Oil, kt	5	1	4			4				1
Diesel Oil, kt	361	35			326	334		1		26
Oven Fuel, kt	1	1				1				
Residual Fuel Oil, kt	27	7	2	1	17	17	2		1	7
Jet Fuel, kt	19	1			18	17				2
Gasoline – total, kt	226	33			193	198		1		27
including, Lead Free Gasoline	226	33			193	198		1		27
Kerosene Oil, kt										
Lubricants, kt	19	4	1		14	12	2			5
Bitumen, kt	26	2			24	22				4
White Spirit, kt										
Paraffin Waxes, kt										
Processed Oils, kt c.e.										
Other Petroleum Products, kt c.e.										
Natural Gas, million standard m^3	1435	17			1418	1327		90		18
Liquefied Petroleum Gas, kt	58	8			50	50		1		7
Fuel wood, thousand m^3 comp.	383	76	307			313		1		69
Wood Waste, kt c.e.	18	4	14			13			1	4
Agricultural Waste, kt c.e.	16		16			16				
Electricity, million kWh	4074		1192		2882	3215		675	184	
Heat, thousand Gcal	3552		3552			2903		649		

Energy Balance 2007 (natural units)

Type of Fuel and Energy	TOTAL	Resources				Distribution				
		Stock at the Start of the Year	Production	Inputs from Other National Sources	Import	Gross Domestic Consumption	Export	Losses	Other Distribution Items	Stock at the End of the Year
Coal – total, kt	256	76			180	129		1		126
anthracite	155	52			103	100				55
brown coal										
Coking Coal, kt										
Oil, kt	9	1	8			8				1
Diesel Oil, kt	386	26	3		357	351		1		34
Oven Fuel, kt	1			1		1				
Residual Fuel Oil, kt	22	7	5	2	8	14	1			7
Jet Fuel, kt	22	2			20	20			1	1
Gasoline – total, kt	231	26			205	203		1	1	26
including, Lead Free Gasoline	231	26			205	203		1	1	26
Kerosene Oil, kt										
Lubricants, kt	21	5			16	10	6			5
Bitumen, kt	30	4			26	26				4
White Spirit, kt										
Paraffin Waxes, kt										
Processed Oils, kt c.e.										
Other Petroleum Products, kt c.e.	1				1	1				
Natural Gas, million standard m^3	1323	18			1305	1213		93		17
Liquefied Petroleum Gas, kt	57	7			50	53		1		3
Fuel wood, thousand m^3 comp.	344	69	275			258				86
Wood Waste, kt c.e.	15	4	11			10			1	4
Agricultural Waste, kt c.e.	15		15			15				
Electricity, million kWh	4031		1100		2931	3364		667		
Heat, thousand Gcal	3094		3094			2554		540		

Energy Balance 2008 (natural units)

Type of Fuel and Energy	TOTAL	Resources				Distribution				
		Stock at the Start of the Year	Production	Inputs from Other National Sources	Import	Gross Domestic Consumption	Export	Losses	Other Distribution Items	Stock at the End of the Year
Coal – total, kt	333	127			206	198				135
anthracite	154	56			98	88				66
brown coal										
Coking Coal, kt										
Oil, kt	16	1	15			14			1	1
Diesel Oil, kt	411	36	4		371	368		1		42
Oven Fuel, kt	1			1		1				
Residual Fuel Oil, kt	28	7	7		14	17	5			6
Jet Fuel, kt	22	1			21	18				4
Gasoline – total, kt	242	29			213	208		2		32
including, Lead Free Gasoline	242	29			213	208		3		33
Kerosene Oil, kt										
Lubricants, kt	16	5			11	11	1			4
Bitumen, kt	27	4			23	24				3
White Spirit, kt	1				1				1	
Paraffin Waxes, kt										
Processed Oils, kt c.e.										
Other Petroleum Products, kt c.e.	1				1	1				
Natural Gas, million standard m^3	1244	17			1227	1138		87	1	18
Liquefied Petroleum Gas, kt	63	3			60	55		1		7
Fuel wood, thousand m^3 comp.	370	86	284			289		3	1	77
Wood Waste, kt c.e.	17	4	13			12				5
Agricultural Waste, kt c.e.	21		21			20				1
Electricity, million kWh	4058		1096	4	2958	3428		630		
Heat, thousand Gcal	3074		3074			2553		520	1	

Energy Balance 2009 (natural units)

Type of Fuel and Energy	TOTAL	Resources				Distribution				
		Stock at the Start of the Year	Production	Inputs from Other National Sources	Import	Gross Domestic Consumption	Export	Losses	Other Distribution Items	Stock at the End of the Year
Coal – total, kt	269	135			134	177		2		90
anthracite	170	74			96	109				61
brown coal										
Coking Coal, kt	2				2	2				
Oil, kt	18	1	17			17				1
Diesel Oil, kt	397	42	5		350	337		1	1	58
Oven Fuel, kt	4				4	1	1			2
Residual Fuel Oil, kt	64	7	16		41	36	9			19
Jet Fuel, kt	21	4			17	14	4			3
Gasoline – total, kt	248	32			216	207		1		40
including, Lead Free Gasoline	248	32			216	207		1		40
Kerosene Oil, kt										
Lubricants, kt	12	4			8	9	1			3
Bitumen, kt	11	3			8	10				1
White Spirit, kt	1				1	1				
Paraffin Waxes, kt										
Processed Oils, kt c.e.										
Other Petroleum Products, kt c.e.	2				2	2				
Natural Gas, million standard m^3	1145	18		1	1126	1068		58	1	18
Liquefied Petroleum Gas, kt	68	7			61	60	1	1	2	4
Fuel wood, thousand m^3 comp.	361	78	283			262			1	98
Wood Waste, kt c.e.	20	5	15			15				5
Agricultural Waste, kt c.e.	27	1	26			25			1	1
Electricity, million kWh	3974		1033	2934	7	3378		596		
Heat, thousand Gcal	2638		2638			2223		415		

Energy Balance 2010 (natural units)

Type of Fuel and Energy	TOTAL	Resources				Distribution				
		Stock at the Start of the Year	Production	Inputs from Other National Sources	Import	Gross Domestic Consumption	Export	Losses	Other Distribution Items	Stock at the End of the Year
Coal – total, kt	271	90			181	186				85
anthracite	178	61			117	129				49
brown coal										
Coking Coal, kt	4				4	4				
Oil, kt	12	1	11			11		1		
Diesel Oil, kt	462	58	4		400	418		1		43
Oven Fuel, kt	3	2			1	2	1			
Residual Fuel Oil, kt	48	19	12		17	31	2			15
Jet Fuel, kt	20	3			17	13	5			2
Gasoline – total, kt	227	41			186	197		1	1	28
including, Lead Free Gasoline	227	41			186	197		1	1	28
Kerosene Oil, kt										
Lubricants, kt	17	3	5		9	10	4			3
Bitumen, kt	23	1			22	21				2
White Spirit, kt	1				1	1				
Paraffin Waxes, kt										
Processed Oils, kt c.e.										
Other Petroleum Products, kt c.e.	2				2	2				
Natural Gas, million standard m³	1206	18			1188	1128		61		17
Liquefied Petroleum Gas, kt	72	5			67	64	2	1	2	3
Fuel wood, thousand m³ comp.	330	99	231			267		1		62
Wood Waste, kt c.e.	12	5	7			10				2
Agricultural Waste, kt c.e.	27	1	26			21	5			1
Other Fuels, kt c.e.										
Electricity, million kWh	4097		1064	3008	25	3488		609		
Heat, thousand Gcal	2874		2874			2397		476	1	

Energy Balance 2011 (natural units)

Type of Fuel and Energy	TOTAL	Resources				Distribution				
		Stock at the Start of the Year	Production	Inputs from Other National Sources	Import	Gross Domestic Consumption	Export	Losses	Other Distribution Items	Stock at the End of the Year
Coal – total, kt	292	85			207	198				94
anthracite	199				199	182				17
brown coal	16	8			8	16				
Coking Coal, kt										
Oil, kt	13		13			12				1
Diesel Oil, kt	449		4		445	446		1		3
Oven Fuel, kt										
Residual Fuel Oil, kt	31	4	10		17	24	7			
Jet Fuel, kt	19				19					
Gasoline – total, kt	212				212	208		1		4
including, Lead Free Gasoline										
Kerosene Oil, kt										
Lubricants, kt	15		5		10	10	5			
Bitumen, kt	19	1			18	19				
White Spirit, kt										
Paraffin Waxes, kt										
Processed Oils, kt c.e.										
Other Petroleum Products, kt c.e.	5				5	3	2			
Natural Gas, million standard m³	1169	17			1152	1152		56		17
Liquefied Petroleum Gas, kt					77	68	1	1		-8
Biomass, thousand m³ comp.	392	65	327			344		1		48
Solid Biomass, TJ	3464	130	3321		13	3460	4		8	
Fuel wood, TJ	2405	122	2283			2405			8	
Wood Waste, TJ	188		180		8	187				1
Agricultural Waste, TJ	872	9	858		5	868	4			
Other Fuels, kt c.e.										
Electricity, million kWh	4161		1016	2479	666	4161		589		
Heat, thousand Gcal	2721		2721			2721		403		

Energy Balance 2012 (natural units)

Type of Fuel and Energy	TOTAL	Resources				Distribution				
		Stock at the Start of the Year	Production	Inputs from Other National Sources	Import	Gross Domestic Consumption	Export	Losses	Other Distribution Items	Stock at the End of the Year
Coal – total, kt	278	94			184	191				87
anthracite	146				146	139				7
brown coal	52	14			38	52				
Coking Coal, kt	1				1	1				
Oil, kt	12	1	11			11		1		1
Diesel Oil, kt	404	3	3		398	403	1	1		
Oven Fuel, kt										
Residual Fuel Oil, kt	26	7	12		7	18	8			
Jet Fuel, kt	22				22	15	7			
Gasoline – total, kt	169	8			161	169		1		
including, Lead Free Gasoline	169	8			161	169		1		
Kerosene Oil, kt										
Lubricants, kt	10		2		8	8	2			
Bitumen, kt	70				70	58				12
White Spirit, kt										
Paraffin Waxes, kt										
Processed Oils, kt c.e.										
Other Petroleum Products, kt c.e.	2		1		1	2				
Natural Gas, million standard m^3	1112	17			1095	1095		54		17
Liquefied Petroleum Gas, kt		4			78	75	7	1		
Solid Biomass, thousand m^3 comp.	464	48	416			398				64
Solid Biomass, TJ	3793		3779		14	3601	38	2		154
Fuel wood, TJ	2936		2936			2838		2		98
Wood Waste, TJ	377		374		3	332				45
Agricultural Waste, TJ	466		455		11	414	38			14
Wood Coal, TJ	17	4	13			17				
Liquid Biofuel, kt			1							1
Other Fuels, kt c.e.										
Electricity, million kWh	4211		932	2433	846	4211		575		
Heat, thousand Gcal	2596		2596			2596		415		

Energy Balance 2013 (natural units)

Type of Fuel and Energy	TOTAL	Resources				Distribution				
		Stock at the Start of the Year	Production	Inputs from Other National Sources	Import	Gross Domestic Consumption	Export	Losses	Other Distribution Items	Stock at the End of the Year
Coal – total, kt	346	87			259	249		1		96
anthracite	298	72			226	231		1		66
brown coal										
Coking Coal, kt										
Oil, kt	12	1	10		1	10		1		1
Diesel Oil, kt	500	44	1		455	442	6	1		51
Oven Fuel, kt										
Residual Fuel Oil, kt	36	6	16		14	18	13			5
Jet Fuel, kt	23	2			21	13	8			2
Gasoline – total, kt	187	25			162	161		1		25
including, Lead Free Gasoline										
Kerosene Oil, kt										
Lubricants, kt	13	3	1		9	8	2			3
Bitumen, kt	50	13			37	45				5
White Spirit, kt										
Paraffin Waxes, kt										
Processed Oils, kt c.e.										
Other Petroleum Products, kt c.e.	2		1		1	2				
Natural Gas, million standard m^3	1048	17			1031	952		80		16
Liquefied Petroleum Gas, kt	97	7			90	74	12	1		10
Fuel wood, thousand m^3 comp.	477	59	418			408		1		68
Wood Waste, kt c.e.	8	4	4			7				1
Agricultural Waste, kt c.e.	29	1	28			25	1			3
Wood Coal, kt	1	1				1				
Biogas, kt	1		1			1				
Liquid Biofuel, kt	1				1					
Electricity, million kWh	4237		905	1876	1456	4151		85	1	
Heat, thousand Gcal	2681		2681			2282		399		

Annex 2-2: Total Consumption as Fuel or Energy in the Republic of Moldova, by the Main Sectors of the National Economy 1990, 1993-2013

Total Consumption as Fuel or Energy in 1990, by the Main Sectors of the National Economy (natural units)

Type of Fuel and Energy	TOTAL Consumption	Of which:			As Fuel and Energy	Of which:						
		For Electricity	For Heat	As Raw Material and for Non-Energy Purposes		For Industry	For Construction	For Transport	For Agriculture	For Trade and Utilities	Sold to Population	For Other Works and Needs
Coal – total, kt	4623	2521	136		1966	43		7	21	453	1429	13
anthracite	4449	2521	133		1795	42		3	21	452	1264	13
brown coal	174		3		171	1		4		1	165	
bituminous coal												
Briquettes, kt	31				31					2	29	
Ukraine Brown Coal, kt	31				31					2	29	
Coking Coal, kt	41			2	39	39						
Diesel Oil, kt	1120	1	7		1112	30	51	395	610	11	2	13
Oven Fuel, kt	93		10		83	11			25	17	28	2
Residual Fuel Oil, kt	2501	989	1130	4	378	348	2		6	21		1
Jet Fuel, kt												
Fuel for Diesel Engines, kt	61	1	43		17	7			2	4		4
Aviation Fuel, kt	2				2			2				
Gasoline, kt	796				796	5	8	655	7		117	4
Kerosene for Tractors, kt	26		1		25	15			8	1		1
Kerosene for Lighting, kt	11				11				1		10	
Aviation Kerosene, kt	67				67			67				
Lubricants, kt												
Natural Gas, million standard m^3	3908	1527	1712	35	634	260	2	71	2	42	257	
Liquefied Petroleum Gas, kt	146				146			13	1	6	125	1
Fuel wood, thousand m^3 comp.	216		1	37	178	15			4	37	117	5
Wood and Agricultural Waste, kt c.e.	16		2		14	6					8	
Other Fuels, kt c.e.												
Electricity, million kWh	11349	4			11345	5404	120	238	1670	1195	1763	955
Heat, thousand Gcal	20983				20983	10452	184	210	1631	2432	5228	843

Total Consumption as Fuel or Energy in 1993, by the Main Sectors of the National Economy (natural units)

Type of Fuel and Energy	TOTAL Consumption	Of which:			As Fuel and Energy	Of which:						
		For Electricity	For Heat	As Raw Material and for Non-Energy Purposes		For Industry	For Construction	For Transport	For Agriculture	For Trade and Utilities	Sold to Population	For Other Works and Needs
Coal – total, kt	2138.7	1629.2	90.3	0.2	419.0	15.0	0.2	4.1	10.0	200.5	172.3	16.9
anthracite	185.1	5.0	15.1		165.0	3.9	0.1		3.8	61.7	93.6	1.9
brown coal	84.1		15.8		68.3	2.9			1.4	41.0	16.9	6.1
bituminous coal	1869.5	1624.2	59.4	0.2	185.7	8.2	0.1	4.1	4.8	97.8	61.8	8.9
Coking Coal, kt	17.3		0.1		17.2	16.8	–	–	–	0.1	0.2	0.1
Diesel Oil, kt	468.4	0.3	5.7	0.4	462.0	12.0	6.9	214.6	218.1	3.4	1.0	6.0
Oven Fuel, kt	11.5		2.3		9.2	1.1	0.3		5.5	1.2	0.3	0.8
Residual Fuel Oil, kt	1296.9	657.9	546.9	0.7	91.4	63.0	2.7	7.4	5.0	12.6		0.7
Residual Fuel Oil for Ships, kt												
Fuel for Engines, kt	2.8		0.8		2.0	0.6	0.1	0.2	0.8	0.3		
Aviation Gasoline, kt	0.4				0.4	0.1		0.3				
Gasoline, kt	219.6			0.3	219.3	0.2	0.4	209.8	1.3		6.7	0.9
Kerosene Oil, kt	41.5		3.2		38.3	4.5	0.1	20.6	5.7	1.1	0.6	5.7
Lubricants, kt												
Natural Gas, million standard m³	2224.8	1011.5	792.5		424.8	93.0		19.3	2.0	33.8	258.3	5.5
Liquefied Petroleum Gas, kt	39.9		0.8	0.1	39.0	0.3	0.1	8.4	0.3	1.0	28.6	0.3
Fuel wood, thousand m³ comp.	130.1		0.6	6.4	123.1	8.4			1.1	14.0	98.3	1.3
Wood and Agricultural Waste, kt c.e.	10.6		1.7	0.9	8.0	2.3			0.1	0.2	5.0	0.4
Other Fuels, kt c.e.	1.0				1.0				1.0			
Electricity, million kWh	6122.2		1.8		6120.4	2077.8	64.1	129.3	792.9	677.4	1913.4	465.5
Heat, thousand Gcal	8703.4				8703.4	3290.4	44.1	52.3	578.2	1824.7	2343.1	570.6

Total Consumption as Fuel or Energy in 1994, by the Main Sectors of the National Economy (natural units)

Type of Fuel and Energy	TOTAL Consumption	Of which:			As Fuel and Energy	Of which:						
		For Electricity	For Heat	As Raw Material and for Non-Energy Purposes		For Industry	For Construction	For Transport	For Agriculture	For Trade and Utilities	Sold to Population	For Other Works and Needs
Coal – total, kt	476		41		435	10		3	6	151	257	8
anthracite	174		7		167				2	27	136	2
brown coal	44		4		40	2		3	1	30	3	1
bituminous coal	258		30		228	8			3	94	118	5
Coking Coal, kt	12				12	12						
Diesel Oil, kt	390	1	7	1	382	12	6	144	212	2	5	1
Oven Fuel, kt	4		1		3	1			1	1		
Residual Fuel Oil, kt	363	27	304		32	12	1	2	2	6	1	8
Fuel for Engines, kt	1				1							1
Gasoline, kt	211				211		1	159	2		47	2
Kerosene Oil, kt	16		1		15	1		11	1			2
Lubricants, kt	17				17			9	7			1
Natural Gas, million m³ standard	1213	138	711		364	66	1	52	2	18	217	8
Liquefied Petroleum Gas, kt	19				19			6			12	1
Fuel wood, thousand m³ comp.	134		1	7	126	1			2	13	107	3
Wood and Agricultural Waste, kt c.e.	14		5	1	8	1					7	
Other Fuels, kt c.e.	1				1				1			
Electricity, million kWh	4347		2		4345	1036	37	101	586	896	1280	409
Heat, thousand Gcal	6658				6658	2110	14	28	322	1457	2405	322

Total Consumption as Fuel or Energy in 1995, by the Main Sectors of the National Economy (natural units)

Type of Fuel and Energy	TOTAL Consumption	Of which: For Electricity	For Heat	As Raw Material and for Non-Energy Purposes	As Fuel and Energy	Of which: For Industry	For Construction	For Transport	For Agriculture	For Trade and Utilities	Sold to Population	For Other Works and Needs
Coal – total, kt	269		25		244	6		3	4	149	74	8
anthracite	78		5		73	1			1	17	51	3
brown coal	34		2		32	1		3	1	24	2	1
bituminous coal	157		18		139	4				108	21	4
Coking Coal, kt	14				14	13						1
Diesel Oil, kt	379	1	7	1	370	12	6	139	201	2	7	3
Oven Fuel, kt	1		1		1	1			6			1
Residual Fuel Oil, kt	347	29	280		38	9	2	2		6		19
Gasoline, kt	223				223		1	143	2		75	2
Kerosene Oil, kt	13				13	1		11				2
Lubricants, kt	17				17			10	7		1	
Natural Gas, million standard m^3	1227	118	712		397	90	1	48	5	17	232	4
Liquefied Petroleum Gas, kt	19				19			4		1	12	2
Fuel wood, thousand m^3 comp.	228		1	4	223	4			3	16	195	5
Wood and Agricultural Waste, kt c.e.	11		3		8						7	1
Other Fuels, kt c.e.												
Electricity, million kWh	4138		2		4136	967	29	120	452	610	1527	431
Heat, thousand Gcal	6126				6126	1874	15	23	279	1134	2506	295

Total Consumption as Fuel or Energy in 1996, by the Main Sectors of the National Economy (natural units)

Type of Fuel and Energy	TOTAL Consumption	Of which: For Electricity	For Heat	As Raw Material and for Non-Energy Purposes	As Fuel and Energy	Of which: For Industry	For Construction	For Transport	For Agriculture	For Trade and Utilities	Sold to Population	For Other Works and Needs
Coal – total, kt	372		24		348	3		3	4	135	194	9
anthracite	84		2		82	1			1	18	60	2
brown coal	35		2		33	1		3		26	2	2
bituminous coal	253		20		233	1				91	132	5
Coking Coal, kt	15				15	14					1	
Diesel Oil, kt	323	1	5		317	10	5	124	157	2	15	4
Oven Fuel, kt	7		1		6	2			3			1
Residual Fuel Oil, kt	311	34	251		26	8	2	1		5		10
Gasoline, kt	214				214		1	135	5		73	
Kerosene Oil, kt	20				20			18				2
Lubricants, kt	16				16			8	6		1	1
Natural Gas, million standard m^3	1349	180	727		442	68	1	68	5	22	275	3
Liquefied Petroleum Gas, kt	22				22			4		1	15	2
Fuel wood, thousand m^3 comp.	276		1	1	274	4			2	19	238	11
Wood and Agricultural Waste, kt c.e.	15		3		12					1	11	
Other Fuels, kt c.e.	2				2				1			1
Electricity, million kWh	4094		1		4093	927	28	106	398	762	1402	470
Heat, thousand Gcal	6027				6027	1871	12	19	251	989	2570	315

