Ministry of Environment and Forests

National Environmental Protection Agency

Romania's Greenhouse Gas Inventory 1989-2009

National Inventory Report

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LIST OF ABBREVIATIONS

AD	Activity Data
AGB	Above Ground Biomass
AR	Afforestation/Reforestation
AWMS	Animal Waste Management Systems
BEF	Biomass Expansion Factor
BGB	Below Ground Biomass
BOD	Biochemical Oxygen Demand
BOF	Basic Oxygen Furnace
C	Carbon
C_2F_6	Hexafluoroethane
$CaCO_3$	Calcium Carbonate (limestone)
CaO	Calcium Oxide (lime)
CaO*MgO	Dolomitic lime
CF_4	Tetrafluoromethane
CH_4	Methane
CKD	Cement Kiln Dust
CO	Carbon Monoxide
CO_2	Carbon Dioxide
COD	Chemical Oxygen Demand
CORINAIR	Coordination of Information on the Environment, sub-project: Air
CRF	Common Reporting Format
CWPB	Centre Worked Pre-baked
D	Deforestation
DOC	Degradable Organic Carbon
DOC_F	Fraction of DOC Dissimilated
DOM	Dead Organic Matter
DW	Dead Wood
EAF	Electric Arc Furnace
EB	Energy Balance

EC	European Commission
EF	Emission Factor
EUROSTAT	Statistical Office of the European Communities
ERT	Expert Review Team
EU-ETS	European Union-Emission Trading Scheme
FAO	Food and Agriculture Organization
FFN	National Forest Fund
FLRFL	Forest Land Remaining Forest Land
FM	Forest Management
FORLUC	Forest Land Use
GD	Governmental Decision
Gg	Giga gram
GHG	Greenhouse Gas
GPG	Good Practice Guidance
GWP	Global Warming Potential
HCFC	Fluorinated Gases
HFCs	Hydrofluorocarbons
ICAS	Forest Research and Management Institute
ICIM	National Research and Development Institute for Environmental Protection
ICPA	National Institute of Research and Development in Soil Science, Agrochemistry and Environment
ICPIL	Research and Design Institute of Wood Industry
IPCC 1996	Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories - 1996
IPCC GPG 2000	IPCC Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories -2000
IPCC GPG 2003	IPCC Good Practice Guidance for Land Use, Land Use Change and Forestry -2003
IPCC	Intergovernmental Panel on Climate Change
IPPC	Integrating Pollution Prevention and Control
ISPB	Public Health Institute of Bucharest
ITRSV	Territorial Inspectorates on Forestry and Hunting Regime

JI	Joint Implementation
KP	Kyoto Protocol
L	Level
LB	Loss in Biomass
LULUCF	Land Use, Land Use Change and Forestry
M	meter
MADR	Ministry of Agriculture and Rural Development
MCF	Methane Conversion Factor
MEF	Ministry of Environment and Forests
$MgCO_3$	Magnesium Carbonate
MgO	Magnesium Oxide
MSW	Municipal Solid Waste
N	Nitrogen
N_2O	Nitrous Oxide
NACE	National Classification of Economic Activities
NEPA	National Environmental Protection Agency
NFI	National Forest Inventory
NGHGI	National Greenhouse Gas Inventory
NH_3	Ammonia
NIR	National Inventory Report
NIS	National Institute for Statistics
NMVOC	Non-methane Volatile Organic Compound
NOx	Nitrogen Oxides
NSCR	Non Selective Catalytic Reduction
PFCs	Perfluorocarbons
QA/QC	Quality Assurance/Quality Control
RAR	Romanian Automobile Register
Rev	Revegetation
RNP	Public National Forest Administration
SF_6	Sulphur Hexafluoride
SILV 4	Statistical Report Forest regeneration works performed in the forestry fund, degraded lands and other lands outside the forest fund

SNAP	Selected Nomenclature for Air Pollution
SNFI 1984	Synthesis of National Forest Inventory, 1988
SO_2	Sulphur Dioxide
SRC	Selective Catalytic Reduction
SWDS	Solid Waste Disposal Sites
SWPB	Side Worked Pre-baked
SY	Statistical Yearbook
T	Trend
UNFCCC	United Nations Framework Convention on Climate Change
VFAFF	Forest Vegetation outside of the National Forest Fund
YR	Year

Notation Keys	IE	Included elsewhere
	NA	Not Applicable
	NE	Not Estimated
	NO	Not occurring
	C	Confidential

ES EXECUTIVE SUMMARY

ES.1. Background information on greenhouse gas inventories, climate change and supplementary information required under Article 7, paragraph 1, of the Kyoto Protocol

ES.1.1 Background information on climate change

Romania signed the United Nations Framework Convention on Climate Change (UNFCCC) in 1992, and ratified it in 1994 by Law 24. Romania signed the Kyoto Protocol in 1999 and ratified it in January 2001, being the first Annex 1 Party that ratified it. Romania committed itself to reduce the greenhouse gas (GHG) emissions by 8% comparing to 1989 (base year) levels in the first commitment period 2008-2012.

The estimation on climate change impact on Romania has been realized through the elaboration of a study, by the Romanian Academy; in this sense, different atmosphere General Circulation Models were selected, models which reflect the best Romanian conditions. In accordance with the results generated by these models, presuming that the CO_2 atmospheric concentration would double, it is expected for the coming decades that the average global temperature will increase by 2.4-7.4^{0}C.

ES.1.2 Background information on greenhouse gas inventories

As a Party to the United Nations Framework Convention on Climate Change (UNFCCC), and its Kyoto Protocol, Romania is required to elaborate, regularly update and submit the national GHG Inventory.

In compliance with the reporting requirements, this is the fourteenth version of the National Inventory Report (NIR) submitted by Romania, covering the national inventories of GHG emissions/removals for the period 1989-2009.

This report documents Romania's National Inventory of anthropogenic emissions/removals of direct GHGs: CO_2, CH_4, N_2O, HFC, PFC, SF_6 and indirect GHGs: NO_x, CO, NMVOC and SO_2. This report includes descriptions of methods, data sources, key categories, quality assurance and quality control (QA/QC) activities carried out and a trend analysis. The NIR also comprises a full quantitative assessment of the uncertainty; the uncertainty analysis is presented both on the subsectoral level and in the Annex 7.

ES.1.3 Background information on supplementary information required under Article 7, paragraph 1, of the Kyoto Protocol

Considering the provisions in Decision 15/CMP. 1, the report specifies the information required under Article 7.1 of the Kyoto Protocol; Romania is reporting also elements on Afforestation, Reforestation, Deforestation, Forest Management and Revegetation activities (KP Art. 3 paragraphs 3 and 4 activities), within the current NGHGI.

ES.2 Summary of national emission and removal related trends, and emission and removals from KP-LULUCF activities

ES.2.1 GHG inventory

For the trends analysis, the GHG emissions resulted from each sector were converted into CO_2 equivalent according to the IPCC's Global Warming Potential (the GWP values are presented in the Annex 6 of the NIR). The evolution of the total GHG emissions is presented in the next chart.

The GHG emissions trend reflects the main trends in the economic development of the country. The period is characterized by a process of transition to a market economy, restructuring of the economy, bringing into operation of the first reactor at the Cernavoda nuclear power plant (1996). The emissions have started to increase after 1999 as a consequence of the economy revitalization; in 2009, the emissions decreased significantly comparing to the level in 2008 due to the economic crisis.

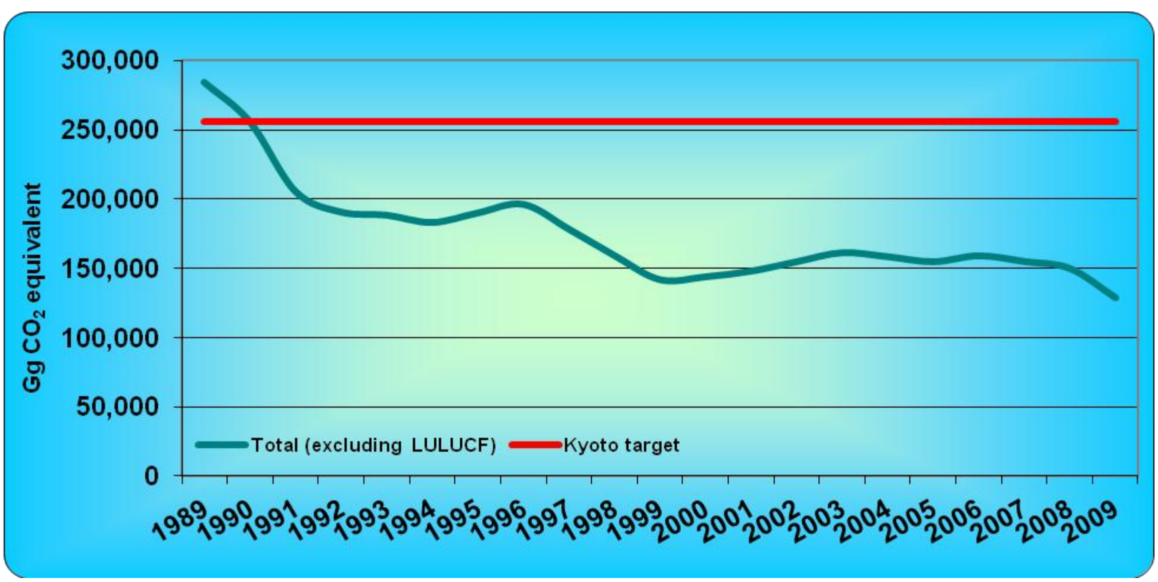
The largest contributor to the total national GHG emissions is CO_2, followed by CH_4 and N_2O. The share of each direct GHG in total emissions in 1989 and, respectively 2009, and the average share of each direct GHG in total emissions for 1989-2009 are presented in the table.ES.1.

The total GHG emissions in CO_2 equivalent during 1989-2009 are presented in the figure ES.1.

Table ES. 1 Share of each direct GHG in total emissions in 1989, 2009, respectively 1989-2009

GHG	1989 (%)	2009 (%)	Average share for1989-2009 (%)
CO_2	67.94%	66.94%	68.54%
CH_4	16.84%	18.64%	17.51%
N_2O	14.04%	14.39%	13.33%
HFCs	0.00%	0.0195%	0.0041%
PFCs	1.18%	0.01%	0.61%
SF_6	0.00%	0.0057%	0.0073%

Figure ES 1 The total GHG emissions in CO_2 equivalent during 1989-2009



According to the figure above, there is a great probability for Romania to meet the Kyoto Protocol commitments on the limitation of the GHG emissions in the 2008-2012 commitment period. In 2009, the GHG emissions without LULUCF have decreased with 54.57% since the base year.

ES.2.2 KP-LULUCF activities

The data relevant to the KP LULUCF activities are presented within the Chapter 11.

ES.3 Overview of source and sink category emissions estimates and trends, including KP-LULUCF activities

ES.3.1 GHG inventory

The present NGHGI for 1989–2009 was compiled according to the recommendations for GHG inventories set out in the Updated UNFCCC reporting guidelines on annual inventories following incorporation of the provisions of Decision 14/CP. 11 (FCCC/SBSTA/2006/9) and in the Annotated outline of the National Inventory Report including reporting elements under the Kyoto Protocol, using the Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories (IPCC 1996) as well as the IPCC Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories (IPCC GPG 2000) and Good Practice Guidance for Land Use, Land-Use Change and Forestry (IPCC GPG 2003).

The inventories cover all sectors and the majority of the IPCC categories. The direct GHGs (including groups of gases) included in the national inventory are:

- Carbon dioxide (CO_2);
- Methane (CH_4);
- Nitrous oxide (N_2O);
- Hydrofluorocarbons (HFCs);

- Perfluorocarbons (PFCs);
- Sulphur hexafluoride (SF_6).

The report also contains data on calculations of emissions of the indirect GHGs: NO_x, NMVOC, CO and SO_2, which should be included according to the reporting guidelines. Some minor IPCC source categories are not estimated, such as the emissions from asphalt roofing and from road paving with asphalt due to the lack of activity data.

GHG emissions inventories have been reported since the 2005 submission using the CRF Reporter software, delivered by the UNFCCC Secretariat. This version of NIR refers to figures in CRF table’s generated using CRF Reporter version 3.5.2.

ES.3.2 KP LULUCF activities

The data relevant to the KP LULUCF activities are presented within the Chapter 11.

ES.4 Other information

The emissions of the indirect GHGs (NO_x, NMVOC, CO and SO_2) are included in the report, as requested by the UNFCCC reporting guidelines. A detailed description of the calculation methodologies for these gases is not included in this report.

Fuel combustion activities in the Energy sector are the major sources of SO_2, NO_x and CO emissions. Additional to the Energy sector, the NMVOC emissions are generated by the Solvent and Other Product Use sector.

PART 1 ANNUAL INVENTORY SUBMISSION

1 INTRODUCTION

1.1. Background information on greenhouse gas inventories, climate change and supplementary information required under Article 7, paragraph 1, of the Kyoto Protocol

1.1.1. Background information on climate change

In Romania, the climate variability will have direct effects on certain sectors such as agriculture, forestry, water management, residential and infrastructure will lead to changes in the vegetation cycle and to movement of the demarcation lines between forests and meadows, will determine the increase of the frequency and of the intensity of the extreme meteorological events (storms, floods, droughts). The changes in the Romanian climate regime are framed within the global context, considering the regional conditions: the temperature increase will be more pronounced during the summer, while in north-western Europe the most pronounced temperature increase is expected in winter.

Taking into account the estimates presented within the Fourth IPCC Assessment Report, in Romania it is expected a increase of the average annual temperature compared to the 1980-1990 similar to that specific to the whole Europe, with small differences between the models results in respect to the first decades of the XXI century, and with larger differences in respect to the end of the same century:

- between 0.5°C and 1.5°C, for 2020-2029;
- between 2.0°C and 5.0°C, for 2090-2099, depending on the scenario (e.g. between 2.0°C and 2.5°C for the scenario foreseeing the lowest increase of the average global temperature and between 4.0°C and 5.0°C in case of the scenario with the most pronounced temperature increase).

Considering the pluviometrical view, over than 90% of the climate models forecasts for 2090-2099 pronounced droughts during the summer in Romania, especially in south and south-east (with negative deviations compared to 1980-1990 larger than 20%). Taking into account the winter precipitations, the deviations are smaller while the uncertainty is larger.

Effects on agriculture

The agriculture represents the most vulnerable sector, the elaborated studies highlighting the following aspects:

- wheat crop - a production increase with approximately 0.4-0.7 t/ha and the decrease of the vegetation season by 16-27 days;
- non-irrigated maize crop – the grains production increase with approximately 1.4-5.6 t/ha, a decrease of the vegetation season ranging between 2-32 days, a decrease of the vegetation cycle ranging between 2-19%; the estimated values depend on the model used;
- irrigated maize crop - the results depend on the models used and on the conditions of the locations chosen for data sampling;
- for analyzing the effects on the main crops agricultural productivity, several agro-meteorological models were used.

Effects on silviculture

Out of the national area, 27.1% represent the area covered by forests; the forests are unevenly spread on the country’s territory (51.9% in the mountain area, 37.2% in the hilly area and 10.9% in the plain area). The forest fund area accounts for 6 470 thousand ha, out of which approximately 6 309 thousand ha represents forests while the rest of the area is destined to forest crop, production and management. In the lower and hilly forested areas, a considerable drop of the forests productivity is foreseen after 2040, due to the increase of the temperatures and to the decrease of the precipitations volume.

Effects on the water management

The hydrological consequences of the increase of the CO_2 atmospheric concentration are significant. The modeling of the effects produced by this phenomenon was realized focusing on the main hydrographic basins. The modeling results show the probable effects of the changes in the precipitations volume and in the evapo-transpiration.

Effects on the human establishments

The industrial, commercial, residential and infrastructure sectors (including the supplying with energy and water, the transport and the waste disposal) are vulnerable to the climate change. The main impact of the climate change on urban areas, on infrastructure and on constructions is mainly linked to the effects of extreme meteorological events such as heat waves, pronounced snowfalls, storms, and floods, increase of the slopes instability and the modification of some geophysical properties. Thus, urban planning and designing of a appropriate infrastructure plays an important role in minimizing the impact of climate change and in reducing the risk on the anthropic environment.

1.1.2. Background information on greenhouse gas inventories

As a Party to the UNFCCC and its Kyoto Protocol, Romania is required to produce and regularly update the national GHG inventory. According to the COP decision regarding the UNFCCC guidelines on reporting and reviewing (FCCC/CP/1999/7), Parties shall submit a National Inventory Report (NIR) containing detailed and complete information on their inventories, in order to ensure the transparency of the inventory. This is the fourteenth complete submission of the national GHG inventory of Romania. The structure of the National Inventory Report is in line with the Annotated outline of the National Inventory Report including reporting elements under the Kyoto Protocol, document provided by the UNFCCC Secretariat.

The submission of present inventory covers the obligation of Romania under the UNFCCC. It also constitutes Romania’s submission under the Kyoto Protocol.

For this submission, Romania prepared: the CRF Reporter database and the CRF Tables containing emissions/removals estimates and background data for 1989-2009 and the National Inventory Report.

The greatest attention during the preparation was payed to the direct GHGs mentioned by the Kyoto Protocol - CO_2, CH_4, N_2O, HFCs, PFCs and SF_6. In addition, the indirect GHGs (NO_X, CO, NMVOCs, and SO2) were also taken into account.

The GHG inventories submitted annually by Parties are subject to reviews by Expert Review Teams coordinated by the UNFCCC Secretariat.

Up to now, the GHG inventories of Romania were reviewed as follows:

Year	Submission	Review process
2002	CRF tables and draft NIR submitted (late submission)	No Review
2003	CRF tables and NIR submitted	In - country Review
2004	CRF tables and NIR submitted	Desk Review
2005	CRF Reporter database, CRFs for LULUCF and NIR submitted	Centralized Review
2007	2006 2nd submission : CRF Reporter database, CRF Tables and NIR + Initial Report of Romania under the Kyoto Protocol	In - country Review
2008	2007 and 2008 submissions: CRF Reporter database, CRF Tables and NIR	Centralized Review
2009	2009 submission: CRF Reporter database, CRF Tables and NIR	Centralized Review
2010	2010 submission: CRF Reporter database, CRF Tables and NIR	Centralized Review

The reports on these reviews can be found on the UNFCCC website.

1.1.3. Background information on supplementary information required under Article 7, paragraph 1, of the Kyoto Protocol

The present NIR includes supplementary information required under Article 7, paragraph 1, of the Kyoto Protocol as follows:

- information on anthropogenic greenhouse gas emissions by sources and removals by sinks from LULUCF activities under KP's Article 3, paragraphs 3 and 4, in accordance with the provisions in Section I.D of the Annex to Decision 15-CMP. 1;
- information on Kyoto units (emission reduction units (ERUs), certified emission reductions (CERs), temporary certified emission reductions (tCERs), long-term certified emission reductions (lCERs), assigned amount units (AAUs) and removal units (RMUs)), as set out in Section I.E of the Annex to Decision 15/CMP. 1;
- changes in national systems in accordance with Article 5, paragraph 1, of the Kyoto Protocol, as set out in Section I.F of the Annex to Decision 15/CMP. 1;
- changes in national registries as set out in Section I.G of the Annex to Decision 15/CMP. 1;
- minimization of adverse impacts in accordance with Article 3, paragraph 14, of the Kyoto Protocol, as set out in Section I.H of the Annex to Decision 15/CMP. 1.

1.2. A description of the institutional arrangements for inventory preparation, including the legal and procedural arrangements for inventory planning, preparation and management

1.2.1. Overview of institutional, legal and procedural arrangements for compiling GHG inventory and supplementary information required under Article 7, paragraph 1, of the Kyoto Protocol

The Governmental Decision no. 1570 for establishing the National System for the estimation of anthropogenic greenhouse gas emissions levels from sources and removals by sinks, adopted in 2007, and the subsequent relevant procedures are regulating all the institutional, legal and procedural aspects for supporting the Romanian authorities to estimate the greenhouse gas emissions/removals levels, to report and to archive the national GHGI information, including supplementary information required under Article 7, paragraph 1, of the Kyoto Protocol.

The system is based on Article 5 of the Kyoto Protocol and complies with the provisions of the subsequent decisions of the CMPs of the Kyoto Protocol and with the provisions of the Decision 280/2004/EC of the European Parliament and of the Council and of the Decision 166/2005/EC of the European Commission concerning a mechanism for monitoring Community GHG emissions and for implementing the Kyoto Protocol.

The main objective of the Governmental Decision is to ensure the fulfillment of the provisions and the obligations of Romania under the UNFCCC, the Kyoto Protocol and the European Community legislation.

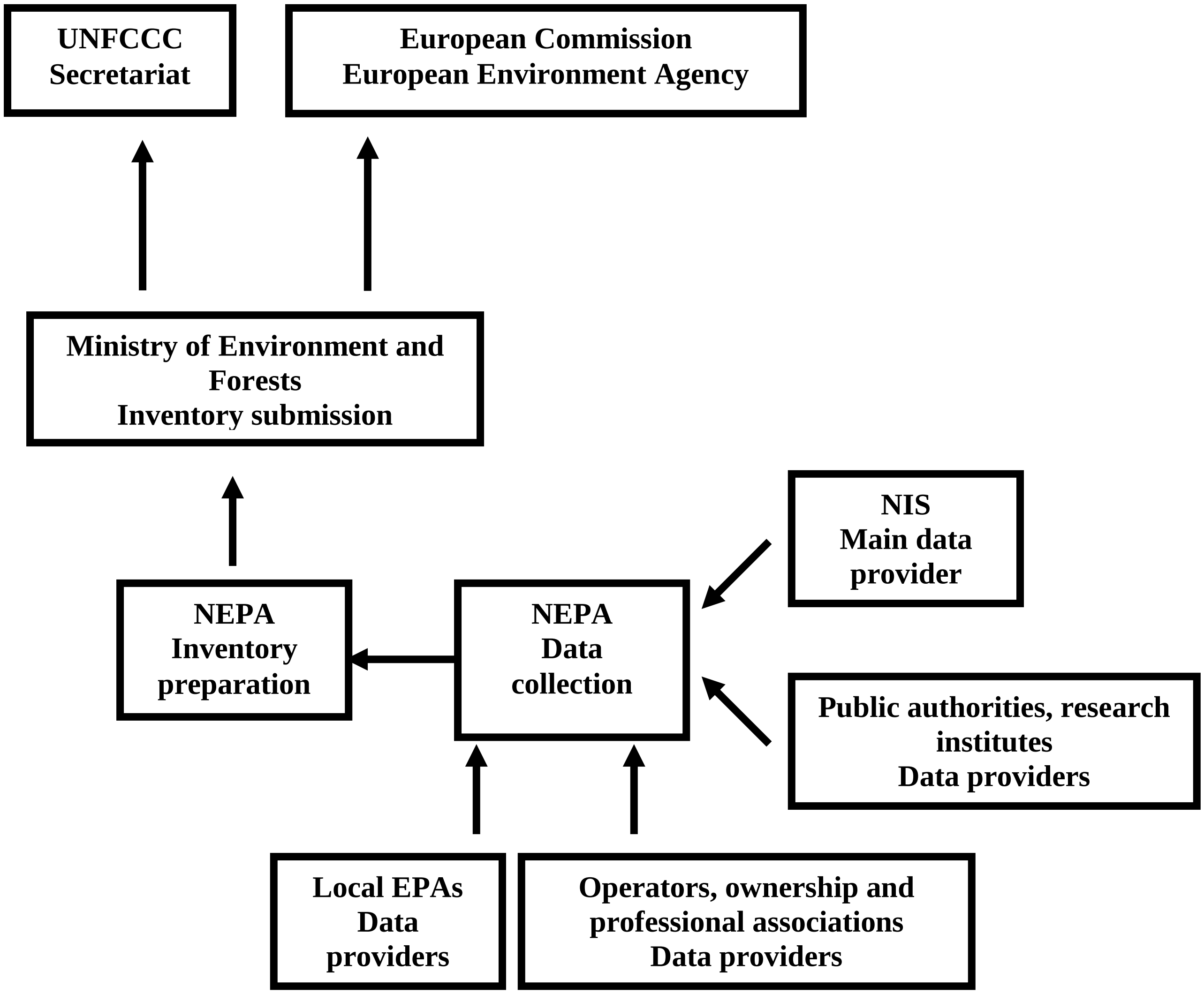
The competent authority, which is responsible for administrating the National System, is the National Environmental Protection Agency (NEPA), under the subordination of the Ministry of Environment and Forests.

The name and contact information for the national entity and its designated representative with overall responsibility for the national inventory are:

- national entity
    - name: National Environmental Protection Agency;
    - address: Splaiul Independentei no. 294, Sector 6, Bucharest, Postal Code 060031;
    - telephone/ fax: +40-21-2071155.
- designated representative with overall responsibility
    - name: Sorin Deaconu;
    - telephone/fax: +40-21-2071155;
    - e-mail: sorin.deaconu@anpm.ro.

The inventory system currently used in Romania is presented in the Figure 1.1.

Figure 1.1 Current national inventory system description



1.2.2. Overview of inventory planning

The GHG inventory preparation is based on a clear internal plan defining specific activities to be annually performed and the associated deadlines.

1.2.3. Overview of inventory preparation and management, including for supplementary information required under Article 7, paragraph 1, of the Kyoto Protocol

NEPA has also the obligation of the preparation and management of the GHGI; in this sense, the Governmental Decision no. 1570/2007 and the subsequent relevant procedures supports NEPA by defining a legal, institutional and procedural framework to involve actively all the relevant responsible public authorities, different research institutes, economic operators, and professional associations.

The procedures subsequent to the Governmental Decision no. 1570/2007 comprise:

- Ministry of Environment Order no. 1376/2008 for approving the Procedure on NGHGI reporting and the modality for answering to the observations and questions raised following the NGHGI review;
- Ministry of Environment Order no. 1474/2008 for approving the Procedure on processing, archiving and storage of data specific to the NGHGI;
- NEPA's President Decision no. 23/2009 for approving the Procedure on selection of the estimation methods and of the emission factors needed for the estimation of the GHG levels;
- NEPA's President Decision no. 24/2009 for approving the QA/QC Procedure related to the NGHGI.

Central public authorities and the institutions under their authority, in their coordination or subordination, different research institutes, and the economic operators have the responsibility for submitting activity data needed for the GHG emissions/removals calculation.

The main activity data supplier is the National Institute for Statistics (NIS) through the yearly-published documents like the National Statistical Yearbook and the Energy Balance.

Based on contract number 46/23 may 2011 with MEF, in 2011 the Forest Research and Management Planning Institute is administrating the NGHGI LULUCF Sector both under the UNFCCC and the KP; the main activities implemented comprise also:

- preparation of the LULUCF emissions/removals estimates according also with the provisions in the IPCC GPG 2003; consequently, the completion of databases and associated CRF Tables and elaboration of NIR;
- implementing the QC activities;
- documenting associated to the NGHGI LULUCF Sector;
- representing Romania during the annual review coordinated by the UNFCCC Secretariat.

The Ministry of Environment and Forests submits officially the national GHGI to the UNFCCC Secretariat, the European Commission and the European Environment Agency taking into account the specific deadlines.

1.3. Inventory preparation

1.3.1. GHG inventory and KP-LULUCF inventory

The present NIR was compiled according to the recommendations for inventories set out in the Annotated outline of the National Inventory Report including reporting elements under the Kyoto Protocol and includes detailed information on the inventories for all years from the base year to the year 2009, in order to ensure the transparency of the inventory. The emissions are estimated using the Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories (IPCC 1996), as well as the IPCC Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories (IPCC GPG 2000) and IPCC Good Practice Guidance for Land Use, Land-Use Change and Forestry (IPCC GPG 2003).

According to the Governmental Decision no. 1570/2007 establishing the National System for the estimation of the GHG emissions levels from sources and removals by sinks, the implementation of the National System ensures the NGHGI quality in three phases:

- planning;
- preparation and
- management of the NGHGI preparation activities.

1.3.2. Data collection, processing and storage, including for KP-LULUCF inventory

Data collection

Data collection process comprises the following steps:

- identification of data requirements;
- identification of potential data suppliers;
- preparation of specific questionnaires;
- submitting the questionnaires to the potential suppliers of data;
- data collection;
- data verification: activity data received are examined (time series discrepancies, large changes in values from the previous to the current inventory year).

Data processing and emissions/removals calculation

Data processing is done according to the provisions in the Ministry of Environment Order no. 1474/2008 for approving the Procedure on processing, archiving and storage of data specific to the NGHGI. Methods and emission factors selection is done according to the provisions in the NEPA's President Decision no. 23/2009 for approving the Procedure on selection of the estimation methods and of the emission factors needed for the estimation of the GHG levels.

Activities are carried out at NEPA and at ICAS, in respect to the LULUCF Sector, and comprise:

- primary data processing:
    - check the completeness of all data and information for all years and categories within the analyzed period;
    - complete the datasets, using also default IPCC interpolation/extrapolation and/or alternative techniques;
    - check the accuracy and consistency of datasets;
    - values transformation in order to reach the measurement unit adequate within the

method used;
  - data aggregation/disaggregation considering the IPCC classification;
  - calculation and/or adjustment of different parameters considering the available data.
- selection of the emission factors and of the methods;
- application of methods;
- emissions/removals estimates, using the most recent data;
- internal review (errors are rectified);
- preparation of the national inventory report.

Data archive

Data archiving is done according to the provisions of the Ministry of Environment Order no. 1474/2008 for approving the Procedure on processing, archiving and storage of data specific to the NGHGI.

NEPA team manages and maintains the NGHGI database and the documentation of specific inventory information. According to the provisions in IPCC GPG 2000, the NGHGI documentation includes:

- assumptions and criteria for selection of AD and EF;
- EF used, including references to the IPCC documents for default factors or to published references or other documentation for emission factors used in higher tier methods;
- AD or sufficient information to enable activity data to be traced to the referenced source;
- information on the uncertainty associated with AD and EF;
- rationale for choice of methods;
- methods used, including those used to estimate uncertainty;
- changes in data inputs or methods from previous years;
- identification of individuals providing expert judgment for uncertainty estimates and their qualifications to do so;

- details of electronic databases or software used in production of the inventory, including versions, operating manuals, hardware requirements and any other information required to enable their later use;
- worksheets and interim calculations for category estimates and aggregated estimates and any recalculations of previous estimates;
- final inventory report and any analysis of trends from previous years;
- QA/QC plans and outcomes of QA/QC procedures.

All inventory information, as far as needed to reconstruct and interpret inventory data and to describe the national system and its functions, is accessible at a single location at the NEPA's headquarters in Bucharest. While all information officially submitted according to the requirements of the Kyoto Protocol is translated into English, this may not be possible for background information made available during the review process as the official inventory documentation language is Romanian.

Specific NGHGI data are archived as follows:

- electronically – all available documents;
- on paper – the documents used for the NGHGI preparation unavailable in electronic format and the correspondence with different organizations.

In order to ensure the security of databases and the confidentiality of the background data, both paper and electronical data are kept under strict access conditions. Furthermore, electronic data backup activities are undertaken on NEPA's server with daily frequency during the generation of the official submission and weekly in rest of cases.

Considering the provisions of relevant regulations, NEPA designated the manager of the archiving system.

1.3.3. QA/QC procedures and extensive review of GHG inventory and KP-LULUCF inventory

Romania established the QA/QC Procedure based on the UNFCCC and Kyoto Protocol's provisions related to the GHG inventory and the national system, the IPCC 1996 and IPCC GPG 2000 provisions, and to the Governmental Decision no. 1570/2007 establishing the National System for the estimation of the anthropogenic GHG emissions levels from sources and removals by sinks. QA/QC activities are both described within the QA/QC Programme and within the QA/QC Procedure related to the NGHGI, approved by the NEPA's President Decision no. 24/2009.

1.4. Brief general description of methodologies and data sources used

1.4.1. GHG inventory

The emissions are estimated using the Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories (IPCC 1996), as well as the IPCC Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories (IPCC GPG 2000).

Emissions/removals by sinks in LULUCF sector are estimated using IPCC Good Practice Guidance for Land Use, Land-Use Change and Forestry (IPCC GPG 2003).

The following table presents the main data sources used for activity data:

Sector	**Data sources**
Energy	• National Institute for Statistics - Energy Balance and other additional data • Energy producers through 42 Local/Regional Environmental Protection Agencies • Ministry of Economy • Romanian Civil Aviation Authority • Transgaz SA
Industrial Processes	• National Institute for Statistics- Statistical Yearbook and other additional data • Industrial operators through through 42 Local/Regional Environmental Protection Agencies • Direct information from industrial operators
Solvent and other product use	• National Institute for Statistics • Industrial operators through 42 Local/Regional Environmental Protection Agencies
Agriculture	• National Institute for Statistics
LULUCF	• National Institute for Statistics through Statistical Yearbook • Ministry of Agriculture, Forests and Rural Development (MADR)-Forests General Directorate (2007-2008); Ministry of Environment and Forests-Forests General Directorate (2009) • National Forest Administration (RNP) • ICAS
Waste	• National Institute for Statistics • National Environmental Protection Agency • Public Health Institute • National Administration “Romanian Waters” • Food and Agriculture Organization • Landfill operators through 42 Local/Regional Environmental Protection Agencies

The sources of the emission factors/increment rates used are: IPCC 1996, IPCC GPG 2000, IPCC GPG 2003, national research institutes and plants, in a very limited number. The methods used to estimate emissions/removals and the sources of EF are described in Summary 3 of CRF Tables (mostly Tier 1, Tier 2 for some industrial processes and CORINAIR methodology in case of solvent and other product use).

1.4.2. KP-LULUCF activities

The data relevant to the KP LULUCF activities are presented within the Chapter 11.

1.5. Brief description of key categories, including KP-LULUCF key categories

1.5.1. GHG inventory

The key category analysis has been performed according to the provisions of Chapter 7 of IPCC GPG 2000 and Chapter 5 of IPCC GPG 2003.

Separate key category analysis were conducted taking into account both the exclusion and inclusion of the LULUCF sector and also both level and trend criteria; all IPCC sectors and categories, sources and sinks (as suggested in Table 7.1 of IPCC GPG 2000 and in Table 5.4.1 of IPCC GPG 2003), and gases were analyzed. The key category analysis followed a Tier 1 approach.

Taking into account the exclusion of the LULUCF sector, in 2009:

- 18 categories are considered as key ones both by level and trend;
- 5 categories are considered as key ones, only by level;
- 8 categories are considered as key ones, only by trend

Taking into account the inclusion of the LULUCF sector, in 2009:

- 18 categories are considered as key ones, both by level and trend;
- 6 categories are considered as key ones, only by level;
- 10 categories are considered as key ones, only by trend

The most important key categories in 2009 are:

- CO_2 from Energy Industries - solid fuels;
- CO_2 from Forest Land remaining Forest Land;
- CO_2 from Road transport;
- Direct N_2O emissions from Agricultural Soils;

- CO_2 from Energy Industries - gaseous fuels;
- CH_4 from Fugitive emissions-oil and natural gas.

The results of the key category analysis for 1989 and 2009 are presented in the Annex 1 using the template provided by Tables 7A1-7A3 of IPCC GPG 2000 and by Tables 5.4.5, 5.4.7 and 5.4.8 of IPCC GPG 2003.

1.5.2. KP-LULUCF activities

The data relevant to the KP LULUCF activities are presented within Annex 1 and Chapter 11.

1.6. Information on the QA/QC plan including verification and treatment of confidentiality issues

1.6.1. QA/QC procedures

The QA/QC Programme and the QA/QC Procedure comprise information on:

- the national authority responsible for the coordination of QA/QC activities;
- the objectives envisaged within the QA/QC framework;
- the QA/QC Plan;
- the QC procedures;
- the QA procedures.

According to the provisions of the Governmental Decision no. 1570/2007 establishing the national system and to those in the NEPA’s President Decision no. 24/2009, NEPA represents the competent authority responsible with the implementation of the QA/QC activities under the NGHGI; additionally, ICAS has the responsibility of implementing QC activities associated to the LULUCF Sector. For this purpose, NEPA is performing the following activities:

- ensures that specific QA/QC objectives are established;
- develops and regularly updates a QA/QC plan;
- implements the QA/QC procedures.

Considering the provisions of relevant regulations, NEPA designated a QA/QC coordinator.

The overall objective of the QA/QC programme is to develop the NGHGI in line with the requirements of the IPCC 1996, IPCC GPG 2000 and IPCC GPG 2003 and with the provisions of the Decision 280/2004/EC of the European Parliament and of the Council and Decision 166/2005/EC of the European Commission.

Romania's QA/QC plan closely follows the definitions, guidelines and processes presented in Chapter 8 – Quality Assurance and Quality Control of the IPCC GPG 2000. The QA/QC plan constitutes the heart of the QA/QC procedures. It outlines the current and planned QA/QC activities. The specific QA/QC activities are performed during all stages of the inventory preparation.

The QA/QC plan is reviewed periodically, if needed, and can be modified as appropriate when changes in processes occur or based on the advice from independent reviewers.

The QA/QC plan is intended to ensure the fulfillment of the NGHGI principles in Romania. The objectives of the plan include:

- applying greater QC effort for key categories and for those categories where data and methodological changes have occurred recently;
- periodically checking the validity of all information as changes in reporting, methods of collection or frequency of data collection occur;
- conducting the general procedures outlined in QC procedures (Tier 1) on all parts of the inventory over a complete exercise;
- balancing efforts between development and implementation of QA/QC procedures and continuous improvement of inventory estimates;
- customizing the QC procedures to the resources available and the particular characteristics of Romania's greenhouse gas inventory;

- confirming that the national statistical institute and other agencies supplying activity data to NEPA have implemented QC procedures.

QC activities

The following QC activities are conducted annually before and during the preparation of estimates (15 September-30 October):

- checking the specific requirements regarding the reporting deadlines;
- verification of the collection of data against the information needed;
- checking the correct transcription of input data from the format they were provided into the calculation sheets;
- checking the correctness of conversion factors to be used in calculation;
- checking the data structures integrity and the desaggregation of activity data at calculation sheets level;
- checking the concordance between the measurement units of data in the calculation sheets and the equivalent data in the CRF Reporter format;
- checking the consistency and the data values magnitude order used in the AD and EF series, at the calculation sheets level;
- identifying parameters common to multiple source or sink categories and checking the values consistency between source or sink categories;
- checking the emissions/removals calculation into the calculation sheets by reproducing a representative sample calculation;
- checking the correctness of the aggregation of estimated emissions/removals at the calculation sheets level.

The following QC activities are conducted annually during and after the preparation of estimates (15 October -10 January-10 March):

- checking the emissions/removals estimates existence for all sources and sinks and for the entire time series;

- checking the explanations existence when the emissions/removals estimates are lacking;
- checking the correctness and consistency of choosing the AD, EF and methods used along the entire time series;
- checking the trends for identifying the outliers and re-analyze the values;
- checking the correctness of recalculations and the existence of explanations;
- checking the recording and archiving of AD, EF and methods used;
- checking the correctness and the completeness of the data transcription from the calculation sheets level to the CRF Reporter level;
- checking the correctness and the completeness of the data transcription from the CRF Reporter level to the CRF tables level;
- checking the data used in the NIR against the CRF tables and calculation sheets;
- checking the correctness of applied methods descriptions, at the NIR’s level;
- checking the references completeness at the NIR’s level;
- checking the archiving of the CRF tables, NIR, CRF Reporter’s specific databases and the calculation sheets;
- checking the key categories persistency along the time series;
- checking the adequate qualification of individuals providing expert judgments on the uncertainty estimates and the archiving of documentation regarding the qualification and the expert judgments;
- checking the uncertainty calculation correctness by partially replying the Monte Carlo analysis;
- verification of the ERT recommendations implementation;
- checking the completeness of the QA/QC documentation archiving: QA/QC programme, checklists, ERT report, improvements lists;
- checking the QA/QC programme performance and propose improvements.

The results of all checks outlined above are documented in the annual QC checklists for inventory preparation. For this purpose QC checklists are used consistently throughout the years by all experts involved in the inventory preparation.

QA activities

By becoming an European Union Member State from the 1st of January 2007, Romania is obliged to prepare and submit the NGHGI according to the Decision 280/2004/EC of the European Parliament and of the Council and Decision 166/2005/EC of the European Commission, which provides for a QA activity after the first submission of data on 15th of January and a final QA for all 27 EU Member States during first half of March, for the preparation of the EC inventory. In this respect, starting with 2007, Romania has the possibility to verify the inventory twice before the official submission to the UNFCCC Secretariat.

In order to get an objective assessment of the inventory quality and for identifying areas where improvements can be made, NEPA involve third party reviewers at the QA activities level according to the provisions in IPCC-GPG, depending on the availability of resources. In this scope, NEPA is developing the specific procedural arrangements. MEF through its international contacts and bilateral agreements supports NEPA in identifying the available processes for ensuring the implementation of QA activities.

Until now, NEPA was the beneficiary of technical support provided by the Austrian Environment Agency (as part of the twinning project RO/2006/IB/EN/09). One of the most important activity performed within this framework was the review of different sectors of the NGHGI. Austrian experts provided specific recommendations comprising:

- improvement of transparency at sectorial level considering the trend and recalculations description;
- improvement of transparency at sectorial level by providing a cumulative table on the status of emissions/removals estimation for every sub-sector;
- improvement on knowledge on practical ways of performing and documenting the QA/QC activities;
- improvement of the NGHGI archiving structure.

Until first half of 2011, NGHGI team is the beneficiary of a Netherlands Government to Government (G2G) project. One of its main aims is to develop the reporting capacity of the

NGHGI team also by assessing the possibility to use higher tier methods. Specific activities comprised

- advices on improving the GHG Inventory sectorial data documentation (through the use of the documentation list);
- training courses/presentations on use of data specific to other reporting mechanisms at the GHG Inventory level:
    - use of ETS data;
    - use of COPERT model.
- discussions/advices on methodological issues (data collection, emissions estimation) on GHG emissions recovery within the Industrial Processes and Waste activities;
- advices on moving to higher Tier levels in the Energy Sector:
    - calculation of specific emission factors;
    - use of COPERT model in estimating the Road Transport emissions.
- advices on using national data for the calculation of natural gas transit fugitive emissions;
- advices on moving on Tier 2 at the Enteric Fermentation, Manure Management and Agricultural Soils levels:
    - precise identification of activity data needs;
    - workshop on elaborating the specific requirements for a emission factors/other parameters study development;
    - other relevant advices.
- advices on moving on First Order Decay method at the Solid Waste Disposal Sites level;
- other advices relevant to the Waste Sector;
- identification of the practical ways to complete the estimation of emissions/removals specific to Kyoto Protocol’s Art. 3.3 and 3.4 activities: afforestation/reforestation/deforestation, forest management and revegetation.

National inventory submissions to the UNFCCC Secretariat are subject to the review procedures defined in the relevant COP/MOP decisions.

All recalculations planned and done (including those following the UNFCCC ERT review) are mentioned in the improvements lists.

The results of QA checks (excepting those of checks performed by ERT) are documented in the annual QA checklists for inventory preparation. For this purpose, QA checklists are used consistently throughout the years by all inventory experts involved in the inventory compilation.

1.6.2. Verification activities

Several verification activities were performed by the NGHGI team, as follows:

- Industrial Processes – comparison of data sets used with data provided by the Ministry of Economy/NIS;
- Agriculture - comparison of data sets used with relevant data on FAO/Eurostat; - Waste – comparison of data sets used with Eurostat data.

All verification activities are described in detail within the sectorial Category-specific QA/QC and verification sections.

1.6.3. Treatment of confidentiality issues

Due to the confidentiality clause assigned to some activity data on Energy and Industrial Processes activities, also in the Statistical Law context, all specific measures have been taken in this sense.

All aspects pertaining to assuring the data confidentiality are described within the Methodological issues sections of the relevant categories.

1.7. General uncertainty evaluation, including data on the overall uncertainty for the inventory totals

1.7.1. GHG inventory

The present NIR comprises a full quantitative assessment of the uncertainty. Romania built the uncertainty analysis in order to help prioritizing efforts to improve the accuracy of the inventory in the future and to guide decisions on methodological choice, and also for providing a complete NGHGI.

Romania carried out the uncertainty analysis on the basis of the Tier 1 method according to the provisions in Chapter 6 of the IPCC GPG 2000, in the Chapter 5 of the IPCC GPG 2003 and also taking into account local conditions.

The uncertainty calculation was performed using the framework provided in the IPCC GPG 2000 and also in the IPCC GPG 2003. The disaggregation of the inventory into categories is equivalent to the key category analysis splitting, except two particular cases specific to the Waste sector.

The uncertainty analysis is presented both at the NIR's Uncertainties and time series consistency sectorial sections and in Annex 7.

1.7.2. KP-LULUCF activities

The data relevant to the KP LULUCF activities are presented within the Chapter 11.

1.8. General assessment of the completeness

1.8.1. GHG inventory

The inventory covers all sectors and all gases in the period 1989-2009 and it is complete in terms of geographical coverage. Emissions are presented by sector, by sub-sector and by gas.

Due to the lack of the activity data, there are still some gaps in the inventory, such as the estimation of emissions from asphalt roofing and road paving with asphalt.

All the sources/sinks not covered and the relevant justifications are presented in the Annex 5.

1.8.2. KP-LULUCF

The data relevant to the KP LULUCF activities are presented within the Chapter 11.

2. TRENDS IN GREENHOUSE GAS EMISSIONS

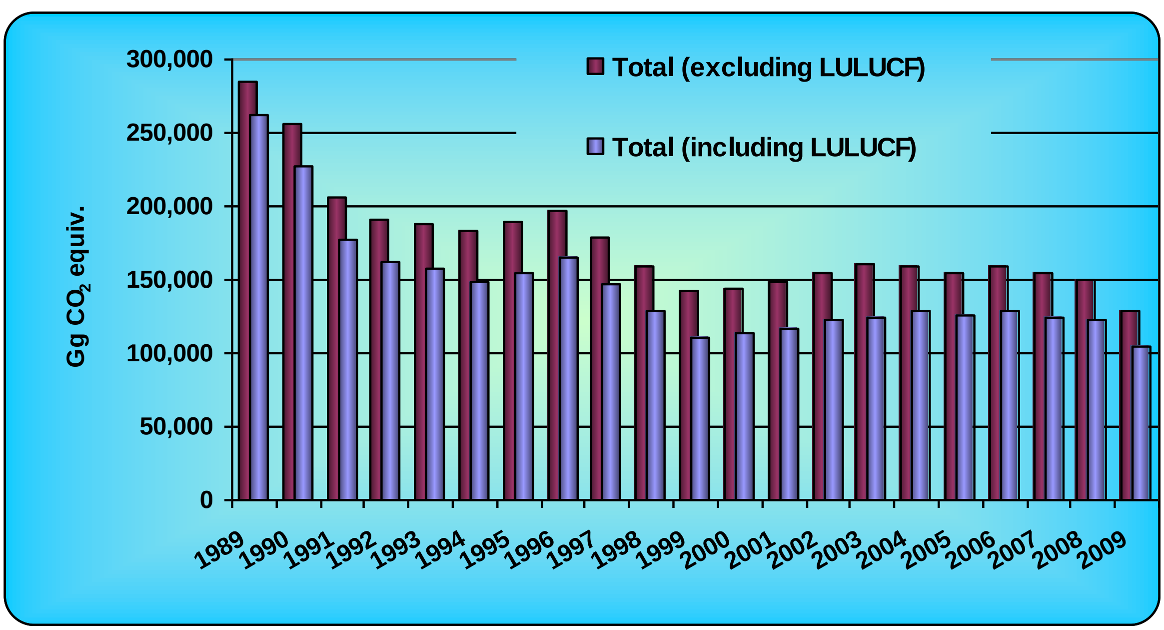
2.1. Description and interpretation of emissions trends for aggregated greenhouse gas emissions

The total GHG emissions in 2009, excluding removals by sinks, amounted to 128,745.91 Gg CO_2 equivalents.

According to the provisions of the Kyoto Protocol, Romania has committed itself to reduce the GHG emissions by 8% in 2008-2012 considering the base year (1989) levels.

The total GHGs emissions (without considering sinks) decreased with 54.74 % in 2009 in comparison to 1989 while the net GHG emissions/removals (taking into account the CO_2 removals) decreased with 60.35%. Based on these observations, there is a great probability for Romania to meet the commitments to reduce the GHG emissions in the first commitment, 2008-2012.

Figure 2.1 Trends of the aggregated GHG emissions



The emissions trend reflects the changes in this period characterized by a process of transition to a market economy. The emissions trend can be split in three parts: the period 1989-1999, the period 1999-2008 and the year 2009. The decline of economic activities and energy consumption in the period 1989-1992 had directly caused the decrease of the total emissions in that period. With the entire economy in transition, some energy intensive industries reduced their activities and this is reflected in the GHG emissions reduction. Emissions have started to increase until 1996, because of the economy revitalization. Considering the starting of the operation of the first reactor at the Cernavoda nuclear power plant (1996), the emissions decreased again in 1997.

The decrease continued until 1999. The increased trend after 1999 reflects the economic development in the period 1999-2008. The limited decrease of GHG emissions in 2005, compared with 2004 and 2006 levels was caused by the record-breaking hydrological year positively influencing the energy produced in hydropower plants. Due to the economic crisis, the emissions have significantly decreased in 2009 comparing with 2008.

2.2. Description and interpretation of emissions trends by gas

All GHG emissions, except HFCs and SF_6, decreased comparing with the base year. The shares of GHG emissions have not significantly changed during the period. The largest contributor to total GHG emissions is CO_2, followed by CH_4 and N_2O. In the base year, the shares of GHG emissions were: 67.94% CO_2, 16.84% CH_4, 14.04% N_2O, 1.18% PFCs. In 2009, the shares of GHG emissions were: 66.94 % CO_2, 18.64 % CH_4, 14.39% N_2O, 0.01 % PFCs. The F gases started to be used as substitutes for ODS in refrigerating and air conditioning systems since 1995. In 2009, the contribution of these gases to the total GHG emissions is negligible: 0.0195 % HFCs and 0.00573 % SF_6. Next table presents the trend of the aggregated emissions, split by gas.

Table 2.3 Trends by gas [Gg CO2 equivalent]

Year	CO_2 including LULUCF	CO_2 excluding LULUCF	CH_4 excluding LULUCF	N_2O excluding LULUCF	HFCs	PFCs	SF_6
1989	171,559.85	193,282.79	47,906.89	47,906.89	NA,NE,NO	3,349.56	NA,NE,NO
1990	148,083.49	176,517.62	44,019.35	44,019.35	NA,NE,NO	2,115.83	NA,NE,NO
1991	108,767.01	136,482.50	38,669.93	38,669.93	NA,NE,NO	1,942.09	NA,NE,NO
1992	100,621.08	129,425.79	35,185.82	35,185.82	NA,NE,NO	1,352.13	NA,NE,NO
1993	97,408.50	128,643.07	33,282.77	33,282.77	NA,NE,NO	1,409.43	NA,NE,NO
1994	91,346.12	125,438.32	32,234.47	32,234.47	NA,NE,NO	1,490.97	NA,NE,NO
1995	95,757.79	130,829.84	33,250.43	33,250.43	0.37	1,773.69	0.06
1996	106,261.77	137,070.79	33,802.49	33,802.49	0.73	1,769.07	0.06
1997	91,945.75	122,708.69	30,074.36	30,074.36	1.22	1,786.59	0.02
1998	78,193.11	108,490.45	27,585.91	27,585.91	2.65	1,753.54	0.01
1999	61,429.33	92,630.75	26,425.49	26,425.49	2.84	1,603.62	0.05
2000	66,776.14	96,757.31	27,031.61	27,031.61	3.41	1,292.37	0.00
2001	69,234.12	101,076.69	25,826.30	25,826.30	3.53	1,044.49	0.00
2002	75,292.81	107,367.18	26,441.49	26,441.49	4.22	717.86	0.01
2003	76,087.94	112,427.31	27,421.91	27,421.91	6.41	261.51	17.83
2004	82,384.62	111,485.14	26,881.19	26,881.19	8.93	132.60	22.64
2005	77,077.89	106,224.64	26,834.74	26,834.74	6.62	81.90	49.56
2006	81,579.52	111,483.78	26,612.11	26,612.11	22.61	55.03	67.76
2007	79,930.93	110,231.36	25,699.12	25,699.12	17.66	24.23	58.39
2008	76,609.51	103,505.85	25,657.58	25,657.58	20.52	15.34	16.33
2009	61,587.81	86,179.99	23,994.84	23,994.84	25.12	7.00	7.38

Carbon dioxide (CO_2) – the most significant anthropogenic greenhouse gas is the carbon dioxide. The decrease of CO_2 emissions (from 193282.7856 Gg in 1989 to 86,179.99 Gg in 2009) is caused by the decline of the amount of fossil fuels burnt in the energy sector (especially in the public electricity and heat production, and manufacturing industries and constructions sectors) as a consequence of activity decline.

Methane (CH_4) – the methane emissions, related mainly to the Fugitive emissions from fossil fuels extraction and distribution and to the livestock, decreased in 2009 by 49.91% compared with the levels in 1989. The decrease of CH_4 emissions in Agriculture is due to the decrease of the livestock level.

Nitrous oxide (N_2O) – the N_2O emissions are mainly generated within the Agricultural Soils activities in the Agriculture sector and within the Chemical industry activities in the

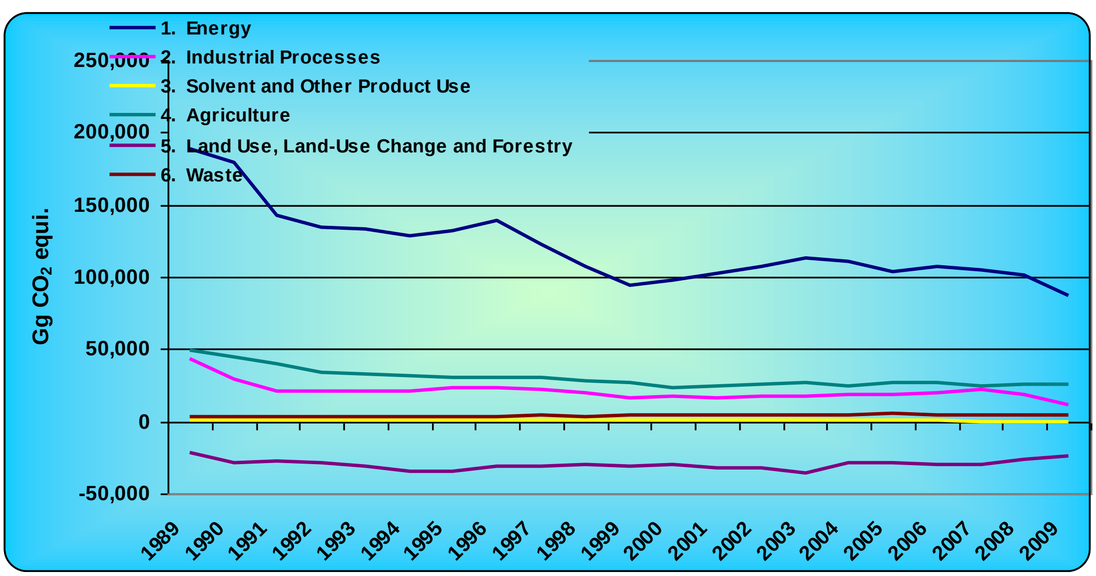
Industrial Processes sector. The decline of these activities (decline of livestock, decline of N synthetic fertilizer applied on soils amounts, decrease of the crop productions level) is reflected in the N_2O emissions trend. The N_2O emissions in 2009 decreased with 53.60 % in comparison with the level in the base year.

Fluorocarbons and SF_6 (HFCs, PFCs, SF_6) – the F-gases started to be used as substitutes for ODS in refrigerating and air conditioning systems since 1995; therefore the emissions resulted as a consequence of the use of these substances and are estimated beginning with the same year. The PFCs emissions generated in the production of the primary aluminium are reported for the entire analyzed period (1989-2009) and have decreased with 99.79% in 2009 comparing with the level in 1989).

2.3. Description and interpretation of emissions trends by category

The figure below shows the GHG emissions trends by each sector. The GHG emissions are expressed in Gg CO_2 equivalent.

Figure 2.2 Trends by sector



Energy represents the most important sector in Romania. The Energy sector accounted for 68.00% of the total national GHG emissions in 2009. The GHG emissions resulted from the Energy sector decreased with 53.54 % compared with the base year.

Industrial Processes contributes to total GHG emissions with 8.82%. A significant decrease of GHG emissions was registered in this sector (73.42% decreases in 2009 compared to the level in 1989) due to the decline or the termination of certain production activities.

Solvent and Other Product Use the trend of emissions resulted from this sector follows the general trend: emissions have decreased seriously after 1989, then the emissions were relatively stable from 1992 to 2002; after 2002, emissions started to increase, and due to the revitalization of the relevant economic activities (automobile manufacture, construction and buildings).

The GHG emissions level decreased in 2009 by 81.06% in comparison with the level recorded in 1989.

Agriculture GHG emissions have also decreased. The GHG emissions in 2009 are 49.34 % lower in comparison with the 1989 emissions due to:

- the decline of livestock;
- the decrease of rice cultivated area;
- the decrease of crop productions level;
- the decline of N synthetic fertilizer applied amounts.

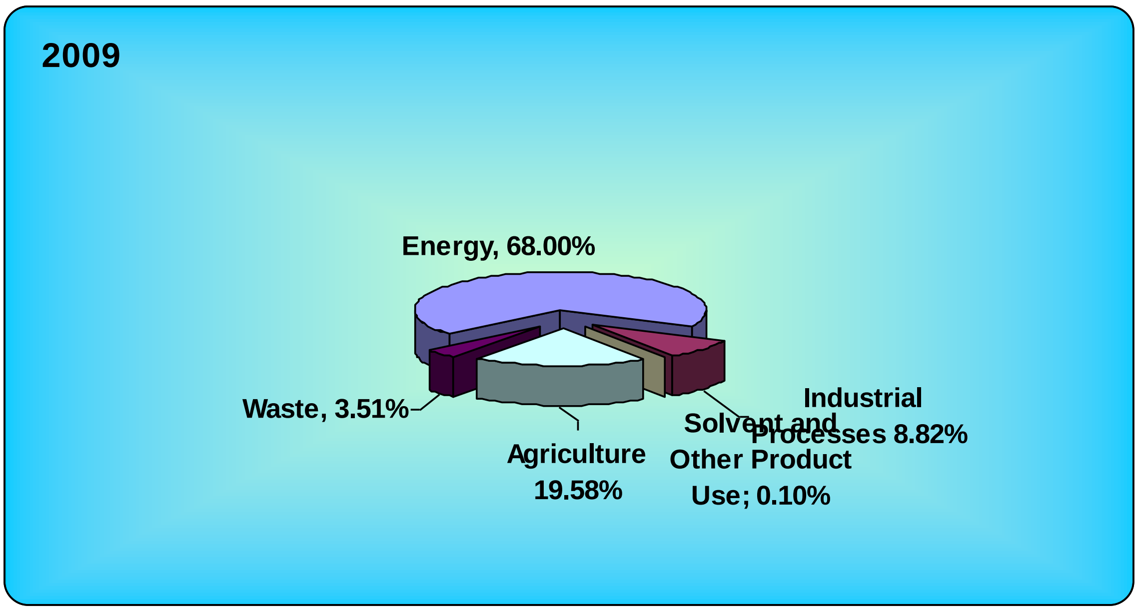
In 2009, 19.58 % of the total GHG emissions resulted from the agriculture sector.

LULUCF The net GHG removals/emissions level is 13.10% higher in 2009 in comparison with the level in the base year. The Romanian land use sector acts as a net sink, at an average uptake of 24,487.46 Gg/year, being relatively stable over the last 21 years.

Waste sector emissions have increased in 2009 with 54.62% in comparison with the level in 1989. The contribution of the waste sector to the total GHG emissions in 2009 is 3.51 %.

The participation of sectors to GHG emissions (excluding LULUCF) is presented in the next figure.

Figure 2.3 Sectoral GHG emissions in 2009 [%]



2.4. Description and interpretation of emissions trends for indirect greenhouse gases and SO_2

The trends of the indirect GHGs are similar with the GHGs trends (Table 2.2), except for CO emissions, which strongly increased staring with 1995, due to the raise of the amount of the firewood used in households.

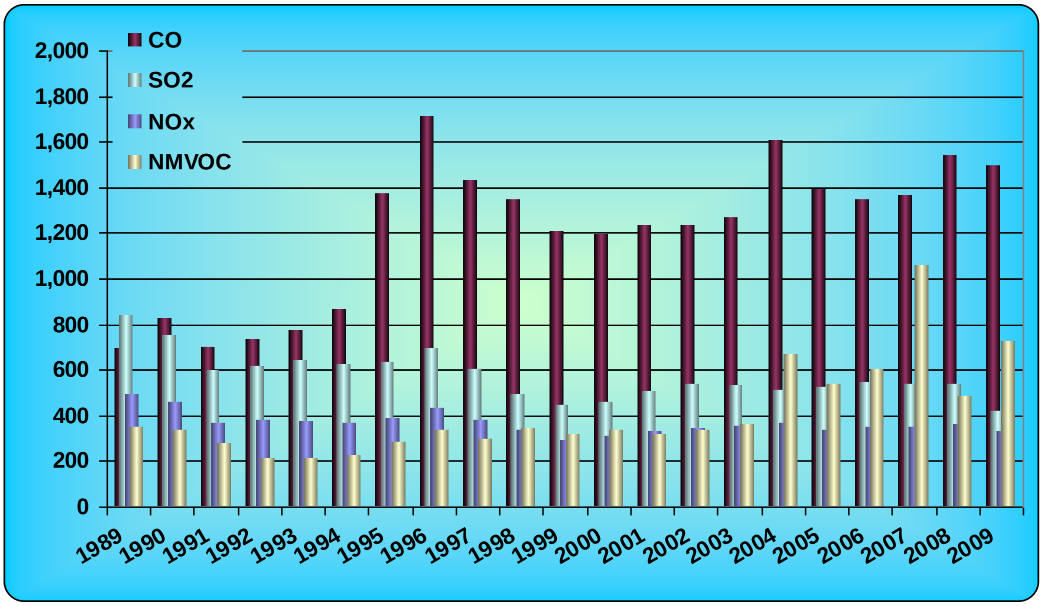
The NO_x, NMVOC and SO_2 emissions evolution follows the general direct GHG emissions trend. The SO_2 emissions decrease is caused by the decline of the fuels burnt for energy and the decrease of sulphur content in fuels.

The indirect GHG emissions trends are presented in Figure 2.4.

Table 2.4 Indirect GHG emissions levels [Gg]

Year	**NO_x**	**CO**	**NMVOC**	**SO_2**
1989	490.53	692.04	344.94	833.46
1990	459.28	824.42	335.34	754.58
1991	366.70	701.29	276.08	597.98
1992	376.28	732.12	207.06	611.71
1993	373.26	770.17	209.76	642.48
1994	367.76	861.91	221.96	619.18
1995	386.17	1370.43	280.53	635.97
1996	429.21	1715.39	335.01	695.35
1997	376.13	1434.57	292.99	603.31
1998	335.76	1343.61	341.73	492.08
1999	289.37	1208.67	314.03	445.62
2000	304.21	1195.63	336.00	456.72
2001	327.61	1237.75	316.14	504.73
2002	341.74	1233.01	331.85	538.56
2003	352.71	1268.84	362.72	530.16
2004	367.02	1610.33	665.13	512.15
2005	332.05	1389.78	538.79	522.07
2006	343.94	1345.03	601.21	542.07
2007	348.14	1364.66	1055.97	537.17
2008	358.71	1542.40	481.44	535.07
2009	324.31	1496.71	724.28	420.80

Figure 2. 4 Indirect GHG emissions trends [Gg]



2.5. Description and interpretation of emissions trends for KP-LULUCF inventory in aggregate and by activity, and by gas

The data relevant to the KP LULUCF activities are presented within the Chapter 11.

3. ENERGY (CRF sector 1)

3.1. Overview of the sector

The emissions of the GHG Inventory - Energy sector are represented by two activity categories:

- Combustion activities (CRF Category 1.A);
- Fugitive emissions from fuels (CRF Category 1.B).

Following the IPCC classification, the combustion processes are divided into the following sub-sectors:

- A.1 energy industries;
- A.2 manufacturing industries and construction;
- A.3 transport;
- A.4 other sectors (commercial/ institutional, residential, agriculture/ forestry/ fisheries).

The fugitive emissions from fuels are generated by the following categories:

- 1. B.1 Solid fuels;
- 1. B.2 Oil and natural gas.

Compared to the other GHG emissions sectors (Industry, Agriculture, LULUCF, Waste), the Energy sector represents the largest source of anthropogenic GHG emissions in Romania. In 2009, the Energy sector was responsible for about 92.09% of the total GHG emissions (87,542.28 Gg CO_2 equivalents).

In 2009, the energy resources (primary energy produced, energy imported and 31 December 2008 stock) and the final energy consumption registered a decrease compared to 2008, with -11.3% and, respectively, -10.5%. The decrease in the energy resources was due to the decreased production of primary energy, by 31.2%. Final energy consumption remained relatively constant in transport (+27.5%) and decreased mainly in the tertiary sector and industry (-27.5%) (Extracts from the Energy Balance for 2009).

Figure 3.1 Variation of GHG emissions compared to 2009

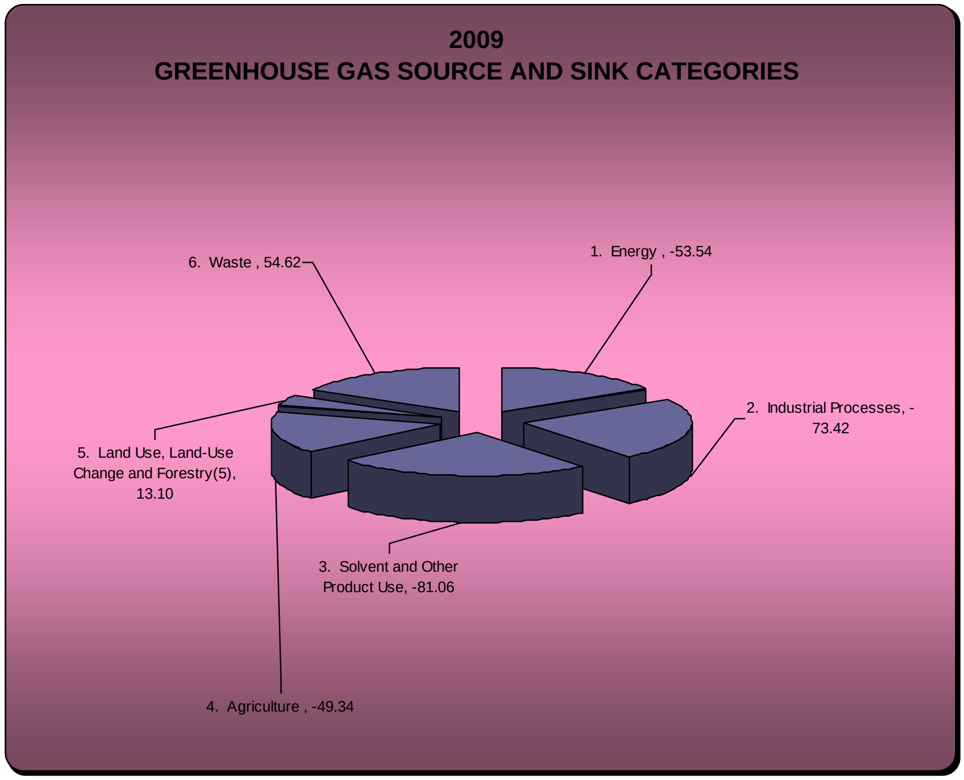


Table 3.1 Status of emissions estimation within the Energy Sector for 2009

IPCC category-Energy Sector	Emissions estimation status		
	CO_2	CH_4	N_2O
1AA Fuel Combustion – Sectoral Approach			
1A1 Energy Industries	✓	✓	✓
1A2 Manufacturing Industries and Construction	✓	✓	✓
1A3 Transport			
1A3a Civil Aviation	✓	✓	✓
1A3b Road Transportation	✓	✓	✓
1A3c Railways	✓	✓	✓
1A3d Navigation	✓	✓	✓
1A3e Other Transportation - pipeline	✓	NO	NO
1A4 Other Sectors			
1A4a Commercial/institutional	✓	✓	✓
1A4b Residential	✓	✓	✓
1A4c Agriculture/Forestry/Fisheries	✓	✓	✓

IPCC category-Energy Sector	Emissions estimation status		
	CO_2	CH_4	N_2O
1B Fugitive Emissions from Fuels			
1B1 Solid Fuels			
1B1a Coal Mining and Handling	NE	✓	NE
1B1b Solid Fuel Transformation	NE	NE	NE
1B1c Other	NA	NA	NA
1B2 Oil and Natural Gas			
1B2a Oil	NO,NE	✓	NE
1B2b Natural Gas	✓	✓	
1B2c Venting and Flaring	NE	✓	NE
1B2b Other	NA	NA	NA
1C Memo items			
1C1 International Bunkers			
1C1a Aviation	✓	✓	✓
1C1b Marine	✓	✓	✓
1C2 Multilateral Operations	NE	NE	NE
1C3 CO_2 Emissions from Biomass	✓		
1AB Fuel Combustion – Reference Approach	✓		

Within the Energy sector, the GHG emissions are generated as presented in the next table.

Table 3.2 Shares of GHG emission categories within the Energy sector, in 2009

Energy sector-categories	Percentages for 2009
Energy industries	39.09%
Manufacturing Industries and Construction	12.57%
Commercial/ institutional	3.13%
Residential	20.82%
Agriculture/ Forestry/ Fisheries	0.90%
Fugitive emissions - solid fuels	2.41%
Fugitive emissions - oil and natural gas	6.93%
Transports	14.15%

The most important GHG in the sector is CO_2. Small amounts of CH_4 and N_2O are also emitted in the Energy sector.

Figure 3.2 The different GHG's contribution to the 2009 Energy emissions

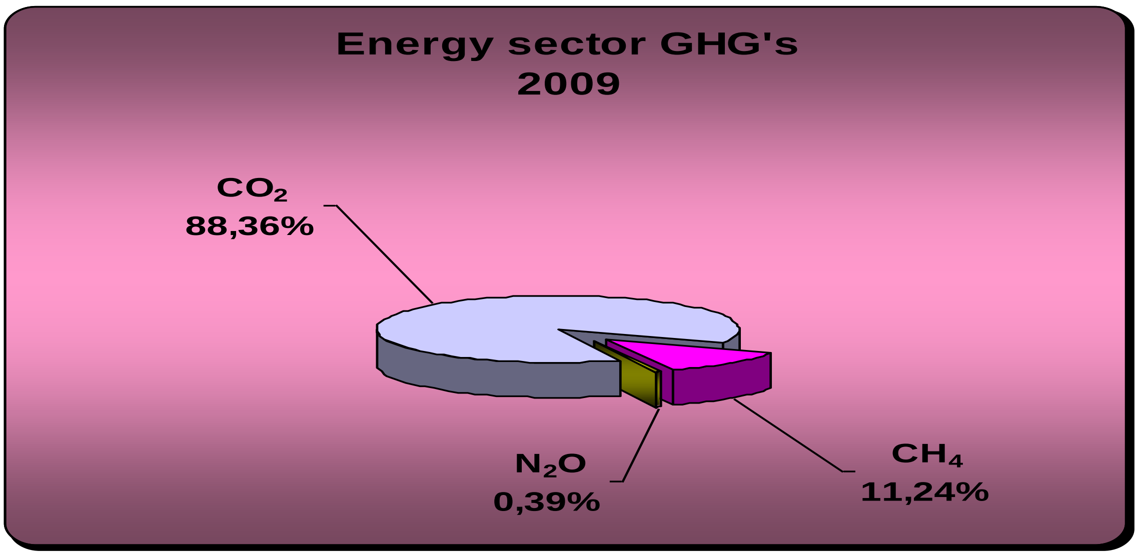
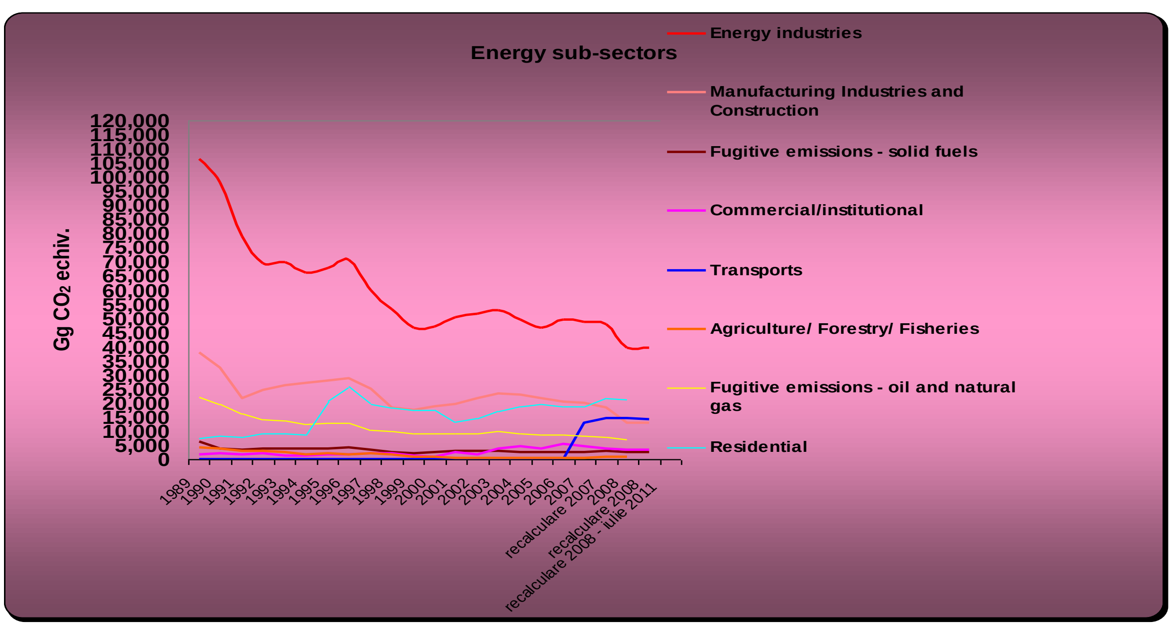


Figure 3.3 The energy sector emission trend for the period 1989-2009



The emissions trend reflects the changes in this period characterized by a process of transition to a market economy.