Total Consumption as Fuel or Energy in 1997, by the Main Sectors of the National Economy (natural units)

Type of Fuel and Energy	TOTAL Consumption	Of which:			As Fuel and Energy	Of which:						
		For Electricity	For Heat	As Raw Material and for Non-Energy Purposes		For Industry	For Construction	For Transport	For Agriculture	For Trade and Utilities	Sold to Population	For Other Works and Needs
Coal – total, kt	265		21		244	3		5	2	117	111	6
anthracite	90		1		89	1			1	15	70	2
brown coal	25		2		23			4		15	3	1
bituminous coal	150		18		132	2		1		87	38	3
Coking Coal, kt	12				12	12						
Diesel Oil, kt	305	1	3		301	8	5	110	146	2	28	2
Oven Fuel, kt	6		1		5	3			2			
Residual Fuel Oil, kt	224	29	178		17	5	2	1	1	1		7
Gasoline, kt	244				244		1	112	3		127	1
Kerosene Oil, kt	22				22			21				1
Lubricants, kt	15				15			7	6		1	1
Natural Gas, million standard m³	1461	226	743		492	97	1	30	10	22	330	2
Liquefied Petroleum Gas, kt	26				26			5			20	1
Fuel wood, thousand m³ comp.	274		1	1	272	4			2	16	244	6
Wood and Agricultural Waste, kt c.e.	13		2		11						10	1
Other Fuels, kt c.e.	9		1		8	4			4			
Electricity, million kWh	3367		–		3767	887	25	114	283	702	1339	417
Heat, thousand Gcal	5552		–		5552	1769	11	11	208	866	2427	260

Total Consumption as Fuel or Energy in 1998, by the Main Sectors of the National Economy (natural units)

Type of Fuel and Energy	TOTAL Consumption	Of which:			As Fuel and Energy	Of which:						
		For Electricity	For Heat	As Raw Material and for Non-Energy Purposes		For Industry	For Construction	For Transport	For Agriculture	For Trade and Utilities	Sold to Population	For Other Works and Needs
Coal – total, kt	197		19		178	5			2	124	41	6
anthracite	34		1		33	3				13	17	
brown coal	20		2		18	1				13		4
bituminous coal	143		16		127	1				98	24	2
Coking Coal, kt	10				10	9						1
Diesel Oil, kt	246	1	1		244	4	3	93	107	1	32	4
Oven Fuel, kt	10		1		9	1			6	1		1
Residual Fuel Oil, kt	172	21	141		10	6	1	1		1		1
Gasoline, kt	207				207			93	2		110	2
Kerosene Oil, kt	21				21	1		17				3
Lubricants, kt	11				11			6	4		1	
Natural Gas, million standard m³	1355	153	749		453	93	1	29	9	18	301	2
Liquefied Petroleum Gas, kt	25				25			4			20	1
Fuel wood, thousand m³ comp.	280		2	1	277	2			2	17	252	4
Wood and Agricultural Waste, kt c.e.	7		1		6						6	
Other Fuels, kt c.e.	4		1		3	2			1			
Electricity, million kWh	3213				3211	803	17	116	213	550	1104	408
Heat, thousand Gcal	5173				5173	1495	10	12	142	759	2497	258

Total Consumption as Fuel or Energy in 1999, by the Main Sectors of the National Economy (natural units)

Type of Fuel and Energy	TOTAL Consumption	Of which:			As Fuel and Energy	Of which:						
		For Electricity	For Heat	As Raw Material and for Non-Energy Purposes		For Industry	For Construction	For Transport	For Agriculture	For Trade and Utilities	Sold to Population	For Other Works and Needs
Coal – total, kt	151		8		143	1			1	84	51	6
anthracite	51				51	1				13	37	
brown coal	10		1		9					6	1	2
bituminous coal	90		7		83					65	13	4
Coking Coal, kt	7				7	7						
Diesel Oil, kt	178	1	1		176	3	2	68	71	2	29	1
Oven Fuel, kt	9		1		8	3			3	1	1	
Residual Fuel Oil, kt	104	9	90		5	2	1			1		1
Gasoline, kt	119				119			56	1		61	1
Kerosene Oil, kt	22				22			21				1
Lubricants, kt	8				8			3	3			2
Natural Gas, million standard m³	1150	174	553	1	422	90	1	31	5	15	278	2
Liquefied Petroleum Gas, kt	31				31			5			25	1
Fuel wood, thousand m³ comp.	257		1	1	255	1			2	10	238	4
Wood and Agricultural Waste, kt c.e.	13		1		12						11	1
Other Fuels, kt c.e..	14	1	11		2	2						
Electricity, million kWh	2566				2566	715	14	65	115	540	774	343
Heat, thousand Gcal	3899				3899	1047	6	4	124	548	2022	148

Total Consumption as Fuel or Energy in 2000, by the Main Sectors of the National Economy (natural units)

Type of Fuel and Energy	TOTAL Consumption	Of which:			As Fuel and Energy	Of which:						
		For Electricity	For Heat	As Raw Material and for Non-Energy Purposes		For Industry	For Construction	For Transport	For Agriculture	For Trade and Utilities	Sold to Population	For Other Works and Needs
Coal – total, kt	125		5		120	2				64	50	4
anthracite	70				70	1				25	44	
brown coal	8		1		7					5		2
bituminous coal	47		4		43	1				34	6	2
Coking Coal, kt	7				7	6						1
Diesel Oil, kt	192	1	1		190	3	2	74	57	1	52	1
Oven Fuel, kt	14		2		12	3			4	3	1	1
Residual Fuel Oil, kt	47	3	40		4	2	1			1		
Gasoline, kt	117				117			50	1		66	
Kerosene Oil, kt	21				21			20				1
Lubricants, kt	7				7			3	2		1	1
Natural Gas, million standard m³	928	197	354	1	376	107		18	5	16	225	5
Liquefied Petroleum Gas, kt	35				35			6			28	1
Fuel wood, thousand m³ comp.	240			1	239	1			1	12	220	5
Wood and Agricultural Waste, kt c.e.	19		2		17						17	
Other Fuels, kt c.e.	3		2		1						1	
Electricity, million kWh	2244				2244	627	11	61	71	393	790	291
Heat, thousand Gcal	2673				2673	909	4	3	38	428	1194	97

Total Consumption as Fuel or Energy in 2001, by the Main Sectors of the National Economy (natural units)

Type of Fuel and Energy	TOTAL Consumption	Of which:			As Fuel and Energy	Of which:						
		For Electricity	For Heat	As Raw Material and for Non-Energy Purposes		For Industry	For Construction	For Transport	For Agriculture	For Trade and Utilities	Sold to Population	For Other Works and Needs
Coal – total, kt	108		5		103	2				67	29	5
anthracite	40				40	1				11	28	
brown coal	5				5					4	1	
bituminous coal	63		5		58	1				52		5
Coking Coal, kt	8				8	8						
Diesel Oil, kt	210	1	1		208	3	2	79	55	1	67	1
Oven Fuel, kt	15		1		14	3			5	5		1
Residual Fuel Oil, kt	45	6	33		6	3	1			2		
Gasoline, kt	128				128			55	1		70	2
Kerosene Oil, kt	16				16			16				
Lubricants, kt	7				7			3	2		2	
Natural Gas, million standard m^3	1044	297	381	1	365	98	1	11	3	22	230	
Liquefied Petroleum Gas, kt	47				47	12		4			27	4
Fuel wood, thousand m^3 comp.	222				222	1			2	16	198	5
Wood and Agricultural Waste, kt c.e.	26		5		21						20	1
Other Fuels, kt c.e.	1				1					1		
Electricity, million kWh	2208		2		2206	648	10	60	59	347	813	269
Heat, thousand Gcal	2809				2809	984	3	4	18	582	1128	90

Total Consumption as Fuel or Energy in 2002, by the Main Sectors of the National Economy (natural units)

Type of Fuel and Energy	TOTAL Consumption	Of which:			As Fuel and Energy	Of which:						
		For Electricity	For Heat	As Raw Material and for Non-Energy Purposes		For Industry	For Construction	For Transport	For Agriculture	For Trade and Utilities	Sold to Population	For Other Works and Needs
Coal – total, kt	151		4		147	1				80	58	8
anthracite	88		2		86	1				27	57	1
brown coal	3				3					3		
bituminous coal	60		2		58					50	1	7
Coking Coal, kt	8				8	7						1
Diesel Oil, kt	255		1		254	3	2	118	73	1	56	1
Oven Fuel, kt	6		1		5	2			1	1		1
Residual Fuel Oil, kt	33	2	28		3		1			1		1
Gasoline, kt	162				162			80			82	
Kerosene Oil, kt	19				19			18				1
Lubricants, kt	7				7			3	2		1	1
Natural Gas, million standard m^3	1066	257	371	2	436	125	1	20	4	43	242	1
Liquefied Petroleum Gas, kt	48				48			5			42	1
Fuel wood, thousand m^3 comp.	270		1		269	1			2	20	242	4
Wood and Agricultural Waste, kt c.e.	26		8		18						17	1
Other Fuels, kt c.e.	1				1							1
Electricity, million kWh	2451		2		2449	733	9	61	63	566	774	243
Heat, thousand Gcal	2699				2699	987	3	4	13	422	1180	90

Total Consumption as Fuel or Energy in 2003, by the Main Sectors of the National Economy (natural units)

Type of Fuel and Energy	TOTAL Consumption	Of which:			As Fuel and Energy	Of which:							
		For Electricity	For Heat	As Raw Material and for Non-Energy Purposes		For Industry	For Construction	For Transport	For Agriculture	For Trade and Utilities	Sold to Population	For Other Works and Needs	For Industry
Coal – total, kt	219		5		214	1				2	115	91	5
anthracite	160		2		158	1				1	69	87	
brown coal	1				1						1		
bituminous coal	58		3		55					1	45	4	5
Coking Coal, kt	5				5	5							
Diesel Oil, kt	287		2	1	284	3	2	139	69		1	68	2
Oven Fuel, kt	3		1		2	1			1				
Residual Fuel Oil, kt	26	2	18		6	3	1				1		1
Gasoline – total, kt	192				192			99				92	1
including, Lead Free Gasoline	192				192			99				92	1
Kerosene Oil, kt	13				13			12					1
Lubricants, kt	11				11			3	2			2	4
Bitumen, kt	12			12									
White Spirit, kt	1			1									
Other Petroleum Products, kt c.e.	2			2									
Natural Gas, million standard m^3	1143	234	390	2	517	133	1	15	4	2	56	304	2
Liquefied Petroleum Gas, kt	50				50			6			1	42	1
Fuel wood, thousand m^3 comp.	311		1		310	2			2	2	49	252	3
Wood Waste, kt c.e.	21		1		20						5	15	
Agricultural Waste, kt c.e.	11		7		4							3	1
Electricity, million kWh	2529		2		2527	865	8	51	52	68	513	836	134
Heat, thousand Gcal	2799				2799	935	4	4	11	17	454	1288	86

Total Consumption as Fuel or Energy in 2004, by the Main Sectors of the National Economy (natural units)

Type of Fuel and Energy	TOTAL Consumption	Of which:			As Fuel and Energy	Of which:							
		For Electricity	For Heat	As Raw Material and for Non-Energy Purposes		For Industry	For Construction	For Transport	For Agriculture	For Trade and Utilities	Sold to Population	For Other Works and Needs	For Industry
Coal – total, kt	185		6		179	6				1	100	70	2
anthracite	144		2		142	5				1	68	67	1
bituminous coal	41	0	4	0	37	1	0	0	0	0	32	3	1
Coking Coal, kt	2				2	2							
Oil, kt													
Diesel Oil, kt	325		2		323	4	2	141	62		1	111	2
Oven Fuel, kt	3				3	1					2		
Residual Fuel Oil, kt	24	2	16		6	4	1				1		
Jet Fuel, kt	14				14			11					3
Gasoline – total, kt	210				210			71				137	2
including, Lead Free Gasoline	210				210			71				137	2
Kerosene Oil, kt	1				1								1
Lubricants, kt	11				11			2	2			2	5
Bitumen, kt	17			17									
White Spirit, kt													
Paraffin Waxes, kt													
Processed Oils, kt c.e.													
Other Petroleum Products, kt c.e.	1			1									
Natural Gas, million standard m^3	1167	247	359	6	555	138	1	23	7	2	65	316	3
Liquefied Petroleum Gas, kt	52				52			5			1	46	
Fuel wood, thousand m^3 comp.	251			1	250	1			1	1	29	214	4
Wood Waste, kt c.e.	16		1		15	1					2	11	1
Agricultural Waste, kt c.e.	16		11		5							4	1
Electricity, million kWh	2634				2634	871	10	47	48	64	475	964	155
Heat, thousand Gcal	2686				2686	1011	4	2	14	18	418	1129	90

Total Consumption as Fuel or Energy in 2005, by the Main Sectors of the National Economy (natural units)

Type of Fuel and Energy	TOTAL Consumption	Of which:			As Fuel and Energy	Of which:							
		For Electricity	For Heat	As Raw Material and for Non-Energy Purposes		For Industry	For Construction	For Transport	For Agriculture	For Trade and Utilities	Sold to Population	For Other Works and Needs	For Industry
Coal – total, kt	180		5		175	8				2	83	81	1
anthracite	142		3		139	6				1	54	77	1
bituminous coal	38	0	2	0	36	2	0	0	0	1	29	4	0
Coking Coal, kt													
Oil, kt	6			6									
Diesel Oil, kt	331	1	2		328	4	3	155	56		1	107	2
Oven Fuel, kt	1				1								1
Residual Fuel Oil, kt	21	3	13		5	4							1
Jet Fuel, kt	15				15			12					3
Gasoline – total, kt	215				215			69				146	
including, Lead Free Gasoline	215				215			69				146	
Kerosene Oil, kt	1				1								1
Lubricants, kt	11			1	10			2	2			2	4
Bitumen, kt	16			16									
White Spirit, kt													
Paraffin Waxes, kt													
Processed Oils, kt c.e.													
Other Petroleum Products, kt c.e.	2			1	1								1
Natural Gas, million standard m^3	1339	281	411	5	642	179	1	22	3	3	73	357	4
Liquefied Petroleum Gas, kt	53				53			5			1	45	2
Fuel wood, thousand m^3 comp.	253			2	251	1			1	1	26	218	4
Wood Waste, kt c.e.	13		1		12	1					1	10	
Agricultural Waste, kt c.e.	16		8		8							7	1
Electricity, million kWh	2921				2921	974	10	50	51	90	581	1041	124
Heat, thousand Gcal	3084				3084	1007	5	2	20	24	544	1395	87

Total Consumption as Fuel or Energy in 2006, by the Main Sectors of the National Economy (natural units)

Type of Fuel and Energy	TOTAL Consumption	Of which:			As Fuel and Energy	Of which:							
		For Electricity	For Heat	As Raw Material and for Non-Energy Purposes		For Industry	For Construction	For Transport	For Agriculture	For Trade and Utilities	Sold to Population	For Other Works and Needs	For Industry
Coal – total, kt	189		4		185	6				1	79	93	6
anthracite	143		2		141	6					44	90	1
bituminous coal	46	0	2	0	44	0	0	0	0	1	35	3	5
Coking Coal, kt													
Oil, kt	4			4									
Diesel Oil, kt	334		1		333	4	3	180	56		1	87	2
Oven Fuel, kt	1				1								1
Residual Fuel Oil, kt	17	1	11		5	4	1						
Jet Fuel, kt	17				17			12					5
Gasoline – total, kt	198				198			73				123	2
including, Lead Free Gasoline	198				198			73				123	2
Kerosene Oil, kt													
Lubricants, kt	12				12			4	2			3	3
Bitumen, kt	22			22									
White Spirit, kt													
Paraffin Waxes, kt													
Processed Oils, kt c.e.													
Other Petroleum Products, kt c.e.													
Natural Gas, million standard m^3	1327	274	400	3	650	179	2	5	2	4	79	375	4
Liquefied Petroleum Gas, kt	50				50			5			1	43	1
Fuel wood, thousand m^3 comp.	313			2	311	1			2	1	32	272	3
Wood Waste, kt c.e.	13				13						1	12	
Agricultural Waste, kt c.e.	16		7		9							8	1
Electricity, million kWh	3215				3215	1026	14	58	55	100	653	1154	155
Heat, thousand Gcal	2903				2903	932	6	4	10	26	480	1330	115

Total Consumption as Fuel or Energy in 2007, by the Main Sectors of the National Economy (natural units)

Type of Fuel and Energy	TOTAL Consumption	Of which:			As Fuel and Energy	Of which:							
		For Electricity	For Heat	As Raw Material and for Non-Energy Purposes		For Industry	For Construction	For Transport	For Agriculture	For Trade and Utilities	Sold to Population	For Other Works and Needs	For Industry
Coal – total, kt	129		3		126	3					63	54	6
anthracite	100		2		98	3					39	51	5
bituminous coal	29	0	1	0	28	0	0	0	0	0	24	3	1
Coking Coal, kt													
Oil, kt	8			8									
Diesel Oil, kt	351		1		350	3	4	211	49			80	3
Oven Fuel, kt	1				1								1
Residual Fuel Oil, kt	14		7	3	4	2	1						1
Jet Fuel, kt	20				20			14					6
Gasoline – total, kt	203				203			80			1	121	1
including, Lead Free Gasoline	203				203			80			1	121	1
Kerosene Oil, kt													
Lubricants, kt	10			1	9			5	1			3	
Bitumen, kt	26			26									
White Spirit, kt													
Paraffin Waxes, kt													
Processed Oils, kt c.e.													
Other Petroleum Products, kt c.e.	1			1									
Natural Gas, million standard m^3	1213	269	351	3	590	176	1	5	1	4	87	314	2
Liquefied Petroleum Gas, kt	53				53			6			1	45	1
Fuel wood, thousand m^3 comp.	258			1	257				2	1	31	220	3
Wood Waste, kt c.e.	10				10						1	9	
Agricultural Waste, kt c.e.	15		8		7							7	
Electricity, million kWh	3364				3364	1049	15	65	50	115	630	1295	145
Heat, thousand Gcal	2554				2554	724	6	2	8	16	444	1274	80

Total Consumption as Fuel or Energy in 2008, by the Main Sectors of the National Economy (natural units)

Type of Fuel and Energy	TOTAL Consumption	Of which:			As Fuel and Energy	Of which:							
		For Electricity	For Heat	As Raw Material and for Non-Energy Purposes		For Industry	For Construction	For Transport	For Agriculture	For Trade and Utilities	Sold to Population	For Other Works and Needs	For Industry
Coal – total, kt	198		4		194	84				1	57	45	7
anthracite	88		3		85	9				1	30	43	2
bituminous coal	110	0	1	0	109	75	0	0	0	0	27	2	5
Coking Coal, kt													
Oil, kt	14			14									
Diesel Oil, kt	368		1		367	3	4	218	47			92	3
Oven Fuel, kt	1				1								1
Residual Fuel Oil, kt	17	1	9		7	2	1				2		2
Jet Fuel, kt	18				18			14					4
Gasoline – total, kt	208				208			77			1	129	1
including, Lead Free Gasoline	208				208			77			1	129	1
Kerosene Oil, kt													
Lubricants, kt	11				11			6	1			3	1
Bitumen, kt	24			24									
White Spirit, kt													
Paraffin Waxes, kt													
Processed Oils, kt c.e.													
Other Petroleum Products, kt c.e.	1			1									
Natural Gas, million standard m^3	1138	240	355	4	539	103	1	5	3	5	87	332	3
Liquefied Petroleum Gas, kt	55				55			10			1	43	1
Fuel wood, thousand m^3 comp.	289			1	288				1	1	33	249	4
Wood Waste, kt c.e.	12				12						1	11	
Agricultural Waste, kt c.e.	20		12		8						1	7	
Electricity, million kWh	3428				3428	948	14	62	54	130	711	1371	138
Heat, thousand Gcal	2553				2553	730	5	2	11	20	452	1262	71

Total Consumption as Fuel or Energy in 2009, by the Main Sectors of the National Economy (natural units)

Type of Fuel and Energy	TOTAL Consumption	Of which:			As Fuel and Energy	Of which:							
		For Electricity	For Heat	As Raw Material and for Non-Energy Purposes		For Industry	For Construction	For Transport	For Agriculture	For Trade and Utilities	Sold to Population	For Other Works and Needs	For Industry
Coal – total, kt	177		5		172	57				1	58	55	1
anthracite	109		4		105	3				1	45	55	1
bituminous coal	68	0	1	0	67	54	0	0	0	0	13	0	0
Coking Coal, kt	2				2	2							
Oil, kt	17			17									
Diesel Oil, kt	337		1		336	2	3	186	43			101	1
Oven Fuel, kt	1				1								1
Residual Fuel Oil, kt	36	8	17	4	7	1					4		2
Jet Fuel, kt	14				14			14					
Gasoline – total, kt	207				207			64				142	1
including, Lead Free Gasoline	207				207			64				142	1
Kerosene Oil, kt													
Lubricants, kt	9				9			5	1			1	2
Bitumen, kt	10			10									
White Spirit, kt	1			1									
Paraffin Waxes, kt													
Processed Oils, kt c.e.													
Other Petroleum Products, kt c.e.	2			1	1						1		
Natural Gas, million standard m^3	1068	222	300		546	59		7	2	5	129	343	1
Liquefied Petroleum Gas, kt	60				60			10			8	42	
Fuel wood, thousand m^3 comp.	262			1	261				2	1	30	226	2
Wood Waste, kt c.e.	15				15						1	13	1
Agricultural Waste, kt c.e.	25		15		10						10		
Electricity, million kWh	3378				3378	872	13	50	59	171	695	1450	68
Heat, thousand Gcal	2223				2223	419	2	2	10	11	460	1291	28

Total Consumption as Fuel or Energy in 2010, by the Main Sectors of the National Economy (natural units)

Type of Fuel and Energy	TOTAL Consumption	Of which:			As Fuel and Energy	Of which:							
		For Electricity	For Heat	As Raw Material and for Non-Energy Purposes		For Industry	For Construction	For Transport	For Agriculture	For Trade and Utilities	Sold to Population	For Other Works and Needs	For Industry
Coal – total, kt	186		3		183	52				1	42	83	5
anthracite	129		3		126	10					32	83	1
bituminous coal	57				57	42				1	10		4
Coking Coal, kt	4				4	4							
Oil, kt	11			11									
Diesel Oil, kt	418		1		417	4	3	249	44	1	2	113	1
Oven Fuel, kt	2				2	2					1		1
Residual Fuel Oil, kt	31	3	19	6	3	1	1			1			
Jet Fuel, kt	13				13			13					
Gasoline – total, kt	197				197			69				127	1
including, Lead Free Gasoline	197				197			69				127	1
Kerosene Oil, kt				1									
Lubricants, kt	10			21	9			6	1			1	1
Bitumen, kt	21			1									
White Spirit, kt	1												
Paraffin Waxes, kt													
Processed Oils, kt c.e.													
Other Petroleum Products, kt c.e.	2			2									
Natural Gas, million standard m^3	1128	216	321		591	79	1	2	3	10	130	364	2
Liquefied Petroleum Gas, kt	64				64	1	1	13		1	6	40	2
Fuel wood, thousand m^3 comp.	267				267	1			3	2	25	232	4
Wood Waste, kt c.e.	10				10					1		8	1
Agricultural Waste, kt c.e.	21		17		4					1		2	1
Electricity, million kWh	3488		2		3486	975	13	46	54	185	598	1514	101
Heat, thousand Gcal	2397				2397	531	2	1	8	16	457	1324	58

Total Consumption as Fuel or Energy in 2011, by the Main Sectors of the National Economy (natural units)

Type of Fuel and Energy	TOTAL Consumption	Of which:			Of which:							
		For Electricity	For Heat	As Raw Material and for Non-Energy Purposes	As Fuel and Energy	For Industry	For Construction	For Transport	For Agriculture	For Trade and Utilities	Sold to Population	For Other Works and Needs
Coal – total, kt	198		3		195	72				42	75	6
anthracite	182		2		180	72				34	72	2
bituminous coal	16		1		15					8	3	4
Coking Coal, kt												
Oil, kt	12			12								
Diesel Oil, kt	444			1	443	3	3	262	41	3	129	2
Oven Fuel, kt												
Residual Fuel Oil, kt	24	15	1	5	3	1	1					1
Jet Fuel, kt	19			6	13			13				
Gasoline – total, kt	207							82			123	2
including, Lead Free Gasoline	207							82			123	2
Kerosene Oil, kt												
Lubricants, kt	10				10			6	1	1	4	2
Bitumen, kt	19			19								
White Spirit, kt												
Paraffin Waxes, kt												
Processed Oils, kt c.e.												
Other Petroleum Products, kt c.e.	3			3								
Natural Gas, million standard m^3	1152	383	128		584	84	1	2	3	151	343	1
Liquefied Petroleum Gas, kt	67				67		1	10		2	54	
Biomass, thousand m^3 comp.	344		14		329	3			2	29	292	3
Solid Biomass, TJ	3448		400	1	3047	47			27	267	2690	16
Fuel wood, TJ	2398			1	2397	17			15	219	2134	12
Wood Waste, TJ	181					25				17	137	2
Agricultural Waste, TJ	469					5			12	31	419	2
Other Fuels, kt c.e.												
Electricity, million kWh	3571				3571	992	14	50	54	821	1547	93
Heat, thousand Gcal	2318				2318	487	3		10	483	1283	52

Total Consumption as Fuel or Energy in 2012, by the Main Sectors of the National Economy (natural units)

Type of Fuel and Energy	TOTAL Consumption	Of which:			Of wich:							
		For Electricity	For Heat	As Raw Material and for Non-Energy Purposes	As Fuel and Energy	For Industry	For Construction	For Transport	For Agriculture	For Trade and Utilities	Sold to Population	For Other Works and Needs
Coal – total, kt	191		3		188	52				40	95	1
anthracite	139		3		136	5				36	94	1
bituminous coal	52				52	47				4	1	
Coking Coal, kt	1					1						
Oil, kt	10			10								
Diesel Oil, kt	402			6	396	4	3	264	38		86	1
Oven Fuel, kt												
Residual Fuel Oil, kt	18	11	1	5	1		1					
Jet Fuel, kt	15											
Gasoline – total, kt	168				168			62			105	1
including, Lead Free Gasoline	168				168			62			105	1
Kerosene Oil, kt												
Lubricants, kt	8				8			6	1		1	
Bitumen, kt	58			37	21	21						
White Spirit, kt												
Paraffin Waxes, kt												
Processed Oils, kt c.e.												
Other Petroleum Products, kt c.e.	2		1	1								
Natural Gas, million standard m^3	1095	371	124		546	78	1	2	4	151	310	1
Liquefied Petroleum Gas, kt	74				74		1			3	56	1
Solid Biomass, thousand m^3 comp.	398		15		383	3			4	35	341	
Solid Biomass, TJ	3599		230	1	3368	55			33	350	2929	1
Fuel wood, TJ	2835		1		2835	17			31	244	2543	
Wood Waste, TJ	329			1	328	36				18	273	1
Agricultural Waste, TJ	188				188	2			2	88	96	
Wood Coal, TJ	17				17						17	
Liquid Biofuel, kt												
Other Fuels, kt c.e.						2			2	88	96	
Electricity, million kWh	3636					1011	16		52	837	1576	106
Heat, thousand Gcal	2181					444	1		10	499	1183	45

Total Consumption as Fuel or Energy in 2013, by the Main Sectors of the National Economy (natural units)

Type of Fuel and Energy	TOTAL Consumption	Of which:			Of which:							
		For Electricity	For Heat	As Raw Material and for Non-Energy Purposes	As Fuel and Energy	For Industry	For Construction	For Transport	For Agriculture	For Trade and Utilities	Sold to Population	For Other Works and Needs
Coal – total, kt	249		14		235	93			1	43	98	
anthracite	231		11		220	86				37	97	
bituminous coal												
Coking Coal, kt												
Oil, kt	10			10								
Diesel Oil, kt	442		1	6	435	4	3	299	42		86	1
Oven Fuel, kt	2			2								
Residual Fuel Oil, kt	18	1	13	3	1	1						
Jet Fuel, kt	13				13			13				
Gasoline – total, kt	161				161			161				
including, Lead Free Gasoline	161				161			161				
Kerosene Oil, kt												
Lubricants, kt	8			8								
Bitumen, kt	45			36	9							
White Spirit, kt												
Paraffin Waxes, kt												
Processed Oils, kt c.e.												
Other Petroleum Products, kt c.e.	2			2								
Natural Gas, million standard m^3	952	186	305		461	71	1	9	4	87	289	
Liquefied Petroleum Gas, kt	74				74			13		3	58	
Fuel wood, thousand m^3 comp.	408		5	4	399	3			4	23	369	
Wood Waste, kt c.e.	7				7					1	6	
Wood Coal, kt	25		13		12					4	8	
Biogas, kt	1				1					1		
Liquid Biofuel, kt	1	1										
Electricity, million kWh	4151				4151	1453	10	59	53	965	1611	
Heat, thousand Gcal	2282				2282	512			9	674	1087	

Annex 3. Additional Methodologies and Data Sources

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 IPCC 2006 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, 1994-2014

	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
Natural Gas, million m³, including:	1298.0	1098.4	1281.5	1261.4	1081.3	1028.5	1030.8	1187.8	862.5	931.5	970.5
MTPP Dnestrovsk	1030.0	1098.4	1231.8	1113.3	856.6	841.3	768.4	937.4	719.3	756.2	838.7
Other plants in energy sector	268.0	0.0	49.7	148.1	224.7	187.2	262.4	250.4	143.2	175.3	131.8
	2005	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**%**
Natural Gas, million m³, including:	972.1	611.1	885.7	995.2	1448.3	1549.9	1428.8	1458.9	958.4	1350.7	4.1
MTPP Dnestrovsk	805.4	429.4	719.0	766.2	1267.2	1339.4	1220.0	1255.8	754.3	1162.6	12.9
Other plants in energy sector	166.7	181.7	166.7	229.0	181.1	210.5	208.8	203.1	204.1	188.1	-29.8
Residual Fuel Oil, kt	NA	NA	NA	7.6057	19.7749	19.5171	16.2301	13.8776	12.2680	14.0393	84.6
Bituminous coal, kt	NA	NA	NA	115.4448	230.8896	201.1057	160.6409	159.9969	180.8061	178.3061	54.5

Source: Official Letter from „Moldova Gaz" No. 02/1-476 dated 23.02.2011, answer to Letter No. 03-07/175 dated 02.02.2011 from the Ministry of Environment; Letter No. 02/1-288 dated 22.01.2014, answer to Letter No. 320/2014-01-01 dated 03.01.2014 from the Climate Change Office; Letter No. 02/1-507 dated 10.02.2015, answer to Letter No. 407/2015-01-09 dated 29.01.2015 from the Climate Change Office; State Statistical Service of the Transnistrian Moldovan Republic (2015), *Socio-economic development* *of the TMR, 2014 (final data). Chapter 4 «Material and Energy Resources», page 22.* / State Statistical Service of the Ministry of Economy of the TMR - Tiraspol, 2015 – 81p.; State Statistical Service of the Transnistrian Moldovan Republic (2014), *Socio-economic development of the TMR, 2013 (final data). Chapter 4 «Material and Energy Resources», page 22.* / State Statistical Service of the Ministry of Economy of the TMR - Tiraspol, 2014 – 88p.; .; State Statistical Service of the Transnistrian Moldovan Republic (2013), *Socio-economic development of the TMR, 2012, Chapter 4 «Material and Energy Resources», page 23.* 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, 1994-2014

	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
Natural Gas, million m^3	275.1	71.72	52.11	151.5	146.5	136.1	143.9	174.5	73.2	79.0	71.9
	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	%
Natural Gas, million m^3	102.5	133.9	232.6	250.5	121.9	113.5	123	134.9	110.8	129.7	-52.9
Residual Fuel Oil, kt	NA	NA	NA	0.8715	0.5705	0.3208	0.3089	0.2581	0.3713	0.3713	-57.4
Bituminous coal, kt	NA	NA	NA	0.0737	0.1473	0.1108	0.1102	0.084	0.0324	0.0772	4.7

Source: Official Letter from „Moldova Gaz" No. 02/1-476 dated 23.02.2011 answer to Letter No. 03-07/175 dated 02.02.2011 from the Ministry of Environment; Letter No. 02/1-288 dated 22.01.2014, answer to Letter No. 320/2014-01-01 dated 03.01.2014 from the Climate Change Office; Letter No. 02/1-507 dated 10.02.2015, answer to Letter No. 407/2015-01-09 dated 29.01.2015 from the Climate Change Office; State Statistical Service of the Transnistrian Moldovan Republic (2015), *Socio-economic development of the TMR, 2014 (final data). Chapter 4 «Material and Energy Resources», page 22.* / State Statistical Service of the Ministry of Economy of the TMR - Tiraspol, 2015 – 81p.; State Statistical Service of the Transnistrian Moldovan Republic (2014), *Socio-economic development of the TMR, 2013 (final data). Chapter 4 «Material and Energy Resources», page 22.* / State Statistical Service of the Ministry of Economy of the TMR - Tiraspol, 2014 – 88p.; State Statistical Service of the Transnistrian Moldovan Republic (2013), *Socio-economic development of the TMR, 2012, Chapter 4 «Material and Energy Resources», page 23.* 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, 1995-2014

	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
Diesel Oil, kt	2.9748	2.3819	3.1773	2.4552	2.2670	1.6176	1.5949	1.2404	0.8601	0.7708
Compressed Natural Gas, mil. m^3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
Diesel Oil, kt	0.5394	0.4471	0.3259	0.2945	0.3893	0.8235	0.9326	1.0272	1.1664	NA
Compressed Natural Gas, mil. m^3	0.0	0.0	0.0	0.0	4.1	6.9	1.8	2.2	5.2	4.8

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); Official Letter from „Moldova Gaz" No. 02/1-476 dated 23.02.2011, answer to Letter No. 03-07/175 dated 02.02.2011 from the Ministry of Environment; Letter No. 02/1-288 dated 22.01.2014, answer to Letter No. 320/2014-01-01 dated 03.01.2014 from the Climate Change Office; Letter No. 02/1-507 dated 10.02.2015, answer to Letter No. 407/2015-01-09 dated 29.01.2015 from the Climate Change Office.

Table A3-1.2.4: Fuel Consumption within the Source Category 1A4a 'Commercial/ Institutional Sector' for the ATULBD, 1999-2014

	1999	2000	2001	2002	2003	2004	2005	2006
Natural Gas, million m^3	6.7	9.3	13.6	81.8	87.5	229.1	181.5	152.1
	2007	2008	2009	2010	2011	2012	2013	2014
Natural Gas, million m^3	14.4	19.7	16.1	37.7	209.2	202.3	99.9	105.1

Source: Official Letter from „Moldova Gaz" No. 02/1-476 dated 23.02.2011, answer to Letter No. 03-07/175 dated 02.02.2011 from the Ministry of Environment; Letter No. 02/1-288 dated 22.01.2014, answer to Letter No. 320/2014-01-01 dated 03.01.2014 from the Climate Change Office; Letter No. 02/1-507 dated 10.02.2015, answer to Letter No. 407/2015-01-09 dated 29.01.2015 from the Climate Change Office.

Table A3-1.2.5: Fuel Consumption within the Source Category 1A4b 'Residential Sector' for the ATULBD,1995-2013

	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
LPG, kt *	2.5000	2.3000	1.4000	1.3000	0.8000	0.4000	0.3000	0.4000	0.5000	0.5000
Natural Gas, million m^3 *	216.6	163.4	354.8	321.6	293.2	217.7	196.4	175.4	176.6	162.8
Natural Gas, million m^3 **	63.0	118.8	196.1	241.2	294.2	253.1	196.4	163.5	176.6	132.0
	2005	2006	2007	2008	2009	2010	2011	2012	2013	%
LPG, kt *	0.5000	0.5000	0.4486	0.4962	0.3869	0.5798	0.6060	0.4767	0.3863	-84.5
Natural Gas, million m^3 *	164.8	161.2	150.8	150.0	156.0	174.3	184.5	184.1	180.6	-16.6
Natural Gas, million m^3 **	144.2	157.0	149.2	148.7	154.7	173.0	184.5	184.1	180.6	186.7
Fire Wood, thousand m^3 ***	NA, NE	NA, NE	NA, NE	7.8848	10.1793	10.8175	9.9527	5.3788	4.6888	NA, NE

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), 2014 (page 23). ** Official Letter from „Moldova Gaz" No. 02/1-476 dated 23.02.2011, answer to Letter No. 03-07/175 dated 02.02.2011 from the Ministry of Environment; Letter No. 02/1-288 dated 22.01.2014, answer to Letter No. 320/2014-01-01 dated 03.01.2014 from the Climate Change Office; Letter No. 02/1-507 dated 10.02.2015, answer to Letter No. 407/2015-01-09 dated 29.01.2015 from the Climate Change Office; *** *Socio-economic development of the TMR, 2014 (final data). Chapter 4 «Material and Energy Resources», page 22.* / State Statistical Service of the Ministry of Economy of the TMR - Tiraspol, 2015 – 81p.; State Statistical Service of the Transnistrian Moldovan Republic (2014), *Socio-economic development of the TMR, 2013 (final data). Chapter 4 «Material and Energy Resources», page 22.* / State Statistical Service of the Ministry of Economy of the TMR - Tiraspol, 2014 – 88p.; State Statistical Service of the Transnistrian Moldovan Republic (2013), *Socio-economic development of the TMR, 2012, Chapter 4 «Material and Energy Resources», page 23.* 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, 1995-2014

	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
Diesel Oil, kt	9.6830	6.1160	8.8580	5.7920	3.0730	1.7550	1.6930	1.2220	1.2580	0.7810
Gasoline, kt	29.7480	23.8190	31.7730	24.5220	22.6700	16.1760	15.9490	12.4040	8.6010	7.7080
Natural Gas, million m^3	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.9000	0.7000

	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
Diesel Oil, kt	0.6120	0.5740	0.3980	0.3340	0.4230	0.6608	0.5818	0.6126	0.8485	0.7207
Gasoline, kt	5.3940	4.4710	3.2590	2.9450	3.8930	8.2439	9.3260	10.2722	11.6636	11.3853
Natural Gas, million m^3	0.4000	0.1000	0.0000	0.1000	0.0000	0.1000	0.1000	0.2000	0.0000	0.0000
Coal, kt	NA, NE	NA, NE	NA, NE	0.0153	0.0115	0.0090	0.0310	0.0240	0.0240	0.0240
Residual Fuel Oil, kt	NA, NE	NA, NE	NA, NE	0.0032	0.0032	0.0032	0.0032	0.0032	0.0032	0.0032

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), 2014 (page 102). Official Letter from „Moldova Gaz" No. 02/1-476 dated 23.02.2011, answer to Letter No. 03-07/175 dated 02.02.2011 from the Ministry of Environment; Letter No. 02/1-288 dated 22.01.2014, answer to Letter No. 320/2014-01-01 dated 03.01.2014 from the Climate Change Office; Letter No. 02/1-507 dated 10.02.2015, answer to Letter No. 407/2015-01-09 dated 29.01.2015 from the Climate Change Office. State Statistical Service of the Transnistrian Moldovan Republic (2015), *Socio-economic development of the TMR, 2014 (final data). Chapter 4 «Material and Energy Resources», page 22.* / State Statistical Service of the Ministry of Economy of the TMR - Tiraspol, 2015 – 81p.; State Statistical Service of the Transnistrian Moldovan Republic (2014), *Socio-economic development of the TMR, 2013 (final data). Chapter 4 «Material and Energy Resources», page 22.* / State Statistical Service of the Ministry of Economy of the TMR - Tiraspol, 2014 – 88p.; State Statistical Service of the Transnistrian Moldovan Republic (2013), *Socio-economic development of the TMR, 2012, Chapter 4 «Material and Energy Resources», page 23.* 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 A3-1.2.7: Fuel Consumption within the Source Category 1A5 'Other' (Other Works and Needs) for the ATULBD, 1995-2014

	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
Lubricants, kt	1.0650	1.1190	1.5740	1.1880	1.1330	0.6050	0.7560	0.6150	0.4030	0.3160
	2005	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**
Lubricants, kt	0.2200	0.1480	0.1530	0.0790	0.1070	0.1944	0.1932	0.2055	0.2042	0.2132

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), 2014 (page 102).