The emissions trend can be split in two parts: the period 1989-1996 and the period 1996-2004. The decline of economic activities and energy consumption in the period 1989-1992 had directly caused the decline in total emissions in that period. With the entire economy in transition, some energy intensive industries reduced their activities and this is reflected in the GHG emissions reduction.

Emissions have started to increase until 1996, because of economy revitalization. Considering the starting of the operation at the first reactor at the Cernavoda nuclear power plant (1996), the emissions started to decrease again. The decrease continued until 1999. The increased trend after 1999 reflects the economic development in the period 1999-2004.

At the end of 2007, the second unit of the Cernavoda nuclear plant was functioning, therefore the decrease in emission trend is not very noticeable; for 2008 it was noticed a slight tendency of decrease of emissions.

The firewood consumption in households increased in 2008 due to the increase of the inhabitable space in the rural area (according to the Energy Balance).

The decreased fuel consumptions, especially in industry, are due to the decrease of economic activities level in the second semester of 2008.

Available energy resources totaled, in 2009, 43.8 million tons of oil equivalent (tep), decreasing with 5.591 thousands tep (-11.3%) compared to the previous year, due to diminished imports of electricity and heat energy.

In comparison with 2008, the final energy consumption had declined in the industry, including construction, with 27.5%, remaining relatively constant in the transport and population fields.

Also, the GDP is 13.3% lower in 2009 than in the year 2008.

The electricity consumption in 2009 decreased by 9.1% than in the year 2008.

In 2009, the thermoelectric power consumption was reduced by 12% comparing with 2008.

Coal has a share of 55.9% while the hydrocarbons have a share of 15.5% in the fuel consumption for producing thermoelectric power.

Figure 3.4 The trend of the GHG emissions in the Energy sector in the 1989-2009 period (Gg CO_2 equivalent)

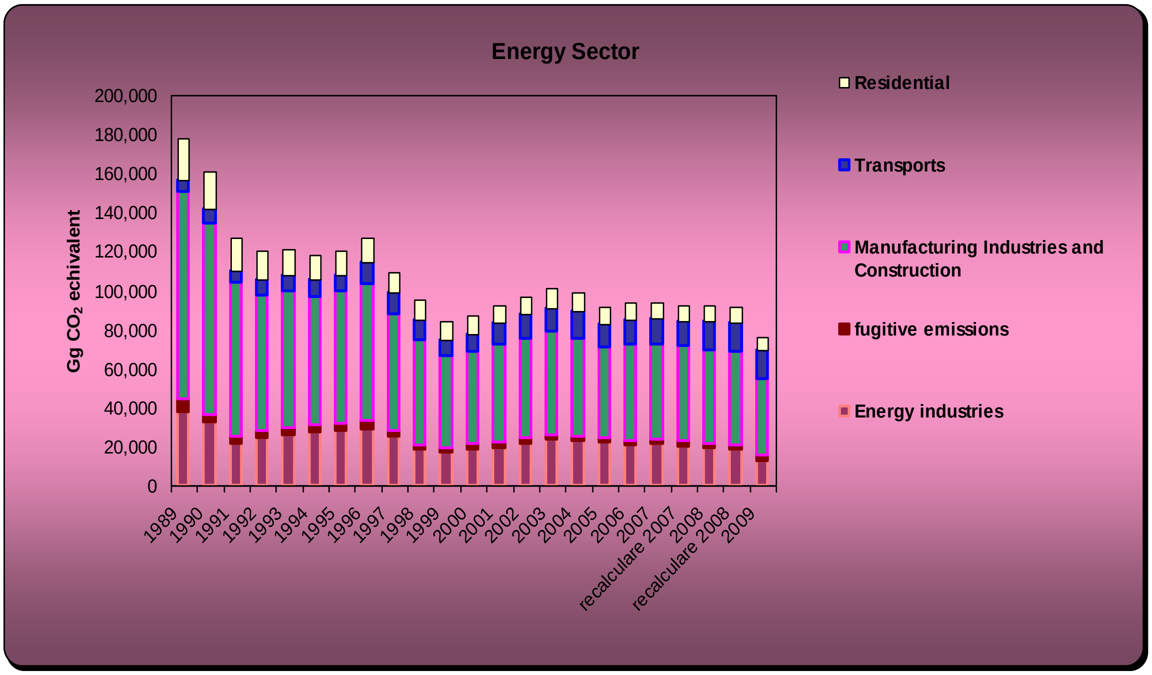


Table 3.3 Contributions to the Energy sector GHG emissions

Energy categories GHG emissions contribution	1989	2009
A.1. Energy industries	55.71%	33.61%
A.2. Manufacturing Industries and Construction	19.72%	10.93%
A.3. Transports	3.04%	12.45%
A.4. Other sectors	6.76%	12.88%
B.1. Fugitive emissions - solid fuels	3.34%	2.08%
B.2. Fugitive emissions - oil and natural gas	11.42%	6.00%

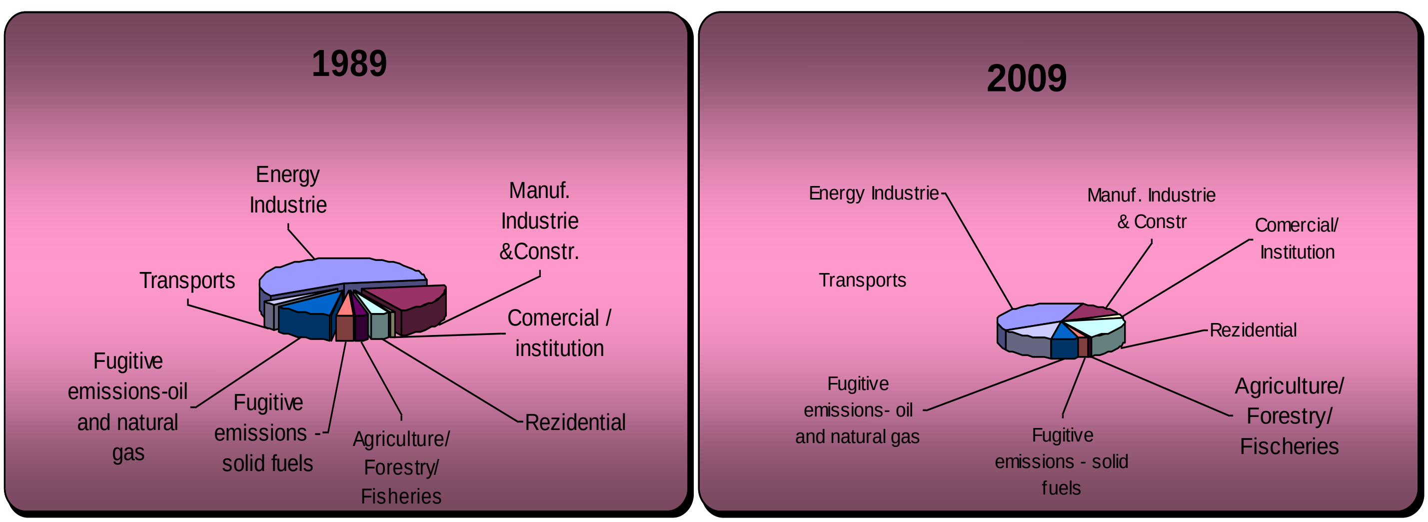
There is a slight decrease of the CO_2 emissions within the Power Industry due to starting of the activity, in late 2007, at the second unit of Cernavoda nuclear power plant and also to the increased energy production from hydropower and wind plats (+7.8% compared to 2007); within the Manufacturing Industry there is a decrease of the CO_2 emissions explained by the reduction of the economic activities level in the second half of 2008.

Within Transport it is noticed an increase in CO_2 emissions due to the change in statistical methodology related to fuels: the amount of fuels consumed by road construction equipment, agricultural equipment or machinery of the transport companies were passed to the transport section (details provided by the INS).

Within the "Other sectors" sub-sector there is an increase of the CO_2 emissions explained by NIS as due to increased consumption of firewood for heating, amount declared by population, the increase being correlated with increasing living space in rural areas (statistical figures are taken from the family budget survey).

In the Energy sector in 2009 compared with 2008 there were decreases of energy consumption in industries sub-sectors (37.1% for metallurgy, 20% for chemical industry and 28.2% for transport) and relatively constant values on household consumption (0.6%).

Figure 3.5 GHG Energy sector emissions by sub-sectors in 1989 and in 2009

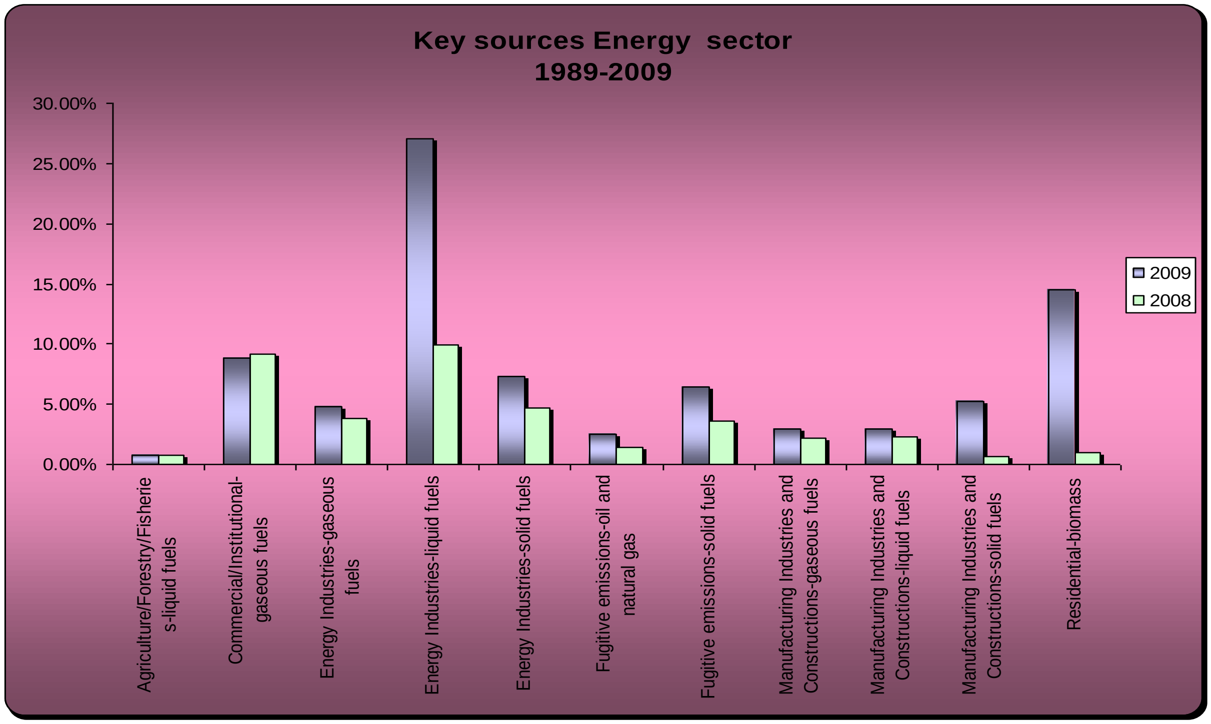


3.1.1. Key sources

Table 3.4 Energy key sources in 2009

Key category	GHG	Criteria (excluding LULUCF)	Contribution of Key categories in total GHG emissions [%]	Criteria (including LULUCF)	Contribution of Key categories in total GHG emissions [%]
Agriculture/Forestry/Fisheries-liquid fuels	CO_2	T	0.56%	T	0.47%
Commercial/Institutional-gaseous fuels	CO_2	L,T	1.69%	L,T	1.41%
Energy Industries-gaseous fuels	CO_2	L,T	6.56%	L,T	5.49%
Energy Industries-liquid fuels	CO_2	L,T	3.60%	L,T	3.01%
Energy Industries-solid fuels	CO_2	L,T	20.27%	L	16.98%
Fugitive emissions-oil and natural gas	CH_4	L,T	6.29%	L,T	5.27%
Fugitive emissions-solid fuels	CH_4	L,T	1.89%	L,T	1.58%
Manufacturing Industries and Constructions-gaseous fuels	CO_2	L,T	4.74%	L,T	3.97%
Manufacturing Industries and Constructions-liquid fuels	CO_2	L,T	2.25%	L,T	1.88%
Manufacturing Industries and Constructions-solid fuels	CO_2	L,T	2.15%	L,T	1.80%
Residential-biomass	CH_4	L,T	0.69%	T	0.58%
Residential-gaseous fuels	CO_2	L,T	3.90%	L,T	3.26%
Residential-solid fuels	CO_2	T	0.04%	T	0.03%
Residential-liquid fuels	CO_2	T	0.65%	T	0.55%
Road transport	CO_2	L,T	11.18%	L,T	7.70%
Road transport	N_2O	T	0.27%	T	0.23%

Figure 3.6 Key sources Energy sector GHG emissions in 1989 and in 2009



3.2. Fuel combustion (CRF 1.A)

3.2.1. Comparison of the sectoral approach with the reference approach

In calculating GHG emissions from the Energy sector, were used two methods indicated in the guidelines:

- Reference Approach;
- Sectoral Approach.

The "Reference Approach" is a top-down method using a national balance (taking into account the non-energy use of fuels), calculated from the following quantities:

- Production;
- Import and export;
- Stock changes.

The “Sectoral Approach” is a more specific method (a bottom-up method), using the fuel consumption for each of the sub-sectors:

- Power and thermal energy production;
- Manufacturing industries and constructions;
- Transports;
- Commercial/institutional;
- Residential;
- Agriculture/forestry/fisheries,

and other subsectors that could emit GHG emissions.

Table 3.5 The differences between CO_2 emissions estimates using RA and SA methods

Differences RA-SA	
Year	**Difference in emissions [%]**
1989	20.70
1990	10.21
1991	17.76
1992	11.39
1993	11.96
1994	10.32
1995	14.77
1996	6.57
1997	8.29
1998	10.14
1999	11.83
2000	9.16
2001	9.46
2002	2.40
2003	4.09
2004	3.66
2005	5.00
2006	8.38
2007	9.33
2008	16.56
2009	9.96

Figure 3.7 The differences between CO_2 emissions estimates using RA and SA methods

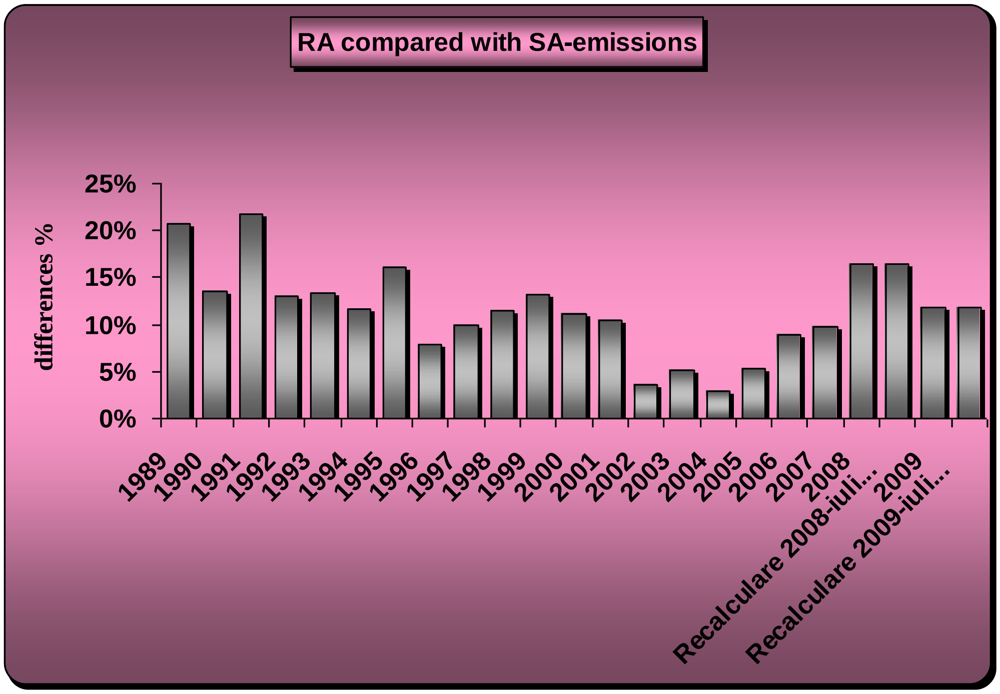


Table 3.6 The difference between CO_2 emissions estimated using RA and using SA in 2009

2009	Liquid fuels	Solid fuels	Gaseous fuels	Total
	[%]			
Differences in fuel consumption	16.25	6.36	3.73	**8.58**
Differences in emissions	19.07	2.49	9.73	**9.96**

A comparison between the Reference Approach (RA) and the Sectoral Approach (RA) indicates differences in both the energy consumption data and CO_2 emissions.

One of the reasons for these differences refers to the fact that the “Reference Approach” deals with the non-energy uses of fuels as if they are combustion activities. A correction is done by the carbon stored from non-energy fuel use, but the information related to this area is limited in the national energy balance. The highest difference is observed in 1989 due to the large amount of non-energy use of fuels. Another reason is probably caused by the high statistical differences reported in the energy balance.

Other reason is the fact that the reference approach does not estimate the fuel delivered for international bunkers consumption. For the sectoral approach, the fuel consumption is divided into domestic and international bunkers (the later not being included in the overall sectoral fuel consumption).

Another explication for the differences between the two approaches is provided in the Energy Balance, in the 60 category "statistical differences", which includes:

- stock variations not recorded statistically;
- energy consumptions for military purposes;
- differences generated by the statistical investigation system (while the energy producers are exhaustive recorded, the consumers are inquired on a sampling base, admitting a margin of error).

3.2.2. International bunker fuels

The methodologies and AD developed in order to disaggregate emissions into domestic and international (for both civil aviation and for navigation transport) are presented in chapter 3.4 Fuel combustion, Transport (CRF sector 1.A.3), sub-chapter 3.4.2.

Methodological issues

In 2008 there were made more regular foreign flights compared to 2007, and fewer domestic scheduled flights, the demand for such flights being very small (possibly due to the very high fuel prices in that period (details provided by the Romanian Civil Aviation Authority); this explains the decrease by 90% of fuel consumption in domestic flights.

In 2009 there was a revival of international flights comparative with 2008, registering an increase of over 70% of fuel consumption in Civil Aviation.

3.2.3. Feedstock and non-energy use of fuels

The Romanian Energy Balance reports aggregated data on non-energy use of fuel, in category 36 (“non-energy”), which includes:

- natural gas and oil products used in chemical substances production;
- natural gas injected in the bedding;
- crude oil for drilling fluids treatment;
- products used for lubricating, washing and insulating.

Therefore, this fuel consumption category of the E.B. was used for estimating non-energy use for natural gas, gas/diesel oil and other oil. For coal oil and tars the assumption suggested in the methodology (6 % from the coking coal consumption is assumed to be stored in products) was applied.

3.2.4. CO_2 capture from flue gases and subsequent CO_2 storage

3.2.5. Country-specific issues

At present, for Romania there were not developed national emission factors, by each fuel type; necessary steps to obtain approval for a study elaboration have been made. Within the Energy Sector national statistical data provided by NIS were used.

3.2.6. Source category - Fuel combustion, energy industry (CRF sector 1.A.1.)

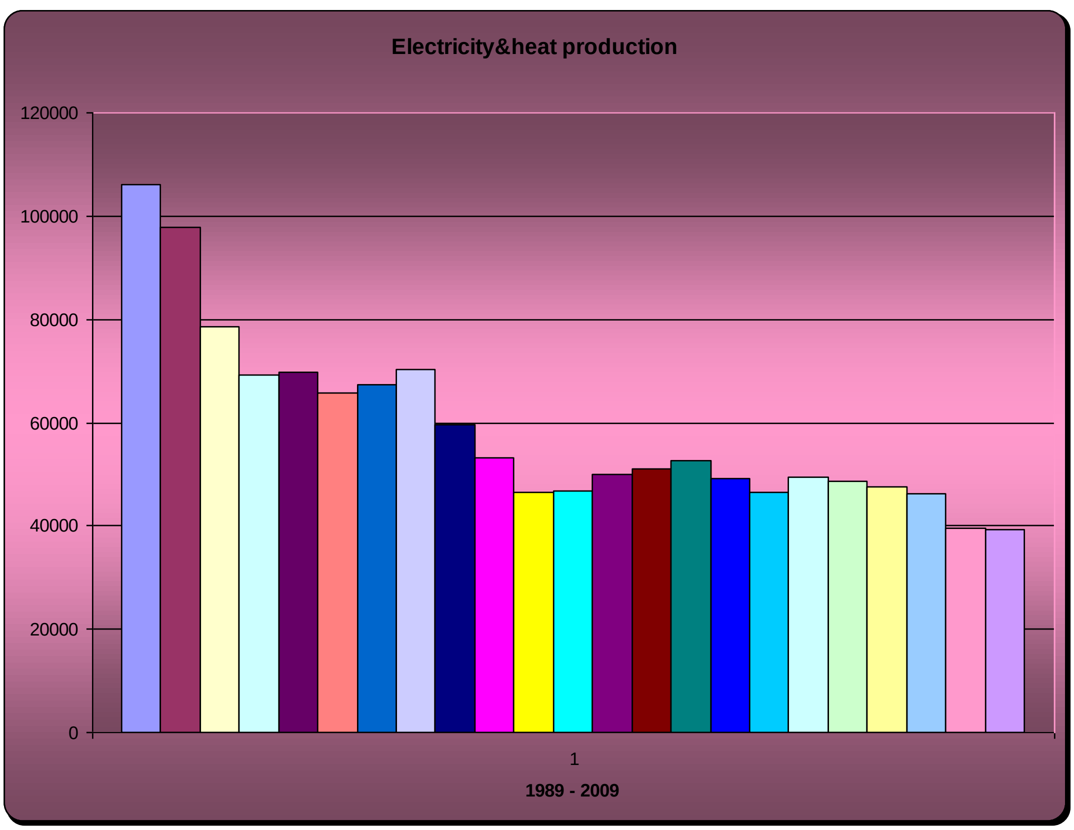
3.2.6.1. Source category description

CO_2 emissions from fuel combustion activities accounted for 39,146.27 Gg CO_2 equivalent in 2009. Within the fuel combustion sector, 45.62% of the CO_2 emissions correspond to 1.A.1 Energy Industry, this sub-sector being the main emitter regarding combustion activities.

The following fuel consumptions are included in this category:

- for conventional thermal power stations and heat plants (public and autoproducers);
- petroleum refining plants;
- solid transformation plants;
- oil and gas extraction and coal mining;
- and the own consumption of the energy sector.

Figure 3.8 The trend of the energy industries



3.2.6.2. Methodological issues

The data regarding fuel consumption are provided through the Energy Balance (E.B.), by the National Institute for Statistics.

The fuel consumption for this category is aggregated from the following Energy Balance categories: “conventional thermal power stations” (cat. 10), “heat plants” (cat. 12) and “consumption of the energy sector” (cat. 28), for the 1992-2009 E.B system.

For the 1989-1991 system, for the energy industries consumption the category “electricity and heat production industry” (chapter 21 of the 1989 E.B.) was used as activity data. Mentioning that for the 1989-1991 system, the consumptions in E.B. are given in t.c.e. (tonnes of coal equivalent), which has been transformed in TJ, using a conversion factor (also provided in the E.B.) of about: $29.3*10^6$ J/kg c.e (29.3 GJ/t.c.e.).

The Energy Balance uses NACE codes; therefore, a disaggregation of fuel consumption according to IPCC source categories was not possible. Thus, the fuel consumptions and the emissions estimates are aggregately reported in sub-sector 1.A.1.a (public electricity and heat production), including also auto producers from the mining, refining, metallurgy, chemicals, car manufacturing and other industries.

The emission factors (EF) used for estimating CH_4, N_2O, NO_x, CO, NMVOC, SO_2 emissions are the default EF indicated in the IPCC methodology and for CO_2: using a calculated emission factor based on reports made by EU ETS operators in three years (2007, 2008 and 2009). EF value for each type of fuel is considered as a specific amount until the completion of the study on the Romanian national emission factors to be finished in late 2011.
Detailed information is available within Annex 8.1.

- for estimating CH_4 emissions: (Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories: Reference Manual) table I-7 (CH_4 default emission factors);
- for N_2O emissions estimates: (Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories: Reference Manual) table I-8 (N_2O default emission factors);
- for estimating NO_x estimates: (Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories: Reference Manual) table I-9 (NO_x default emission factors);

- for estimating CO estimates: (Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories: Reference Manual) table I-10 (CO default emission factors);
- in estimating NMVOC emissions: (Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories: Reference Manual) table I-11 (NMVOC default emission factors)

3.2.6.3. Uncertainties and time-series consistency

The uncertainty was estimated using the key categories ranking:

- Energy Industries-liquid fuels;
- Energy Industries-solid fuels;
- Energy Industries-gaseous fuels;
- Energy Industries-biomass, with combined uncertainty estimates of about: 5.38% (for CO_2 estimates), 20.6% (for CH_4 estimates) and 200% for N_2O emissions estimates.

The uncertainties used in calculating combined uncertainty are:

- activity data uncertainty – based on information from the National Institute for Statistics, declaring that the system used in aggregating statistical data has a sampling error of about 3-5% (for a conservative approach, the later 5% value has been used);
- emission factors (2% for CO_2 emissions, 20% for CH_4, and 200% for N_2O emission estimates) using expert judgment.

The activity data, EF and methodology used in estimating GHG emissions are consistent for the entire period.

3.2.6.4. Source- specific QA/QC and verification, if applicable

All the activities specified/described in the QA/QC program, regarding quality control were undertaken.

The activities were performed by the Romanian Energy sector expert of the GHG Inventory, the results of this activities being mentioned in the Checklists.

Following recommendations made by experts of ERT were made recalculations.

The unconformities noted and solved following these activities are described in the Chapter 3.2.6.5. – Source-specific recalculations, including changes made in response to the review process and at the Chapter 10 - Recalculations and improvements levels; the quantitative effects of their solving are described at the Chapter 3.2.6.5. – Source-specific recalculations, including changes made in response to the review process.

Following the quality assurance activities undertaken, as part of the GHG emissions estimates, there were no recalculations required.

3.2.6.5. Source- specific recalculation,if applicable, including changes made in response to the review process

In order to improve the emissions estimates quality some important recalculations were made:

- activity data
  - 1AA.1.A – gaseous fuels – recalculation of the energy balance occurred after review by the N.I.S. for 2007 and 2008.

  - 1AA1A – liquid fuels , solid fuels and gaseous fuels – recalculation of EF calculated for emissions estimates for CO_2

Table 3.7 Change made at activity data and their effects on emission estimates

Year	Sub-sector	Changes at AD level (TJ)		Effects of changes on emission estimates for CO_2 (Gg)		Differences (%)
		NIR 2010 v.3.2. submissions	**NIR 2011 v.2.1. submissions**	**NIR 2010 v.3.2. submissions**	**NIR 2011 v.2.1. submissions**	
2008	1AA.1.A-Solid fuels	318,314.819	318,314.819	31,285.08	30,039.92	-0.39
	1AA.1.A-Liquid fuels	318,314.819	318,314.819	5,594.02	5,599.73	0.10
	1AA.1.A-Gaseous fuels	318,314.819	318,314.819	10,530.51	10,428.51	-0.97
2009	1AA.1.A-Solid fuels	65,272.55	65,272.55	26,202.08	26,098.68	-0.39
	1AA.1.A-Liquid fuels	65,272.55	65,272.55	4,645.22	4,638.44	-0.14
	1AA.1.A-Gaseous fuels	65,272.55	65,272.55	8,448.30	8,451.20	0.03

Table 3.7 Change made at activity data and their effects on emission estimates (continued)

Year	Sub-sector	Changes at AD level (TJ)		Effects of changes on emission estimates for CH_4 (Gg)		Differences (%)
		NIR 2010 v.3.2. submissions	**NIR 2011 v.1.2. submissions**	**NIR 2010 v.3.2. submissions**	**NIR 2011 v.1.2. submissions**	
2008	1AA.1.A-Gaseous	155,630.29	188,652.95	0.16	0.19	+21.22%
	1AA.1.A-biomass	1,359,55	1,359,55	0.0402	0.0407	+1.2%
2008	1AA.1.A-Gaseous	155,630.29	188,652.95	0.16	0.18	+12.5%

Table 3.7 Change made at activity data and their effects on emission estimates (continued)

Year	Sub-sector	Changes at AD level (TJ)		Effects of changes on emission estimates for CO (Gg)		Differences (%)
		NIR 2010 v.3.2. submissions	NIR 2011 v.1.2. submissions	NIR 2010 v.3.2. submissions	NIR 2011 v.1.2. submissions	
2008	1AA.1.A-Gaseous	155,630.29	188,652.95	3.11	3.77	+21.22%

Table 3.7 Change made at activity data and their effects on emission estimates (continued)

Year	Sub-sector	Changes at AD level (TJ)		Effects of changes on emission estimates for NOx (Gg)		Differences (%)
		NIR 2010 v.3.2. submissions	NIR 2011 v.1.2. submissions	NIR 2010 v.3.2. submissions	NIR 2011 v.1.2. submissions	
2008	1AA.1.A-Gaseous	155,630.29	188,652.95	23.34	28.30	21.25%

Table 3.7 Change made at activity data and their effects on emission estimates (continued)

Year	Sub-sector	Changes at AD level (TJ)		Effects of changes on emission estimates for NMVOC (Gg)		Differences (%)
		NIR 2010 v.3.2. submissions	NIR 2011 v.1.2. submissions	NIR 2010 v.3.2. submissions	NIR 2011 v.1.2. submissions	
2008	1AA.1.A-Gaseous	155,630.29	188,652.95	0.78	0.94	20.51%

Table 3.7 Change made at activity data and their effects on emission estimates (continued)

Year	Sub-sector	Changes at AD level (TJ)		Effects of changes on emission estimates for SO_2 (Gg)		Differences (%)
		NIR 2010 v.3.2. submissions	NIR 2011 v.1.2. submissions	NIR 2010 v.3.2. submissions	NIR 2011 v.1.2. submissions	
2008	1AA.1.A-Gaseous	155,630.29	188,652.95	63.81	77.35	21.22%

3.2.6.6. Source- specific planned improvements, if applicable

We will try to obtain more detailed data, in respect to the IPCC GPG 2000 provisions. Based on the NEPA's analysis of data collected from the operators under the EU-ETS, national emission factors are envisaged to be obtained in 2011 (please see Annex 8.1).

3.2.7. Fuel combustion, Manufacturing Industries and Construction (CRF sector 1.A.2.)

3.2.7.1. Source category description

The subsector Manufacturing Industries and Construction was responsible in 2009 for 12.57 % of the total Energy sector GHG emissions (about 12,697.36 Gg CO_2 equivalents).

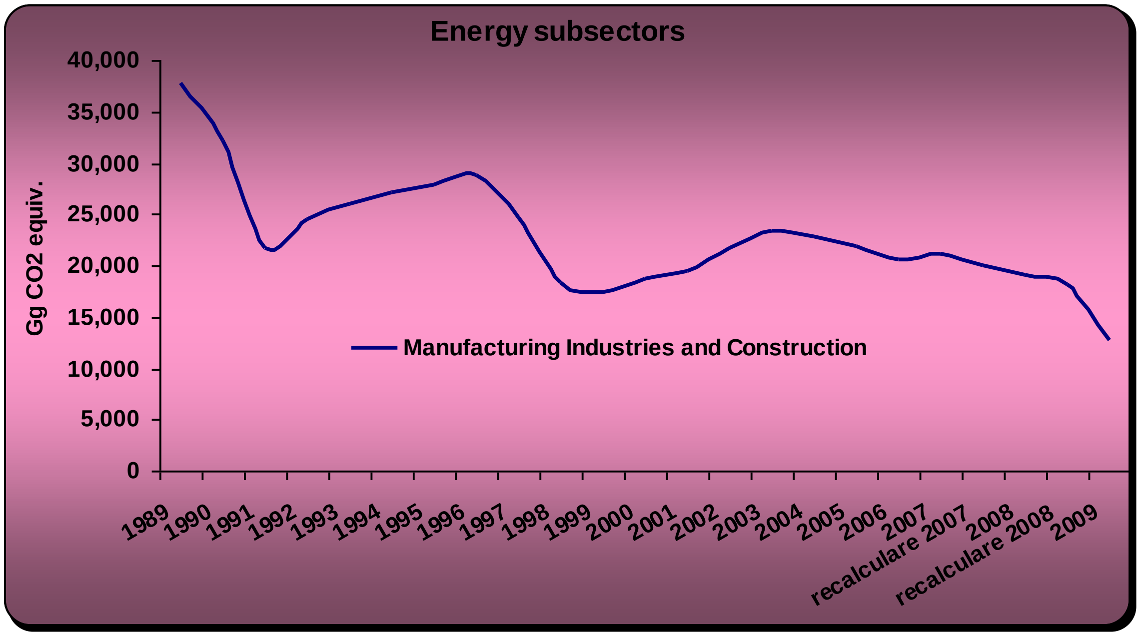
The industries included in this category are the following:

- Extraction and preparation of metal-bearing minerals (NACE Rev.1 code 13);
- Other mining activities (NACE Rev. 1 code 14);
- Food, beverages, tobacco (NACE Rev.1 code 15, 16);
- Textile and textile products (NACE Rev.1 code 17);
- Textile, fur and leather garments (NACE Rev. 1 code 18);
- Leather goods and footwear (NACE Rev. 1 code 19);
- Wood manufacture (excluding furniture manufacturing) – (NACE Rev.1 code 20)

- Pulp, paper and cardboard (NACE Rev.1 code 21);
- Publishing, printing and records reproducing on supports (NACE Rev. 1 code 22);
- Chemicals, Synthetic and artificial fibers (NACE Rev. 1 code 24);
- Rubber and plastic manufacture (NACE Rev. 1 code 25);
- Other non-metallic products (NACE Rev. 1 code 26);
- Metallurgy (NACE Rev. 1 code 27);
- Metallic constructions, machines, equipments (NACE Rev. 1 codes: 28, 29, 30, 31, 32, 33, 34, 35);
- Furniture production and other not-classified activities (NACE Rev. 1 code 36);
- Waste and other recyclable materials recovery (NACE Rev. 1 code 37);
- Water handling (NACE Rev. 1 code 41);
- Constructions (NACE Rev. 1 code 45) excluding fuel consumption for the energy sector, and that for administrative buildings heating (later being included in "commercial/institutional" category).

Because the Energy Balance uses NACE codes, the fuel consumptions and emissions estimates are reported aggregately, in the CRF Reporter, in category 1.A.2.f. Other (which includes: a.Iron and Steel; b.Non-Ferrous Metals; c.Chemicals; d.Pulp, Paper and Print; e.Food Processing, Beverages and Tobacco and other industries).

Figure 3.9 The GHG emissions trend for the category Manufacturing Industries and Constructions



3.2.7.2. Methodological issues

The activity data are taken from the Energy Balance (category 38 "industry" for the 1992-2009 system, and "direct consumption" - from the industry consumption category and "constructions", category 55 for the 2009 EB).

The emission factors (EF) used for estimating CH_4, N_2O, NO_x, CO, NMVOC, SO_2 emissions are the default EF indicated in the IPCC methodology, the same as those used for the energy industry category, since there are no national EF available and the emission factor (EF) used for estimating CO_2 emissions calculating of the reports submitted by operators using in the EU-ETS, (please see Annex 8.1).

3.2.7.3. Uncertainties and time- series consistency

The uncertainty was estimated using the key categories analysis ranking:

- Manufacturing Industries and Construction-liquid fuels,
- Manufacturing Industries and Construction -solid fuels,
- Manufacturing Industries and Construction -gaseous fuels,
- Manufacturing Industries and Construction –biomass, with combined uncertainty estimates of about: 5.38% (for CO_2 estimates), 20.6% (for CH_4 estimates) and 200% for N_2O emissions estimates.

The combined uncertainty estimates are the following: 7% (for CO_2 estimates), 20.6% (for CH_4 estimates) and 200% for N_2O emissions estimates.

The uncertainties used in calculating combined uncertainty are the same as those for the Energy Industries category.

The activity data, EF and methodology used in estimating GHG emissions are consistent for the entire period.

3.2.7.4. Source- specific QA/QC and verification, if applicable

All the activities specified/described in the QA/QC program, regarding quality control were undertaken.

The activities were/have been performed by the Romanian Energy sector expert of the GHG Inventory, the results of this activities being mentioned in the Check Lists.

There were made recalculations following recommendations made by experts of ERT The unconformities noted and solved following these activities are described in the Chapter 3.2.7.4. – Source-specific recalculations, including changes made in response to the review process and at the Chapter 10 - Recalculations and improvements levels; the quantitative effects of their solving are described at the Chapter 3.2.7.5. – Source-specific recalculations, including changes made in response to the review process.

All noted unconformities following the UNFCCC review of the NGHGI are described at the Improvements list level, their solving being envisaged as planned improvement.

3.2.7.5. Source- specific recalculation, if applicable, including changes made in response to the review process

In order to improve the emissions estimates quality some important recalculations were made:

- activity data
  - 1AA.2.F – Manufacture ind.&Constructions – other non-specified - biomass, for 1989 – 2008 the emissions values were corrected because EF was wrong;
  - It registered an increase for the emissions by CH_4 of 1.348% per year from time series1989 to 2008.
  - 1AA.2.F – Manufacture ind.&Constructions:
    - liquid for 2007 and 2008 ;
    - solid fuels for 2007 ,

recalculations were made due to review EB for by the INS for 2007 and 2008.

- 1AA.2F – solid fuels, liquid fuels and gaseous fuels for CO_2 emissions using EF calculated, (see please Annex 8.1).

Table 3.8 Change made at activity data and their effects on emission estimates

Year	Sub-sector	Changes at AD values level (TJ)		Effects of changes on emission estimates for CO_2 (Gg)		Differences (%)
		NIR 2010 v.3.2. submissions	NIR 2011 v.1.2. submissions	NIR 2010 v.3.2. submissions	NIR 2011 v.1.2. submissions	
2007	1AA.2.F-liquid (Gasoline)	17,634.23	2,586.90	84,133.49	69,086.15	-21.78%
	1AA.2.F-solid (Coke oven gas)	5,046.54	5,044.73	235.74	235.66	-0.036%
2008	1AA.2.F-liquid (Gasoline)	13,834.70	1,300.78	72,649.83	60,086.17	-20.91%
2008	1AA.2.F-liquid (Refinery gas)	72,88.58	7,258.84	481.53	479.53	-0.41%

Table 3.8 Change made at activity data and their effects on emission estimates (continued)

Year	Sub-sector	Changes at AD level (TJ)		Effects of changes on emission estimates for CH_4 (Gg)		Differences (%)
		NIR 2010 v.3.2. submissions	NIR 2011 v.1.2. submissions	NIR 2010 v.3.2. submissions	NIR 2011 v.1.2. submissions	
2007	1AA.2.F-liquid	17,634.23	2,586.90	0.17	0.14	-21.78%
	1AA.2.F-solid	5,046.54	5,044.73	0.35976	0.35974	-0.0056%
2008	1AA.2.F-liquid	13,834.70	1,300.78	0.14	0.12	-20.90%

Table 3.8 Change made at activity data and their effects on emission estimates (continued)

Year	Sub-sector	Changes at AD level (TJ)		Effects of changes on emission estimates for N_2O (Gg)		Differences (%)
		NIR 2010 v.3.2. submissions	NIR 2011 v.1.2. submissions	NIR 2010 v.3.2. submissions	NIR 2011 v.1.2. submissions	
2007	1AA.2.F-liquid	17,634.23	2,586.90	0.05	0.04	-21.78%
	1AA.2.F-solid	5,046.54	5,044.73	0.050366	0.050363	-0.005%
2008	1AA.2.F-liquid	13,834.70	1,300.78	0.043	0.036	-20.90%

Table 3.8 Change made at activity data and their effects on emission estimates (continued)

Year	Sub-sector	Changes at AD level (TJ)		Effects of changes on emission estimates for NO_X (Gg)		Differences (%)
		NIR 2010 v.3.2. submissions	NIR 2011 v.1.2. submissions	NIR 2010 v.3.2. submissions	NIR 2011 v.1.2. submissions	
2007	1AA.2.F-liquid	17,634.23	2,586.90	16.83	13.82	-21.78%
	1AA.2.F-solid	5,046.54	5,044.73	10.7927	10.7922	-0.005%
2008	1AA.2.F-liquid	13,834.70	1,300.78	14.53	12.02	-20.90%

Table 3.8 Change made at activity data and their effects on emission estimates (continued)

Year	Sub-sector	Changes at AD level (TJ)		Effects of changes on emission estimates for CO (Gg)		Differences (%)
		NIR 2010 v.3.2. submissions	NIR 2011 v.1.2. submissions	NIR 2010 v.3.2. submissions	NIR 2011 v.1.2. submissions	
2007	1AA.2.F-liquid	17,634.23	2,586.90	1.26	1.04	-21.78%
	1AA.2.F-solid	5,046.54	5,044.73	0.71951	0.71948	0.005%
2008	1AA.2.F-liquid	13,834.70	1,300.78	1.09	0.90	-20.90%

Table 3.8 Change made at activity data and their effects on emission estimates (continued)

Year	Sub-sector	Changes at AD level (TJ)		Effects of changes on emission estimates for NMVOC (Gg)		Differences (%)
		NIR 2010 v.3.2. submissions	NIR 2011 v.1.2. submissions	NIR 2010 v.3.2. submissions	NIR 2011 v.1.2. submissions	
2007	1AA.2.F-liquid (Gasoline)	17,634.23	2,586.90	0.42	0.34	-17.88%
	1AA.2.F-solid (Coke oven gas)	5,046.54	5,044.73	0.179879	0.179870	-0.005%
2008	1AA.2.F-liquid (Gasoline)	13,834.70	1,300.78	0.36	0.30	-20.91%

Table 3.8 Change made at activity data and their effects on emission estimates (continued)

Year	Sub-sector	Changes at AD level (TJ)		Effects of changes on emission estimates for SO_2 (Gg)		Differences (%)
		NIR 2010	NIR 2011	NIR 2010	NIR 2011	
2007	1AA.2.F-liquid (Gasoline)	17,634.23	2,586.90	4,408.56	600.16	-85.39%
	1AA.2.F-solid (Coke oven gas)	5,046.54	5,044.73	5,339.24	5,337.32	0.0036%
2008	1AA.2.F-liquid (Gasoline)	13,834.70	1,300.78	3,209.65	301.78	90.59%

3.2.7.6. Source- specific planned improvements, if applicable

For CO_2 emissions using Tier 2 method with calculated EF for each type of fuel, (see please Annex 8.1).

For the sub-sector 1.AA.2.F-Other Non-Specified, Other Fuels – the CH_4 emissions are marked with "NO" because statistics data from the Energy Balance do not make specification on the composition of these "other fuels". For the 2012 reporting we will get from the NIS the data on fuels relevant to "Other Fuels" for selecting the emission factors which will be used for the CH_4 emissions calculation.

For the sub-sector 1.AA.2.F-Other Non-Specified, Other Fuels – the CH_4 emissions are marked with "NE" because statistics data from the Energy Balance do not make specification on the composition of these "other fuels". For the 2012 reporting we will get from the NIS the data on fuels relevant to "Other Fuels" for selecting the emission factors which will be used for the CH_4 emissions calculation.

3.2.8. Fuel combustion, Transport (CRF sector 1.A.3.)

3.2.8.1. Source category description

In 2009 the emissions from transport categories accounted for 15,269.23 Gg CO_2 equivalent. The GHG covered are: CO_2, CH_4, N_2O, NO_x, NMVOC, CO and SO_2.

Within the fuel combustion sector, 14.15% of the GHG emissions expressed in CO_2 equivalent are represented by the sub-sector 1.A.3 Transport. This sector includes emissions from road transportation, civil aviation, railways, navigation and pipeline transportation.

For road transport we used the tier 2 approach using COPERT III model. Activity data used are taken from the Romanian Automobile Registry (RAR) and the energy balance provided by NIS.

Table 3.9 Table compared to emissions from level 1 and level 2 approach

	CRF - REPORTER							COPERT III						
	CO_2	**CH_4**	**N_20**	**NO_X**	**CO**	**SO_2**	**NMVOC**	**CO_2**	**CH_4**	**N_20**	**NO_X**	**CO**	**SO_2**	**NMVOC**
1989														
1990	6461.25	1.14	0.05	63.96	404.61	8.58	76.43	10816.45	4.65	0.39	88.70	1286.84	1.56	115.40
1991	5429.44	0.99	0.05	53.81	331.15	7.17	62.48	9280.58	2.95	0.39	96.64	1004.26	1.34	87.23
1992	6979.54	1.08	0.06	70.25	375.50	10.02	71.13	8597.62	2.62	0.31	101.08	570.05	1.55	54.97
1993	6738.26	1.16	0.06	66.74	395.89	9.01	74.80	8033.15	1.95	0.32	81.11	378.77	1.39	49.01
1994	7445.31	1.13	0.06	73.24	459.65	9.77	86.77	8694.48	2.61	0.48	74.91	591.04	1.46	54.32
1995	7259.52	1.55	0.06	72.13	406.05	9.23	76.20	7990.26	1.92	0.49	71.94	369.24	1.37	49.90
1996	10151.78	1.73	0.08	101.17	540.67	14.05	102.14	384.71	3.18	0.54	107.89	701.98	1.88	71.46
1997	9613.54	1.65	0.08	94.12	566.12	12.78	106.95	11012.62	3.35	0.46	104.35	711.39	1.74	73.71
1998	9657.06	1.72	0.08	94.36	572.81	12.63	108.10	10498.47	3.48	0.42	95.85	816.03	1.75	73.56
1999	7411.03	1.36	0.06	72.18	469.77	9.47	88.62	5210.09	2.37	0.36	71.42	512.26	1.33	65.36
2000	8243.37	1.45	0.07	79.87	488.32	10.70	92.17	9369.77	3.51	0.43	91.15	762.57	1.58	80.94
2001	10581.07	1.90	0.09	104.41	626.99	14.01	118.32	11087.79	3.72	0.49	109.45	761.31	1.83	95.51
2002	11288.64	1.96	0.09	110.55	685.96	14.88	129.56	12097.50	2.84	0.54	115.44	488.15	2.00	83.76
2003	11484.62	1.83	0.10	113.63	627.92	15.96	118.82	12249.77	3.36	0.58	117.17	540.88	2.10	77.44
2004	13830.33	2.46	0.11	133.03	876.85	17.52	165.50	12973.13	3.71	0.60	121.99	601.03	2.16	86.68
2005	11489.99	1.84	0.09	113.54	627.20	15.93	118.68	11682.81	2.80	0.77	101.77	370.63	1.95	64.09
2006	11952.90	1.81	0.10	120.23	603.33	17.38	114.35	12219.01	2.41	0.73	100.07	339.98	2.12	62.80
2007	12028.41	1.79	0.10	120.34	594.78	17.47	112.76	12259.25	2.78	0.86	74.49	364.55	0.38	47.75
2008	13934.69	1.98	0.11	140.32	631.89	17.47	112.76	14080.47	2.26	1.15	79.83	269.87	0.44	48.06
2009	13997.39	1.99	0.12	141.25	630.99	20.97	119.74	14287.89	2.35	1.12	82.04	269.17	0.09	49.56

Figure 3.10 Comparation of N_2O emissions

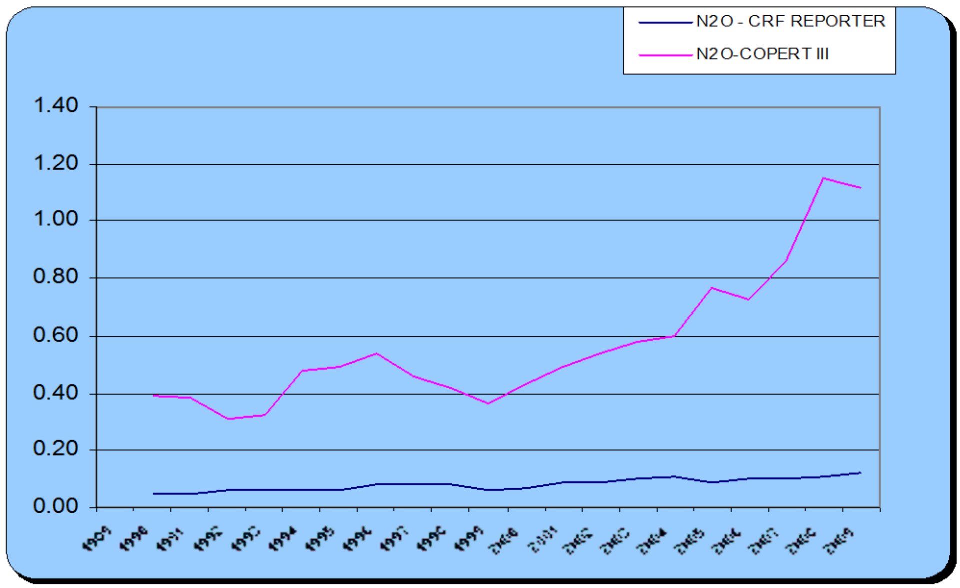


Figure 3.11 Comparation of CH_4 emissions

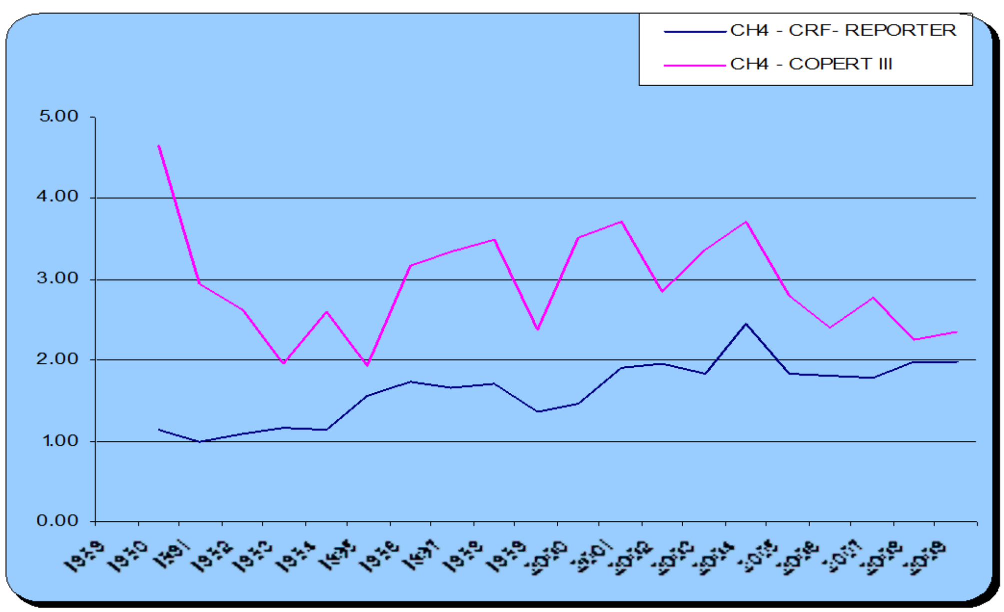


Figure 3.12 Comparation of CO_2 emissions

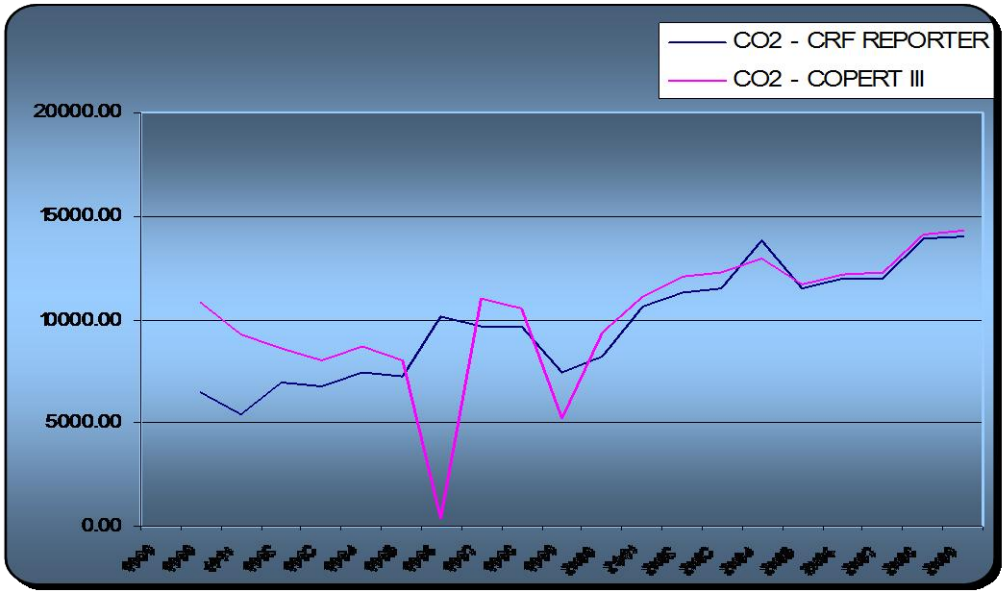


Figure 3.13 Comparation of NMVOC emissions

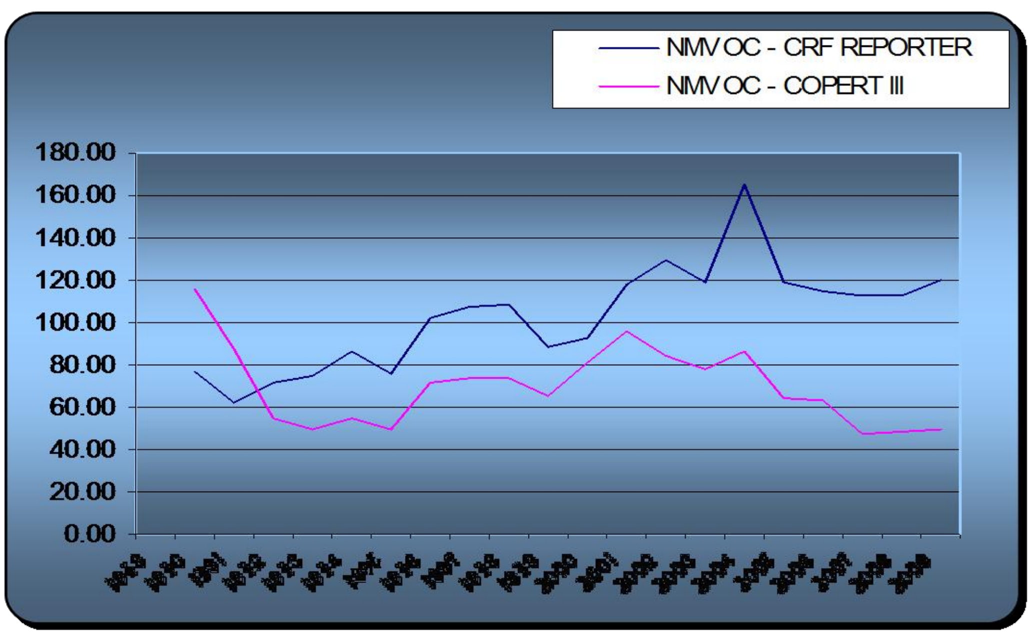


Figure 3.14 Comparation of CO emissions

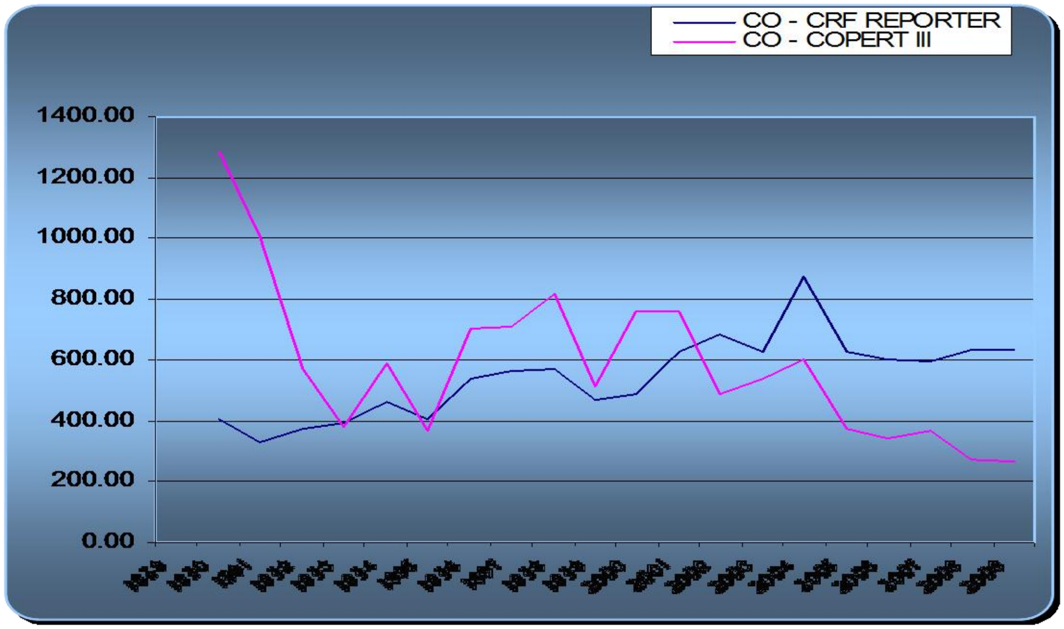


Figure 3.15 Comparation of NO_X emissions

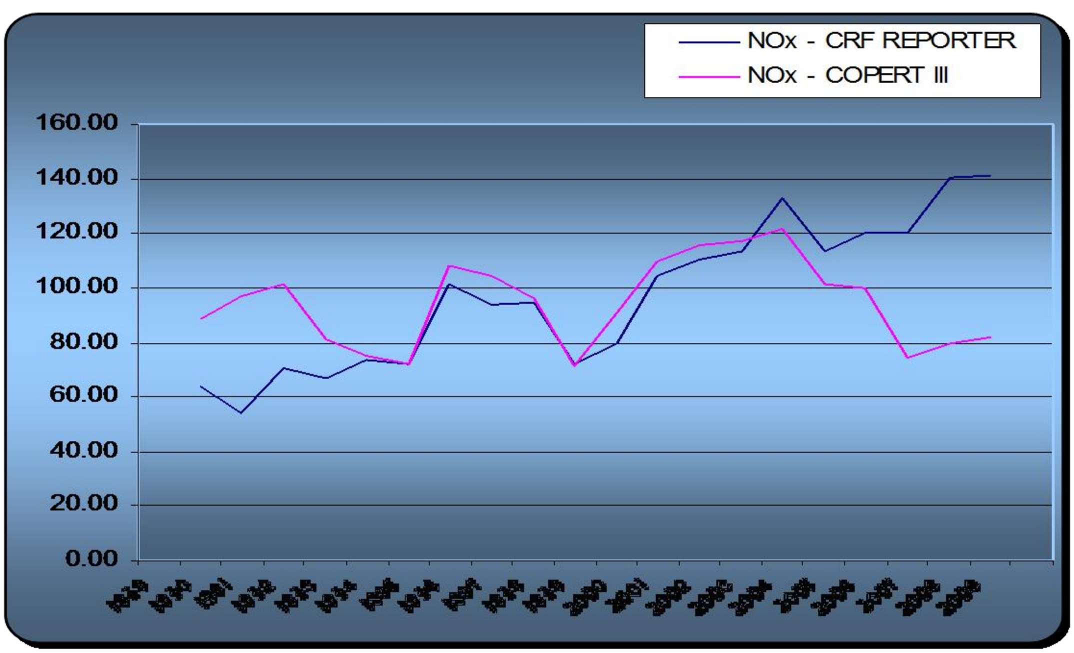


Figure 3.16 Comparation of SO_2 emissions

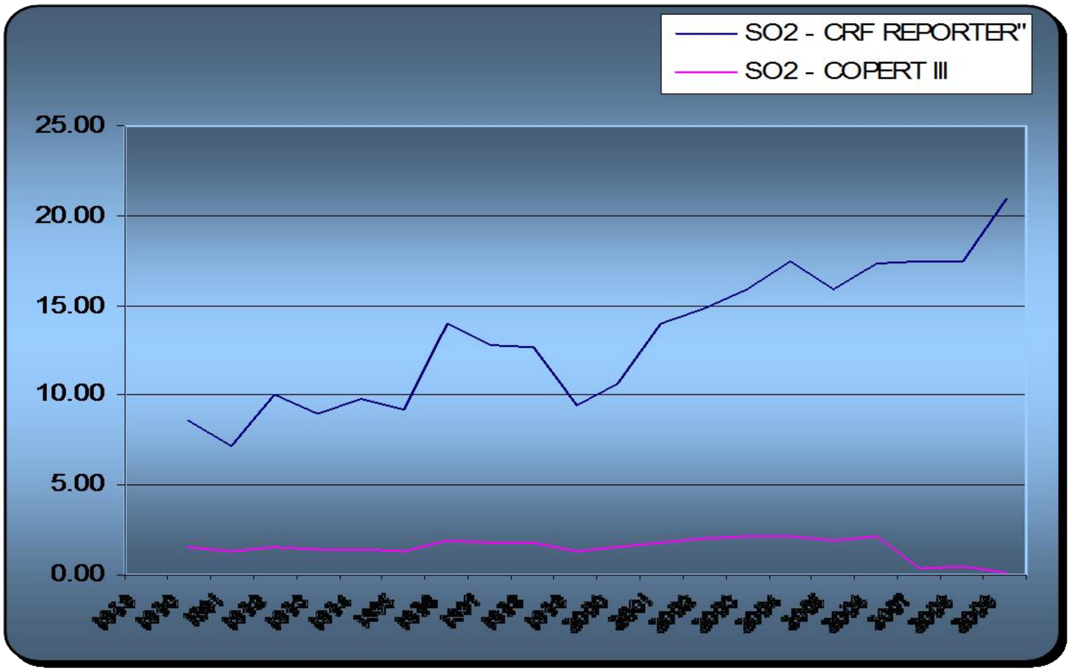


Figure 3.17 The total GHG emissions from the transport sector

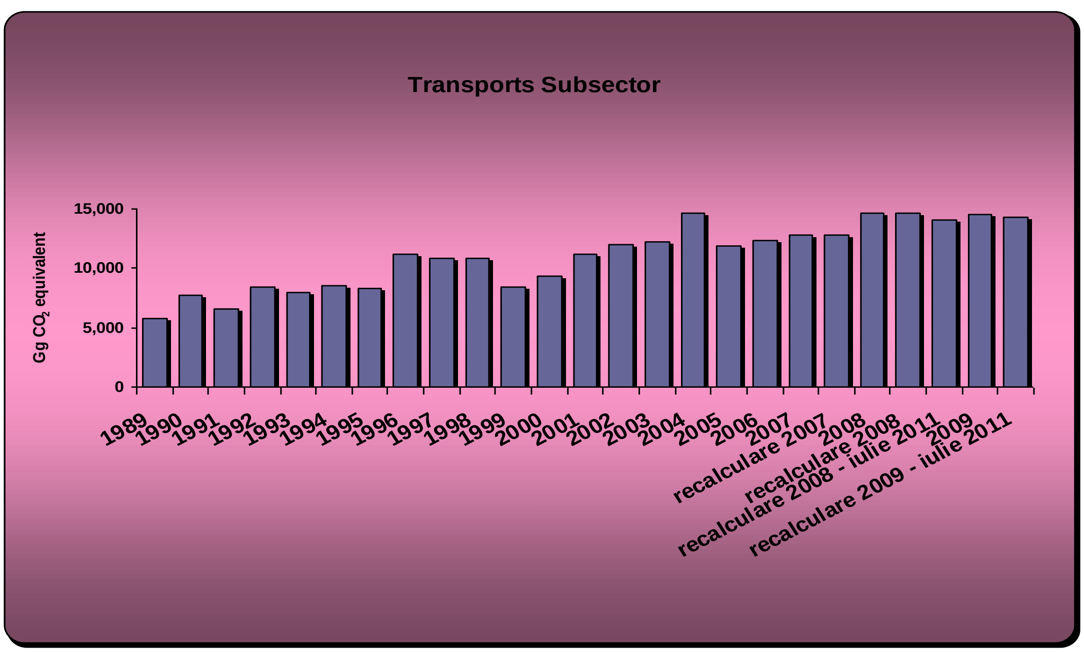
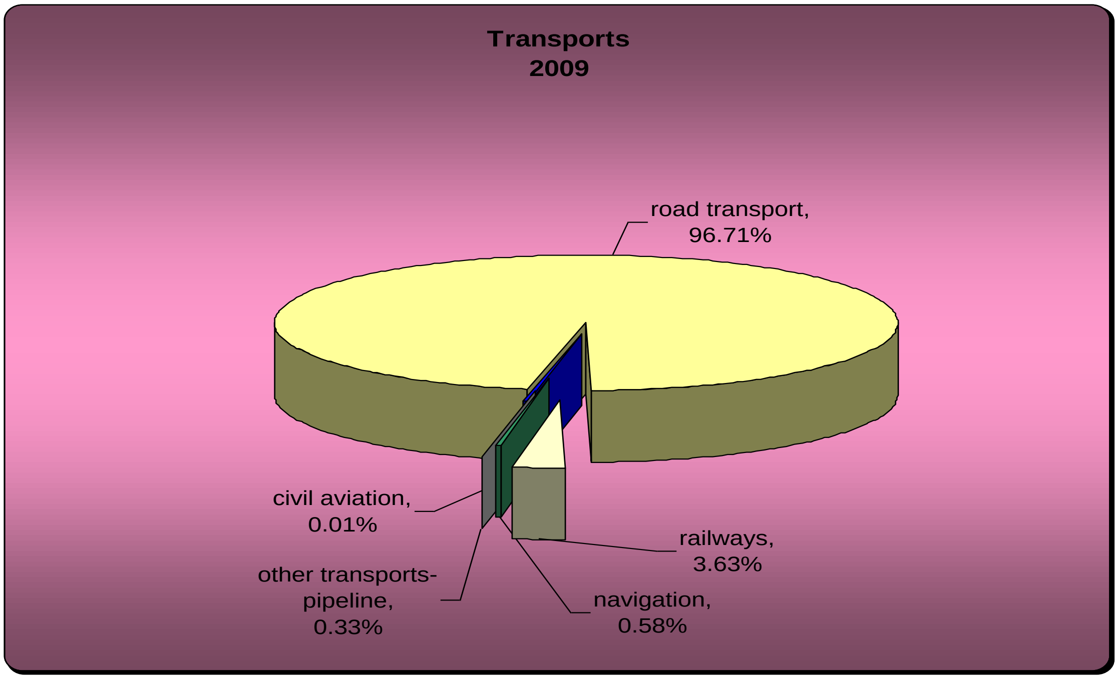


Figure 3.18 Transport categories in 2009

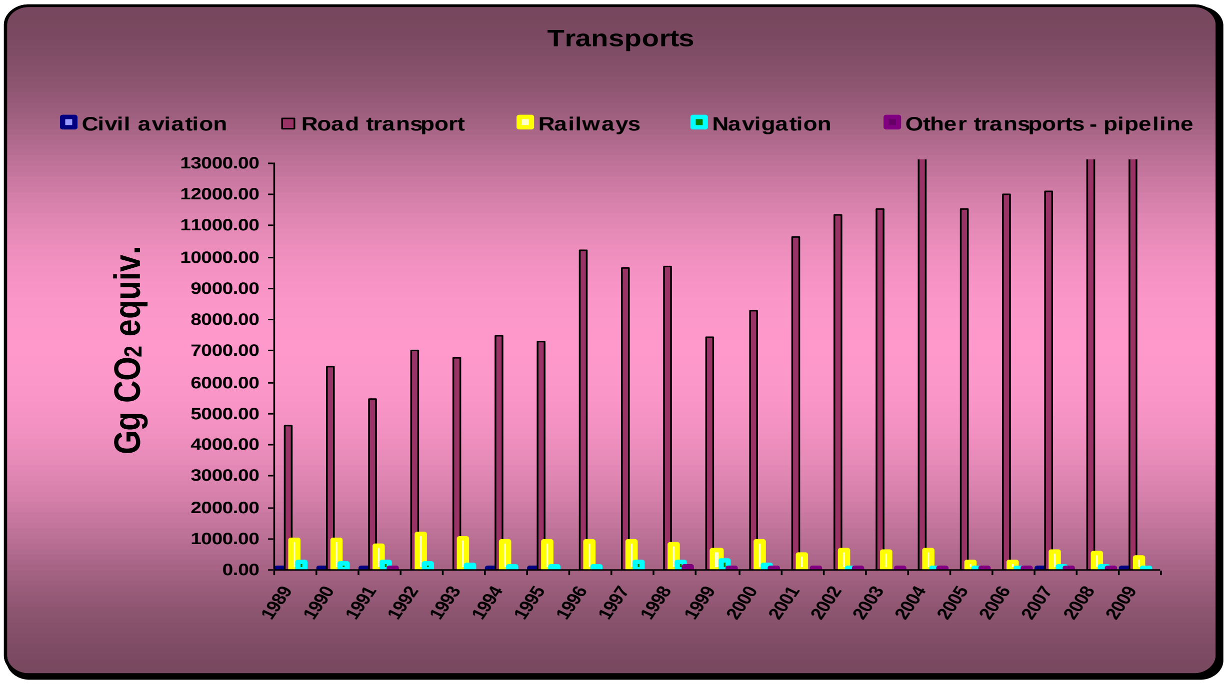


The overall increasing emission trend of the transport sub-sector is given by the emissions trend of the road mean of transport.

In 2009, emissions of CO_2, CH_4 and N_2O were relatively constant compared with those in 2008.

For civil aviation sub-sector (1AA.3.A), an increase in CO_2 emissions could be remarked compared with 2008 due to increasing domestic and international flights.

Figure 3.19 GHG emissions trend for Transport category



The GHG emissions in transport sector are increasing, as a consequence of increase of the mobility and of the number of vehicles.

3.2.8.2. Methodological issues

Methodology

Emission data have been estimated using the amounts of fuel used in the transport sector. Road transportation represents a key category both level and trend view for CO2 emissions (including and excluding LULUCF), tier 2 method was applied. for all excluding the road transport, the transport activities, emissions are estimated using Tier 1 method from IPCC 1996 and expert judgments in order to disaggregate the AD concerning the fuels consumption into domestic and international for civil aviation and navigation, (please see Annex 8.2).

Road, railways, navigation and pipeline transport

For the subcategories of transport: road, railways, navigation and pipeline transportation, the emissions of GHG were calculated taking into account the amounts of fuels used in each transport sector, data provided by the NIS, for the time series 1993 – 2009. Due to the lack of data, for the period 1989-1992 the values concerning the fuel used for each category of transport were obtain by the extrapolation of the values of the time series 1993 to 2004.

For the subcategory of road transport was used COPERT III model for the period 1990-2009.

Domestic civil aviation transport

Starting with 2009 submissions, a new approach was used, in order to estimate emissions from domestic aviation, separately from the international aviation (bunker fuels issue):

- Data provided by the Romanian Civil Aeronautical Authority through the Romanian Ministry of Transport, regarding fuel consumption activity for domestic and international operators;
- For national operators, distances travelled in Romania in comparison to distances travelled abroad served as the basis for disaggregation of fuels consumption into domestic and international for Romanian operators, therefore to determine domestic emissions, respectively emissions from international flights for the national operators;
- Emissions related to fuel consumption from international operators are considered to be fully international;
- The information regarding gasoline consumption covers the period 1999 to 2009 and for jet kerosene 1994 to 2009. After the calculation of the fuels used respectively in domestic and international civil aviation for these time series, the values were extrapolated to the base year 1989. The information concerning the distances travelled by the Romanian operators inside Romania and abroad covers the period 1990 to 2009.

Domestic navigation transport

For navigation the following approach was used, in order to separate the fuels consumption into domestic and international:

- Since Romania has only 2 ports at the Black Sea it was considered that there is no maritime domestic traffic.
- The inland waterways of transports are the Danube and some channels related to the Danube.
- Based on the comparison of the Statistical Yearbook data concerning distance covered by goods and distance covered by passengers (without the domestic/international split and using a conversion factor of about 70 kg/passenger proposed by NIS), which proved that the share of the distance travelled by passengers is very small (of about 0.0003%) comparing to the distance travelled by goods, it was decided to use only the data concerning the loaded goods, available in the Statistical Yearbook, in order to disaggregate the fuels consumption from international and domestic navigation.

The statistical indicator representing loaded goods (in thousands tones) was used, for export and for domestic navigation, for the time series 1993-2009, in order to obtain the percentage applied for disaggregating into domestic and international the overall navigation fuels consumption (on a fuel basis) provided by the NIS . For the remaining time series, the fuels consumptions series were extrapolated.

Emission factors used: default IPCC 1996 values for the emission factors (Workbook: Table. I-2 and I-4; Reference Manual: Tables I-7, I-8, I-9, I-10, I-11 and I-12).

3.2.8.3. Uncertainties and time- series consistency

Because there was no data available regarding uncertainty estimates at this level of disaggregation, the uncertainty was estimated using the key categories ranking (mobile combustion civil aviation, navigation, railways, road respectively other transportation-pipeline, for every GHG: CO_2, CH_4, and N_2O).

The combined uncertainty estimates are the following: 7% (for CO_2 estimates), 40.3% (for CH_4 estimates) and 200% for N_2O emissions estimates.

The uncertainties used in calculating combined uncertainty are:

- activity data uncertainty (5%) – based on information from the National Institute for Statistics (the system used in aggregating statistical data has a sampling error of about 3-5%);

- emission factors (5% for CO_2 emissions, 40% for CH_4, and 200% for N_2O emission estimates) using expert judgment.

Due to the fact that emissions have been calculated using the same emission factors, the same sources of activity data and the same methods and expert judgments (for civil aviation and navigation disaggregation into domestic and international) the time series are consistent.