Annex 3-2: Additional Data Sources for Industrial Processes Sector

Table A3-2.1: Chemical-Mineralogical Composition of Cement Powder Produced at Cement Plant "LAFARGE CIMENT" J.S.C. in Rezina [Filter Powder, Cement Mill Nr. 1]

Date	Time	SiO_2	Al_2O_3	Fe_2O_3	CaO	Free CaO	SO_2	MgO	K_2O	Na_2O	LOI
			Conveyor №1	+ Conveyor №2							
26.09.05	11-00	18.10	5.39	3.41	54.14	1.20	7.85	1.77	1.00	0.21	6.41
			Conveyor №1								
26.09.05	13-00	18.65	5.12	3.41	54.74	1.00	7.88	1.75	0.98	0.21	5.95
			Conveyor №2								
29.09.05	13-00	18.98	5.31	3.42	55.09	1.06	7.49	1.82	0.93	0.19	5.38
Date	**Time**	**Total**	**SM**	**AR**	**LSF**	**C3S**	**C2S**	**C3A**	**C4AF**	**Alkalis**	**I.R.**
			Conveyor №1	+ Conveyor №2							
26.09.05	11-00	98.28	2.06	1.58	89.74	14.41	41.01	8.53	10.38	0.87	0.09
			Conveyor №1								
26.09.05	13-00	98.69	2.19	1.50	89.23	15.27	41.95	7.81	10.37	0.85	0.09
			Conveyor №2								
29.09.05	13-00	98.61	2.17	1.55	88.00	13.68	44.12	8.30	10.41	0.80	0.09

Table A3-2.2: Chemical-Mineralogical Composition of Cement Powder Produced at Cement Plant "LAFARGE CIMENT" J.S.C. in Rezina [Cement, Cement Mill Nr. 1]

Date	Time	SiO_2	Al_2O_3	Fe_2O_3	CaO	FreeCaO	SO_2	MgO	K_2O	Na_2O	LOI
26.09.05	13-00	22.78	5.3	3.67	61.09	0.58	2.71	1.98	0.63	0.23	1.2
Date	**Time**	**Total**	**SM**	**AR**	**LSF**	**C3S**	**C2S**	**C3A**	**C4AF**	**Alkalis**	**I.R.**
26.09.05	13-00	99.58	2.54	1.45	83.84	24.6	46.77	7.85	11.16	0.64	0.2

Table A3-2.3: Raw Materials and Energy Balance for Cement Production at Cement Plant "LAFARGE CIMENT" 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 A3-2.4: Raw Materials Consumption Norms for Cement Production at Cement Plant din Rezina "LAFARGE CIMENT" J.S.C. in Rezina

No.	Name	Supplier	Normative Acts	Measure Unit	Consumption Norm
1	**Raw Material**				
1.1	Limestone and red clay	Cement and slate works in Ribnita, ATULBD	CT 21 RSSM 115-87	kg/t clinker	1710
2	**Correction Supplements**				
2.1	Burning residues	Construction Materials Plant in Evpatoria, Ukraine	CT 6-08-385-77	- „ – „ -	50
2.2	Lime residue	Metal Combined Works in Novolipetk, Ukraine	CT 14-106-198-83	- „ – „ -	50

No.	Name	Supplier	Normative Acts	Measure Unit	Consumption Norm
2.3	Aluminised clay	Mining Department in Kirovograd, Ukraine	CT 14-8-419-83 CT 14 RSSU 136-82 CT 14-14-150-88	- „ – „ -	90
3	Mineral Supplements				
3.1	Granulated slag	Metal Plant in Krivoi Rog, Ukraine	STaS 3476-74	kg/t cement	180
4	Gypsum	Gypsum quarries in Criva, Republic of Moldova	STaS 4013-82	- „ – „ -	56
4.	Additional Materials				
5.	Refraction				
5.1	Alumosilicates, of normal size including: magnesial „Lovinit"	Donețk, Ukraine Czech Republic	STaS 21436-75	kg/t clinker	1.65 0.31 1.34 3.65
5.2	Crushing pieces including: steel balls	Dneprodzerjinsk, The Plant in Kataev-Ivanovsk Experimental Plant in Malinsk, Jitomir region, Ukraine	STaS 7524-83 STaS 24384-80	kg/t cement - „ – „ - - „ – „ -	1.30 0.73 0.57
5.3	Steel-clad plates	Metallic Plant in Volisk, Ukraine	STaS 26645-85	- „ – „ -	-
6.	Energy Sources				
6.1	Fuel for clinker drying Fuel for supplements drying	Petroleum tank farm in Kremenciug, Ukraine	STaS 10585	kg c.e./t clinker - „ – „ -	155.8 20.0
6.2	Electricity	Moldglavenergo, Republic of Moldova		kWh/t cement	164.0

Table A3-2.5: Average Concentration of CaO and MgO in Clay Used for Bricks Production at State Enterprises "Macon" J.S.C. in Chisinau,1990-2014

Year	Average Concentration of CaO in Clay Used, %				Average Concentration of MgO in Clay Used, %			
	From Malo-Haruza Quarry	From Pruncul Quarry	From Micauti Quarry	From Malo-Haruza Quarry	From Pruncul Quarry	From Micauti Quarry	From Malo-Haruza Quarry	From Pruncul Quarry
1990	6.915	4.080	8.220	8.440	2.670	3.210	3.570	3.030
1991	6.915	4.080	8.220	8.440	2.670	3.210	3.570	3.030
1992	6.915	4.080	8.220	8.440	2.670	3.210	3.570	3.030
1993	6.915	4.080	8.220	8.440	2.670	3.210	3.570	3.030
1994	6.915	4.080	8.220	8.440	2.670	3.210	3.570	3.030
1995	6.915	4.080	8.220	8.440	2.670	3.210	3.570	3.030
1996	6.915	4.080	8.220	8.440	2.670	3.210	3.570	3.030
1997	6.915	4.080	8.220	8.440	2.670	3.210	3.570	3.210
1998	6.915	4.080	8.220	8.440	2.670	3.210	3.570	3.210
1999	6.915	4.080	8.220	8.440	2.670	3.210	3.570	3.210
2000	6.915	4.080	8.220	8.440	2.670	3.210	3.570	3.210
2001	6.915	4.080	8.220	8.440	2.670	3.210	3.570	3.210
2002	6.915	4.080	8.220	8.440	2.670	3.210	3.570	3.210
2003	6.915	4.080	8.220	8.440	2.670	3.210	3.570	3.210
2004	6.915	4.080	8.220	8.440	2.670	3.210	3.570	3.210
2005	5.87-7.96	4.080	8.220	8.440	2.16-3.18	3.210	3.570	3.030
2006	5.87-7.96	4.080	8.220	8.440	2.16-3.18	3.210	3.570	3.030
2007	5.87-7.96	4.080	8.220	8.440	2.16-3.18	3.210	3.570	3.030
2008	5.87-7.96	4.080	8.220	8.440	2.16-3.18	3.210	3.570	3.030
2009	5.87-7.96	4.080	8.220	8.440	2.16-3.18	3.210	3.570	3.030
2010	5.87-7.96	4.080	8.220	8.440	2.16-3.18	3.210	3.570	3.030
2011	6.660	4.080	6.700	8.440	2.600	3.210	2.930	3.030
2012	6.660	4.080	6.700	8.440	2.600	3.210	2.930	3.030
2013	6.660	4.080	6.700	8.440	2.600	3.210	2.930	3.030
2014	6.660	4.080	6.700	8.440	2.600	3.210	2.930	3.030

Annex 3-3: Additional Data Sources for Agriculture Sector

Features of Races of Livestock and Poultry Bred in the Republic of Moldova

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*[124] has been crossbred as a result of crossbreeding of *Steppe Red* and *Simmental* with the improved races *Spotted Black* and *Holstein*.

[124] The features of the type Moldovan Spotted Black are cows yield big amounts of milk (6000 kg) after the first birth, the milking intensity is 1.8-2.5 kg/minute, production maturity is 25-27 months, effective production term is 4-6 births, weight of calf at birth is 30-35 kg; breeding heifers at 6 months of age weight 165 kg, at 12 months - circa 270 kg. And at 18 months - circa 375 kg and young cattle left for fattening has a daily weight gain of 1200 g, slaughtering efficiency being of 55%.

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, Rodionov, 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, Tigai, 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 *Tigaie* 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
Tigaie	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) color, and spotted (32.7 per cent), with horns (73.0 per cent) and with no "ear rings" (73.3 per cent). The research made revealed that the goats gene pool to a large extent is represented by less productive crossbreeds, however, well adapted to the climate conditions of the country. Among the improved races, recommended for improving goats productivity in the Republic of Moldova are *Saanen* (a race with remarkable milking abilities high fertility performance and longevity, which is used for crossbreeding aimed to improve the milking abilities of local goats), *French Alpine* (is well adapted for grasslands and not demanding in terms of feeding and maintenance conditions, is used to improve native breeds) and *Angora* (is the most valuable race of wool goats, may be used for crossbreeding with other races in view of improving the quality of the hairy caver) (Bucataru, Radionov, Urzica, 2002; Bucataru, Radionov, Varban, 2003; Bivol, Ciubotaru, 2005) (Table A3-3.4).

Table A3-3.4: Features of Goat Races in the Republic of Moldova

Goat Races	Production	Live Weight, kg		Fertility, lambs per 100 goats	Wool sheared, kg	Milk Yield, kg	Content in Milk, %:	
		♂	♀				fats	proteins
Saanen	milk	75-85	45-55	150-170	2.0-3.5	700-800	3.7	3.0
French Alpine	milk	80-95	50-65	125-135	2.5-3.5	550-650	3.7	3.0
Angora	wool, down	50-60	30-40	120-130	3.0-4.0	150-200	4.2	3.8
Local Goats	milk	42-49	35-41	164-169	2.0-3.0	224-323	4.7	3.4

Horses and Mules

The following races of horses and interspecies hybrids are bred in the RM: *Orlov* (resistant, easily adaptable, hound-gutted, with light traction and riding abilities, live weight: 500-550 kg), *of Don* (resistant, can be used for different kinds of work in the most diverse environmental conditions, with light traction and riding abilities, live weight: 500-550 kg) and *Vladimir Heavy Harness* has harmonious features and energetic temper, with heavy traction and rapid motion abilities, live weight: 700-750 kg), and also assess and mules[125] 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, Rodionov, Urzica, 2002) (Table A3-3.7).

[125] A mule is an interspecies hybrid, obtained by crossbreeding of a mare and an ass, with a live weight of 370-390 kg, of 130-150 cm height in withers and a span of life of 30-40 years, is pest resistant, and is well adaptable to the environment, not demanding in terms of feeding and maintenance conditions, has a greater working power than a horse, but is sterile.

Table A3-3.7: 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, Rodionov, 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, Rodionov, 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: Average Dendrometrical Indicators of the Main Species of Trees Occurring in the Forests of the Republic of Moldova

Species	Average production class	Average consistency	Average amount per 1 ha of forest, m³	Average amount per 1 ha of workable stands, m³	Average total growth, thousand m³	Average growth per ha of forest, m³
Pine	2.1	0.64	34		16.5	2.8
Quercus species	2.8	0.73	150	92	415.4	3.0
Beech	1.7	0.78	281	1313	1.2	2.4
Hornbeam	2.4	0.78	178	234	33.3	3.5
Ash tree	2.1	0.78	177	235	56.0	3.5
Sycamore maple tree	1.7	0.69	55	200	44.4	2.6
Field maple	2.5	0.75	103	165	3.0	3.8
Elm tree	2.6	0.73	87	152	2.9	3.2
Acacia	1.6	0.75	69	132	276.6	3.9
Birch tree	1.6	0.63	50	100	2.0	3.3
Trembling poplar	1.1	0.70	204	237	1.0	5.0
Linden tree	2.2	0.76	171	239	10.7	3.7
Poplar	2.8	0.69	186	310	44.9	7.9
Willow	3.3	0.65	179	248	14.1	7.4
Total forests	2.3	0.73	124	180	1196.9	3.3
Recommendable indicators	1.7	0.80-0.90	140	216	1451.0	4.0

Annex 3-4.2: The dynamic of forest defoliatior outbreaks and implementation of aerial combat measures, thousand ha

	1990	1991	1992	1993	1994	1995	1996	1997
Area affected by forest defoliators (thousand ha)	70.7	49.1	55.6	66.6	66.3	75.0	57.6	63.6
Area covered by aerial combat measures (thousand ha)	13.7	21.5	21.4	38.7	26.7	26.5	20.9	8.8
Share of areas affected by forest defoliators and covered by aerial combat measures (%)	19.4	43.8	38.5	58.1	40.3	35.3	36.3	13.8
	1998	1999	2000	2001	2002	2003	2004	2005
Area affected by forest defoliators (thousand ha)	69.9	95.6	79.9	78.1	75.8	104.8	95.3	82.4
Area covered by aerial combat measures (thousand ha)	11.2	1.2	24.1	0.0	7.5	20.6	26.4	20.6
Share of areas affected by forest defoliators and covered by aerial combat measures (%)	16.0	1.3	30.2	0.0	9.9	19.7	27.7	25.0
	2006	2007	2008	2009	2010	2011	2012	2013
Area affected by forest defoliators (thousand ha)	45.0	30.4	18.7	10.0	16.4	56.0	61.0	85.5
Area covered by aerial combat measures (thousand ha)	1.8	15.8	16.9	9.4	0.4	3.4	25.5	12.3
Share of areas affected by forest defoliators and covered by aerial combat measures (%)	4.0	52.0	90.4	93.6	2.4	6.1	41.8	15.0

Annex 3-4.3: Forest area affected by defoliators, 2006-2014, thousand ha

Species	2006	2007	2008	2009	2010	2011	2012	2013	2014
Quercus species	44.00	29.10	17.81	3.10	9.90	52.30	58.03	82.20	70.24
Ash tree	1.00	1.30	0.88	6.69	6.50	3.43	2.97	3.28	9.54
Elm tree				0.25		0.30			
Total	45.00	30.40	18.69	10.04	16.40	56.03	61.00	85.48	79.78

Annex 3-4.4: Estimated loss from current growth due to forest pests, t/ha/yr

Species	Average loss from current growth due to forest pests, t/ha/yr	Current growth, t/ha/an	Difference, t/ha/yr
Quercus species	0.91	3.8	2.89
Hornbeam	1.22	5.1	3.88
Ash tree	1.29	4.3	3.01
Maple	0.67	2.8	2.13
Elm tree	0.74	3.1	2.36
Linden tree	1.73	7.2	5.47
Willow	1.70	7.1	5.40
Pine	0.46	3.8	3.34
Poplar	1.13	4.7	3.57
Acacia	0.70	2.9	2.20
Other Species	0.48	2.0	1.52

Annex 3-4.5: 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)[126] was used by the Republic of Moldova and Uzbekistan to compile their GHG emissions inventories within the Second National Communications (2009).

Recently, a group of authors[127] updated the evaluation methodology 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:

- 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, Gonenco, 1984). This is the typical ratio of the surface layer of soils, decreasing slightly in deeper layers.

[126] Banaru, Anatol (2000), Methodology to Calculate CO2 Emissions from Arable Soils, In the collection of papers „Climate Change. Research, Studies, Solutions, Ministry of Environment / UNDP Moldova. „Bons Offices" S.R.L. Chisinau, 2000. P. 115-123.

[127] Cerbari, V., Scorpan, V., Taranu, M. (2010), The potential for reducing the CO2 emissions from arable soils of the Republic of Moldova. Mediul Ambiant (Environment), Scientific Journal of Information and Ecological Culture, No. 1 (49), February 2010, ISSN: 1810-9551. P. 6-13.

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 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:

$$V_1 = [(Crop_{(T)} \bullet R_{AG\,(T)} \bullet (1\text{-}Frac_{Remove\,(T)}) + Crop_{(T)} \bullet R_{BG\,(T)}) \bullet k_1] / 1.724$$ [128]

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[129];

$R_{AG\,(T)}$ – ratio of above-ground residues dry matter to harvested yield for crop *T* (Crop(*T*)), $t.d.m_{AG}/t.d.m$[130];

$R_{BG\,(T)}$ – ratio of below-ground residues to harvested yield for crop *T*, $t.d.m_{BG}/t\ dm$[131];

$Frac_{Remove\,(T)}$ – fraction of above-ground residues of crop *T* removed and used for other purposes[132]

k_1 – coefficient reflecting the humificatin of crop residues[133];

1.724 – coefficient reflecting the conversion from humus to carbon[134].

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 3-4.5.1).

Table 3-4.5.1: Coefficients Used to Estimate the Amount of C in Crop Residues Returned to Soils

Crop	DRY	$R_{AG\,(T)}$	$R_{BG\,(T)}$	$Frac_{Remove\,(T)}$	k_1
Winter wheat (crop residues returned to soils without N inputs during stubble-turning)	0.89	1.40	0.23	0.75	0.11
Winter wheat (crop residues returned to soils with N inputs during stubble-turning)	0.89	1.40	0.23	0.75	0.19
Winter rye (crop residues returned to soils without N inputs during stubble-turning)	0.88	1.30	0.22	0.75	0.11
Winter rye (crop residues returned to soils with N inputs during stubble-turning)	0.88	1.30	0.22	0.75	0.19
Barley (crop residues returned to soils without N inputs during stubble-turning)	0.89	1.17	0.22	0.75	0.11
Barley (crop residues returned to soils with N inputs during stubble-turning)	0.89	1.17	0.22	0.75	0.20
Oat (crop residues returned to soils without N inputs during stubble-turning)	0.89	1.17	0.25	0.75	0.11
Oat (crop residues returned to soils with N inputs during stubble-turning)	0.89	1.17	0.25	0.75	0.20
Buckwheat (crop residues returned to soils without N inputs during stubble-turning)	0.88	1.17	0.25	0.75	0.11
Buckwheat (crop residues returned to soils with N inputs during stubble-turning)	0.88	1.17	0.25	0.75	0.20
Millet (crop residues returned to soils without N inputs during stubble-turning)	0.88	1.17	0.22	0.40	0.11
Millet (crop residues returned to soils with N inputs during stubble-turning)	0.88	1.17	0.22	0.40	0.20
Grain maize (crop residues returned to soils without N inputs during stubble-turning)	0.87	1.17	0.22	0.70	0.11
Grain maize (crop residues returned to soils with N inputs during stubble-turning)	0.87	1.17	0.22	0.70	0.20
Sorghum (crop residues returned to soils without N inputs during stubble-turning)	0.89	1.17	0.22	0.50	0.11
Sorghum (crop residues returned to soils with N inputs during stubble-turning)	0.89	1.17	0.22	0.50	0.20
Pea, bean, vetch	0.90	1.30	0.19	0.40	0.25
Soybeans	0.91	1.30	0.19	0.00	0.25
Sugar beet	0.22	0.29	0.20	0.00	0.10
Sun flower (crop residues returned to soils without N inputs during stubble-turning)	0.90	3.80	0.22	0.40	0.08
Sun flower (crop residues returned to soils with N inputs during stubble-turning)	0.90	3.80	0.22	0.40	0.15
Tobacco	0.90	5.77	0.19	0.00	0.10
Rapeseed	0.88	1.17	0.22	0.00	0.11
Potatoes	0.22	0.17	0.20	0.00	0.13
Legumes	0.22	0.17	0.20	0.00	0.13
Melons and gourds	0.22	0.17	0.20	0.00	0.13
Fodder beet	0.22	0.14	0.20	0.00	0.10
Maize for silo and green fodder	0.23	0.25	0.22	0.77	0.17
Perennial grasses for green fodder, silage and fodder	0.26	0.25	0.40	0.74	0.25
Annual grasses (oat and vetch) for green fodder	0.22	0.25	0.40	0.78	0.22
Annual grasses (oat and peas) for green fodder	0.22	0.25	0.40	0.78	0.22

The amount of carbon in organic fertilizers returned to soils (V_2) can be estimated using the following equation:

[128] Arinushkina E.V. Guidelines for Chemical Analysis of Soils (in Russian). Moscow, Moscow State University Press, 1961. p.136.
[129] 2006, IPCC Guidelines, Volume 4, Chapter 11, Table 11.2, Page 11.17.
[130] 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.
[131] 2006 IPCC Guidelines, Volume 4, Chapter 11, Table 11.2, Page 11.17.
[132] Expert opinion, Prof. Valerian Cerbari, Institute of Pedology, Agrochemistry and Soil Protection „Nicolae Dimo"
[133] Rusu M., Mărghitaş M., Oroian I., Mihăilescu T., Dumitraş A. (2005), Agrochemistry Treaty. (in Romanian), Bucuresti, Publishing House Ceres, 2005. 672 p.
[134] Arinushkina E.V. Guidelines for Chemical Analysis of Soils (in Russian). Moscow, Moscow State University Press, 1961. p 136.

$$V_2 = (F_{ON} \bullet k_2) / 1.724$$

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 3-4.5.2)[135];

1.724 – coefficient reflecting the transition from humus to carbon[136].

Table 3-4.5.2: Normative of humus accumulation in the country's chernozems (black 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:

$$E_{r\,(T)} = (Yield\ Fresh_{(T)} \bullet k_{3\,(T)}) / 10^3$$

Where:

Yield Fresh $_{(T)}$ – harvested fresh yield for crop T, t/ha;

$k_{3(T)}$ – coefficient reflecting the N export with the crop yield for crop T, kg/t (see Table 3-4.5.3)[137].

Table 3-4.5.3: 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

[135] 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.
[136] Arinushkina E.V. Guidelines for Chemical Analysis of Soils (in Russian). Moscow, Moscow State University Press, 1961. p 136.
[137] Banaru A. (2002), Methodological Guidelines to Determine Humus Balance in Agricultural Soils (in Romanian). Ministry of Agriculture and Food Industry. Institute of Pedology, Agrochemistry and Soil Protection "Nicolae Dimo" and TACIS FDMOL 9901 Support to Developing Education, Research and Extension Services in Agriculture Project, Chisinau, 2002. 23 p.

Crop	Export of Nitrogen, kg/t
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 synthetic fertilizers can be estimated using the following equation:

$$E_M = F_{SN} \bullet k_4$$

Where:

F_{SN} – total amount of synthetic fertilizer N 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 chemical fertilizers applied to soils, t/yr;

P_{SN} – percentage share of N in chemical fertilizers, % of active substance (Table 3-4.5.4);

k_4 – coefficient reflecting the N use from chemical fertilizers; constitutes circa 50 per cent of the applied quantity (Banaru, 2002).

Table 3-4.5.4: Nitrogen content in chemical fertilizers applied in the country

Chemical Fertilizers	Chemical formula	Active substance, %
Anhydrous ammonia	NH_3	82.0
Sulhpate 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 sulfate	$NH_4NO_3 \bullet (NH_4)_2SO_4$	26.0
Urea	$CO(NH_2)_2$	46.0
Calcium cyanide	$CaCN_2$	21.0
Ammonim phosphate	$NH_4H_2PO_4$	11.0
Diammonium phosphate	$(NH_4)_2HPO_4$	16.0
Superfphosphate	Complex formula	4.0
Ammonium polyphosphate	Complex formula	18.0
Nitrophosphate	Complex formula	22.0
Nitro-ammonium phosphate	Complex formula	23.0
Nitroammophos	Complex formula	16.0
Mixed liquid fertilizers	Complex formula	10.0

E_O – the amount of N exported from organic fertilizers; can be estimated using the following equation:

$$E_O = F_{ON} \bullet k_5$$

Where:

F_{ON} – total N content in organic fertilizers applied to soils, t/yr; can be estimated using the following equation:

$$F_{ON} = F_T \bullet (P_{ON}/10^2)$$

Where:

F_T – total amount of organic fertilizers applied to soils, t/yr;

P_{ON} – percentage share of N in organic fertilizers, % active substance (Table 3-4.5.5);

k_5 – average coefficient reflecting the N content in organic fertilizers (Banaru, 2002) (Table 3-4.5.5).

Table 3-4.5.5: 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 3-4.5.6: 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*)), $t.d.m_{AG}/t.d.m.$[138];

$R_{BG(T)}$ – ratio of below-ground residues to harvested yield for crop *T*, $t.d.m_{BG}/t\ d.m.$[139];

$Frac_{Remove(T)}$ – fraction of above-ground residues of crop *T* removed and used for other purposes[140];

P_{CR} – amount of Nitrogen in crop residues, % active substance (see Table 3-4.5.7);

k_6 – coefficient reflecting the N in crop residues (Banaru, 2002) (see Table 3-4.5.7)

[138] 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
[139] 2006 IPCC Guidelines, Volume 4, Chapter 11, Table 11.2, Page 11.17.
[140] Expert opinion, Prof. Valerian Cerbari, Institute of Pedology, Agrochemistry and Soil Protection „Nicolae Dimo"

Table 3-4.5.7: 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:

$$E_{S(T)} = Yield\ Fresh_{\ (T)} \bullet (k_{7\ (T)} / 10^3) \bullet (k_{8\ (T)} / 10^2)$$

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 3-4.5.8);

$k_{8(T)}$ – coefficients reflecting symbiotic nitrogen export for crop T (Banaru, 2002) (Table 3-4.5.8).

Table 3-4.5.8: 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[141] (Table 3-4.5.9).

Table 3-4.5.9: 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[142] (Table 3-4.5.10).

Table 3-4.5.10: 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

[141] 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.
[142] 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.

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 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 4-1.1: Tier 1 - Individual Source Category Checklist

National Inventory Report: 1990-2013 Source Category: ____________________

Title(s) and Date(s) of Inventory Spreadsheet(s): ____________________

Source category estimates prepared by (name/affiliation): ____________________

INSTRUCTIONS FOR COMPLETING THIS FORM:

This form is to be completed for each source category, and provides a record of the checks performed and any corrective actions taken. The form may be completed by hand or electronically. If appropriate actions to correct any errors that are found are not immediately apparent, the QC staff performing the check should discuss the results with the National Inventory Team Leader and the QA Expert. Once completed, the form should be filed in the project file, with copies to the National Inventory Team Leader.

The first page of this form summarizes the results of the checks (once completed) and highlights any significant findings or actions. The remaining pages in this form list categories of checks to be performed. The expert has discretion over how the checks are implemented. Not all checks will be applicable to every source category; checks/rows that are not relevant or not available should indicate "n/r" or "n/a" (not be left blank or deleted). Rows for additional checks that are relevant to the source category should be added to the form. Additional information on the activities indicated on the form may be found in the IPCC Good Practice Guidance.

The column for supporting documentation should be used to reference any relevant Supplemental Reports (Form 4A-5) or Contact Reports (Form 4A-4) providing additional information. Note that, if a source-category specific QC plan has been developed and implemented, this Tier 1 form should still be completed. Any documents associated with the source-category specific plan should be clearly referenced in the column for supporting documentation.

Summary of Tier 1 Source Category Checks and Corrective Action	
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:

Checklist for Tier 1:

Individual Source Category:

	Item	Check Completed			Corrective Action		Supporting documents (provide reference)
		Date	Individual (first initial, last name)	Errors (Y/N)	Date	Individual (first initial, last name)	
DATA GATHERING, INPUT, AND HANDLING ACTIVITIES: QUALITY CHECKS							
1.	Check a sample of input data for transcription errors						
2.	Review spreadsheets with computerized checks and/or quality check reports						
3.	Identify spreadsheet modifications that could provide additional controls or checks on quality						
4.	Other (specify):						
DATA DOCUMENTATION: QUALITY CHECKS							
5.	Check project file for completeness						
6.	Confirm that bibliographical data references are included (in spreadsheet) for every primary data element						
7.	Check that all appropriate citations from the spreadsheets appear in the *Inventory* document						
8.	Check that all citations in spreadsheets and inventory are complete (i.e., include all relevant information)						
9.	Randomly check bibliographical citations for transcription errors						
10.	Check that originals of new citations are in current docket submittal						
11.	Randomly check that the originals of citations (including *Contact Reports*) contain the material & content referenced						
12.	Check that assumptions and criteria for selection of activity data and emission factors are documented						
13.	Check that changes in data or methodology are documented						
14.	Check that citations in spreadsheets and inventory document conform to acceptable style guidelines						
15.	Other (specify):						
CALCULATING EMISSIONS AND CHECKING CALCULATIONS							
16.	Check that all emission calculations are included (i.e., emissions are not hard-wired)						
17.	Check whether emission units, parameters, and conversion factors are inappropriately hardwired						
18.	Check if units are properly labeled and correctly carried through from beginning to end of calculation						
19.	Check that conversion factors are correct						
20.	Check that temporal and spatial adjustment factors are used correctly						
21.	Check the data relationships (comparability) and data processing steps (e.g., equations) in the spreadsheets						
22.	Check that spreadsheet input data and calculated data are clearly differentiated						
23.	Check a representative sample of calculations, by hand or electronically						
24.	Check some calculations with abbreviated calculations						
25.	Check the aggregation of data within a source category						
26.	When methods or data have changed, check consistency of time series inputs and calculations						
27.	Check for consistency with IPCC inventory guidelines and good practices, particularly if changes occur						
28.	Other (specify):						

Annex 4-1.2: Tier 2 - Source Category Checklist

National Inventory Report: 1990-2013 Source Category: ______________________

Key source category (or includes a key source sub-category): (Y/N) ______________________

Title(s)andDate(s)ofInventorySpreadsheet(s):______________________

Source category estimates prepared by (name/affiliation): ______________________

GENERAL INSTRUCTIONS FOR COMPLETING THIS FORM:

Tier 2 checks focus on the data and methodology used for an individual source category. Not all Tier 2 checks occur each inventory cycle; the specificity and frequency of Tier 2 checks vary across source categories. The form may be completed by hand or electronically. Once completed, the form should be filed in the project file, with copies to the National Inventory Team Leader.

The first table on this form summarizes generally the results of the Tier 2 checks and highlights any significant findings or corrective actions. If appropriate actions—to correct any errors that are found or to follow up on the investigation—are not immediately apparent, the QC staff performing the check should discuss the results with the National Inventory Team Leader and the QA Expert.

The remaining pages in this form are lists of categories of checks to be performed or types of questions to be asked. PART A checks are designed to identify potential problems in the estimates, factors, and activity data. PART B checks focus on the quality of secondary data and direct emission measurement. The expert has discretion over how the checks are implemented. Checks/rows that are not relevant or not available should indicate "n/r" or "n/a" (not be left blank or deleted). Rows for additional checks that are relevant to the source category should be added to the form. Additional information on the activities indicated on the form may be found in the IPCC Good Practice Guidance.

The column for supporting documentation should be used to reference any relevant Supplemental Reports (Form 4A-5) or Contact Reports (Form 4A-4) that provide additional information. Other sources may be included here, if they can be clearly referenced. Note that, if a source-category specific QC plan has been developed and implemented, this Tier 2 form should still be completed. Any documents associated with the source-category specific plan should be clearly referenced in the column for supporting documentation.

Summary of All Tier 2 Activities **Individual Source Category:**	
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:

ADDITIONAL INSTRUCTIONS FOR PART A

The checklist below indicates the types of checks and comparisons that can be performed and is not intended to be exhaustive. Supplemental Reports, Contact Reports, or other documents may be used to report detailed information on the checks conducted. For example, a Supplemental Report could provide information on the variables or sub-variables checked, comparisons made, conclusions that were drawn and rationale for conclusions, sources of information (published, unpublished, meetings, etc.) consulted, and corrective actions required.

Checklist for Tier 2: Part A, Data Gathering and Selection
Individual Source Category:

Item		Check Completed			Corrective Action		Supporting documents (provide reference)
		Date	Individual (first initial, last name)	Errors (Y/N)	Date	Individual (first initial, last name)	
EMISSION DATA QUALITY CHECKS							
1.	Emission comparisons: historical data for source, significant sub-source categories						
2.	Order of magnitude checks						
3.	Reference calculations						
4.	Completeness checks						
5.	Other (detailed checks)						
EMISSION FACTOR QUALITY CHECK							
6.	Assess representativeness of emission factors, given national circumstances and analogous emissions data						
7.	Search for options for more representative data						
8.	Other (detailed checks)						
ACTIVITY DATA QUALITY CHECK: NATIONAL LEVEL ACTIVITY DATA							
9.	Check historical trends						
10.	Compare multiple reference sources						
11.	Check applicability of data						
12.	Check methodology for filling in time series for data that are not available annually						
13.	Other (detailed checks)						
ACTIVITY DATA QUALITY CHECK: SITE-SPECIFIC ACTIVITY DATA							
14.	Inconsistencies across sites						
15.	Compare aggregated and national data						
16.	Other (detailed checks)						

ADDITIONAL INSTRUCTIONS FOR PART B

Completing the Tier 2 checks on secondary data and direct emission measurement may require consulting the primary data sources or authors. The checklist below is intended to be indicative, not exhaustive. Additional information on appropriate checks can be found in the Source Category Chapters of the IPCC Good Practice Guidance.

Additional documentation is likely to be necessary to record the specific actions taken to check the data underlying the source category estimates. For example, Supplemental Reports may be needed to record the data or variables that were checked, and the published references and individuals or organizations consulted as part of the investigation. Contact Reports should be used to report the details of personal communications. Supplemental Reports may also be used to explain the rationale for a finding reported in the summary, the results of research into the QC procedures associated with a survey, or checks of site measurement procedures. Be sure to provide references to all supporting documentation.

Checklist for Tier 2. Part B: Secondary Data and Direct Emission Measurement
Individual Source Category:

Item		Check Completed			Corrective Action		Supporting documents (provide reference)
		Date	Individual (first initial, last name)	Errors (Y/N)	Date	Individual (first initial, last name)	
SECONDARY DATA: SAMPLE QUESTIONS REGARDING THE QUALITY OF INPUT DATA							
1.	Are QC activities conducted during the original preparation of the data (either as reported in published literature or as indicated by personal communications) consistent with and adequate when compared against (as a minimum), Tier 1 QC activities?						
2.	Does the National Bureau of Statistics have a QA/QC plan that covers the preparation of the data?						
3.	For surveys, what sampling protocols were used and how recently were they reviewed?						
4.	For site-specific activity data, are any national or international standards applicable to the measurement of the data; if so, have they been employed?						
5.	Have uncertainties in the data been estimated and documented?						
6.	Have any limitations of the secondary data been identified and documented, such as biases or incomplete estimates? Have errors been found?						
7.	Have the secondary data undergone peer review and, if so, of what nature?						
8.	Other (detailed checks)						
DIRECT EMISSION MEASUREMENT: CHECKS ON PROCEDURES TO MEASURE EMISSIONS							
9.	Identify which variables rely on direct emission measurement						
10.	Check procedures used to measure emissions, including sampling procedures, equipment calibration and maintenance.						
11.	Identify whether standard procedures have been used, where they exist (such as IPCC methods or ISO standards).						
12.	Other (detailed checks)						

Annex 4-1.3: Data/Reference Tracking Sheet

This form illustrates a spreadsheet that was developed to track the data sources used for each variable in the inventory from one inventor cycle to another. The particular citation, reference, contact person, form in which data is received, or other information is indicated for each variable. This tracking is particularly useful for sources that have a large number of variables to be tracked. The spreadsheet can easily be expanded to include each new inventory cycle, and so is useful for tracking sources of data over time. In the table, color- and pattern-coding in a cell is used to indicate, for the current inventory cycle, whether the expert has received or is still waiting for data, or other “status” of the data. The columns within the table should be made wider to accommodate the necessary data. Different formats may be needed to accommodate sources with different data characteristics.

National Inventory Report: 1990-2013 Source Category: ____________________

Key source category (or includes a key source sub-category): (Y/N) ____________________

Title(s)andDate(s)ofInventorySpreadsheet(s):____________________

Source category estimates prepared by (name/affiliation): ____________________

Color key code	
	No action yet taken
	Source investigated, but awaiting arrival or publication
	Source obtained
	Not obtained/needed

Spreadsheet Name	Worksheet Name	Data needed (variable/parameter)	1990 data source	2013 data source
Insert spreadsheet name	Insert name of worksheet within spreadsheet	Give name of data item on worksheet	Provide citation or individual	Provide citation or individual

Annex 4-1.4: Contact Report

This form is used to record personal communications, including telephone conversations or meetings. It is used, as necessary, as a cover sheet for facsimile or e-mail communications.

Date: ______________________ Originator ______________________

Contact by: Telephone ______________ Meeting ______________ Other (specify) ______________

Contact Name:

Title and Organization:

Phone number:

Fax number:

Address:

E-mail address:

Purpose and/or Subject of contact:

Attendees or participants in meeting/telephone conversation (name, affiliation):

Summary of meeting:

Recommended Follow-up Actions:

Annex 4-1.5: Supplemental Report

This form is to be used as needed to provide additional documentation or explanation of QA/QC activities, and to supplement other checklists and forms that are completed. Among other uses, it can record information gathered from sources other than a personal communication (e.g., internet sites or published sources), describe in detail the results of an investigation, or be a cover page for other supporting documentation (such as a source category specific QA/QC plan).

Date:	Source Category:
Subject:	
If part of another report, provide the report name and purpose of supplemental report:	
If not part of another report, provide purpose:	
Sheet # __ of ______	Name, affiliation:

Discussion:

Annex 4-2: Forms and Checklist for Cross-Cutting Quality Control

Annex 4-2.1: Tier 1 - Overall Inventory and Cross-Source Category Checklist

National Inventory Report: 1990-2013 ______________________________

Source Categories included in check: ______________________________

____

____

Title(s) and Date(s) of Inventory Spreadsheet(s): ______________________________

Sourcecategoryestimatespreparedby(name/affiliation): ______________________________

INSTRUCTIONS FOR COMPLETING THIS FORM:

This form is completed under each inventory cycle, and provides a record of the checks performed and any corrective actions taken. The form may be completed by hand or electronically. The checklist below is completed as a record of the checks conducted. It should include information on the variables or sub-variables checked, comparisons made, conclusions that were drawn and rationale for conclusions, sources of information (published, unpublished, meetings, etc.) consulted, and corrective actions required. If appropriate actions to correct any errors that are found are not immediately apparent, the QC staff performing the check should discuss the results with the National Inventory Team Leader and the QA Expert. Once completed, the form should be filed in the project file, with copies to the National Inventory Team Leader.

The first page of this form summarizes the results of the checks (once completed) and highlights any significant findings or actions. The remaining pages in this form list categories of checks to be performed. The expert has discretion over how the checks are implemented. Rows for additional checks that are relevant should be added to the form.

The column for supporting documentation should be used to reference any relevant *Supplemental Reports* (Form 4-2.5) or *Contact Reports* (Form 4-2.4) providing additional information.

Summary of Tier 1 Overall and Cross-Category Checks and Corrective Action	
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:

Detailed Checklist for Tier 1: Overall Inventory Quality and Cross-Source Categories

Item		Check Completed			Corrective Action		Supporting documents (provide reference)
		Date	Individual (first initial, last name)	Errors (Y/N)	Date	Individual (first initial, last name)	
CHECKING EMISSION CALCULATIONS ACROSS SOURCE CATEGORIES							
1.	Check that sources using same data inputs report comparable values (i.e., analogous in magnitude)						
2.	Check across source categories that same electronic data set is used for common data						
3.	Identify common parameters across source categories and check for consistency						
4.	Check that the number of significant digits or decimal places for common parameters, conversion factors, emission factors, or activity data is consistent across source categories						
5.	Check that total emissions are reported consistently (in terms of significant digits or decimal places) across source categories						
6.	Check that emissions data are correctly aggregated from lower reporting levels to higher reporting levels						
7.	Other (specify)						
DOCUMENTATION							
8.	Check if internal documentation practices are consistent across source categories						
9.	Other (specify)						
COMPLETENESS							
10.	Check for completeness across source categories and years						
11.	Check that data gaps are identified and reported as required						
12.	Compare current national inventory estimates with previous years'						
13.	Other (specify):						
MAINTAINING MASTER INVENTORY FILE: SPREADSHEETS AND INVENTORY DOCUMENT							
14	Have file control procedures been followed?						
15.	Other (specify)						
OTHER							
16.	Specify						
17.	Specify						
18.	Specify						

Annex 4-2.2: Master Tracking Sheet for Inventory

NationalInventoryReport:1990-2013______________________________

Tracking form prepared by (name/affiliation): ______________________________

Date of most recent update: ______________________________

INSTRUCTIONS FOR USING THIS TRACKING SHEET:

This form illustrates a spreadsheet that was developed to track the status of the inventory spreadsheets and inventory document during the process of developing and updating the greenhouse gas inventory each inventory cycle. The same form could be used to track either the inventory spreadsheets, or the text for the inventory document. Each row represents a sector or source category. Columns should be self-explanatory. The columns should be made wider to accommodate the necessary data. Different formats or columns may be used to reflect preferences of the National Inventory Team Leader or to accommodate changes in the methodological structure or organizational assignments of the inventory. The comment column can be used to record other relevant information, such as the cause of a delay, when new data supporting data is expected and from whom, when the revised document/estimates are expected, or dates on which revised drafts were submitted.

		Source Responsibilities						
Sector / Source Category	**Annex Included (letter)**	**National Inventory Team Staff**	**Contractor / Contact**	**Date due?**	**Delivered Date?**	**Expect mods?**	**Current Owner?**	**Comments**
Give sector & source category name	Give letter of relevant annex, if any	Lead at NIT for source category	Contractor involved in analysis, or other contact	Date that first draft was due	Date of most recent draft	Y/N—whether modifications to latest draft are expected	Who has the original spreadsheet or text, currently	Any other important information

Annex 4-2.3: Inventory Document Checklist - MSWord Document

National Inventory Report: 1990-2013 *Stage of Document:* ______________________________

Circle all categories of checks conducted: Front Section, Tables & Figures, Equations, References, General Editing, Editing for Content

INSTRUCTIONS FOR COMPLETING THIS FORM:

This form is to be completed each inventory cycle, and provides a record of the checks performed and any corrective actions taken. The form may be completed by hand or electronically. The checklist below should be completed as a record of the checks conducted. If appropriate actions to correct any errors that are found are not immediately apparent, the QC staff performing the check should discuss the results with the National Inventory Team Leader and the QA Expert. Once completed, the form should be filed in the project file, with copies to the National Inventory Team Leader.

The first page of this form summarizes the results of the checks (once completed) and highlights any significant findings or actions. The remaining pages in this form list categories of checks to be performed. The expert has discretion over how the checks are implemented. Rows for additional checks that are relevant should be added to the form.

The column for supporting documentation should be used to reference any relevant *Supplemental Reports* (Form 4-2.5) or *Contact Reports* (Form 4-2.4) providing additional information.