3.2.8.4. Uncertainties and time- series consistency for road transport

Table 3.10 Uncertainties and time- series consistency for road transport

A	B	C	D	E	F	G	G
Base year	**Year**	**Gas**	**Base year emissions or removals Gg CO_2 equiv.**	**Year t emissions or removals Gg CO_2 equiv.**	**Activity data uncertainty %**	**Emission factor/estimation parameter uncertainty %**	**Combined uncertainty %**
1990	1991	CO_2	5,429.44	9,357.669	5%	10%	11.18%
1990	1992	CO_2	5,429.44	8,597.618	5%	10%	11.18%
1990	1993	CO_2	5,429.44	8,115.966	5%	10%	11.18%
1990	1994	CO_2	5,429.44	8,793.496	5%	10%	11.18%
1990	1995	CO_2	5,429.44	8,491.371	5%	10%	11.18%
1990	1996	CO_2	5,429.44	11,678.17	5%	10%	11.18%
1990	1997	CO_2	5,429.44	11,221.16	5%	10%	11.18%
1990	1998	CO_2	5,429.44	10,783.17	5%	10%	11.18%
1990	1999	CO_2	5,429.44	8,358.326	5%	10%	11.18%
1990	2000	CO_2	5,429.44	9,655.361	5%	10%	11.18%
1990	2001	CO_2	5,429.44	11,321.17	5%	10%	11.18%
1990	2002	CO_2	5,429.44	12,273.17	5%	10%	11.18%
1990	2003	CO_2	5,429.44	12,424.73	5%	10%	11.18%
1990	2004	CO_2	5,429.44	13,073.61	5%	10%	11.18%
1990	2005	CO_2	5,429.44	11,799.81	2%	7%	7.28%
1990	2006	CO_2	5,429.44	12,300.42	2%	7%	7.28%
1990	2007	CO_2	5,429.44	12,376.04	2%	7%	7.28%
1990	2008	CO_2	5,429.44	14,251.64	2%	7%	7.28%
1990	2009	CO_2	5,429.44	14,391.26	2%	7%	7.28%

A	B	C	D	E	F	G	G
Base year	**Year**	**Gas**	**Base year emissions or removals Gg CO_2 equiv.**	**Year t emissions or removals Gg CO_2 equiv.**	**Activity data uncertainty %**	**Emission factor/estimation parameter uncertainty %**	**Combined uncertainty %**
1990	1991	CH_4	23.87	3.02	5%	80%	80.15%
1990	1992	CH_4	23.87	2.62	5%	80%	80.15%
1990	1993	CH_4	23.87	1.99	5%	80%	80.15%
1990	1994	CH_4	23.87	2.66	5%	80%	80.15%
1990	1995	CH_4	23.87	2.33	5%	80%	80.15%
1990	1996	CH_4	23.87	3.36	5%	80%	80.15%
1990	1997	CH_4	23.87	3.41	5%	80%	80.15%
1990	1998	CH_4	23.87	3.61	5%	80%	80.15%
1990	1999	CH_4	23.87	2.43	5%	80%	80.15%
1990	2000	CH_4	23.87	3.60	5%	80%	80.15%
1990	2001	CH_4	23.87	3.86	5%	80%	80.15%
1990	2002	CH_4	23.87	2.89	5%	80%	80.15%
1990	2003	CH_4	23.87	3.40	5%	80%	80.15%
1990	2004	CH_4	23.87	3.76	5%	80%	80.15%
1990	2005	CH_4	23.87	2.85	2%	60%	60.03%
1990	2006	CH_4	23.87	2.45	2%	60%	60.03%
1990	2007	CH_4	23.87	2.82	2%	60%	60.03%
1990	2008	CH_4	23.87	2.33	2%	60%	60.03%
1990	2009	CH_4	23.87	2.44	2%	60%	60.03%

A	B	C	D	E	F	G	G
Base year	**Year**	**Gas**	**Base year emissions or removals Gg CO_2 equiv.**	**Year t emissions or removals Gg CO_2 equiv.**	**Activity data uncertainty %**	**Emission factor/estimation parameter uncertainty %**	**Combined uncertainty %**
1990	1991	N_2O	0.04	1.39	5%	380%	380.03%
1990	1992	N_2O	0.04	0.31	5%	380%	380.03%
1990	1993	N_2O	0.04	0.32	5%	380%	380.03%
1990	1994	N_2O	0.04	0.41	5%	380%	380.03%
1990	1995	N_2O	0.04	0.41	5%	380%	380.03%
1990	1996	N_2O	0.04	0.50	5%	380%	380.03%
1990	1997	N_2O	0.04	0.45	5%	380%	380.03%
1990	1998	N_2O	0.04	0.42	5%	380%	380.03%
1990	1999	N_2O	0.04	0.36	5%	380%	380.03%
1990	2000	N_2O	0.04	0.43	5%	380%	380.03%
1990	2001	N_2O	0.04	0.49	5%	380%	380.03%
1990	2002	N_2O	0.04	0.54	5%	380%	380.03%
1990	2003	N_2O	0.04	0.58	5%	380%	380.03%
1990	2004	N_2O	0.04	0.60	5%	380%	380.03%
1990	2005	N_2O	0.04	0.77	2%	320%	320%
1990	2006	N_2O	0.04	0.73	2%	320%	320%
1990	2007	N_2O	0.04	0.86	2%	320%	320%
1990	2008	N_2O	0.04	1.15	2%	320%	320%
1990	2009	N_2O	0.04	1.12	2%	320%	320%

The uncertainty analysis is based on Table 3.4. from IPCC 2006, adapted of Romania.

The activity data for the period 1990-2004 we kept the percentage uncertainty of 5% recommended by the NIS statistics as activity data used COPERT III were:

- Fuel consumption - energy balance provided by NIS;
- Number of vehicles / categories - www.emisia.com;
- Number mileage and other parameters - alternative sources and calculation estimates.

For the period 2005-2009 the percentage had dropped to 2% because:

- Fuel consumption - energy balance provided by NIS;
- Number of vehicles / categories, total mileage and other parameters – RAR.

Fuel consumption has been awarded a 3% share of uncertainty and data from RAR a percentage uncertainty of 2%.

Parameter Estimation Uncertainty (%) for emission factor is the arithmetic mean of the uncertainties for each fuel type and each category of vehicles (gasoline cars, cars with catalytic converters, cars without catalytic converters and diesel cars).

Combined uncertainty was calculated using the formula:

$$\sqrt{\%\,\text{uncertainty activity data}^2 + \%\,\text{uncertainty emission factor}^2}$$

In 2012 is going to run a study on the topic of activity data, model uncertainty for running back COPERT IV. Parameters resulting from the study will be used in INEGES 2013.

3.2.8.5. Source- specific QA/QC and verification

There were performed all the activities concerning quality control which are mentioned in the QA/QC Programme by the person responsible for the Energy sector, the results being mentioned in the Check Lists.

No recalculations were needed following the QA activities developed under the European Community GHG Inventory compilation procedures described in the Decision 280/2004/EC of the European Parliament and of the Council and Decision 166/2005/EC of the European Commission.

All the unconformities noticed and solved as result of the quality assurance and quality control activities performed are mentioned in the Improvements Lists.

Were made recalculations following recommendations made by experts of ERT.

The unconformities noted and solved following these activities are described in the Chapter 3.2.8.5. – Source-specific recalculations, including changes made in response to the review process and at the Chapter 10 - Recalculations and improvements levels; the quantitative effects of their solving are described at the Chapter 3.2.8.5. – Source-specific recalculations, including changes made in response to the review process.

3.2.8.6. Source- specific recalculation, if applicable, including changes made in response to the review process

In order to improve the emissions estimates quality some important recalculations were made:

- activity data
  - 1AA.3.C – Railways - Other fuels-biomass – for 1992 – 2008 ;

Following expert advice ERT, INS distributed biomass fuel EB - coal transport trains. This consumption was not mentioned by the INS in annex consumption for transportation.

Table 3.11 Change made at activity data and their effects on emission estimates:

Year	Sub-sector	Changes at AD level (TJ)		Effects of changes on emission estimates for CO_2 (Gg)		Differences (%)
		NIR 2010 v.3.2. submissions	NIR 2011 v.1.2. submissions	NIR 2010 v.3.2. submissions	NIR 2011 v.1.2. submissions	
1992	1AA.3.C – Railways - Other fuels-biomass	0	0.29	0	0.03	100%
1993		0	0.21	0	0.02	100%
1994		0	0.12	0	0.01	100%
1995		0	0.23	0	0.02	100%
1996		0	0.24	0	0.02	100%
1997		0	0.41	0	0.04	100%
1998		0	0.23	0	0.02	100%
1999		0	0.07	0	0.01	100%
2000		0	70.26	0	6.93	100%
2001		0	58.22	0	5.74	100%
2002		0	154.47	0	15.24	100%
2003		0	128.77	0	12.71	100%
2004		0	4.10	0	0.40	100%
2005		0	28.33	0	2.80	100%
2006		0	24.94	0	2.46	100%
2007		0	468.16	0	46.19	100%
2008		0	35.57	0	3.51	100%
2009		0	2.64	0	0.26	100%

Table 3.11 Change made at activity data and their effects on emission estimates (continued)

Year	Sub-sector	Changes at AD level (TJ)		Effects of changes on emission estimates for CH_4 (Gg)		Differences (%)
		NIR 2010 v.3.2. submissions	NIR 2011 v.1.2. submissions	NIR 2010 v.3.2. submissions	NIR 2011 v.1.2. submissions	
1992	1AA.3.C – Railways - Other fuels-biomass	0	0.29	0	0.000088	100%
1993		0	0.21	0	0.000062	100%
1994		0	0.12	0	0.000035	100%
1995		0	0.23	0	0.000070	100%
1996		0	0.24	0	0.000071	100%
1997		0	0.41	0	0.000124	100%
1998		0	0.23	0	0.000068	100%
1999		0	0.07	0	0.000021	100%
2000		0	70.26	0	0.021079	100%
2001		0	58.22	0	0.017466	100%
2002		0	154.47	0	0.046341	100%
2003		0	128.77	0	0.038632	100%
2004		0	4.10	0	0.001231	100%
2005		0	28.33	0	0.008500	100%
2006		0	24.94	0	0.007481	100%
2007		0	468.16	0	0.140447	100%
2008		0	35.57	0	0.010671	100%
2009		0	2.64	0	0.000791	100%

Table 3.11 Change made at activity data and their effects on emission estimates (continued)

Year	Sub-sector	Changes at AD level (TJ)		Effects of changes on emission estimates for NO_X (Gg)		Differences (%)
		NIR 2010 v.3.2. submissions	NIR 2011 v.1.2. submissions	NIR 2010 v.3.2. submissions	NIR 2011 v.1.2. submissions	
1992	1AA.3.C – Railways - Other fuels-biomass	0	0.29	0	0.000001	100%
1993		0	0.21	0	0.000001	100%
1994		0	0.12	0	0.000000	100%
1995		0	0.23	0	0.000001	100%
1996		0	0.24	0	0.000001	100%
1997		0	0.41	0	0.000002	100%
1998		0	0.23	0	0.000001	100%
1999		0	0.07	0	0.000000	100%
2000		0	70.26	0	0.000281	100%
2001		0	58.22	0	0.000233	100%
2002		0	154.47	0	0.000618	100%
2003		0	128.77	0	0.000515	100%
2004		0	4.10	0	0.000016	100%
2005		0	28.33	0	0.000113	100%
2006		0	24.94	0	0.000100	100%
2007		0	468.16	0	0.001873	100%
2008		0	35.57	0	0.000142	100%
2009		0	2.64	0	0.000011	100%

Table 3.12 Change made at metodology and their effects on emission estimates for Road Transport

Year	Sub-sector	Changes at AD level (TJ)	Effects of changes on emission estimates for CO_2 (Gg)	Changes at AD level (TJ)	Effects of changes on emission estimates for CO_2 (Gg)	Differences (%)
		NIR 2010 v.3.2. submissions	NIR 2011 v.2.1. submissions	NIR 2010 v.3.2. submissions	NIR 2011 v.2.1. submissions	
1990	1 AA.3.B – Road Transport-	91,192.67	91,192.67	6,472.04	10,827.25	67.29
1991		76,721.67	76,721.67	5,429.44	9,357.67	72.35
1992		97,738.83	97,738.83	6,979.54	8,597.62	23.18
1993		94,886.79	94,886.79	6,738.26	8,115.97	20.45
1994		105,067.87	105,067.87	7,445.30	8,793.50	18.11
1995		103,799.82	103,799.82	7,259.52	8,491.37	16.97
1996		142,994.46	142,994.46	10,151.78	11,678.17	15.04
1997		135,391.81	135,391.81	9,613.54	11,221.16	16.72
1998		136,340.87	136,340.87	9,657.06	10,783.17	11.66
1999		104,743.16	104,743.16	7,411.03	8,358.33	12.78
2000		116,306.29	116,306.29	8,243.37	9,655.36	17.13
2001		149,410.02	149,410.02	10,581.07	11,321.17	6.99
2002		159,060.59	159,060.59	11,288.64	12,273.17	8.72
2003		161,179.56	161,179.56	11,484.62	12,424.73	8.19
2004		195,711.83	195,711.83	13,830.33	13,073.61	-5.47
2005		161,474.09	161,474.09	11,489.99	11,799.81	2.69
2006		167,358.44	167,358.44	11,952.90	12,300.42	2.90
2007		168,433.97	168,433.97	12,028.41	12,376.04	2.89
2008		194,801.72	194,801.72	13,934.69	14,251.64	2.27
2009		195,836.71	195,836.71	13,997.39	14,391.26	2.81

Table 3.12 Change made at metodology and their effects on emission estimates for Road Transport (continued)

Year	Sub-sector	Changes at AD level (TJ)	Effects of changes on emission estimates for CH_4 (Gg)	Changes at AD level (TJ)	Effects of changes on emission estimates for CH_4 (Gg)	Differences (%)
		NIR 2010 v.3.2. submissions	NIR 2011 v.2.1. submissions	NIR 2010 v.3.2. submissions	NIR 2011 v.2.1. submissions	
1990	1 AA.3.B – Road Transport	91,192.67	91,192.67	13.58	4.66	-65.68
1991		76,721.67	76,721.67	23.87	3.02	-87.35
1992		97,738.83	97,738.83	20.84	2.63	-87.38
1993		94,886.79	94,886.79	22.76	1.99	-91.26
1994		105,067.87	105,067.87	24.34	2.66	-89.07
1995		103,799.82	103,799.82	27.99	2.33	-91.68
1996		142,994.46	142,994.46	32.45	3.36	-89.65
1997		135,391.81	135,391.81	36.28	3.41	-90.60
1998		136,340.87	136,340.87	34.62	3.61	-89.57
1999		104,743.16	104,743.16	36.17	2.43	-93.28
2000		116,306.29	116,306.29	28.54	3.60	-87.38
2001		149,410.02	149,410.02	30.45	3.86	-87.32
2002		159,060.59	159,060.59	39.89	2.89	-92.75
2003		161,179.56	161,179.56	41.21	3.40	-91.75
2004		195,711.83	195,711.83	38.49	3.76	-90.23
2005		161,474.09	161,474.09	51.71	2.85	-94.49
2006		167,358.44	167,358.44	38.62	2.45	-93.66
2007		168,433.97	168,433.97	37.96	2.82	-92.57
2008		194,801.72	194,801.72	37.58	2.33	-93.80
2009		195,836.71	195,836.71	41.48	2.44	-94.12

Table 3.12 Change made at metodology and their effects on emission estimates for Road Transport (continued)

Year	Sub-sector	Changes at AD level (TJ)	Effects of changes on emission estimates for N_2O (Gg)	Changes at AD level (TJ)	Effects of changes on emission estimates for N_2O (Gg)	Differences (%)
		NIR 2010 v.3.2. submissions	NIR 2011 v.2.1. submissions	NIR 2010 v.3.2. submissions	NIR 2011 v.2.1. submissions	
1990	1 AA.3.B – Road Transport	91,192.67	91,192.67	6.93	0.39	-94.37
1991		76,721.67	76,721.67	14.06	1.39	-90.11
1992		97,738.83	97,738.83	18.18	0.31	-98.29
1993		94,886.79	94,886.79	17.42	0.32	-98.16
1994		105,067.87	105,067.87	19.28	0.41	-97.87
1995		103,799.82	103,799.82	17.92	0.41	-97.71
1996		142,994.46	142,994.46	25.80	0.50	-98.06
1997		135,391.81	135,391.81	4.63	0.45	-90.28
1998		136,340.87	136,340.87	24.60	0.42	-98.29
1999		104,743.16	104,743.16	19.09	0.36	-98.11
2000		116,306.29	116,306.29	20.88	0.43	-97.94
2001		149,410.02	149,410.02	27.16	0.49	-98.19
2002		159,060.59	159,060.59	29.12	0.54	-98.14
2003		161,179.56	161,179.56	9.46	0.58	-93.87
2004		195,711.83	195,711.83	35.40	0.60	-98.30
2005		161,474.09	161,474.09	29.42	0.77	-97.38
2006		167,358.44	167,358.44	30.77	0.73	-97.63
2007		168,433.97	168,433.97	30.73	0.86	-97.20
2008		194,801.72	194,801.72	35.38	1.15	-96.75
2009		195,836.71	195,836.71	36.13	1.12	-96.90

Table 3.12 Change made at metodology and their effects on emission estimates for Road Transport (continued)

Year	Sub-sector	Changes at AD level (TJ)	Effects of changes on emission estimates for CO (Gg)	Changes at AD level (TJ)	Effects of changes on emission estimates for CO (Gg)	Differences (%)
		NIR 2010 v.3.2. submissions	NIR 2011 v.2.1. submissions	NIR 2010 v.3.2. submissions	NIR 2011 v.2.1. submissions	
1990	1 AA.3.B – Road Transport	91,192.67	91,192.67	404.61	1,253.98	209.92
1991		76,721.67	76,721.67	331.15	1,004.26	203.26
1992		97,738.83	97,738.83	375.50	574.05	52.87
1993		94,886.79	94,886.79	395.89	378.77	-4.32
1994		105,067.87	105,067.87	459.65	591.04	28.58
1995		103,799.82	103,799.82	406.04	365.37	-10.01
1996		142,994.46	142,994.46	540.67	701.42	29.73
1997		135,391.81	135,391.81	566.12	711.39	25.66
1998		136,340.87	136,340.87	572.81	816.03	42.46
1999		104,743.16	104,743.16	469.77	512.26	9.04
2000		116,306.29	116,306.29	488.32	762.57	56.16
2001		149,410.02	149,410.02	626.99	761.31	21.42
2002		159,060.59	159,060.59	685.96	488.15	-28.84
2003		161,179.56	161,179.56	627.92	540.88	-13.86
2004		195,711.83	195,711.83	876.85	601.03	-31.46
2005		161,474.09	161,474.09	627.20	370.63	-40.90
2006		167,358.44	167,358.44	603.33	339.98	-43.65
2007		168,433.97	168,433.97	594.78	364.55	-38.71
2008		194,801.72	194,801.72	631.89	269.87	-57.29
2009		195,836.71	195,836.71	630.79	269.17	-57.33

Table 3.12 Change made at metodology and their effects on emission estimates for Road Transport (continued)

Year	Sub-sector	Changes at AD level (TJ)	Effects of changes on emission estimates for SO_2 (Gg)	Changes at AD level (TJ)	Effects of changes on emission estimates for SO_2 (Gg)	Differences (%)
		NIR 2010 v.3.2. submissions	NIR 2011 v.2.1. submissions	NIR 2010 v.3.2. submissions	NIR 2011 v.2.1. submissions	
1990	1 AA.3.B – Road Transport	91,192.67	91,192.67	8.58	1.56	-81.82
1991		76,721.67	76,721.67	7.16	1.34	-81.28
1992		97,738.83	97,738.83	10.02	1.55	-84.53
1993		94,886.79	94,886.79	9.09	1.39	-84.71
1994		105,067.87	105,067.87	9.77	1.46	-85.05
1995		103,799.82	103,799.82	9.23	1.37	-85.16
1996		142,994.46	142,994.46	14.04	1.88	-86.61
1997		135,391.81	135,391.81	12.77	1.74	-86.37
1998		136,340.87	136,340.87	12.63	1.76	-86.06
1999		104,743.16	104,743.16	9.47	1.33	-85.96
2000		116,306.29	116,306.29	10.70	1.58	-85.23
2001		149,410.02	149,410.02	14.01	1.83	-86.94
2002		159,060.59	159,060.59	14.88	2.00	-86.56
2003		161,179.56	161,179.56	15.96	2.10	-86.84
2004		195,711.83	195,711.83	17.52	2.16	-87.67
2005		161,474.09	161,474.09	15.93	1.95	-87.76
2006		167,358.44	167,358.44	17.38	2.12	-87.80
2007		168,433.97	168,433.97	17.47	0.39	-97.77
2008		194,801.72	194,801.72	20.82	0.44	-97.87
2009		195,836.71	195,836.71	20.97	0.09	-99.57

Table 3.12 Change made at metodology and their effects on emission estimates for Road Transport (continued)

Year	Sub-sector	Changes at AD level (TJ)	Effects of changes on emission estimates for NMVOC (Gg)	Changes at AD level (TJ)	Effects of changes on emission estimates for NMVOC (Gg)	Differences (%)
		NIR 2010 v.3.2. submissions	NIR 2011 v.2.1. submissions	NIR 2010 v.3.2. submissions	NIR 2011 v.2.1. submissions	
1990	1 AA.3.B – Road Transport	91,192.67	91,192.67	76.43	115.39	50.97
1991		76,721.67	76,721.67	62.48	87.23	39.61
1992		97,738.83	97,738.83	71.13	54.97	-22.72
1993		94,886.79	94,886.79	74.79	48.96	-34.54
1994		105,067.87	105,067.87	86.77	61.31	-29.34
1995		103,799.82	103,799.82	76.19	46.62	-38.81
1996		142,994.46	142,994.46	102.14	71.32	-30.17
1997		135,391.81	135,391.81	106.94	73.71	-31.07
1998		136,340.87	136,340.87	108.09	73.56	-31.95
1999		104,743.16	104,743.16	88.62	65.36	-26.25
2000		116,306.29	116,306.29	92.17	80.94	-12.18
2001		149,410.02	149,410.02	118.32	95.51	-19.28
2002		159,060.59	159,060.59	129.56	83.76	-35.35
2003		161,179.56	161,179.56	118.82	77.44	-34.83
2004		195,711.83	195,711.83	165.50	86.68	-47.63
2005		161,474.09	161,474.09	118.67	64.52	-45.63
2006		167,358.44	167,358.44	114.35	62.81	-45.07
2007		168,433.97	168,433.97	112.76	47.75	-57.65
2008		194,801.72	194,801.72	119.95	48.07	-59.92
2009		195,836.71	195,836.71	119.74	49.57	-58.60

Table 3.12 Change made at metodology and their effects on emission estimates for Road Transport (continued)

Year	Sub-sector	Changes at AD level (TJ)	Effects of changes on emission estimates for NO_X (Gg)	Changes at AD level (TJ)	Effects of changes on emission estimates for NO_X (Gg)	Differences (%)
		NIR 2010 v.3.2. submissions	NIR 2011 v.2.1. submissions	NIR 2010 v.3.2. submissions	NIR 2011 v.2.1. submissions	
1990	1 AA.3.B – Road Transport	91,192.67	91,192.67	63.96	88.69	38.66
1991		76,721.67	76,721.67	53.81	96.64	79.59
1992		97,738.83	97,738.83	70.25	101.08	43.88
1993		94,886.79	94,886.79	66.74	81.03	21.41
1994		105,067.87	105,067.87	73.24	74.91	2.280
1995		103,799.82	103,799.82	72.13	71.94	-0.26
1996		142,994.46	142,994.46	101.17	107.70	6.45
1997		135,391.81	135,391.81	94.12	104.35	10.87
1998		136,340.87	136,340.87	94.36	95.84	1.56
1999		104,743.16	104,743.16	72.18	71.42	-1.05
2000		116,306.29	116,306.29	79.87	91.15	14.12
2001		149,410.02	149,410.02	104.41	109.45	4.83
2002		159,060.59	159,060.59	110.55	115.44	4.42
2003		161,179.56	161,179.56	113.63	117.18	3.12
2004		195,711.83	195,711.83	133.03	121.99	-8.30
2005		161,474.09	161,474.09	113.54	101.77	-10.37
2006		167,358.44	167,358.44	120.23	100.07	-16.77
2007		168,433.97	168,433.97	120.34	74.50	-38.09
2008		194,801.72	194,801.72	140.32	79.83	-43.11
2009		195,836.71	195,836.71	141.25	82.04	-41.92

3.2.8.7. Source- specific planned improvements, if applicable

To improve the accuracy of estimates by applying more accurate methods, were used activity data to COPERT III model, data by type of vehicle (with or without catalytic converters) in order to improve the reporting of emissions for CO_2, CH_4, N_2O and were introduced in the CRF tables (detailed of the table 3.12).

The uncertainty of the stock data will be assessed by collecting information from different sources and by building detailed models to disseminate this uncertainty down to technology level.

This could be achieved by studying the following objectives:

- evaluate the uncertainty linked with the various input parameters of the COPERT 4 Model;
- assess the uncertainty of road transport emissions in two test cases, at national level;
- including these uncertainty estimates in the COPERT 4 model;
- prepare guidance on the assessment of uncertainty for the Tier 2 method for use COPERT model in estimation GES.

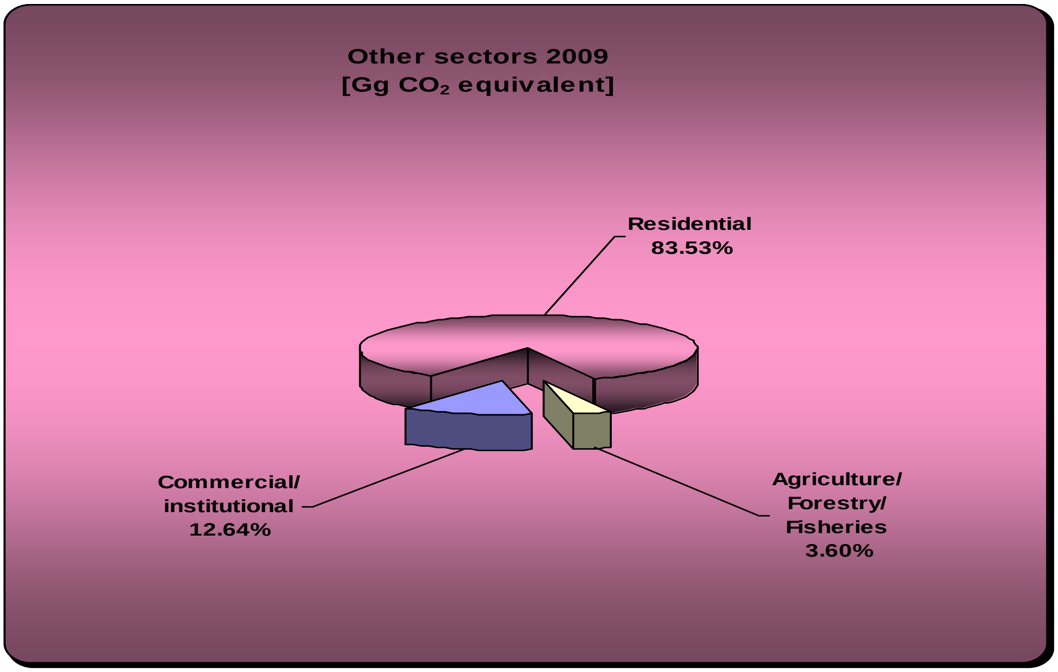
For the sub-sector 1.AA.3.B-Road Transportation, Biomass, LPG and Other Liquid Fuels, within the 2012 reporting we will change the notation keys from "NE " in "IE" after we will discuss with NIS about the consumption of biomass, LPG and other liquid fuels in the Energy Balance but not in the sheet used to calculate the transport emissions.

3.2.9. Fuel combustion, Other sectors (CRF sector 1.A.4.)

3.2.9.1. Source category description

In 2009 the “Other sectors” category was responsible for about 12.36% of the energy sector total GHG emissions (10,609.38 Gg CO_2 equivalent). In this category are included emissions from commercial/institutional, residential and agriculture/forestry/fishery sector

Figure 3.20 "Other sectors" structure in 2009



3.2.9.2. Methodological issues

The activity data (fuel consumptions) are aggregated from the Energy Balance, as follows:

- Categories: 59 ("other economy fields"), 57 ("population") and 58 ("agriculture and forestry"), for the 2008 E.B. system;
- Categories: "other national economy fields", "population", and "agriculture and forestry", chapter 48 for the 1989 Energy Balance (where consumptions are reported in t.c.e., therefore a conversion factor of about 29.3 GJ/ t.c.e. has been used).

The "other economy fields" category includes fuel consumptions declared by the economic agents in various activities, including: commerce, financial activities, banking and insurance, hotels and restaurants, real-estate transactions, rentals and services, public administration and defense, education, health and social assistance, other collective, social and personal services.

The "population" category includes the quantities:

- delivered for open flame consumption for heating and cooking purposes, including energy consumption for residential space by the owners and the administration of the economic agents;
- delivered to the population to produce heat and hot water in central heating and quantities of coal received by the miners as direct allowances (payment) from the mining companies;
- of heat delivered to the population for heating and hot water, both from the public and from auto producer sectors.

The "agriculture and forestry" category includes consumptions recorded in the following activity fields: agriculture, forestry, logging, hunting, fishing (NACE Rev.1. codes 01, 02, 05), and fuel consumption of the fishing ships.

Therefore, the correspondence between CRF and Energy Balance categories is considered the following:

Table 3.13 The correspondence between CRF and Energy Balance categories

Energy Balance category	CRF category
Other economy fields	Commercial/institutional
Population	Residential
Agriculture and forestry	Agriculture/Forestry/Fisheries

The emission factors (EF) used for estimating emissions were the default EF indicated in the IPCC methodology and for CO_2 emissions was used EF calculed the data reported by EU-ETS operators for Residential, Commercial/Institutional and Agriculture/Forestry/Fischeries.

3.2.9.3. Uncertainties and time- series consistency

The uncertainty was estimated using the key categories analysis ranking:

- Commercial/institutional -liquid fuels,
- Commercial/institutional -solid fuels,
- Commercial/institutional -gaseous fuels,
- Commercial/institutional –biomass,

- Residential -liquid fuels,
- Residential -solid fuels,
- Residential -gaseous fuels,
- Residential –biomass,
- Agriculture/Forestry/Fisheries -liquid fuels,
- Agriculture/Forestry/Fisheries -solid fuels,
- Agriculture/Forestry/Fisheries -gaseous fuels,
- Agriculture/Forestry/Fisheries –biomass, with combined uncertainty estimates of about: 2% (for CO_2 estimates), 20.6% (for CH_4 estimates) and 200% for N_2O emissions estimates.

The combined uncertainty estimates are the following: 5.38% (for CO_2 estimates), 20.6% (for CH_4 estimates) and about 200% for N_2O emissions estimates.

The uncertainties used in calculating combined uncertainty are the same as those for the Energy Industries category.

Because the same activity data source was used (Energy Balance), emissions factors are the ones indicated in the IPCC methodology, for the entire period, the time series is considered consistent.

3.2.9.4. Source- specific QA/QC and verification, if applicable

All the activities specified/described in the QA/QC program, regarding quality control were undertaken.

The activities were performed by the responsible person on the Energy sector, the results of these being mentioned on the Checklists level.

The unconformities noted and solved following these activities are described in the Chapter 3.2.9.5. – Source-specific recalculations, including changes made in response to the review process and at the Chapter 10 - Recalculations and improvements levels;

3.2.9.5. Source- specific recalculation, if applicable, including changes made in response to the review process

- activity data
  - 1AA.4.A – Commercial-Institutional – Gaseous fuels (refinery gas), for 2008 the emissions values were corrected because NIS revised EB.

Table 3.14 ***Change made at activity data and their effects on emission estimates:***

Year	Sub-sector	Changes at AD values level (TJ)		Effects of changes on emission estimates for CO_2 (Gg)		Differences (%)
		NIR 2010 v.3.2. submissions	NIR 2011 v.1.2. submissions	NIR 2010 v.3.2. submissions	NIR 2011 v.1.2. submissions	
2008	1AA.4.A – Commercial-Institutional – Gaseous fuels (refinary gas)	9.2	0	0.51	0	-100%

  - 1AA.4.A – Commercial-Institutional – Other fuels - notation key "NE" was changed in "NO" for 2009

3.2.9.6. Source- specific planned improvements, if applicable

We will try to obtain more detailed data, in respect to the IPCC GPG 2000 provisions. A study on developing national EF, by each fuel type, was approved and is underway; in parallel was try to obtain (through calculation) an EF specific to each fuel type, using the ETS data.

The results were used in the sub-sector "Electricity & heat production “, "Manufacturing Industrie & Constr.”, “Commercial/Institutional”, “Residential” and Agriculture/Forestry/ Fischeries” by passing the tier T_2 for CO_2 emissions. Data validations complete the study three years ago in establishing emission factors for fuels. In 2011 Romania will propose the use of national emission factors (EF) on fuel type and will using results study for national emission factors, the values obtained from ongoing studies for CH_4 and N_2O emissions.

3.3. Fugitive emissions from solid fuels and oil and natural gas (CRF 1.B)

3.3.1. Fugitive emissions from fuels (CRF sector 1.B.1-2)

3.3.1.1. Source category description

This section describes fugitive emission of greenhouse gases (CH_4) from coal, oil and natural gas activities.

The activity data are provided by the Statistical Yearbook (for the solid fuels) and by the Energy Balance (for oil and natural gas), both from the National Institute for Statistics.
Emission factors used are the default emission factors from the methodology.

Fugitive emissions have been characterized within the1B2B3 – Transmission category and they are resulting from maintenance operations at the natural gas transit pipelines through Romania.

The activity data are received from TRANSGAZ, the quantity of methane gas being calculated as annual emission. For the calculation of CH_4 emissions the following formula has been used:

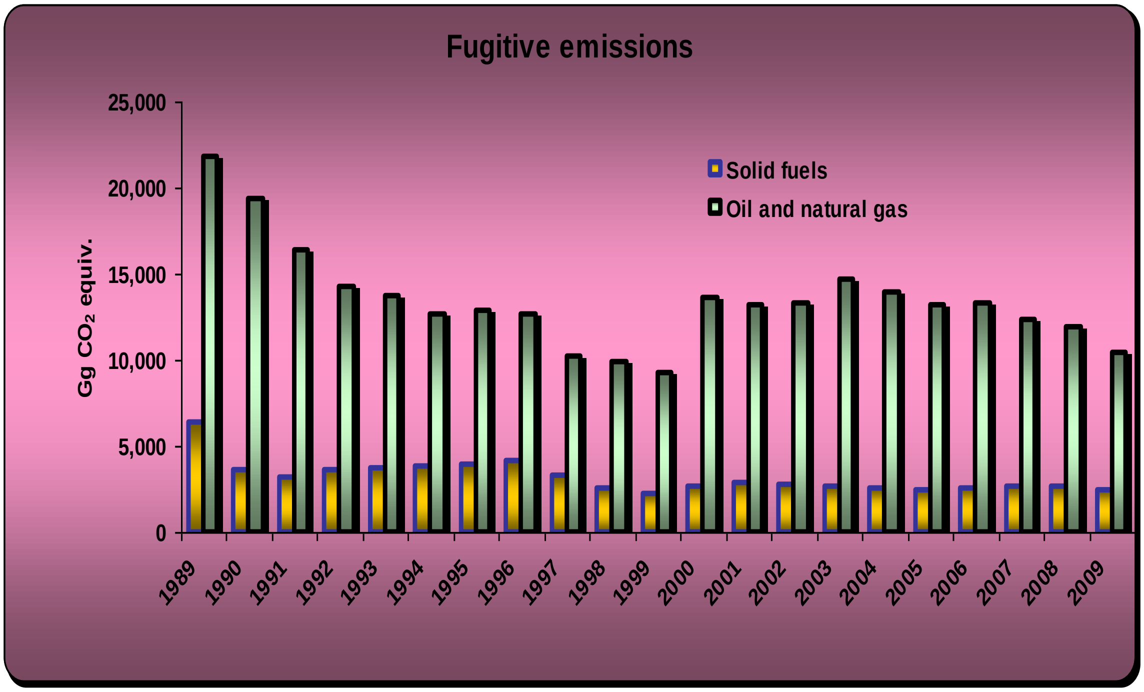
$$\text{Emission}_{\mathrm{CH_4}} = C_{CH_4} * \text{Transformation factor} * \text{Conversion factor}$$

where:

- C_{CH4} = quantity by CH_4 reported by TRANSGAZ as annual emission;
- Conversion factor Nm^3 in m^3 = > 1 Nm^3 =1.054945 m^3;
- The conversion factor converts volume of CH_4 in Gg => 6.7 x 10^{-7} Gg/mc (as per: 1996

IPCC Guidelines for National Greenhouse Gas Inventories: Workbook, page 1.26).
A recalculation was made for 2000-2009 because TRANSGAZ began monitoring the loss of CH_4 during maintenance operations since 2000, this being the first time the natural gas transit fugitive emissions being characterized.

Figure 3.21 Fugitive emissions trend for the 1989-2009 period



3.3.1.2. Methodological issues

1.B.1. Coal mining and handling:

During coal mining, and also during coal handling, methane is being released into atmosphere, as fugitive emissions (methane trapped in coal during the fossil fuel formation process).

In Romania, the coal is being extracted from surface and from underground mines.

The activity data used in estimating GHG emissions are taken from the Romanian Statistical Yearbook (chapter 16.3 "production of the main industrial products", mined coal). Statistical data available only for 2002 and 2003 indicates that the shares of underground-mined coal, and surface mined coal is the following:

- Hard coal and 15% of the lignite (including brown coal) is extracted from underground mines;
- 85% of the lignite (including brown coal) is extracted from surface mines.

These shares have been used for the entire 1989-2009 time series.

1.B.2. Oil and natural gas:

During oil and natural gas extraction, transport/distribution and refining, methane is released into atmosphere as fugitive emissions.

Emissions are estimated, using activity data from the energy balance, as follows:

- For fugitive emissions from oil:
  - production: production (row 1 of the Energy Balance);
  - transport: production (row 1), import (row 2) and export (row 5);
  - refining/ storage: transformation inputs (row 9), and emission factor used is combined: $EF_{refining} + EF_{storage}$.

Until the year 2009 have not been estimated emissions of greenhouse gases because from they are not specified in the IPCC emission factors for CO_2 for Eastern Europe.

In revising for the 2011 NGHGI, the European Commission has proposed an adjustment to the emissions of greenhouse gases using CO_2 emission factor used by Bulgaria, namely 68 089 kg CO_2/PJ for "oil production" and 68.5 kg CO_2/PJ for "Oil Transportation".

The proposed methodology was assimilated in Romania and is subject to recalculations for "oil production" and "Transport oil"as described in 3.3.1.5 section.

- For fugitive emissions from natural gas:
  - production/processing: production (row 1);
  - transmission: production (row 1) and import (row 2);
  - other leakage, industrial plants and power stations: conventional thermal power stations (row 10), heat plants (row 12) and industry (row 38) consumptions;
  - other leakage, residential and commercial sectors: residential (row 58) and commercial/institutional (row 60) consumptions.

Until the year 2009 have not been estimated emissions of greenhouse gases because they are not specified in the IPCC emission factors for CO_2 for Eastern Europe.

In revising for the 2011 NGHGI, the European Commission has proposed an adjustment to the emissions of greenhouse gases using CO_2 emission factor used by Bulgaria, namely 3208 kg CO_2/PJ for "Natural Gas Production" and 2331.52 kg CO_2/PJ for "Natural Gas Transport".
The proposed methodology was assimilated in Romania and is subject to recalculations for "Natural Gas Production" and "Natural Gas Transmission" as described in 3.3.1.5 section.

- For fugitive emissions from venting, natural gas: gas production.

The GHG emissions trend is due to the same trend in activity data (mostly data regarding production of natural gas and other leakages from industrial fuel consumption).
This general decreasing trend for the entire 1989-2009 time series, and in particular during the period 1989-1994 is due to a number of factors such as:

- The decrease of the natural gas national reserves
- Closing unprofitable economic enterprises (after 1989 an analysis was conducted in terms of energy efficiency of industrial processes, therefore, a number of industrial users have been closed)
- Increase energy efficiency at the end consumer by changing the old technologies with new technologies, decreasing energy consumption in large cities due to drastic decline in thermal energy demand from industrial consumers, but also because disconnection of households from the public system of centralized supply of heat, combined with the increasing trend of using individual apartment heating systems
- Increase of the price of natural gas.

4. Until the year 2009 have not been estimated emissions of greenhouse gases because they are not specified in the IPCC emission factor for CO_2 for Eastern Europe.
5. In revising for the 2011 NGHGI, European Commission has proposed an adjustment to the emissions of greenhouse gases CO_2 and CH_4 using the emission factor use of Bulgaria.
6. The emission factors proposed by the European Commission for "Oil Venting - 1.B.2.C.1.1.

Table 3.15 The emission factors proposed by the European Commission for "Oil Venting - 1.B.2.C.1.1.

Year	Emission factor for CH_4	Emission factor for CO_2
1990	295,330.7	61,348.9
1991	297,040.3	61,704.0
1992	292,022.9	60,661.8
1993	295,760.4	61,438.1
1994	296,107.1	61,510.2
1995	295,619.7	61,408.9
1996	293,895.2	61,050.7
1997	303,992.2	63,148.1
1998	293,910.8	61,053.9
1999	293,299.2	60,926.9
2000	293,432.3	60,954.5
2001	293,514.7	60,971.7
2002	294,360.6	61,147.4
2003	294,005.5	61,073.6
2004	293,319.1	60,931.0
2005	294,922.2	61,264.0
2006	294,082.0	61,089.5
2007	294,284.6	61,131.6
2008	293,394.8	60,946.7
2009	283,264.1	58,842.3

The proposed methodology was assimilated in Romania and is subject to recalculations for "Natural Gas Production" and "Natural Gas Transmission" as described in 3.3.1.5 section.

3.3.1.3. Uncertainties and time- series consistency

In calculating uncertainties, the categories corresponding to fugitive emissions are fugitive emissions-solid fuels (with a combined uncertainty estimated to about 250%) and fugitive emissions-oil and natural gas (with about 300% combined uncertainty).

The uncertainties used in calculating combined uncertainty are:

- activity data uncertainty (5%) – based on information from the National Institute for Statistics, declaring that the system used in aggregating statistical data has a sampling error of about 3-5%;

- emission factors (300% for oil and natural gas, 250% for solid fuels) using expert judgment.

Because the same activity data source was used (Energy Balance), emissions factors are the ones indicated in the IPCC methodology, for the entire period, the time series is considered consistent.

- EC proposed activity data are taken from EUROSTAT, and emission factors are asimilation from the CRF tables of Bulgaria. As in last year Eurostat update is 2008, data were extrapolated for the years 2009, and for 2012 will be updated using new recalculation.

3.3.1.4. Source-specific QA/QC and verification, if applicable

All the activities specified/described in the QA/QC program, regarding quality control were undertaken.

The activities have been performed by the Romanian Energy sector expert of the GHG Inventory, the results of this activities being mentioned in the Check Lists.

The unconformities noted and solved following these activities are described in the Chapter 3.3.1.5 – Source-specific recalculations, including changes made in response to the review process and at the Chapter 10 - Recalculations and improvements levels; the quantitative effects of their solving are described at the Chapter 3.3.1.5. – Source-specific recalculations, including changes made in response to the review process.

No recalculations were needed following the QA activities developed under the procedures for the compilation of the European Community GHG Inventory, described in the Decision 280/2004/EC of the European Parliament and of the Council and Decision 166/2005/EC of the European Commission.

There were no unconformities noted following the UNFCCC review of the 2009 submission of the NGHGI.

3.3.1.5. Source- specific recalculation, if applicable, including changes made in response to the review process

Changes have occurred to the notation key for sub-sector 1 AA.1.B

- activity data
  - 1 AA.1.B. - Petroleum Refinery – Other fuels - notation key "NE" was changed in "NO" for 2009 because in this domain no consumption ofother fuels is occuring.
  - 1.B.2.A.2.-Production Oil

The adjustments proposed by the EC in activity data and CH_4 emissions from the oil production are shown in Table 3.12.

Table 3.16 The adjustments proposed by the EC in activity data and CH_4 emissions from the oil production

Year	Sub-sector	Changes at AD values level (TJ)		Effects of changes on emission estimates for CH_4 (Gg)		Differences (%)
		NIR 2010 v.3.2. submissions	NIR 2011 v.1.2. submissions	NIR 2010 v.3.2. submissions	NIR 2011 v.1.2. submissions	
1990	1.B.2.A.2.-Production Oil	NE	47.63769	NE	1019.35	100%
1991		NE	40.86556	NE	861.807	100%
1992		NE	40.49732	NE	763.0993	100%
1993		NE	40.94825	NE	737.0719	100%
1994		NE	40.84621	NE	686.306	100%
1995		NE	40.72446	NE	695.1363	100%
1996		NE	40.0077	NE	685.9663	100%
1997		NE	38.34716	NE	567.7411	100%
1998		NE	37.68817	NE	548.1722	100%
1999		NE	36.59888	NE	518.3426	100%
2000		NE	36.10127	NE	513.9658	100%
2001		NE	35.78074	NE	502.2503	100%
2002		NE	34.95151	NE	502.4704	100%
2003		NE	34.14539	NE	538.3015	100%
2004		NE	33.01795	NE	511.5044	100%
2005		NE	31.51903	NE	486.4607	100%
2006		NE	29.18509	NE	477.7242	100%
2007		NE	27.69401	NE	445.0546	100%
2008		NE	27.43334	NE	434.2992	100%
2009			25.60651		385.8058	100%

- 1.B.2.A.3 -Oil Transportation - adjustment made by the EC has helped EF calculation using the CO_2 used by Bulgaria in the CRF tables.

Table 3.17 1.B.2.A.3-Oil Transportation - adjustment made by the EC

Year	Sub-sector	Changes at AD values level (TJ)		Effects of changes on emission estimates for CO_2 (Gg)		Differences (%)
		NIR 2010 v.3.2. submissions	NIR 2011 v.1.2. submissions	NIR 2010 v.3.2. submissions	NIR 2011 v.1.2. submissions	
1990	1.B.2.A.3.- Transport Oil	974.7	974.7	NE	0.066806	100%
1991		617	617	NE	0.042289	100%
1992		555.4	555.4	NE	0.038067	100%
1993		600.9	600.9	NE	0.041186	100%
1994		625.5	625.5	NE	0.042872	100%
1995		647	647	NE	0.044345	100%
1996		580	580	NE	0.039753	100%
1997		519.8	519.8	NE	0.035627	100%
1998		519.8	519.8	NE	0.035627	100%
1999		441.1	441.1	NE	0.030233	100%
2000		456.95	456.95	NE	0.031319	100%
2001		487.6	487.6	NE	0.03342	100%
2002		515.47	515.47	NE	0.03533	100%
2003		459.934	459.934	NE	0.031524	100%
2004		540.273	540.273	NE	0.03703	100%
2005		586.6922	586.6922	NE	0.040212	100%
2006		568.3015	568.3015	NE	0.038951	100%
2007		551.9282	551.9282	NE	0.037829	100%
2008		545.8212	545.8212	NE	0.037411	100%
2009			472.3583		0.032375	100%

- Natural-Gas Production 1.B.2.B.2. - Adjustment made by EC for CO_2 emissions calculation using EF used by Bulgaria in CRF tables, are presented in Table 3.18.

Table 3.18 Natural -Gas Production 1.B.2.B.2. - Adjustment made by EC for CO_2 emissions calculation using EF used by Bulgaria in CRF tables

Year	Sub-sector	Changes at AD values level (TJ)		Effects of changes on emission estimates for CO_2 (Gg)		Differences (%)
		NIR 2010 v.3.2. submissions	NIR 2011 v.1.3. submissions	NIR 2010 v.3.2. submissions	NIR 2011 v.1.2. submissions	
1990	1.B.2.B.2.- Production Natural Gas	956.18	956.18	NE	3.067799	100%
1991		828	828	NE	2.656548	100%
1992		725.8	725.8	NE	2.32865	100%
1993		691.9	691.9	NE	2.219886	100%
1994		620.6	620.6	NE	1.991127	100%
1995		604.8	604.8	NE	1.940435	100%
1996		576.2	576.2	NE	1.848675	100%
1997		498.77	498.77	NE	1.600249	100%
1998		468.7	468.7	NE	1.503773	100%
1999		468.6	468.6	NE	1.503452	100%
2000		459.2	459.2	NE	1.473293	100%
2001		456	456	NE	1.463026	100%
2002		434.78	434.78	NE	1.394944	100%
2003		440.852	440.852	NE	1.414425	100%
2004		426.887	426.887	NE	1.36962	100%
2005		399.2899	399.2899	NE	1.281078	100%
2006		393.3852	393.3852	NE	1.262133	100%
2007		379.9759	379.9759	NE	1.219111	100%
2008		376.0569	376.0569	NE	1.206538	100%
2009			375.3267		1.204195	100%

- 1.B.2.B.3.-Transmission Natural Gas - The adjustment made by the EC helped calculation the emissions using EF for CO_2 used by Bulgaria in the CRF tables, presented in Table 3.19.

Table 3.19 1.B.2.B.3.-Transmission Natural Gas - The adjustment made by the EC

Year	**Sub-sector**	**Changes at AD values level (TJ)**		**Effects of changes on emission estimates for CO_2(Gg)**		**Differences (%)**
		NIR 2010 v.3.2. submissions	**NIR 2011 v.1.3. submissions**	**NIR 2010 v.3.2. submissions**	**NIR 2011 v.1.2. submissions**	
1990	1.B.2.B.3.-Transmission Natural Gas	322.2	322.2	NE	2.798127	100%
1991		276.01	276.01	NE	2.343178	100%
1992		280.3	280.3	NE	2.041712	100%
1993		283.5	283.5	NE	1.966171	100%
1994		285.5	285.5	NE	1.811591	100%
1995		284.65	284.65	NE	1.878039	100%
1996		280.5	280.5	NE	1.895526	100%
1997		268.6	268.6	NE	1.46093	100%
1998		268.6	268.6	NE	1.46093	100%
1999		261.4	261.4	NE	1.340391	100%
2000		257.7	257.7	NE	1.342084	100%
2001		255.6	255.6	NE	1.296337	100%
2002		249.18	249.18	NE	1.318071	100%
2003		241.581	241.581	NE	1.496157	100%
2004		234.12	234.12	NE	1.405151	100%
2005		223.0035	223.0035	NE	1.351517	100%
2006		205.046	205.046	NE	1.396426	100%
2007		194.7272	194.7272	NE	1.27428	100%
2008		193.4109	193.4109	NE	1.232433	100%
2009			183.799		1.040058	100%

3.3.1.6. Source- specific planned improvements, if applicable

We will try to obtain more detailed data, in respect to the IPCC GPG 2000 provisions.

4. INDUSTRIAL PROCESSES (CRF sector 2)

4.1. Overview of the sector

Only the process related emissions are considered in this sector; emissions due to fuel combustion in manufacturing industries are allocated in the IPCC Category 1A2 Fuel Combustion - Manufacturing Industries and Construction.

GHG emissions from industrial processes are grouped in the following sub-sectors: Mineral products (CRF 2.A), Chemical industry (CRF 2.B), Metal production (CRF 2.C), Consumption of halocarbons and SF_6 (CRF 2.F) and other production (CRF 2.D).

The GHG emissions reported in this sector are: CO_2, CH_4, N_2O, HFCs, PFCs and SF_6**.**

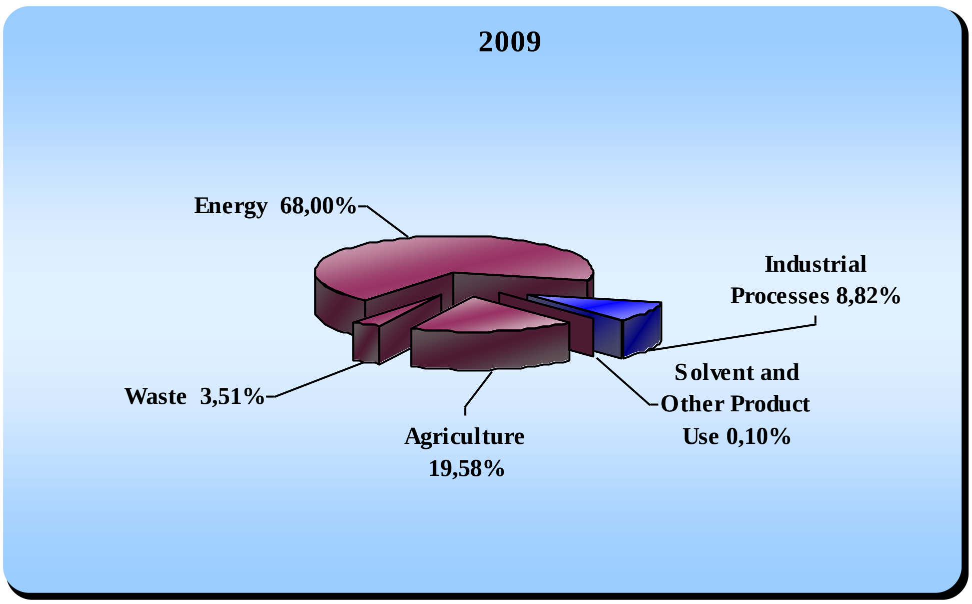
Table 4.3 Status of emissions estimation within the Industrial processes sector

2 INDUSTRIAL PROCESSES	**Emissions estimation status**			
IPCC category	**CO_2**	**CH_4**	**N_2O**	**PFC**
2 A MINERAL PRODUCTS				
2 A 1 CEMENT PRODUCTION	✓	NA	NA	NA
2 A 2 LIME PRODUCTION	✓	NA	NA	NA
2 A 3 LIMESTONE AND DOLOMITE USE	✓	NA	NA	NA
2 A 4 SODA ASH PRODUCTION AND USE	✓	NA	NA	NA
2 A 5 ASPHALT ROOFING	NE	NA	NA	NA
2 A 6 ROAD PAVING WITH ASPHALT	NE	NA	NA	NA
2 A 7 OTHER (GLASS PRODUCTION)	✓	NE	NE	NA
2 B CHEMICAL INDUSTRY				
2 B 1 AMMONIA PRODUCTION	✓	NE	NE	NA
2 B 2 NITRIC ACID PRODUCTION	NA	NA	✓	NA
2 B3 ADIPIC ACID PRODUCTION	NO	NO	NO	NO
2 B 4.1 SILICON CARBIDE PRODUCTION	IE	✓	NA	NA

2 INDUSTRIAL PROCESSES	**Emissions estimation status**			
IPCC category	**CO_2**	**CH_4**	**N_2O**	**PFC**
2 B 4.2 CALCIUM CARBIDE PRODUCTION	NO	NO	NO	NO
2 B 5 OTHER	NE	✓	NE	NA
2 C METAL PRODUCTION				
2 C 1 IRON AND STEEL PRODUCTION	✓	NE	NA	NA
2 C 2 FERROALLOYS PRODUCTION	✓	NE	NA	NA
2 C 3 ALUMINIUM PRODUCTION	✓	NE	NA	✓
2 C 4 SF6 USED IN ALUMINIUM AND MAGNESIUM FOUNDRIES	NO	NO	NO	NO
2 C 5 OTHER	NA	NA	NA	NA
2 D OTHER PRODUCTION				
2 D 1 PULP AND PAPER	NA	NA	NA	NA
2 D 2 FOOD AND DRINK	NE	NA	NA	NA
2 E PRODUCTION OF HALOCARBONS AND SULPHUR HEXAFLUORIDE				
2 E 1 BY-PRODUCT EMISSIONS	NO	NO	NO	NO
2 E 2 FUGITIVE EMISSIONS	NO	NO	NO	NO
2 E 3 OTHER	NO	NO	NO	NO
2 F CONSUMPTION OF HALOCARBONS AND SULPHUR HEXAFLUORIDE				
2 F 1 REFRIGERATION AND AIR CONDITIONING EQUIPMENT	NA	NA	NA	✓
2 F 2 FOAM BLOWING	NA	NA	NA	✓
2 F 3 FIRE EXTINGUISHERS	NA	NA	NA	✓
2 F 4 AEROSOLS	NA	NA	NA	✓
2 F 5 SOLVENTS	NA	NA	NA	✓
2 F 6 OTHER Please specify.	NA	NA	NA	✓
2 G OTHER	NA	NA	NA	NA

In 2009 the GHG emissions from Industrial Processes contributed with 8.82% to the total GHG emissions in Romania.

Figure 4.1 The contribution of Industrial Processes sector to the total GHG emissions in Romania, 2009



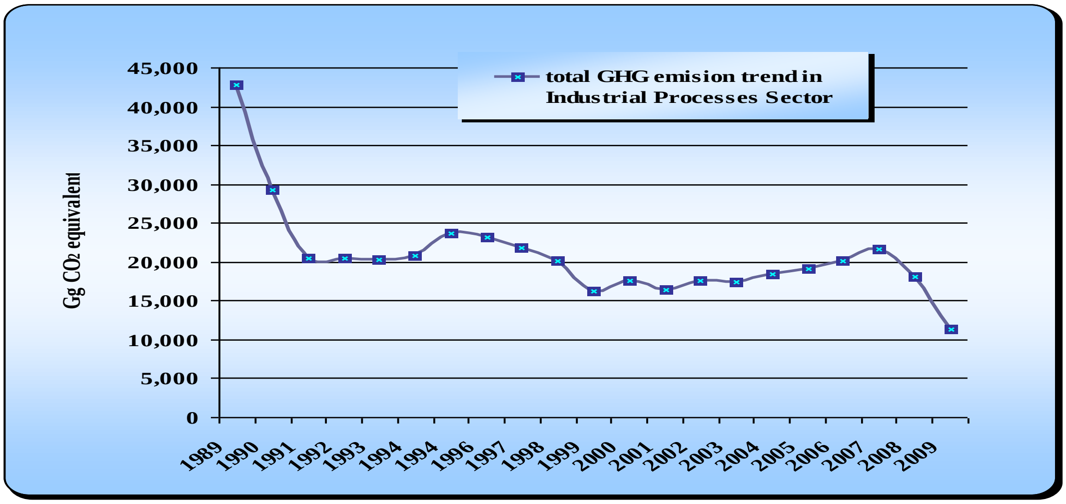
Emissions from this sector estimated in 2009 decreased by 73.42% compared with 1989 and with 37.33 % compared with 2008. The decrease from 1989 to 2009 is the result of the restructuration and privatization in various activity sectors. Starting with 2008 the trend of emission mainly decreased due to reduction of various productions. In 2009 the emissions trends had also decreased due to the economic crisis recorded in many activity areas.

After 1989 the whole Romania recorded a decrease within the Industrial Processes, because many categories of industrial production have decreased (chemical production, mineral production and metal production).

- Cement production, lime production, limestone and dolomite consumption, soda ash production and use, glass production recorded a decrease after 1989.
- Starting with 2004 the cement production has recorded a minor increase.
- In 2008 a minor decrease was recorded in consumption of limestone and dolomite level.

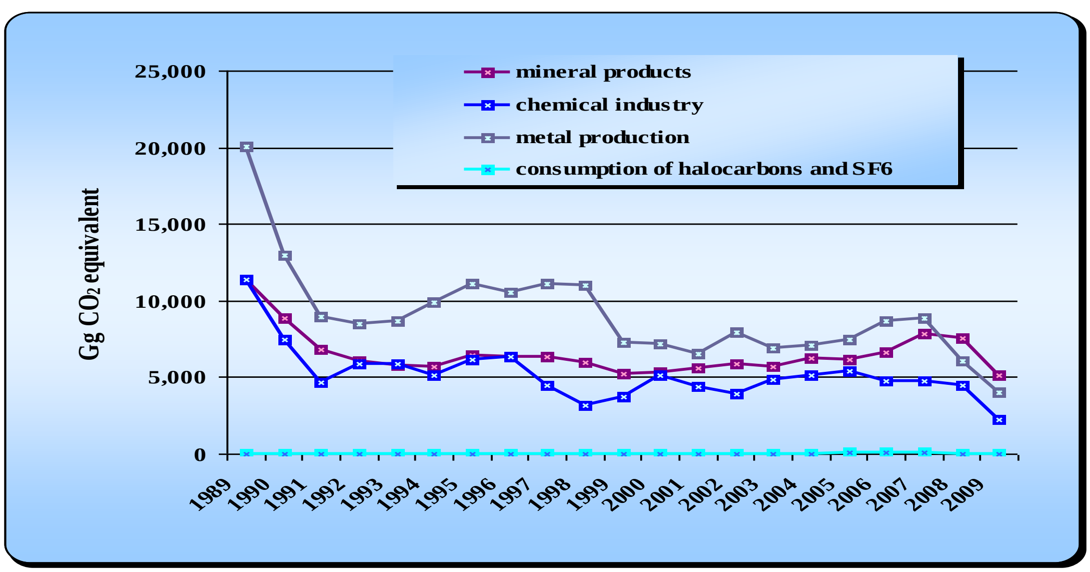
- The lowest level of emissions from ammonia production was recorded in 1998, due to the activity data whose level decreased by almost a half compared to the previous and next year. This happened as one producing plant has stopped its activity since 1998 and another plant has been closed in 1998 and reopened in the next year.
- Nitric acid production recorded a decrease after 1989.
- Adipic acid production stopped at the end of 2001. Starting with 2002, the activity was suspended.
- Calcium carbide production recorded a decrease after 1989 and the activity was suspended starting with 2007.
- Iron and steel production recorded a decrease after 1989.
- Ferroalloys production has recorded a decrease after 1989. The lowest level of emissions from ferroalloys production was recorded in 1999, due to the activity data whose level has decreased. This happened because ferroalloys production has stopped in 1999. In the next year (2000) the production was started again.
- The reduction of PFC emissions from production of aluminium due to changes in technologies, starting with 2003.
- In 2008 the trend of emission decreased due to reduction of production recorded for iron and steel production and ferroalloys production sub-sectors.
- For 2009 year a significant decrease of emissions level was recorded due to the economic crisis within many activity industries.

Figure 4.2 Total GHG emissions trend in Industrial Processes, for 1989–2009 period



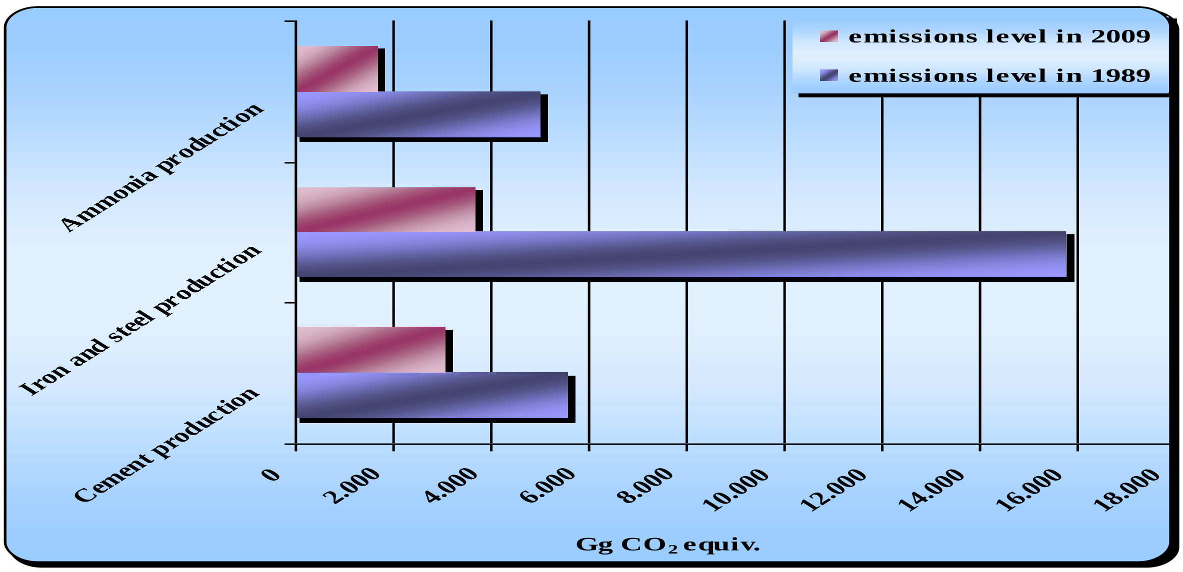
Metal production contributes with 35.20 % to the total GHG emissions from Industrial Processes in 2009. Mineral Product and Chemical Industry are the two other main contributing sectors with 44.82 % and 19.69 %, respectively, of the total GHG emissions in this sector. The contribution of Consumption of halocarbons and SF_6 to the overall sector is very low: 0.29 %.

Figure 4.3 GHG emissions trends in Industrial Processes, by sub-sectors, for 1989–2009 period



In the base year, various industrial processes sub-sectors contributions were: Mineral products 26.52%, Chemical industry 26.64%, and Metal production 46.84%, Consumption of halocarbons and SF_6 0%.

Figure 4.4 Key categories in Industrial Processes in 2009, both by level and trend criteria



The Tier 1 key category analysis performed for 2009 has revealed the following key categories:

Table 4.4 Key categories in industrial processes sector in 2009

2009						
CRF categories	**Key category**	**GHG**	**Criteria-excluding LULUCF**	**Contribution of Key categories in total GHG emissions [%]**	**Criteria-including LULUCF**	**Contribution of Key categories in total GHG emissions [%]**
2.B.1	**Ammonia production**	CO_2	L,T	1.33%	L,T	1.11%
2C.1	**Iron and steel production**	CO_2	L,T	2.86%	L,T	2.39%
2.A.2	**Lime production**	CO_2	L	1.22%	L	1.02%
2.A.3	**Limestone and dolomite use**	CO_2	T	0.28%	T	0.24%
2.A.1	**Cement production**	CO_2	L,T	2.40%	L,T	2.01%
2.B.2	**Nitric acid production**	N_2O	T	0.4%	T	0.34%
2.C.3	**Aluminium production**	PFC	T	0.01%	T	0.0046%

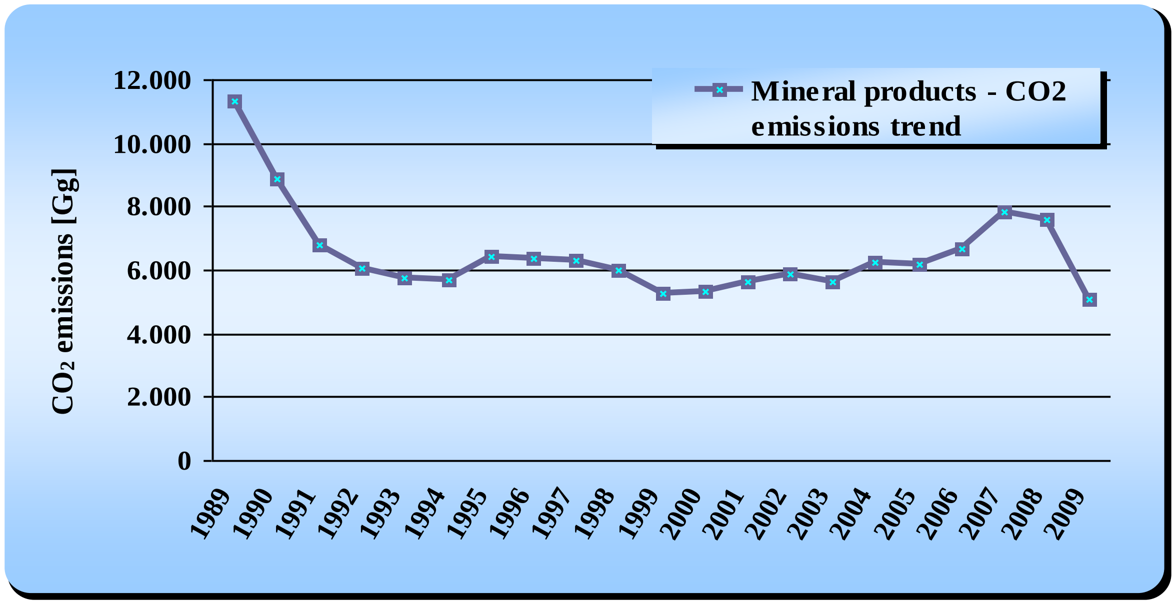
4.2. Source category Mineral products (CRF sector 2.A)

4.2.1. Source category description

GHG emissions reported include estimates for cement production (2A1), lime production (2A2), limestone and dolomite use (2A3), soda ash production and use (2A4), asphalt roofing (2A5) and road paving with asphalt (2A6) and other: glass production (2A7).

CO_2 emissions from cement production represent an important key category of the inventory because of its contribution to the total inventory emissions level (in 2009 CO_2 emissions from production of cement contributed with 2.40% to total greenhouse gas emissions). In the base year, these emissions accounted for 1.96% from the total GHG emissions.

Figure 4.5 GHG emissions trend in the Mineral Products sub-sector for 1989-2009 period [Gg CO_2]



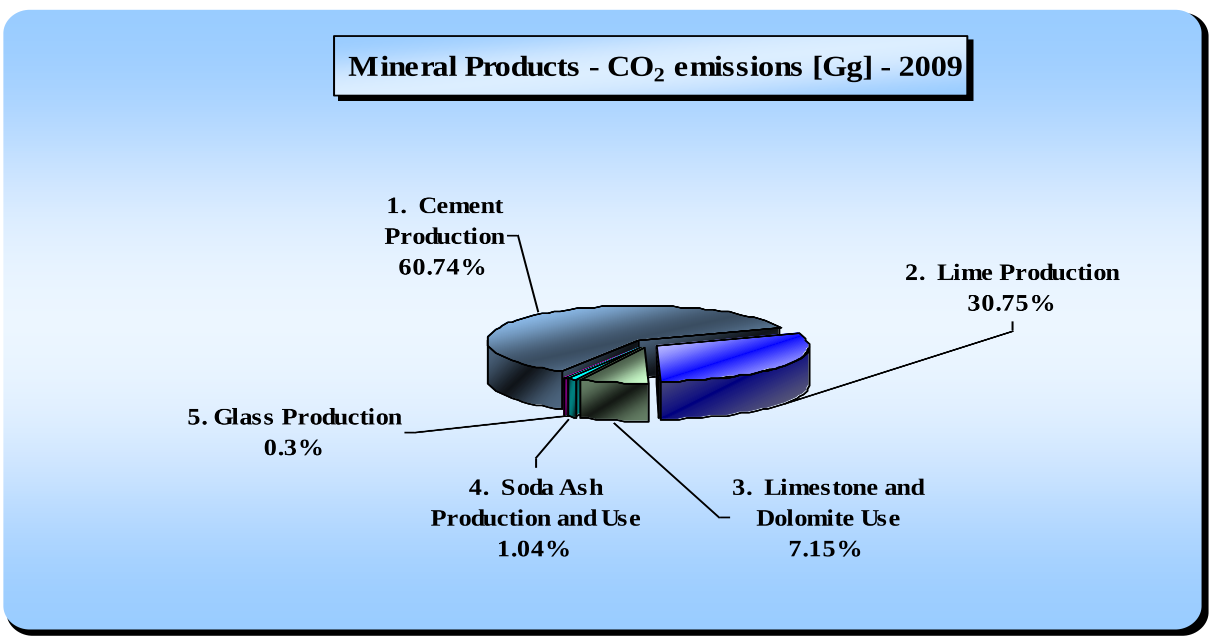
GHG emissions trend in the Mineral Products sub-sector was decreasing during 1989-2009 period due to the decrease recorded after 1989 in cement production, lime production, limestone and dolomite consumption, soda ash production and use, glass production; the emissions were relatively stable during 1993–2007. Starting with 2004 the cement production has recorded a minor increase. In 2009 a significant decrease of emissions level was recorded in cement, lime, limestone and dolomite, soda ash and glass industries due to the economic crisis.

Mineral products sub-sector was responsible for 44.82% of the Industrial Processes sector's GHG emissions in 2009.

Table 4.5 CO_2 emissions in the Mineral products sector, in the year 2009

Sector	CO_2 emissions [Gg]
2.A Mineral Products	5092.66
2.A.1 Cement Production	3093.07
2.A.2 Lime Production	1565.94
2.A.3 Limestone and Dolomite Use	363.88
2.A.4 Soda Ash Production and Use	52.81
2.A.7.1 Glass production	16.95

Figure 4.6 Structure of the Mineral products sub-sector, in 2009



4.2.2. Methodological issues

Cement production (2.A.1)

Methodology

The cement production is a key category from both level and trend point of view (excluding LULUCF). The method for calculating emissions of CO_2 from cement is in line with the IPCC GPG 2000 (Tier 2), considering the "Decision Tree for Estimation of CO_2 Emissions from Cement Production" from IPCC GPG 2000 - page 3.11 and taking into account all the parameters described below.

Activity data

The AD necessary to estimate emissions from this source category are provided by the economic agents (clinker production data) and the National Institute for Statistics (cement production).

Process specific CO_2 is emitted during the production of clinker (calcination process) when calcium carbonate ($CaCO_3$) is heated in a cement kiln. During this process calcium carbonate is converted into lime (CaO - Calcium Oxide) and CO_2. Activity data related to the calcinations process were collected directly from the companies:

- clinker production data was provided by each company 1989-2009 period;
- plant specific content of CaO (%) in clinker was provided by each companies (according with laboratory analyses) starting with 2008 year;
- plant specific content of MgO (%) in clinker was provided by each companies (according with laboratory analyses) starting with 2008 year;
- cement kiln dust (CKD) is completely recycled to the kiln. Two plants reported **a** correction factor for discarded amounts of dust: one of them for the period 1989-2003 and other plant for 2006, 2008 and 2009.

Emission factors

The CO_2 EF also estimated considering the issues from the “Decision Tree for Estimation of CO_2 Emissions from Cement Production” from IPCC GPG 2000 - page 3.11 and taking into account all the information provided by each cement company.

For the period 1989-2007 Romanian cement industry has monitored its CO_2 emissions compliance with the CO_2 Protocol developed by WBCSD (World Business Council for Sustainable Development). According with this Protocol the EF used is **0.525 t CO_2/t** clinker; the same EF was recommended within the IPCC Methodology.