Summary of Document Check	
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:

Detailed Checklist for Inventory Document

Item		Check Completed			Corrective Action		Supporting documents (provide reference)
		Date	Individual (first initial, last name)	Errors (Y/N)	Date	Individual (first initial, last name)	
FRONT SECTION							
1.	Cover page has correct date, title, and contact address						
2.	Document number listed on title page						
3.	Correct footer on every section (draft/date, correct Inventory title, page numbers)						
4.	Tables of contents/tables/figures are accurate: titles match document, page #s match; numbers run consecutively and have correct punctuation						
5.	The Executive Summary and Introduction are updated with appropriate years and discussion of trends						
TABLES AND FIGURES							
6.	All numbers in tables match numbers in spreadsheets						
6a.	All numbers in tables match in the Executive Summary						
6b.	All numbers in tables match in the Changes Section						
6c.	All numbers in tables match in the Introduction						
6d.	All numbers in tables match in the Energy Chapter						
6e.	All numbers in tables match in the Industrial Processes Chapter						
6f.	All numbers in tables match in the Solvent and Other Product Use Chapter						
6g.	All numbers in tables match in the Agriculture Chapter						
6h.	All numbers in tables match in the LULUCF Chapter						
6i.	All numbers in tables match in the Waster Chapter						
6j.	All numbers in tables match in the Annexes						
7.	Check that all tables have correct number of significant digits						
8.	Check alignment in columns and labels						
9.	Check all symbols in tables ("+")						
10.	Check bold in tables						
11.	Table formatting is consistent						
12.	Check that all figures are updated with new data and referenced in the text						
13.	Check table and figure titles for accuracy and consistency with content						
14.	Include all figures with drafts (they are in separate file)						
EQUATIONS-SHOULD ALL HAVE THE FOLLOWING TRAITS							
15.	Equation as follows: z = x + y						
16.	Use times symbol, not the letter x or the * symbol						
17.	Equation centered						
18.	Following the equation use: where, (return) (definition of variables)						
19.	Definition of variables are indented and in Table Text style (and first word capitalized)						
REFERENCES							
20	Check consistency of references used in multiple sections (e.g., IPCC Guidance not IPCC Guidelines)						
21.	In text, citations and references match						
22.	Style of references is consistent						
23.	Use of a,b,c is consistent for same author and year references						
24.	Web addresses should not be hyperlinks, should be enclosed with <> and not hyperlinked or underlined						
GENERAL FORMAT							

Detailed Checklist for Inventory Document

	Item	Check Completed			Corrective Action		Supporting documents (provide reference)
		Date	Individual (first initial, last name)	Errors (Y/N)	Date	Individual (first initial, last name)	
25.	All acronyms are spelled out first time and not subsequent times throughout each chapter						
26.	All dashes are the same–use insert symbol to insert a long "em" dash (—)						
27.	All fonts in text, headings, and subheadings are consistent						
28.	All headers/titles are consistent						
29.	All highlighting, notes, and comments are removed from document						
30.	Annex referencing in text matches correct Annex letters						
31.	Auto numbering for tables and figures sometimes inserts hard return, check all table citations and fix						
32.	Heading formats are used appropriately						
33.	All gases, such as CO_2 and N_2O use the letter "O" rather than the number "0"						
34.	All occurrences of "per cent" are spelled out, not % (except in tables)						
35.	All numbers that should be subscripted are subscripted (e.g., CO_2, SF_6, CH_4, N_2O, etc.)						
36.	No comma in citations						
37.	Notes under tables should be in smaller font than text of document						
38.	Number of decimal points used in the text is consistent						
39.	Section breaks: (1) Each section starts on right-hand (i.e., "odd") side (2) All sections in landscape move to and from landscape properly						
40.	Size, style, and indenting of bullets are consistent						
41.	Spaces–two after a period, one everywhere else						
42.	Spelling check is complete						
43.	Table/figure/box numbering and referencing in text is correct						
OTHER ISSUES							
44.	All numbers in text match tables						
45.	Each section is updated with current year						
46.	In discussion of "Recent Trends in Greenhouse Gas Emissions," all years and explanations are updated						
47.	Other (specify)						
48.	Other (specify)						
49.	Other (specify)						
50.	Other (specify)						

Annex 4-2.4: Inventory Document Checklist - Page Maker Document

National Inventory Report: 1990-2013 *Stage of Document:* ______________________

Circle all categories of checks conducted: *Front Section, Tables & Figures, Equations, References, General Editing, Editing for Content*

INSTRUCTIONS FOR COMPLETING THIS FORM:

This form is to be completed each inventory cycle, and provides a record of the checks performed and any corrective actions taken. The form may be completed by hand or electronically. The checklist below should be completed as a record of the checks conducted. If appropriate actions to correct any errors that are found are not immediately apparent, the QC staff performing the check should discuss the results with the National Inventory Team Leader and the QA Expert. Once completed, the form should be filed in the project file, with copies to the National Inventory Team Leader.

The first page of this form summarizes the results of the checks (once completed) and highlights any significant findings or actions. The remaining pages in this form list categories of checks to be performed. The expert has discretion over how the checks are implemented. Rows for additional checks that are relevant should be added to the form.

The column for supporting documentation should be used to reference any relevant *Supplemental Reports* (Form 4-2.5) or *Contact Reports* (Form 4-2.4) providing additional information.

Summary of Inventory Document Check: Page Maker Document	
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:

Detailed Checklist for Inventory Document

Item		Check Completed			Corrective Action		Supporting documents (provide reference)
		Date	Individual (first initial, last name)	Errors (Y/N)	Date	Individual (first initial, last name)	
FRONT SECTION							
1.	Cover page has correct date, title, and contact address						
2.	Cover has the logo of the MENR						
3.	Correct footer on every section (correct Inventory title and page number)						
4.	Table of contents/tables/figures etc. is accurate						
TABLES AND FIGURES							
5.	Check alignment in columns and tables						
6.	Check all symbols in tables ("+")						
7.	Check bold in tables						
8.	All line widths are consistent in tables						
9.	All column widths are consistent in tables						
10.	Table formatting is consistent						
11.	All figures have been inserted into text and are accurate (correct proportions, etc.)						
EQUATIONS-SHOULD ALL HAVE THE FOLLOWING TRAITS							
12.	Equation as follows: $z = x + y$						
13.	Equation centered						
GENERAL FORMAT							
14.	All dashes are the same–use insert symbol.						
15.	All fonts are consistent						
16.	All headers/titles are consistent						
17.	All numbers that should be subscripted are (CO_2, SF_6, CH_4, N_2O, etc.)						
18	Notes under tables should be in smaller font than text of document						
19.	All sections in Landscape go to and from landscape properly						
20.	Size and style of bullets is consistent						
21.	Spaces–two after a period, one everywhere else						
22.	No widows/orphans in document						
23.	Fractions are formatted correctly						
OTHER ISSUES							
24.	Bookmarks are correct and function properly						
25.	The entire document has been scanned for any erroneous looking items or data that may have been altered during the software transition						

Annex 4-2.5: Contact Report

This form is to be used to record personal communications, including telephone conversations or meetings. It can also be used, as necessary, as a cover sheet for facsimile or e-mail communications.

Date: ______________________ Originator ______________________

Contactby: Telephone______________ Meeting______________ Other(specify)______________

Contact Name:

Title and Organization:

Phone number:

Fax number:

Address:

E-mail address:

Purpose and/or Subject of contact:

Attendees or participants in meeting/telephone conversation (name, affiliation):

Summary of meeting:

Recommended Follow-up Actions:

Annex 4-2.6: Supplemental Report

This form is to be used as needed to provide additional documentation or explanation of QA/QC activities, and to supplement other checklists and forms that are completed. Among other uses, it can record information gathered from sources other than a personal communication (e.g., internet sites or published sources), describe in detail the results of an investigation, or be a cover page for other supporting documentation (such as a source category specific QA/QC and Uncertainty Management Plan).

Date:	Source Category:
Subject:	
If part of another report, provide the report name and purpose of supplemental report:	
If not part of another report, provide purpose:	
Sheet # __ of ______	Name, affiliation:

Discussion:

Annex 5. Uncertainty

Annex 5-1: Overall Inventory Uncertainty for 2013

IPCC Classification	IPCC Source Categories	Pollutant	Base Year Emissions (1990)	Year t Emissions (2013)	Activity Data Uncertainty	Emission Factor Uncertainty	Combined Uncertainty	Combined Uncertainty as % of Total Sectoral Emissions in the Year t (2013)	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
			Gg CO_2 eq		%								
1A1	Energy Industries	CO_2	19,332.7655	3,308.1821	5	5	7.0711	1.8363	-0.0862	0.0881	-0.4312	0.6233	0.7579
1A1	Energy Industries	CH_4	9.2887	1.3734	5	50	50.2494	0.0054	0.0000	0.0000	-0.0024	0.0003	0.0024
1A1	Energy Industries	N_2O	51.2316	4.3651	3	50	50.0899	0.0172	-0.0003	0.0001	-0.0173	0.0005	0.0174
1A2	Manufacturing Industries and Construction	CO_2	2,188.7285	607.6708	5	5	7.0711	0.3373	-0.0036	0.0162	-0.0180	0.1145	0.1159
1A2	Manufacturing Industries and Construction	CH_4	2.0005	0.6760	5	50	50.2494	0.0027	0.0000	0.0000	0.0000	0.0001	0.0001
1A2	Manufacturing Industries and Construction	N_2O	5.1641	1.4119	3	50	50.0899	0.0056	0.0000	0.0000	-0.0005	0.0002	0.0005
1A3	Transport	CO_2	3,926.6606	1,835.2651	5	5	7.0711	1.0187	0.0134	0.0489	0.0669	0.3458	0.3522
1A3	Transport	CH_4	25.4493	6.7267	5	40	40.3113	0.0213	-0.0001	0.0002	-0.0020	0.0013	0.0024
1A3	Transport	N_2O	104.5052	35.1848	5	50	50.2494	0.1388	0.0000	0.0009	-0.0004	0.0066	0.0066
1A4	Other sectors	CO_2	7,762.4898	1,945.5770	5	5	7.0711	1.0800	-0.0183	0.0518	-0.0916	0.3665	0.3778
1A4	Other sectors	CH_4	244.4965	88.1695	5	50	50.2494	0.3478	0.0001	0.0023	0.0069	0.0166	0.0180
1A4	Other sectors	N_2O	30.7924	16.7922	3	50	50.0899	0.0660	0.0002	0.0004	0.0084	0.0019	0.0087
1A5	Other	CO_2	154.2715	30.3317	5	5	7.0711	0.0168	-0.0006	0.0008	-0.0029	0.0057	0.0064
1A5	Other	CH_4	0.0484	0.0009	5	50	50.2494	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
1A5	Other	N_2O	0.4911	0.0862	3	50	50.0899	0.0003	0.0000	0.0000	-0.0001	0.0000	0.0001
1B2	Fugitive Emissions from Fuels	CO_2	0.6377	2.1589	25	25	35.3553	0.0060	0.0001	0.0001	0.0013	0.0020	0.0024
1B2	Fugitive Emissions from Fuels	CH_4	682.2942	520.6450	25	25	35.3553	1.4450	0.0077	0.0139	0.1925	0.4904	0.5269
1B2	Fugitive Emissions from Fuels	N_2O	0.0002	0.0053	25	25	35.3553	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
2.A.1	Cement Production	CO_2	971.7056	476.9147	3	2	3.6056	0.1350	0.0039	0.0127	0.0078	0.0539	0.0545
2.A.2	Lime Production	CO_2	148.6611	4.0523	8	2	8.2462	0.0026	-0.0012	0.0001	-0.0025	0.0012	0.0028
2.A.3	Limestone and Dolomite Use	CO_2	619.4733	14.3708	15	5	15.8114	0.0178	-0.0052	0.0004	-0.0261	0.0081	0.0273
2.A.4	Soda ash use	CO_2	32.9560	15.5217	15	2	15.1327	0.0184	0.0001	0.0004	0.0002	0.0088	0.0088
2.A.7	Other: Mineral wool production	CO_2	8.0816	0.0000	8	5	9.4340	0.0000	-0.0001	0.0000	-0.0004	0.0000	0.0004
2.A.7	Other: Brick and expanded clay production	CO_2	49.4409	15.6916	15	5	15.8114	0.0195	0.0000	0.0004	-0.0001	0.0089	0.0089
2.C.1	Steel Production	CO_2	11.7182	3.1441	3	5	5.8310	0.0014	0.0000	0.0001	-0.0001	0.0004	0.0004
2.F.1	Refrigeration and Air Conditioning Equipment	HFC	0.0000	96.9365	8	50	50.6360	0.3853	0.0026	0.0026	0.1291	0.0292	0.1324
2.F.2	Foam	HFC	0.0000	45.1716	25	50	55.9017	0.1982	0.0012	0.0012	0.0602	0.0426	0.0737
2.F.4	Aerosols	HFC	0.0000	0.0791	5	50	50.2494	0.0003	0.0000	0.0000	0.0001	0.0000	0.0001
2.F.8	Electric Equipment	PFC	0.0000	0.0273	3	50	50.0899	0.0001	0.0000	0.0000	0.0000	0.0000	0.0000
2.F.8	Electric Equipment	SF_6	0.0000	0.6803	3	50	50.0899	0.0027	0.0000	0.0000	0.0009	0.0001	0.0009
3.A.1	Conventional Solvent Paint Application	CO_2	39.7292	19.6123	5	25	25.4951	0.0393	0.0002	0.0005	0.0041	0.0037	0.0055
3.A.1	Waterborne Paint Application	CO_2	1.8598	0.8445	5	50	50.2494	0.0033	0.0000	0.0000	0.0003	0.0002	0.0003

IPCC Classification	IPCC Source Categories	Pollutant	Base Year Emissions (1990)	Year t Emissions (2013)	Activity Data Uncertainty	Emission Factor Uncertainty	Combined Uncertainty	Combined Uncertainty as % of Total Sectoral Emissions in the Year t (2013)	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
			Gg CO_2 eq		%								
3.B	Degreasing and Dry Cleaning	CO_2	62.7662	29.9961	5	20	20.6155	0.0485	0.0002	0.0008	0.0046	0.0057	0.0073
3.C	Polyurethane foam processing	CO_2	1.4311	0.4113	20	25	32.0156	0.0010	0.0000	0.0000	0.0000	0.0003	0.0003
3.C	Polystyrene foam processing	CO_2	1.0756	0.7209	20	25	32.0156	0.0018	0.0000	0.0000	0.0002	0.0005	0.0006
3.C	Rubber processing	CO_2	1.1226	0.0016	5	25	25.4951	0.0000	0.0000	0.0000	-0.0003	0.0000	0.0003
3.C	Pharmaceutical products manufacturing	CO_2	0.4454	2.6841	5	25	25.4951	0.0054	0.0001	0.0001	0.0017	0.0005	0.0018
3.C	Paints manufacturing	CO_2	0.3851	0.4021	5	25	25.4951	0.0008	0.0000	0.0000	0.0002	0.0001	0.0002
3.C	Tyre production	CO_2	0.1444	0.0332	20	25	32.0156	0.0001	0.0000	0.0000	0.0000	0.0000	0.0000
3.C	Manufactury of shoes	CO_2	3.1236	0.3958	5	25	25.4951	0.0008	0.0000	0.0000	-0.0004	0.0001	0.0004
3.D.1	Printing industry	CO_2	0.7352	0.3936	5	25	25.4951	0.0008	0.0000	0.0000	0.0001	0.0001	0.0001
3.D.2	Domestic solvent use	CO_2	9.1741	8.5495	5	50	50.2494	0.0337	0.0001	0.0002	0.0072	0.0016	0.0074
3.D.3	Seed Oil Extraction and Seed Drying	CO_2	0.4982	0.1233	20	25	32.0156	0.0003	0.0000	0.0000	0.0000	0.0001	0.0001
3.D.3	Adhesives Use	CO_2	3.5466	2.3936	5	25	25.4951	0.0048	0.0000	0.0001	0.0008	0.0005	0.0009
3.D.3	Vehicles dewaxing	CO_2	0.0592	0.0295	5	25	25.4951	0.0001	0.0000	0.0000	0.0000	0.0000	0.0000
3.D.3	Tobacco combustion	CO_2	0.0002	0.0001	5	20	20.6155	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
3.D.3	Use of N_2O for Anaesthesia	N_2O	0.0205	0.0000	5	1	5.0990	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
4.A.1	Cattle	CH_4	1574.8883	379.4545	10	15	18.0278	0.5370	-0.0041	0.0101	-0.0620	0.1430	0.1558
4.A.3	Sheep	CH_4	180.3631	107.4261	10	15	18.0278	0.1520	0.0012	0.0029	0.0185	0.0405	0.0445
4.A.4	Goats	CH_4	4.9589	18.8883	10	15	18.0278	0.0267	0.0005	0.0005	0.0069	0.0071	0.0099
4.A.6	Horses	CH_4	17.8597	17.3769	10	30	31.623	0.0431	0.0003	0.0005	0.0090	0.0065	0.0112
4.A.7	Mules and Asses	CH_4	0.3551	0.4500	10	30	31.623	0.0011	0.0000	0.0000	0.0003	0.0002	0.0003
4.A.8	Swine	CH_4	58.2774	14.0012	10	30	31.623	0.0348	-0.0002	0.0004	-0.0046	0.0053	0.0070
4.A.10	Rabbits	CH_4	3.5062	3.6699	15	30	33.541	0.0097	0.0001	0.0001	0.0020	0.0021	0.0029
4.B.1	Cattle	CH_4	149.1503	18.9426	10	20	22.361	0.0333	-0.0008	0.0005	-0.0169	0.0071	0.0183
4.B.3	Sheep	CH_4	4.9668	2.8922	10	30	31.623	0.0072	0.0000	0.0001	0.0010	0.0011	0.0015
4.B.4	Goats	CH_4	0.1013	0.3742	10	30	31.623	0.0009	0.0000	0.0000	0.0003	0.0001	0.0003
4.B.6	Horses	CH_4	1.5478	1.5060	10	30	31.623	0.0037	0.0000	0.0000	0.0008	0.0006	0.0010
4.B.7	Mules and Asses	CH_4	0.0270	0.0342	10	30	31.623	0.0001	0.0000	0.0000	0.0000	0.0000	0.0000
4.B.8	Swine	CH_4	136.5695	22.6344	10	20	22.361	0.0397	-0.0006	0.0006	-0.0126	0.0085	0.0152
4.B.9	Poultry	CH_4	15.8990	7.5849	15	30	33.541	0.0200	0.0001	0.0002	0.0017	0.0043	0.0046
4.B.10	Rabbits	CH_4	0.4754	0.4976	10	30	31.623	0.0012	0.0000	0.0000	0.0003	0.0002	0.0003
4.B.11a	Cattle	N_2O direct	417.0778	75.2788	10	30	31.623	0.1869	-0.0018	0.0020	-0.0530	0.0284	0.0601
4.B.11b	Sheep	N_2O direct	126.7716	68.7634	10	30	31.623	0.1707	0.0007	0.0018	0.0206	0.0259	0.0331
4.B.11c	Goats	N_2O direct	4.7478	16.0582	10	30	31.623	0.0399	0.0004	0.0004	0.0115	0.0061	0.0130
4.B.11d	Horses	N_2O direct	14.9787	13.1103	10	30	31.623	0.0325	0.0002	0.0003	0.0064	0.0049	0.0081
4.B.11e	Mules and Asses	N_2O direct	0.1796	0.2231	10	30	31.623	0.0006	0.0000	0.0000	0.0001	0.0001	0.0002
4.B.11f	Swine	N_2O direct	391.6369	56.5303	10	30	31.623	0.1403	-0.0020	0.0015	-0.0611	0.0213	0.0647
4.B.11g	Poultry	N_2O direct	138.6228	74.9153	15	30	33.541	0.1973	0.0007	0.0020	0.0223	0.0423	0.0478

IPCC Classification	IPCC Source Categories	Pollutant	Base Year Emissions (1990)	Year t Emissions (2013)	Activity Data Uncertainty	Emission Factor Uncertainty	Combined Uncertainty	Combined Uncertainty as % of Total Sectoral Emissions in the Year t (2013)	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
			Gg CO_2 eq		%								
4.B.11h	Rabbits	N_2O direct	22.3408	23.7736	15	30	33.541	0.0626	0.0004	0.0006	0.0129	0.0134	0.0187
4.B.12a	Cattle	N_2O indirect	94.5635	14.5805	10	75	75.664	0.0866	-0.0005	0.0004	-0.0350	0.0055	0.0354
4.B.12b	Sheep	N_2O indirect	20.6004	11.1741	10	75	75.664	0.0664	0.0001	0.0003	0.0084	0.0042	0.0094
4.B.12c	Goats	N_2O indirect	0.7715	2.6095	10	100	100.499	0.0206	0.0001	0.0001	0.0063	0.0010	0.0063
4.B.12d	Horses	N_2O indirect	2.4340	2.1304	10	100	100.499	0.0168	0.0000	0.0001	0.0035	0.0008	0.0036
4.B.12e	Mules and Asses	N_2O indirect	0.0292	0.0363	10	100	100.499	0.0003	0.0000	0.0000	0.0001	0.0000	0.0001
4.B.12f	Swine	N_2O indirect	106.9121	14.0047	10	75	75.664	0.0832	-0.0006	0.0004	-0.0445	0.0053	0.0448
4.B.12g	Poultry	N_2O indirect	36.5912	18.5493	15	75	76.485	0.1114	0.0002	0.0005	0.0122	0.0105	0.0161
4.B.12h	Rabbits	N_2O indirect	3.6304	3.8632	15	100	101.119	0.0307	0.0001	0.0001	0.0070	0.0022	0.0073
4.D.1a	Synthetic N Fertilizers Application	N_2O direct	448.6586	205.1115	5	6	7.810	0.1258	0.0014	0.0055	0.0084	0.0386	0.0396
4.D.1b	Organic N Applied as Fertilizer	N_2O direct	265.7072	1.1621	25	6	25.710	0.0023	-0.0024	0.0000	-0.0142	0.0011	0.0143
4.D.1c	Urine and Dung N Deposited on Pasture	N_2O direct	91.9302	40.7834	50	50	70.711	0.2264	0.0003	0.0011	0.0128	0.0768	0.0779
4.D.1d	N in Crop Residue	N_2O direct	169.5561	111.5439	5	25	25.495	0.2232	0.0014	0.0030	0.0360	0.0210	0.0417
4.D.1e	N Mineralisation	N_2O direct	192.1384	549.4030	5	25	25.495	1.0996	0.0129	0.0146	0.3225	0.1035	0.3387
4.D.2a	Atmospheric Deposition of N volatilized	N_2O indirect	109.7501	26.1645	70	150	165.529	0.3400	-0.0003	0.0007	-0.0443	0.0690	0.0820
4.D.2b	N Leaching/Runoff from Managed Soils	N_2O indirect	255.3242	201.2231	75	150	167.705	2.6491	0.0031	0.0054	0.4578	0.5687	0.7301
5.A.1	Forest Lands Remaining Forest Lands	CO_2	-2,197.5790	-1,887.6165	25	5	25.495	-3.7779	-0.0304	-0.0503	-0.1522	-1.7781	1.7846
5.A.1	Non-CO_2 Emissions from Vegetation Fires	CH_4	0.2347	0.9128	10	30	31.623	0.0023	0.0000	0.0000	0.0007	0.0003	0.0007
5.A.1	Non-CO_2 Emissions from Vegetation Fires	N_2O	0.1917	0.7454	10	50	50.990	0.0030	0.0000	0.0000	0.0009	0.0003	0.0009
5.B.1	Cropland Covered with Woody Vegetation	CO_2	-725.2315	-483.4705	25	10	26.9258	-1.0219	-0.0063	-0.0129	-0.0632	-0.4554	0.4598
5.B.2	Annual Change in Carbon Stocks in Mineral Soils	CO_2	-1,490.8146	3,728.9563	10	10	14.1421	4.1398	0.1129	0.0994	1.1288	1.4051	1.8023
5.B.1	Non-CO_2 Emissions from Vegetation Fires	CH_4	2.0547	0.0564	10	30	31.6228	0.0001	0.0000	0.0000	-0.0005	0.0000	0.0005
5.B.1	Non-CO_2 Emissions from Vegetation Fires	N_2O	0.7864	0.0216	10	50	50.9902	0.0001	0.0000	0.0000	-0.0003	0.0000	0.0003
5.C.1	Grassland Remaining Grassland	CO_2	-1,469.8567	-1,461.3867	15	10	18.0278	-2.0681	-0.0257	-0.0389	-0.2565	-0.8260	0.8649
5.C.2	Land Converted to Grassland	CO_2	-6.3800	4.1664	30	10	31.6228	0.0103	0.0002	0.0001	0.0017	0.0047	0.0050
6.A.1	Managed Solid Waste Disposal on Land	CH_4	361.6968	590.1795	10	20	22.3607	1.0360	0.0125	0.0157	0.2491	0.2224	0.3339
6.A.2	Unmanaged Solid Waste Disposal on Land	CH_4	547.4446	340.2676	20	20	28.2843	0.7555	0.0041	0.0091	0.0823	0.2564	0.2693
6.A.3	Industrial Solid Waste Disposal on Land	CH_4	635.1066	413.4471	30	20	36.0555	1.1702	0.0053	0.0110	0.1054	0.4674	0.4791
6.B.2	Domestic and Commercial Wastewater	CH_4	215.6014	136.4857	10	30	31.6228	0.3388	0.0017	0.0036	0.0506	0.0514	0.0721
6.B.2	Domestic and Commercial Wastewater	N_2O	105.6201	85.4174	15	30	33.5410	0.2249	0.0013	0.0023	0.0396	0.0483	0.0625
			$\sum C$	$\sum D$				$\sqrt{\sum H^2}$					$\sqrt{\sum M^2}$
	TOTAL		**37532.2437**	**12738.7123**				**7.5489**					**3.1116**