For this period there is not representative monitoring of CaO and MgO content in clinker in order to be taken into account to estimate the plant specific CO_2 EF for clinker production**.**

Starting with 2008, analyses have been made for CaO and MgO content and can be considered as representative in order to be used for calculating CO_2 emissions or plant specific clinker EF (plant specific content of CaO and MgO -% in clinker was provided by each company - according with laboratory analyses). A weighted average related with the plant specific EF’s for clinker production is presented in the table 4.4.

CO_2 emissions from clinker are estimated using a combined **Tier 2** with **country specific method**, according to the formulas:

Equation 4.1 Calculation of CO_2 emissions from clinker

$$Emissions_{\,Clinker\ Production} = EF_{clinker} \times Clinker\ Production$$

Equation 4.2 Calculation of EF for clinker

Starting with 2008 EF for clinker is calculated based on IPCC formula:

$$EF_{clinker} = 0.785 \times CaO\ Content\ (Weight\ Fraction)\ in\ Clinker + 1.091 \times MgO\ Content\ (Weight\ Fraction)\ in\ Clinker$$

For 1989-2007 period the CO_2 emission factor use for clinker was 0.525 t CO_2/t clinker.

Equation 4.3 Calculation of CO_2 emissions from CKD (cement kiln dust)

$$Emissions\ CKD = EF_{CKD} \times amount\ of\ CKD \times CKD_{Correction\ Factor}$$

Emissions resulted from discarded cement kiln dust were calculated separately (this is the case for 1989-2003 period, 2006, 2008 and 2009 years), taking into account its degree of calcinations and added to the CO_2 emissions resulted from calcinations (the production of clinker). The correction factor for discarded amounts of dust varies between 1.00 and 1.13 and due to the small amount of CKD the same EF as clinker production 0.525 t CO_2 / t clinker was used.

Equation 4. 4 Calculation of CO_2 emissions

Emissions = Emissions from Clinker Production + Emissions from CKD

Starting with 2008 the figures related with clinker production, plant specific CO_2 EF for clinker production and CO_2 emissions from clinker production were compared with the data reported in monitoring plan of GHG emissions for the **EU-ETS cement production installations**. The data are similar.

Table 4.6 Clinker production data and CO_2 emissions from clinker production in the period 1989- 2009

Years	**Activity data and CO_2 emissions from Cement Production subsector (2.A.1) 2011 submission**		
	Clinker production [kt]	**Emission factor [tCO_2/tclinker]**	**CO_2 Emissions [Gg]**
1989	10571.00	0.525	5571.72
1990	8379.00	0.525	4415.68
1991	6037.00	0.525	3179.42
1992	5488.00	0.525	2886.60
1993	5349.00	0.525	2814.55
1994	5232.00	0.525	2752.45
1995	5937.82	0.525	3124.87
1996	6037.50	0.525	3178.71
1997	5669.27	0.525	2984.91
1998	5497.25	0.525	2896.51
1999	4971.03	0.525	2627.14
2000	5005.78	0.525	2638.26
2001	5218.31	0.525	2749.91
2002	4984.02	0.525	2624.48
2003	4995.76	0.525	2632.38
2004	5661.24	0.525	2972.15
2005	6006.96	0.525	3153.65
2006	6916.22	0.525	3631.21
2007	7670.40	0.525	4026.96
2008	7780.03	0.530	4142.66
2009	5801.76	0.531	3093.07

SO_2 emissions from cement production are estimated using the following formula:

Equation 4.5 Calculation emissions of SO_2 from cement

SO_2 [Gg] = Quantity of Cement Produced (t) x Emission Factor x 10-6

The default emission factor 0.3kg SO_2/tonne cement is used**.**

Table 4.7 Cement production data and SO_2 emissions from cement production in the period 1989- 2009

Years	Activity data and SO_2 emissions from Cement Production subsector (2.A.1) 2011 submission		
	Cement production [kt]	Emission factor[kg SO_2 /t cement]	SO_2 Emissions[Gg]
1989	12225.00	0.30	3.67
1990	9468.00	0.30	2.84
1991	6692.00	0.30	2.01
1992	6271.00	0.30	1.88
1993	6158.00	0.30	1.85
1994	5998.00	0.30	1.80
1995	6842.00	0.30	2.05
1996	6956.00	0.30	2.09
1997	6553.00	0.30	1.97
1998	6577.00	0.30	1.97
1999	5580.00	0.30	1.67
2000	6058.00	0.30	1.82
2001	5668.00	0.30	1.70
2002	5680.00	0.30	1.70
2003	5992.00	0.30	1.80
2004	6239.00	0.30	1.87
2005	7043.00	0.30	2.11
2006	8253.00	0.30	2.48
2007	10060.00	0.30	3.02
2008	10660.00	0.30	3.20
2009	7902.00	0.30	2.37

The amount of cement produced is provided by the National Institute for Statistics. The data set in case of cement production is complete.

Lime production (2.A.2)

Methodology

The lime production is a key category only considering the level criteria.

Total CO_2 emissions from lime production were estimated using production data and the emission factors, in line with the Good Practice Guidance - IPCC GPG 2000, considering the "Decision Tree for lime production" from IPCC GPG 2000 - page 3.21 and taking into account the information from "Table 3.4 - Basic Parameters for the Calculation of Emission Factors for Lime Production "– page 3.22 (IPCC GPG 2000).

Activity data

The ADs necessary to estimate emissions from this source category (quicklime and dolomite lime) are provided by the National Statistics. The data set in case of dolomite lime production is not complete; the data for 1989-1991 are missing.

A linear extrapolation was used to estimate dolomite lime production for 1989-1991 in order to complete the time series. The production data are broken down by quicklime and dolomite lime as type of lime and there is no information about the commercial and captive lime production. The NIS provides only the national total production data on quicklime and dolomite lime.

Starting with 2007 the data related with lime production are confidential.

Emission factors

The CO_2 EF's are estimated considering the Equations 3.4, 3.5A, 3.5 B, from IPCC GPG 2000, page 3.20. taking into account the default values from" Table 3.4 - Basic Parameters for the Calculation of Emission Factors for Lime Production " – page 3.22 (IPCC GPG 2000).

For confidentiality reasons the presentation of CO_2 emission factor used to estimate emission from lime production is omitted.

Table 4.8 CO_2 emissions from lime production in the period 1989-2009

Year	**Emissions from Lime Production subsector (2.A.2) 2011 submission**
	CO_2 emissions [Gg]
1989	3810.03
1990	3079.97
1991	2538.15
1992	2131.90
1993	2002.94
1994	1972.52
1995	2197.02
1996	2129.78
1997	2102.86
1998	2056.60
1999	1842.79
2000	1829.65
2001	1921.54
2002	2147.65
2003	2031.61
2004	2131.59
2005	1982.07
2006	1974.76
2007	2767.49
2008	2662.19
2009	1565.94

Limestone and dolomite use (2.A.3)

Methodology

The IPCC methodology has been followed for estimating the CO_2 emissions from limestone and dolomite used. According with IPCC 1996 and GPG 2000 Methodology there are no described methods in order to estimate the CO_2 emissions on higher levels, therefore it was followed the methodology from Revised 1996 IPCC Guidelines for National GHG Inventories: Workbook, page 2.6 and Revised 1996 IPCC Guidelines for National GHG Inventories: Reference Manual, page 2.10.

The method estimates the amount of limestone and dolomite used in the iron and steel production, pulp and paper production, sugar mills production, ceramics plants, for all-time series.

Activity data

The activity data were provided directly by the plants (iron and steel producers, pulp and paper producers, sugar mills producers, ceramics producers).

In order to estimate CO_2 emissions from limestone and dolomite used subsector it was made a questionnaire which it was sent to the local environmental protection agencies. Each agency manages all economic agents which are in its responsibility (iron and steel producers, pulp and paper producers, sugar mills producers, ceramics producers) in order to complete the needed data. The completed questionnaire has been sent to NEPA where the data are aggregated.

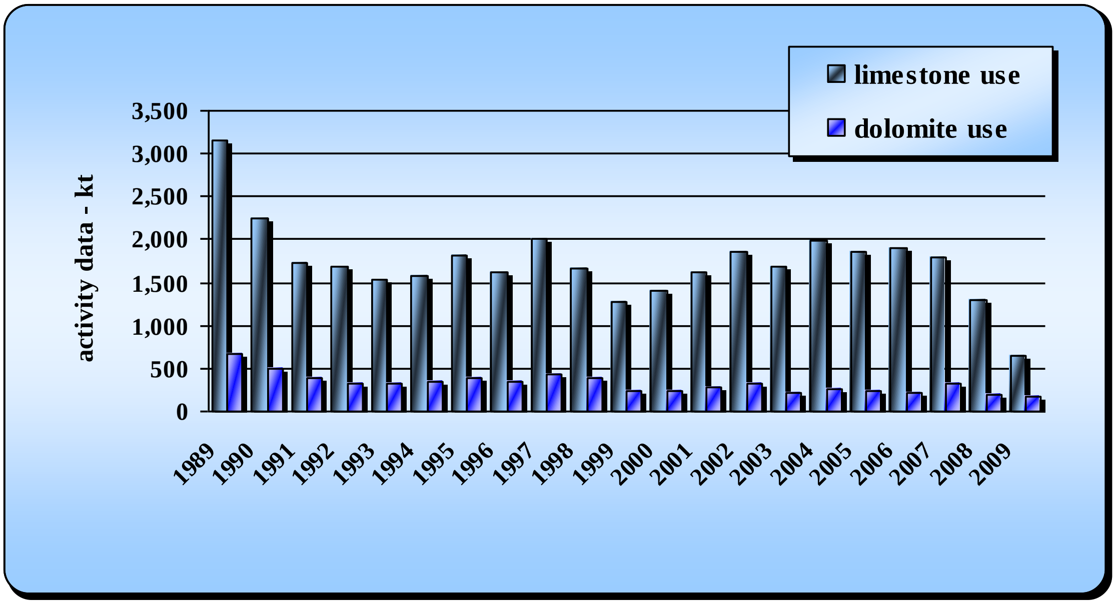
Table 4.9 Amount of limestone and dolomite used and CO_2 emissions in the period 1989-2009

Year	Activity data from Limestone and Dolomite Use subsector (2.A.3) 2011 submission			
	Limestone use	**Dolomite use**	**Total limestone and dolomite consumption**	**CO_2 emission from limestone and dolomite consumption**
	[kt]			**[Gg]**
1989	3148.89	680.28	3829.17	1710.01
1990	2244.56	489.84	2734.40	1221.26
1991	1721.31	386.41	2107.72	941.69
1992	1687.14	323.59	2010.73	896.69
1993	1525.24	330.03	1855.27	828.53
1994	1581.70	335.71	1917.41	856.08
1995	1815.37	382.23	2197.60	981.08
1996	1628.11	354.48	1982.59	885.45
1997	1998.62	421.32	2419.94	1080.36
1998	1658.89	384.09	2042.98	913.12
1999	1266.73	241.20	1507.94	672.42
2000	1410.08	242.75	1652.84	736.23
2001	1625.89	272.90	1898.79	845.57
2002	1867.23	319.13	2186.36	973.81
2003	1691.64	219.40	1911.04	848.97
2004	1981.16	264.95	2246.11	998.09
2005	1848.52	247.50	2096.02	931.41
2006	1909.57	221.73	2131.30	945.98
2007	1790.28	332.00	2122.27	946.08
2008	1300.54	201.27	1501.80	668.24
2009	644.11	168.70	812.81	363.88

Emission factors

The default emission factors 477 kg CO_2/tonne dolomite and 440 kg CO_2/tonne limestone are used.

Figure 4.7 Amount of limestone and dolomite used, related with iron and steel production, pulp and paper production, sugar mills production, ceramics plants in the period 1989-2009



Soda ash production and use (2.A.4)

Methodology

According with IPCC 1996 and GPG 2000 Methodology there are no described methods in order to estimate the CO_2 emissions on higher levels, therefore it was followed the methodology from Revised 1996 IPCC Guidelines for National GHG Inventories: Workbook, page 2.8 and Revised 1996 IPCC Guidelines for National GHG Inventories: Reference Manual, pages 2.12-2.13.

Total CO_2 emissions from soda ash production were estimated using the quantity of trona utilized and the emission factor, in line with the IPCC 1996. CO_2 emission from soda ash use were estimated using the data provided directly from economic agents which use soda ash in their activities and the default emission factor, line with the IPCC 1996.

Activity data

Soda ash production data are annually provided by the National Statistics. Starting with 2007 the data related with soda ash production are confidential.

Data on soda ash use were provided directly from economic agents who use soda ash in theirs activities (the soda ash consumption data has been provided by pulp and paper producers, chemicals producers, flue gas desulphurization, water treatment, and soap and detergents producers).

In order to estimate CO_2 emissions from soda ash use subsector it was made a questionnaire which it was sent to the local environmental protection agencies. Each agency manages all economic agents which are in its responsibility (pulp and paper producers, chemicals producers, flue gas desulphurization, water treatment, and soap and detergents producers) in order to complete the needed data. The completed questionnaire has been sent to NEPA where the data are aggregated.

Emission factors

The default emission factors for soda ash use 415 kg CO_2 / tonne of soda ash use is used.

For confidentiality reasons the presentation of CO_2 emission factor used to estimate emission from soda ash production is omitted.

Figure 4.8 CO_2 emissions from soda ash production and use in the period 1989-2009

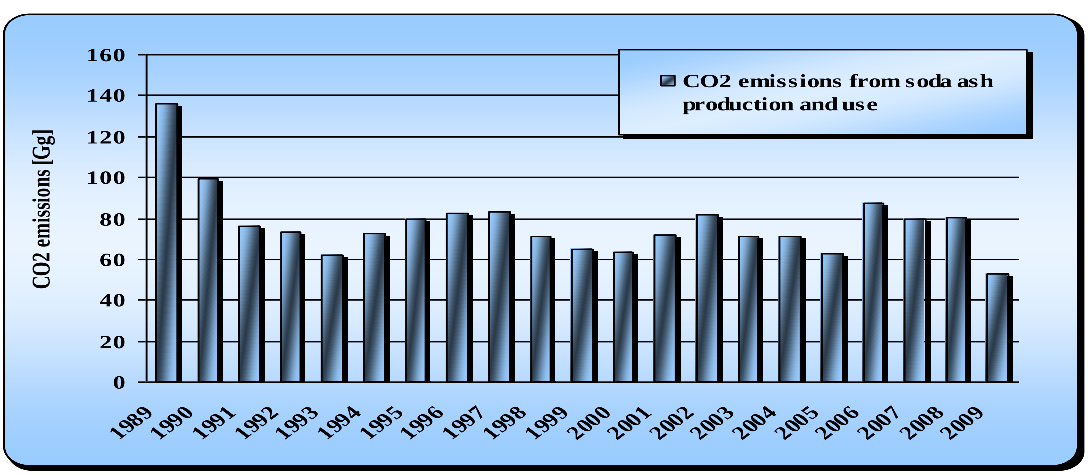


Table 4.10 CO_2 emissions from soda ash production and use in the period 1989-2009

Year	Emissions from Soda Ash Production and Use subsector (2.A.4) 2011 submission
	CO_2 emissions [Gg]
1989	136.35
1990	99.11
1991	75.90
1992	73.38
1993	61.92
1994	72.59
1995	79.43
1996	82.54
1997	83.08
1998	71.20
1999	64.88
2000	63.20
2001	72.18
2002	81.66
2003	71.43
2004	71.54
2005	62.71
2006	87.34
2007	79.84
2008	80.58
2009	52.81

Asphalt roofing production (2.A.5)

Methodology

The default 1996 IPCC methodology for estimation the emissions from asphalt roofing production sub-sector has been used. According with IPCC 1996 and GPG 2000 Methodology there are no described methods in order to estimate the NMVOC emissions on higher levels, therefore it was followed the methodology from Revised 1996 IPCC Guidelines for National GHG Inventories: Workbook, page 2.9, tables 2-2 and 2-3.

Activity data

The data on asphalt roofing production sub-sector are provided by National statistics. These data are available starting with 2007 year. The data taking into account in order to estimate CO and NMVOC emissions are: petroleum bitumen for materials insulation, petroleum bitumen for pipelines insulation, products based on bitumen – waterproofing, bitumen oil for industry. Starting with 2007 the data related with asphalt roofing production are confidential.

Emission factors

The default IPCC emission factors were used in order to estimate NMVOC and CO emissions.

Table 4.11 Emission factors for NMVOC, CO from Asphalt roofing production sector

EMISIONS FACTORS FOR ASPHALT ROOFING PRODUCTION – SATURATION PROCES [Kg/tone product]	
NMVOC	**0.0475**
CO	**0.0095**
EMISIONS FACTORS FOR ASPHALT BLOWING PROCESS – no control [Kg/tone product]	
NMVOC	**2.4**

Road paving with asphalt (2.A.6)

Methodology

The default 1996 IPCC methodology for estimation the emissions from road paving with asphalt sub-sector has been used. According with IPCC 1996 and GPG 2000 Methodology there are no described methods in order to estimate the NMVOC emissions on higher levels, therefore it was followed the methodology from Revised 1996 IPCC Guidelines for National GHG Inventories: Reference Manual, page 2.14, table 2-4.

Activity data

The data on road paving with asphalt sub-sector are provided by National statistics. These data are available starting with 1998 year. The activity data taking into account in order to estimate NMVOC emissions are: natural bitumen and asphaltic rocks, bituminous mixtures based on natural or artificial aggregate and bitumen or natural asphalt, petroleum bitumen road. Starting with 2007 the data related with road paving with asphalt are confidential.

Emission factors

The default IPCC emission factor was used in order to estimate NMVOC emissions.

Others: glass production (2.A.7.1)

Methodology

CO_2 emissions are estimated for both container glass and flat glass. Total emissions from glass production were estimated using production data and the emission factors, in line with CORINAIR methodology. According with IPCC 1996 and GPG 2000 Methodology there are no described methods in order to estimate the CO_2 emissions,, therefore it was followed the CORINAIR methodology.

Activity data

Emissions are estimated for both container glass and flat glass based on data provided by National Statistics. Starting with 2007 the data related with container glass and flat glass production are confidential.

Emission factors

For confidentiality reasons the presentation of CO_2 and NMVOC emission factors used to estimate emission from both container glass and flat glass production are omitted.

Table 4.12 CO_2 emissions from Container glass and flat glass production in the period 1989-2009

Year	**Emissions from Glass Production subsector (2.A.7.1) 2011 submission**
	CO_2 emissions [Gg]
1989	109.75
1990	85.95
1991	69.70
1992	61.70
1993	56.95
1994	53.75
1995	59.85
1996	61.10
1997	48.70
1998	45.70
1999	33.15
2000	40.35
2001	42.50
2002	49.50
2003	64.25
2004	45.20
2005	35.35
2006	30.10
2007	25.55
2008	23.70
2009	16.95

4.2.3. Uncertainties and time series consistency

Cement production (2.A.1)

Time series is consistent; emissions have been calculated using the same emission factors, the same sources of activity data and the same methods for the entire time series 1989-2009.
The uncertainty related to the activity data for CO_2 emissions is 1.5% (based on clinker production data) in line with the IPCC 2006 and the uncertainty associated with emission factor

for CO_2 is 1.5 % in line with the IPCC Good Practice Guidance (based on plant specific CaO and MgO content in clinker) **(**Table 3.2.).
Aggregated uncertainty value: the overall uncertainty resulted after aggregation of the AD and EF uncertainties according to the previsions in chapter 6 of IPCC GPG 2000 is 2.12%.

Lime production (2.A.2)

Time series is consistent; emissions have been calculated using the same emission factors, the same sources of activity data and the same methods for the entire time series 1989-2009.

The uncertainty related to the activity data for CO_2 emissions is 2% in line with the IPCC 2006 and the uncertainty associated with emission factor for CO_2 emissions is ± 2% in line with the IPCC Good Practice Guidance.
Aggregated uncertainty value: the overall uncertainty resulted after aggregation of the AD and EF uncertainties according to the previsions in chapter 6 of IPCC GPG 2000 is 2.83%.

Limestone and dolomite use (2.A.3)

Time series is consistent; emissions have been calculated using the same emission factors, the same sources of activity data and the same methods for the entire time series 1989-2009.
By expert judgment the uncertainty related to the activity data for CO_2 emissions is 7.5% and the uncertainty associated with emission factor for CO_2 emissions is 30%.

Aggregated uncertainty value: the overall uncertainty resulted after aggregation of the AD and EF uncertainties according to the previsions in chapter 6 of IPCC GPG 2000 is 30.92%.

Soda ash production and use (2.A.4)

Time series is consistent; emissions have been calculated using the same emission factors, the same sources of activity data and the same methods for the entire time series 1989-2009.
By expert judgment the uncertainty related to the activity data for CO_2 emissions is 7.5% and the uncertainty associated with emission factor for CO_2 emissions is 30%.
Aggregated uncertainty value: the overall uncertainty resulted after aggregation of the AD and EF uncertainties according to the previsions in chapter 6 of IPCC GPG 2000 is 30.92%.

Glass production (2.A.7.1)

Time series is consistent; emissions have been calculated using the same emission factors, the same sources of activity data and the same methods for the entire time series 1989-2009.

The uncertainty related to the activity data for CO_2 emissions is 5% and the uncertainty associated with emission factor for CO_2 emissions is 60%.

The uncertainty associated with emission factor and activity data are in line with the IPCC 2006.

Aggregated uncertainty value: the overall uncertainty resulted after aggregation of the AD and EF uncertainties according to the previsions in chapter 6 of IPCC GPG 2000 is 60.21%.

4.2.4. Source specific QA/QC and verification

All activities regarding quality control (QC) as described in QA/QC Program have been undertaken.

These activities have been accomplished by the Romanian Industrial Processes sector expert, activity results of these actions being mentioned in Check lists. After these activities unconformities have not been notified.

Starting with 2008 year the data used in order to estimate CO_2 emissions from clinker production were compared with the data reported in monitoring plans of GHG emissions for the **EU-ETS cement production installations**. The data are similar.

In order to improve the accuracy of activity data, emission factors and emissions have been developed new approaches, which are presented in sub sectors "recalculation specific sources" and Chapter 10.

No recalculations were needed following the QA activities developed under the procedures for the compilation of the European Community GHG Inventory, described in the Decision 280/2004/EC of the European Parliament and of the Council, and Decision 166/2005/EC of the European Commission.

All notified and solved recommendations following various QA/QC activities are described in Improvement Lists.

4.2.5. Source specific recalculation, including changes made in response to the review process

Cement production (2.A.1)

Change in the notation keys (NK) for all-time series 1989-2008 as the CO_2 recovery notation keys for the Cement production sub-sector was changed from NE in NO.

Lime production (2.A.2)

Change in the notation keys (NK) for all-time series 1989-2008 as the CO_2 recovery notation keys for the Lime production sub-sector was changed from NE in NO.

Limestone and Dolomite use (2.A.3)

Change in notation keys (NK) for all-time series 1989-2008 as the CO_2 recovery notation keys for the Limestone and Dolomite use sub-sector was changed from NE in NO.

Soda ash production and use (2.A.4)

Change in notation keys (NK) for all-time series 1989-2008 as the CO_2 recovery notation keys for the Soda ash production and use sub-sector was changed from NE in NO.

Asphalt roofing (2.A.5)

Recalculation for 2007-2008 time series in AD for asphalt roofing sub-sector, as it was identified a new source of data in order to estimate the CO and NMVOC emissions starting with 2011 submission (2.A.5);

Table 4.13 Recalculations of CO and NMVOC emissions [Gg] in the Asphalt roofing sub-sector

The effects of recalculations in Asphalt roofing sub sector (2.A.5)						
Years	**2010 submission**	**2011 submission**	**Diff. [%]**	**2010 submission**	**2011 submission**	**Diff. [%]**
	NMVOC emissions [Gg]			**CO emissions [Gg]**		
1989	NE	NE	NE	NE	NE	NE
1990	NE	NE	NE	NE	NE	NE
1991	NE	NE	NE	NE	NE	NE
1992	NE	NE	NE	NE	NE	NE
1993	NE	NE	NE	NE	NE	NE
1994	NE	NE	NE	NE	NE	NE
1995	NE	NE	NE	NE	NE	NE
1996	NE	NE	NE	NE	NE	NE
1997	NE	NE	NE	NE	NE	NE
1998	NE	NE	NE	NE	NE	NE
1999	NE	NE	NE	NE	NE	NE
2000	NE	NE	NE	NE	NE	NE
2001	NE	NE	NE	NE	NE	NE
2002	NE	NE	NE	NE	NE	NE
2003	NE	NE	NE	NE	NE	NE
2004	NE	NE	NE	NE	NE	NE
2005	NE	NE	NE	NE	NE	NE
2006	NE	NE	NE	NE	NE	NE
2007	NE	0.01	100.00	NE	0.00002	100
2008	NE	0.01	100.00	NE	0.00003	100
2009		0.01			0.00003	

Change in notation keys (NK) for all-time series 1989-2008 as the CO_2 recovery notation keys for the Asphalt roofing sub-sector was change from NE in NO.

Road paving with asphalt (2.A.6)

Recalculation for 1998-2008 time series in AD for road paving with asphalt sub-sector, as it was identified a new source of data in order to estimate the NMVOC emissions starting with 2011 submission (2.A.6);

Table 4.14 Recalculations of NMVOC emissions [Gg] in the Road paving with asphalt sub-sector

The effects of recalculations in road paving with asphalt sub-sector (2.A.6)			
Years	**2010 submission**	**2011 submission**	
	NMVOC emissions [Gg]		**Differences [%]**
1989	NE	NE	NE
1990	NE	NE	NE
1991	NE	NE	NE
1992	NE	NE	NE
1993	NE	NE	NE
1994	NE	NE	NE
1995	NE	NE	NE
1996	NE	NE	NE
1997	NE	NE	NE
1998	NE	61.55	100.00
1999	NE	54.90	100.00
2000	NE	71.42	100.00
2001	NE	49.74	100.00
2002	NE	49.88	100.00
2003	NE	60.88	100.00
2004	NE	304.68	100.00
2005	NE	216.45	100.00
2006	NE	303.81	100.00
2007	NE	766.02	100.00
2008	NE	170.53	100.00
2009		442.88	

Change in notation keys (NK) for all-time series 1989-2008 as the CO_2 recovery notation keys for the Road paving with asphalt sub-sector was change from NE in NO.

Glass production (2.A.7.1)

Change in notation keys (NK) for all-time series 1989-2008 as the CO_2 recovery, CH_4 recovery, and N_2O recovery notation keys for the Glass production sub-sector was change from NE in NO.

4.2.6. Source specific planned improvements, including those in response to the review process

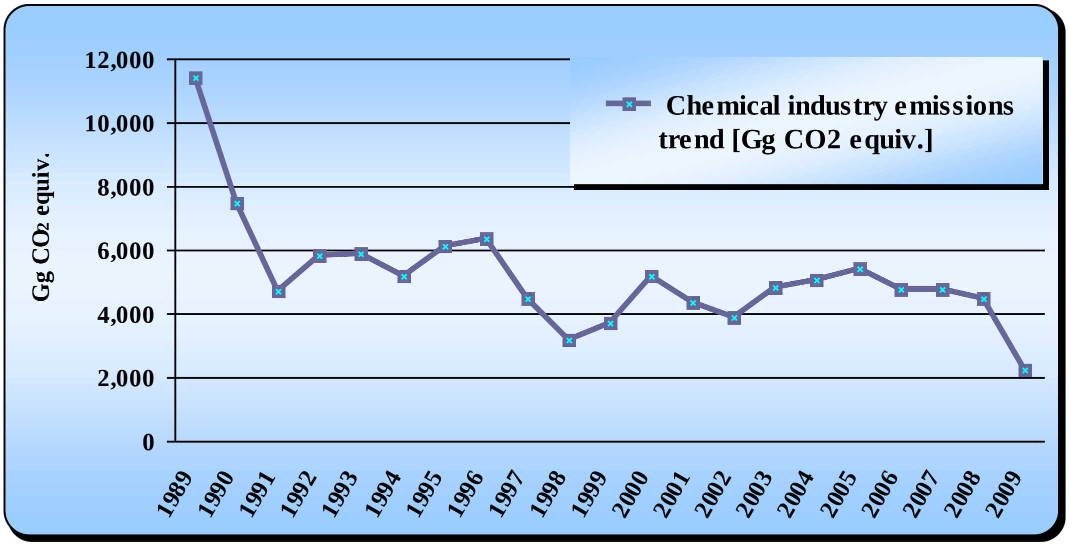
More detailed data will try to be obtained, in respect to the IPCC GPG 2000 provisions.

4.3. Source category Chemical Industry (CRF sector 2.B)

4.3.1. Source category Description

CRF sector 2.B includes: ammonia production (2B.1), nitric acid production (2B.2), adipic acid production (2B.3) -until 2001, silicon carbide production (2B.4.1) calcium carbide production (2B.4.2) and other productions (2B.5): carbon black, methanol, ethylene, etc. Chemical industry sub-sector was responsible for 19.69 % of the total Industrial Processes sector's GHG emissions in 2009.

Figure 4.9 GHG emissions trend in the Chemical Industry sub-sector for 1989-2009 period [Gg CO_2 equiv.]



GHG emissions trend in the Chemical Industry sub-sector for 1989-2009 period due:

- The lowest level of emissions from ammonia production was recorded in 1998, due to the activity data decreased by almost a half compared to the previous and next year. This happened as one producing plant has stopped its activity since 1998 and another plant has been closed in 1998 and reopened in the next year;
- Nitric acid production recorded a decreased after 1989;
- Adipic acid production stopped at the end of 2001. Starting 2002, this activity is suspended;
- Carbide production had recorded a decrease after 1989 and it was stopped the production starting with 2007;
- For 2009 year a significant decrease of emissions level was recorded due to the economic crisis.

Table 4.15 GHG emissions from the Chemical Industry sector, in 2009 (Gg)

Sector	CO_2	CH_4	N_2O
	[Gg] - 2009		
2.B Chemical Industry	1,708.50	0.55	1.67
2.B.1 Ammonia Production	**1,708.50**	0.00	0.00
2.B.2 Nitric Acid Production	0.00	0.00	**1.67**
2.B.3 Adipic Acid Production	NO	NO	NO
2.B.4.1 Silicon Carbide Production	IE	**0.29**	0.00
2.B.4.2 Calcium Carbide Production	NO	NO	NO
2.B.5 Others (ethylene, carbon black, methanol, sulphuric acid)	0.00	**0.27**	0.00

4.3.2. Methodological issues

Ammonia production (2.B.1)

Methodology

The ammonia production is a key category, from both level and trend point of view. The CO_2 emissions from ammonia production are estimated according to the Tier 1b methodology. In order to allow for the use of a higher Tier calculation method compliance with IPCC 1996 Methodology, national parameters values are collected/processed/developed through the ongoing study Elaboration of national emission factors/other parameters relevant to NGHGI Industrial Processes Sector in order to improve the ammonia production sub sector.

Activity data

Ammonia production data are annually provided by the National Institute for Statistics.

Emission factors

The CO_2 emissions from ammonia production are estimated according to the Tier 1b methodology, using the amount of ammonia production and the default emission factor 1.5 t CO_2/t ammonia productions.

Although emissions from ammonia production are decreasing along the time series, this source category results in a large amount of CO_2 emissions.

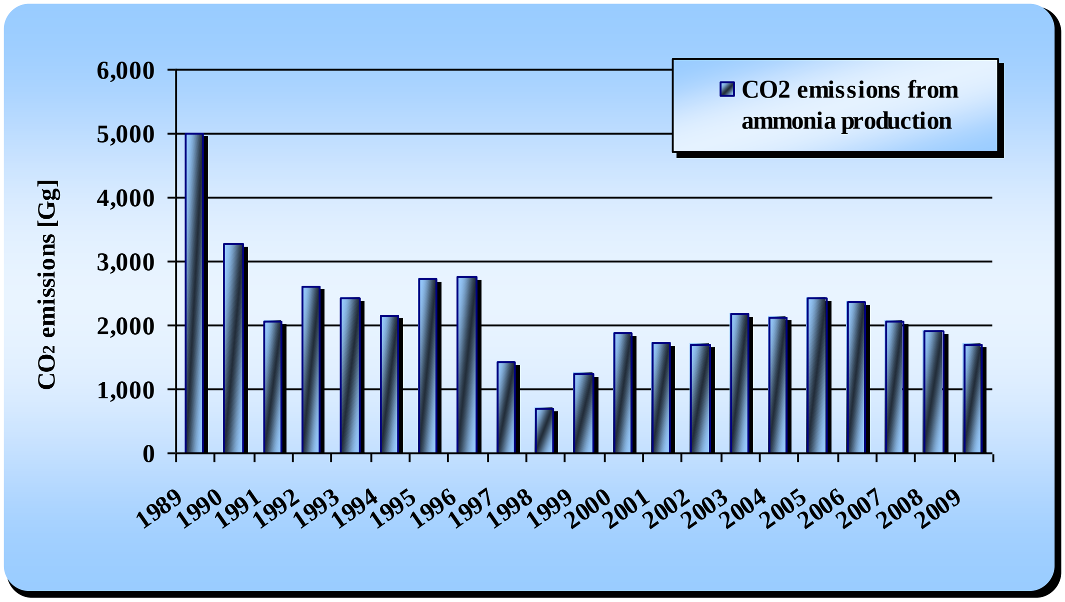
Within the chemical industry sector, ammonia production is one of the most important GHG emission source. The lowest level of emissions was recorded in 1998, due to the activity data decreased by almost a half compared to the previous and next year. This happened as one producing plant has stopped its activity since 1998 and another plant has been closed in 1998 and reopened in the next year.

The CO and SO_2 emissions from ammonia production are estimated according to the revised methodology (default 7.9 kg CO/ tonne of product and 0.03 kg SO_2/ tonne of product).

Table 4.16 Ammonia production related to the CO_2 emissions in the period 1989-2009

Year	**Activity data and emissions from Ammonia Production subsector (2.B.1) 2011 submission**	
	Ammonia production [kt]	**CO_2 emissions [Gg]**
1989	3337.00	5005.50
1990	2178.00	3267.00
1991	1375.00	2062.50
1992	1733.00	2599.50
1993	1620.00	2430.00
1994	1443.00	2164.50
1995	1809.00	2713.50
1996	1841.00	2761.50
1997	951.00	1426.50
1998	468.00	702.00
1999	834.00	1251.00
2000	1255.00	1882.50
2001	1155.00	1732.50
2002	1137.00	1705.50
2003	1445.00	2167.50
2004	1422.00	2133.00
2005	1611.00	2416.50
2006	1580.00	2370.00
2007	1371.00	2056.50
2008	1275.00	1912.50
2009	1139.00	1708.50

Figure 4.10 The trend of CO_2 emissions from ammonia production in the period 1989–2009



Nitric acid production (2.B.2)

Methodology

The nitric acid production is a key category, only from trend point of view. Nitric acid production results in N_2O and NOx emissions. Emissions have been calculated by multiplying annual nitric acid production (tons HNO_3 100% by each plant) by a default emission factor, which reflects the process, in line with IPCC GPG 2000 and CORINAIR Methodology. According with the Decision Tree for N_2O Emissions from Adipic Acid and Nitric Acid Production from IPCC GPG 2000 – pg. 3.32, in order to use of a higher Tier calculation method it is need to collect the information regarding emissions and destruction data directly from plants, but the data on plant specific emissions there are not sufficiently documented and explained by operators, therefore the data emissions could not be used in this report 2011.

Activity data

Specific questionnaires have been sent to the local EPA in order to collect information on nitric acid production from economic agents. Based on this survey, 7 manufacturers of nitric acid have been identified. From these 7 factories, one stopped its production in 1990 and other factory has stopped its activity during the 2006-2008 periods.

In order to estimate the N_2O and NO_X emissions, within the questionnaires the economic agents had been asked about the data related with the abatement techniques are used for NOx or N_2O emissions reduction.

Emission factors

The emission factors used reflects the production process:

- dual pressure type process (ammonia oxidation takes place at medium pressure and absorption takes place at high pressure) - this is the case of 6 factories. According to IPCC Good Practice Guidance, N_2O emission factor for European designed dual pressure plants is in the range from 8 to 10 kg N_2O /tonne nitric acid. The mean of this range (9 kg N_2O /tonne nitric acid) has been used to estimate N_2O emissions. The NOx emission factor used is according to CORINAIR methodology: 7.5 kg NOx/tonne nitric acid for medium pressure plants;
- plants without NSCR – this is the case of only one factory. According to IPCC Good Practice Guidance, N_2O emission factor for this plant is in the range from 10 to 19 kg N_2O /tonne nitric acid. The mean of this range (14.5 kg N_2O /tonne nitric acid) has been used to estimate N_2O emissions. An emission factor of 12 kg NOx/tonne nitric acid has been used to estimate NOx emissions from this factory.

The emissions have been estimated, considering the process type and the NO_x abatement technology installed at each plant:

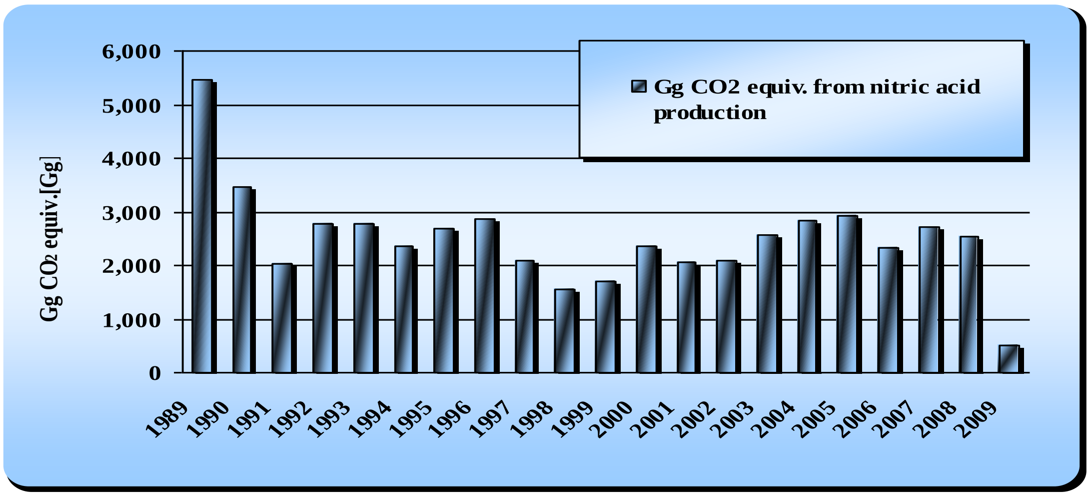
- extended absorption for NO_x – used at one factory (it was used since 1997);
- selective catalytic reduction (SCR) for NO_x – used at one single plant since 2003;
- selective catalytic reduction (SCR) for N2O - used at two plants starting with 2009.

These abatement techniques are used both for NOx and N_20 reduction emissions.

Table 4.17 Nitric acid production related to the N_2O and NO_x emissions in the period 1989-2009

Years	Activity data and emissions from Nitric Acid Production subsector (2.B.2) 2011 submission		
	Nitric acid production [kt]	N_2O emission [Gg]	NO_x emissions [Gg]
1989	1913.76	17.63	14.68
1990	1205.92	11.16	9.30
1991	710.92	6.52	5.43
1992	979.13	8.99	7.49
1993	978.06	8.97	7.48
1994	837.50	7.59	6.33
1995	959.74	8.68	7.23
1996	1020.64	9.21	7.67
1997	749.26	6.77	4.78
1998	550.47	4.98	3.88
1999	603.48	5.50	4.10
2000	831.48	7.58	5.32
2001	720.62	6.60	4.88
2002	745.11	6.75	4.98
2003	917.50	8.28	2.07
2004	1000.14	9.17	2.67
2005	1037.32	9.42	3.19
2006	821.55	7.53	2.08
2007	962.52	8.77	2.54
2008	883.12	8.16	3.24
2009	589.89	1.67	1.94

Figure 4.11 The trend of CO_2 emissions from nitric acid production, 1989-2009 [Gg CO_2 equivalent]



Adipic acid production (2.B.3)

Methodology

The IPCC methodology has been followed for estimating the emissions from adipic acid production. According with the Decision Tree for N_2O Emissions from Adipic Acid and Nitric Acid Production from IPCC GPG 2000 - pg 3.32 because the adipic acid sub sector is not a key source category the default emissions factors were used; therefore it was followed the methodology from Revised 1996 IPCC Guidelines for National GHG Inventories: Workbook, page 2.17- 2.18.

Activity data

Emissions are estimated based on national statistics for the period 1989-1997, after this year no reports on adipic acid production are made. Based on response from the local Environment Protection Agencies that were requested to provide information on this activity (1998-2001), only one producer has been identified. The facility stopped its activity at the end of 2001. Starting 2002**,** this activity is suspended.

Emission factors

Table 4.18 The default EFs used to estimate emissions from adipic acid production.

EMISSION FACTORS FOR ADIPIC ACID PRODUCTION (KG/TONNE PRODUCT)			
N_2O.	**NO_x**	**NMVOC**	**CO**
300	**8.1**	**43.3**	**34.4**

Silicon Carbide production (2.B.4.1)

Methodology

Total CH_4 emissions from Silicon Carbide production were estimated using the production data and the IPCC 1996 emission factor. According with Revised 1996 IPCC Guidelines for National GHG Inventories: Workbook, page 2.20 the default value on CH_4 emission factor was used, considering that the silicon carbide sub-sector is not a key source category.

The CO_2 emissions from Silicon Carbide production are noted as IE because the emissions related with coke consumption are accounted in Energy Sector (1AA2F- Other non-specified – solid fuels subsector).

Within the Romanian Energy Balance there are provided the information related with coke consumption on “Manufacture of other non-metallic mineral products”, the data are not disaggregated per industry type, the coke consumption being provided from all “Manufacture of other non-metallic mineral products industry” and implicitly for the production of silicon carbide subsector.

Activity data

National Statistics provided annually the amount of Silicon Carbide production starting with 2003 year. In 2007 the production was stopped and was reopened in 2008.Tha data related with Silicon Carbide productions are confidential starting with 2008.

Emission factors

For confidentiality reasons the presentation of CH_4 emission factor used to estimate emission from Silicon Carbide production is omitted.

Calcium Carbide production (2.B.4.2)

Methodology

Total CO_2 emissions from calcium carbide production were estimated using the production data and the default emission factor, in line with IPCC 1996. According with Revised 1996 IPCC Guidelines for National GHG Inventories: Workbook, page 2.19 the default value on CO_2 emission factor was used (table 2-8), considering that the calcium carbide sub-sector is not a key source category.

Activity data

National Institute for Statistics provided annually the amount of calcium carbide production. Starting with 2007 the production was stopped.

Emission factors

Currently the EF of carbide use (1.1 ton/ton) is applied in order to estimate CO_2 emission from calcium carbide production.

Table 4.19 CO_2 emissions from Calcium Carbide Production in the period 1989-2009

Years	Emissions from Calcium Carbide Production subsector (2.B.4.2) 2011 submission
	CO_2 emissions[Gg]
1989	198.00
1990	141.90
1991	103.40
1992	95.70
1993	92.40
1994	73.70
1995	99.00
1996	116.60
1997	100.10
1998	80.30
1999	59.40
2000	60.50
2001	58.30
2002	58.30
2003	49.50
2004	69.30
2005	37.40
2006	22.00
2007	NO
2008	NO
2009	NO

Other production: carbon black, ethylene, methanol, propylene, polystyrene, polyethylene, sulphuric acid, Phtalic anhydride, polypropylena, polyvinylchloride (2.B.5)

Methodology

Total emissions from other production were estimated using the production data and the emission factors, in line with IPCC 1996. According with IPCC 1996 and GPG 2000 Methodology there are no described methods in order to estimate the emissions on higher levels, therefore it was followed the methodology from Revised 1996 IPCC Guidelines for National

GHG Inventories: Workbook, page 2.21-2.25 and Revised 1996 IPCC Guidelines for National GHG Inventories: Reference Manual, pages 2.22-2.25.

Activity data

National Statistics provided annually the amounts of these production processes. Carbon black and sulphuric acid are not produce anymore.

Emission factors

For confidentiality reasons the presentation of emission factors used to estimate emission from those productions are omitted.

Emissions of CH_4, NO_X, CO, NMVOC, and SO_2 were estimated from those productions.

4.3.3. Uncertainties and time series consistency

Ammonia production (2.B.1)

Time series is consistent; emissions have been calculated using the same emission factors, the same sources of activity data and the same methods were used for the entire time series 1989-2009.

The uncertainty related to the activity data for CO_2 emissions is 5% and the uncertainty associated with default emission factor for CO_2 emissions is 42.5%.

The uncertainty associated with emission factor and activity data are in line with the IPCC 2006.

Aggregated uncertainty value: the overall uncertainty resulted after aggregation of the AD and EF uncertainties according to the previsions in chapter 6 of IPCC GPG 2000 is 42.79%.

Nitric acid production (2.B.2)

Time series is consistent; emissions have been calculated using the same emission factors (considering the process type and the NOx abatement technology installed at each plant), the same sources of activity data and the same methods were used for the entire time series 1989-2009.

The uncertainty related to the activity data for N_2O emissions is 2% and the uncertainty associated with emission factor for N_2O emissions is 40%.

The uncertainty associated with emission factor and activity data are in line with the IPCC 2006.

Aggregated uncertainty value: the overall uncertainty resulted after aggregation of the AD and EF uncertainties according to the previsions in chapter 6 of IPCC GPG 2000 is 40.05%.

Adipic acid production (2.B.3)

Time series is consistent; emissions have been calculated using the same emission factors, the same sources of activity data and the same methods were used for the entire time series 1989-2009.

The uncertainty related to the activity data for CO_2 emissions is 2% and the uncertainty associated with default emission factor for CO_2 emissions is 10%.

The uncertainty associated with emission factor and activity data are in line with the IPCC 2006.

Aggregated uncertainty value: the overall uncertainty resulted after aggregation of the AD and EF uncertainties according to the previsions in chapter 6 of IPCC GPG 2000 is 10.2%.

Silicon Carbide production (2.B.4.1)

Time series is consistent; emissions have been calculated using the same emission factors, the same sources of activity data and the same methods were used for the time series 2003-2009.

The uncertainty related to the activity data for CH_4 emissions is 5% and the uncertainty associated with default emission factor for CH_4 emissions is 10%.

The uncertainty associated with emission factor and activity data are in line with the IPCC 2006.

Aggregated uncertainty value: the overall uncertainty resulted after aggregation of the AD and EF uncertainties according to the previsions in chapter 6 of IPCC GPG 2000 is 11.18%.

Calcium Carbide production (2.B.4.2)

Time series is consistent; emissions have been calculated using the same emission factors, the same sources of activity data and the same methods were used for the entire time series 1989-2009.

The uncertainty related to the activity data for CO_2 emissions is 5% and the uncertainty associated with default emission factor for CO_2 emissions is 10%.

The uncertainty associated with emission factor and activity data are in line with the IPCC 2006.

Aggregated uncertainty value: the overall uncertainty resulted after aggregation of the AD and EF uncertainties according to the previsions in chapter 6 of IPCC GPG 2000 is 11.18%.

Other production (2.B.5)

Time series is consistent; emissions have been calculated using the same emission factors, the same sources of activity data and the same methods were used for the entire time series 1989-2009.

By expert judgment the uncertainty related to the activity data for CH4 emissions is 7.5% and the uncertainty associated with default emission factors for CH_4 emissions are 30%.

Aggregated uncertainty value: the overall uncertainty resulted after aggregation of the AD and EF uncertainties according to the previsions in chapter 6 of IPCC GPG 2000 is 30.92%.

4.3.4. Source specific QA/QC and verification

All activities regarding quality control (QC) as described in QA/QC Program have been undertaken.

These activities have been accomplished by the Romanian Industrial Processes sector expert, activity results of these actions being mentioned in Check lists. After these activities unconformities have not been notified.

Due to the large fluctuation in ammonia production, AD obtained from national statistics and has been checked against the data obtained from the local environmental protection agencies. The differences in AD generated by these two different data sources are negligible.

AD obtained regarding nitric acid production from economic agents has been checked against the data obtained from the national statistics. The differences between the two sets of data are very large (the data from factories are higher than national statistics). This probably due to nitric acid production that is integrated as part of larger production processes and it is not counted in the national statistics. According to IPCC Good Practice Guidance, the statistics may miss an average of one-half of a national total and it is good practice to use plant level data.

In order to improve the accuracy of activity data, emission factors and emissions have been developed, there were developed new approaches which are presented in the sub- sectors “Source specific recalculation” and Chapter 10.

No recalculations were needed following the QA activities developed under the procedures for the compilation of the European Community GHG Inventory, described in the Decision 280/2004/EC of the European Parliament and of the Council, and Decision 166/2005/EC of the European Commission.

All notified and solved recommendations following various QA/QC activities are described in Improvement Lists.

4.3.5. Source specific recalculation, including changes made in response to the review process

Table 4.20 The effects of recalculations in Chemical Industry subsector (2B)

The effects of recalculations in Chemical Industry subsector (2B)			
Years	**2010 submission**	**2011 submission**	**Differences [%]**
	CO_2 equivalent [Gg]		
1989	11,386.81	11,386.81	0.00
1990	7,470.42	7,470.42	0.00
1991	4,696.67	4,696.67	0.00
1992	5,841.47	5,841.47	0.00
1993	5,865.65	5,865.65	0.00
1994	5,148.19	5,148.19	0.00
1995	6,112.55	6,112.55	0.00
1996	6,346.09	6,346.09	0.00
1997	4,480.32	4,480.32	0.00
1998	3,204.00	3,204.00	0.00
1999	3,719.04	3,719.04	0.00
2000	5,176.43	5,176.43	0.00
2001	4,349.43	4,349.43	0.00
2002	3,873.92	3,873.92	0.00
2003	4,809.61	4,813.46	0.08
2004	5,075.49	5,087.20	0.23
2005	5,394.89	5,412.41	0.32
2006	4,752.83	4,769.04	0.34
2007	4,789.18	4,789.18	0.00
2008	4,452.18	4465.54	0.30
2009		2,236.85	

Ammonia production (2.B.1)

Change in notation keys (NK) for all-time series 1989-2008 as the CO_2 recovery, CH_4 recovery, and N_2O recovery notation keys for the Ammonia production sub-sector was changed from NE in NO.

Nitric acid production (2.B.2)

Change in notation keys (NK) for all-time series 1989-2008 as the N_2O recovery, notation keys for the Nitric acid production sub-sector was changed from NE in NO.

Adipic acid production (2.B.3)

Change in notation keys (NK) for time series 1989-2001 as the CO_2 recovery, N_2O recovery notation keys for the Adipic acid production sub-sector was changed from NE in NO.

Silicon Carbide production (2.B.4.1)

Recalculation for 2003-2008 time series at the silicon carbide sub-sector activity data (AD) level, as a new source was identified; the CH_4 emissions started to be estimated with the 2011 submission (2.B.4.1)

Table 4.21 Recalculations of CH_4 [Gg] emissions in the Silicon Carbide production sub- sector

The effects of recalculations in Silicon Carbide production subsector (2.C.1)			
Years	**2010 submission**	**2011 submission**	**Differences [%]**
	CH_4 emissions [Gg]		
1989	NE	NE	NE
1990	NE	NE	NE
1991	NE	NE	NE
1992	NE	NE	NE
1993	NE	NE	NE
1994	NE	NE	NE
1995	NE	NE	NE
1996	NE	NE	NE
1997	NE	NE	NE
1998	NE	NE	NE
1999	NE	NE	NE
2000	NE	NE	NE
2001	NE	NE	NE
2002	NE	NE	NE
2003	NE	0.18	100.00
2004	NE	0.56	100.00
2005	NE	0.83	100.00
2006	NE	0.77	100.00
2007	NE	0.00	0.00
2008	NE	0.64	100.00
2009		0.29	

Change in notation keys (NK) for all-time series 1989-2008 as the CO_2 recovery and CH_4 recovery notation keys for the Silicon Carbide production sub-sector was changed from NE in NO

Calcium Carbide production (2.B.4.2)

Change in notation keys (NK) for all-time series 1989-2008 as the CO_2 recovery and CH4 recovery notation keys for the Calcium Carbide production sub-sector was changed from NE in NO.

Other production (2.B.5)

Recalculation for 2003-2008 time series in AD for Other non-specified sub-sector (phthalic anhydride, polypropylene, polyvinylchloride) – Chemical industry, as it was identified a new source of data in order to estimate the NMVOC emissions starting with 2011 submission (2.B.5).

Table 4.22 Recalculations of NMVOC [Gg] emissions in the Other production sub- sector (2.B.5)

The effects of recalculations in Other production sub- sector (2.B.5)			
Years	**2010 submission**	**2011 submission**	**Differences [%]**
	NMVOC emissions [Gg]		
1989	3.54	3.54	0.00
1990	2.66	2.66	0.00
1991	2.11	2.11	0.00
1992	1.26	1.26	0.00
1993	1.26	1.26	0.00
1994	0.96	0.96	0.00
1995	1.11	1.11	0.00
1996	1.26	1.26	0.00
1997	1.05	1.05	0.00
1998	0.93	0.93	0.00
1999	0.71	0.71	0.00
2000	0.84	0.84	0.00
2001	1.39	1.39	0.00
2002	1.18	1.18	0.00
2003	0.85	1.99	135.20
2004	0.91	2.39	161.41
2005	0.94	2.47	163.69
2006	1.07	2.61	144.79
2007	1.20	2.90	140.46
2008	1.41	2.92	107.35
2009		1.54	

Change in notation keys (NK) for all-time series 1989-2008 as the CO_2 recovery, CH_4 recovery and N_2O recovery notation keys for the Other production sub-sector was changed from NE in NO.

4.3.6. Source specific planned improvements, including those in response to the review process.

In order to allow for the use of a higher Tier calculation method national parameters values are collected/processed/developed through the ongoing study Elaboration of national emission factors/other parameters relevant to NGHGI Industrial Processes Sector in order to improve the ammonia production sub sector.

4.4. Source category Metal Production (CRF sector 2.C)

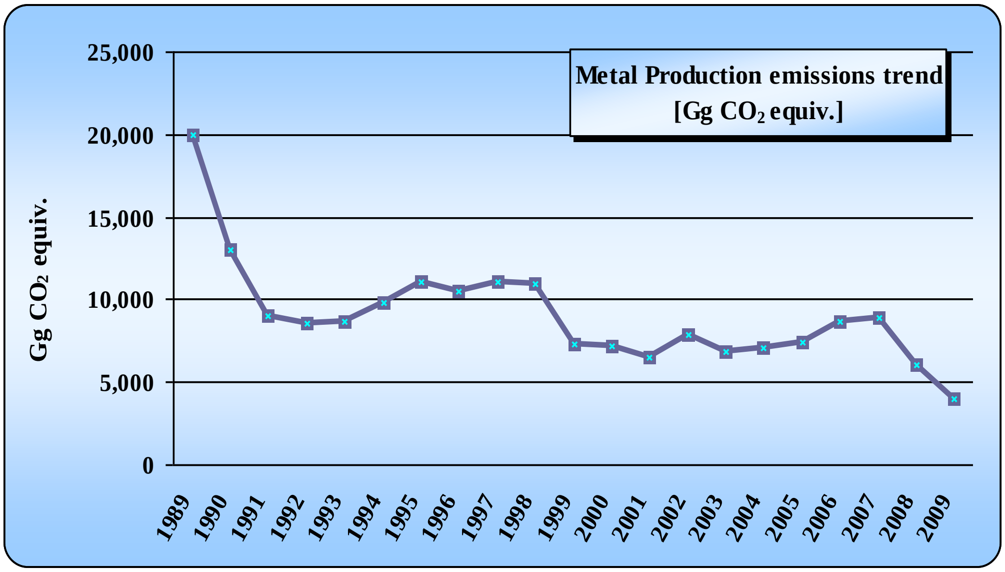
4.4.1. Source category description

The emission estimates cover sub-categories 2C.1 Iron and steel production, 2C.2 Ferroalloy production and 2C.3 Aluminium production. The use of SF_6 in aluminium and magnesium foundries (2C.4 sub-category) is not applicable in Romania. Metal production industry sub-sector is responsible for 35.20 % of the total Industrial Processes sector's GHG emissions in 2009.

CO_2 emissions from iron and steel production represent an important key category of the inventory because of its contribution to the total inventory level (in 2009 CO_2 emissions from production of iron and steel contributed 2.86 % to total greenhouse gas emissions). In the base year, these emissions accounted for 5.56 % from the total GHG emissions.

The CO_2 emissions from ferroalloys production have been included in the inventory. Aluminium production results in a smaller quantity of CO_2 emissions and also PFCs emissions. PFCs emissions from aluminium production represent a significant source of emissions due to high GWP values.

Figure 4.12 GHG emissions trend in the Metal Products sub-sector for 1989-2009 period [Gg CO2 equiv.]



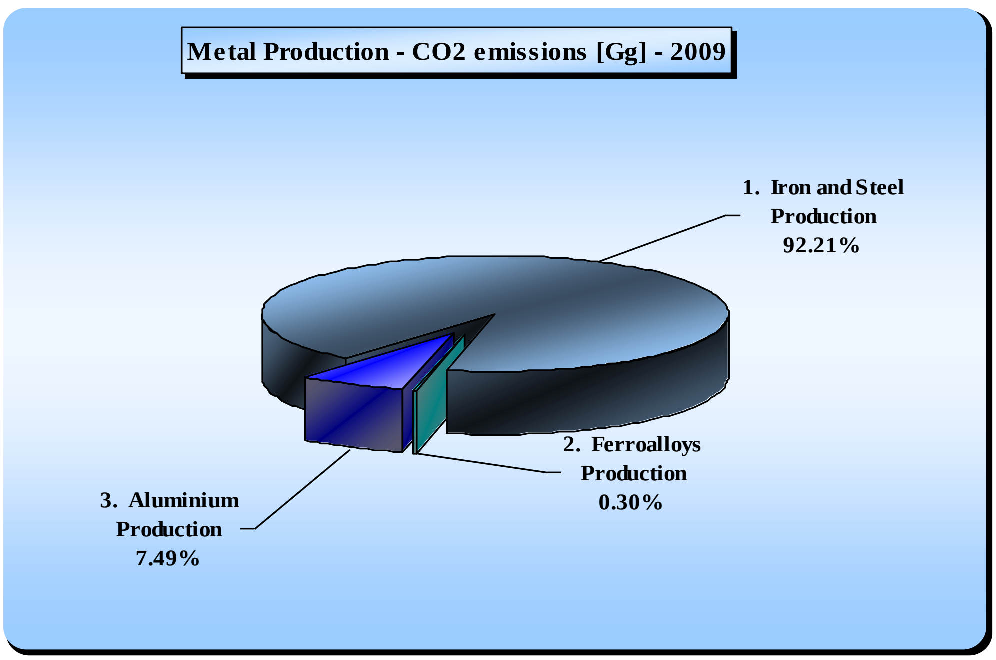
GHG emissions trend in the Metal Products sub-sector for 1989-2009 period due:

- Iron and steel production recorded a decreased after 1989;
- Ferroalloys production has recorded a decreased after 1989. The lowest level of emissions from Ferroalloys production was recorded in 1999, due to the activity data decreased. This happened because ferroalloys production has stopped in 1999. In the next year (2000) the production was started again;
- the reduction of PFC emissions from production of aluminum due to changes in technology starting with 2003;
- In 2008 the trend of emission decreased due to reduction of production recorded for iron and steel production and ferroalloys production sub-sectors.
- In 2009 the emissions trends had also decreased due to the economic crisis recorded in iron and steel and ferroalloys industry

Table 4.23 GHG emissions from Metal Production sub-sector, in the year 2009 [Gg CO_2 equiv.]

Sector	CO_2	PFCs
	CO_2 equivalent [Gg] 2009	
2.C Metal Production	**3,992.41**	**7.00**
2.C.1 Iron and Steel Production	**3,681.54**	0.00
2.C.2 Ferroalloys Production	**11.83**	0.00
2.C.3 Aluminium Production	**299.04**	**7.00**

Figure 4.13 Structure of the Metal Production sub-sector, in 2009



4.4.2. Methodological issues

Iron and steel production (2.C.1)

Methodology

Iron and steel production sub-sector results in a large amount of CO_2 emissions, and it represents a key category within the Industrial Processes sub-sector, from both level and trend point of view.

The method for calculating emissions of CO_2 from Iron and steel production is in line with Good Practice Guidance 2000 (Tier 2 method), considering the “Decision Tree for Iron and Steel Industry” from IPCC GPG 2000 - page 3.27 and taking into account all the information provided by each iron and steel production company.

Activity data

The recommended Tier 2 method, according to the IPCC Good Practice Guidance, is to base the calculations on the amount of reducing agent (coke oven coke) used in blast furnaces for the production of iron. Other information needed to use the Tier 2 method is the amount of pig iron produced as well as the amount used for steel production and produced steel, and the carbon content of all those parts. All these information have been collected at plant level.

The coke from coal is used to reduce the iron. Steel is also produced from ferrous scrap using a basic oxygen furnace (BOF) and electric arc furnace (EAF).
For 1989-2006 period the data related sinter consumption were provided by Ministry of Economy due to inconsistence in data provided by economic agents.
Starting with 2007 the data regarding sinter consumption were provided by economic agents and checked again with the data obtained from Ministry of Economy. The differences in AD generated by these two different data sources are negligible.

The coke consumption to reduce the iron has been subtracted from the energy sector consumption (category 1A2), starting with the last in country review. There are some differences between the two sources of data (energy balance and Industrial processes sector - INEGES). This happened because the both source of data have used different method for estimating the coke consumption in furnace.

- Industrial processes (INEGES) - the amount of coke consumption in furnace is provided directly by economic agents based on specific questionnaires made by NEPA;
- Energy Balance – the amount of coke consumption in furnace is estimated based on the internationally agreed method which takes into account the amount the gas furnace produced and net calorific value (100 % efficiency).

Emission factors

- **CO_2 emissions from pig iron production**

CO_2 emissions were calculated following closely the IPCC GPG guidelines Tier 2 approach, according to the formula:

Equation 4.6 Calculation of CO_2 emissions from pig iron production

Emissions $_{pig\ iron}$ = Emission Factor $_{reducing\ agent}$ x Mass of Reducing Agent + (Mass of Carbon in the ore – Mass of Carbon in the Crude Iron) x 44/12

where:

- EF reducing agent (coke oven coke) = 3.1 tone CO_2 /tone reducing agent (default value)
- Mass of reducing agent: plant level data
- Carbon content in ore: 0 (default value)
- Carbon content in iron: 2.48% (country specific value)

- **CO_2 emissions from steel production**

CO_2 emissions resulted from steel productions were estimated based on IPCC GPG formula, Tier 2 approach***:***

Equation 4.7 Calculation of CO_2 emissions from steel production

Emissions $_{crude\ steel}$ = (Mass of Carbon in the Crude Iron used for Crude Steel Production – Mass of Carbon in the Crude Steel) x 44/12 + Emission Factor $_{EAF}$ x Mass of Steel Produced in EAF

where:

- Carbon content in crude iron used for crude steel: 2.48% (country specific value)
- Carbon content in crude steel: 0.28 % (country specific value)
- EF EAF=0.005 t/t (default value)
- Mass of steel produced in EAF: plant level data
- Crude iron used for crude steel production: plant level data

The NMVOC, NOx, CO, SO_2 emissions are estimated using the default emission factors applied to the first fusion raw pig iron production.

Table 4.24 Emission factors for NMVOC, NOx, CO, SO2 from iron and steel sector

The NMVOC, NOx, CO, SO_2 emission factors for iron and steel sector			
gNMVOC/tonne produce	g NOx/tonne produce	g CO/tonne produce	g SO_2/tonne produce
20	76	112	30

Figure 4.14 The trend of CO_2 emissions from iron and steel production sub-sector in the period 1989-2009

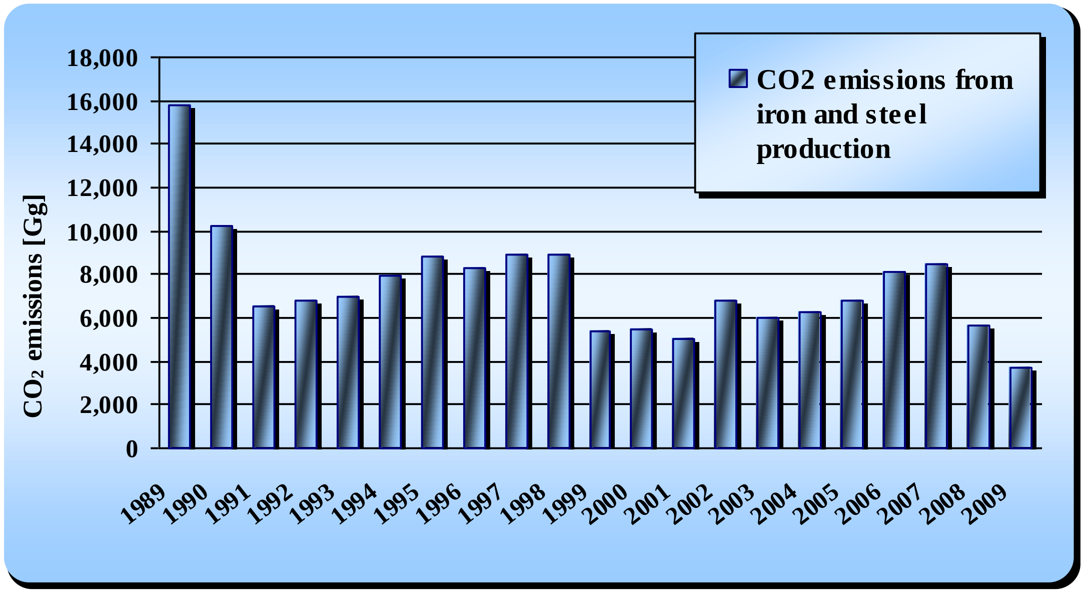


Table 4.25 The input data used to calculate emissions from iron and steel industry in the period 1989-2009

Years	Activity data from Iron and Steel Production subsector (2.C.1) 2011 submission			
	steel	pig iron	sinter	coke
	[kt]			
1989	13,277.49	8,495.13	13,626.00	4,484.93
1990	8,946.33	5,916.27	11,357.00	2,885.29
1991	6,469.65	4,231.80	7,290.00	1,813.25
1992	4,898.15	3,001.32	4,761.00	1,983.73
1993	4,973.05	3,118.79	3,346.00	2,022.36
1994	5,517.41	3,421.21	5,452.00	2,328.98
1995	6,231.60	4,118.57	6,671.00	2,556.48
1996	5,730.68	3,905.79	5,449.00	2,393.18
1997	6,407.76	4,445.20	6,532.00	2,542.14
1998	6,200.39	4,463.69	6,514.00	2,533.64
1999	4,205.03	2,943.28	4,164.00	1,526.91
2000	4,511.78	3,041.54	3,875.00	1,535.27
2001	4,769.68	3,221.86	6,185.00	1,391.06
2002	5,397.01	3,969.80	6,979.00	1,887.50
2003	5,644.58	4,084.94	6,609.00	1,639.11
2004	6,182.77	4,246.50	6,601.00	1,713.40
2005	6,260.40	4,117.92	6,600.00	1,892.03
2006	6,226.21	3,984.65	5,780.00	2,330.18
2007	6,271.24	3,946.68	6,359.22	2,404.92
2008	5,068.86	3,238.79	3,445.55	1,647.09
2009	2,835.51	1,568.86	1,806.98	1,070.40

Ferroalloys production (2.C.2)

Methodology

The CO_2 emissions within the production of ferroalloys sub-sector are calculated based on the production volume and the emission factors, in line with IPCC 1996. According with Revised 1996 IPCC Guidelines for National GHG Inventories: Workbook, page 2.36 the default values on

CO_2 emission factors were used (table 2-17), considering that the ferroalloys production sub-sector is not a key source category.

In order to estimate the emission the production data are take into account in a disaggregate manner, by type of products (ferromanganese production, ferrosilicon production, silicon manganese production, ferrochromium production).

During de time series the ferroalloys production have decreased therefore there were just silicon manganese and ferrochromium production, for 2007 and 2008 and only ferrochromium production for 2009.

Activity data

The national statistics reports the ferroalloys production for the period 1992-2008, in a disaggregate manner, by type of products.

National Institute for Statistics did not provide any data for the periods 1989-1991.

The activity data for the beginning of the time series (1989-1991) were provided by Ministry of Economy. The lowest level of emissions was recorded in 1999.

This happened because ferroalloys producing plant stopped its activity in 1999 and reopened in the next year.

Starting with 2007 the data related with ferroalloys production are confidential.

Emission factors

For confidentiality reasons the presentation of CO_2 emission factors used to estimate emission from ferroalloys production are omitted.

Table 4.26 CO_2 emission from Ferroalloys Production in the period 1989-2009

Years	**Emissions from Ferroalloys Production subsector (2.C.2) 2011 submission**
	CO_2 emissions[Gg]
1989	474.15
1990	331.19
1991	248.73
1992	192.81
1993	143.74
1994	223.63
1995	229.54
1996	266.19
1997	163.03
1998	120.15
1999	0.98
2000	141.53
2001	145.59
2002	144.02
2003	241.55
2004	331.39
2005	201.43
2006	95.57
2007	45.68
2008	18.32
2009	11.83

Aluminium production (2.C.3)

Methodology

The aluminium production is a key category, only from **trend** point of view.

Primary aluminium production is carried out in one facility in Romania, where the pre-baked process is used.

The most significant emissions process resulted are:

- **Carbon dioxide (CO_2)** emissions resulted from the consumption of carbon anodes in the reaction to convert aluminum oxide to aluminum metal. At these emissions are added the emission from decomposition of sodium carbonate (ash) used in electrolysis cell;
- **Perfluorocarbons (PFCs)** emissions of **CF_4** and **C_2F_6** during anode effects;

The PFC process emissions calculation taking into account the technology use within the facility along the time period 1989-2010:

- From **1989 to 1996**, the technology used was **SWPB** (Side Worked Pre-baked);
- From **1997 to 2002** the combined technology was used **(SWPB and CWPB)** in different percentages;
- **Starting with 2003**, the technology was changed to **CWPB** (Centre Worked Pre-baked).

For the period **1989-2002 the CO_2** emissions within the production of primary aluminium are calculated based on the production volume in line with **IPCC 1996 Methodology (Tier 1b)** and the **PFC emissions** from aluminium production are calculated in line with **IPCC 1996 Methodology (Tier 1b Method) for C_2F_6** emissions and also **IPCC GPG 2000 Methodology (Tier 1 Method) for CF_4 emissions**, considering the type of technology use within the facility. **Starting with 2003 the CO_2** emissions within the production of primary aluminium are calculated in line with **IPCC 2006 Methodology (Tier 3 Method)** and the PFC **emissions** are calculated based on **GPG 2000 Methodology (Tier 2 Method)** using the technology specific over voltage coefficient and weight fraction C_2F_6/CF_4 from **IPCC 2006 Methodology (Tier 2 Method)**.

Activity data

Along the time period (1989-2010), the emissions processes within the production of primary aluminium are calculated used the specific operating facility data in order to respect the IPCC Methodolog as following:

- For the period **1989 – 1996** the technology used was **SWPB** (Side Worked Pre-baked). In this period the **CO_2 emissions** are calculated based on **aluminium production** in line with **IPCC 1996 Methodology (Tier 1b Method).** The calculation of CO_2 emissions does not include the emissions from anode baking. The **PFC emissions** are calculated based also on

aluminium production and taking into account the **technology use** within the facility, in line with **IPCC GPG 2000 Methodology (Tier 1 Method) for CF_4 emissions and IPCC 1996 Methodology (Tier 1b Method) for C_2F_6** emissions;

- **From 1997 to 2002** the combined technology was used: **SWPB** (Side Worked Pre-baked) and **CWPB** (Center Worked Prebaked) in different percentages. **The CO_2 emissions** are also calculated based on **aluminium production** in line with **IPCC 1996 Methodology (Tier 1b Method).** The calculation of CO_2 emissions does not include the emissions from anode baking. The **PFC emissions** for this period were estimated based on **aluminium production** and taking into account a weighted average of the two **constants related technologies** applied SWPB and CWPB, in line with **IPCC GPG 2000 Methodology (Tier 1 Method) for CF_4 emissions and IPCC 1996 Methodology (Tier 1b Method) for C_2F_6** emissions;
- **Starting with 2003** the technology was changed to **CWPB** (Centre Worked Pre-baked). **The CO_2 emissions** within the production of primary aluminium are calculated in line with **IPCC 2006 Methodology (Tier 3 Method –** Equation 4.21**)** taking into account the **specific operating facility data**. At these emissions are added the emission from **decomposition of sodium carbonate** used in electrolysis cell. The **PFC emissions** are calculated based on **GPG 2000 Methodology (Tier 2 Method** - Equation 3.11**)**, considering **the plant specific** data and using the technology specific over voltage coefficient and weight fraction C_2F_6/CF_4 from **IPCC 2006 Methodology**.