Annex 5-2: Summary of Direct Greenhouse Gas Uncertainties

Annex 5-2.1: Carbon Dioxide Uncertainties (CO_2)

IPCC Classification	IPCC Source Categories	Pollutant	Base Year Emissions (1990)	Year t Emissions (2013)	Activity Data Uncertainty	Emission Factor Uncertainty	Combined Uncertainty	Combined Uncertainty as % of Total Sectoral Emissions in the Year t (2013)	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
			Gg CO_2 equivalent		%								
1A1	Energy Industries	CO_2	19,332.7655	3,308.1821	5	5	7.0711	2.8437	-0.0706	0.1124	-0.3531	0.7945	0.8694
1A2	Manufacturing Industries and Construction	CO_2	2,188.7285	607.6708	5	5	7.0711	0.5223	-0.0001	0.0206	-0.0006	0.1459	0.1459
1A3	Transport	CO_2	3,926.6606	1,835.2651	5	5	7.0711	1.5776	0.0250	0.0623	0.1252	0.4407	0.4582
1A4	Other sectors	CO_2	7,762.4898	1,945.5770	5	5	7.0711	1.6724	-0.0076	0.0661	-0.0378	0.4672	0.4688
1A5	Other	CO_2	154.2715	30.3317	5	5	7.0711	0.0261	-0.0004	0.0010	-0.0022	0.0073	0.0076
1B2	Fugitive Emissions from Fuels	CO_2	0.6377	2.1589	25	25	35.3553	0.0093	0.0001	0.0001	0.0017	0.0026	0.0031
2.A.1	Cement Production	CO_2	971.7056	476.9147	3	2	3.6056	0.2090	0.0070	0.0162	0.0139	0.0687	0.0701
2.A.2	Lime Production	CO_2	148.6611	4.0523	8	2	8.2462	0.0041	-0.0013	0.0001	-0.0025	0.0016	0.0030
2.A.3	Limestone and Dolomite Use	CO_2	619.4733	14.3708	15	5	15.8114	0.0276	-0.0054	0.0005	-0.0269	0.0104	0.0289
2.A.4	Soda ash use	CO_2	32.9560	15.5217	15	2	15.1327	0.0286	0.0002	0.0005	0.0004	0.0112	0.0112
2.A.7	Other: Mineral wool production	CO_2	8.0816	0.0000	8	5	9.4340	0.0000	-0.0001	0.0000	-0.0004	0.0000	0.0004
2.A.7	Other: Brick and expanded clay production	CO_2	49.4409	15.6916	15	5	15.8114	0.0302	0.0001	0.0005	0.0003	0.0113	0.0113
2.C.1	Steel Production	CO_2	11.7182	3.1441	3	5	5.8310	0.0022	0.0000	0.0001	0.0000	0.0005	0.0005
3.A.1	Conventional Solvent Paint Application	CO_2	39.7292	19.6123	5	25	25.4951	0.0608	0.0003	0.0007	0.0072	0.0047	0.0086
3.A.1	Waterborne Paint Application	CO_2	1.8598	0.8445	5	50	50.2494	0.0052	0.0000	0.0000	0.0006	0.0002	0.0006
3.B	Degreasing and Dry Cleaning	CO_2	62.7662	29.9961	5	20	20.6155	0.0752	0.0004	0.0010	0.0085	0.0072	0.0111
3.C	Polyurethane foam processing	CO_2	1.4311	0.4113	20	25	32.0156	0.0016	0.0000	0.0000	0.0000	0.0004	0.0004
3.C	Polystyrene foam processing	CO_2	1.0756	0.7209	20	25	32.0156	0.0028	0.0000	0.0000	0.0004	0.0007	0.0008
3.C	Rubber processing	CO_2	1.1226	0.0016	5	25	25.4951	0.0000	0.0000	0.0000	-0.0003	0.0000	0.0003
3.C	Pharmaceutical products manufacturing	CO_2	0.4454	2.6841	5	25	25.4951	0.0083	0.0001	0.0001	0.0022	0.0006	0.0023
3.C	Paints manufacturing	CO_2	0.3851	0.4021	5	25	25.4951	0.0012	0.0000	0.0000	0.0003	0.0001	0.0003
3.C	Tyre production	CO_2	0.1444	0.0332	20	25	32.0156	0.0001	0.0000	0.0000	0.0000	0.0000	0.0000
3.C	Manufactury of shoes	CO_2	3.1236	0.3958	5	25	25.4951	0.0012	0.0000	0.0000	-0.0004	0.0001	0.0004
3.D.1	Printing industry	CO_2	0.7352	0.3936	5	25	25.4951	0.0012	0.0000	0.0000	0.0002	0.0001	0.0002
3.D.2	Domestic solvent use	CO_2	9.1741	8.5495	5	50	50.2494	0.0522	0.0002	0.0003	0.0102	0.0021	0.0104
3.D.3	Seed Oil Extraction and Seed Drying	CO_2	0.4982	0.1233	20	25	32.0156	0.0005	0.0000	0.0000	0.0000	0.0001	0.0001
3.D.3	Adhesives Use	CO_2	3.5466	2.3936	5	25	25.4951	0.0074	0.0000	0.0001	0.0012	0.0006	0.0013
3.D.3	Vehicles dewaxing	CO_2	0.0592	0.0295	5	25	25.4951	0.0001	0.0000	0.0000	0.0000	0.0000	0.0000
3.D.3	Tobacco combustion	CO_2	0.0002	0.0001	5	20	20.6155	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
5.A.1	Forest Lands Remaining Forest Lands	CO_2	-2,197.5790	-1,887.6165	25	5	25.495	-5.8503	-0.0433	-0.0641	-0.2164	-2.2666	2.2769
5.B.1	Cropland Covered with Woody Vegetation	CO_2	-725.2315	-483.4705	25	10	26.9258	-1.5825	-0.0095	-0.0164	-0.0954	-0.5805	0.5883
5.B.2	Annual Change in Carbon Stocks in Mineral Soils	CO_2	-1,490.8146	3,728.9563	10	10	14.1421	6.4107	0.1409	0.1266	1.4086	1.7911	2.2786
5.C.1	Grassland Remaining Grassland	CO_2	-1,469.8567	-1,461.3867	15	10	18.0278	-3.2027	-0.0357	-0.0496	-0.3570	-1.0529	1.1118
5.C.2	Land Converted to Grassland	CO_2	-6.3800	4.1664	30	10	31.6228	0.0160	0.0002	0.0001	0.0020	0.0060	0.0063
			$\sum C$	$\sum D$				$\sqrt{\sum H^2}$					$\sqrt{\sum M^2}$
	TOTAL		**29443.8250**	**8226.1217**				**10.0890**					**3.6293**

Annex 5-2.2: Methane Uncertainties (CH_4)

IPCC Classification	IPCC Source Categories	Pollutant	Base Year Emissions (1990)	Year t Emissions (2013)	Activity Data Uncertainty	Emission Factor Uncertainty	Combined Uncertainty	Combined Uncertainty as % of Total Sectoral Emissions in the Year t (2013)	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
			Gg CO_2 equivalent		%								
1A1	Energy Industries	CH_4	9.2887	1.3734	5	50	50.2494	0.0256	-0.0008	0.0003	-0.0386	0.0020	0.0386
1A2	Manufacturing Industries and Construction	CH_4	2.0005	0.6760	5	50	50.2494	0.0126	-0.0001	0.0001	-0.0044	0.0010	0.0045
1A3	Transport	CH_4	25.4493	6.7267	5	40	40.3113	0.1006	-0.0015	0.0014	-0.0602	0.0098	0.0610
1A4	Other sectors	CH_4	244.4965	88.1695	5	50	50.2494	1.6442	-0.0096	0.0181	-0.4817	0.1279	0.4984
1A5	Other	CH_4	0.0484	0.0009	5	50	50.2494	0.0000	0.0000	0.0000	-0.0003	0.0000	0.0003
1B2	Fugitive Emissions from Fuels	CH_4	682.2942	520.6450	25	25	35.3553	6.8311	0.0294	0.1068	0.7348	3.7762	3.8470
4.A.1	Cattle	CH_4	1574.8883	379.4545	10	15	18.0278	2.5386	-0.1004	0.0778	-1.5064	1.1009	1.8658
4.A.3	Sheep	CH_4	180.3631	107.4261	10	15	18.0278	0.7187	0.0016	0.0220	0.0238	0.3117	0.3126
4.A.4	Goats	CH_4	4.9589	18.8883	10	15	18.0278	0.1264	0.0033	0.0039	0.0497	0.0548	0.0740
4.A.6	Horses	CH_4	17.8597	17.3769	10	30	31.623	0.2039	0.0015	0.0036	0.0462	0.0504	0.0684
4.A.7	Mules and Asses	CH_4	0.3551	0.4500	10	30	31.623	0.0053	0.0001	0.0001	0.0016	0.0013	0.0020
4.A.8	Swine	CH_4	58.2774	14.0012	10	30	31.623	0.1643	-0.0037	0.0029	-0.1121	0.0406	0.1192
4.A.10	Rabbits	CH_4	3.5062	3.6699	15	30	33.541	0.0457	0.0004	0.0008	0.0107	0.0160	0.0192
4.B.1	Cattle	CH_4	149.1503	18.9426	10	20	22.361	0.1572	-0.0130	0.0039	-0.2605	0.0550	0.2662
4.B.3	Sheep	CH_4	4.9668	2.8922	10	30	31.623	0.0339	0.0000	0.0006	0.0009	0.0084	0.0084
4.B.4	Goats	CH_4	0.1013	0.3742	10	30	31.623	0.0044	0.0001	0.0001	0.0020	0.0011	0.0022
4.B.6	Horses	CH_4	1.5478	1.5060	10	30	31.623	0.0177	0.0001	0.0003	0.0040	0.0044	0.0059
4.B.7	Mules and Asses	CH_4	0.0270	0.0342	10	30	31.623	0.0004	0.0000	0.0000	0.0001	0.0001	0.0002
4.B.8	Swine	CH_4	136.5695	22.6344	10	20	22.361	0.1878	-0.0108	0.0046	-0.2168	0.0657	0.2265
4.B.9	Poultry	CH_4	15.8990	7.5849	15	30	33.541	0.0944	-0.0002	0.0016	-0.0074	0.0330	0.0338
4.B.10	Rabbits	CH_4	0.4754	0.4976	10	30	31.623	0.0058	0.0000	0.0001	0.0014	0.0014	0.0020
5.A.1	Non-CO_2 Emissions from Vegetation Fires	CH_4	0.2347	0.9128	10	30	31.623	0.0107	0.0002	0.0002	0.0048	0.0026	0.0055
5.B.1	Non-CO_2 Emissions from Vegetation Fires	CH_4	2.0547	0.0564	10	30	31.6228	0.0007	-0.0002	0.0000	-0.0066	0.0002	0.0066
6.A.1	Managed Solid Waste Disposal on Land	CH_4	361.6968	590.1795	10	20	22.3607	4.8974	0.0800	0.1211	1.5999	1.7122	2.3434
6.A.2	Unmanaged Solid Waste Disposal on Land	CH_4	547.4446	340.2676	20	20	28.2843	3.5716	0.0077	0.0698	0.1543	1.9743	1.9804
6.A.3	Industrial Solid Waste Disposal on Land	CH_4	635.1066	413.4471	30	20	36.0555	5.5320	0.0128	0.0848	0.2555	3.5984	3.6075
6.B.2	Domestic and Commercial Wastewater	CH_4	215.6014	136.4857	10	30	31.6228	1.6017	0.0035	0.0280	0.1064	0.3960	0.4100
			$\sum C$	$\sum D$				$\sqrt{\sum H^2}$					$\sqrt{\sum M^2}$
	TOTAL		**4874.6623**	**2694.6736**				**11.2430**					**6.4324**

Annex 5-2.3: Nitrous Oxide Uncertainties (N_2O)

IPCC Classification	IPCC Source Categories	Pollutant	Base Year Emissions (1990)	Year t Emissions (2013)	Activity Data Uncertainty	Emission Factor Uncertainty	Combined Uncertainty	Combined Uncertainty as % of Total Sectoral Emissions in the Year t (2013)	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
			Gg CO_2 equivalent		%								
1A1	Energy Industries	N_2O	51.2316	4.3651	3	50	50.0899	0.1305	-0.0069	0.0014	-0.3475	0.0058	0.3475
1A2	Manufacturing Industries and Construction	N_2O	5.1641	1.4119	3	50	50.0899	0.0422	-0.0004	0.0004	-0.0199	0.0019	0.0200
1A3	Transport	N_2O	104.5052	35.1848	5	50	50.2494	1.0555	-0.0060	0.0109	-0.2999	0.0774	0.3098
1A4	Other sectors	N_2O	30.7924	16.7922	3	50	50.0899	0.5022	0.0002	0.0052	0.0116	0.0222	0.0250
1A5	Other	N_2O	0.4911	0.0862	3	50	50.0899	0.0026	-0.0001	0.0000	-0.0026	0.0001	0.0026
1B2	Fugitive Emissions from Fuels	N_2O	0.0002	0.0053	25	25	35.3553	0.0001	0.0000	0.0000	0.0000	0.0001	0.0001
3.D.3	Use of N_2O for Anaesthesia	N_2O	0.0205	0.0000	5	1	5.0990	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
4.B.11a	Cattle	N_2O direct	417.0778	75.2788	10	30	31.623	1.4212	-0.0442	0.0234	-1.3248	0.3313	1.3656
4.B.11b	Sheep	N_2O direct	126.7716	68.7634	10	30	31.623	1.2982	0.0008	0.0214	0.0251	0.3026	0.3036
4.B.11c	Goats	N_2O direct	4.7478	16.0582	10	30	31.623	0.3032	0.0042	0.0050	0.1268	0.0707	0.1452
4.B.11d	Horses	N_2O direct	14.9787	13.1103	10	30	31.623	0.2475	0.0017	0.0041	0.0495	0.0577	0.0760
4.B.11e	Mules and Asses	N_2O direct	0.1796	0.2231	10	30	31.623	0.0042	0.0000	0.0001	0.0012	0.0010	0.0016
4.B.11f	Swine	N_2O direct	391.6369	56.5303	10	30	31.623	1.0672	-0.0459	0.0176	-1.3761	0.2488	1.3984
4.B.11g	Poultry	N_2O direct	138.6228	74.9153	15	30	33.541	1.5001	0.0008	0.0233	0.0249	0.4945	0.4951
4.B.11h	Rabbits	N_2O direct	22.3408	23.7736	15	30	33.541	0.4760	0.0038	0.0074	0.1132	0.1569	0.1935
4.B.12a	Cattle	N_2O indirect	94.5635	14.5805	10	75	75.664	0.6586	-0.0108	0.0045	-0.8097	0.0642	0.8122
4.B.12b	Sheep	N_2O indirect	20.6004	11.1741	10	75	75.664	0.5048	0.0001	0.0035	0.0102	0.0492	0.0502
4.B.12c	Goats	N_2O indirect	0.7715	2.6095	10	100	100.499	0.1566	0.0007	0.0008	0.0687	0.0115	0.0696
4.B.12d	Horses	N_2O indirect	2.4340	2.1304	10	100	100.499	0.1278	0.0003	0.0007	0.0268	0.0094	0.0284
4.B.12e	Mules and Asses	N_2O indirect	0.0292	0.0363	10	100	100.499	0.0022	0.0000	0.0000	0.0007	0.0002	0.0007
4.B.12f	Swine	N_2O indirect	106.9121	14.0047	10	75	75.664	0.6326	-0.0130	0.0044	-0.9733	0.0616	0.9752
4.B.12g	Poultry	N_2O indirect	36.5912	18.5493	15	75	76.485	0.8470	-0.0002	0.0058	-0.0122	0.1224	0.1230
4.B.12h	Rabbits	N_2O indirect	3.6304	3.8632	15	100	101.119	0.2332	0.0006	0.0012	0.0613	0.0255	0.0664
4.D.1a	Synthetic N Fertilizers Application	N_2O direct	448.6586	205.1115	5	6	7.810	0.9564	-0.0089	0.0638	-0.0536	0.4513	0.4545
4.D.1b	Organic N Applied as Fertilizer	N_2O direct	265.7072	1.1621	25	6	25.710	0.0178	-0.0427	0.0004	-0.2562	0.0128	0.2565
4.D.1c	Urine and Dung N Deposited on Pasture	N_2O direct	91.9302	40.7834	50	50	70.711	1.7217	-0.0022	0.0127	-0.1109	0.8973	0.9042
4.D.1d	N in Crop Residue	N_2O direct	169.5561	111.5439	5	25	25.495	1.6978	0.0072	0.0347	0.1802	0.2454	0.3044
4.D.1e	N Mineralisation	N_2O direct	192.1384	549.4030	5	25	25.495	8.3623	0.1397	0.1710	3.4927	1.2088	3.6960
4.D.2a	Atmospheric Deposition of N volatilized	N_2O indirect	109.7501	26.1645	70	150	165.529	2.5856	-0.0097	0.0081	-1.4482	0.8060	1.6573
4.D.2b	N Leaching/Runoff from Managed Soils	N_2O indirect	255.3242	201.2231	75	150	167.705	20.1467	0.0212	0.0626	3.1782	6.6411	7.3624
5.A.1	Non-CO_2 Emissions from Vegetation Fires	N_2O	0.1917	0.7454	10	50	50.990	0.0227	0.0002	0.0002	0.0100	0.0033	0.0106
5.B.1	Non-CO_2 Emissions from Vegetation Fires	N_2O	0.7864	0.0216	10	50	50.9902	0.0007	-0.0001	0.0000	-0.0060	0.0001	0.0060
6.B.2	Domestic and Commercial Wastewater	N_2O	105.6201	85.4174	15	30	33.5410	1.7104	0.0094	0.0266	0.2834	0.5638	0.6310
			ΣC	ΣD				$\sqrt{\Sigma H^2}$					$\sqrt{\Sigma M^2}$
	TOTAL		**3213.7563**	**1675.0222**				**22.4266**					**8.8471**