Table 4.27 The activity data, PFC and CO_2 emissions from aluminium production subsector in the period 1989-2010

Year	Emissions and activity data from Aluminium Production subsector (2.C.3) 2011 v.2.1 submission			
	CF_4 emissions	C_2F_6 emissions	CO_2 emissions	Aluminium production
	[tones]		[Gg]	[kt]
1989	451.42	45.14	398.31	265.54
1990	285.15	28.52	251.61	167.74
1991	261.74	26.17	230.94	153.96
1992	182.23	18.22	160.79	107.19
1993	189.95	19.00	167.60	111.74
1994	200.94	20.09	177.30	118.20
1995	239.02	23.90	210.90	140.60
1996	238.39	23.84	210.35	140.23
1997	240.75	24.08	245.56	163.70
1998	236.30	23.63	262.07	174.71
1999	216.08	21.61	261.12	174.08
2000	174.14	17.41	259.91	173.27
2001	140.73	14.07	269.73	179.82
2002	96.75	9.68	279.89	186.59
2003	34.35	4.16	334.96	198.05
2004	17.35	2.10	362.15	215.26
2005	10.75	1.30	372.62	239.01
2006	7.23	0.87	397.31	255.82
2007	3.18	0.38	402.14	262.51
2008	2.02	0.24	399.93	265.24
2009	0.92	0.11	299.04	200.56

Emission factors

Along the period 1989-2010 the emissions processes within the production of primary aluminium are calculated used the specific operating facility data in order to respect the IPCC Methodolog as following:

- For the period **1989 – 1996** the technology used was **SWPB** (Side Worked Pre-baked). For this period the **CO_2 emissions** are calculated based on primary aluminium production data and the **default EF (1.5 tonnes CO_2/tonne Al)** in line with **IPCC 1996 Methodology (Tier 1b Method).** The calculation of CO_2 emissions does not include the emissions from anode baking. The **PFC emissions** are calculated based also on aluminium production and taking into account the technology use within the facility, in line with **IPCC GPG 2000 Methodology (Tier 1 Method) for CF_4 emissions and IPCC 1996 Methodology (Tier 1b Method) for C_2F_6** emissions. **Emissions of CF_4** were estimated by multiplying annual primary aluminium production with the default emission factor **(1.7 kg CF_4/tonne Al)** provided by **IPCC GPG 2000 Methodology (Tier 1 Method)** and considering the technologies in this period, **SWPB** (Side Worked Pre-baked). Compliance with **IPCC 1996 Methodology (Tier 1b Method)** it is recommended that the default rate for **C_2F_6 emissions be 1/10 that of CF_4.**

- From **1997 to 2002** period the combined technology was used **SWPB** (Side Worked Pre-baked) and **CWPB** (Center Worked Prebaked) in different percentages. The **CO_2 emissions** are also calculated based on aluminium production data and the **default EF (1.5 tonnes CO_2/tonne Al)** in line with **IPCC 1996 Methodology (Tier 1b Method)**.The calculation of CO_2 emissions does not include the emissions from anode baking. The **PFC emissions** for this period were estimated based on aluminium production and taking into account a **weighted average** of the two constants related technologies applied **SWPB and CWPB**, in line with **IPCC GPG 2000 Methodology (Tier 1 Method) for CF_4 emissions and IPCC 1996 Methodology (Tier 1b Method) for C_2F_6** emissions; **Emissions of CF_4** were estimated by multiplying annual primary aluminium production with the default emission factors **(1.7 kg CF_4/tonne Al – SWPB technology and 0.31 kg CF_4/tonne Al – CWPB technology)** provided by **IPCC GPG 2000 Methodology (Tier 1 Method**) and considering the **percentage of each technology** for every period years (SWPB and CWPB). Compliance with **IPCC 1996 Methodology** it is recommended that the default rate for **C_2F_6 emissions be 1/10 that of CF_4.**

- **Starting with 2003** the technology was changed to **CWPB** (Centre Worked Pre-baked).

I. The **CO_2 emissions** within the production of primary aluminium are calcu**late**d in line with **IPCC 2006 Methodology,** considering the specific operating facility data **(Tier 3 Method** –

Equation 4.21**).** The **parameters used** in order to estimate the **CO_2 emissions** are: total metal production (aluminium), net prebaked anode consumption , CO_2 molecular mass, ash content in baked anodes, sulphur content in baked anodes, compliance with the below equation. At these emissions are added the **emission from decomposition of sodium carbonate** used in electrolysis cell.

Equation 4.7 CO_2 emissions from prebaked anode consumption (tier 3 Method – IPCC 2006 Methodology)

$$\mathbf{E_{CO2} = NAC * MP * \frac{100 - Sa - Ash_a}{100} * \frac{44}{12}}$$

where:

- E_{CO2} = CO_2 emissions from prebaked anode consumption, tonnes CO_2
- MP = total metal production, tonnes Al (plant specific data);
- NAC = net prebaked anode consumption per tonne of aluminium, tonnes C/ tonne Al (plant specific data);
- Sa = sulphur content in baked anodes, wt % (plant specific data);
- Ash_a = ash content in baked anodes, wt % (plant specific data);
- 44/12 = CO_2 molecular mass: carbon atomic mass ratio, dimensionless

II. The PFC emissions are calculated based on **GPG 2000 Methodology (Tier 2 Method)** and **IPCC 2006 Methodology (Tier 2 Method)**, using **Overvoltage Method** and considering the plant specific data and also average parameters from measurements at numerous facilities.

In order to calculate **CF_4 emission** there was used **IPCC GPG 2000 Methodology (Tier 2 Method –** Equation 3.11) and default parameter obtain from measurements at numerous facilities compliance with **IPCC 2006 Methodology (Tier 2 Method).**

Equation 4.8 CF_4 emissions by Overvoltage Method (Tier 2 Method – GPG 2000 Methodology)

EF (kg CF_4 per tonne of Al) = Over-Voltage Coefficient *AEO / CE

$$\mathbf{E_{CF4} = EF_{CF4} * MP}$$

where:

- EF (kg CF_4 per tonne of Al) = Emission factor for CF_4 using Overvoltage Method
- AEO = Anode effect over-voltage in mV/cellday (plant specific data);
- CE = Aluminium production process current efficiency expressed in percent (plant specific data);
- E_{CF4} = CF_4 emissions from using Overvoltage Method;
- MP = total metal production, tonnes Al (plant specific data).

Measurement data are not available to determine smelter-specific Overvoltage coefficients, therefore default coefficients were used (an average parameters from measurements at numerous facilities), compliance with **IPCC 2006 Methodology (Tier 2 Method – table 4.16)**: Overvoltage Coefficient = **1.16 [(kg CF4/tAl) / (mV)]**

In order to **calculate C_2F_6 emission** there was used **IPCC 2006 Methodology (Tier 2 Method –** Equation 4.27).

Equation 4.9 C_2F_6 emissions by Overvoltage Method (Tier 2 Method - IPCC 2006 Methodology)

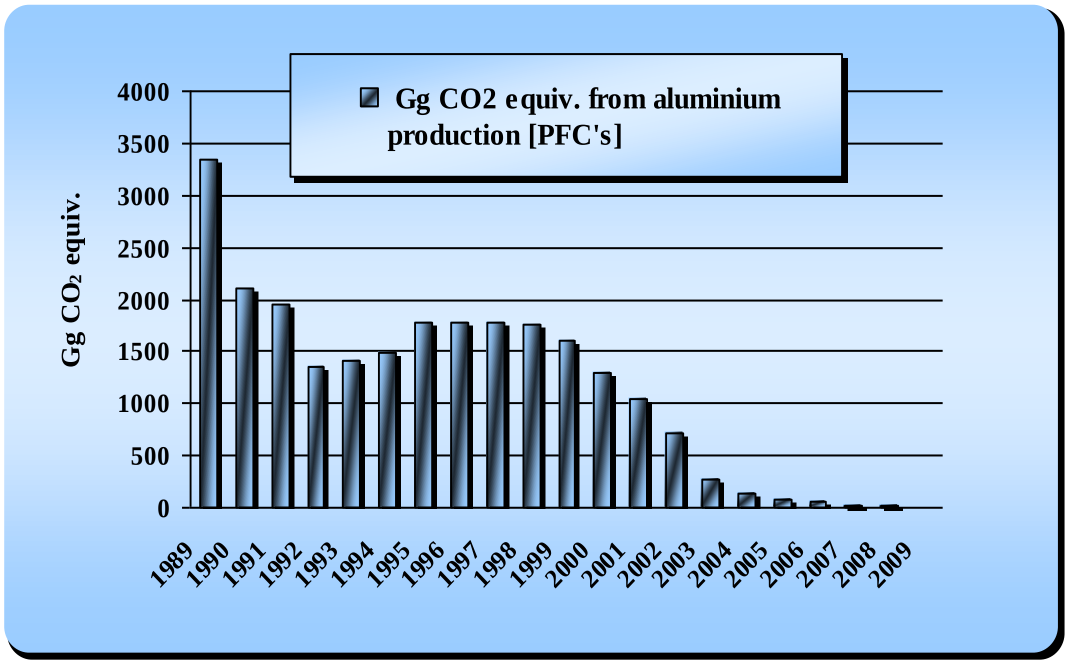
$$EC_2F_6 = ECF_4 \bullet FC_2F_6 / CF_4$$

where:

- E_{C2F6} = emissions of C_2F_6 from aluminium production, kg C_2F_6
- $F_{C2F6/CF4}$ = weight fraction of C_2F_6/CF_4, kg C_2F_6/kg CF_4

The data related with weight fraction of C_2F_6/CF_4, kg C_2F_6/kg CF_4 was in line with **IPCC 2006 Methodology (Tier 2 Method – table 4.16):** weight fraction **C_2F_6/CF_4 = 0.121**

Figure 4.15 The trend of PFC emissions [GgCO_2 equiv] from Primary aluminium production sub-sector in the period 1989-2009



The **CO, SO_2 emissions** are also estimated related to primary aluminium production.

Table 4. 28 Emission factors for CO and SO_2 from primary aluminium production

Gas	Process	Emission Factor [Kg/tonne primary Al produced]
CO	**Anode baking**	**400**
SO_2	**Anode baking**	**0,9**

SF_6 used in aluminium and magnesium foundries (2.C.4)

Methodology

The default IPCC methodology for estimation the emissions from this sub-sector cannot be applied because this activity is not applicable in the country.

Activity data

This activity is not applicable in the country.

Emission factors

The default IPCC emission factors cannot be used because this activity is not applicable in the country.

4.4.3. Uncertainties and time series consistency

Iron and steel production (2.C.1)

Time series is consistent; emissions have been calculated using the same emission factors, the same sources of activity data and the same methods were used for the entire time series 1989-2009.

According to the IPCC GPG, the information on the carbon contents of pig iron and crude steel collected at plant level has an uncertainty of 5% and uncertainty in the emission factors for the reducing agents is within 5%.

Aggregated uncertainty value: the overall uncertainty resulted after aggregation of the AD and EF uncertainties according to the previsions in chapter 6 of IPCC GPG 2000 is 7.07%.

Ferroalloys production (2.C.2)

Time series is consistent; emissions have been calculated using the same emission factors, two sources of activity data and the same methods were used for the entire time series 1989-2009.

The uncertainty related to the activity data for CO_2 emissions is 5% and the uncertainty associated with default emission factor for CO_2 emissions is 37.5%.

The uncertainty associated with emission factor and activity data are in line with the IPCC 2006.

Aggregated uncertainty value: the overall uncertainty resulted after aggregation of the AD and EF uncertainties according to the previsions in chapter 6 of IPCC GPG 2000 is 37.83%.

Aluminium production (2.C.3)

Time series is consistent. Due to the data are provided directly from economic agent the emissions have been calculated using higher method in line with **IPCC Methodology** just only staring with 2003 year; for the first period 1989-2002 because the plant specific information data have not been not available, the emissions were calculated based on tier **1 method** – **IPCC Methodology**. There is the same source of activity data for the entire time series 1989-2010.

CO_2 emissions

For the first period 1989-2002 the uncertainty related to the **activity data for CO_2** emissions is **1 %** and the uncertainty associated with the **default emission factor for CO_2** emissions is **10%**.

For the **last period 2003-2010** the uncertainty associated with **CO_2 emission factor** is **5 %** and the uncertainty related to **activity data for CO_2** is **2 %.** These uncertainty data are in line with the **IPCC 2006 Methodology**.

PFC emissions

For the first period 1989-2002 the uncertainty related to the **activity data for PFC** emissions is **1 %** and the uncertainty associated with the **default emission factors for PFC** emissions is **6%**.

For the **last period 2003-2010** the uncertainty associated with **PFC emission factor** is **6%** and the uncertainty related to **activity data for PFC** is **2 %.** These uncertainty data are in line with the **IPCC 2006 Methodology**.

Aggregated uncertainty value: the overall uncertainty for CO_2 resulted after aggregation of the AD and EF uncertainties according to the previsions in chapter 6 of IPCC GPG 2000 is 5.39% and for PFC is 6.33%.

4.4.4. Source specific QA/QC and verification

All activities regarding quality control (QC) as described in QA/QC Program have been undertaken.

These activities have been accomplished by the Romanian Industrial Processes sector expert, activity results of these actions being mentioned in Check lists. After these activities unconformities have not been notified.

AD on primary aluminium production obtained from economic agent has been checked against the data obtained from the national statistics. The differences in AD generated by these two different data sources are negligible (there are some small differences in the first part of the time series, when statistical data are a little bit higher, but the data from plant are consider to be more reliable).

AD on iron and steel production obtained from local environmental protection agencies has been checked against the data obtained from national statistics and Ministry of Economy. The differences in AD generated by these three different data sources are negligible.

In order to improve the accuracy of activity data, emission factors and emissions have been developed, there were developed new approaches which are presented in the sub- sectors "Source specific recalculation" and Chapter 10.

No recalculations were needed following the QA activities developed under the procedures for the compilation of the European Community GHG Inventory, described in the Decision 280/2004/EC of the European Parliament and of the Council, and Decision 166/2005/EC of the European Commission.

All notified and solved recommendations following various QA/QC activities are described in Improvement Lists.

4.4.5. Source specific recalculation, including changes made in response to the review process.

Table 4.29 The effects of recalculations in Metal Production sub-sector (2.C)

The effects of recalculations in Metal Production subsector (2C)			
Years	**2010 v 3.2 submission**	**2011 v 2.1 submission**	**Differences [%]**
	CO_2 equivalent [Gg]		
1989	20,053.12	20,026.45	-0.13
1990	12,990.07	12,973.25	-0.13
1991	8,999.47	8,987.58	-0.13
1992	8,530.47	8,520.98	-0.11
1993	8,694.57	8,685.25	-0.11
1994	9,884.54	9,874.26	-0.10
1995	11,076.25	11,066.42	-0.09
1996	10,555.62	10,546.98	-0.08
1997	11,090.94	11,080.20	-0.10
1998	11,017.04	11,006.49	-0.10
1999	7,275.29	7,266.04	-0.13
2000	7,156.56	7,144.51	-0.17
2001	6,519.39	6,504.56	-0.23
2002	7,923.45	7,906.24	-0.22
2003	7,035.00	6,857.39	-2.52
2004	7,454.36	7,105.87	-4.67
2005	7,934.94	7,453.27	-6.07
2006	9,217.80	8,668.24	-5.96
2007	9,505.70	8,903.95	-6.33
2008	6668.92	6048.25	-9.31
2009		3,999.41	

Iron and steel production sub-sector (2.C.1.)

Recalculation of the entire time series of emissions at the iron and steel production sub-sector level as the CO_2 emissions released from consumed electrodes (2.C.1.5) were added to the CO_2 emissions resulted from steel production (according to the Tier 2 approach, starting with the 2011 submission (2.C.1).

Table 4. 30 Recalculations of CO_2 [Gg] emissions in the Iron and steel Production sub- sector

The effects of recalculations in Iron and Steel Production subsector (2.C.1)			
Years	**2010 submission**	**2011 submission**	**Differences [%]**
	CO_2 emissions [Gg]		
1989	15831.10	15804.43	-0.17
1990	10291.45	10274.62	-0.16
1991	6577.71	6565.82	-0.18
1992	6824.74	6815.25	-0.14
1993	6973.80	6964.48	-0.13
1994	7992.64	7982.36	-0.13
1995	8862.28	8852.45	-0.11
1996	8310.22	8301.58	-0.10
1997	8893.75	8885.24	-0.10
1998	8877.87	8870.94	-0.08
1999	5405.10	5400.61	-0.08
2000	5455.86	5450.97	-0.09
2001	5050.05	5045.04	-0.10
2002	6768.55	6764.47	-0.06
2003	6024.43	6019.38	-0.08
2004	6287.12	6280.22	-0.11
2005	6805.45	6797.42	-0.12
2006	8128.87	8120.36	-0.10
2007	8440.71	8431.94	-0.10
2008	5622.56	5614.65	-0.14
2009		3681.54	

The figures for NMVOC, NO_x, SO_2 and CO emissions have been updated based on new data inputs.

Change in notation keys (NK) for all-time series 1989-2008 as the CO_2 recovery and CH_4 recovery notation keys for the Iron and steel production sub-sector was change from NE in NO. Since the CO_2 emissions released from consumed electrodes (2.C.1.5) were added to the CO_2 emissions resulted from steel production (tier 2) the activity data for electrodes have been noted as IE from NE during the all-time series.

Ferroalloys production (2.C.2)

Change in notation keys (NK) for all-time series 1989-2008 as the CO_2 recovery and CH4 recovery notation keys for the Ferroalloys production sub-sector was change from NE in NO.

Aluminium production (2.C.3)

CF_4 recovery and C_2F_6 recovery notation keys for the Aluminium production sub-sector was change from NE in NO

CO2 emissions

Recalculation of the **2003-2009** period of emission due to starting with **2003** introduced an improvement in method for calculating CO_2 emissions. Has been passed from tier 1 to **tier 3 Method** - IPCC 2006 Methodology.
Recalculation of the 1989- 1993 / 1996-2000 period for CO_2 emissions for the aluminum production sub-sector due to finally activity data were provided.

PFC emissions

Recalculation of the **1997-2009 period** of emissions due to change the method for calculating **PFC emissions**. Has been passed from tier 1 to tier **2 Method -** IPCC Methodology.
For CF_4 emissions the recalculation were made due to improvement of the method starting **with 2003 to 2009 yea**r; there is used tier 2 method for emissions calculation.
For C_2F_6 emissions the recalculation were made due to change the method for emissions calculation for **1997-2002 period**. **Starting with 2003 to 2009** the recalculations was made due to improvement of the method for emissions calculation; it is used tier **2 method - IPCC Methodology**, for C_2F_6 emissions calculation.

Table 4.31 Recalculations of CO_2 [Gg] emissions in the aluminium production sub- sector

The effects of recalculations in aluminium production subsector (2C3)			
Years	**2010 v 3.2 submission**	**2011 v 2.1 submission**	**Differences [%]**
	CO_2 emissions [Gg]		
1989	398.31	398.31	**0.0011**
1990	251.60	251.61	**0.0022**
1991	230.94	230.94	**0.0019**
1992	160.79	160.79	**-0.0003**
1993	167.60	167.60	**0.0015**
1994	177.30	177.30	0.0000
1995	210.90	210.90	0.0000
1996	210.35	210.35	**-0.0024**
1997	245.55	245.56	***0.0024***
1998	262.07	262.07	***-0.0008***
1999	261.11	261.12	***0.0033***
2000	259.90	259.91	***0.0025***
2001	269.73	269.73	*0.0000*
2002	279.89	279.89	*0.0000*
2003	297.07	334.96	***12.7542***
2004	322.89	362.15	***12.1587***
2005	358.51	372.62	***3.9334***
2006	383.74	397.31	***3.5365***
2007	393.76	402.14	***2.1276***
2008	397.128	399.93	***0.7056***
2009		299.04	

Table 4.32 Recalculations of PFC emissions [Gg CO_2 equivalent] in the aluminium production sub- sector

The effects of recalculations in aluminium production subsector (2C3)			
Years	**2010 v 3.2 submission**	**2011 v 2.1 submission**	**Differences [%]**
	PFC emissions [Gg CO_2 equivalent]		
1989	3,349.56	3,349.56	0.00
1990	2,115.83	2,115.83	0.00
1991	1,942.09	1,942.09	0.00
1992	1,352.13	1,352.13	0.00
1993	1,409.43	1,409.43	0.00
1994	1,490.97	1,490.97	0.00
1995	1,773.53	1,773.53	0.00
1996	1,768.86	1,768.86	0.00
1997	1,788.61	1,786.37	***-0.13***
1998	1,756.95	1,753.33	***-0.21***
1999	1,608.10	1,603.35	***-0.30***
2000	1,299.27	1,292.10	***-0.55***
2001	1,054.02	1,044.20	***-0.93***
2002	730.99	717.86	***-1.80***
2003	471.95	261.50	***-44.59***
2004	512.96	132.12	***-74.24***
2005	569.56	81.81	***-85.64***
2006	609.63	55.01	***-90.98***
2007	625.55	24.20	***-96.13***
2008	630.90	15.34	***-97.57***
2009		7.00	

4.4.6. Source specific planned improvements, including those in response to the review process.

More detailed data will try to be obtained, in respect to the IPCC GPG 2000 provisions.

4.5. Source category Other Production (CRF sector 2.D)

4.5.1. Source category description

This sector includes NOx, CO, NMVOC and SO_2 emission resulted from the pulp and paper production **(2.D.1),** alcoholic beverages production and food production **(2.D.2).** The activity data necessary to estimate these emissions are provided in the Statistical Yearbook.

4.5.2. Methodological issues

Methodology

According with IPCC 1996 and GPG 2000 Methodology there are no described methods in order to estimate the emissions on higher levels, therefore it was followed the methodology from Revised 1996 IPCC Guidelines for National GHG Inventories: Workbook and Revised 1996 IPCC Guidelines for National GHG Inventories: Reference Manual

In the pulp and paper production (2.D.1*)* sub-sector the pulp production was broken down by kraft and acid sulphite processes.

In the food and drink production (2.D.2) sub-sector the emission was estimated based on the total annual production of the particular food and drink manufacturing process.

The emissions of NOx, CO, NMVOC, and SO_2 within the production of pulp and paper and food and drink sub-sector are calculated based on the production volume and the emission factors, in line with the IPCC 1996.

Activity data

In the pulp and paper production (2.D.1) sub-sector, the emission was estimated based on the total annual production of dried pulp, provided by National Statistics.

In the food and drink production (2.D.2) sub-sector the AD were provided by the National Statistics. The data set in case of bread production is not complete; the data for 1989-2000 are missing. A linear extrapolation was used to estimate bread production in order to complete the time series.

Emission factors

For confidentiality reasons the presentation of NOx, CO, NMVOC, SO_2 emission factors used to estimate emission from the production of pulp and paper and food and drink sub-sector are omitted.

4.5.3. Uncertainties and time series consistency

Time series is consistent; emissions have been calculated using the same emission factors, the same sources of activity data and the same methods were used for the entire time series 1989-2008.

4.5.4. Source specific QA/QC and verification

All activities regarding quality control (QC) as described in QA/QC Program have been undertaken.

These activities have been accomplished by the Romanian Industrial Processes sector expert, activity results of these actions being mentioned in Check lists. After these activities unconformities have not been notified.

No recalculations were needed following the QA activities developed under the procedures for the compilation of the European Community GHG Inventory, described in the Decision 280/2004/EC of the European Parliament and of the Council, and Decision 166/2005/EC of the European Commission.

All notified and solved recommendations following various QA/QC activities are described in Improvement Lists.

4.5.5. Source specific recalculation, including changes made in response to the review process

No recalculations were made relative to previous submission.

4.5.6. Source specific planned improvements, including those in response to the review process.

More detailed data will try to be obtained, in respect to the IPCC GPG 2000 provisions.

4.6. Source category Production of Halocarbons and SF_6 (CRF sector 2.E)

4.6.1. Source category description

F-gases are not produced in Romania and therefore there are no fugitive emissions from manufacturing. Additionally, there is no production of other fluorinated gases (HCFC) that could lead to by-product F-gas emissions.

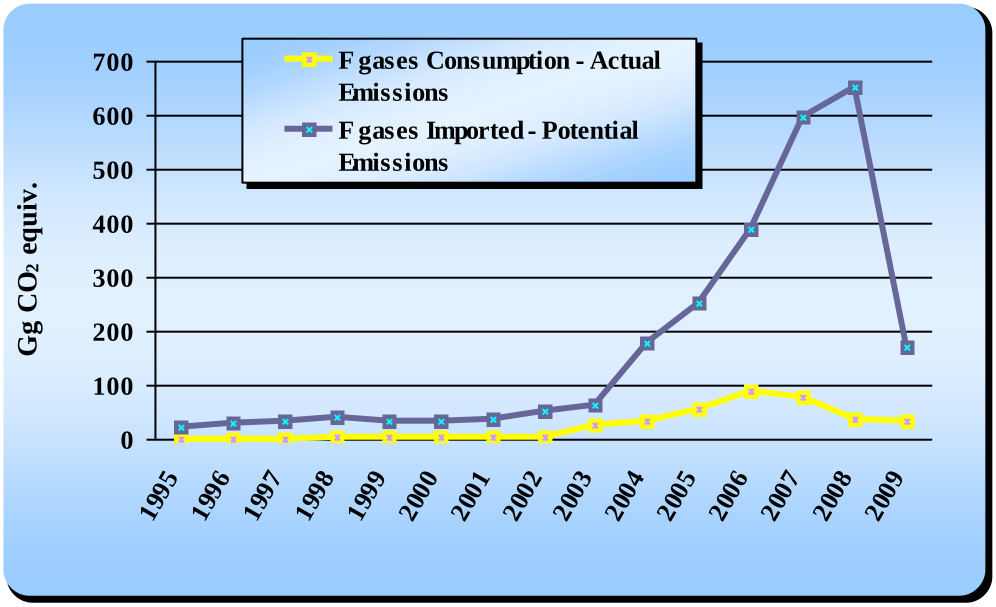
4.7. Source category Consumption of Halocarbons and SF_6 (CRF sector 2.F)

4.7.1. Source category Description

In order to estimate consumption of HFCs, PFCs and SF_6 in the period 1989-2008 two sets of questionnaires have been sent to:

- trading companies, to identify the amounts of F gases imported/exported;
- Local Environment Protection Agencies, to identify manufacturing and service companies as possible sources of handling or consumption of these compounds.

Figure 4.16 The trend of CO_2 emissions [Gg CO_2 equiv.] Consumption of Halocarbons and SF_6 sub-sector in the period 1989-2009



4.7.2. Methodological issues

Methodology

Both potential and actual emissions were estimated. Potential emissions were estimated using Tier 1a method and actual emissions were estimated using Tier 2 method according to the IPCC methodology.

Activity data

The results of the questionnaires were:

- F-gases are not produced in the country;
- export is not applicable;
- there were identified two big importers in the country , for 2009
- The most important economic agent is an Air-Conditioning equipment producer

(consumption of HFC 134a);

- based on the data from questioners there is also a big Domestic Refrigeration equipment producer;
- there are many registered services, distributed around the country, which perform servicing mainly on domestic and commercial equipment, some of these shops also service industrial equipment, but the majority of this work is done by the original equipment manufacturers, which all operate their own service teams;
- the use of F-gases started in 1995.

For the 2003-2008 period the actual emissions related with SF_6 increased significantly because according to the questionnaires received from the operators a new economic agent using SF_6 in its activity (production of pieces and accessories for vehicles and motor vehicle) was identified. Starting with 2008 the actual emissions decreased related to 2007 because the same economic agent user of SF_6 has reduced significantly its SF_6 consumption.

There are large inter-annual variations for PFC emissions from refrigeration and air condition equipment and low emissions in 2008 in comparison to previous due to along the estimated period many economic operators using F-gases in their activity have decreased its consumption or have been closed.

The ascending trend of HFC emissions is also caused by the increasing production of the equipments using F-Gases and the developing field industry.
In other sub-sector within the Consumption of Halocarbons and SF_6 category (2.F.9) there were taken into account next activity: nuclear electricity and heat production, production of pieces and accessories for vehicles and motor vehicle.

Emission factors

- **Potential emissions**

Potential emissions were estimated using Tier 1a method, based on formula:

Equation 4.10 Calculation of potential emissions

Potential Emissions = Production + Imports – Exports - Destruction

where:

- production = not applicable
- imports = imported HFC/PFC in bulk (HFC-32, HFC-125, HFC-134a, HFC-143a were identified in 2009)
- exports - not applicable
- destruction - not estimated

Potential emissions are equaled with the amount of substance imported in bulk.

- **Actual emissions**

Actual emissions were estimated using Tier 2 method according to the IPCC methodology The determination of emissions of F-gases is based on a calculation of the actual emission. The emission factors used to estimate actual emissions (initial emissions, lifetime time emissions and end-of-life emissions) are the recommended emission factors from IPCC GPG (Table 3.22).

Table 4.33 Implied emission factors use to estimate the emissions related to Consumption of halocarbons and SF_6

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	**IMPLIED EMISSION FACTORS**		
	Product manufacturing factor	**Product life factor**	**Disposal loss factor**
1. Refrigeration[(1)]	**(% per annum)**		
Air Conditioning Equipment			
Domestic Refrigeration	0.60	0.30	70.00
Commercial Refrigeration	1.75	20.00	70.00
Transport Refrigeration	0.60	32.50	70.00
Industrial Refrigeration	1.75	16.00	80.00
Stationary Air-Conditioning	0.60	3.00	70.00
Mobile Air-Conditioning	0.50	15.00	70.00
2. Foam Blowing[(1)]			
Hard Foam			
Soft Foam			
3. Fire Extinguishers / *(please specify chemical)*[(1)]	65 - 40		
4. Aerosols [(1)]			
5. Solvents [(1)]	50.00		
6. Other applications using ODS[(2)] **substitutes** [(1)]			
7. Semiconductors [(1)]			
8. Electric Equipment[(1)]	0.06		
9. Other ***(please specify)***[(1)]			
Other non-specified	50.00		

In 2009, the sub-sector 2F Consumption of halocarbons and SF_6 includes the following source categories and the following F-gases:

Table 4.34 Source categories and the F-gases in Consumption of halocarbons and SF_6 sub-sector

Source category	**Sub-sector**	**HFCs/PFCs/SF_6**
2F1 Refrigeration and air conditioning equipment	Domestic refrigeration	HFC-32, HFC-143a, HFC-134a, HFC-125, HFC-134, HFC-143
2F1 Refrigeration and air conditioning equipment	Commercial refrigeration	HFC-143a, HFC-32, HFC-125, HFC-134, HFC-143, HFC-134a
2F1 Refrigeration and air conditioning equipment	Industrial refrigeration	HFC-143a, HFC-134a, HFC-32, HFC-23, HFC-134, HFC-125, HFC-134, HFC 143
2F1 Refrigeration and air conditioning equipment	Transport refrigeration	HFC-134a,HFC-134,HFC-125, HFC-143a
2F1 Refrigeration and air conditioning equipment	Stationary air conditioning	HFC-125, HFC-134a, HFC-32, HFC-143a, HFC-23, HFC-134, HFC-143
2F1 Refrigeration and air conditioning equipment	Mobile air conditioning	HFC-134a, HFC-134, HFC-143a, HFC-125, HFC-32
2F8 Electrical equipments	Electrical equipments	SF6, HFC-134a, HFC-23
2F3 Fire extinguishers		SF_6, HFC-134, HFC-125, HFC-227ea
2F9 Other non specified		HFC-134a, HFC-32, HFC-134, HFC-143a, SF6, HFC-125

4.7.3. Uncertainties and time series consistency

By expert judgment the uncertainty related to the activity data for HFC/PFC/SF_6 emissions is 30% and the uncertainty associated with the default emission factor for HFC/PFC/SF_6 emissions is 50%.

Aggregated uncertainty value: the overall uncertainty resulted after aggregation of the AD and EF uncertainties according to the previsions in chapter 6 of IPCC GPG 2000 is 58.31%.

4.7.4. Source specific QA/QC and verification

All activities regarding quality control (QC) as described in QA/QC Program have been undertaken.

These activities have been accomplished by the Romanian Industrial Processes sector expert, activity results of these actions being mentioned in Check lists. After these activities unconformities have not been notified.

No recalculations were needed following the QA activities developed under the procedures for the compilation of the European Community GHG Inventory, described in the Decision 280/2004/EC of the European Parliament and of the Council, and Decision 166/2005/EC of the European Commission.

All notified and solved recommendations following various QA/QC activities are described in Improvement Lists.

4.7.5. Source specific recalculation, including changes made in response to the review process

There are no recalculations.

4.7.6. Source specific planned improvements, including those in response to the review process.

More detailed data will try to be obtained, in respect to the IPCC GPG 2000 provisions.

5. SOLVENT AND OTHER PRODUCT USE (CRF sector 3)

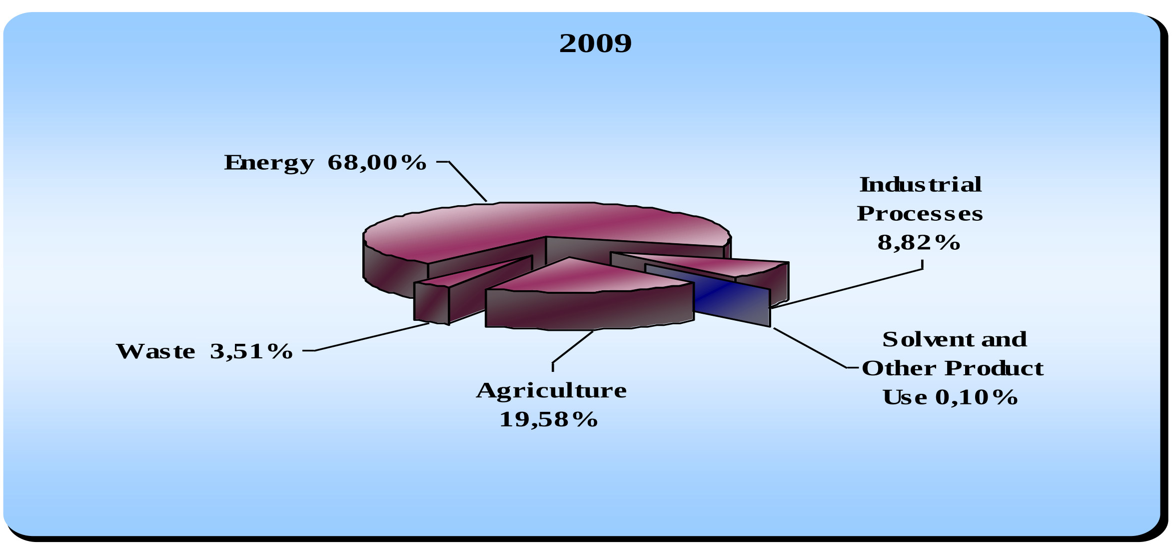
5.1. Overview of the sector

Solvents are chemical compounds, which are used to dissolve substances as paint, glues, ink, rubber, plastic, and pesticides or for cleaning purposes (degreasing). After application of these substances or other procedures of solvent use most of the solvent is released into air. The use of solvents leads to emissions of non-methane volatile organic compounds (NMVOC), which is regarded as an indirect greenhouse gas. The NMVOC emissions will over a period of time in the atmosphere oxidize to CO_2, which is included in the total greenhouse gas emissions reported to the UNFCCC Secretariat.

5.2. Source category

Paint application (3A), Degreasing and Dry Cleaning (3B), Chemical Products, Manufacture and Processing (3C), Other (3D). In 2009 the GHG emissions from Solvent and other product use sector contributed to 0.10% of the total GHG emissions in Romania.

Figure 5.1 The contribution of Solvent and other product use sector to the total GHG emissions in Romania, 2009



5.2.1. Source category description

- 3 A source category includes emissions resulted from: domestic use, automobile manufacture and repairing, construction and buildings;
- 3 B source category refers to emissions resulted from metal degreasing, dry cleaning, electronic components manufacturing, other industrial cleaning;
- 3 C source category includes emissions from chemicals manufacturing or processing: polyester processing, polyvinyl chloride processing, polyurethane foam processing, rubber processing, pharmaceutical products manufacturing, paints manufacturing, glues manufacturing;
- 3 D source category refers to emissions resulted from other use of solvents, such as: mineral wool induction, preservation of wood, domestic solvent use (other than paint application), under seal treatment and conservation of vehicles.

5.2.2. Methodological issues

Methodology

IPCC guidelines do not provide methodology to determine NMVOC emissions, which is the main source of emissions in this sector. Due to this reason, the NMVOC emissions resulted from Solvents and Other Product use are estimated based on CORINAIR methodology, using the correspondence between IPCC categories and SNAP codes:

IPCC categories	SNAP codes
3A Paint application	**0601 Paint application**
3B Degreasing and Dry Cleaning	**0602 Degreasing, dry cleaning and electronics**
3C Chemical Products, Manufacture and Processing	**0603 Chemical products manufacturing and processing**
3D Other	**0604 Other use of solvents & related activities**

Activity data

For 2009 submission the AD used to calculate emissions are provided by the national statistics and economic agents but the main data source is national statistics.

Emission factors

CO_2 emissions from solvent use were calculated from NMVOC emissions of this sector.
The following equation has been applied:

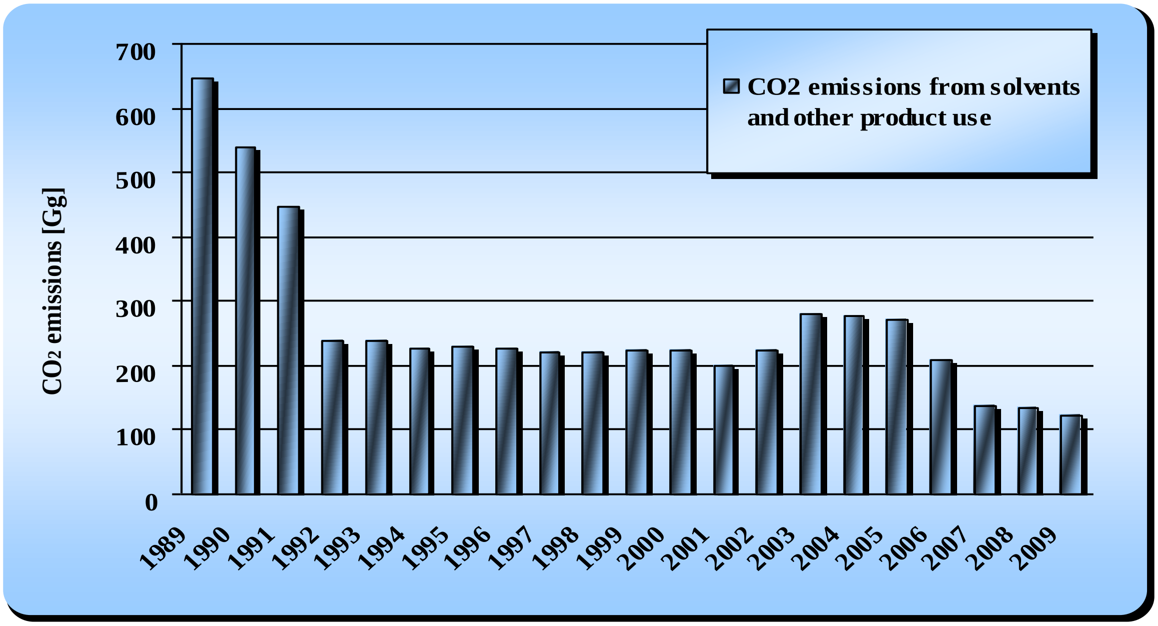
Equation 5.1 Calculation of CO_2 emissions from solvent use

CO_2 emissions = 0,85 x (44/12) x emissions of NMVOC
where 0,85 is carbon content conversion factor.

Table 5. 1 CO_2 emissions resulted from Solvent and other product use in the period 1989-2009

Solvents and Other Product Use - 2011 submission					
Year	**3a**	**3b**	**3c**	**3d**	**Total**
	CO_2 emissions [Gg]				
1989	141.20	100.70	0.00	403.90	**645.80**
1990	111.60	88.20	0.00	340.70	**540.50**
1991	84.50	70.10	0.00	293.60	**448.20**
1992	52.00	31.00	0.00	154.60	**237.60**
1993	51.10	30.90	0.00	155.50	**237.50**
1994	41.50	30.90	0.00	153.00	**225.40**
1995	43.90	30.90	0.00	154.60	**229.40**
1996	39.60	30.80	0.00	154.90	**225.30**
1997	33.00	30.80	0.00	155.20	**219.00**
1998	31.50	30.80	0.00	159.60	**221.90**
1999	30.50	30.80	0.00	161.10	**222.40**
2000	32.70	30.80	0.00	160.80	**224.30**
2001	41.50	17.50	0.00	141.50	**200.50**
2002	45.50	17.80	0.00	159.00	**222.30**
2003	106.60	21.80	0.00	151.50	**279.90**
2004	99.80	25.80	0.00	151.80	**277.40**
2005	95.14	16.85	0.00	157.66	**269.65**
2006	162.42	16.82	0.00	29.26	**208.50**
2007	35.37	20.18	0.00	82.26	**137.82**
2008	25.16	28.19	0.00	81.79	**135.14**
2009	11.05	25.43	0.00	85.85	**122.33**

Figure 5.2 The trend of CO_2 emissions resulted from Solvent and other product use sector, in the year 2009



The trend of emissions resulted from this sector follow the general emission trend: emissions have been seriously decreased after 1989, then the emissions are relatively stable from 1992 to 2002 and after 2002, emissions are started to increase, as an increase in economic activities (automobile manufacture, construction and buildings).

5.2.3. Uncertainties and time series consistency

Uncertainties are rather large due to the diverse nature of many solvent-using processes.

By expert judgment the uncertainty related to the activity data is 30% and the uncertainty associated with the CO_2 emissions is 50%.

Aggregated uncertainty value: the overall uncertainty resulted after aggregation of the AD and EF uncertainties according to the previsions in chapter 6 of IPCC GPG 2000 is 58.31%.

5.2.4. Source specific QA/QC and verification

All activities regarding quality control (QC) as described in QA/QC Program have been undertaken.

These activities have been accomplished by the Romanian Industrial Processes sector expert, activity results of these actions being mentioned in Check lists. After these activities unconformities have not been notified.

No recalculations were needed following the QA activities developed under the procedures for the compilation of the European Community GHG Inventory, described in the Decision 280/2004/EC of the European Parliament and of the Council, and Decision 166/2005/EC of the European Commission.

All notified and solved recommendations following various QA/QC activities are described in Improvement Lists.

5.2.5. Source specific recalculation, including changes made in response to the review process

Considering new NMVOC emissions collected data, as a result of a performed recalculation, the NMVOC and CO_2 emissions data on 2008 have been recalculated (3.A).

Table 5.2 The effects of recalculations in Solvent and Other Product Use sector

The effects of recalculations in Solvents and Other Product Use Sector 2011 submission						
Years	**2010 submission**	**2011 submission**	**Diff. [%]**	**2010 submission**	**2011 submission**	**Diff. [%]**
	CO_2 emissions [Gg]			**NMVOC emissions [Gg]**		
1989	645.80	645.80	0.00	228.80	228.80	0.00
1990	540.50	540.50	0.00	191.40	191.40	0.00
1991	448.20	448.20	0.00	159.70	159.70	0.00
1992	237.60	237.60	0.00	81.64	81.64	0.00
1993	237.50	237.50	0.00	81.84	81.84	0.00
1994	225.40	225.40	0.00	79.33	79.33	0.00
1995	229.40	229.40	0.00	82.32	82.32	0.00
1996	225.30	225.30	0.00	81.01	81.01	0.00
1997	219.00	219.00	0.00	78.89	78.89	0.00
1998	221.90	221.90	0.00	73.38	73.38	0.00
1999	222.40	222.40	0.00	79.37	79.37	0.00
2000	224.30	224.30	0.00	80.17	80.17	0.00
2001	200.50	200.50	0.00	71.00	71.00	0.00
2002	222.30	222.30	0.00	72.80	72.80	0.00
2003	279.90	279.90	0.00	92.19	92.19	0.00
2004	277.40	277.40	0.00	91.63	91.63	0.00
2005	269.65	269.65	0.00	98.09	98.09	0.00
2006	208.50	208.50	0.00	80.86	80.86	0.00
2007	137.82	137.82	0.00	73.09	73.09	0.00
2008	134.74	135.14	0.30	69.23	69.36	0.18
2009		122.33			46.00	

5.2.6. Source specific planned improvement, including those in response to the review process.

More detailed data will try to be obtained, in respect to the IPCC GPG 2000 provisions.

6. AGRICULTURE (CRF sector 4)

6.1. Overview of sector

This chapter provides information on the estimation of the greenhouse gas emissions from the agriculture sector (Sectoral Report for Agriculture, Table 4 in the Common Reporting Format). The following source categories are quantified and reported:

- CH_4 emissions from enteric fermentation;
- CH_4 and N_2O emissions from manure management;
- CH_4 emissions from rice cultivation;
- N_2O emissions from agricultural soils;
- CH_4, N_2O, NO_x and CO emissions from field burning of agricultural residues.

The direct GHGs reported within this sector are CH_4 and N_2O while indirect gases comprise NO_x and CO.

Domestic livestock are the major source of CH_4 emissions from agriculture, both from enteric fermentation and manure management. Manure management also generates N_2O emissions.

Table 6.1 gives an overview of the IPCC categories included in this chapter and provides information on the status of related emissions estimates.

Table 6.5 Status of emissions estimation within the Agriculture sector

IPCC category	Emissions estimation status	
	CH_4	N_2O
4A Enteric fermentation		
4A1 Cattle	✓	NA
4A1a Dairy cattle	✓	NA
4A1b Non-dairy cattle	✓	NA
4A2 Buffalo	✓	NA
4A3 Sheep	✓	NA
4A4 Goats	✓	NA
4A5 Camels and llamas	NO	NO
4A6 Horses	✓	NA
4A7 Mules and asses	✓	NA
4A8 Swine	✓	NA
4A9 Poultry	✓	NA
4A10 Other livestock	NA	NA
4B Manure management		
4B1 Cattle	✓	✓
4B1a Dairy cattle	✓	✓
4B1b Non-dairy cattle	✓	✓
4B2 Buffalo	✓	✓
4B3 Sheep	✓	✓
4B4 Goats	✓	✓

Table 6.1 (continued) Status of emissions estimation within the Agriculture sector

IPCC category	**Emissions estimation status**	
	CH_4	**N_2O**
4B5 Camels and llamas	NO	NO
4B6 Horses	✓	✓
4B7 Mules and asses	✓	✓
4B8 Swine	✓	✓
4B9 Poultry	✓	✓
4B10 Other livestock	NA	NA
4B11 Anaerobic lagoon	NA	✓
4B12 Liquid/Slurry	NA	✓
4B13 Daily spread	NA	IE[1)]
4B14 Solid storage	NA	✓
4B15 Dry lot	NA	✓
4B16 Pasture/range/paddock	NA	IE[1)]
4B17 Pit	NA	✓
4B18 Other AWMS	NA	✓

Observations

1) In respect to the IPCC GPG 2000 provisions, N_2O emissions from Daily spread and Pasture range and paddock AWMS are reported under 4D – Agricultural soils (see Chapter 6.5).

Table 6.1 (continued) Status of emissions estimation within the Agriculture sector

IPCC category	Emissions estimation status	
	CH_4	N_2O
4C Rice cultivation		
4C1 Irrigated	✓	NA
4C11 Continuously flooded	NO	NA
4C12 Intermittently flooded	✓	NA
4C121 Single aeration	NO	NA
4C122 Multiple aeration	✓	NA
4C2 Rainfed	NO	NA
4C3 Deep water	NO	NA
4C4 Other	NO	NA
4D Agricultural soils		
4D1 Direct soil emissions	NA	✓
4D11 Synthetic fertilizers	NA	✓
4D12 Animal manure applied to soils	NA	✓
4D13 N-fixing crops	NA	✓
4D14 Crop residue	NA	✓
4D15 Cultivation of histosols	NA	✓
4D16 Other direct emissions	NA	NA
4D2 Pasture range and paddock manure	NA	✓
4D3 Indirect emissions	NE	✓
4D4 Other	NA	NA

Table 6. 1 (continued) Status of emissions estimation within the Agriculture sector

IPCC category	Emissions estimation status	
	CH_4	N_2O
4E Prescribed burning of savannas	NO	NO
4F Field burning of agricultural residues	NO	NO

Figure 6.10 Total GHG emissions trend in Agriculture for 1989–2009

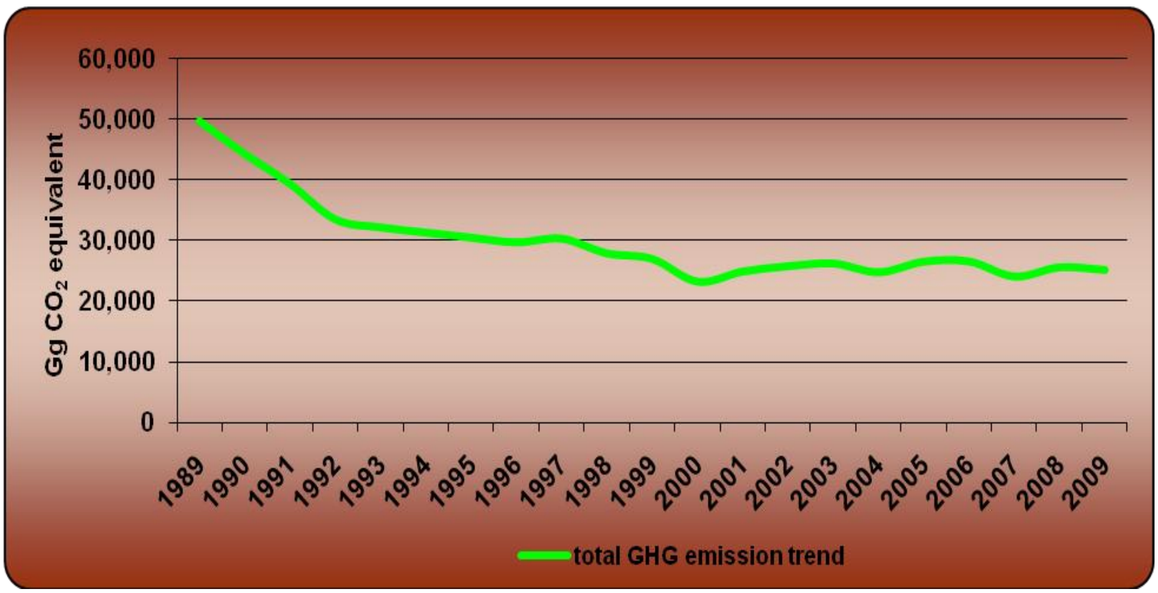
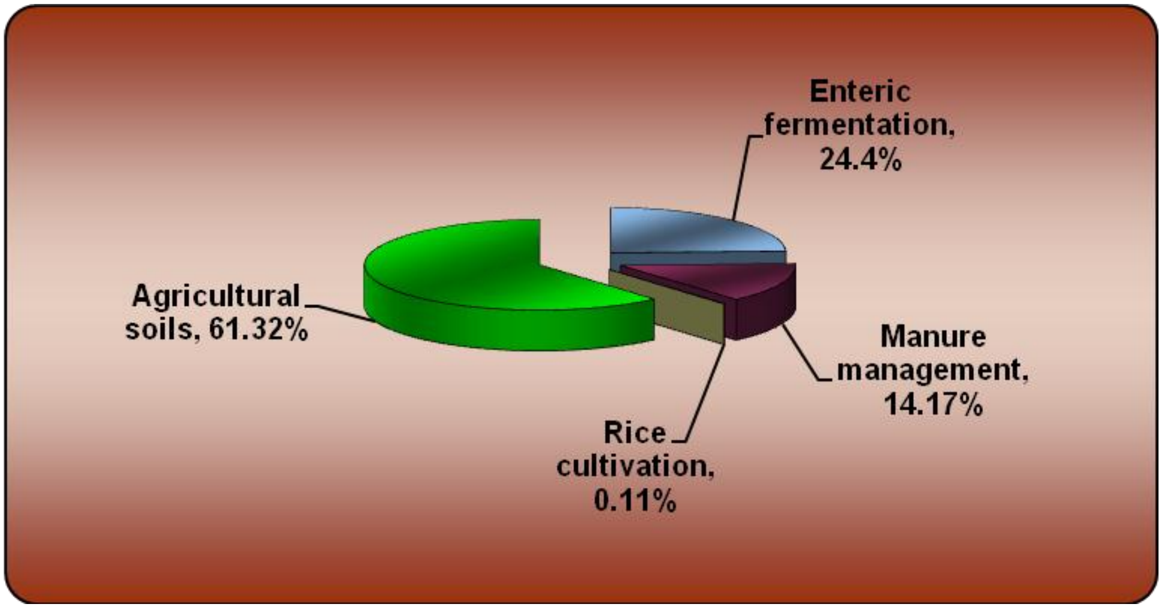


Figure 6.11 Contribution of the sub-sectors in the total GHG emissions from Agriculture, in 2009



Another source of methane is represented by anaerobic decomposition of organic material in flooded rice fields.

Microbiological processes in soil lead to N_2O emissions. Three N_2O sources are distinguished:

- direct soil emissions from agricultural soils (sources: synthetic fertilizers, animal waste applied to soil, biological nitrogen fixation, crop residue);
- direct soil emissions from animal production (from grazing animals);
- indirect soil emissions (atmospheric deposition, leaching and run off).

Burning of agricultural residues is a net source of CH_4, CO, N_2O and NO_x emissions for 1989-2001. Due to the implementation of the legislation which forbidden the burning of the agricultural residues, from 2002 to 2009 emissions are considered as not occurring.

Emissions from prescribed burning of savannas do not occur in Romania.

The Agriculture sector accounted for 19.58% of the total GHG emissions in 2009, reaching 25,205.7 Gg CO_2 equivalent (Table 6.2). Within the GHG emissions from the agriculture sector, the N_2O emissions have the largest contribution (in 2009, N_2O emissions contribution is 67.51% to the total Agriculture sector's CO_2 equivalent emissions), followed by the CH_4 emissions (that account for the remaining 32.49%).

Over the period 1989–2009, the GHG emissions resulted from agriculture sector decreased by 47.78% (Figure 6.1). In case of emissions resulted from enteric fermentation and manure management, the descending trend reflects the decrease in animal population over the period.

The rice cultivation generated in 2009 a significantly reduced emission compared to the base year 1989 (55.04% decrease comparing with the base year).

In case of agricultural soils, the emissions decreased over the period (48.52% decrease in 2009 comparing with 1989), due to the decrease of the amount of the synthetic fertilizer applied, of the livestock populations and of the crop productions level.

As presented in the Table 6.3, the Agriculture sector's CH_4 emissions decreased in 2009 with almost a half the level recorded in the base year (-45.55%). Because the methane emissions are mainly resulted in domestic livestock, the decrease of their level is due to the decline of the domestic livestock.

Table 6.4 indicates that N_2O emissions from the Agriculture sector decreased in 2009 with 48.78% comparing with the base year. The reasons for this decrease are:

- the decrease of the amount of chemical fertilizers applied to soils;
- the decline of the domestic livestock;

- the decrease of the crop productions level.

In the general context of the transition of the economy to a market based approach, the activity data level decreased substantially in the last years of the characterized period in comparison to the base year.

The livestock number decreased in the last years of the characterized period in comparison to 1989 mainly due to:

- the import of animals;
- the draught which affected the crop production levels and the crop production prices;
- state incentives in some periods;
- closing of the old/opening new facilities due to the restructuration of the economy.

The crop productions level decreased in the late years of the analyzed period in comparison to 1989 mainly due to the change in agricultural land property regime and to the transition to the market economy. Reasons for the inter-annual changes in crop production levels include:

- existence of draught periods;
- existence if state incentives for some periods;
- changes in the land property regime, including the disaggregation of large farms before 1990 and crystallization of new large farms in the late years.

Table 6.6 Contribution of Agriculture sector in total GHG emissions, in 1989–2009

Year	Total GHG emissions [Gg CO_2 equivalent]	GHG emissions from Agriculture [Gg CO_2 equivalent]	Contribu-tion of Agriculture in total GHG emissions [%]	Methane emissions from Agriculture [Gg CO_2 equivalent]	Contribution of methane emissions in total GHG emissions from Agriculture [%]	Nitrous oxide emissions from Agriculture [Gg CO_2 equivalent]	Contribution of nitrous oxide emissions in total GHG emissions from Agriculture [%]
1989	284,478.13	49,751.30	17.49	16,524.58	33.21	33,226.72	66.79
1990	255,997.62	44,337.26	17.32	15,658.68	35.32	28,678.58	64.68
1991	205,684.40	39,421.73	19.17	14,213.70	36.06	25,208.03	63.94
1992	190,746.90	33,554.23	17.59	12,458.13	37.13	21,096.10	62.87
1993	188,453.70	32,215.71	17.09	10,995.09	34.13	21,220.63	65.87
1994	183,208.27	31,365.70	17.12	10,809.69	34.46	20,556.01	65.54
1995	190,040.55	30,536.99	16.07	10,352.91	33.90	20,184.08	66.10
1996	196,339.66	29,760.54	15.16	10,333.86	34.72	19,426.68	65.28
1997	178,381.59	30,357.99	17.02	10,171.92	33.51	20,186.08	66.49
1998	159,352.63	27,933.22	17.53	9,450.52	33.83	18,482.70	66.17
1999	141,875.57	27,028.30	19.05	8,794.62	32.54	18,233.67	67.46
2000	143,951.05	23,261.40	16.16	8,231.04	35.38	15,030.36	64.62
2001	148,003.02	24,945.38	16.85	8,070.88	32.35	16,874.50	67.65
2002	154,848.38	25,812.01	16.67	8,287.78	32.11	17,524.23	67.89
2003	161,313.71	26,266.22	16.28	8,423.01	32.07	17,843.21	67.93
2004	158,427.14	24,817.13	15.66	8,558.73	34.49	16,258.40	65.51
2005	154,848.59	26,569.85	17.16	8,693.33	32.72	17,876.52	67.28
2006	159,145.23	26,599.63	16.71	8,907.25	33.49	17,692.38	66.51
2007	155,002.52	24,108.90	15.55	8,785.82	36.44	15,323.08	63.56
2008	149,899.01	25,643.34	17.11	8,531.29	33.27	17,112.05	66.73
2009	128,745.91	25,205.70	19.58	8,188.33	32.49	17,017.37	67.51

Table 6.7 Distribution of CH_4 emissions within Agriculture sub-sectors, in 1989–2009 [Gg]

Year	Total CH_4 emission - Agriculture	Enteric Fermentation	Manure Management	Rice Cultivation	Agricultural Soils	Prescribed Burning of Savannas	Field burning of agricultural residues
1989	786.88	561.32	217.75	2.96	NA, NE	NO	4.86
1990	745.65	544.86	194.13	2.39	NA, NE	NO	4.27
1991	676.84	486.58	184.83	1.30	NA, NE	NO	4.13
1992	593.24	427.76	161.82	0.98	NA, NE	NO	2.68
1993	523.58	376.53	142.68	0.86	NA, NE	NO	3.50
1994	514.75	374.38	136.00	0.33	NA, NE	NO	4.03
1995	493.00	364.89	123.17	0.45	NA, NE	NO	4.49
1996	492.09	362.91	125.79	0.61	NA, NE	NO	2.78
1997	484.38	353.27	126.18	0.29	NA, NE	NO	4.64
1998	450.02	332.69	113.80	0.12	NA, NE	NO	3.41
1999	418.79	312.62	102.61	0.10	NA, NE	NO	3.46
2000	391.95	296.18	93.17	0.08	NA, NE	NO	2.52
2001	384.33	290.09	89.85	0.05	NA, NE	NO	4.34
2002	394.66	298.78	95.86	0.02	NA, NE	NO	NO
2003	401.10	304.32	96.77	0.01	NA, NE	NO	NO
2004	407.56	302.07	105.40	0.09	NA, NE	NO	NO
2005	413.97	306.39	107.30	0.28	NA, NE	NO	NO
2006	424.15	314.29	109.46	0.40	NA, NE	NO	NO
2007	418.37	311.89	105.88	0.60	NA, NE	NO	NO
2008	406.25	304.38	101.16	0.71	NA, NE	NO	NO
2009	389.92	292.81	95.78	1.33	NA, NE	NO	NO

Table 6.8 Distribution of N_2O emissions within Agriculture sub-sectors, in 1989–2009 [Gg]

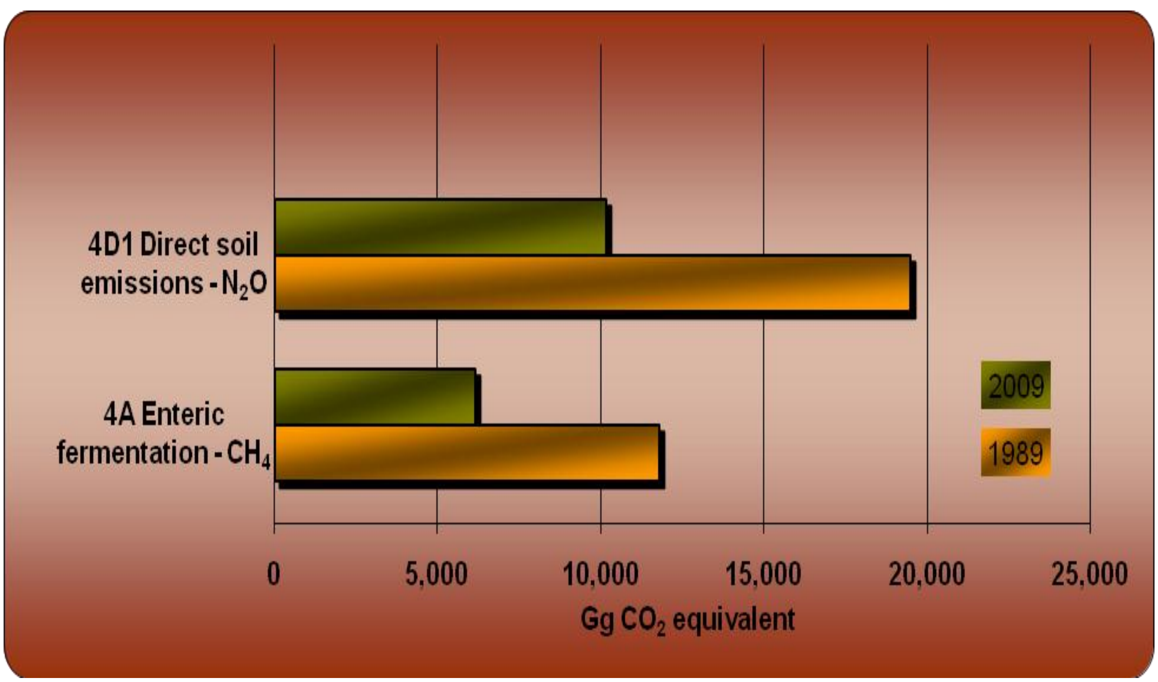
Year	Total N_2O emission - Agriculture	Enteric Fermentation	Manure Management	Rice Cultivation	Agricultural Soils	Prescribed Burning of Savannas	Field burning of agricultural residues
1989	107.18		10.21		96.85	NO	0.12
1990	92.51		8.88		83.53	NO	0.10
1991	81.32		8.72		72.49	NO	0.11
1992	68.05		7.93		60.05	NO	0.07
1993	68.45		7.28		61.09	NO	0.09
1994	66.31		6.99		59.22	NO	0.10
1995	65.11		6.41		58.59	NO	0.11
1996	62.67		6.48		56.11	NO	0.08
1997	65.12		6.47		58.53	NO	0.12
1998	59.62		5.91		53.63	NO	0.09
1999	58.82		5.37		53.35	NO	0.09
2000	48.49		5.01		43.41	NO	0.06
2001	54.43		4.87		49.46	NO	0.11
2002	56.53		5.11		51.42	NO	NO
2003	57.56		5.16		52.39	NO	NO
2004	52.45		5.48		46.96	NO	NO
2005	57.67		5.62		52.04	NO	NO
2006	57.07		5.72		51.35	NO	NO
2007	49.43		5.54		43.89	NO	NO
2008	55.20		5.28		49.92	NO	NO
2009	54.89		5.04		49.86	NO	NO

Table 6.5 and Figure 6.3 describe Key categories in Agriculture, both from level and trend and including and excluding LULUCF views.

Table 6.9 Key categories overview – Agriculture, 2009

Key categories	GHG	Excluding LULUCF		Including LULUCF	
		Criteria	Contribution in total GHG emissions [%]	Criteria	Contribution in total GHG emissions and removals [%]
4D1 Direct soil emissions	N_2O	L, T	**7.91**	L, T	**6.62**
4A Enteric fermentation	CH_4	L, T	**4.78**	L, T	**4**
4D3 Indirect soil emissions	N_2O	L	**2.78**	L	**2.33**
4B Manure management	CH_4	L	**1.56**	L	**1.31**
4D2 Pasture, Range and Paddock Manure	N_2O	L	**1.32**	L	**1.1**
4B Manure management	N_2O	L	**1.21**	L	**1.02**

Figure 6.12 Key Categories in Agriculture, both by level and trend



6.2. Source category Enteric Fermentation (CRF source category 4.A)

6.2.1. Source category description

Methane is produced by herbivores as a by-product of enteric fermentation, a digestive process by which carbohydrates are broken down by micro-organisms into simple molecules for absorption into the bloodstream. Although ruminants are the largest source, both ruminant and non-ruminant animals produce CH_4.

Enteric Fermentation:

- is the main source of CH_4 emissions in the Agriculture sector (in 2009, CH_4 emissions from Enteric Fermentation represented 75.09% of total CH_4 emissions in the Agriculture sector);
- is the second source in the Agriculture sector (in 2009, CH_4 emissions from Enteric Fermentation as CO_2 equivalent represented 24.4% from Total Agriculture emissions);
- contributed with 4.78% to Total GHG emissions of Romania.

Emissions from enteric fermentation are declining since 1989 due to the decrease of livestock number (Figure 6.4).

Figure 6.13 Methane emission trend due to the Enteric Fermentation

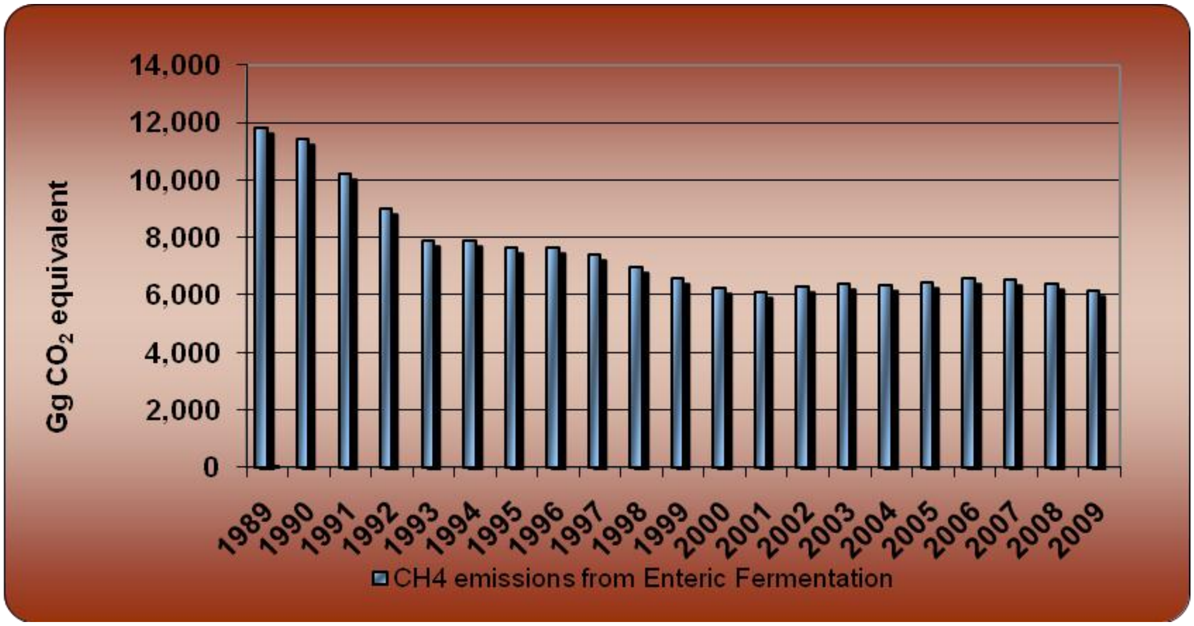


Table 6.10 Observations on source category 4A – "Enteric Fermentation"

Source indicative	Source (livestock) type	Observation	Data source
4A1	Cattle	Includes livestock data from two different cattle categories: dairy cows and non-dairy cattle.	AD: SY, other correspondence, NIS, 1989-2010; expert judgment; EF: IPCC GPG 2000, IPCC 1996
4A2	Buffalo		AD: SY, other correspondence, NIS, 1989-2010; expert judgment; EF: IPCC GPG 2000, IPCC 1996
4A3	Sheep		AD: SY, other correspondence, NIS, 1989-2010; EF: IPCC GPG 2000, IPCC 1996
4A4	Goats		
4A6	Horses		
4A7	Mules and asses		AD: FAO, 2010; EF: IPCC GPG 2000, IPCC 1996
4A8	Swine		AD: SY, other correspondence, NIS, 1989-2010; EF: IPCC GPG 2000, IPCC 1996
4A9	Poultry		

6.2.2. Methodological issues

Methodology

Despite the fact that Enteric fermentation is a key category, both from level and trend views, tier 2 method could not be applied, due to the lack of detailed data needed. Therefore, a tier 1 method has been applied. For calculation of methane emissions from enteric fermentation, the equations 4.12 and 4.13 of IPCC GPG 2000 were used.

Emission factors

According to the provisions in IPCC GPG 2000, the calculation methodology took into account IPCC 1996 default emissions factors for developed countries (Tables 4-3 and 4-4 from Reference Manual). They were considered also the following:

- a temperate climate zone;
- Romania belongs to Eastern Europe;
- Romanian conditions are similar to those in developed countries.

Considering the provisions in IPCC GPG 2000 corroborated to those in IPCC 1996 Reference Manual, the emissions factors specific to Dairy cows have been calculated through interpolation between default emissions factors values, using the Average milk production per animal (cow and buffalo cow for 1989-2007/cow for 2008-2009) data series (Table 6.7).

Table 6.11 Default emission factors used for calculation of Dairy cows methane emissions from Enteric fermentation

Year	Average milk production per animal (cow and buffalo cow for 1989-2007/cow for 2008-2009, calfs feeding included; l/head/year)	Emission Factors [kg CH_4/head/year]
1989	1892.00	70.94
1990	2063.00	73.55
1991	2203.00	75.69
1992	2305.00	77.25
1993	2440.00	79.32
1994	2790.00	83.76
1995	2955.00	85.66
1996	3018.00	86.39
1997	3057.00	86.84
1998	3030.00	86.53
1999	2990.00	86.07
2000	2867.00	84.65
2001	2957.00	85.69
2002	3076.00	87.06
2003	3198.00	88.46
2004	3539.59	92.40
2005	3403.74	90.83
2006	3556.69	92.59
2007	3488.72	91.81
2008	3557.08	92.60
2009	3542.30	92.43

The emission factors used for livestock except Dairy cows are presented in Table 6.8.

Table 6.12 Default emission factors used for calculation of methane emissions from Enteric fermentation of livestock except Dairy cows

Source indicative	Livestock (source) type	Emission Factors [kg CH_4/head/year]
4A1b	Cattle – Non-dairy cattle	56
4A2	Buffalo	55
4A3	Sheep	8
4A4	Goats	5
4A6	Horses	18
4A7	Mules and asses	10
4A8	Swine	1.5
4A9	Poultry	Not estimated

Activity data

Dairy cows

For 1989-2003 period the number of Dairy cows was obtained by dividing the Cow's and buffalo cow's milk (calfs feeding included) production by the Average production per animal (cow's and buffalo cow's milk), values provided by NIS through the SY 1989-2003. For 2004-2009 period NIS provided by other relevant correspondence Dairy cows data, information which is also sent to Eurostat.

Non-dairy cattle

Total bovines data are provided by Romanian National Institute for Statistics (NIS) being released through Statistical Yearbook 1989-2010 and other relevant correspondence. Non-dairy cattle values were obtained by subtracting the Dairy cows and Buffalo values from Total bovines number.

Buffalo

Total bovines data are provided by Romanian National Institute for Statistics (NIS) being released through Statistical Yearbook 1989-2010 and other relevant correspondence. Beginning with 2004, NIS provides to Eurostat a more complete set of data, comprising also Buffalo data.
By expert judgment, we extended the Buffalo data series to 1989-2003 period, considering that 1.38% of Total bovines are Buffalo (the percentage was obtained using the arithmetic mean of Buffalo values for 2004 and 2005).

Mules and asses

Due to impossibility of finding data from Romanian sources we used Mules and asses data from FAO databases.

Other livestock (sheep, goats, horses, swine and poultry)

All livestock data are provided by NIS through the Statistical Yearbook 1989-2010 and other relevant correspondence.

Livestock data series are presented in Table 6.9.

Table 6.13 Livestock data series for 1989-2009

Year	Livestock data series [thousands heads]								
	Dairy cows	Non-dairy cattle	Buffalo	Sheep	Goats	Horses	Mules and asses	Swine	Poultry
1989	2,177.27	4,150.19	88.54	16,210.00	1,078.00	702.00	36	14,351.00	127,561.00
1990	1,954.00	4,250.19	86.82	15,435.00	1,017.00	663.00	35	11,671.00	113,968.00
1991	1,898.46	3,408.29	74.26	14,062.00	1,005.00	670.00	35	12,003.00	121,379.00
1992	1,782.17	2,512.73	60.10	13,879.00	954.00	749.00	35	10,954.00	106,032.00
1993	1,783.07	1,849.10	50.83	12,079.00	805.00	721.00	34	9,852.00	87,725.00
1994	1,778.92	1,768.44	49.64	11,499.00	776.00	751.00	33	9,262.00	76,532.00
1995	1,787.82	1,645.14	48.04	10,897.00	745.00	784.00	32	7,758.00	70,157.00
1996	1,771.94	1,675.82	48.24	10,381.00	705.00	806.00	31	7,960.00	80,524.00
1997	1,720.02	1,667.58	47.40	9,663.00	654.00	816.00	30	8,235.00	78,478.00
1998	1,679.93	1,510.42	44.64	8,937.00	610.00	822.00	30.5	7,097.00	66,620.00
1999	1,647.12	1,361.77	42.10	8,121.00	558.00	858.00	31	5,848.00	69,143.00
2000	1,692.29	1,138.10	39.61	7,657.00	538.00	865.00	30	4,797.00	70,076.00
2001	1,692.12	1,069.24	38.64	7,251.00	525.00	860.00	31	4,447.00	71,413.00
2002	1,684.01	1,154.28	39.72	7,312.00	633.00	879.00	28	5,058.00	77,379.00
2003	1,694.78	1,162.24	39.98	7,447.00	678.00	897.00	28	5,145.00	76,616.00
2004	1,566.40	1,207.87	33.79	7,425.33	660.72	839.59	28	6,494.67	87,014.41
2005	1,625.68	1,191.18	44.81	7,610.96	686.77	833.95	29	6,622.30	86,552.20
2006	1,639.36	1,253.64	40.59	7,678.21	727.41	804.87	29	6,814.61	84,990.60
2007	1,572.93	1,213.90	32.16	8,469.20	865.07	862.00	29	6,564.91	82,036.00
2008	1483.30	1170.23	30.08	8881.58	898.31	819.51	29	6173.68	84373.00
2009	1419.03	1063.35	29.92	9141.48	917.30	763.99	30	5793.42	83843.08

6.2.3. Uncertainties and time-series consistency

By expert judgment, the uncertainty related to the activity data is 20%.