Annex 5-3: Summary of Sector Uncertainties

Annex 5-3.1: Energy Sector

IPCC Classification	IPCC Source Categories	Pollutant	Base Year Emissions (1990)	Year t Emissions (2013)	Activity Data Uncertainty	Emission Factor Uncertainty	Combined Uncertainty	Combined Uncertainty as % of Total Sectoral Emissions in the Year t (2013)	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
			Gg CO_2 equivalent		%								
1A1	Energy Industries	CO_2	19332.7655	3308.1821	5	5	7.0711	2.3949	-0.0596	0.0946	-0.2980	0.6693	0.7326
1A1	Energy Industries	CH_4	9.2887	1.3734	5	50	50.2494	0.0071	0.0000	0.0000	-0.0017	0.0003	0.0018
1A1	Energy Industries	N_2O	51.2316	4.3651	3	50	50.0899	0.0224	-0.0003	0.0001	-0.0142	0.0005	0.0142
1A2	Manufacturing Industries and Construction	CO_2	2188.7285	607.6708	5	5	7.0711	0.4399	-0.0001	0.0174	-0.0006	0.1229	0.1229
1A2	Manufacturing Industries and Construction	CH_4	2.0005	0.6760	5	50	50.2494	0.0035	0.0000	0.0000	0.0002	0.0001	0.0002
1A2	Manufacturing Industries and Construction	N_2O	5.1641	1.4119	3	50	50.0899	0.0072	0.0000	0.0000	0.0000	0.0002	0.0002
1A3	Transport	CO_2	3926.6606	1835.2651	5	5	7.0711	1.3286	0.0211	0.0525	0.1054	0.3713	0.3860
1A3	Transport	CH_4	25.4493	6.7267	5	40	40.3113	0.0278	0.0000	0.0002	-0.0004	0.0014	0.0014
1A3	Transport	N_2O	104.5052	35.1848	5	50	50.2494	0.1810	0.0002	0.0010	0.0086	0.0071	0.0111
1A4	Other Sectors	CO_2	7762.4898	1945.5770	5	5	7.0711	1.4085	-0.0064	0.0557	-0.0319	0.3936	0.3949
1A4	Other Sectors	CH_4	244.4965	88.1695	5	50	50.2494	0.4536	0.0006	0.0025	0.0284	0.0178	0.0335
1A4	Other Sectors	N_2O	30.7924	16.7922	3	50	50.0899	0.0861	0.0002	0.0005	0.0117	0.0020	0.0119
1A5	Other	CO_2	154.2715	30.3317	5	5	7.0711	0.0220	-0.0004	0.0009	-0.0018	0.0061	0.0064
1A5	Other	CH_4	0.0484	0.0009	5	50	50.2494	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
1A5	Other	N_2O	0.4911	0.0862	3	50	50.0899	0.0004	0.0000	0.0000	-0.0001	0.0000	0.0001
1B2	Fugitive Emissions from Fuels	CO_2	0.6377	2.1589	25	25	35.3553	0.0078	0.0001	0.0001	0.0014	0.0022	0.0026
1B2	Fugitive Emissions from Fuels	CH_4	682.2942	520.6450	25	25	35.3553	1.8846	0.0094	0.0149	0.2360	0.5266	0.5771
1B2	Fugitive Emissions from Fuels	N_2O	0.0002	0.0053	25	25	35.3553	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
MI	International Bunkers	CO_2	217.3668	115.1928	5	5	7.0711	0.0834	0.0016	0.0033	0.0078	0.0233	0.0246
MI	International Bunkers	CH_4	0.9036	0.3097	5	10	11.1803	0.0004	0.0000	0.0000	0.0000	0.0001	0.0001
MI	International Bunkers	N_2O	2.1560	1.1813	5	100	100.1249	0.0121	0.0000	0.0000	0.0017	0.0002	0.0017
MI	CO_2 Emissions from Biomass	CO_2	210.8274	1246.2329	50	80	94.3398	12.0367	0.0340	0.0357	2.7174	2.5212	3.7068
			$\sum C$	$\sum D$				$\sqrt{\sum H^2}$					$\sqrt{\sum M^2}$
	TOTAL (without „Memo Items”)		**34521.3158**	**8,404.6226**				**12.3544**					**3.7942**
	TOTAL (with „Memo Items”)		**34952.5696**	**9,767.5393**				**12.5844**					**3.8643**

Annex 5-3.2: Industrial Processes Sector

IPCC Classification	IPCC Source Categories	Pollutant	Base Year Emissions (1990)	Year t Emissions (2013)	Activity Data Uncertainty	Emission Factor Uncertainty	Combined Uncertainty	Combined Uncertainty as % of Total Sectoral Emissions in the Year t 2013	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
			Gg CO_2 eq.		%								
2.A.1	Cement Production	CO_2	971.7056	476.9147	3	2	3.6056	2.5566	0.0659	0.2589	0.1319	1.0984	1.1063
2.A.2	Lime Production	CO_2	148.6611	4.0523	8	2	8.2462	0.0497	-0.0272	0.0022	-0.0545	0.0249	0.0599
2.A.3	Limestone and Dolomite Use	CO_2	619.4733	14.3708	15	5	15.8114	0.3378	-0.1146	0.0078	-0.5730	0.1655	0.5965
2.A.4	Soda Ash Use	CO_2	32.9560	15.5217	15	2	15.1327	0.3492	0.0019	0.0084	0.0038	0.1788	0.1788
2.A.7	Other: Mineral Wool Production	CO_2	8.0816	0.0000	8	5	9.4340	0.0000	-0.0016	0.0000	-0.0080	0.0000	0.0080
2.A.7	Other: Brick and Expanded Clay Production	CO_2	49.4409	15.6916	15	5	15.8114	0.3689	-0.0013	0.0085	-0.0064	0.1807	0.1808
2.C.1	Steel Production	CO_2	11.7182	3.1441	3	5	5.8310	0.0273	-0.0006	0.0017	-0.0031	0.0072	0.0079
2.F.1	Refrigeration and Air Conditioning Equipment	HFC	0.0000	96.9365	8	50	50.6360	7.2979	0.0526	0.0526	2.6312	0.5954	2.6977
2.F.2	Foam Blowing	HFC	0.0000	45.1716	25	50	55.9017	3.7544	0.0245	0.0245	1.2261	0.8670	1.5017
2.F.4	Aerosols	HFC	0.0000	0.0791	5	50	50.2494	0.0059	0.0000	0.0000	0.0021	0.0003	0.0022
2.F.8	Electric Equipment	PFC	0.0000	0.0273	3	50	50.0899	0.0020	0.0000	0.0000	0.0007	0.0001	0.0007
2.F.8	Electric Equipment	SF_6	0.0000	0.6803	3	50	50.0899	0.0507	0.0004	0.0004	0.0185	0.0016	0.0185
			$\sum C$	$\sum D$				$\sqrt{\sum H^2}$					$\sqrt{\sum M^2}$
	TOTAL		**1842.0368**	**672.5900**				**8.6179**					**3.3439**

Annex 5-3.3: Solvents and Other Products Use Sector

IPCC Classification	IPCC Source Categories	Pollutant	Base Year Emissions (1990)	Year t Emissions (2013)	Activity Data Uncertainty	Emission Factor Uncertainty	Combined Uncertainty	Combined Uncertainty as % of Total Sectoral Emissions in the Year t (2013)	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
			Gg CO_2 equivalent		%								
3.A	Conventional Solvent Paint Application	CO_2	39.7292	19.6123	5	25	25.4951	7.5087	-0.0108	0.1555	-0.2698	1.0996	1.1322
3.A	Waterborne Paint Application	CO_2	1.8598	0.8445	5	50	50.2494	0.6373	-0.0011	0.0067	-0.0545	0.0474	0.0722
3.B	Degreasing and Dry Cleaning	CO_2	62.7662	29.9961	5	20	20.6155	9.2862	-0.0248	0.2378	-0.4963	1.6818	1.7535
3.C	Polyurethane Foam Processing	CO_2	1.4311	0.4113	20	25	32.0156	0.1977	-0.0027	0.0033	-0.0682	0.0922	0.1147
3.C	Polystyrene Foam Processing	CO_2	1.0756	0.7209	20	25	32.0156	0.3466	0.0012	0.0057	0.0303	0.1617	0.1645
3.C	Rubber Processing	CO_2	1.1226	0.0016	5	25	25.4951	0.0006	-0.0047	0.0000	-0.1172	0.0001	0.1172
3.C	Pharmaceutical Products Manufacturing	CO_2	0.4454	2.6841	5	25	25.4951	1.0276	0.0194	0.0213	0.4854	0.1505	0.5082
3.C	Paints Manufacturing	CO_2	0.3851	0.4021	5	25	25.4951	0.1540	0.0016	0.0032	0.0394	0.0225	0.0454
3.C	Tyre Production	CO_2	0.1444	0.0332	20	25	32.0156	0.0160	-0.0003	0.0003	-0.0085	0.0074	0.0113
3.C	Manufactory of Shoes	CO_2	3.1236	0.3958	5	25	25.4951	0.1515	-0.0099	0.0031	-0.2484	0.0222	0.2494
3.D.1	Printing	CO_2	0.7352	0.3936	5	25	25.4951	0.1507	0.0000	0.0031	0.0011	0.0221	0.0221
3.D.2	Domestic Solvent Use	CO_2	9.1741	8.5495	5	50	50.2494	6.4513	0.0294	0.0678	1.4680	0.4793	1.5443
3.D.3	Seed Oil Extraction and Seed Drying	CO_2	0.4982	0.1233	20	25	32.0156	0.0593	-0.0011	0.0010	-0.0277	0.0276	0.0391
3.D.3	Use of Glues and Other Adhesives	CO_2	3.5466	2.3936	5	25	25.4951	0.9164	0.0041	0.0190	0.1032	0.1342	0.1693
3.D.3	Vehicles Dewaxing	CO_2	0.0592	0.0295	5	25	25.4951	0.0113	0.0000	0.0002	-0.0003	0.0017	0.0017
3.D.3	Tobacco Combustion	CO_2	0.0002	0.0001	5	20	20.6155	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
3.D.3	Use of N_2O for Anesthesia	N_2O	0.0205	0.0000	5	1	5.0990	0.0000	-0.0001	0.0000	-0.0001	0.0000	0.0001
			$\sum C$	$\sum D$				$\sqrt{\sum H^2}$					$\sqrt{\sum M^2}$
	TOTAL		**126.1169**	**66.5917**				**13.6664**					**2.6747**

Annex 5-3.4. Agriculture Sector

IPCC Classification	IPCC Source Categories	Pollutant	Base Year Emissions (1990)	Year t Emissions (2013)	Activity Data Uncertainty	Emission Factor Uncertainty	Combined Uncertainty	Combined Uncertainty as % of Total Sectoral Emissions in the Year t (2013)	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
			Gg CO_2 eq.		%								
4.A.1	Enteric Fermentation: Cattle	CH_4	1574.8883	379.4545	10	15	18.0278	3.2165	-0.0555	0.0749	-0.8326	1.0597	1.3477
4.A.3	Enteric Fermentation: Sheep	CH_4	180.3631	107.4261	10	15	18.0278	0.9106	0.0063	0.0212	0.0938	0.3000	0.3143
4.A.4	Enteric Fermentation: Goats	CH_4	4.9589	18.8883	10	15	18.0278	0.1601	0.0033	0.0037	0.0498	0.0528	0.0725
4.A.6	Enteric Fermentation: Horses	CH_4	17.8597	17.3769	10	30	31.6228	0.2584	0.0020	0.0034	0.0585	0.0485	0.0760
4.A.7	Enteric Fermentation: Mules and Asses	CH_4	0.3551	0.4500	10	30	31.6228	0.0067	0.0001	0.0001	0.0018	0.0013	0.0022
4.A.8	Enteric Fermentation: Swine	CH_4	58.2774	14.0012	10	30	31.6228	0.2082	-0.0021	0.0028	-0.0620	0.0391	0.0733
4.A.10	Enteric Fermentation: Rabbits	CH_4	3.5062	3.6699	15	30	33.5410	0.0579	0.0004	0.0007	0.0130	0.0154	0.0201
4.B.1	Manure Management: Cattle	CH_4	149.1503	18.9426	10	20	22.3607	0.1992	-0.0086	0.0037	-0.1725	0.0529	0.1805
4.B.3	Manure Management: Sheep	CH_4	4.9668	2.8922	10	30	31.6228	0.0430	0.0002	0.0006	0.0048	0.0081	0.0094
4.B.4	Manure Management: Goats	CH_4	0.1013	0.3742	10	30	31.6228	0.0056	0.0001	0.0001	0.0020	0.0010	0.0022
4.B.6	Manure Management: Horses	CH_4	1.5478	1.5060	10	30	31.6228	0.0224	0.0002	0.0003	0.0051	0.0042	0.0066
4.B.7	Manure Management: Mules and Asses	CH_4	0.0270	0.0342	10	30	31.6228	0.0005	0.0000	0.0000	0.0001	0.0001	0.0002
4.B.8	Manure Management: Swine	CH_4	136.5695	22.6344	10	20	22.3607	0.2380	-0.0069	0.0045	-0.1371	0.0632	0.1510
4.B.9	Manure Management: Poultry	CH_4	15.8990	7.5849	15	30	33.5410	0.1196	0.0002	0.0015	0.0054	0.0318	0.0322
4.B.10	Manure Management: Rabbits	CH_4	0.4754	0.4976	10	30	31.6228	0.0074	0.0001	0.0001	0.0018	0.0014	0.0022
4.B.11a	Manure Management: Cattle	N_2O direct	417.0778	75.2788	10	30	31.6228	1.1193	-0.0197	0.0149	-0.5913	0.2102	0.6275
4.B.11b	Manure Management: Sheep	N_2O direct	126.7716	68.7634	10	30	31.6228	1.0225	0.0031	0.0136	0.0919	0.1920	0.2129
4.B.11c	Manure Management: Goats	N_2O direct	4.7478	16.0582	10	30	31.6228	0.2388	0.0028	0.0032	0.0833	0.0448	0.0946
4.B.11d	Manure Management: Horses	N_2O direct	14.9787	13.1103	10	30	31.6228	0.1949	0.0013	0.0026	0.0404	0.0366	0.0545
4.B.11e	Manure Management: Mules and Asses	N_2O direct	0.1796	0.2231	10	30	31.6228	0.0033	0.0000	0.0000	0.0009	0.0006	0.0011
4.B.11f	Manure Management: Swine	N_2O direct	391.6369	56.5303	10	30	31.6228	0.8406	-0.0213	0.0112	-0.6390	0.1579	0.6582
4.B.11g	Manure Management: Poultry	N_2O direct	138.6228	74.9153	15	30	33.5410	1.1815	0.0033	0.0148	0.0989	0.3138	0.3290
4.B.11h	Manure Management: Rabbits	N_2O direct	22.3408	23.7736	15	30	33.5410	0.3749	0.0028	0.0047	0.0853	0.0996	0.1311
4.B.12a	Manure Management: Cattle	N_2O indirect	94.5635	14.5805	10	75	75.6637	0.5187	-0.0050	0.0029	-0.3722	0.0407	0.3744
4.B.12b	Manure Management: Sheep	N_2O indirect	20.6004	11.1741	10	75	75.6637	0.3975	0.0005	0.0022	0.0374	0.0312	0.0487
4.B.12c	Manure Management: Goats	N_2O indirect	0.7715	2.6095	10	100	100.4988	0.1233	0.0005	0.0005	0.0451	0.0073	0.0457
4.B.12d	Manure Management: Horses	N_2O indirect	2.4340	2.1304	10	100	100.4988	0.1007	0.0002	0.0004	0.0219	0.0059	0.0227
4.B.12e	Manure Management: Mules and Asses	N_2O indirect	0.0292	0.0363	10	100	100.4988	0.0017	0.0000	0.0000	0.0005	0.0001	0.0005
4.B.12f	Manure Management: Swine	N_2O indirect	106.9121	14.0047	10	75	75.6637	0.4983	-0.0061	0.0028	-0.4575	0.0391	0.4592
4.B.12g	Manure Management: Poultry	N_2O indirect	36.5912	18.5493	15	75	76.4853	0.6671	0.0006	0.0037	0.0471	0.0777	0.0909
4.B.12h	Manure Management: Rabbits	N_2O indirect	3.6304	3.8632	15	100	101.1187	0.1837	0.0005	0.0008	0.0462	0.0162	0.0489
4.D.1a	Synthetic N Fertilizers Application	N_2O direct	448.6586	205.1115	5	6	7.8102	0.7533	0.0033	0.0405	0.0198	0.2864	0.2871
4.D.1b	Organic N Applied as Fertilizer	N_2O direct	265.7072	1.1621	25	6	25.7099	0.0140	-0.0218	0.0002	-0.1308	0.0081	0.1310
4.D.1c	Urine and Dung N Deposited on Pasture	N_2O direct	91.9302	40.7834	50	50	70.7107	1.3560	0.0004	0.0081	0.0215	0.5695	0.5699
4.D.1d	N in Crop Residue	N_2O direct	169.5561	111.5439	5	25	25.4951	1.3372	0.0080	0.0220	0.1991	0.1558	0.2528
4.D.1e	N Mineralization	N_2O direct	192.1384	549.4030	5	25	25.4951	6.5862	0.0925	0.1085	2.3131	0.7672	2.4370
4.D.2a	Atmospheric Deposition of N volatilized	N_2O indirect	109.7501	26.1645	70	150	165.5295	2.0365	-0.0039	0.0052	-0.5902	0.5115	0.7810
4.D.2b	N Leaching/Runoff from Managed Soils	N_2O indirect	255.3242	201.2231	75	150	167.7051	15.8677	0.0186	0.0397	2.7828	4.2147	5.0505
			$\sum C$	$\sum D$				$\sqrt{\sum H^2}$					$\sqrt{\sum M^2}$
	TOTAL		**5063.8990**	**2126.7254**				**17.9094**					**5.9925**

Annex 5-3.5: Land Use, Land-Use Change and Forestry Sector

IPCC Classification	IPCC Source Categories	Pollutant	Base Year Emissions (1990)	Year t Emissions (2013)	Activity Data Uncertainty	Emission Factor Uncertainty	Combined Uncertainty	Combined Uncertainty as % of Total Sectoral Emissions in the Year t (2013)	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
			Gg CO_2 eq		%								
5.A.1	Forest Land Remaining Forest Land	CO_2	-2,197.5790	-1,887.6165	25	5	25.4951	493.0092	0.3133	0.3207	1.5665	11.3372	11.4449
5.A.1	Non-CO_2 Emissions from Vegetation Fires	CH_4	0.2347	0.9128	10	30	31.6228	-0.2957	-0.0002	-0.0002	-0.0046	-0.0022	0.0051
5.A.1	Non-CO_2 Emissions from Vegetation Fires	N_2O	0.1917	0.7454	10	50	50.9902	-0.3894	-0.0001	-0.0001	-0.0063	-0.0018	0.0066
5.B.1	Land Covered with Woody Vegetation	CO_2	-725.2315	-483.4705	25	10	26.9258	133.3594	0.0800	0.0821	0.7999	2.9038	3.0119
5.B.2	Annual Change in Carbon Stocks in Mineral Soils	CO_2	-1,490.8146	3,728.9563	10	10	14.1421	-540.2401	-0.6361	-0.6335	-6.3605	-8.9586	10.9869
5.B.2.1	Non-CO_2 Emissions from Stubble Fields Burning	CH_4	2.0547	0.0564	10	30	31.6228	-0.0183	0.0000	0.0000	-0.0001	-0.0001	0.0002
5.B.2.1	Non-CO_2 Emissions from Stubble Fields Burning	N_2O	0.7864	0.0216	10	50	50.9902	-0.0113	0.0000	0.0000	-0.0001	-0.0001	0.0001
5.C.1	Grassland Remaining Grassland	CO_2	-1,469.8567	-1,461.3867	15	10	18.0278	269.8928	0.2435	0.2483	2.4351	5.2663	5.8020
5.C.2	Land Converted to Grassland	CO_2	-6.3800	4.1664	30	10	31.6228	-1.3497	-0.0007	-0.0007	-0.0073	-0.0300	0.0309
			$\sum C$	$\sum D$				$\sqrt{\sum H^2}$					$\sqrt{\sum M^2}$
	TOTAL		**-5,886.5942**	**-97.6148**				**790.9149**					**17.1591**

Annex 5-3.6: Waste Sector

IPCC Classification	IPCC Source Categories	Pollutant	Base Year Emissions (1990)	Year t Emissions (2013)	Activity Data Uncertainty	Emission Factor Uncertainty	Combined Uncertainty	Combined Uncertainty as % of Total Sectoral Emissions in the Year t (2013)	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
			Gg CO_2 eq.		%								
6.A.1	Managed Solid Waste Disposal on Land	CH_4	361.6968	590.1795	10	20	22.3607	8.4282	0.1533	0.3164	3.0666	4.4742	5.4242
6.A.2	Unmanaged Solid Waste Disposal on Land	CH_4	547.4446	340.2676	20	20	28.2843	6.1465	-0.0637	0.1824	-1.2746	5.1591	5.3143
6.A.3	Industrial Solid Waste Disposal on Land	CH_4	635.1066	413.4471	30	20	36.0555	9.5204	-0.0639	0.2216	-1.2783	9.4030	9.4895
6.B.2	Domestic and Commercial Wastewater	CH_4	215.6014	136.4857	10	30	31.6228	2.7565	-0.0238	0.0732	-0.7145	1.0347	1.2574
6.B.2	Domestic and Commercial Wastewater	N_2O	105.6201	85.4174	15	30	33.5410	1.8297	-0.0017	0.0458	-0.0520	0.9713	0.9727
			$\sum C$	$\sum D$				$\sqrt{\sum H^2}$					$\sqrt{\sum M^2}$
	TOTAL		**1865.4695**	**1565.7972**				**14.5051**					**12.2573**