According to the IPCC GPG 2000 provisions, the uncertainty associated to the emission factors is ±50 %.

The overall uncertainty resulted after the aggregation of the activity data and of the emission factors uncertainties according to the provisions in Chapter 6 of the IPCC GPG 2000 is 53.85%.

Due to the fact that all activity data are provided by NIS or FAO and the same emission factors and methodologies are used for the whole period, the time series 1989-2009 is consistent.

6.2.4. *Source-specific QA/QC and verification*

All quality control activities described in the QA/QC Programme were performed. The activities were performed by the responsible person on the Agriculture sector, the results of these being mentioned on the Checklists level.

Following these activities there were no unconformities recorded.

The activity data series were also compared to those on FAO and Eurostat, the data being reported at the same level of aggregation and the figures comparable.

No recalculations were needed following the QA activities developed under the procedures for the compilation of the European Community GHG Inventory, described in the Decision 280/2004/EC of the European Parliament and of the Council and Decision 166/2005/EC of the European Commission.

All noted unconformities following the UNFCCC review of the 2009 submission of the NGHGI are described at the Improvements list level, their solving being envisaged as planned improvement.

6.2.5. *Source-specific recalculations, including changes made in response to the review process*

In order to improve the emissions estimates quality some important recalculations were made:

- emission factors

- the value of the emission factor associated to the sheep has been changed from 5 to 8 kg CH_4/head/year, for the 1989-2007 period, following the recommendation of the ERT reviewing the 2010 National Greenhouse Gas Inventory, recommendations part of the "Potential Problems and Further Questions from the ERT formulated in the course of the 2010 review of the greenhouse gas inventories of Romania submitted in 2010" (4.A.3);

- the value of the emission factor associated to the swine has been changed from 1 to 1.5 kg CH_4/head/year, for the 1989-2007 period, following the recommendation of the ERT reviewing the 2010 National Greenhouse Gas Inventory, recommendations part of the "Potential Problems and Further Questions from the ERT formulated in the course of the 2010 review of the greenhouse gas inventories of Romania submitted in 2010" (4.A.8).

The implications of all changes made on emission estimates are described in Table 6.10.

Table 6.10 Implication of recalculations on emission estimates

Year	**Effects of changes on emission estimates**		
	2010 v.3.2 submission – CH_4 emissions [Gg]	**2011 v.3.1 submission – CH_4 emissions [Gg]**	**Difference [%]**
1989	505.52	**561.32**	**11.04**
1990	492.72	**544.86**	**10.58**
1991	438.40	**486.58**	**10.99**
1992	380.65	**427.76**	**12.38**
1993	335.36	**376.53**	**12.27**
1994	335.26	**374.38**	**11.67**
1995	328.32	**364.89**	**11.14**
1996	327.78	**362.91**	**10.72**
1997	320.16	**353.27**	**10.34**
1998	302.33	**332.69**	**10.04**
1999	285.33	**312.62**	**9.56**
2000	270.81	**296.18**	**9.37**
2001	266.11	**290.09**	**9.01**
2002	274.31	**298.78**	**8.92**
2003	279.40	**304.32**	**8.92**
2004	276.54	**302.07**	**9.23**
2005	280.24	**306.39**	**9.33**
2006	287.85	**314.29**	**9.19**
2007	283.20	**311.89**	**10.13**
2008	304.38	**304.38**	**11.04**
2009		**292.81**	

6.2.6. Source-specific planned improvements, including those in response to the review process

In respect to the IPCC GPG 2000, in order to allow for the use of a Tier 2 calculation method with national parameters values, national parameters values are collected/processed/developed through the ongoing study Elaboration of national emission factors/other parameters relevant to NGHGI Sectors Energy, Industrial Processes, Agriculture and Waste, to allow for the higher tier calculation methods.

The approach associated to the annual mean values of livestock numbers use is further considered.

6.3. Source category Manure Management (CRF source category 4.B)

6.3.1. Source category description

Managing a large number of animals in a confined area creates conditions for CH_4 emissions due to the anaerobic decomposition of manure. Some manure nitrogen is converted to N_2O during storage of manure.

Manure Management:

- is the second source of CH_4 and the fourth source of N_2O emissions in the Agriculture sector (in 2009, CH_4 emissions from Manure Management represented 24.56% of total CH_4 emissions while N_2O accounted for 9.17% of total N_2O emissions in the Agriculture sector);
- is the fourth largest source in the Agriculture sector (in 2009, CH_4 and N_2O emissions from Manure Management as CO_2 equivalent represented 14.17% from Total Agriculture emissions);
- contributed with 2.77% to Total GHG emissions of Romania.

Emissions from manure management are declining since 1989 due to the decrease of the animal population over the period (Figure 6.5).

The observations on source category 4B – “Manure Management” are presented in the Table 6.14

Figure 6.14 Overall trend of emissions from Manure Management

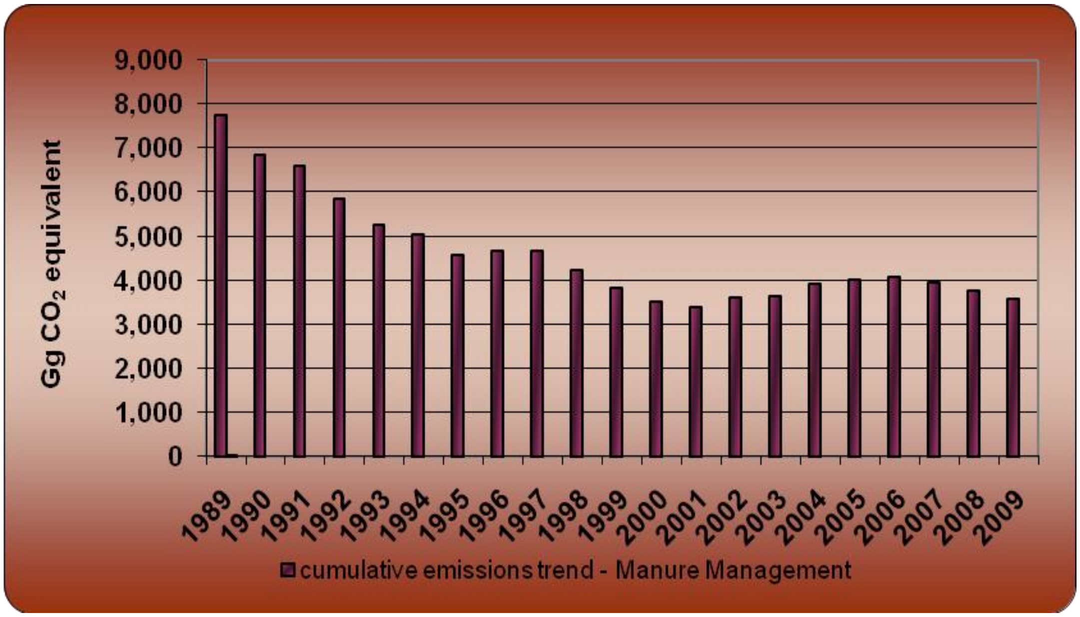


Table 6.15 Observations on source category 4B – "Manure Management"

Source indicative	Source type	Observation	Data source
Observations on source category 4B – "Manure Management – CH_4 and N_2O emissions"			
4B1	Cattle	Includes livestock data from two different cattle categories: dairy cows and non-dairy cattle.	AD: SY, other correspondence, NIS, 1989-2010; expert judgment; EF: IPCC GPG 2000, IPCC 1996
4B2	Buffalo		AD: SY, other correspondence, NIS, 1989-2010; expert judgment; EF: IPCC GPG 2000, IPCC 1996
4B3	Sheep		AD: SY, other correspondence, NIS, 1989-2010; EF: IPCC GPG 2000, IPCC 1996
4B4	Goats		
4B6	Horses		
4B7	Mules and asses		AD: FAO, 2010; EF: IPCC GPG 2000, IPCC 1996
4B8	Swine		AD: SY, other correspondence, NIS, 1989-2010; EF: IPCC GPG 2000, IPCC 1996
4B9	Poultry		
Observations on source category 4B – "Manure Management – N_2O emissions"			
4B11	Anaerobic Lagoon		AD: IPCC GPG 2000, IPCC 1996; EF: IPCC GPG 2000, IPCC 1996
4B12	Liquid/Slurry		
4B13	Daily Spread		
4B14	Solid storage		
4B15	Dry lot		
4B16	Pasture/range/paddock		
4B17	Pit		
4B18	Other AWMS		

6.3.2. Methodological issues

CH_4 emissions

Methodology

Despite the fact that CH_4 emissions from Manure Management is a key category, by level view, tier 2 method could not be applied, due to the lack of detailed data needed. Therefore, a tier

1 method has been applied. For calculation of methane emissions from manure management, the equations 4.15 and 4.13 of IPCC GPG 2000 were used.

Emission factors

According to the provisions in IPCC GPG 2000, the calculation methodology took into account IPCC 1996 default emissions factors for developed countries (Tables 4-5 and 4-6 from Reference Manual). They were considered also the following:

- a temperate climate zone;
- Romania belongs to Eastern Europe;
- Romanian conditions are similar to those in developed countries

The emission factors used are presented in Table 6.12.

Table 6.16 Default emission factors used for calculation of methane emissions from Manure management

Source indicative	Livestock (source) type	Emission Factors [kg CH_4/head/year]
4B1a	Cattle – Dairy cows	19
4B1b	Cattle – Non-dairy cattle	13
4B2	Buffalo	9
4B3	Sheep	0.28
4B4	Goats	0.18
4B6	Horses	2.1
4B7	Mules and asses	1.14
4B8	Swine	7
4B9	Poultry	0.117

Activity data

They were used the same activity data as for calculation of CH_4 emissions from enteric fermentation. Data are presented in Chapter 6.2.2.

N_2O emissions

Methodology

Despite the fact that N_2O emissions from Manure Management is a key category, by level view, tier 2 method could not be applied, due to the lack of detailed data needed. Therefore, a tier 1 method has been applied. For calculation of nitrous oxide emissions from manure management, the equation 4.18 of IPCC GPG 2000 was used.

In respect to the IPCC GPG 2000 provisions, N_2O emissions from Pasture range and paddock AWMS are reported under 4D – Agricultural soils (see Chapter 6.5).

Emission factors

According to the provisions in IPCC GPG 2000, the calculation methodology took into account IPCC default emissions factors (Table 4-12 of IPCC GPG 2000 together with Table 4-22 of Reference Manual). The emission factors used are presented in Table 6.13.

Table 6.17 N_2O emission factors for animal waste per AWMS

Source indicative	AWMS (source) type	Emission factor EF_3 [kg N_2O-N/kg N excreted]
4B11	Anaerobic Lagoon	0.001
4B12	Liquid/Slurry	0.001
4B13	Daily Spread	0
4B14	Solid storage	0.02
4B15	Dry lot	0.02
4B16	Pasture/range/paddock	0.02
4B17	Pit	0.001
4B18	Other AWMS	0.005

Activity data

They were used the same livestock population numbers as for calculation of CH_4 emissions from enteric fermentation. Data are presented in Chapter 6.2.2.

Considering that Romania belongs to Eastern Europe, default values for different parameters were taken into account as follows:

- nitrogen excretion per head of animal per region (Table 4-20 together with Table B-1 of Reference Manual; values are presented in Table 6.14);
- percentages of manure N produced in different Animal Waste Management Systems (AWMS; Tables B-3 – B-6 of Appendix B of Section 4.2 and Table 4-21 of Reference Manual; values are presented in Table 6.15).

Table 6.18 Default values for nitrogen excretion per head of animal

Source indicative	Livestock (source) type	Nitrogen excretion [kg N/head/year]
4B1a	Cattle – Dairy cows	70
4B1b	Cattle – Non-dairy cattle	50
4B2	Buffalo	50
4B3	Sheep	16
4B4	Goats	25
4B6	Horses	25
4B7	Mules and asses	25
4B8	Swine	20
4B9	Poultry	0.6

Table 6.19 Percentages of manure N produced in different AWMS in Eastern Europe

Livestock type	Animal Waste Management Systems [%]			
	Anaerobic Lagoon	Liquid/ Slurry	Daily Spread	Solid storage
Non dairy cattle	0	28	0	0
Buffalo	-	24	0	-
Dairy cattle	0	18	1	68
Poultry	0	28	0	0
Sheep	0	0	0	0
Swine	8	0	0	39
Other animals (includes goats, horses and mules and asses)	0	0	0	0

Table 6.15 (continued) Percentages of manure N produced in different AWMS in Eastern Europe

Livestock type	Animal Waste Management Systems [%]			
	Dry lot	Pasture/range/paddock	Pit	Other AWMS
Non dairy cattle	0	26	-	46
Buffalo	0	29	-	47
Dairy cattle	0	13	-	0
Poultry	0	1	-	71
Sheep	0	73	-	27
Swine	14	-	38	1
Other animals (includes goats, horses and mules and asses)	0	92	-	8

6.3.3. Uncertainties and time-series consistency

CH_4 emissions

By expert judgment, the uncertainty related to the activity data is 20%.
According to the IPCC 1996 Reference Manual provisions, the uncertainty associated to the emission factors is ± 20 %.

The overall uncertainty resulted after the aggregation of the activity data and of the emission factors uncertainties according to the provisions in Chapter 6 of the IPCC GPG 2000 is 28.28%.

N_2O emissions

By expert judgment, the uncertainty related to the activity data is 53.85%.
According to the IPCC GPG 2000 provisions, the uncertainty associated to the emission factors is 100 %. The overall uncertainty resulted after the aggregation of the activity data and of the emission factors uncertainties according to the provisions in Chapter 6 of the IPCC GPG 2000 is 113.58%.
Due to the fact that all activity data are provided by NIS or FAO and the same emission factors

and methodologies are used for the whole period, the time series 1989-2009 is consistent.

6.3.4. Source-specific QA/QC and verification

All quality control activities described in the QA/QC Programme were performed. The activities were performed by the responsible person on the Agriculture sector, the results of these being mentioned on the Checklists level.

Following these activities there were no unconformities recorded.The activity data series were also compared to those on FAO and Eurostat, the data being reported at the same level of aggregation and the figures comparable.

No recalculations were needed following the QA activities developed under the procedures for the compilation of the European Community GHG Inventory, described in the Decision 280/2004/EC of the European Parliament and of the Council and Decision 166/2005/EC of the European Commission.

All noted unconformities following the UNFCCC review of the 2009 submission of the NGHGI are described at the Improvements list level, their solving being envisaged as planned improvement.

6.3.5. Source-specific recalculations, including changes made in response to the review process

In order to improve the emissions estimates quality some important recalculations were made:

- emission factors

Following the recommendation of the ERT reviewing the 2010 National Greenhouse Gas Inventory, recommendations part of the "Potential Problems and Further Questions from the ERT formulated in the course of the 2010 review of the greenhouse gas inventories of Romania submitted in 2010" the recalculations performed for the 1989-2007 period are:

- the value of the emission factor associated to the sheep has been changed from 0.16 to 0.28 kg CH_4/head/year (4.B.3);

- the value of the emission factor associated to the goats has been changed from 0.17 to 0.18 kg CH_4/head/year (4.B.4);
- the value of the emission factor associated to the horses has been changed from 1.6 to 2.1 kg CH_4/head/year (4.B.6);
- the value of the emission factor associated to the mules and assess has been changed from 0.9 to 1.14 kg CH_4/head/year (4.B.7);
- the value of the emission factor associated to the poultry has been changed from 0.018 to 0.117 kg CH_4/head/year (4.B.9).

The implications of all changes made on emission estimates are described in Table 6.16.

Table 6.20 Implication of recalculations on emission estimates

Year	**Effects of changes on emission estimates**		
	2010 v.3.2 submission – CH_4 emissions [Gg]	**2011 v.3.1 submission – CH_4 emissions [Gg]**	**Difference [%]**
1989	202.80	**217.75**	**7.37**
1990	180.64	**194.13**	**7.47**
1991	170.78	**184.83**	**8.23**
1992	149.27	**161.82**	**8.41**
1993	132.17	**142.68**	**7.95**
1994	126.65	**136.00**	**7.38**
1995	114.51	**123.17**	**7.56**
1996	116.15	**125.79**	**8.30**
1997	116.83	**126.18**	**8.00**
1998	105.71	**113.80**	**7.66**
1999	94.35	**102.61**	**8.76**
2000	84.87	**93.17**	**9.78**
2001	81.47	**89.85**	**10.29**
2002	86.87	**95.86**	**10.35**
2003	87.83	**96.77**	**10.18**
2004	95.47	**105.40**	**10.41**
2005	97.39	**107.30**	**10.18**
2006	99.71	**109.46**	**9.78**
2007	96.29	**105.88**	**9.95**
2008	101.16	**101.16**	**7.37**
2009		**95.78**	

6.3.6. Source-specific planned improvements, including those in response to the review process

In respect to the IPCC GPG 2000, in order to allow for the use of a Tier 2 calculation method with national parameters values, national parameters values are collected/processed/developed through the ongoing study Elaboration of national emission factors/other parameters relevant to NGHGI Sectors Energy, Industrial Processes, Agriculture and Waste, to allow for the higher tier calculation methods.

The approach associated to the annual mean values of livestock numbers use is further considered.

The approach associated to the reparation of animals in different climate regions is further considered.

6.4. Source category Rice Cultivation (CRF source category 4.C)

6.4.1. Source category description

Anaerobic decomposition of organic material in flooded rice fields produces methane. Methane escapes to the atmosphere primarily by transport through the rice plants and its flux depends upon the input of organic carbon, water regimes, time and duration of drainage, soil type, etc.

Rice Cultivation:

- is the smallest source of CH_4 emissions in the Agriculture sector (in 2009, CH_4 emissions from Rice Cultivation represented 0.34% of total CH_4 emissions in the Agriculture sector);
- is the smallest source in the Agriculture sector (in 2009, CH_4 emissions from Rice Cultivation as CO_2 equivalent represented 0.11% from Total Agriculture emissions);
- contributed with 0.02% to Total GHG emissions of Romania.

Emissions from rice cultivation are declining since 1989 due to the decrease of rice cultivated area (Figure 6.6).

Figure 6. 15 Methane emission trend due to the Rice Cultivation

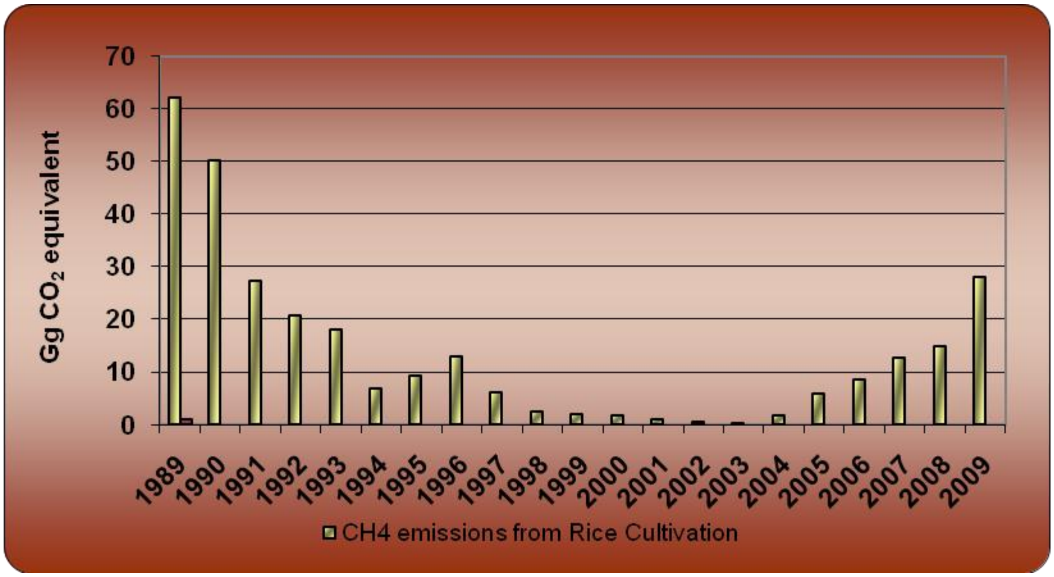


Table 6.21 Observations on source category 4C – "Rice Cultivation"

Source indicative	**Source (livestock) type**	**Observation**	**Data source**
4C122	Rice harvested area		AD: SY, NIS, 1989-2010; expert judgment; EF: IPCC GPG 2000

6.4.2. Methodological issues

Methodology

Due to small importance of source category Rice Cultivation into Total GHG emission level (Rice Cultivation does not meet the key category thresholds) a tier 1 method has been applied. For calculation of methane emissions from rice cultivation, the equations 4.41 and 4.42 of IPCC GPG 2000 were used.

Emission factors

Considering the provisions in IPCC GPG 2000 and the data provided by the Ministry of Agriculture, the calculation methodology took into account:

- a seasonally integrated emission factor value for continuously flooded fields without organic amendments (EF_c) of 20 g CH_4/m^2;
- a default value of 0.2 for the scaling factor to account for the differences in ecosystem and water management regime (SF_W) corresponding to lowland – irrigated – intermittently flooded – multiple aeration water management regime;
- yearly default values for the scaling factor to account for both type and amount of amendment applied (SF_O). Default values were selected after the estimation of the rice residues productivity values, considering that all rice residues were incorporated into the soil following the harvesting. Rice residues productivity values and default values for the scaling factor to account for the type and amount of amendment applied are presented in the Table 6.18.

Table 6.22 Rice residues productivity values and default values for the scaling factor to account for the type and amount of amendment applied (SF_O)

Year	Rice residues productivity [tones d.m./ha]	Scaling factor to account for the type and amount of amendment applied (SF_O)
1989	1.07	1.5
1990	1.25	1.5
1991	1.09	1.5
1992	1.78	1.5
1993	2.28	1.8
1994	2.48	1.8
1995	2.92	1.8
1996	2.04	1.8
1997	2.01	1.8
1998	2.25	1.8
1999	1.78	1.5
2000	1.93	1.5
2001	0.94	1
2002	0.90	1
2003	2.25	1.8
2004	3.13	1.8
2005	2.75	1.8
2006	2.46	1.8
2007	2.46	1.8
2008	3.70	1.8
2009	4.08	2.5

Activity data

Total rice cultivated area is provided by Romanian National Institute for Statistics (NIS) being released through Statistical Yearbook 1989-2010.

By expert judgment, total harvested area equals total cultivated area (the number of harvests per year equals 1).

Harvested area data series are presented in Table 6.19.

Table 6.23 Harvested area data series for 1989-2009

Year	Harvested area [10^8 m^2]
1989	4.93
1990	3.99
1991	2.16
1992	1.64
1993	1.2
1994	0.46
1995	0.62
1996	0.85
1997	0.4
1998	0.17
1999	0.16
2000	0.14
2001	0.12
2002	0.05
2003	0.01
2004	0.12
2005	0.39
2006	0.56
2007	0.84
2008	0.99
2009	1.33

6.4.3. Uncertainties and time-series consistency

By expert judgment, the uncertainty related to the activity data is 5%.
According to the IPCC GPG 2000 provisions, the uncertainty associated to the emission factors is ± 40%.

The overall uncertainty resulted after the aggregation of the activity data and of the emission factors uncertainties according to the provisions in Chapter 6 of the IPCC GPG 2000 is 40.31%.

Due to the fact that all activity data are provided by NIS and the same emission factors and methodologies are used for the whole period, the time series 1989-2009 is consistent.

6.4.4. Source-specific QA/QC and verification

All quality control activities described in the QA/QC Programme were performed. The activities were performed by the responsible person on the Agriculture sector, the results of these being mentioned on the Checklists level.

Following these activities there were no unconformities recorded.

The activity data series were also compared to those on FAO and Eurostat, the data being reported at the same level of aggregation and the figures comparable.

No recalculations were needed following the QA activities developed under the procedures for the compilation of the European Community GHG Inventory, described in the Decision 280/2004/EC of the European Parliament and of the Council and Decision 166/2005/EC of the European Commission.

There were no unconformities noted following the UNFCCC review of the 2009 submission of the NGHGI.

6.4.5. Source-specific recalculations, including changes made in response to the review process

There was not any recalculation done since last submission.

6.4.6. Source-specific planned improvements, including those in response to the review process

In respect to the IPCC GPG 2000 provisions, more detailed data on rice cultivation techniques used are proposed to be obtained.

6.5. Source category Agricultural soils (CRF source category 4.D)

6.5.1. Source category description

Microbial processes of nitrification and denitrification in agricultural soils produce nitrous oxide emissions. There can be distinguished three types of emissions:

- direct soils emissions result from the following nitrogen input to soils:
    - synthetic fertilizers;
    - nitrogen from animal waste;
    - biological nitrogen fixation;
    - reutilized nitrogen from crop residues;
    - sewage sludge application.

Cultivation of organic soils may increase soil organic matter mineralization and, in effect, N_2O emissions.

- direct soil emissions from animal production include those emissions induced by grazing animals (Pasture, Range and Paddock Manure);
- indirect emissions take place after nitrogen is lost from the field as NO_x and NH_3 or after leaching or runoff.

Increases in the amount of nitrogen added to the soil generally result in higher N_2O emissions.

Direct soil emissions (4D1)

Direct soil emissions:

- is the main source of N_2O emissions in the Agriculture sector (in 2009, N_2O Direct soil emissions represented 59.82% of total N_2O emissions in the Agriculture sector);
- is the largest source in the Agriculture sector (in 2009, N_2O Direct soil emissions as CO_2 equivalent represented 40.39% from Total Agriculture emissions);
- contributed with 7.91% to Total GHG emissions of Romania.

Pasture, Range and Paddock Manure (4D2)

Pasture, Range and Paddock Manure:

- is the third largest source of N_2O emissions in the Agriculture sector (in 2009, N_2O emissions from Pasture, Range and Paddock Manure represented 9.95% of total N_2O emissions in the Agriculture sector);
- is the fifth largest source in the Agriculture sector (in 2009, N_2O emissions from Pasture, Range and Paddock as CO_2 equivalent represented 6.72% from Total Agriculture emissions);
- contributed with 1.32% to Total GHG emissions of Romania.

Indirect soil emissions (4D3)

Indirect soil emissions:

- is the second largest source of N_2O emissions in the Agriculture sector (in 2009, N_2O Indirect soil emissions represented 21.05% of total N_2O emissions in the Agriculture sector);
- is the third largest source in the Agriculture sector (in 2009, N_2O Indirect soil emissions as CO_2 equivalent represented 14.21% from Total Agriculture emissions);
- contributed with 2.78% to Total GHG emissions of Romania.

Emissions from Agricultural Soils are declining since 1989 (Figures 6.7 and 6.8) due to the decrease of the:

- amount of synthetic fertilizer applied;
- livestock populations;
- crop productions level.

Figure 6.16 Overall emissions trend of Agricultural Soils

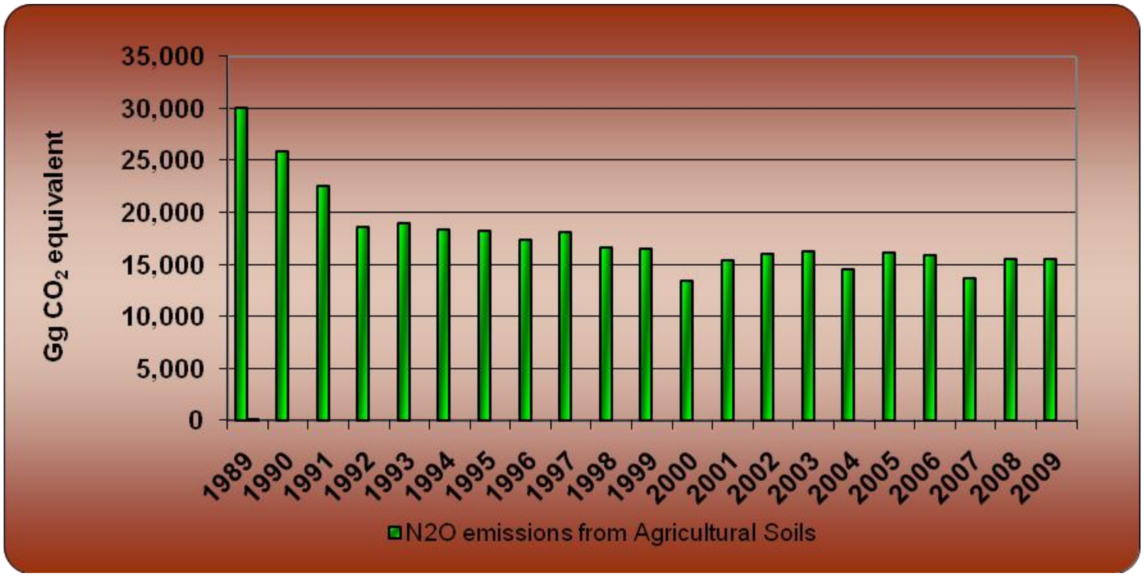


Figure 6.17 N_2O emissions trends – Agricultural Soils

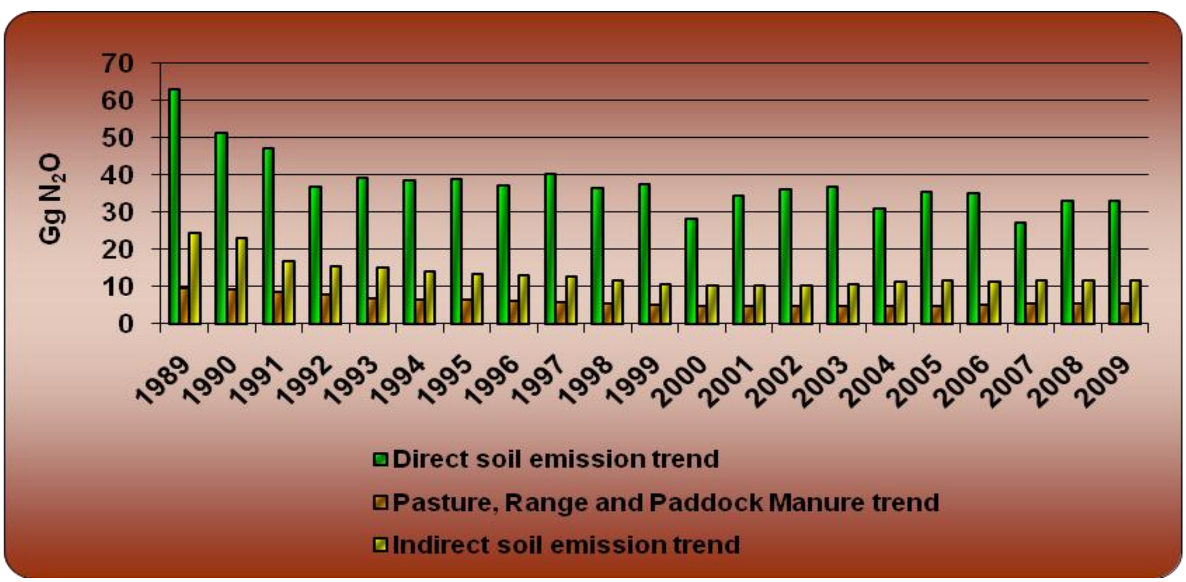


Table 6.24 Observations on source category 4D – "Agricultural Soils"

Source indicative	Source (livestock) type	Observation	Data source
4D11, 4D3	Amount of N synthetic fertilizer used		AD: SY, NIS, 1989-2010; EF: IPCC GPG 2000
4D12, 4D2, 4D3	Animals number by livestock	Includes data on eight different livestock types: cattle (Dairy cows and Non-dairy cattle), buffalo, sheep, goats, horses, mules and asses, swine and poultry	AD: SY, other correspondence, NIS, 1989-2010; expert judgment; FAO 2010; EF: IPCC GPG 2000
4D13, 4D14	Productions of N-fixing crops	Includes data on four types of N-fixing crops: pea beans, bean, other leguminous, soybeans, perennial green fodder (lucerne and clover)	AD: SY, other correspondence, NIS, 1989-2010; EF: IPCC GPG 2000
4D14	Production of non-N fixing crops	Includes data on 26 types of non-N-fixing crops: wheat and rye, barley and two-row barley, oats, maize grains, sorghum, rice, other grains, potatoes, sugar beet, fodder roots, industrial fiber crops, sunflower, rape, flax for oil, other oilseed crops, other industrial crops, tomatoes, dry onion, dry garlic, cabbage, green peppers, water melons, melons, other vegetables, annual green fodder	
4D15	Area of cultivated organic soils		AD: specific correspondence, ICPA and MADR, 2010; EF: IPCC GPG 2000

6.5.2. Methodological issues

N_2O Direct soil emissions

Methodology

Despite the fact that Direct soil emissions is a key category, both from level and trend views, tier 2 method could not be applied, due to the lack of detailed data needed. Therefore, a

tier 1 method has been applied. For calculation of nitrous oxide Direct soil emissions, the equations 4.20, 4.22, 4.23, 4.25 and 4.28 of IPCC GPG 2000 were used.
By expert judgment, $Frac_{PRP}$ values were calculated for every year using the following equation:

Equation 6.1 Calculation of fraction of livestock nitrogen excreted and deposited onto soil during grazing ($Frac_{PRP}$)

FracPRP = Nex(Pasture Range and Paddock)/Nex

where

- $N_{ex(Pasture\ Range\ and\ Paddock)}$ = nitrogen excretion from Pasture Range and Paddock
- N_{ex} = nitrogen excretion from all Animal Waste Management Systems

Emission factors

The calculation methodology took into account IPCC GPG 2000 default emissions factors (Table 4.17 of IPCC GPG 2000):

- EF_1 = 0.0125 (fraction of N-input, kg N_2O-N/kg N);
- EF_2 = 8 (value specific to Middle-Latitude Organic Soils; kg N_2O-N/ha/year).

Activity data

Data used for calculation of the annual amount of synthetic fertilizer nitrogen applied to soils adjusted to account for the amount that volatilizes as NH_3 and NO_x (F_{SN})

The amount of synthetic fertilizer applied to soils data are provided by Romanian National Institute for Statistics (NIS) being released through Statistical Yearbook 1989-2010.

Data series are presented in Table 6.22.

Default IPCC GPG 2000 value of FracGASF used is presented in Table 6.21.

Data used for calculation of the annual amount of animal manure nitrogen intentionally applied to soils adjusted to account for the amount that volatilizes as NH_3 and NO_x and excluding manure produced during grazing (F_{AM})

Livestock data are presented in Chapter 6.2.2.

Nitrogen excretion per head of animal and fraction of nitrogen excretion produced in different AWMS values used are presented in Chapter 6.3.2.

Fraction of livestock nitrogen excreted and deposited onto soil during grazing ($Frac_{PRP}$) values are presented in Table 6.22.

Fraction of livestock nitrogen excretion contained in excrements burned for fuel ($Frac_{FUEL-AM}$) and fraction of livestock nitrogen excretion that volatilizes as NH_3 and NO_x ($Frac_{GASM}$) default values are presented in Table 6.21.

Data used for calculation of amount of nitrogen fixed by N-fixing crops cultivated annually (F_{BN})

Productions of pulses and soybeans data are provided by NIS through SY 1989-2010 and are presented in Table 6.22.

According to provisions in IPCC 1996, a default value of 0.85 was used to adjust for the default water content in crop productions.

Fraction of nitrogen in N-fixing crop ($Frac_{NCRBF}$) default value used is presented in Table 6.21.

Data used for calculation of amount of nitrogen in crop residues returned to soils annually (F_{CR})

Productions of non-N-fixing crops are provided by NIS through SY 1989-2010 and specific correspondence and are presented in Table 6.22.

According to provisions in IPCC 1996, a default value of 0.85 was used to adjust for default water content in crop productions.

Fraction of nitrogen in non-N-fixing crop ($Frac_{NCR0}$), fraction of total aboveground biomass that is removed from the field as crop product ($Frac_{R}$) and fraction of crop residue that is burned rather than left on field ($Frac_{BURN}$) default values used are presented in Table 6.21.

Table 6.25 Default IPCC values for specific fractions used (described in IPCC GPG 2000 and in Table 4-19 of Reference Manual)

Specific fraction	Default IPCC value	Associated measurement unit
$Frac_{BURN}$	0.1 or less in developed countries (accordingly to the provisions in page 4.89 of IPCC GPG 2000), for 1989-2001; 0 for 2002-2008	kg N/kg crop-N
$Frac_{R}$	0.5	kg N/kg crop-N
$Frac_{FUEL-AM}$	0	kg N/kg N excreted
$Frac_{GASF}$	0.1	kg NH_3-N + NO_x-N/kg of synthetic fertilizer N applied
$Frac_{GASM}$	0.2	kg NH_3-N + NO_x-N/kg of N excreted by livestock
$Frac_{NCRBF}$	0.03	kg N/kg of dry biomass
$Frac_{NCR0}$	0.015	kg N/kg of dry biomass

Due to the fact that data series provided by NIS through SY 1989-2010 and specific correspondence are not fully consistent, we solved the inconsistency issue together with NIS representatives by correspondence, as follows:

- we considered for the whole time series Wheat and rye crop production due to lack of data disaggregated on Wheat and on Rye crop productions for 1989-1998 period;
- for 1989-2003 period we added the amount of Plants used for silage crop to Annual green fodder crop;

- for 1989-1998 period we added to the amounts of Tobacco and of Medicinal and aromatic plants crop productions the amount of Other plants crop production obtaining the value of Other industrial plants;
- for 1989-1998 period we added to the amount of Total vegetables crop production the amounts of Water melons and melons and of Fodder pumpkins crop productions. Therefore, for the same period, Water melons and Melons amounts of crop productions are comprised in Other vegetables;
- beginning with 2005 data on Melons crop production are included in Water melons and melons crop production data.

Area of organic soils cultivated

Data on area of organic soils cultivated were provided by the National Institute of Research and Development in Soil Science, Agrochemistry and Environment and by the Ministry of Agriculture and Rural Development; data are presented in Table 6.22.

Table 6.26 Activity data series used for calculation of direct soil emissions, for 1989-2009

Year	Amount of synthetic fertilizer applied to soil [thousands tonnes/year]	Fraction of livestock nitrogen excreted and deposited onto soil during grazing [fraction]	Production of pulses and soybeans [thousands tonnes/year]			
			Pea beans	Beans	Other leguminous	Soya beans
1989	665.3	0.2972	98.50	143.6	13.8	303.9
1990	656.0	0.3118	49.40	57.5	5.2	141.2
1991	275.0	0.3008	32.30	46.0	1.2	178.6
1992	258.0	0.3150	33.20	41.2	0.3	126.2
1993	346.0	0.3114	36.40	48.4	0.4	95.4
1994	313.0	0.3144	38.10	37.4	0.6	100.1
1995	306.0	0.3255	54.30	41.8	0.9	107.9
1996	268.0	0.3146	33.70	42.1	1.2	113.1
1997	262.0	0.3047	27.30	50.2	1.1	121.1
1998	254.0	0.3125	24.40	46.9	1.2	200.8
1999	225.0	0.3173	27.00	47.7	2.1	183.4
2000	239.0	0.3242	14.20	21.8	0.9	69.5
2001	268.0	0.3228	21.70	36.5	3.0	72.7
2002	239.0	0.3166	20.50	33.6	1.2	145.9
2003	252.0	0.3192	23.50	36.7	0.4	224.9
2004	270.0	0.2992	58.00	53.5	0.8	298.5
2005	299.0	0.2997	39.10	41.7	0.1	312.8
2006	252.0	0.2987	36.10	34.9	0.6	344.9
2007	265.0	0.3200	17.70	18.0	0.5	136.1
2008	279.8	0.3314	36.90	25.2	0.4	90.6
2009	296.06	0.3413	30.00	22.3	0.6	84.3

Table 6.22 (continued) Activity data series used for calculation of direct soil emissions, for 1989-2009

Year	Production of non-N-fixing crops [thousands tonnes/year]							
	Wheat and rye	Barley and two-row barley	Oats	Maize grains	Sorghum	Rice	Other grains	Potatoes
1989	7,935.2	3,436.3	167.8	6,761.8	7.6	70.1	0.5	4,420.3
1990	7,379.0	2,679.6	234.0	6,809.6	3.5	66.5	1.3	3,185.6
1991	5,558.9	2,950.7	258.2	10,497.3	6.0	31.4	4.1	1,872.8
1992	3,227.6	1,678.0	507.7	6,828.3	4.5	38.9	3.5	2,601.6
1993	5,354.5	1,552.8	553.6	7,987.5	5.5	36.4	2.8	3,708.9
1994	6,186.5	2,133.6	496.8	9,343.2	7.1	15.2	1.4	2,946.7
1995	7,709.3	1,816.3	404.4	9,923.1	4.4	24.1	1.2	3,019.9
1996	3,164.1	1,107.5	290.5	9,607.9	4.3	23.1	2.3	3,591.4
1997	7,185.6	1,889.3	325.4	12,686.7	4.8	10.7	4.8	3,206.4
1998	5,207.9	1,238.0	362.1	8,623.4	11.4	5.1	4.8	3,319.2
1999	4,682.5	1,018.6	389.6	10,934.8	2.5	3.8	5.5	3,957.1
2000	4,456.2	867.0	243.8	4,897.6	1.5	3.6	7.8	3,469.8
2001	7,763.7	1,580.0	382.4	9,119.2	5.6	1.5	18.5	3,997.1
2002	4,441.1	1,160.4	327.4	8,399.8	2.6	0.6	24.6	4,077.6
2003	2,496.5	540.8	323.1	9,577.0	5.0	0.3	21.7	3,947.2
2004	7,867.4	1,406.0	447.1	14,541.6	28.4	5.0	107.5	4,230.2
2005	7,389.7	1,079.1	377.5	10,388.5	1.9	14.3	94.5	3,738.6
2006	5,561.9	772.9	346.9	8,984.7	1.3	18.4	73.2	4,015.9
2007	3,065.1	531.4	251.6	3,853.9	1.2	27.5	84.1	3,712.4
2008	7,212.4	1,209.4	382.0	7,849.1	20.9	48.9	103.7	3,649.0
2009	5,235.5	1,182.1	295.8	7,973.3	14.4	72.4	99.5	4,004.0

Table 6.22 (cont.) AD series used for calculation of direct soil emissions, for 1989-2009

Year	Production of non-N-fixing crops [thousands tonnes/year]								
	Sugar beet	Fodder roots	Industrial fiber crops (flax for fiber, hemp for fiber)	Sunflower	Rape	Flax for oil	Other oilseed crops	Other industrial crops (tobacco, medicinal and aromatic plant)	Tomatoes
1989	6,771.1	4,094.2	241.1	655.8	18.0	48.9	7.7	90.5	1,011.3
1990	3,277.7	2,575.0	125.3	556.2	10.9	28.0	3.0	42.1	813.6
1991	4,702.7	2,139.3	73.7	612.0	8.8	22.8	1.2	41.1	692.8
1992	2,896.7	1,343.4	64.2	774.0	1.4	17.9	0.8	38.6	831.0
1993	1,776.3	1,465.1	14.6	695.8	1.4	28.0	0.2	29.2	798.9
1994	2,763.8	1,245.3	9.3	763.7	0.3	6.5	3.5	28.2	716.4
1995	2,654.6	1,332.4	13.1	932.9	0.4	4.7	9.5	36.8	730.9
1996	2,848.2	1,301.1	17.1	1,095.6	1.9	4.5	3.6	32.3	689.3
1997	2,725.5	1,247.9	11.5	858.1	11.6	4.8	6.2	36.2	463.3
1998	2,361.4	1,119.5	11.8	1,073.3	28.7	3.0	11.8	47.3	677.5
1999	1,414.9	1,174.6	8.0	1,300.9	108.2	2.8	11.3	30.0	708.6
2000	666.9	800.6	2.3	720.9	76.1	1.0	1.0	18.6	628.7
2001	875.5	1,035.2	3.2	823.5	101.8	2.0	5.5	24.4	651.7
2002	954.6	1,042.5	6.4	1,002.8	35.9	1.8	8.1	28.7	658.8
2003	764.5	985.6	3.9	1,506.4	8.1	1.5	19.5	20.4	818.9
2004	672.7	280.3	3.0	1,557.8	98.7	2.5	37.6	28.5	1,330.1
2005	729.7	711.9	5.2	1,340.9	147.6	0.1	1.7	19.1	627.0
2006	1,152.2	777.0	3.9	1,526.2	175.1	0.3	3.6	29.0	835.0
2007	748.8	595.0	0.6	546.9	361.5	0.4	1.7	9.6	640.8
2008	706.7	756.3	0.3	1,169.9	673.0	0.2	8.6	13.5	814.4
2009	816.8	567.5	0.002	1,098.0	569.6	1.1	11.0	14.9	755.6

Table 6.22 (continued) Activity data series used for calculation of direct soil emissions, for 1989-2009

Year	Production of non-N-fixing crops [thousands tonnes/year]					
	Dry onion	Dry garlic	Cabbage	Green peppers	Water melons	Melons
1989	412.7	46.6	877.3	253.3		
1990	225.4	30.6	551.9	182.0		
1991	218.5	32.2	616.5	166.8		
1992	339.3	43.5	676.2	181.7		
1993	344.0	48.9	853.9	176.3		
1994	310.9	56.4	711.3	163.2		
1995	363.0	69.5	824.4	195.6		
1996	305.6	54.1	857.4	186.6		
1997	337.0	63.3	761.2	167.4		
1998	365.2	72.0	837.8	191.4		
1999	401.1	84.5	885.4	212.3	787.9	65.3
2000	296.3	68.3	731.9	174.8	488.0	43.1
2001	396.5	82.9	819.2	184.8	506.7	43.9
2002	340.8	72.4	821.4	197.4	600.0	51.3
2003	350.4	76.5	1,019.2	249.1	706.3	58.3
2004	332.8	65.9	919.1	237.2	723.2	41.9
2005	363.6	68.4	1,009.4	203.8	691.8	
2006	390.7	64.2	1,106.0	279.1	641.8	
2007	325.0	49.9	893.2	184.9	408.0	
2008	395.6	72.3	964.6	238.7	562.3	
2009	378.1	63.2	1,001.9	245.7	652.8	

Table 6.22 (continued) Activity data series used for calculation of direct soil emissions, for 1989-2009

Year	Production of non-N-fixing crops [thousands tonnes/year]			Area of cultivated organic soils [ha]
	Other vegetables	Annual green fodder	Perennial green fodder (lucerne, clover)	
1989	1,594.4	15,801.8	18,057.0	28,507
1990	1,247.7	14,403.5	12,963.9	28,507
1991	1,519.6	11,036.2	15,228.6	28,507
1992	1,389.5	7,124.8	10,989.5	28,507
1993	1,770.1	7,001.4	11,758.2	28,507
1994	1,590.5	6,491.3	11,669.4	28,507
1995	1,685.1	6,019.5	12,209.9	28,507
1996	1,841.4	6,014.6	12,088.2	28,507
1997	1,767.4	5,344.1	13,301.2	28,507
1998	1,796.0	4,919.3	12,331.4	28,507
1999	1,220.5	5,362.9	13,509.2	28,507
2000	950.0	3,317.4	9,212.0	28,507
2001	1,162.6	3,725.6	11,535.7	28,507
2002	1,231.3	4,382.4	12,469.4	28,507
2003	1,405.8	4,725.3	12,613.9	32,507
2004	1,123.7	1,923.5	6,608.8	36,507
2005	660.6	2,455.0	10,127.5	40,507
2006	822.1	3,182.6	10,622.3	44,507
2007	615.0	2,222.5	7,330.2	48,507
2008	772.0	2,860.7	9,273.3	52,507
2009	804.6	2,898.2	9,461.5	56,507

Pasture, Range and Paddock Manure emissions

Methodology

Despite the fact that Pasture, Range and Paddock Manure is a key category, by level view, tier 2 method could not be applied, due to the lack of detailed data needed. Therefore, a tier 1 method has been applied for the estimation of the emissions levels. The methodology described in Chapter 6.3.2 applies also in this case with the specification that it should be applied only for Pasture, Range and Paddock Manure system.

Emission factors

IPCC 1996 default emission factor used according to the provisions in IPCC GPG 2000 is specified in Chapter 6.3.2 – N_2O emissions section.

Activity data

Activity data took into consideration are presented in Chapter 6.3.2 – N_2O emissions section.

Indirect soil emissions

Methodology

Despite the fact that Indirect soil emissions is a key category, from level view, tier 2 method could not be applied, due to the lack of detailed data needed. Therefore, a tier 1 method has been applied. For calculation of indirect nitrous oxide soil emissions, the equations 4.30, 4.31 and 4.34 from IPCC GPG 2000 were used.

According to IPCC GPG 2000 provisions, N_2O produced from discharge of human sewage N into rivers or estuaries are to be reported under Domestic and Commercial Wastewater in Chapter 5.

Emission factors

The calculation methodology took into account IPCC GPG 2000 default emissions factors (Table 4.18 from IPCC GPG 2000):

- EF_4 = 0.01 [kg N_2O-N/kg NH_3-N and NO_x-N emitted];
- EF_5 = 0.025 [kg N_2O-N/kg N leaching/runoff].

Activity data

A default IPCC GPG 2000 value of 0.3, specific to the fraction of fertilizer and manure nitrogen that is lost through leaching and runoff, $Frac_{LEACH}$, was considered.

All other activity data are presented in the relevant Direct soil emissions section.

6.5.3. Uncertainties and time-series consistency

Direct soil emissions

By expert judgment, the uncertainty related to the activity data is 20%.

According to the IPCC 1996 Reference Manual provisions, the uncertainty associated to the emission factors is 80%.

The overall uncertainty resulted after the aggregation of the activity data and of the emission factors uncertainties according to the provisions in Chapter 6 of the IPCC GPG 2000 is 82.46%.

Pasture, Range and Paddock Manure emissions

By expert judgment, the uncertainty related to the activity data is 53.85%.

According to the IPCC GPG 2000 provisions, the uncertainty associated to the emission factors is 100 %.

The overall uncertainty resulted after the aggregation of the activity data and of the emission factors uncertainties according to the provisions in Chapter 6 of the IPCC GPG 2000 is 113.58%.

Indirect soil emissions

By expert judgment, the uncertainty related to the activity data is 30%.

According to the IPCC GPG 2000 provisions, the uncertainty associated to the emission factors is ±50 %.

The overall uncertainty resulted after the aggregation of the activity data and of the emission factors uncertainties according to the provisions in Chapter 6 of the IPCC GPG 2000 is 58.31%.

Due to the fact that all activity data are provided by NIS, FAO, MADR or ICPA and the same emission factors and methodologies are used for the whole period, the time series 1989-2009 is consistent.

6.5.4. Source-specific QA/QC and verification

All quality control activities described in the QA/QC Programme were performed. The activities were performed by the responsible person on the Agriculture sector, the results of these being mentioned on the Checklists level.

The unconformities noted and solved following these activities are described in the Chapter 6.5.5 – Source-specific recalculations, including changes made in response to the review process and at the Chapter 10 - Recalculations and improvements levels; the quantitative effects of their solving are described at the Chapter 6.5.5 – Source-specific recalculations, including changes made in response to the review process.

As possible, the activity data series were also compared to those on FAO and Eurostat, the data being reported at the same level of aggregation and the figures comparable.

No recalculations were needed following the QA activities developed under the procedures for the compilation of the European Community GHG Inventory, described in the Decision 280/2004/EC of the European Parliament and of the Council and Decision 166/2005/EC of the European Commission.

The unconformity noted and solved following the UNFCCC review of the 2009 submission of the NGHGI is described in the Chapter 6.5.5 – Source-specific recalculations, including changes made in response to the review process and at the Chapter 10 - Recalculations and improvements levels; its quantitative effects of their solving are described at the Chapter 6.5.5 – Source-specific recalculations, including changes made in response to the review process.

All other noted unconformities following the UNFCCC review of the 2009 submission of the NGHGI are described at the Improvements list level, their solving being envisaged as planned improvement.

The unconformities noted and solved following the previously specified activities are described at the Improvements list level.

6.5.5. Source-specific recalculations, including changes made in response to the review process

In order to improve the emissions estimates quality some important recalculations were made:

- activity data

- the industrial fibre crops (flax for fibre, hemp for fibre) and other industrial crops (tobacco, medicinal and aromatic plant) production values have been included within the non-N-fixing crops production solving an identified error; the recalculation is relevant to the 1989-2008 time series (4.D.1.4);
- new data on annual cultivated organic soils areas have been provided by the National Institute of Research and Development in Soil Science, Agrochemistry and Environment and by the Ministry of Agriculture and Rural Development; the recalculation is relevant to the 1989-2008 time series (4.D.1.5).

All the changes made at the activity data level and their implications on emission estimates are described in Table 6.23.

Table 6.27 Changes made at activity data level and their effects on emission estimates

Year	**Changes on the production of non-N-fixing crops ($crop_0$) series [thousands tonnes/year]**		**Changes on the area of cultivated organic soils (F_{OS}) series [hectares]**	
	2010 v.3.2 submission	**2011 v.1.2 submission**	2010 v.3.2 submission	**2011 v.1.2 submission**
1989	54,392.7	**54,724.3**	NO	**28,507**
1990	44,264.6	**44,432.0**	NO	**28,507**
1991	42,948.8	**43,063.6**	NO	**28,507**
1992	30,510.3	**30,613.1**	NO	**28,507**
1993	34,162.3	**34,206.1**	NO	**28,507**
1994	35,953.6	**35,991.1**	NO	**28,507**
1995	37,725.2	**37,775.1**	NO	**28,507**
1996	32,995.0	**33,044.4**	NO	**28,507**
1997	39,071.5	**39,119.2**	NO	**28,507**
1998	32,228.8	**32,287.9**	NO	**28,507**
1999	34,735.6	**34,773.6**	NO	**28,507**
2000	22,912.3	**22,933.2**	NO	**28,507**
2001	33,285.4	**33,313.0**	NO	**28,507**
2002	29,835.6	**29,870.7**	NO	**28,507**
2003	29,607.0	**29,631.3**	NO	**32,507**
2004	37,980.2	**38,011.7**	NO	**36,507**
2005	32,095.6	**32,119.9**	NO	**40,507**
2006	30,731.1	**30,764.0**	NO	**44,507**
2007	19,120.8	**19,131.0**	NO	**48,507**
2008	30,470.7	**30,484.5**	1661	**52,507**
2009		**28,756.0**		**56,507**

Table 6. 23 Changes made at activity data level and their effects on emission estimates (continued)

Year	**Effects of changes on emission estimates**		
	2010 v.3.2 submission – N_2O emissions [Gg]	**2011 v.1.2 submission – N_2O emissions [Gg]**	**Difference [%]**
1989	70.19	**96.85**	**37.99**
1990	64.30	**83.53**	**29.90**
1991	49.99	**72.49**	**45.02**
1992	43.71	**60.05**	**37.40**
1993	43.64	**61.09**	**39.98**
1994	41.90	**59.22**	**41.33**
1995	40.48	**58.59**	**44.72**
1996	38.18	**56.11**	**46.96**
1997	38.84	**58.53**	**50.69**
1998	35.34	**53.63**	**51.74**
1999	33.36	**53.35**	**59.92**
2000	29.66	**43.41**	**46.33**
2001	32.34	**49.46**	**52.94**
2002	32.31	**51.42**	**59.12**
2003	33.03	**52.39**	**58.65**
2004	36.56	**46.96**	**28.44**
2005	36.31	**52.04**	**43.33**
2006	34.82	**51.35**	**47.47**
2007	32.26	**43.89**	**36.04**
2008	35.32	**49.92**	**41.33**
2009		**49.86**	

6.5.6. Source-specific planned improvements, including those in response to the review process

In respect to the IPCC GPG 2000 provisions, more detailed data which allow for using of Tier 2 method are proposed to be obtained.

In respect to the IPCC GPG 2000, in order to allow for the use of a Tier 1 calculation method with national parameters values, national parameters values are collected/processed/developed through the ongoing study Elaboration of national emission factors/other parameters relevant to NGHGI Sectors Energy, Industrial Processes, Agriculture and Waste, to allow for the higher tier calculation methods.

The approach associated to the annual mean values of livestock numbers use is further considered.

6.6. Source category Prescribed Burning of Savannas (CRF source category 4.E)

Prescribed Burning of Savannas does not occur in Romania.

6.7. Source category Field Burning of Agricultural Residues (CRF source category 4.F)

6.7.1. Source category description

Burning of agricultural crop residues is a significant source of emissions of methane, carbon monoxide, nitrous oxide and nitrogen oxides. However, the burning of crop residues is not thought to be a net source of carbon dioxide because the carbon released to the atmosphere is reabsorbed during the next growing season.

Due to the implementation of the legislation which forbidden the burning of the agricultural residues, from 2002 to 2009 emissions are considered as not occurring.

Emissions from field burning of agricultural residues in 2009 are lower than emissions in 1989 considering the implementation of the Ministry of Agriculture and Ministry of Environment relevant legislation which forbidden the field burning of agricultural residues since middle 2001. For 1989-2001, the emissions trend does not describe a linear trajectory, emissions values being directly proportional to crop productions values (Figure 6.9).

Figure 6. 18 Cumulative emissions trend - Field Burning of Agricultural Residues

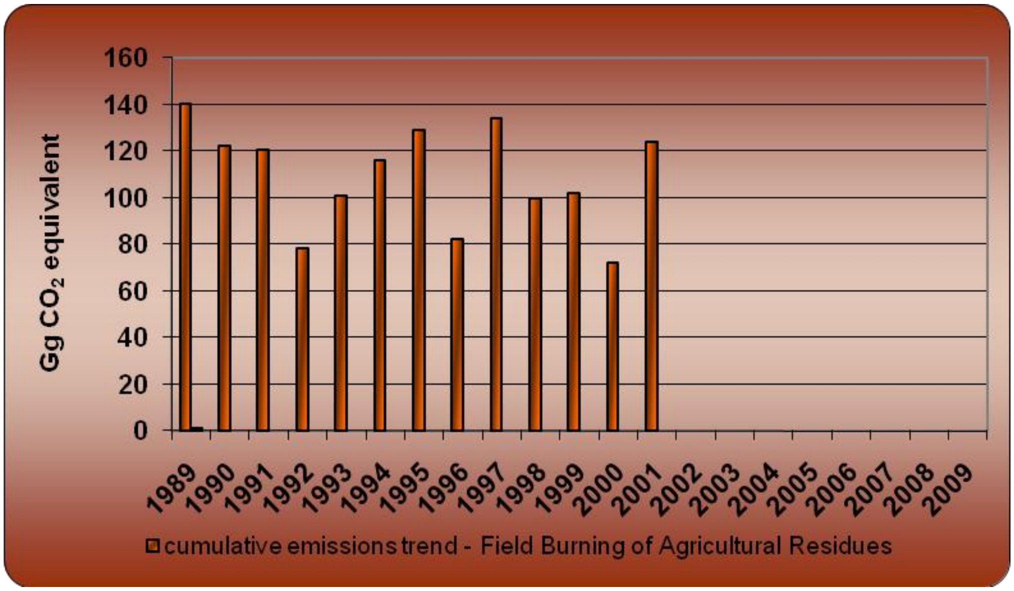


Table 6.28 Observations on source category 4F – "Field Burning of Agricultural Residues"

Source indicative	Source (livestock) type	Observation	Data source
4F	Crop productions	Includes data on 13 types of crops productions: wheat and rye, barley and two-row barley, oats, maize grains, sorghum, rice, other grains, pea beans, bean, other leguminous, potatoes, sugar beet and soybeans.	AD: SY, other correspondence NIS, 1989-2002;EF: IPCC GPG 2000, IPCC 1996

6.7.2. Methodological issues

Methodology

Due to the fact that CH_4 and N_2O emissions from field burning of agricultural residues are not key categories, neither from level nor from trend views, a tier 1 method has been applied. For calculation of methane, carbon monoxide, nitrous oxide and nitrogen oxides emissions, the equation on page 4.82 of IPCC 1996 - Reference Manual was used.

Emission factors

According to the provisions in IPCC GPG 2000, the calculation methodology took into account IPCC 1996 default emissions ratios (Table 4-16 of Reference Manual). Emission ratios are presented in Table 6.25.

Table 6.29 Default emission ratios for agricultural residue burning of residues calculations

Gas	Default IPCC 1996 emission ratios
Methane	0.005
Carbon monoxide	0.06
Nitrous oxide	0.007
Nitrogen oxides	0.121

Activity data

Crop production

Crop production data are presented in Chapter 6.5.2.

Other parameters

Default IPCC 1996 values of Residue to crop ratios, Dry matter fraction of residue, Fraction burned in fields, Fraction oxidized, Carbon fraction of residue and Nitrogen-carbon ratios (partially described in Table 4-17 of Reference Manual) are presented in Table 6.26.

Table 6.30 Specific parameters used for calculation of Total carbon released

Type of crop production	Parameters used for calculation of Total C released					
	Residue to crop ratios [fraction]	Dry matter fraction of residue [to. dry matter/to. Biomass]	Fraction burned in fields [fraction]	Fraction oxidized [fraction]	Carbon fraction of residue [to.C/to. dry matter]	Nitrogen-carbon ratio [fraction]
Wheat and rye	1.3	0.85	0.1	0.9	0.4853	0.012
Barley and two-row barley	1.2	0.85	0.1	0.9	0.4567	0.015
Oats	1.3	0.85	0.1	0.9	0.45	0.015
Maize grains	1	0.4	0.1	0.9	0.4709	0.02
Sorghum	1.4	0.85	0.1	0.9	0.45	0.02
Rice	1.4	0.85	0.1	0.9	0.4144	0.014
Other grains	1.3	0.85	0.1	0.9	0.4853	0.012
Pea beans	1.5	0.85	0.1	0.9	0.45	0.015
Bean	2.1	0.85	0.1	0.9	0.45	0.015
Other leguminous	2.1	0.85	0.1	0.9	0.45	0.015
Potatoes	0.4	0.45	0.1	0.9	0.4226	0.015
Sugar beet	0.2	0.15	0.1	0.9	0.4072	0.015
Soybeans	2.1	0.85	0.1	0.9	0.45	0.05

6.7.3. Uncertainties and time-series consistency

CH_4 emissions

By expert judgment, the uncertainty related to the activity data is 10%.
According to the IPCC GPG 2000 provisions, the uncertainty associated to the emission factors is ±20%.

The overall uncertainty resulted after the aggregation of the activity data and of the emission factors uncertainties according to the provisions in Chapter 6 of the IPCC GPG 2000 is 22.36%.

N_2O emissions

By expert judgment, the uncertainty related to the activity data is 10%.
According to the IPCC GPG 2000 provisions, the uncertainty associated to the emission factors is ±20 %.

The overall uncertainty resulted after the aggregation of the activity data and of the emission factors uncertainties according to the provisions in Chapter 6 of the IPCC GPG 2000 is 22.36%.

Due to the fact that the whole crop productions data series are provided by NIS, that the same default parameters, emission factors and methodologies are used for the 1989-2001 and also considering relevant Ministry of Agriculture and Ministry of Environment regulations which forbidden field burning of the agricultural residues since middle 2001, the time series 1989-2009 is consistent.

6.7.4. Source-specific QA/QC and verification

All quality control activities described in the QA/QC Programme were performed. The activities were performed by the responsible person on the Agriculture sector, the results of these being mentioned on the Checklists level.

Following these activities there were no unconformities recorded.

The activity data series were also compared to those on FAO and Eurostat, the data being reported at the same level of aggregation and the figures comparable.

No recalculations were needed following the QA activities developed under the procedures for the compilation of the European Community GHG Inventory, described in the Decision 280/2004/EC of the European Parliament and of the Council and Decision 166/2005/EC of the European Commission.

There were no unconformities noted following the UNFCCC review of the 2009 submission of the NGHGI.

6.7.5. Source-specific recalculations, including changes made in response to the review process

There was not any recalculation done since last submission.

6.7.6. Source-specific planned improvements, including those in response to the review process

There are no improvements envisaged.

7. LULUCF (CRF sector 5)

7.1. Overview of LULUCF

Major part of the Romanian territory is covered by agricultural land (including arable, orchards, vineyards, pastures), namely 63% of total national area. Meantime, area covered by forest vegetation is some 27%. Artificial land, consisting in constructed areas and road/railways, covers some 4.5%, while humid areas, water and lakes some 3.5% and other land 2%. The official statistics provide annually data on land use categories for entire country territory on the time series since 1989. Consequently, there is no part of the territory which has not been considered in the national GHG inventory.

Estimating emissions and removals of greenhouse gas (GHG) from the land use, land use change and forestry (LULUCF) follows the methodology presented in Good Practice Guidance (GPG) for LULUCF, IPCC, 2003.

The quantitative levels of the GHG emissions and CO_2 removals, on land categories and GHG sources in the LULUCF in Romania, are presented in Table 7.1.

Table 7.1 GHGs emissions and CO_2 removals on land in 1989 and 2009

IPCC Subcategories	**Emission ("+") / removal ("-"), in GgCO_2eq**	
	1989	**2009**
5A1. Forest land remaining Forest Land	-19979	-23589
5A2. Land converted to Forest Land	-17	-1142
5B1. Cropland remaining Cropland	-4509	-120
5B2. Land converted to Cropland	NO	197
5C1. Grassland remaining Grassland	NE, NO	NE, NO
5C2. Land converted to Grassland	NE, NO	NE, NO
5D1. Wetlands remaining Wetlands	NA, NO	NA, NO
5D2. Land converted to Wetlands	NE, NO	NE, NO
5E1. Settlements remaining Settlements	NO	NO
5E2. Land converted to Settlements	2782	24
5F1. Other land remaining Other Land	NO	NO
5F2. Land converted to Other Land	NE, NO	NE, NO
Table I. Direct N_2O emissions from N fertilization of Forest Land and Other	IE	IE

IPCC Subcategories	Emission (“+”) / removal (“-“), in $GgCO_2eq$	
	1989	2009
Table II. Non-CO_2 emissions from drainage of soils and wetlands	NA, NO	NA, NO
Table III. N_2O emissions from disturbance associated with land-use conversion to cropland	NO	0.08
Table IV. CO_2 emissions from agricultural lime application	NA, NO	NA, NO
Table V. Biomass Burning	1.3	27

A generally increasing CO_2 removal trend is visible on forestland and decreasing CO_2 emissions from land converted to settlements, compared to base year (1989).

Major contribution to total GHG inventory is given by CO_2, while the other GHGs having practically insignificant contributions (

Table 7.2).

Table 7.2 Emissions / removals for the period 1989-2009

("-"CO_2 removal, "+" GHG emission, in $GgCO_2$ eq)

Reported year	Total GHG	N_2O	CH_4	CO_2
1989	-21723	<0.01	<0.01	-21723
1990	-28434	<0.01	<0.01	-28434
1991	-27715	<0.01	<0.01	-27715
1992	-28805	<0.01	<0.01	-28805
1993	-31235	<0.01	<0.01	-31235
1994	-34092	<0.01	<0.01	-34092
1995	-35072	<0.01	<0.01	-35072
1996	-30809	<0.01	<0.01	-30809
1997	-30763	<0.01	<0.01	-30763
1998	-30297	<0.01	<0.01	-30297
1999	-31201	<0.01	<0.01	-31201
2000	-29980	<0.01	<0.01	-29981
2001	-31840	0.01	<0.01	-31843
2002	-32070	0.01	<0.01	-32074
2003	-36333	0.02	<0.01	-36339
2004	-29092	0.03	<0.01	-29101
2005	-29135	0.04	<0.01	-29147
2006	-29888	0.05	<0.01	-29904
2007	-30280	0.06	<0.01	-30300
2008	-26873	0.08	<0.01	-26896
2009	-24568	0.08	<0.01	-24592

The estimates are derived based on complete land use and land use change matrix. Emission factors are computed based on country specific data for forestland, while for the other land uses IPCC GPG for LULUCF (2003) default data is used.

Current GHG emissions and removal estimates reflect a certain level of completeness (

Table 7.3) on land subcategories and C pools.

Table 7.3 Status of estimating emissions / removals by sinks in the LULUCF sector

(for completeness on C pools and GHG sources more information is available with the specific chapters in the NIR)

IPCC Category	**Status of estimating emissions / removals**		
	CO_2	**CH_4**	**N_2O**
5A Forest Land			
5A1 Forest Land remaining Forest Land	✓	✓	✓
5A2 Land converted to Forest Land	✓	NO	IE, NO
5B Cropland	✓	NA, NO	✓
5C Grassland	✓	NO	NO
5D Wetlands	✓	NA, NO	NA, NO
5E Settlements	✓	NE, NO	NE, NO
5F Other land	✓	NE, NO	NE, NO
5G Other			
5G1 Harvested Wood Products	NO	NO	NO

Compared to previous submission, there is major recalculation that leads to 33% decrease of the annual sink in 2009 for the sub-category 5A1, the most important contributor to LULUCF sector. Meantime LULUCF sink is reported 33% less compared to earlier version of the national GHG inventory. This is due to major re-calculation of the emissions/removal on forestland and all other categories.

Key categories in the national GHG inventory are 5A1 Forest Land remaining Forest Land and 5A2 Land converted to Forest Land.

7.1.1. Information on approaches used for representing land areas and on land-use databases used for the inventory preparation

The standard reporting format of the national GHG inventory on LULUCF requires estimation of GHG emissions and CO_2 removals on six land-use categories: Forest Land, Cropland, Grassland, Wetlands, Settlements and Other Land. In relation to the activities carried out, any of these categories is further divided into one of two subcategories:

i. Land remaining in the same category during the inventory year;
ii. Land converted from one category to another.

According to the GPG LULUCF 2003, the main requirement for reporting land-use is "consistency", which requires that land with certain well defined characteristics is allocated in the same subcategory in time as to avoid over- or under-estimation of emissions, according to the reporting conventions. Also, the definition of land and method used for its area estimation should not allow missing or double accounting of some lands.
Reporting of land categories in the national GHG inventory of Romania is based on two key data sources:

i. National statistics on land-use categories (i.e. forest vegetation area on “national forest fund” and “forest vegetation outside the forest fund”, arable, vineyard, orchards, pasture and hayfields, road and constructed areas, wetlands and waters, other land);
ii. Forestry statistics on national forest fund, the afforestation area (forest plantations on non-forest lands) and deforestation.

The National Institute of Statistics (NIS) is responsible for compiling of annual data on the national land fund. Information is presented as the “net area” for each category of land at the end of the calendar year. Data in the datasets sums up the country's total area, so that entire national territory is counted in the national GHG inventory. Time series are available since 1989 and are consistently collected under constant definitions in time. Definitions are set according the Law of Cadastre and Real Estate (Law 7/1996). For all non-forest land use categories, NIS data allows the breakdown by main sub-categories of land use (e.g. agricultural land is split in arable lands, vineyards and orchards). Nevertheless, these land categories are easily aggregated into the six IPCC land categories (see Table 7.1).

Table 7.4 National definitions of lands and correspondence with the IPCC land categories

NIS datasets / IPCC land category	**National land definitions**
Forestry land /Forestland	This category are: forest lands or those that serve the culture, production or administration of forest, lands for afforestation and unproductive lands comprising rocks, steep and stony slopes, ravines, gullies, torrents, if they are included in forestry planning.
Agricultural land / Cropland, Grassland	This category includes: arable land, vineyards, orchards, vineyards and orchards, nurseries, hops and mulberry trees, pastures, hayfields, greenhouses, solariums, greenhouses, the land covered with forest vegetation if it is not part of forest fund, wooded pastures, land occupied with agro-zoo-technical constructions and land improvements, fishery facilities, roads and technological storage.
Construction, road and railways land/ Settlements	This category includes all lands, regardless of the category of use, located in urban and rural area, inside a certain boundary according legal provisions. It also includes, special purpose land category used for roads, railways, air and water transport, those representing works of hydraulic engineering, heating systems, electricity and gas transport, mining and oil fields, those needed for the national defense; natural reserves and monuments as well as those for archaeological sites and historical ensembles and others alike.
Land permanently covered by water and humid zones / Wetlands	This category includes minor beds of watercourses, natural lakes and artificial basins at their maximum retention, arms and canals of the Danube Delta, the bottom of the inland maritime waters and territorial and contiguous sea.
Other lands/ Other Land	Lands which are not included under the other categories (i.e. small rocks and stony areas)

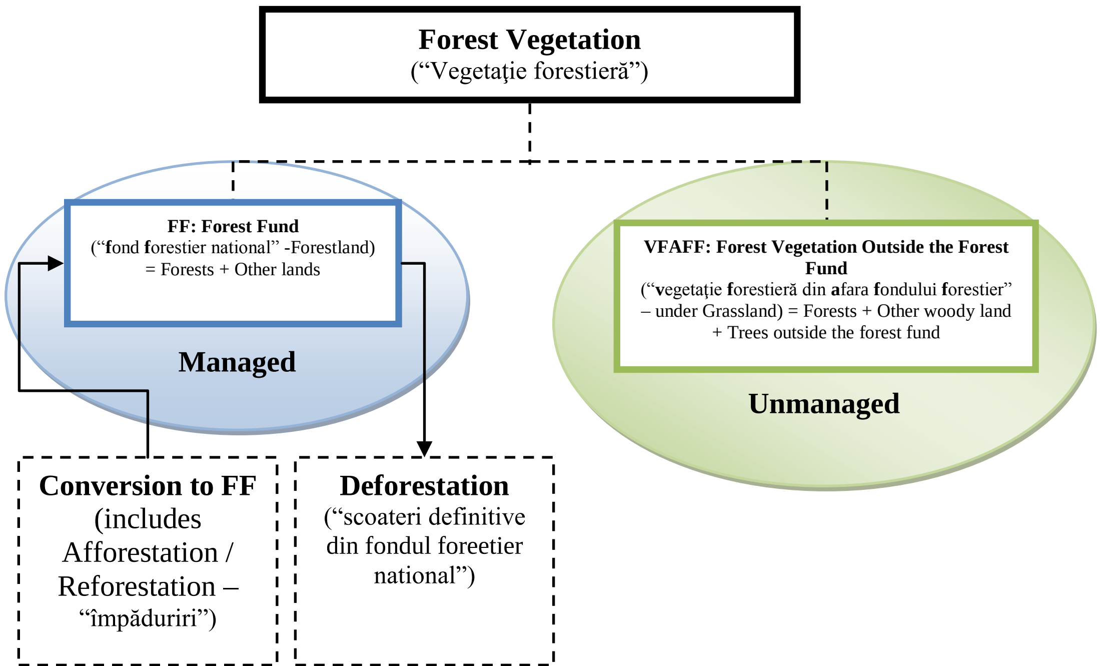
National statistics provides data on two types of forest land:

i. "National forestry fund", which includes forest lands under forestry management planning. These lands are managed according management plans, which are renewed every 10 (5) years, and approved by the central public authority responsible for forestry and implemented by the forest administrators (namely a forest districts);

ii. "Forest vegetation outside the national forest fund", comprises areas with forest vegetation not included in forest management plans and where specific rules are applied only on the harvesting and transport of wood by forest landowners.

Since 2008, Romania began implementing a National Forest Inventory (NFI) based on statistical inventory of the forests. NFI implements a forest definition harmonized with FAO's one. This definition is also consistent with the above land categories definition.

Under national classification of lands covered by forest vegetation into several land categories, the following outline gives further explanation on the match of national land data with the IPCC land categories, following the UNFCCC, including KP reporting requirements.



The data compiling system managed by NIS is implemented according Law 226/2009 (Law on the organization and functioning of official statistics in Romania) which provides the legal framework, institutional responsibilities, reporting procedures and information processing, as well as own system of control and quality assurance. County and national level aggregated datasets are publicly available on the NIS site (www.insse.ro).

Forest administration structures (forest districts) prepare sector statistical reports (SILV) at the end of each year, which provide data on the area of forest land they have under management. Data is centralized by NIS bodies, first at the county level and then at the national level.

Conversions among land categories are regulated. Despite that, national statistics report "net" of the area of each category of land at the end of the year, but do not report explicit area under change from one category to another. Therefore, additional information is needed to build up the land use change matrix in order to show the lands in conversion in time at the national level. Also, in order that matrix allows identification and consistency with land activities under Marrakesh Accords, more detailed information from forestry sectorial statistics are incorporated. Such data is available either at the NIS (afforestation / reforestation from the SILV 4 – “Forest regeneration works performed in the forestry fund, degraded lands and other lands outside the forest fund”) or at the central public authority responsible for forestry (synoptic of definitive “leaving land” from national forest fund which is equivalent to “deforestation”; statistics on forest fires affected areas). For these procedures there is a template officially approved for reporting.

The Territorial Inspectorates for Forestry and Hunting Regime (ITRSV), which are the regional representative of the central public authority responsible for forestry, annually collect data and accurate information on forest land area and on conversions from / to forest lands, as follows:

i. “National forest fund” area, which is measured continuously; annually around 10% from the national forest fund area, along with the new forest management planning of the forest districts. However, forest fund area is annually updated based on all conversions from / to forest land (inputs / outputs from the forestry fund) operated into the management plans.
ii. Land area with “forest vegetation outside the national forest fund” is also reported annually by the ITRSV.
iii. Information on conversions from forest land: highly detailed standard documentation of "permanent “leaving land from national forest fund" (namely deforestation), the exact location of the land (i.e. administrative and geographical location), the surface, the subsequent destination of the land, as well as information on forest stand (e.g. full description of the stand and site characteristics). Forest areas affected by damaging factors (e.g. windfalls, fires) follow the same procedure, in the case of conversion.
iv. Information on conversions to the forest land by plantation of non-forest lands: detailed standard documentation about the exact location of the area (administrative and geographical location), the area of land involved, etc. of the Conversion to forest fund by natural expansion of forestland, in some special circumstances (i.e. on alluvial deposits), is included by the procedure mentioned under i) above.

Such information is collected at national scale following officially approved procedures. Data is archived by the central public authority responsible for forestry in Romania and NIS. Also, a copy of each forest management plan, mentioned under i) above, is achieved by the Forest Research and Management Institute in Bucharest, since ~ 1950.

Type of land information which is currently available in Romania allows an Approach 2 for forest land and conversions from/to forest land, seconded by explicit historical observation of all these three types of land. Further on, the national GHG inventory land datasets allows a level corresponding to Tier 2 for forest land and conversions, while a Tier 1 for the other land-use categories, according IPCC GPG LULUCF 2003.

Using the above mentioned data and information sources, *the land-use and land-use change matrix* was built. The matrix is based on following data, ranking them according to their quality (i.e. ability to provide explicit location) and reporting requirement:

1. Annual net area of afforestation and deforestation (“permanent leaving land from the forest fund”), available from the forestry statistics (central public authority responsible for forestry).
2. Annual net area of the land use categories from the national statistics (NIS).
3. Share of land use categories afforested area, based on the results of a desk study on the change to forest land, complemented with "expert judgment". This study checked the documentation of funding in afforestation projects over 2002-2005 (covering about one fifth from the total afforested area since 1990). This way the origin of land resulted as follows: 80% arable land and 20% pastures (“Romania Afforestation of Degraded Agricultural Land Project: Baseline Study, Emission Reductions Projections and Monitoring Plans”, de S. Brown et al., May 2002). It was also assumed that this proportion would have occurred for the entire afforested area for each year of the time series.
4. Land area permanently leaving the forest fund from the archives of the central public authority responsible for forestry. The most likely destination of lands converted from forest land is for construction areas and roads (e.g. residential, infrastructure). Also, it is considered that some forest land can convert to "Other land" taking into account natural causes (landslides, erosion of rivers banks) that cannot be associated with true deforestation, but accounted for as conversions to the category "other land" by the national GHG inventory. According the forest code interdiction of reducing the national forest fund area, the conversions of forestland to the other land-use categories is not occurring.

5. The area of the most likely conversions among non-forest land categories was considered as following "expert judgments":
   - The land area in conversion is estimated taking into consideration the maximum area of land possible to remain in the same category from one year to another;
   - In the case of arable lands, the most likely conversion was assumed to occur to pastures/hayfields.
   - In the case of pastures, the most likely conversion was assumed to occur to "forest vegetation outside the forest fund" under the natural expansion of forest vegetation into the abandoned pastures in the mountain and hilly areas, especially after 1991.
   - In the Grassland category it was assumed that there were mainly transitions between subcategories within this category (from pastures to hayfields or to forest vegetation outside the forest fund).
   - In the case of construction land (e.g. waste dumps, industrial perimeters) the most likely conversion was assumed to occur to "other land".
   - The wetlands conversion was made most likely to pastures, "forests vegetation outside the forest fund" and "other land" categories.
   - The "other land" category area is relatively constant over time and it is used in the matrix as a buffer for transitions that could not be attributed to other categories of land.

Also, in the very few cases of large differences of land category areas reported by the national statistics on consecutive years, these were considered as reporting errors and not real conversions. This was the case for: i) "forest vegetation outside the forest fund" in 1999-2000 and 2003-2006; ii) pasture in 1999 and iii) other land in 1999-2003. In this case the chosen solution was to correct these values by replacing them with the simple arithmetic mean of the values from two years before and two years after the mentioned periods and allocate or subtract the land area from/to the category where the highest change was noticed (i.e. "forest vegetation outside the forest fund" to pasture or hayfields).

The matrix is built up for a period of 20 years for the lands under conversion, according to the IPCC LULUCF GPG (2003).

The matrix allows cross-checks. Thus, it was started on the idea that the national total area is constant over time while it is composed of the sum of the six categories of land use (total national land fund). It also allows checking the surface of a category at the end of the year to be equal to the value at the beginning of the year, plus/ minus conversions over the current year. The complete land conversion matrix over 1989-2009 is presented in Annex 8.3.

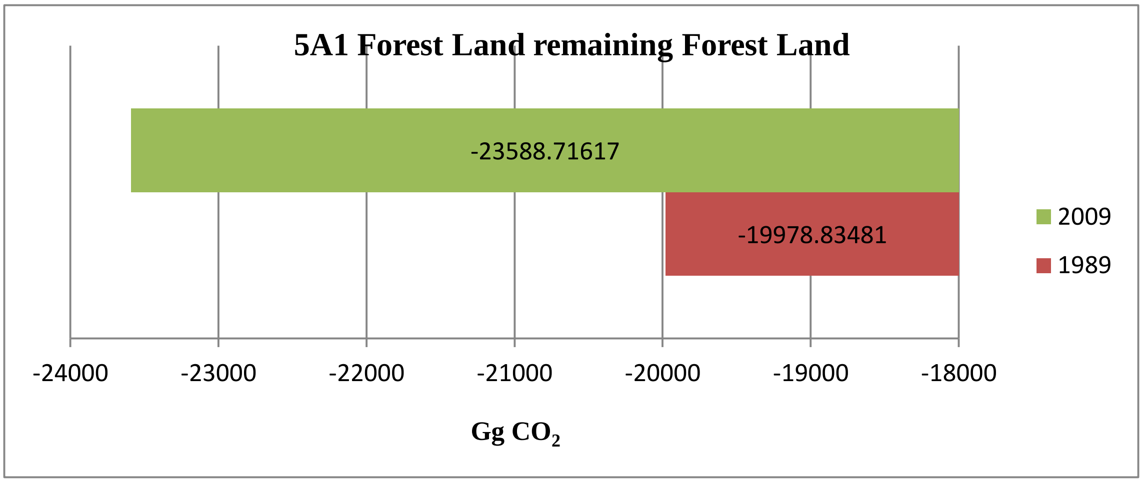
Table 7.5 describe the major key categories in the LULUCF sector, based on level and trend assessment, showing also the change of the annual removal compared to the base year.

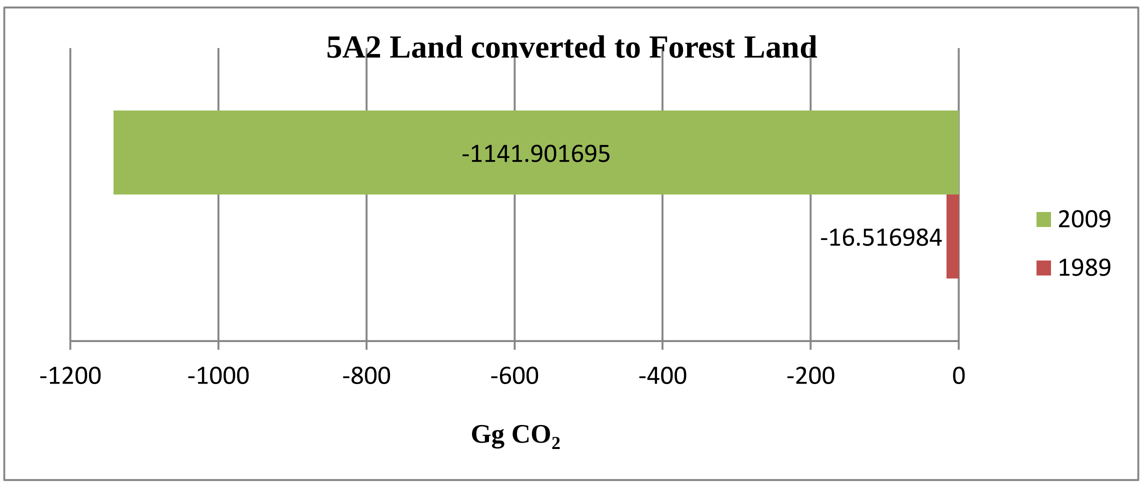
Table 7.5 Key categories overview – LULUCF, 2009

Key categories	**GHG**	**Criteria**	**Contribution to the national GHG inventory (level / trend) [%]**	
			Level	**Trend**
5A1 Forest Land remaining Forest Land	CO_2	L, T	15.29%	17.87%
5A2 Land converted to Forest Land	CO_2	L, T	0.74%	1.49%
5B1 Cropland remaining Cropland	CO_2	T	-	2.83%
5E2 Land converted to Settlements	CO_2	T	-	1.78%

Figure 7.1 presents the change of the annual CO_2 removal in 5A1 and 5A2 in the latest year compared to the base year.

Figure 7.1 Major Key categories in LULUCF, both by level and trend





7.2. Forest Land (5.A)

7.2.1. *Description*

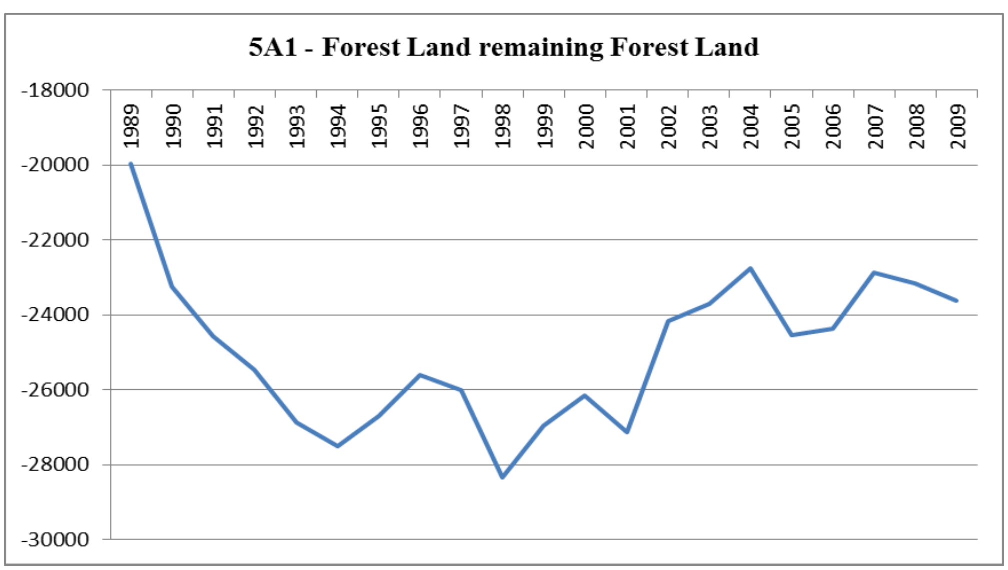
At the end of 2009, forest land area in Romania was about 6300 Kha, which represents about 27% of the country area. The total area of forest land has increased by about 1% during 1990-2009. The deciduous forests have the highest share (69% of forest area), while the Coniferous share is 31%. Among the deciduous, beech is the most widespread species (32% of the forest land), followed by oak (17%), hardwood species (hornbeam, locust, maple, ash, etc. – 15%) and softwood species (poplar, willow, lime, etc. – 5%).

Among the Coniferous, spruce is the most widespread species (21% of the forest land), followed by fir (5%) and other species (pine, larch, etc. – 5%). According to the inventory of the forest fund in 1984 the total standing wood volume was 1.341 million cubic meters, with an average of 218 cubic meters per hectare. Total annual growth of the forests was 34.6 million meters with an annual average increment of 5.6 m^3/ha/ year. Romanian forests grow more than is harvested from them, with a growing / harvesting ratio of about 2. The stand age class structure reflects an unbalanced distribution of age classes on the surface, with a surplus in classes II and III and a deficit in classes I and V.

Forest fires do not occur frequently on forest land and affect only small scattered areas. Litter fires, which affect only the forest floor (litter, dead organic matter), are the most common, while crown fires rarely occur. Usually, annual wildfires affect areas under 1,000 ha of forest land. The disturbing factors through their effects on forest vegetation (fallings and breakings due to wind or snow) negatively affect the Romanian forestry. The fallings due to the catastrophically winds occur at least once in a decade, especially in the Coniferous species forest.

Both land sub-categories of forestland are key category for CO_2 in the national GHG inventory (Table 7.5), thus higher methodological levels is required.

Figure 7.2 Annual CO_2 removal in 5A1



Under the current data availability there is a change of annual removal estimate only given by the annual harvest variation (i.e. total volume harvested, share on species).

7.2.2. *Information on approaches used for representing land areas and on land-use databases used for the inventory preparation*

In Romania there are two types of lands included by forest vegetation terminology (See also Chapter 7.1.1):

i. "National forest fund", which includes forest land subject to forest management planning, of which "lands covered by forest" are considered **managed forest land.**

ii. "Forest vegetation outside the national forest fund", made up of areas covered with forest vegetation which is not subject to forest management planning, which is further considered **unmanaged forest land**. Such areas are reported under Grassland (5C).

Although 5A1 is the most important key category, the current version of national GHG inventory data still takes into account heterogeneous data sources. A recalculation is expected with actual data from The National Forest Inventory (NFI) which currently performs its first cycle (field measurements will be completed most likely in 2012). Data sets currently available allow the use of different estimation methods for the two subcategories included in forest land: Forest Land remaining Forest Land (CRF 5A1) and Land converted to Forest Land (CRF 5A2).

7.2.3. *Methodological issues*

7.2.3.1. *Forest Land remaining Forest Land (5A1)*

CO_2 removals and emissions have been calculated following the default “gain-loss” method (Equation 3.2.2 of IPCC GPG 2003), according to data currently available. The method involves estimation of the C stock change for all C pools on breakdowns of forest area (the activity data) and various proxy and parameters (used to estimate the emission/removal factors).

Then the estimates are summed up to the country level. Generally, a Tier 2 applies in the case of Forest Land remaining Forest Land sub-category, as long as the country specific estimates of activity data and emission/removal factors are available. Effort was also done in order to use as much as possible actual and updated data, where available.

7.2.3.1.1. *Change of C stocks in living biomass*

General equation for estimation of C stock relies on equation 3.2.2 from IPCC GPG LULUCF (2003):

$\Delta CFF_{LB} = (\Delta CFF_G - \Delta CFF_L)$,

where:

- ΔCFF_{LB} = annual change in carbon stocks in living biomass (includes above- and belowground biomass) in forest land remaining forest land, tonnes C yr^{-1}
- ΔCFF_G = annual increase in carbon stocks due to biomass growth, tonnes C yr^{-1}. These estimates result from the multiplication of the activity data and country specific emission factors, as further on described.
- ΔCFF_L = annual decrease in carbon stocks due to biomass loss, tonnes C yr^{-1}. These estimates result from removal of biomass (i.e. wood harvest) and other losses (i.e. forest fires).

Activity data

The national statistics provide time series of forest fund area for the 1989-2009 period, both for the total Forest Land category and broken down on major species / groups of species (i.e. Coniferous, beech, oaks, deciduous hardwood and softwood). Forest fund area consists of two types of land:

i. "forest area", which is the area actually covered with forests (softwood, hardwood and mixed)
ii. “other lands from the forest fund”, which are areas from the forest fund which are not covered by forests (e.g. unproductive lands, lands for forestry administration, forest roads, etc.)

In the land-use change matrix, the forest fund (called FF) comprises only "forest area" because only on these occur CO_2 removal and GHG emission processes (respectively point i) above). The other type of lands ("other lands" from the forest fund) is actually conventionally included in the land use change matrix under "forest vegetation outside the forest fund" (called VFAFF), because on these areas do not occur CO_2 removal and emission. "Other lands from the forest fund" represents about 38% of the total surface of the VFAFF category, while the rest is represented by forest vegetation on pasture and hayfields.

Activity data is provided by land-use change matrix (the area, see Annex 8.3). The area and the structure of the forest land by species/groups of species are annually obtained from the statistical survey SILV I, where there are presented annually updated data on the structure of the species / groups of species of the forest fund (Table 7.6).

Table 7.6 Activity data on area of species/ groups of species used for calculation of the "increase" in carbon stocks due to living biomass growth

Year/ Parameter	Forest land areas by species [kha]					
	Total	Coniferous	Beech	Oaks	Various Hardwood	Various Softwood
1989	6,249	1,926	1,893	1,146	967.40	316.60
1990	6,252	1,929	1,896	1,145	965.89	316.11
1991	6,253	1,930	1,902	1,142	963.63	315.37
1992	6,253	1,926	1,906	1,143	962.88	315.12
1993	6,249	1,916	1,915	1,139	963.63	315.37
1994	6,246	1,913	1,909	1,144	964.39	315.61
1995	6,245	1,903	1,925	1,133	967.40	316.60
1996	6,240	1,890	1,935	1,131	967.40	316.60
1997	6,236	1,883	1,939	1,129	968.15	316.85
1998	6,227	1,868	1,942	1,127	971.92	318.08
1999	6,226	1,861	1,943	1,122	979.46	320.54
2000	6,223	1,856	1,951	1,120	976.44	319.56
2001	6,225	1,853	1,956	1,117	979.00	320.00
2002	6,239	1,856	1,973	1,117	972.00	321.00
2003	6,221	1,839	1,985	1,109	971.00	317.00
2004	6,222	1,852	1,996	1,099	965.00	310.00
2005	6,233	1,873	2,023	1,084	941.00	312.00
2006	6,272	1,893	2,028	1,084	954.00	313.00
2007	6,315	1,920	2,041	1,077	963.00	314.00
2008	6,309	1,938	2,052	1,058	954.00	307.00
2009	6,334	1,935	2,037	1,077	961.00	324.00

Annual increase in C stocks in living biomass

Annual estimation of C stock growth, as the result of biomass increase, respectively total annual increase of aboveground and belowground biomass, is based on various parameters available from different country specific data sources, meeting the Tier 2 methodological level (with the exception of belowground biomass, where Tier 1 applies). Thus, the average annual increase in biomass (G_{TOTAL}) is calculated with the equation 3.2.5 from GPG LULUCF 2003, as follows:

$$G_{TOTAL} = I_v * D * (1+R)$$

where:

- G_{TOTAL} = average annual biomass increment above and belowground, tonnes d.m. $ha^{-1}yr^{-1}$
- I_V =average annual increment of the growing stock on species/group of species, $m^3ha^{-1}yr^{-1}$;
- R = root-to-shoot ratio appropriate to increments, dimensionless;
- D = basic wood density, tonnes d.m. m^{-3}.

Details of the country specific data used for estimation are as following.

- **Average annual increment in volume** (I_V) of the standing wood by species and groups of species available in the „Summary of the Forest Fund Inventory of Romanian Socialist Republic” (by ICAS, Ministry of Forests, 1984). This Forest Inventory was based on data drawn from the forest management plans for the national forest fund. Forest management plans are renewed every 10 (5) years and include specific estimates at the forest stands in terms of area, volume, species composition, current growth, etc. Growths values were calculated by summing the corresponding forest management plans data in force for the year 1984. Annual growth is the increase in the aboveground stand volume, including trunk and branches. For this reason there is not applied any biomass expansion factor (BEF). Note that only these data are available at this time and they are used in all national and international reporting (e.g. FAO). At this time there is no updated value of forest growth. New estimates of the indicators of the forest vegetation are expected with the finalization of the National Forest Inventory (expected by the end of 2012);

- **Wood density** (D). Specific values for our country are available from "Studies and research for expansion of wood industry row material base taking into account the structure, the physical-mechanical and technological characteristics of national forest tree species", ICPIL Manuscript, 1985, confirmed with the data provided by The National Institute of Wood (2008). Values result from a national evaluation that took place within an assessment of the national forest resources, completed in 1985 (along with the Forest Fund Inventory). These values represent the best estimates for the breakdown used in forestry statistics and applied also in the national GHG inventory.
- **The default values of the ratio "root-to-shoot"** (R) from Table 3A.1.8 of IPCC GPG 2003. Corresponding report defaults "root-to-shoot" were chosen assuming that the above-ground biomass is greater than the value of 150 t/ha for all estimates (species and groups of species);
- **C fraction** (CF) is assumed to be 0.5 of the dry biomass according to the IPCC GPG LULUCF (2003).

The parameters used for the estimation in the national GHG inventory are consistent with the data structure of the species and groups of species from the annual NIS reports (Table 7.7), a structure also used in the forest fund inventory conducted in 1984.

Table 7.7 Parameter values used to estimate annual increment of the stock of C in biomass

Species/ groups of species	I_V [m^3/ha/an]	D [tone d.m./m^3]	R [dimensionless]
Coniferous	6.5	0.4	0.23
Beech	5.4	0.64	0.24
Oaks	4.7	0.645	0.24
Various hardwood	4.7	0.6	0.24
Various softwood	7.8	0.41	0.24

Annual loss of C stock from living biomass

CO_2 emissions as losses from biomass C stocks, includes reduction of C stocks caused by:

i. wood harvesting;
ii. disturbances (illegal logging, forest fires).

Fact is that the wood resulted from windfalls is covered by national statistics as normal harvest, in the year when the wood is harvested (not necessarily in the year of disturbance).

Collecting firewood from forests is not a common practice in Romania, thus it is not included in the forest statistics and therefore is not quantified in the GHG inventory.

Instead, there may be illegal cutting of trees, which are taken into account as separate entry in the national GHG inventory because these statistics are not included in the annual statistics on wood harvesting. Illegal logging statistics is based on field checks data achieved by forest administrators, further summarized regional by ITRSV offices, then as national forestry statistics by the central public authority responsible for forestry. In the procedure of assessment of the trees illegally cut, the volume is estimated based on the official yield tables.

Forest fires do not occur frequently in forest land and affect only small areas. Litter fires, which affect only the forest floor (litter, lying deadwood), are the most common, while crown fires rarely occur. Usually, annual wildfires affect areas under 1,000 ha of forest land in a high number of locations. In the case of forest fires, CO_2, CH_4, N_2O emissions are calculated based on country-specific activity data and default emission factors; all GHG emissions are reported in CRF Table 5 (V) "Emissions from biomass burning".

To calculate the variation of C stocks from biomass due to losses, the equations 3.2.6-3.2.8 from IPCC LULUCF GPG (2003) are tailored to specific available data. Currently available data allow the use of Tier 1, thus assuming that the belowground biomass C stock is entirely emitted in the same year.

Annual decrease of carbon stock due to biomass loss (ΔL_{FF}) is:

$$\Delta L_{FF} = L_{fellings} + L_{other\ losses}$$

where:

- $L_{felings}$= annual carbon loss due to wood harvesting [tC/year]
- $L_{other\ losses}$= other annual carbon losses, due to illegal logging [tC/year]

Further on, the annual carbon loss due to timber harvest ($L_{harvest}$) is computed as following:

$$L_{fellings} = H \times D \times (1+R) \times CF$$

where:

- H = annual volume of wood extracted [m^3/year]

Parameters D, R and CF have the same meaning as in the other equations in section 7.2.3.1.1 . As well, for the estimation of the gain or loss, the values of these parameters are identical for same breakdown (i.e. on species/group of species).

NIS provides annual data on the annual volume of wood extracted from forests. Data is collected and compiled at the same level of disaggregation as any other forest information following same procedure by the NIS. Worthy to notice, the suppliers of data on wood harvesting are forest land administrators (i.e. forest districts).

The statistics includes i) the normal harvest, respectively the allowable cut composed by main and secondary products resulting from the implementation of management plans, and ii) any wood volume resulted from forest disturbances. Thus, the statistics include both commercial wood (for industrialization) and firewood (Table 7.8). Harvest statistics refer to entire aboveground volume of the stands (Technical Norms for commercial wood volume assessment, MAPPM 2000).

Table 7.8 Activity data for harvested wood volume during 1989-2009

(thousands cubic meters/year)

Year/ Type of activity data	Legally harvested wood					Illegal logging volume
	Coniferous	Beech	Oaks	Various hardwood	Various softwood	
1989	6,516	6,636	1,842	2,268	2,004	83
1990	5,813	4,958	2,045	2,071	1,762	121
1991	4,956	4,644	1,919	2,089	1,769	187
1992	4,418	4,629	1,739	2,109	1,524	282
1993	4,564	4,073	1,629	1,872	1,452	158
1994	4,285	4,037	1,651	1,741	1,228	146
1995	4,973	4,215	1,551	1,774	1,300	122
1996	5,751	4,266	1,658	1,876	1,252	129
1997	5,836	4,263	1,489	1,757	1,164	137
1998	5,195	3,635	1,276	1,491	1,045	122
1999	5,564	4,115	1,358	1,588	1,093	130
2000	5,346	4,509	1,333	1,731	1,366	143
2001	4,915	4,260	1,288	1,673	1,274	141
2002	7,166	4,439	1,495	1,805	1,478	102

Year/ Type of activity data	Legally harvested wood					Illegal logging volume
	Coniferous	Beech	Oaks	Various hardwood	Various softwood	
2003	7,139	4,748	1,532	1,823	1,450	81
2004	6,357	5,412	1,694	2,030	1,589	71
2005	6,061	4,794	1,586	1,852	1,378	86
2006	5,765	4,997	1,632	1,915	1,375	65
2007	7,491	5,182	1,485	1,668	1,412	176
2008	6,766	5,208	1,653	1,760	1,318	174
2009	6,635	5,489	1,403	1,845	1,148	180

Other annual carbon losses (illegal logging):

$$\mathbf{L_{other\ losses} = H_i \times D \times (1+R) \times CF}$$

where:

- H_i = volume extracted annually by illegal logging [m^3/year].

Other parameters have the same meaning as the previous equation. Illegal logging statistics refers to entire aboveground volume of the stands/ trees.

7.2.3.1.2. *Change of C stocks in dead organic matter*

Currently, it was assumed that the average transfer rates in and from the C pools in dead organic matter, respectively lying dead wood and litter, are equal, so that annual net change is zero (Tier 1) according to the IPCC GPG LULUCF (2003). At this date there is no consistent data and information on these C pools. Because 5A1 is a key category in the national GHG inventory, a higher methodological level will be addressed in future submissions (see section 7.2.7 on the planned improvements).

7.2.3.1.3. *Change of C stocks in forest soils*

The change of the C stocks in the organic matter of mineral soils it was assumed that annual net change is zero (Tier 1 of the IPCC GPG LULUCF 2003).

In order to improve the reporting of the national GHG inventory, several existing data sets were considered. A first set of test data from projects on forest monitoring ICP Forests (MO4/2005 Report "Evaluation of carbon stored in forest soils at surveillance levels I and II, author A. Surdu). This allowed comparison of data from two successive monitoring moments in the same sample plots (i.e. 16x16 km grid, 240 sample plots in the national forest fund). The soil samples were collected in 1994 and 2004. Estimates show an annual decline in soil C stock by about 0.4 tC $yr^{-1}ha^{-1}$ for all major soil types. Given that both forest management and site conditions have not changed during this period, the differences seem not credible. These differences are likely caused by changing methodologies of soil samples collection (e.g. different depths in 1994 and 2004).

For these reasons it was considered that these data sets cannot be used in reporting until it is confirmed from other sources. Since 5A1 is a key category in the national GHG inventory, a higher methodological level will be addressed in future reports. Currently there are under analysis and development estimation and reporting methods of GHG emissions from soil C pools under forestland (see section 7.2.7).

Organic soil area in forest land in Romania is negligible. That's why they are not considered in the GHG inventory.

7.2.3.2. *Land converted to Forest Land (5A2)*

Activity data

Conversion of land to forest land is produced through plantation of forest trees on land taken in the national forest fund. Under specific circumstances the natural expansion of forest vegetation is a conversion to forest fund, if such areas are included in the forest management plans (e.g. new forest vegetation on alluvial deposits).

The activity data for conversions to forest land is provided by the change in land-use matrix (see Annex 8.3). The total area converted to forest in 2009 compared to 1990 is of 136.6 kha, of which 29.8 kha are artificial plantations (eligible as afforestation/reforestation activity under the Kyoto Protocol).

Annual change of C stock in living biomass in artificial plantations

The change of C stock in living biomass was determined based on the data and information from two research projects:

1. Reports to the implementation of the monitoring plan of the project "Afforestation of Degraded Agricultural Land Project in Romania" as a flexible mechanism of "Joint Implementation (JI)" under the Kyoto Protocol. The monitoring is carried out by the Forest Research and Management Institute (Romania) according to “Monitoring Plan for Changes in Carbon Stocks in Forest Plantations”, agreed by partners in the project. This plan covers all issues related to sampling, measuring, processing, reporting and archiving data and information. The first verification of carbon stock accumulated in the project was made in 2007 and the second is scheduled for 2012 (to cover 2008-2012).
2. The research project "Modeling Carbon Storage in the Transitional Ecosystem Structures Associated with Forest Land Use Change in Romania (FORLUC)" financed by the Ministry of Education and Research (Romania) during 2006-2009. The final report is available at ICAS Bucharest and some results are currently under publishing in various peer-review journals. The data obtained in the two projects have allowed the development of biomass equations for eight forest species, most used in plantations on degraded lands in Romania. Both projects estimate changes of C stocks in the living biomass pools based on measurements in about 250 sampling plots (out of which 185 are permanent which monitor all C pools, subject to re-measurement in the JI project). Plots position was established based on a randomized sampling design, which allowed the establishment of geographical coordinates (latitude, longitude) of each sample areas in part. For the 185 permanent plots, the centers are land marked and flagged according to the requirements of the monitoring plan. Non-permanent plots can be also re-identify based on GPS coordinates measurements of the plot centers). Annual change of C stock in living biomass according to the age of the plantations was determined from measurements in sample areas (for plantations younger than 10 years). For older age categories there were fulfilled simulations by *CO_2 fix v.2.0* on the yield table data from "Trees and Forest Stands Biometrics in Romania" (Giurgiu et al. 1972). Since the species composition of the national artificial forest area is not known, in the calculations it was taken into account a corresponding proportion of the species from the JI

project (50% acacia, 30% indigenous poplars and willow, and 20% oaks). The data used to calculate the annual amount of C stored in biomass in forest plantations, are presented in

3.

4. Table 7.9. These data will be reviewed and updated by the end of 2012 after the second monitoring of the JI project (scheduled for 2012) and the incorporation of biomass equations involving data collected over 2010-2011.

Table 7.9 Annual amount of C (t) seized in biomass in forestry plantations

Plantation age (years)	Poplar & Willow	Acacia	Oak
1	0.1	0.1	0.3
2	0.2	0.4	0.4
3	0.4	0.5	0.2
4	0.7	0.7	0.3
5	0.9	1.8	0.4
6	1.4	2.3	0.5
7	1.7	2.5	0.6
8	1.8	2.8	0.6
9	2.1	3.1	0.6
10	2.3	3.1	0.6
11	2.5	3.2	0.8
12	2.7	3.3	0.9
13	2.9	3.3	1.0
14	2.9	2.6	1.1
15	2.9	2.9	1.2
16	2.9	3.1	0.9
17	2.8	2.6	0.7
18	2.8	2.9	0.8
19	2.7	3.1	0.9
20	2.8	3.2	1.0

The data collected allows a Tier 2 (IPCC GPG LULUCF 2003 methodological level) estimation of C stock change in living biomass.

Annual change of C stocks in the soils and dead organic matter in artificial plantations

At this time there is no information on changes of the C stocks in the forest soils of land converted to forest land (through artificial afforestation).

Regarding the change of C stocks in the dead organic matter on lands under conversion to forests land (young plantations), there is only partial data from the first monitoring of JI project. The net values of annual increase of the C stock are computed as a time average according to the plantation age. Values are species-specific: 0.3 tC $ha^{-1}yr^{-1}$ in plantations of robinia and 0.1 tC $ha^{-1}yr^{-1}$ in plantations of poplar and willow. For oak plantations, these values were negligible (practically zero). These data are currently used for estimation in the GHG inventory, also assuming the same structure of the planted area on species as for the calculation of changes in the biomass.

Updated data on soil and dead organic matter will be reported in a future submission, after the re-measurements in 2012 of soils in the JI project.

Annual change of C stock in living biomass in natural expansions of forests on non-forest land

As far as such areas occur by natural expansion and are included in the forest fund they are assumed to be part of the forest fund and include under the normal regeneration process following forest management plans. Also, the calculation of their sink is part of the calculation of 5A1 Forest Land remaining forestland.

7.2.4. Uncertainties and time-series consistency

Preliminary estimates of the uncertainty determined for 5A1 sink in 2009 was 33% (ranging between 25% and 50%) for growth of biomass and 35% for loss of biomass (between 26% and 54%). Under current completeness, total average net sink uncertainty in 2009 was 53%, ranging from 34% to 117%. Uncertainty estimation was done with @Risk application. It was assumed that the values of all parameters have normal distributions. Nominal uncertainty of the parameters and proxies used in the GHG inventory range from 6% to 100% (Table 7.10), according to the specifications of data sources.

Table 7.10 Nominal uncertainty input parameters of national GHG inventory for 5A1 - Forest Land remaining Forest Land

*(95 % confidence interval, defined as ± 2 * StDev / mean, in %)*

Parameter	Nominal uncertainty and 95% confidence interval for	Source
Annual increment in wood volume, Harvested wood volume	15	Assumed equal to volume standing stock. Technical standards for the forest management planning (Ministry of Forestry, 1986, 2000)
Activity data for living biomass	6	
Wood density	20 (16-25)	Values re-simulated based on average, min and max data, available in Mos (1985)
“Root-to-shoot” ratio	30 (22 - 39)	Values re-simulated based on IPCC data (Table 3A.1.8)
Illegal logging volume	100	Expert judgment
Forest fires emissions – activity data	30	
Forest fires emissions – emission factors	100	

Current estimate of the uncertainty is still preliminary, as far as the uncertainty introduced by some very old data is not yet accounted (for example, the annual growth of the wood volume, dated 1984). Meantime, new data is expected from NFI, at the latest in 2013.

Regarding 5A2, there is an estimation of uncertainty for the afforestation lands for plantations aged less than 10 years on some 7,000 hectares included under the JI project. The uncertainty of the cumulated C stock was ± 15% (for 95% confidence interval), while for the area the uncertainty was less than 1%. New estimate will be available in 2012 submission, after second monitoring of the JI project.

7.2.5. Category-specific QA/QC verification

Currently, there are two levels of QA/QC implemented for the LULUCF sector in the national GHG inventory.

Firstly, the QA/QC is ensured by the data providers. They apply official procedures in order to ensure and control the quality of data provided for the purpose of the national GHG inventory estimation.

Secondly, LULUCF GHG inventory compilers perform basic checks consisting in various procedures applied to avoid errors associated with different stages of data processing or calculation. A complete QA/QC plan must be prepared and presented in a future submission. Nevertheless, for the moment there are applied check and rules for quality assurance:

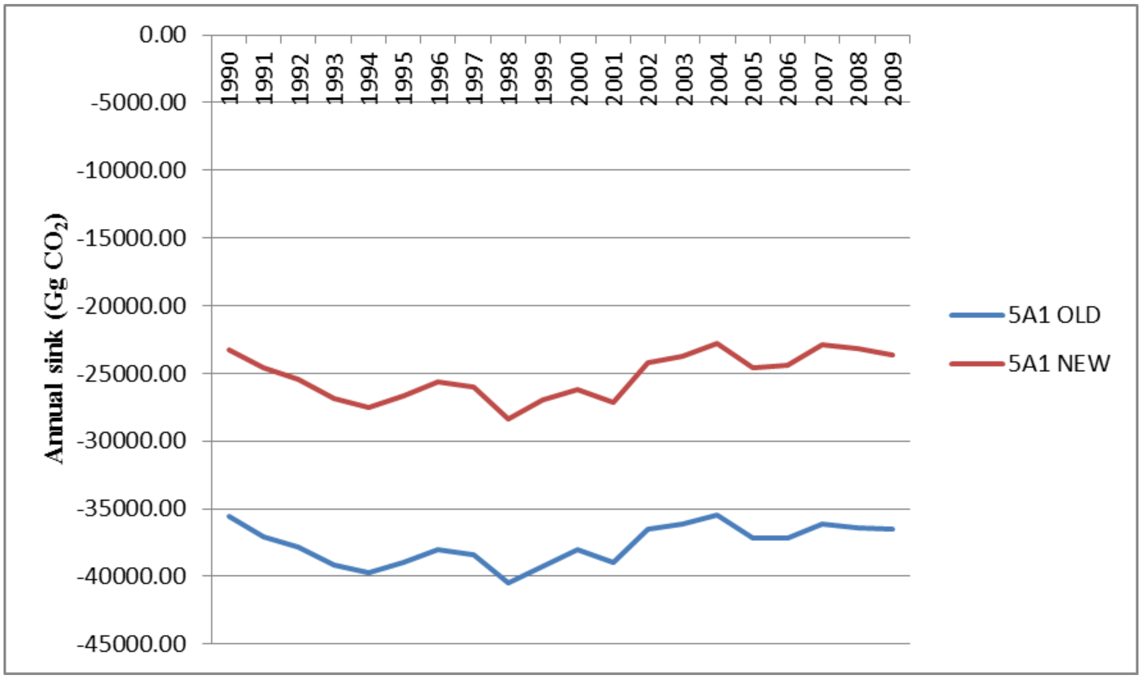
- Archiving of hard copies of the original data on the land categories (i.e. statistical reports). This makes it easier to access and control the inputs at any time.
- Procedures are established and followed step by step to avoid handling errors.
- Verification of land use matrix according the procedures mentioned in the section 0.
- Experts consultation for specific issues (i.e. suitability of ICP Forests data on soils; allocation of land among various categories).
- The project contractor on LULUCF sector (contract duration is till November 2011), namely Forest Research and Management Institute Bucharest, implements steps to ensure that the staff involved has gradually increasing understanding of the national GHG inventory requirements. This included short training sessions on the IPCC GPG for LULUCF 2003 guidelines and relevant UNFCCC decisions.
- Cross check and review of the NIR text.

So far, there is no performed any specific verification, neither for the inventory estimate nor for various parameters used in the inventory. Nevertheless, some scientific papers were issued recently on the sink in Romanian forests. Thorough verification procedures could be established in the future, while the reporting will move toward use of the NFI data (in 2013).

7.2.6. Category-specific recalculations, including changes made in response to the review process

In the current version of the national GHG inventory, the 2011 re-submission for the year 2009, there was a recalculation (Figure 7.3).

Figure 7.3 Recalculation of 5A1 sink under current and previous submission



Reasons for recalculation were:

- Development of a complete land use change matrix for 1989-2009. This resulted in reporting of all land use sub-categories, with 20 years transition period for lands under various conversions. Land use change matrix is able to provide both conversions among land categories and subcategories, and within the subcategories (among various types of land as provided by national statistics).
- The “forest vegetation outside the forest fund” was moved from the category 5A1 Forest remaining forest to 5C1 Grassland remaining grassland, under better implementation of national definitions on forest fund and forest vegetation, based on national legislation. By this change, the area of 5A1 diminished by some 6% compared to that previously reported. As well, the 5A1 sink diminished constantly over the time series by some 4%, but the trend remained unchanged.

- BEF was excluded from the calculation of annual growth for all forest species, because the Romania's yield table include the volume of the whole standing stock, respectively stem and branches, and the same situation is in the case of annual increment, which refers at stem and branches, too. This correction generated a reduction of the previously computed annual sink by some 25 %. The recalculation has no impact on the trend.
- The index "fraction of biomass residues" was excluded from the formula for calculating the loss of biomass, as far as annual harvest of wood reported by national statistics includes the entire wood standing volume. The effect of this correction led to additional decrease of the previously computed sink by some 10%. The recalculation has no impact on the trend.
- Values of root-to-shoot factor (R) were also adjusted to smaller IPCC default values, which are considered more realistic also based on some data from a national research study (Giurgiu, et al, 2004, Forest Mensuration Methods and Tables). The recalculation has no impact on the trend.

7.2.7. Category-specific planned improvements, including those in response to the review process

Despite the improvement brought by current version of 2011 re-submission (September 2011) due to land change matrix availability and various correction of parameters used for the estimation of emissions factors (C stock change factors), there is still a major bottleneck given by the outdated data and “NE” (not estimated) C pools changes, used in the estimation of current GHG inventory.

- The key change in meeting requirements of the reporting ***living biomass*** for the category “Forest Land remaining Forest Land" in the GHG inventory is constituted by the shift to the anticipated use of the expected NFI data once available. This is likely to happen with submission 2013. With the new data of annual increment the time series will be totally or partially recalculated, thus updated data will be used since 2008. Meanwhile, other parameters currently used can be updated (for example, the volume of standing timber, dead wood, etc.).
- The stock of C from ***dead wood*** (DW) from NFI data will be available for the years of the commitment period (2008-2012). Historically there is no quantitative data on dead organic

matter pool on Romanian forests, neither for litter nor for dead wood. For the entire time series the C stock change from dead wood has to be obtained by simulation based on the forest inventory data from 1984, as a workaround, and validated with NFI data. Currently, FRMI retrieves entire database of the inventory of forest fund 1984 (standing volume, annual growth, species composition and age structure) at country level, which in will be approach as an simulation exercise before the new NFI data will be available in 2013. A search of available empiric models for simulation, as well as a call for expertise and knowledge support is underway. Nevertheless, these depend on availability of resources. Estimating changes in this C pool, using simulation and new NFI data could be reported as early as 2013.

- Under missing of historical datasets, a similar approach, based on simulation, is expected for the stock of C from **litter** (LT) and changing the amount of C from the litter of the forest land and in the case of conversions from / to Forest Land. Upon the availability of resources, estimating of changes in C pool would follow same schedule with the dead wood pool estimation.
- To report change of C stocks of the organic matter in ***mineral soils*** (SOC), an assessment is further expected, mainly focusing on three approaches:
    i. Soil database of the forest management plans (FMP) combined with the NFI soil available data. The FMP database contains soil analysis associated to management activity, accumulated since 1960 on. Datasets are expected complete regarding the humus content, site and forest description parameters. Limitation could come from the particularity of sampling points which were randomly and non-repetitively located. In Romanian forest management planning system, the country national forest fund was several times completely “screened” in 10 (5) years period, so several time series since 1960 are available. The work assumes retrieval of datasets and definition of the statistical processing method. This work could provide preliminary results by the end of 2012, upon availability of funding.
    ii. Work already carried out by exploring ICP Forest datasets 1994 and 2004. Processing of ICP Forest datasets have shown an annual drop of C stock which is considered non credible under national circumstances (~0.5 tC/ha/yr for many type of soils). The problem seems to be related to the methodological differences in 1994 (humus on 30 cm depth measured by Kjeldahl) and 2004 (method involved elemental analyzer on 40 cm depth). Thus, another option would be to re-sample

the C content in the same known plots in 2012, having used a method consistent with the one in 2004. Such work could provide results by the end of 2012, upon availability of funding.

iii. A preliminary exercise of simulation of C stocks and changes with the increment data given by the 1984 forest fund inventory and validation with the results measured in the NFI (of all parameters of all C pools: biomass, dead wood, litter). Further on, once the actual increment data would be available by the NFI, final simulations would be run as to obtain the changes in these C polls. Empirical models are preferred for this. Later validation exercise would also involve the actual NFI data of C stocks in available pools (dead wood and organic matter in mineral soils). This work could provide preliminary results by the end of 2012 and final by end of 2013, upon availability of funding.

Table 7.11 Approach of the issues raised by the Report of the individual review of the annual submission of Romania submitted in 2010 (with additional reference to issues pointed in ARR 2009)

Nr. crt	Report paragraph	Identified issue	Current status of implementation
Sector overview			
1	106 (also highlighted in para 81, 82 of ARR 2009)	In 2008, net removals from the LULUCF sector amounted to 36,414.56 Gg CO_2 eq, offsetting 22.3 per cent of total emissions excluding the LULUCF sector. Since the base year (1989), net removals have increased by 12.3 per cent. The key driver for the rise in net removals is the reduction of losses in living biomass (from 6,523.46 to 5,888.39 Gg C from 1989 to 2008) in forest land remaining forest land. Within the sector, 100.0 per cent of the removals were from forest land remaining forest land, since this is the only category for which the Party provides quantitative estimates of emissions and removals. Romania has not improved the inventory of the LULUCF sector since its previous submission and emissions and removals are reported as “NA” or “NE”, except for CO_2 removals from carbon stock changes in living biomass in forest land	Current resubmission for 2010 recalculate the 5A sink based on official available data, land use-change matrix and removing errors made by using inappropriate BEFs and other factors used in the calculation.

Nr. crt	Report paragraph	Identified issue	Current status of implementation
		remaining forest land and CO_2, CH_4 and N_2O emissions from biomass burning (wildfires). The ERT concludes that the inventory of the LULUCF sector is very incomplete. Romania justifies the absence of emission estimates for the other categories as due to the lack of availability of relevant data.	
2	107 (82/ ARR 2009)	In addition, Romania reports areas under land-use change – grassland converted to forest land (339 ha), forest land converted to cropland (4,339 ha), cropland converted to settlements (6,694 ha), forest land converted to settlements (6 ha), forest land converted to other land (8,294 ha), cropland converted to other land (4,306 ha) and wetlands converted to other land (600 ha) – but does not provide estimates of removals or sinks.	Estimates are provided in the current submission, for land conversions. Assumptions, methodology and datasets used are described in the relevant sub-chapters of the NIR
3	108 (82/ ARR2009)	The NIR does not provide a land-use matrix for the consistent representation of lands, and it only mentions that a land-use change matrix was built for determining the area of forest land remaining forest land and afforested and deforested areas, based on expert judgment. Responding to questions raised by the ERT during the review, the Party provided a land-use matrix for all years since 1989. The ERT concluded that Romania is using the IPCC approach 2, but the Party did not provide information on the methods and sources used to construct these matrices. The ERT considers that the use of expert judgment in this case is not appropriate or consistent with the IPCC good practice guidance for LULUCF, and that the Party needs to use other methodologies to construct the matrices, such as surveys, sampling or remote sensing. The ERT concluded that the problems with data collection on land use and land-use change reflect problems regarding the ability of the national system to provide the necessary information for the inventory of the LULUCF sector, and these problems also impact on the quality of reporting of the additional information on Article 3, paragraphs 3 and 4, of the Kyoto Protocol (see para. 145 below), in particular paragraph 6 of the	Land use change matrix principle and data is shown under the section 0. Full land use matrix on 1989-2009 is presented in the Annex 8.3. Current land data is considered robust to respond the UNFCCC requirements.

Nr. crt	Report paragraph	Identified issue	Current status of implementation
		annex to decision 15/CMP.1. The ERT strongly recommends that the Party significantly improve the reporting of land areas in its next annual submission and provide estimates of emissions and removals for the missing categories and pools.	
4	109	The QC procedures for the LULUCF sector are briefly explained in the NIR; however, the NIR does not provide sufficient information on the QC process to enable the ERT to verify how this was done and its results. To improve transparency, the ERT recommends that Romania include detailed information on QC procedures in its next and future annual submissions.	Current QA/QC procedure implemented for LULUCF sector is described under section 7.2.5.
5	110	The ERT also notes that no significant improvements have been introduced in the 2010 submission for the LULUCF sector and that most of the recommendations made in several previous reviews reports have not been followed. The ERT strongly recommends that Romania elaborate and implement improvement plans for this sector as a matter of urgency.	Major issue taken into consideration with current submission is development of land use change matrix. Also, an improvement plan for this sector is provided in the section 7.2.6 above.
		Key categories *Forest land remaining forest land – CO_2*	
	111 (85/ARR 2009)	Romania uses the IPCC method 1 and a mixture of tier 1 and tier 2 methodologies to estimate gains and losses in carbon stock changes from living biomass. Gains in carbon stock changes in living biomass were estimated using country-specific data on the average annual net increment in volume, Iv (m3/ha/year), for commercial wood. The Party also applies country-specific wood densities, which are higher than the IPCC default values. However, Romania uses constant values for Iv and wood densities through the whole period 1989–2008 which, for the main species, were derived from the national forest inventory published in 1985. The ERT considers that values established from measurements taken 20 years ago may not be appropriate for the entire time series, taking into consideration the possible changes in the	The 5A1 removal was recalculated by removing parameters inappropriately used before, which led to the overestimation of annual sink. Nevertheless, data is still outdated, as new NFI data will be delivered only in 2013. An improvement plan is shown under section 7.2.6 above.

Nr. crt	Report paragraph	Identified issue	Current status of implementation
		age/class distribution in the forest of Romania. Given that the Party informed the ERT during the review that it plans to have data from a new national forest inventory in 2011; the ERT recommends that the Party use this data to improve the estimates in its 2012 annual submission. The ERT also recommends that Romania use remote-sensing data and geographic information tools to make better use of the information collected.	
6	112	Biomass expansion factors (BEFs) and root-to-shoot (R) values were based, respectively, on tables 3A.1.10 and 3A.1.8 of the IPCC good practice guidance for LULUCF. From these tables, the Party decided to use intermediate values for BEFs. The ERT considers that, given that Romanian forests are approximate mature forests, it would have been more appropriate to use the values in the lower limit of the interval the range. This simple option may reduce the estimates of removals by 14.6 per cent. In addition, R values were chosen to be around the average IPCC default ranges, but it is not transparent in the NIR what assumptions were used to select the values from among the several aboveground classes presented in table 3A.1.8. The ERT recommends that the Party revise the BEF and R values and improve the transparency of reporting by providing information on the assumptions that it uses.	In the previous calculation of 5A1, BEF1 and BEF2 were both incorrectly involved in the calculation (so they were removed in the current submission). Explanations are provided under section 7.2.3.1.1. R values were also reviewed to smaller values. Wood density data were not changed, considering country specific data priority over the default data and lacking arguments for lower density under similar forest structure and management as before.
7	113	To estimate losses from carbon stock, Romania uses many expert judgments to overcome problems regarding the availability of AD (e.g. that the annual extracted volume includes branches and leaves and the consideration of the BEF is not necessary). The NIR is not transparent because it does not describe in detail the source of harvesting data or provide references to the information used. The ERT reiterates the recommendation made in	Construction of harvest statistics procedure is described, together with the reason why the BEF2 has not too been applied anymore (see section 7.2.3.1.1.

Nr. crt	Report paragraph	Identified issue	Current status of implementation
		the previous review report21 that Romania provides detailed information on the use of expert judgments (e.g. the number of experts consulted, institutions) and on the planned improvements to obtain more objective information based on monitoring data or scientific studies. In addition, information on losses of carbon is not provided in a disaggregated form for commercial felling and use for fuel wood. The ERT recommends that the Party disaggregate these figures to improve transparency and to allow the estimation of non-CO_2 emissions due to the use of fuel wood.	
8	114 (84/ARR 2009)	The ERT identified inconsistent reporting for the pools dead organic matter and soil organic carbon: Romania reports emissions/removals as “NE” in CRF table 5.A, but the NIR states that changes in these pools are assumed to be zero, following the IPCC tier 1 approach. Romania did not provide transparent and verifiable information to justify that the use of the tier 1 methodology is appropriate (i.e. that the pools are stable) and, therefore, the ERT encourages the Party to make all necessary improvements in order to report this key category using a tier 2 or tier 3 methodology and make the best use of data from its updated national forestry inventory.	These pools are still reported as “NE” in 2010 resubmission. The effort to explore and utilize existing databases is ongoing, as described at the first part of current section (7.2.7).

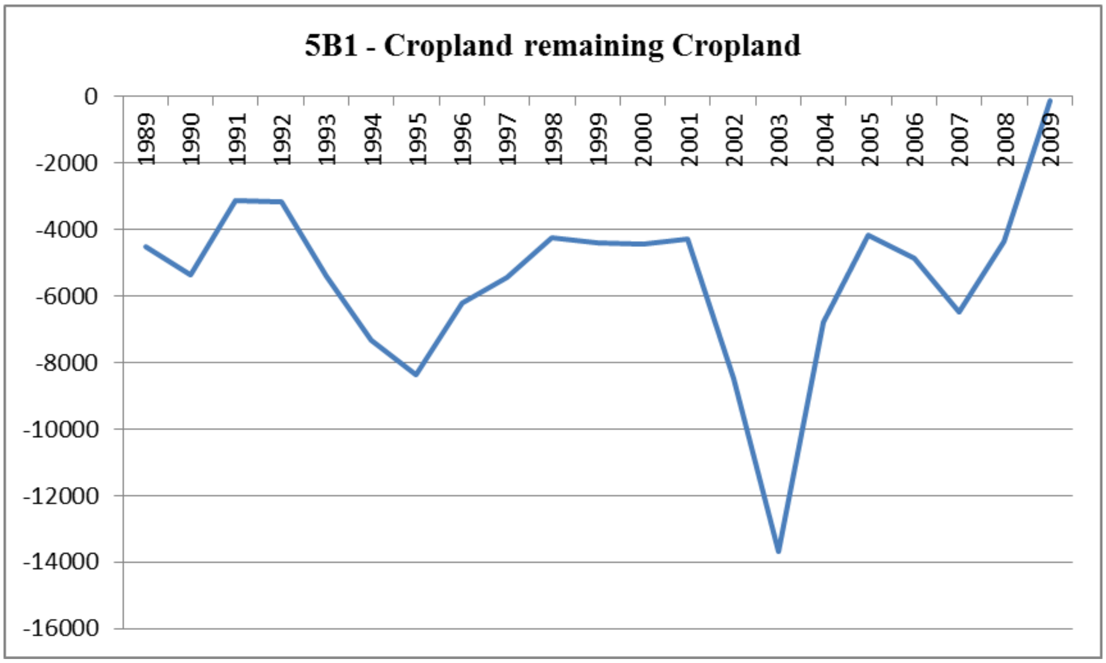
7.3. Cropland (5.B)

7.3.1. Description

Area occupied by Cropland represents about 42% of the total country territory, slightly decreasing from 1990. Of the total area occupied, 62% is arable land, 20% is orchards and 18% is land covered with vineyards. In 2009 there were some 9843 Kha of cropland, including 1.6% lands in conversion from other uses. Conversion category also includes the lands subject to revegetation activities eligible for reporting under the Kyoto Protocol. They occupy a very small area (less than 0.01% of total area of land included in this category).

While area of 5B1 was steadily decreasing since the base year, the annual CO_2 removal generally also decreases (Figure 7.4).

Figure 7.4 Annual CO_2 sink in 5B1



Annual variability of the sink is generated by the net change of total area occupied by permanent crops (vineyard, orchards) and the rate of the annual conversion to other land uses (i.e. to non-woody crops). In 2003 there is very small conversion from vineyard or orchards to non woody crops, which makes the sink in existing crops higher.

7.3.2. Information on approaches used for representing land areas and on land-use databases used for the inventory preparation

The definition of this land category and the types of lands included in here are reported in section 7.1.1.

7.3.3. Methodological issues

Activity data used to calculate GHG emissions for the lands included in this category is provided by land use change matrix, for both 5B1 and 5B2 subcategories. Estimation of carbon stock changes corresponds to Tier 1, estimating annual rates of growth and loss for national level data on the major type of crops. Cropland remaining Cropland is a key category in the national GHG inventory.

7.3.3.1. *Change of C stock in living biomass*

Estimation of C stocks changes was made individually on each of the three different types of land included in the Cropland category:

- *Lands with woody perennial crops (vineyards and orchards).* Woody perennial species occupied about 38% of area of the Cropland. Estimation of the above-ground biomass C stock change, the IPCC default emission factors were used (Table 3.3.2 from the IPCC GPG LULUCF 2003), as following: annual biomass accumulation rate of 2.1 tC ha^{-1} yr^{-1} and a C stock in biomass loss of 63 tC ha. There is no biomass or growth data available at national level.
- *Land which are subject to revegetation*. These lands are included in the category 5B1, but not highlighted as a specific land use in the land use change matrix (under scattered and non-identifiable locations). Calculation of C stocks changes in all pools is identical with that for artificial afforestation reported in the subcategory 5A2 (see sub-chapter 7.2.3.2), as they differ only by land use category on which they occur.
- *Land in conversion to agricultural land.* There is no conversion of Forest Land to Cropland. For the conversions of non-forest lands to croplands, C stock changes in biomass are not calculated as no biomass data is available and the change of the living biomass stocks were considered negligible. Such C stock changes were reported as NO in the CRF tables.

For the estimation of C stock changes on lands with woody perennial crops (vineyards and orchards) the following equation was applied:

$C_{stock\ change} = C_{stock\ increase} - C_{stock\ decrease}$

$C_{stock\ increase} = A_{CLp} * C_{stock\ increment}$

where:

- A_{CLp} – area of permanent cropland in a year [ha];
- $C_{stock\ increment}$ – annual growth of carbon stock in the living biomass [tC ha^{-1} $year^{-1}$], as default value from IPCC GPG LULUCF 2003.

$C_{stock\ decrease} = (A_{CLp\ current\ year} - A_{CLp\ previous\ year}) * C_{standing\ C\ stock}$

where:

- $A_{CLp\ current\ year}$ – area of permanent cropland in the current year [ha];
- $A_{CLp\ previous\ year}$ – area of permanent cropland in the previous year [ha];
- $C_{standing\ C\ stock}$ – default value for standing carbon stock of woody biomass in permanent croplands [tC ha^{-1}], as default value from IPCC GPG LULUCF 2003.

7.3.3.2. *Change of C stock in dead organic matter and soil*

Carbon stock change in mineral soils on land category 5B1 is not yet estimated, but planned to be done with the following submission.

For the category 5B2, there are available the average values of C stocks in soils (Table 7.12), as reference values nationwide on major land use categories. Under conversion of land use, the change in the soil C stocks is considered occurring linearly over a transition period of 20 years. For example, for land conversion from Forest Land to Grassland, there is an annual decrease in C stock of 1.3 tC $yr^{-1}ha^{-1}$. Also, there is a decrease is 1.9 tC $yr^{-1}ha^{-1}$ for the conversion to Cropland.

In conversions from cropland to grassland and hayfields, there is an increase of 0.6 t tC $yr^{-1}ha^{-1}$. For conversions to and from "Other Lands" and artificial areas there are not calculated emissions (reference C stock change values are not available for “Other lands” and Wetlands).

Table 7.12 Reference C stocks in soil in relation to land use

Category of land-use	The stock of organic C (tC/ha)	References
Forest Land (5A)	76	Dincă L (personal communication, 2011). Estimate based on C last cycle of forest management plan database.
Cropland (5B)	38	Value for HAC soils (temperate cold and dry climate) from Table 3.3.4 of the IPCC GPG 2003. For "long term cultivated" for temperate areas. Factors obtained by applying the values are: F_{LU}= 0.82; F_{MG}= 1.0; F_{I}=0.92
Grassland (5C), Wetlands (5D)	50	IPCC reference value in 2003 for the stock of C in soil under natural vegetation for the HAC soils (temperate cold and dry climate)

Organic soil surface is negligible in Romania, are therefore emissions are reported as NO, but the soil database ("Monitoring soil quality in the Romania", ICPA, 2006) is searched for further documentation.

Change of C stock of the dead organic mass is estimated for the areas eligible for re-vegetation activities under the Kyoto Protocol.

7.3.4. Uncertainties and time series consistency

Data and information currently available does not allow an assessment of uncertainties in estimating emissions for this category of land. The estimation of uncertainties will be performed with a future reporting, to the extent that more documented and country specific data will be available.

7.3.5. Category-specific QA/QC and verification

General QA/QC rules are mentioned in the section7.2.5 subcategory, under Forest Land (5.A).

7.3.6. Category-specific recalculations, including changes made in response to the review process

Starting with this submission a land use change matrix is available, which led to re-calculation of all activity data and emission factors. GHG emissions/removals are practically estimated for this category for the first time.

7.3.7. Category-specific planned improvements, including those in response to the review process

For land remaining in the same category and lands under conversion to Cropland, existing data and information would allow a combined approach of country specific data (namely the C stock in soils) with default IPCC data (C stock change adjustment factors). Future improvement of estimation of C stock changes in soils organic matter is endeavored by exploration of the database related to "Monitoring soil quality in the Romania" (ICPA, 2006) based on 2000-2002 reference period. Despite currently available aggregated data from this database (used above inn Table 7.11), the nationwide reference C stocks on soil types and land categories is considered highly uncertain, without lack of involvement of adequate expertise from agricultural field. Adequate reporting in the future is anyway depending on the involvement of right expertise and upon availability of financial resources.

Table 7.13 **Implementation of the issues identified in the report of the individual review of the annual submission of Romania submitted in 2010**

Nr. crt	Report paragraph	Identified issue	Current status of implementation
		Sector overview	
1	107	Given that cropland and grassland together represent 61.7 per cent of the country’s area, and that no estimates of potential carbon fluxes from	GHG emissions/ removal from CL and GL are

Nr. crt	Report paragraph	Identified issue	Current status of implementation
		these lands are reported, the ERT considers that net removals may be overestimated.	estimated, including the improvement plan for next years.
2	107	In addition, Romania reports areas under land-use change – grassland converted to forest land (339 ha), forest land converted to cropland (4,339 ha), cropland converted to settlements (6,694 ha), forest land converted to settlements (6 ha), forest land converted to other land (8,294 ha), cropland converted to other land (4,306 ha) and wetlands converted to other land (600 ha) – but does not provide estimates of removals or sinks.	Estimates are reported for several of mentioned land sub-categories, they are also subject of future improvement, as showed under each land category section.
3	82/2009	The total reported area of the country is 23,839.10 kha, consisting of 28.3 per cent forest land, 41.3 per cent cropland, 20.4 per cent grassland, 3.6 per cent wetlands, 4.5 per cent settlements and 1.9 per cent other land. The total land area fluctuates slightly over the reporting period. The data on land use were derived from different statistical information using expert judgment. Romania has reported for all land-use categories the area remaining and the area converted to that category. However, except for forest land remaining forest land, emissions and removals were not estimated for any categories, which have instead been reported as “NA” or “NE”. Romania explained, during the review, that the data needed to estimate these emissions and removals were not available. The ERT concluded that the Party’s inventory for the LULUCF sector is incomplete in terms of emissions by sources and removals by sinks. The ERT recommends that Romania intensify its efforts to improve the completeness of its inventory for the LULUCF sector. The ERT reiterates the recommendation made in previous review reports regarding the estimation of carbon removals/emissions from cropland and grassland. The ERT recommends that Romania resolve this problem and report thereon in its next annual submission. The ERT also recommends that Romania disaggregate cropland and grassland into different land-use subcategories (e.g. perennial crops, annual crops, set-aside land,	Data is derived from unique source of data: the national statistics, as explained in the section 7.1.1. GHG estimates are reported for several of mentioned land sub-categories, they are also subject of future improvement, as showed under each land category section.

Nr. crt	Report paragraph	Identified issue	Current status of implementation
		etc.) and management systems (e.g. unique combinations of different practices). The ERT further recommends that Romania apply carbon stock parameters at a disaggregated level and explore potential sources of information for carrying out this request, such as relevant information from neighboring countries or any available data sources (e.g. the Revised 1996 IPCC Guidelines or the IPCC good practice guidance for LULUCF), or develop a permanent plot sample in order to measure biomass change in and biomass stock of a number of dominant perennial crops. The ERT encourages the Party to describe the methods used and its application of data in a transparent manner.	

7.4. Grassland (5.C)

7.4.1. Description

Grassland area is approximately 5,000 kha, occupying 22% of the total country area. Out of these, 63% are pastures, 28% hayfields and 8% forest vegetation outside the forest fund. The difference of 1% is represented by the lands under conversion among the lands included in this category. According to the national legislation, “forest vegetation outside the forest fund is not part of the national forest fund”, is being unmanaged land. After 1991, by applying the laws on the rights of property restitution, many lands have been abandoned (pastures, hayfields, orchards, vineyards, croplands). In many cases, on those lands, forest vegetation appeared by spontaneous regeneration. They cannot be mistaken with forest funds areas that are subject to a rigorous regime (e.g., are subject to forest management planning; strict regulations on land entries and leaving from the forest fund; mapped and land-marked boundaries in the field).

7.4.2. Information on approaches used for representing land areas and on land-use databases used for the inventory preparation

The definition of this land category and the types of lands included in here are reported in section 0.

7.4.3. Methodological issues

Activity data used to calculate GHG emissions for the land included in the Grassland category is provided by the land use change matrix, both for the 5C1 and 5C2 category. Estimation of carbon stock change in the Grassland category corresponds to Tier 1.

7.4.3.1. *Change of C stock in living biomass*

Estimate of the change of C stocks vary by type of land included in this land category:

i. *Land remaining under the same use.* In the case of grasslands where there are no changes in usage it was considered that there are no changes in the C stocks of all pools.

ii. *Land in conversion to grassland.* There is no conversion of forest land to grassland. For conversions from other, non-forest lands, the changes in the biomass C stocks are considered negligible, thus reported as NO.

iii. For "*forest vegetation outside the forest fund*" at this time there is only updated information on the total area occupied, as reported by NIS, while information about the characteristics of forest vegetation (e.g. species composition, standing wood volume, annual growth in volume, age structure, etc. .) is not available. This deficiency will be settled once the data from NFI will be available, and included in a future submission of the GHG inventory.

7.4.3.2. *Change of C stock in dead organic matter and soil*

For i) land remaining in the same land use and ii) land in conversion to Grassland, C stock changes are not yet estimated; these are expected to be calculated at the earliest in the 2013 version of the national GHG inventory, according to the improvement plan mentioned for this land category.

For iii) "forest vegetation outside the forest fund" these estimates may be available only in 2013 after the completion of NFI, which provides information on all land covered by forest vegetation in Romania.

7.4.4. Uncertainties and time-series consistency

Data and information currently available does not allow an assessment of uncertainties in estimating emissions for this category of land. The estimation of uncertainties will be performed with a future reporting, to the extent that will be available data. Nevertheless, the area of "forest vegetation outside the forest fund" as reported by the NIS is considered as highly uncertain, but likely to be settled with NFI data in the near future.

7.4.5. Category-specific QA/QC and verification

General QA/QC rules are mentioned in the 7.2.5 subcategory, under Forest Land (5.A).

7.4.6. Category-specific recalculations, including changes made in response to the review process

Starting with this submission, a land use change matrix is available, which led to re-calculation of activity data for all land subcategories. With this submission of the national GHG inventory, for first time, the emissions on these land subcategories are estimated.

7.4.7. Category-specific planned improvements, including those in response to the review process

Improvements would focus on soil organic matter, as in Cropland (see Chapter 7.3.7 above). For the "forest vegetation outside the forest fund" there is additional option to generate time series data exactly in the same manner as for forest land (5A1).

7.5. Wetlands (5.D)

7.5.1. Description

Wetlands area is about 3% of total land area. Absolute area is about 830 Kha, out of which 17% represents lands under conversion to wetlands during past 20 years. In Romania, peat bogs occupy very small area (as well as peat extraction activities). Also, in the last 20 years there was not reported drainage or continuous flooding activities of any category of land use.

7.5.2. Information on approaches used for representing land areas and on land-use databases used for the inventory preparation

The definition of this land category and the types of lands included in here are reported under the section 0.

7.5.3. Methodological issues

7.5.3.1. *Changes of C stock in living biomass and dead organic matter and in soils*

Despite the existence of data concerning areas of land included in the two land subcategories (5D1 and 5D2), C stock changes associated with 5D1 are not estimated in the absence of appropriate methodologies in IPCC GPG 2003. According to the land use change matrix, there were only conversions from "Grassland" and "Other Lands". In these conversions, emissions/removal from biomass and dead organic matter are considered negligible. C stock change in mineral soils will be calculated in the following submission, according to the improvement plan mentioned for this land category.

7.5.4. Uncertainties and time-series consistency

Data and information currently available does not allow an assessment of uncertainties in estimating emissions for this category of land. The estimation of uncertainties will be performed with a future reporting, to the extent that will be available data.

7.5.5. Category-specific QA/QC and verification

General QA/QC rules are mentioned in the 7.2.5 subcategory, under Forest Land (5.A).

7.5.6. Category-specific recalculations, including changes made in response to the review process

Starting with this submission a land use change matrix is available, which led to re-calculation of all activity data. With this submission of the national GHG inventory, for first time, the emissions on these land subcategories are estimated.

7.5.7. Category-specific planned improvements, including those in response to the review process

Calculation of emissions from conversion to wetlands will hopefully be presented in a future version of the GHG inventory, based on national data available in the database of the project "Monitoring soil quality in Romania" (ICPA, 2006), considering the IPCC methodologies available.

Report of the individual review of the annual submission of Romania submitted in 2010

Nr. crt	Report paragraph	Identified issue	Current status of implementation
Sector overview			
1	107	In addition, Romania reports areas under land-use change – grassland converted to forest land (339 ha), forest land converted to cropland (4,339 ha), cropland converted to settlements (6,694 ha), forest land converted to settlements (6 ha), forest land converted to other land (8,294 ha), cropland converted to other land (4,306 ha) and wetlands converted to other land (600 ha) – but does not provide estimates of removals or sinks.	Activity data are provided by a consistent land use change matrix. For land subcategories which are not key categories Tier 1 is assumed for biomass, while for SOM changes estimates are provided or are under preparation as stipulated in the development plan above.

7.6. Settlements (5.E)

7.6.1. Description

Area of settlements is about 5% of the total land area, respectively 1100 kha. Area in conversion to "Settlements" during the last 20 years is about 9% of the total area of this category. In the 1990-2009 there are reported conversions to "Settlements" from almost all land categories.

7.6.2. Information on approaches used for representing land areas and on land-use databases used for the inventory preparation

The definition of this land category and the types of lands included here are reported under the section 0.

7.6.3. Methodological issues

7.6.3.1. *Changes of C stock in living biomass and dead organic matter and in soils*

GHG emissions associated with the 5E1 are not estimated in the absence of an appropriate methodology in IPCC GPG LULUCF 2003.

For conversions to settlements (CRF subcategory 5E2) in case of non-forest lands, the CO_2 emissions from biomass and dead organic matter were considered negligible. The change in C stocks of soil is not yet calculated as far as country specific data is missing and IPCC GPG LULUCF 2003 does not provide a methodology for that. Land conversion to Settlements is a key category based on trend assessment.

In the case of conversions from forest land it was considered that the emission occurs in the year of conversion. C stock change in biomass was estimated based on national average standing stock wood volume per hectare. According to the 1984 Forest Fund Inventory, this value is 218 m^3ha^{-1}. Estimation also considered an annual increment weighted average of the wood density of 520 kg/m3, as nationwide value, and the default C fraction in dry wood. R, root-to-shoot value was 1.26, also obtained as a weighted average. No BEF was applied as the reported volume refers to aboveground standing stock. Consequently, a country specific value of 71.42 $tCha^{-1}$ of the standing stock in living biomass resulted.

Emissions from DOM were also estimated, but only lying dead wood C pool was considered as there is available some preliminary data from NFI (and there is no other data in the country). Further on, DW only included lying dead wood, a national average of 0.63 m^3ha^{-1} or 0.12tC ha^{-1}. Dead wood density was considered 400kg/m3. An average standing dead wood stock is also estimated from NFI, with the national average of 3.13 m^3ha^{-1} or 0.62 tC ha^{-1}. Standing dead wood is not included in this pool because it is harvested, and it is reported in the regular harvest statistics.

Emissions from the change of C stocks in the mineral soils were not calculated, as far as there is no an IPCC methodology provided and country specific data is missing.

7.6.4. Uncertainties and time-series consistency

Data and information currently available does not allow an assessment of uncertainties in estimating emissions for this category of land. The estimation of uncertainties will be performed with a future reporting, to the extent that will be available data.

7.6.5. Category-specific QA/QC and verification

General QA/QC rules are mentioned in the 7.2.5 subcategory, under Forest Land (5.A).

7.6.6. Category-specific recalculations, including changes made in response to the review process

Starting with this submission a land use change matrix is available, which led to re-calculation of all activity data. With this submission of the national GHG inventory, for first time, the emissions on these land subcategories are estimated.

7.6.7. Category-specific planned improvements, including those in response to the review process

Calculation of corresponding emissions from lands in conversion to settlements will be presented in a future version of the GHG inventory, based on national data available in the database of the project "Monitoring soil quality in Romania" (ICPA 2006), considering the IPCC methodologies available (upon resources availability). The land use change matrix is subject to continuous verification and improvement, and the estimates of the activity data may suffer minor corrections in the future (for land use conversions to settlements).

7.7. Other land (5.F)

7.7.1. Description

Area occupied by "Other Lands" is about 2% of the total land area, 475 kha respectively. Out of this, 62% are areas under conversion to Other land. This category was used as a "buffer" in the matrix of land use change (for relocation of areas among categories, so total area of land remaining in the same category and under conversion always equals the net values reported by the national statistics at the end of each calendar year). Thus, one of the features is the conversion to "Other Lands" of some 50kha of forest land for a period of 20 years. This cannot be considered "definitive leave from the forest fund" respectively legal forest “leaving” (associated with "deforestation" under the Kyoto Protocol), as not being resulted from legal proceedings (which are strictly regulated). Explaining the transition of the area concerned to "Other Lands" is, first, by the continuous erosion of the Danube banks on the Romanian side (the forest fund stretches along the Danube on a length of some 1000 km) and inland rivers, as well as some decrease in the forest fund area over planning cycle because of changing the cartographical base used in the determination of the area of forest parcels in subsequent planning.

7.7.2. Information on approaches used for representing land areas and on land-use databases used for the inventory preparation

The definition of this land category and the types of lands included in here are reported under section 0.

7.7.3. Methodological issues

7.7.3.1. *Changes of C stock in living biomass and dead organic matter and in soils*

For category 5F1, GPG LULUCF IPCC does not recommend a method for calculating GHG emissions.

There were not calculated emissions from C stock change in biomass in conversions of non-forest lands.

In case of Forest Land conversion to Other Land (5F2), CO_2 emissions from living biomass removal were estimated according to the national average standing wood volume per hectare, considering that the emission occurs in the year of conversion. C stock changes in DOM pool were also reported. The parameters used and computation assumptions are reported in the section covering the category 5E Settlements. Soils C stock changes are not yet estimated (reported as NE in the CRF).

7.7.4. Uncertainties and time-series consistency

Data and information currently available does not allow an assessment of uncertainties in estimating emissions for this category of land. The estimation of uncertainties will be performed in a future reporting, if the data will be available.

7.7.5. Category-specific QA/QC and verification

General QA/QC rules are mentioned in the 7.2.5 subcategory, under Forest Land (5.A).

7.7.6. Category-specific recalculations, including changes made in response to the review process

Starting with this submission a land use change matrix is available, which led to re-calculation of all activity data. With this submission of the national GHG inventory, for first time, the emissions on these land subcategories are estimated.

7.7.7. Category-specific planned improvements, including those in response to the review process

The land use change matrix is subject to continuous verification and improvement, and ways to control and verify the parameters specific to this land category used are extremely low. Further exploration of national soils databases is necessary in order to improve reporting on soils.

7.8. GHG emission from sources

7.8.1. Direct N_2O emissions from N fertilization of Forest Land and Other (CRF Table 5(I))

Fertilization of forest land is extremely limited (i.e. rarely occurs in forest nurseries) under very extensive forest management practices in the country. In any case, although it may occasionally occur, the statistics on fertilizer amount applied is not breakdown on land uses. Thus related emissions are assumed as reported under Chapter 4 Agriculture of the national GHG inventory. Thus, these emissions are reported as “IE” in CRF Table 5(I).

7.8.2. Non-CO_2 emissions from drainage of soils and wetlands (CRF Table 5(II))

Since 1989 there is no reported any activity of drainage of lands in Romania. Thus, such emissions are reported as “NO” in the national GHG inventory.

7.8.3. N_2O emissions from disturbance associated with land-use conversion to cropland (CRF Table 5(III))

Land use change from forestland to cropland is not legally allowed, and does not occur in Romania. Nevertheless, there are conversions from grassland and wetlands, which summed some 90kha since 1989. Such conversions lead to soil perturbation which associates with N_2O emissions by humus decomposition. According the land use matrix, from total cumulated area under conversion to arable land, in 2009, 53% were conversions from grasslands, 38 % from wetlands and 10 % from other land (they are all reported under 5B2). N_2O emissions are estimated assuming 20 years transition period. Activity data results from the land use change matrix. The amount of soil C mineralized (600 kgC/yr) is a country specific value. Calculation relies on equation 3.3.14 din IPCC GPG 2003 and it is based on default factors: N released by net mineralization (112.5 kg N $yr^{-1}ha^{-1}$), a default C/N ratio (15) and IPCC N_2O Emission factor (0.0125 kgN_2O/ 1kg N).

7.8.4. CO_2 emissions from agricultural lime application (CRF Table 5(IV))

Since 1990 there is not reported any activity of liming of lands in Romania.

7.8.5. Biomass Burning (CRF Table 5(V))

Controlled biomass burning is not allowed in Romania, while the wildfire frequency is very limited. Nevertheless, occasionally it is practiced illegally on arable or grass lands.

For forestland, the area annually affected by fires is reported in forest statistics. Characteristically, the forest fires consist in ground floor dead mass burning (litter and lying dead wood), and in extremely few cases of the stand crown fires (in average 2 % of annually affected area). As far as the wood is not qualitatively affected, it is harvested and reported in the annual wood harvest statistics. From all these reasons, CO_2, N_2O and CH_4 are all reported in CRF Table 5(V). Annually affected area is reported by National Forest Administration ROMSILVA (Table

7.14), which administrates only part of national forest fund area. For the rest of forest lands there is no activity data available, but it is likely to be small.

Table 7.14 Forest fires area

Year	**Total affected area (ha)**
1989	93
1990	444
1991	277
1992	729
1993	518
1994	312
1995	208
1996	227
1997	68
1998	137
1999	379
2000	3607
2001	1020
2002	3590
2003	762
2004	124
2005	212
2006	946
2007	2949
2008	843
2009	974
Average area	915

GHG emissions from forest fires are computed based on Eq. 3.2.19 of the IPCC GPG 2003.

$\mathbf{L_{forest\ fires} = S_{forest\ fires} \times M_f}$, where:

$L_{forest\ fires}$ = total amount of C annually emitted (tC yr^{-1});

$S_{forest\ fires}$ = annually affected area (ha yr^{-1});

M_f = amount of C in „dead wood lying on the soil surface" [MgC ha^{-1}].

This is computed from the nationally average dead wood volume, preliminarily available from the NFI. Conversion from dead wood volume to dead mass was done assuming 400 kg/m^3

(same input data as for the estimation of DOM related emissions in land converted to settlements 5E2). Carbon content was 0.5 according GPG LULUCF 2003.

It was also assumed that entire available dead wood was burnt in the fires. Regarding the litter there is no available quantitative data for the moment, so the contribution of this C pool to forest fires emissions is not yet estimated. It was also assumed that there are no understory emissions. They will be taken into account once the simulation of all C pools would be available (see the improvements expected under 5A).

For the calculation of absolute CO_2 and non-CO_2 emissions from forest fires, IPCC default factors are used in the formulas 3.2.19 of IPCC GPG 2003.

Emission of CO_2 [Gg yr^{-1}] = (C emitted) [tC yr^{-1}] x (44/12)/1000,
Emission of CH_4 [Gg yr^{-1}] = (C emitted) [tC yr^{-1}] x (emission ratio) x (16/12)/1000,
Emission of CO [Gg yr^{-1}] = (C emitted) [tC yr^{-1}] x (emission ratio) x (28/12)/1000,
Emission of N_2O [Gg yr^{-1}] = (C emitted) [tC yr^{-1}] x (N/C ratio) x (emission ratio) x (44/28)/1000,
Emission of NOx [Gg yr^{-1}] = (C emitted) x [N/C ratio] x (emission ratio) x (46/14)/1000,

where:

- (C emitted) = $L_{forest\ fires}$, respectively total amount of C annual emitted (tC/year),
- N/C ratio = ratio of nitrogen/carbon in the burnt dead mass,
- (emission ratio) = default values of direct and indirect GHG emission factors from forest fires. According Table 3A.1.15 of IPCC GPG 2003 these values are: CH_4 – 0.012; CO – 0.06; N_2O – 0.007 and NOx – 0.121.

7.8.6. Category-specific planned improvements, including those in response to the review process

Effort to improve the data is endeavored, but linked to the improvements under other land categories (i.e. 5A).

Table 7.15 **Approach of the issues raised by the Report of the individual review of the annual submission of Romania submitted in 2010 (with additional reference to issues pointed in ARR 2009)**

Nr. crt	Report paragraph	Identified issue	Current status of implementation
Non-key categories *Forest Land – CH_4 and N_20*			
1	115 (86/ARR 2009)	To estimate emissions from biomass burning, the Party assumed that only biomass on the forest floor is burnt during a wildfire (i.e. about 6,755 kg C/ha). This assumption and the value or the parameters used to derive this value are based on expert judgment, but the information in the NIR is not sufficient to assess how the value was established. The ERT recommends that Romania provide additional documentation in the NIR, including references to literature, to support the assumptions used in the expert judgment in its next annual submission.	Reference is available and the assumption for C stock change factor in DOM is presented in the section 7.2. Further on, the data availability will be increased with NFI data on lying dead wood (DW), while litter data is not yet available. The effort to completely estimate litter pool is described under the section 7.2.7.

8. WASTE (CRF SECTOR 6)

8.1 Overview of the sector

This chapter provides information on the estimation of the greenhouse gas emissions from the Waste sector.

The following source categories are quantified and reported:

- CH_4 emissions from Solid Waste Disposal on Land;
- CH_4 and N_2O emissions from Wastewater Handling;
- CO_2 emissions from Waste Incineration.

Table 8.1 Status of emissions estimation within the Waste sector

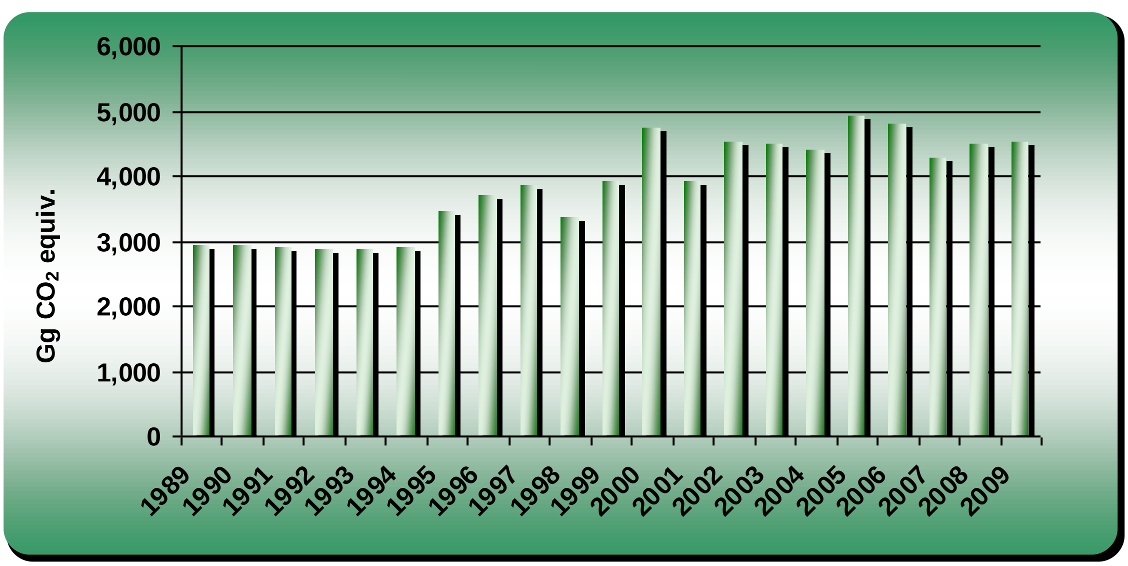
IPCC category	Emissions estimation status		
	CO_2	CH_4	N_2O
6A Solid Waste Disposal on Land			
6A.1 Managed Waste Disposal on Land	NA	✓	NA
6A.2 Unmanaged Waste Disposal on land	NA	✓	NA
6A.2.1 deep (>5m)	NA	✓	NA
6A.2.2 shallow (<5 m)	NA	✓	NA
6A.3 Other	NA	NA	NA
6B Wastewater Handling			
6B.1 Industrial Wastewater	NA	✓	NE
6B.1.a. wastewater	NA	✓	NE
6B.1.b. sludge	NA	IE*	NE
6B.2 Domestic and Commercial wastewater			
6B.2.1 Domestic and Commercial wastewater (w/o human sewage)	NA	✓	NE
6B.2.1.a wastewater	NA	✓	NE
B.2.1.b sludge	NA	✓	NE

IPCC category	Emissions estimation status		
	CO_2	CH_4	N_2O
6B.2.2 Human sewage	NA	NA	✓
6B.3 Other	NA	NA	NA
6C Waste Incineration			
6C.1 Biogenic	NE	NE	NE
6C.2 Non-biogenic	✓	NE	NE
6C.2.a. Hazardous waste	✓	NE	NE
6C.2.b. Clinical waste	✓	NE	NE
6D Other	NA	NA	NA

Observations

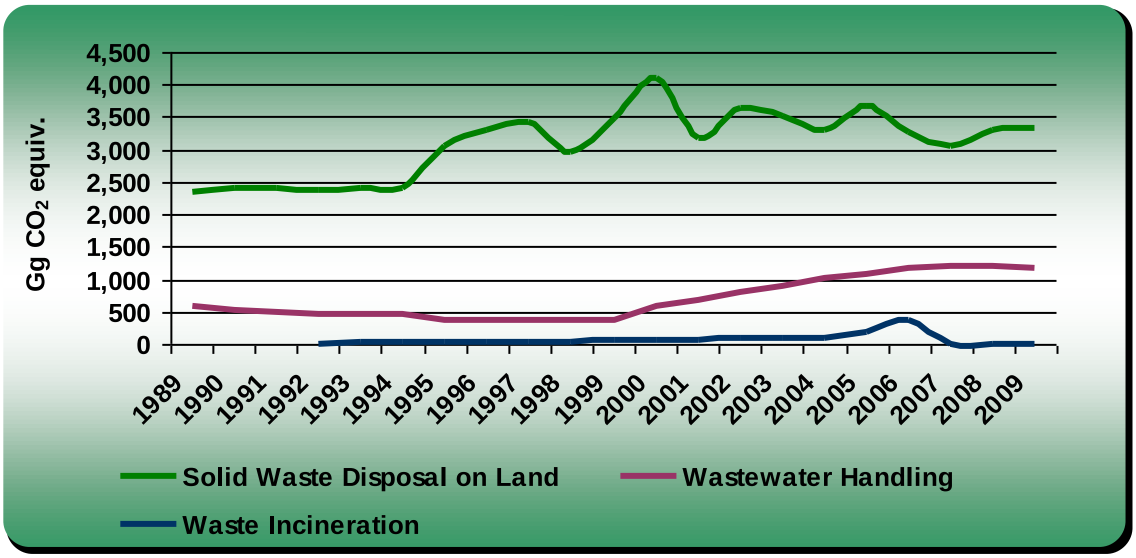
* CH_4 emissions from industrial sludge are reported under 6.B.1.a – Industrial wastewater.

Figure 8.3 Total GHG emissions trend in Waste for 1989–2009 period



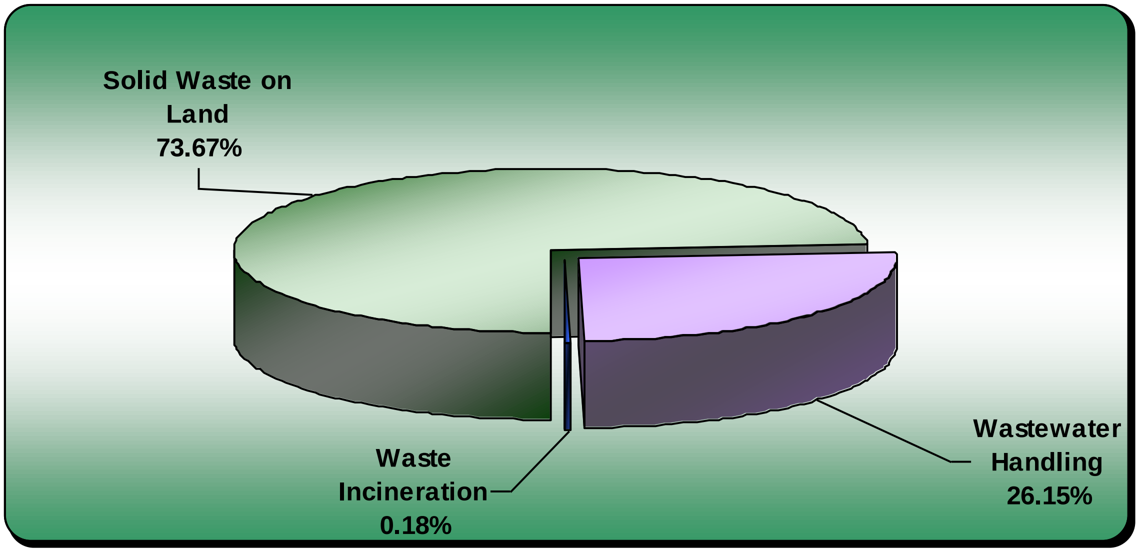
Over the 1989-2009 period, the GHG emissions resulted from the Waste sector increased by 54.62 %, due to the population consumption growth, the increase of waste managed sites number and also the increase of population number connected to sewerage systems.

Figure 8.4 GHG emissions trends in Waste, by sub-sectors for 1989–2009 period



This sector includes emissions from landfills (6.A), wastewater handling (6.B) and waste incineration (6.C).

Figure 8.5 Contribution of the sub-sectors in the total GHG emissions from Waste in 2009



In 2009 within the activities specific to the waste sector were generated 4,514.184 Gg CO_2 equivalents, accounting for 3.51 % from the total GHG emissions.

Solid waste disposal on land (Landfills) is the main category within the waste sector, accounting for 73.67% of the sector's total emissions. Wastewater handling and waste incineration account for approximately 26.15% and, respectively, 0.18%.

Table 8.2 Contribution of Waste sector in total GHG emissions, in 1989–2009 period

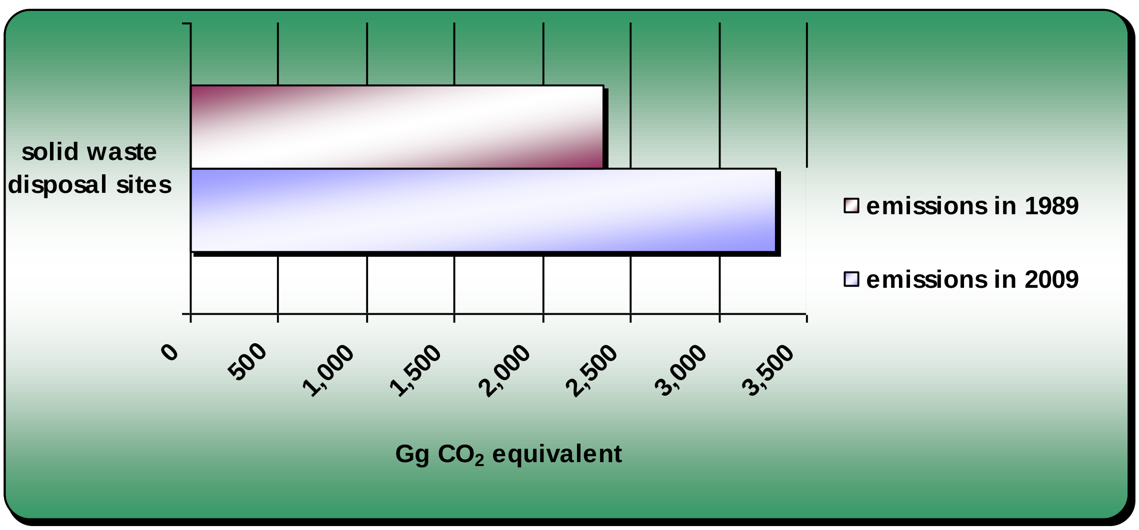
Year	Total GHG emissions (excluding LULUCF) [Gg CO_2 equivalent]	GHG emissions from Waste [Gg CO_2 equivalent]	Contribution of Waste in total GHG emissions [%]	CH_4 emissions from Waste [Gg CO_2 equivalent]	Contribution of CH_4 emissions in total GHG emissions from Waste [%]	N_2O emissions from Waste [Gg CO_2 equivalent]	Contribution of N_2O emissions in total GHG emissions from Waste [%]	CO_2 emissions from Waste [Gg]	Contribution of CO_2 emissions in total GHG emissions from Waste [%]
1989	282,992.39	2919.60	1.03	2748.11	94.13	171.49	5.87		
1990	254,619.48	2923.83	1.15	2749.50	94.04	174.33	5.96		
1991	204,377.25	2890.69	1.41	2716.93	93.99	173.76	6.01		
1992	189,493.85	2855.88	1.51	2673.92	93.63	171.06	5.99	10.90	0.38
1993	187,368.54	2873.69	1.53	2684.45	93.42	173.02	6.02	16.21	0.56
1994	182,190.28	2899.94	1.59	2703.19	93.22	175.22	6.04	21.53	0.74
1995	189,090.71	3443.46	1.82	3263.14	94.76	153.48	4.46	26.84	0.78
1996	195,399.74	3688.08	1.89	3503.00	94.98	152.93	4.15	32.15	0.87
1997	177,490.00	3834.32	2.16	3640.83	94.95	156.03	4.07	37.47	0.98
1998	158,545.15	3359.50	2.12	3158.82	94.03	157.90	4.70	42.78	1.27
1999	141,129.05	3895.54	2.76	3687.60	94.66	159.85	4.10	48.09	1.23
2000	143,243.96	4745.79	3.31	4506.32	94.95	173.50	3.66	65.97	1.39
2001	147,323.47	3912.20	2.66	3652.47	93.36	185.08	4.73	74.65	1.91
2002	154,145.81	4508.45	2.92	4211.44	93.41	218.74	4.85	78.27	1.74
2003	160,602.77	4497.28	2.80	4177.66	92.89	233.75	5.20	85.88	1.91
2004	157,682.44	4404.06	2.79	4049.99	91.96	246.75	5.60	107.32	2.44
2005	154,091.40	4921.77	3.19	4483.22	91.09	259.75	5.28	178.79	3.63
2006	158,385.16	4813.09	3.04	4164.76	86.53	283.85	5.90	364.48	7.57
2007	154,198.76	4271.82	2.77	3973.43	93.01	287.78	6.74	10.62	0.25
2008	149,899.01	4492.17	3.00	4194.49	93.37	289.09	6.44	8.59	0.19
2009	128,745.91	4514.18	3.51	4216.53	93.41	289.53	6.41	8.12	0.18

Table 8.3 describes Key categories in the Waste sector.

Table 8.3 Key categories overview – Waste, 2009

CRF categories	Key category	GHG	Criteria (excluding LULUCF)	Contribution of Key categories in total GHG emissions [%]	Criteria (including LULUCF)	Contribution of Key categories in total GHG emissions [%]
6.A	**Solid waste disposal sites**	CH_4	**L, T**	2.58	**L, T**	2.16
6.B	**Wastewater handling**	CH_4	**T**	0.69	**T**	0.58

Figure 8.6 The GHG emissions of the 2009 Waste key category, both by level and trend



8.2 Source category Solid Waste Disposal on Land (CRF sector 6.A)

8.2.1 Source category description

Anaerobic decomposition of organic matter by methanogenic bacteria in Solid Waste Disposal Sites (SWDS) results in the release of CH_4 to the atmosphere. Municipal Solid Waste (MSW) typically contains significant quantities of degradable organic matter.

The main option of waste disposal in Romania is the storage method.

From the total generated municipal wastes, approximately 77% are stored in 2009.

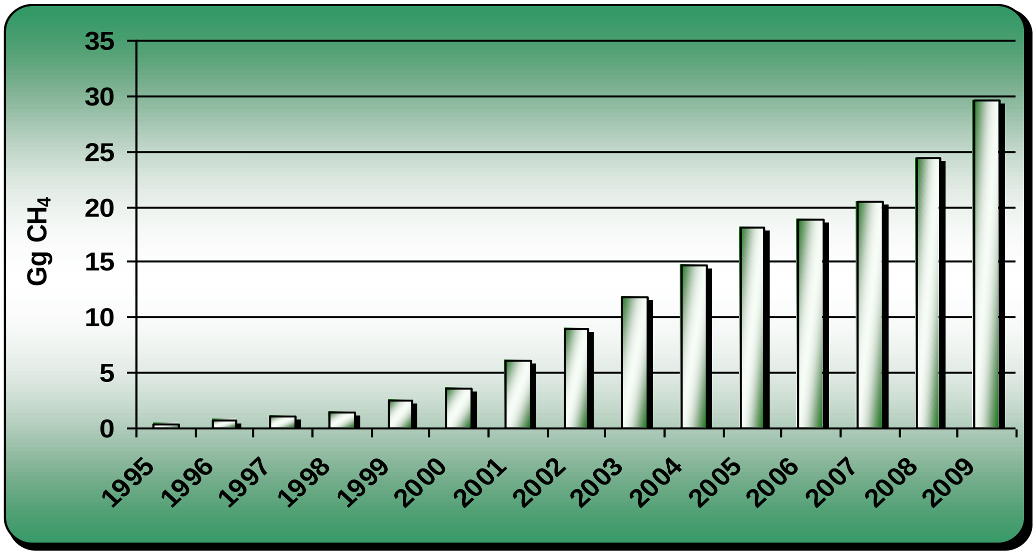
The landfills are classified as managed and, respectively, unmanaged.

In 2009 from 126 waste deposits:

- 25 managed waste landfills had free storage capacity; the deposits complied with the provisions in the Directive 99/31/EC, respective in the GD 349/2005;
- 101 unmanaged waste landfills (87 deep sites and 14 shallow sites) were functioning; the deposits will cease storage activity gradually until 2017.

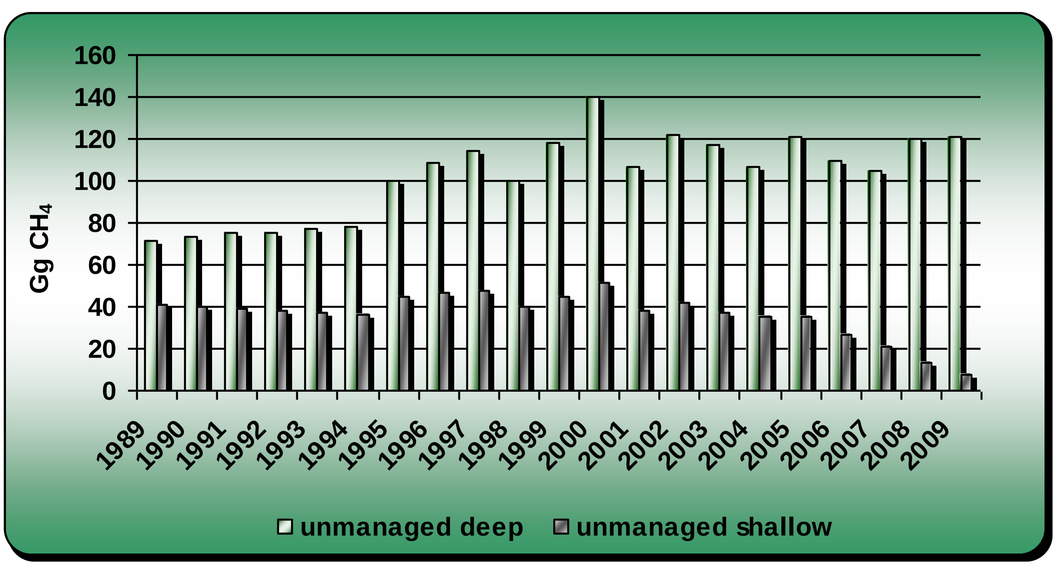
The percentage of domestic wastes selective collection is very low and large amounts of recyclable materials (paper, cardboard, glass, plastics, metals) are not recovered, but are finally stored together with other municipal wastes

Figure 8.7 CH_4 emissions trends from waste disposed to managed sites for 1995–2009 period



Since 1995 new managed sites have been opened the total number of these facilities reaching the sum of 25 in 2009.

Figure 8.8 CH_4 emissions trends from waste disposed to unmanaged site for 1989–2009 period



8.2.2 Methodological issues

Methodology

Despite the fact that Solid Waste Disposal Sites is a key category both from level and trend views, tier 2 method could be applied just for managed sites, due to the fact that there are no sufficient historical data series to estimate the amount of the collected waste.

CH_4 emissions from managed waste disposal on land were calculated using First Order Decay method, according to the equations 5.1 and 5.2 from pages 5.6 – 5.7 of IPCC GPG 2000. Historical data are not necessary, first managed site being opened in 1995 year.

CH_4 emissions from unmanaged waste disposal sites were calculated using Default method, according to the equation 5.3 from page 5.7 of IPCC GPG 2000.
For unmanaged sites Tier 2 method could not be used, because the FOD method requires historical data on waste generation and management practices in Romania for a period of at least 50 years, in according with IPCC GPG 2000.

Emission factors

Default emissions factors according to the provisions in IPCC GPG 2000 have been used. The emissions factors are presented in Table 8.4.

Table 8.4 Parameters used to calculate the emission factors (SWDS)

Type of site	Methane Correction Factor (IPCC GPG 2000 Table 5.1)	Fraction of DOC which actually decrease including C (IPCC GPG 2000)	Fraction of carbon release as methane IPCC GPG 2000)	The methane generation rate constant - k (IPCC GPG 2000)
Managed	1	0.55	0.5	0.05
Unmanaged-deep	0.8	0.55	0.5	-
Unmanaged-shallow	0.4	0.55	0.5	-

The fraction of degradable organic carbon (DOC) in MSW was calculated according to the equation 5.4 from page 5.9 of IPCC GPG 2000 and using the percentage composition of domestic waste.

The percentage composition of domestic waste data for 2003-2009 period were provided by the Waste Directorate of NEPA. Data for 1989-2002 period were obtained using backward trend extrapolation, by expert judgment.

Table 8.5 The percentage composition of domestic waste (source: NEPA)

Year	Paper and textiles [%]	Garden, park waste and other non-food organic Putrescibles [%]	Food waste [%]	Wood and straw[%]
2003	13.11	15.67	40.20	1.00
2004	11.67	12.53	38.12	1.00
2005	12.76	14.50	38.60	1.00
2006	12.68	14.36	36.45	1.00
2007	11.48	13.77	34.45	1.00
2008	8.32	6.03	45.29	1.59
2009*	8.32	6.03	45.29	1.59

Observations

* Preliminary data.

In FOD method, the methane generation rate constant k has been used **for** calculation of methane emissions from managed sites. It used a default value for k - 0.05 (a half-life of about 14 years), according to IPCC GPG 2000, because there is no national value for this factor.

Activity data

For 1989–1997 where no information was available, the amount of MSW was estimated based on: waste generation rates, population whose waste goes to SWDSs and to the Fraction of MSW Disposed to SWDSs (parameters provided by the National Institute for Statistics).

Amounts of MSW were calculated according to IPCC 1996, Workbook- Worksheet 6-1A.

The National Research and Development Institute for Environmental Protection (ICIM Bucharest) was responsible for statistical inquires on waste for 1998–2002 period while the Waste Directorate of National Environmental Protection Agency is responsible for statistical inquires on waste for 2003–2009 period.

The Amounts of MSW disposed to manage sites became available starting with 1995 and used for CH_4 emissions estimate. The emissions are reported under 6.A.1 Managed waste disposal on land. From 1989 to 1994 the emissions are reported as NO because there are no managed sites before 1995 year.

The Waste Directorate of NEPA provided activity data for unmanaged sites, divided in deep and shallow sites only for 2003–2009 periods. For 1989-2002 period data were obtained using extrapolation technique.

Industrial waste landfilled is not included in the estimation because cannot be disaggregated to the relevant industry branches. Introduction of all industrial waste would lead to an overestimation of emissions.

Table 8.6 Amount of MSW disposed to Solid Disposal on Land (source: ICIM, NEPA)

Year	Amount of waste disposed to managed sites [Gg]	Amount of waste disposed to unmanaged deep sites [Gg]	Amount of waste disposed to unmanaged shallow sites [Gg]
1989	NO	1790.68	2034.92
1990	NO	1851.25	2022.55
1991	NO	1884.31	1979.35
1992	NO	1891.51	1910.43
1993	NO	1930.19	1874.47
1994	NO	1968.02	1837.61
1995	150.00	2501.33	2245.52
1996	150.00	2733.21	2358.88
1997	150.00	2878.27	2387.82
1998	150.00	2501.01	1994.16

Year	Amount of waste disposed to managed sites [Gg]	Amount of waste disposed to unmanaged deep sites [Gg]	Amount of waste disposed to unmanaged shallow sites [Gg]
1999	490.00	2964.97	2271.75
2000	490.00	3525.69	2595.30
2001	1500.00	2682.43	1896.57
2002	1705.00	3073.21	2086.45
2003	1720.00	2810.00	1800.00
2004	1930.00	2850.00	1850.00
2005	2080.00	3020.00	1780.00
2006	2558.26	2817.22	1392.41
2007	2841.68	2874.98	1132.44
2008	3187.59	3506.79	754.62
2009*	3500.00	3550.00	450.00

Observations

* Data were estimated using municipal services waste generation and management forecast.

CH_4 recovery

Starting with the last submission, data on methane recovered from landfill facilities, data specific to 2001-2008, have been collected from the operators. The amount of methane recovery is very low and it is not used for energy recovery device, just for flaring.

According to the data sources used there is no methane recovery from the unmanaged sites. The emissions are reported as NO.

8.2.3 Uncertainties and time series consistency

Uncertainty associated with the activity data is 30%, according to the provisions in IPCC GPG 2000.

According to the provisions in Table 5.2 of IPCC GPG 2000 the uncertainties related with parameters are the following:

- Degradable organic carbon ±20%;
- Fraction of Degradable Organic Carbon Dissimilated ±30%;
- CH_4 correction factor

=1: -10 %, +0 %;

0.4: ±30%

=0.6: +60%.

- Fraction by volume of CH_4 in landfill gas (0.5): +20%;
- Methane Generation Rate Constant (k) = 0.05: + 20%

The uncertainty associated with the emission factors specific to CH_4 from managed solid waste disposal is estimated to 46.90% while that associated to the emission factors specific to CH_4 from unmanaged solid waste disposal is estimated to 72.8%.

The uncertainty related to the activity data for CH_4 from managed solid waste disposal and unmanaged sites is estimated to 30%.

The overall uncertainty resulted after the aggregation of the AD and EF uncertainties according to the provisions in Chapter 6 of IPCC GPG 2000 is 55.68% for CH_4 from managed sites and, respectively, 78.74% for CH_4 from unmanaged sites.

Taking into account the actual situation, the data series can be considered consistent.

8.2.4 Source specific QA/QC and verification

All activities regarding quality control (QC) as described in the QA/QC Programme have been undertaken.

These activities have been accomplished by the person in charge with the Waste sector, activity results being mentioned in the Checklists.

Unconformities have not been notified as a result of these activities.

Also, the activity data series used have been compared with the data provided by the Eurostat, the two data sets being comparable.

No recalculations were needed following the QA activities developed under the procedures for the compilation of the European Community GHG Inventory, described in the Decision 280/2004/EC of the European Parliament and of the Council and Decision 166/2005/EC of the European Commission.

Unconformities have not been notified following NGHGI 2009 review by ERT.

All notified and solved improvements following various QA/QC activities are described in the Improvement Lists.

8.2.5 Source specific recalculation, including changes made in response to the review process

In order to improve the quality emissions estimates the following recalculation was done:

- method
  - the FOD method has been used for managed sites
- activity data
  - final activity data has been provided by the Waste Directorate of the National Environmental Protection Agency (NEPA) for the amount of municipal solid waste in 2008 and for the percentage composition of waste (comparative to provisional data used in the 2010 submission of NGHGI);
  - the data collection methodology on the percentage composition of waste has been changed, starting with 2008

- methane recovered
  - starting with the last submission, data on methane recovered from landfill facilities, data specific to 2001-2008, have been collected from the operators.

Effects of the recalculations due to changes at the AD series and other parameters are described within the Table 8.7.

Table 8.7 Changes made at parameters level and their effects on emission estimates

Year	Changes on methane recovered from managed sites [Gg]		Changes on the percentage composition [%]		Changes on the amount of municipal solid waste disposed to managed sites [Gg]	
	2010 v.3.2 submission	2011 v.3.1 submission	2010 v.3.2 submission	2011 v.3.1 submission	2010 v.3.2 submission	2011 v.3.1 submission
1989	NO	**NO**	NO	**NO**	NO	**NO**
1990	NO	**NO**	NO	**NO**	NO	**NO**
1991	NO	**NO**	NO	**NO**	NO	**NO**
1992	NO	**NO**	NO	**NO**	NO	**NO**
1993	NO	**NO**	NO	**NO**	NO	**NO**
1994	NO	**NO**	NO	**NO**	NO	**NO**
1995	NO	**NO**	0.1357	**0.1357**	150.00	**150.00**
1996	NO	**NO**	0.1357	**0.1357**	150.00	**150.00**
1997	NO	**NO**	0.1357	**0.1357**	150.00	**150.00**
1998	NO	**NO**	0.1357	**0.1357**	150.00	**150.00**
1999	NO	**NO**	0.1357	**0.1357**	490.00	**490.00**
2000	NO	**NO**	0.1357	**0.1357**	490.00	**490.00**
2001	NO	**0.95**	0.1357	**0.1357**	1500.00	**1500.00**
2002	NO	**1.87**	0.1357	**0.1357**	1705.00	**1705.00**
2003	NO	**2.74**	0.1424	**0.1424**	1720.00	**1720.00**
2004	NO	**3.59**	0.1282	**0.1282**	1930.00	**1930.00**
2005	NO	**4.40**	0.1366	**0.1366**	2080.00	**2080.00**
2006	NO	**8.68**	0.1328	**0.1328**	2558.26	**2558.26**
2007	NO	**11.95**	0.1240	**0.1240**	2841.68	**2841.68**
2008	NO	**13.11**	0.1240	**0.1162**	2864.41	**3187.59**

Table 8.7 Changes made at parameters level and their effects on emission estimates (continued)

Year	Effects of changes on emission estimates		
	2010 v.3.2 submission [Gg]	2011 v.3.1 submission [Gg]	Difference [%]
1995	7.46	0.36	-95.12
1996	7.46	0.71	-90.48
1997	7.46	1.04	-86.07
1998	7.46	1.35	-81.87
1999	24.38	2.48	-89.84
2000	24.38	3.54	-85.46
2001	74.64	6.06	-91.88
2002	84.84	8.94	-89.46
2003	89.79	11.92	-86.73
2004	90.70	14.78	-83.70
2005	104.17	18.15	-82.57
2006	124.58	18.85	-84.87
2007	129.21	20.54	-84.10
2008	130.24	24.42	-81.25

8.2.6 Source specific planned improvement including those in response to the review process

In order to allow for the use of a higher Tier calculation method national parameters values are collected/processed/developed through the ongoing study “Elaboration of national emission factors/other parameters relevant to NGHGI Waste Sector”.

8.3 Source category Wastewater Handling (CRF sector 6.B)

8.3.1 Source category description

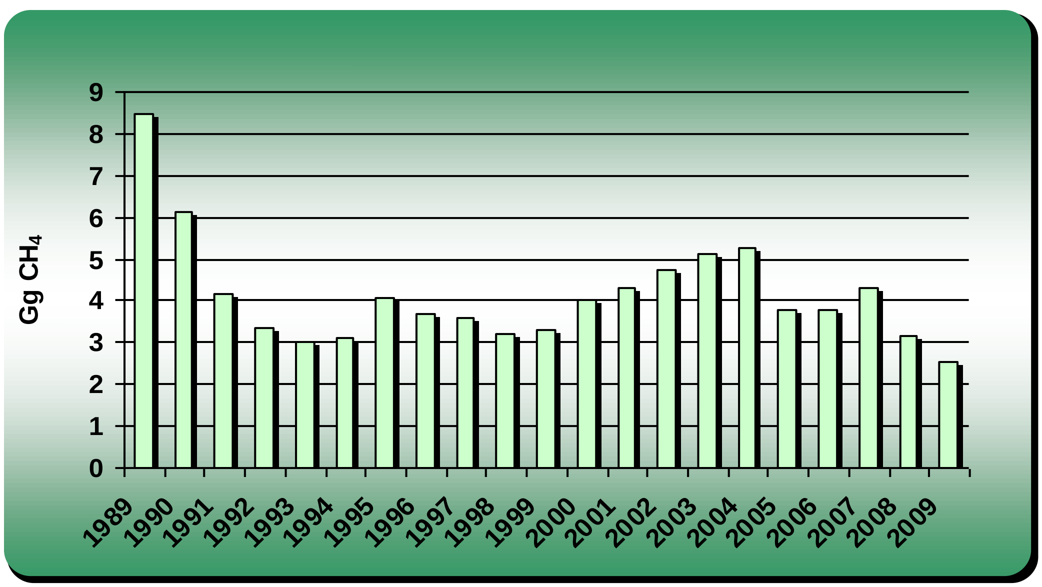
This sector includes methane emissions from domestic/industrial wastewater handling and nitrous oxide emissions from human sewage.

Methane and nitrous oxide are produced from anaerobic decomposition of organic matter by bacteria in sewage facilities, from food processing and other industrial facilities during Wastewater handling.

In 2009, the statistical analysis of the main sources of Wastewater in Romania revealed the following global issues:

- to a total volume of 5,206.21 million evacuated m^3/an, 39.5% is wastewater which must be treated;
- of the total volume of wastewater requiring treatment plant 2,058.89 million m^3/year, about 485.44 mil. m^3 were sufficient (appropriate) treatment, 664.44 mil. m^3, representing untreatment wastewater and 909.02 mil. m^3, insufficient treatment Wastewater.

Figure 8.9 CH_4 emissions trends from industrial wastewater handling for 1989–2009 period



The specific emissions trend is due to the decrease of the major industrial productions. Starting with 2008 the trend of emission mainly decreased due to reduction of various productions level. In 2009 the emissions trends had also decreased due to the economic crisis influencing many activity areas.

Figure 8.10 CH_4 emissions trends from domestic/ commercial wastewater for 1989–2009 period

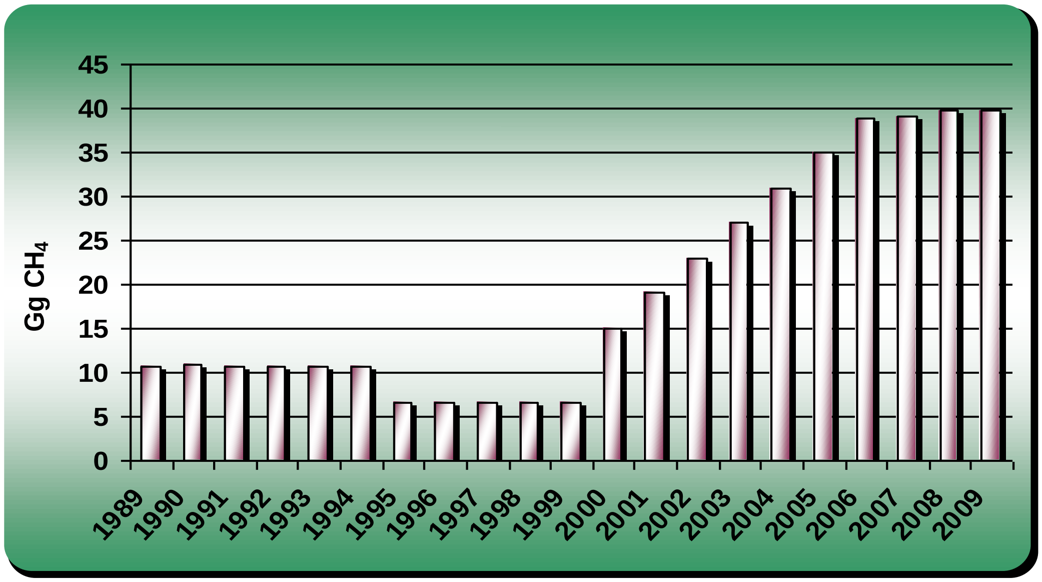
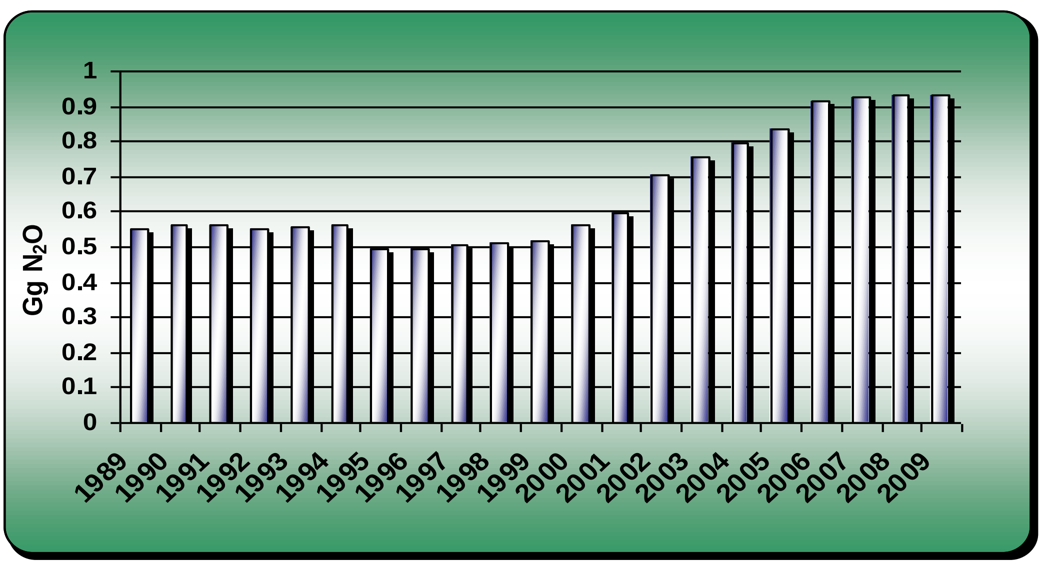


Figure 8.11 N_2O emissions trends from human sewage for 1989–2009 period



Romania Wastewater handling faced three periods (using an expert judgment on the issue of wastewater) and that can be observed in the above CH_4 and N_2O emissions (CO_2 equivalent) trend:

- 1990-1995: the system failed because wastewater was not considered as a priority and also because of the lack of funds and organization;
- 1995-2000: percentage of population connected to sewerage and treated wastewater reached minimum values. European funds began to be attracted, organizational problems have been solved and local administrations have been decentralized by the end of period;
- 2000-2007: wastewater became a priority; there are several projects in progress: in the Valea Jiului, MUDP I, MUDP II, PHARE, ISPA and bilateral agreements (Germany, Denmark, Austria); population connected to sewerage and treated wastewater percentages significantly increased in both urban and rural areas.

8.3.2 Methodological issues

Industrial wastewater handling

CH_4 emissions from industrial wastewater and sludge (CRF 6.B.1)

Methodology

Default method is used for calculating CH_4 emissions from industrial wastewater according to the IPCC GPG 2000.

For methane emissions from industrial wastewater calculation, the equation 5.5 from page 5.14 was used.

Emissions factor

The weighted MCF (Methane conversion factor) value is determined according to equation 5.8 from IPCC GPG 2000. The percentage of domestic wastewater anaerobic treated is 2% and for aerobic treatment is 98%.

The default value of 0.25 kg CH_4/kg COD (Chemical Oxygen Demand) according to IPCC GPG 2000 has been used.

Activity data

The activity data have been provided by National Institute for Statistics are presented in Table 8.8.

Table 8.8 Production of the main industrial products (source: SY)

Year	Beer	Wine	Oil &Grease	Paper	Pulp	Petroleum Refining
	Unit [t/yr]					
1989	1,151,300	463,200	248,000	552,000	574,000	30,615,000
1990	1,052,700	470,500	270,000	427,000	380,000	23,664,000
1991	980,300	500,800	236,000	307,000	235,000	15,191,000
1992	1,001,400	470,700	216,000	262,000	171,000	13,299,000
1993	992,900	654,900	213,000	248,000	132,000	13,191,000
1994	904,600	842,500	194,000	262,000	128,000	14,744,000
1995	876,800	735,100	224,000	332,000	194,000	15,259,000
1996	811,800	670,900	236,000	299,000	177,000	13,426,000
1997	765,100	731,400	246,000	306,000	154,000	12,429,000
1998	998,900	507,100	173,000	281,000	129,000	12,520,000
1999	1,113,300	566,100	245,000	276,000	144,000	9,894,000
2000	1,266,400	545,300	253,000	328,000	187,000	10,532,000
2001	1,266,300	546,300	296,000	388,000	172,000	10,948,000
2002	1,162,700	548,800	228,000	421,000	199,000	11,906,000
2003	1,329,200	545,700	243,000	457000	212,000	10,736,000
2004	1,440,600	707,100	258,000	492,000	187,000	12,371,000
2005	1,529,500	260,200	264,000	385,000	103,000	13,890,000
2006	1,748,400	501,400	338,000	401,000	80,000	13,237,000
2007	1,921,300	528,900	220,000	461,000	C*	13,006,000
2008	2,024,000	536,900	158,000	369,000	C*	13,095,000
2009	1,809,000	495,700	185,000	310,000	C*	11,340,000

Observations

* Confidential.

Table 8.9 Parameters used to estimate total organic industrial wastewater (IPCC GPG 2000, table 5-4)

Default Parameters	Industry type				
	Beer	**Wine**	**Oil & Grease**	**Pulp &Paper**	**Petroleum Refineries**
Degradable Organic Component [g/l]	2.9	1.5	0.85	9	1
Wastewater Generation [m^3/Mg]	6.3	23	3.1	162	0.6

CH_4 emissions from industrial sludge

CH_4 emissions from industrial sludge are reported IE because emissions are included at the industrial wastewater level.

Domestic and commercial wastewater handling (CRF 6.B.2)

CH_4 emissions from domestic and commercial wastewater and sludge (CRF 6.B.2.1)

Figure 8.12 CH_4 emissions trends from Domestic/ Commercial wastewater

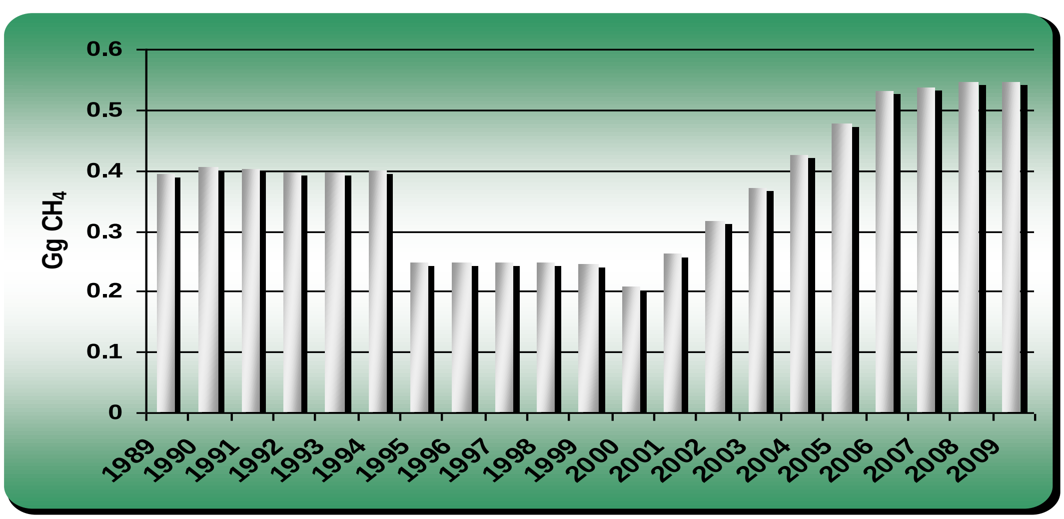
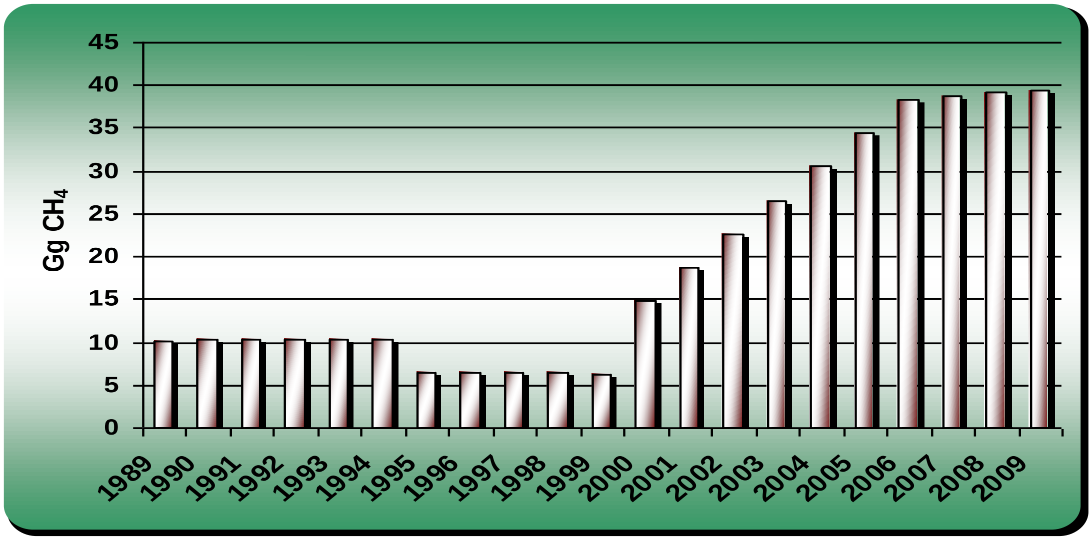


Figure 8.13 CH_4 emissions trends from Domestic/commercial sludge



Methodology

The method is similar to the one used for calculating methane emissions from industrial wastewater.

For calculation of methane emissions from domestic and commercial wastewater, the equations 6, 10 and 12 of IPCC 1996, Reference Manual (Waste Chapter) were used.

Emissions factor

The weighted MCF (Methane conversion factor) value is determined according to equation 5.8 from IPCC GPG 2000. The percentages of domestic wastewater anaerobic treated are 2% and for aerobic treatment are 98%.

The default value of 0.6 kg CH_4/kg BOD (Biochemical Oxygen Demand) according to IPCC GPG 2000 has been used.

Activity data

Parameter used to estimate total domestic/commercial organic wastewater is:

DOC – Degradable organic component [kg BOD/1000 persons/y] = 18,250 kg BOD/1000 persons/ yr; default value for Europe region has been used (source: IPCC 1996, Workbook table 6-5).

Using an expert judgment of Prof. Dr. Vladimir Rojanschi on the issue of domestic wastewater in Romania there was the following situation:

Table 8.10 The percentage of population connected to sewerage and wastewater treated

Parameters	**1989 – 1994 period**	**1995-1999 period**
Population connected to sewerage	urban 45% rural 10%	urban 40% rural 8%
Treated wastewater	urban 50% rural 0%	urban 35% rural 0%

The National Institute for Statistics through „The statistical survey on inhabitants whose houses are connected to sewerage systems and wastewater handling systems" provided data about the percentage of population connected to sewerage and wastewater treated for 2006 – 2009 period. There are no data available for 1989 – 2005, because the statistical survey has been realized since 2006 year. The interpolation technique was used for 2000 – 2005 period.

Table 8.11 Inhabitants whose houses are connected to sewerage and wastewater systems

Sewerage systems and wastewater treatment plants	**2006**	**2007**	**2008**	**2009**
Urban sewerage systems [number of people]	9,070,564	9,195,900	9,237,821	9,251,827
Urban sewerage systems with treatment [number of people]	6,068,655	6,130,399	6,215,164	6,236,525

Table 8.12 Romanian population

Year	Total Population [1000 persons]	Population whose wastewater is treated [1000 persons]
1989	23,151.56	2,770.16
1990	23,206.72	2,836.99
1991	23,185.08	2,824.29
1992	22,788.97	2,782.66
1993	22,755.26	2,791.40
1994	22,730.62	2,796.21
1995	22,680.95	1,744.01
1996	22,607.62	1,737.56
1997	22,545.93	1,736.66
1998	22,502.80	1,728.70
1999	22,458.02	1,722.38
2000	22,435.21	2,351.01
2001	22,408.39	2,971.91
2002	21,794.79	3,592.81
2003	21,733.56	4,213.71
2004	21,673.33	4,834.61
2005	21,623.85	5,455.51
2006	21,584.37	6,068.66
2007	21,537.56	6,130.40
2008	21,504.44	6,215.16
2009	21,469.96	6,236,525

CH_4 from domestic/commercial wastewater recovered and/or flared are reported NO.

CH_4 emissions from domestic and commercial sludge

Methodology

For calculation of methane emissions from domestic and commercial sludge the equations 7, 11 and 13 of IPCC 1996, Reference Manual (Waste Chapter) were used.

Emissions factor

The percentage of domestic and commercial sludge anaerobic treated is 96% and for aerobic treatment is 4%.

The default value of 0.6 kg CH_4/kg BOD (Biochemical Oxygen Demand) according to IPCC GPG 2000 has been used.

Activity data

Using an expert judgment on the issue of domestic wastewater the fraction of domestic/commercial degradable organic component removed as sludge are 35% until 2000 and 60% for 2000–2009 period.

Table 8.13 The total domestic/commercial organic sludge

Year	Total domestic/commercial organic sludge [Gg DC]
1989	17.69
1990	18.12
1991	18.04
1992	17.77
1993	17.83
1994	17.86
1995	11.14
1996	11.10
1997	11.09
1998	11.04
1999	11.00
2000	25.74
2001	32.54
2002	39.34
2003	46.14
2004	52.94
2005	59.74
2006	66.45
2007	67.13
2008	68.06
2009	68.30

Nitrous Oxide emissions from Human Sewage (CRF 6.B.2.2)

Methodology

The IPCC default methodology only includes N_2O emissions from human sewage based on annual per capita protein intake.

For calculation of nitrous oxide emissions from human sewage, the equation 15 from page 6.28 of IPCC 1996 was used.

Emissions factor

Default emissions factors according to the provisions in IPCC 1996 have been used. The emissions factors are presented in Table 8.14.

Table 8.14 Parameters used to calculate emission factor from Human Sewage

Fraction of Nitrogen in Protein $Frac_{NPR}$ [g N/kg protein]	**Emission factor EF_6 [kg N_2O-N/kg sewage=N produced]**
Source: IPCC 1996	Source: IPCC 1996
0.16	0.01

Activity data

For 1989-1999 period data on population connected to sewerage were provided by Prof. Dr. Vladimir Rojanschi and for 2006–2008 period data were provided by INS. For 2000-2005 data were obtained by interpolation technique.

Updated Activity data for protein consumption provided by Food and Agriculture Organization website have been used:

- 91g/person/day for years 1989-1992;
- 93 g/person/day for years 1994-1996;
- 95 g/person/day for 1997 year;
- 98 g/person/day for years 1999–2001;

- 109 g/person/day for 2002 year;
- 110 g/person/day for years 2003–2005.

The values for the missing years have been obtained using the interpolation and extrapolation technique.

8.3.3 Uncertainties and time series consistency

CH_4 from industrial wastewater

Uncertainty associated with the activity data is 144%, according to the provisions in IPCC Good Practice Guidance (Table 5.5). The following values were used:

- Quantity of industrial wastewater: -25 % to +25 %;
- Wastewater /unit of production and COD/ unit of wastewater: +100 %.

The uncertainties associated with the emission factor specific to CH_4 from industrial wastewater are estimated to be 30%.

The uncertainties associated with the activity data specific to CH_4 from industrial wastewater are estimated to be 143.61%.

The overall uncertainty resulted after the aggregation of the AD and EF uncertainties according to the provisions in Chapter 6 of IPCC GPG 2000 is 146.71%.

CH_4 from domestic and commercial wastewater

Uncertainty associated with the activity data is 30%, according to the provisions in the IPCC Good Practice Guidance (Table 5.3). The following values were used:

- Human population: -5% to +5%;
- BOD/person: -30% to +30%.

The uncertainties associated with the emission factor specific to CH_4 from domestic and commercial wastewater are estimated to be 30%.

The uncertainties associated with the activity data specific to CH_4 from domestic and commercial wastewater are estimated to be 30.41%.

The overall uncertainty resulted after the aggregation of the AD and EF uncertainties according to the provisions in Chapter 6 of IPCC GPG 2000 is 42.72%.

N_2O from human sewage

The uncertainty in N2O emissions is 30% for emission factor and 50% for activity data, by expert judgment.

The overall uncertainty resulted after the aggregation of the AD and EF uncertainties according to the provisions in Chapter 6 of IPCC GPG 2000 is 58.31%.

Time series is consistent, emissions resulted from this source category were estimated for the entire period using the same assumptions and the same emission factors (default values, indicated in the methodology).

8.3.4 Source specific QA/QC and verification

All activities regarding quality control (QC) as described in the QA/QC Programme have been undertaken.

These activities have been accomplished by the person in charge with Waste sector, activity results being mentioned in the Check lists.

Unconformities have not been notified as a result of these activities.

Following QA activity accomplishment according European Community GHG emissions inventory compiling procedure, as described in 280/2004/EC decision, proved that recalculations are not necessary.

Unconformities have not been notified following NGHGI 2009 review by ERT. All notified and solved improvement following various QA/QC activities are described in Improvement Lists.

8.3.5 Source specific recalculation, including changes made in response to the review process

There was not any recalculation done since last submission.

8.3.6 Source specific planned improvement including those in response to the review process

In order to allow for the use of Tier 1 calculation method with national parameters values, national parameters values are collected/processed/developed through the ongoing study “Elaboration of national emission factors/other parameters relevant to NGHGI Waste Sector”.

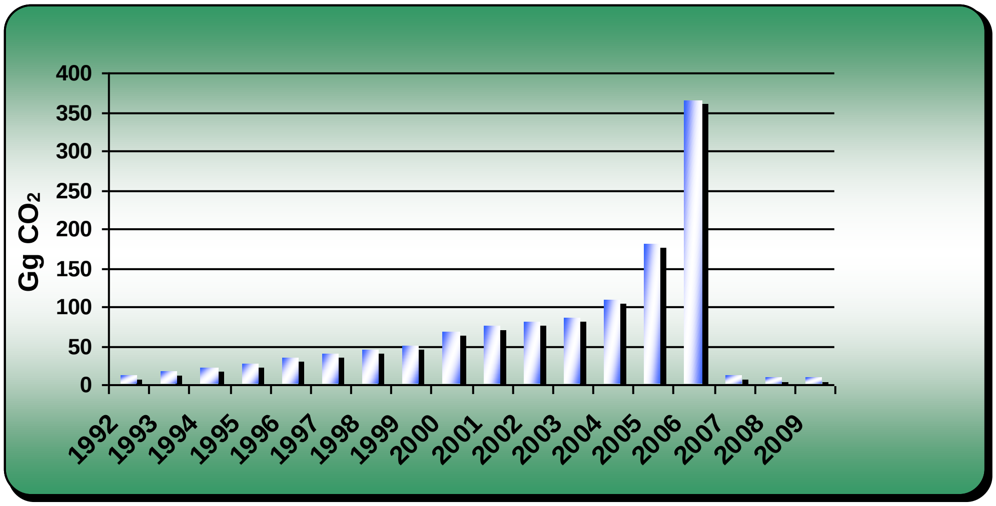
8.4 Source category Waste Incineration (CRF sector 6.C)

8.4.1 Source category description

Waste incineration like other types of combustion, is a source of CO_2 emissions.
Waste incineration includes emissions resulted from the incineration of clinical waste and hazardous waste.

Municipal waste composition and characteristics (humidity about 50% and calorific power <8400 kJ/kg), also higher costs implied by this method, makes the incineration process with energy recovery inefficient. Nowadays, in Romania there are no municipal waste incineration installations

Figure 8.14 CO_2 emissions trends from waste incineration, for 1992–2009 period



The specific emissions trend is due to the increase of the incinerators number over the period 1992-2006. The difference between 2006 and 2007 is due to the fact that in 2007 a private operator ceased the activity of an incinerator. During 2008-2009, the relevant emissions level remained relatively constant.

8.4.2 Methodological issues

Carbon dioxide emissions from the incineration of clinical waste and hazardous waste (non-biogenic waste)

Methodology

For calculation of carbon dioxide emissions from waste incineration, the equation 5.11 from page 5.25 of IPCC GPG 2000 was used.

Emissions factor

Default emissions factors according to the provisions in IPCC GPG 2000 have been used.

The emissions factors are presented in Table 8.15.

Table 8.15 Default data for estimation of CO_2 from waste incineration (source: IPCC GPG 2000. table 5-6)

EF's	Clinical Waste	Hazardous Waste
C content of Waste	60%	50%
Fossil Carbon as % of Total Carbon	40%	90%
Efficiency of Combustion	95%	99,5%

Activity data

Public Health Institute of Bucharest (ISPB) was provided the data on amounts of clinical waste generated and of clinical waste incinerated. From 2008, this type of waste was not burnt in improper installation.

Table 8.16 Amounts of clinical waste (source: ISPB)

Year	Amount of clinical waste generated	Amount of clinical waste incinerated
	Unit [Gg/yr]	
2000	15.03	15.03
2001	19.06	19.06
2002	17.6	17.03
2003	18.98	18.79
2004	17.55	17.03
2005	15.49	13.55
2006	14.84	12.61
2007	14.08	10.00
2008	11.11	6.44
2009	97.76	4.79

Hazardous waste is generated by industrial sector. Data regarding the amounts of incinerated hazardous waste were provided only for 2003-2008 period. The amounts were estimated using backward trend extrapolation for 1992-2002 period, by expert judgment.

The amount of industrial waste has been increased from 2003 until 2006 because operators incinerated all their stock of hazardous industrial waste.

Table 8.17 Amounts of hazardous waste incinerated (source: NEPA)

Year	Amount of hazardous waste incinerated
	Unit [Gg/yr]
2003	42.74
2004	56.70
2005	102.00
2006	215.59
2007	1.38
2008	1.95
2009	2.51

8.4.3 Uncertainties and time series consistency

The uncertainty estimate associated with activity data amounts to 50% and uncertainty estimate associated with emissions factor amounts 30%, based on expert judgments.

The overall uncertainty resulted after the aggregation of the AD and EF uncertainties according to the provisions in Chapter 6 of IPCC GPG 2000 is 58.31%.

Time series is consistent, emissions resulted from this source category were estimated using the same assumptions and the same emission factors (default values, indicated in the methodology).

8.4.4 Source specific QA/QC and verification

All activities regarding quality control (QC) as described in the QA/QC Programme have been undertaken.

These activities have been accomplished by the person in charge with Waste sector, activity results being mentioned in the Check lists. Unconformities have not been notified as a result of these activities.

Following QA activity accomplishment according European Community GHG emissions inventory compiling procedure, as described in 280/2004/EC decision, proved that recalculations are not necessary.

Unconformities have not been notified following NGHGI 2009 review by ERT.

All notified and solved improvement following various QA/QC activities are described in Improvement Lists.

8.4.5 Source specific recalculation, including changes made in response to the review process

In order to improve the quality of the emission estimates important recalculations were made:

- activity data
    - starting with 2006, the values for industrial hazardous incinerated waste amount have been recalculated because it has been noticed that three plants that have been considered as incineration plants proved to be co-incineration plants.

Table 8.18 Changes made at activity data level and their effects on emission estimates

Year	Changes on amount of hazardous waste incinerated		Effects of changes on emission estimates		
	2010 v.3.2 submission [Gg]	2011 v.3.1 submission [Gg]	2010 v.3.2 submission [Gg]	2011 v.3.1 submission [Gg]	Difference [%]
1989	NO	NO	NO	NO	-
1990	NO	NO	NO	NO	-
1991	NO	NO	NO	NO	-
1992	6.64	6.64	10.90	10.90	0.00
1993	9.88	9.88	16.21	16.21	0.00
1994	13.11	13.11	21.53	21.53	0.00
1995	16.35	16.35	26.84	26.84	0.00
1996	19.58	19.58	32.15	32.15	0.00
1997	22.82	22.82	37.47	37.47	0.00
1998	26.06	26.06	42.78	42.78	0.00
1999	29.29	29.29	48.09	48.09	0.00
2000	32.53	32.53	53.41	53.41	0.00
2001	35.77	35.77	58.72	58.72	0.00
2002	39.00	39.00	64.03	64.03	0.00
2003	42.74	42.74	70.17	70.17	0.00
2004	56.70	56.70	93.09	93.09	0.00
2005	102.00	102.00	167.47	167.47	0.00
2006	226.90	215.59	372.51	353.94	-4.99
2007	12.19	1.38	20.01	2.26	-88.69
2008	21.25	1.95	34.88	3.21	-90.81

8.4.6 Source specific planned improvement including those in response to the review rocess

In order to improve the estimation accuracy, more detailed data will be requested for the whole time series.

9. OTHER (CRF sector 7)

There are no GHG emissions that were calculated, and could not be allocated to one of the categories.

10. Recalculations and improvements

10.1. Recalculations and improvements

This chapter presents the changes in GHG emissions/removals between the 2010 version 3.2 and 2011 Greenhouse Gas Inventory submissions version 2.1. Since the 2010 version 3.2 submission, recalculations have been performed for almost all sectors. The recalculations have been carried out in order to account for better activity data (AD) and emission factors (EF) and to correct for some errors in the calculations.

10.2. Explanations and justifications for recalculations, including for KP-LULUCF activities

10.2.1. GHG Inventory

Recalculations by categories

The inventory contains improvements in the following sectors:

Energy:

- As a result of the Energy Balance (EB) revision by the National Institute of Statistics (NIS), the natural gas and biomass consumptions changed for 1989-2008 year (1.AA.1.A);
- As a result of the EB revision by NIS, the gasoline, coke oven coke and refinery gas consumptions changed for 1989 - 2008 years (1.AA.2.F);
- As a result of the EB revision by NIS, the biomass consumption in the railways transport changed for 1992 - 2008 years (1.AA.3.C);
- As a result of the EB revision by NIS, the refinery gas consumption changed for 2008 year the emissions values were corrected because NIS revised EB(1.AA.4.A);

- Considering new monitoring data provided by Transgaz, the CH_4 emissions from the natural gas pipeline transit begun to be characterized within the current submission, for the 2000-2008 period (1.B.2.B.3);
- 1 AA.1.B.- Petroleum Refinery – Other fuels - notation key "NE" was changed in "NO" for 2009 because in this domain not there consumption by other fuels;
- 1.B.2.A.2, 1.B.2A.3, 1.B.2.B.2, 1.B.2.B.3 and 1.B.2.C.1.1 - The adjustments proposed by the European Commission in activity data and CH_4 and CO_2 emissions using the emissions factors the Bulgaria's in CRF tables.
- 1.A.A.2.F.- Other- Other Fuels- notation key "NE" was changed in "NO" for CO_2, CH_4 and N_2O;
- 1A.A.3.B – Road Transport – Biomass - notation key "NE" was changed in "NO" for CO_2, CH_4 and N_2O;
- 1.A.A.3.E – Other Transportation– Other non-specified- Biomass- notation key "NE" was changed in "NO" for CH_4 and N_2O;
- 1.A.A.3.E – Other Fuels - notation key "NE" was changed in "NO" for CH_4 and N_2O;
- 1.A.A.4.B- Residential- Other Fuels- notation key "NE" was changed in "NO" for CO_2, CH_4 and N_2O;
- 1.A.A.4.C- Agriculture/Forestry/Fisheries- Other Fuels- notation key "NE" was changed in "NO" for CO_2, CH_4 and N_2O;
- 1A.A.5.A.- Mobile- Biomass- notation key "NE" was changed in "NO" for CO_2, CH_4 and N_2O;
- 1.A.A.1.A- Public Electricity and Heat Production, 1A.A.1.C- Manufacturing Ind. & Construction, 1.A.A.4.A- Commercial/Institutional, 1.A.A.4.B- Residential and 1.A.A.4.C- Agriculture/Forestry/ Fischeries - Tier 2 - have used specific emission factors for each type of fuel Romania (liquid, gaseous and solid) for CO2 emissions;
- 1.A.A.3.B- Road Transportation – Tier 2 - have used Copert III model .

Industrial Processes:

- Change in the notation keys (NK) for all-time series 1989-2008 as the CO_2 recovery notation keys for the Cement production sub-sector was changed from NE in NO (2.A.1);

- Change in the notation keys (NK) for all-time series 1989-2008 as the CO_2 recovery notation keys for the Lime production sub-sector was changed from NE in NO (2.A.2);
- Change in notation keys (NK) for all-time series 1989-2008 as the CO_2 recovery notation keys for the Limestone and Dolomite use sub-sector was changed from NE in NO (2.A.3);
- Change in notation keys (NK) for all-time series 1989-2008 as the CO_2 recovery notation keys for the Soda ash production and use sub-sector was changed from NE in NO (2.A.4);
- Change in notation keys (NK) for all-time series 1989-2008 as the CO_2 recovery notation keys for the Asphalt roofing sub-sector was changed from NE in NO (2.A.5);
- Change in notation keys (NK) for all-time series 1989-2008 as the CO_2 recovery notation keys for the Road paving with asphalt sub-sector was changed from NE in NO (2.A.6);
- Change in notation keys (NK) for all-time series 1989-2008 as the CO_2 recovery, CH_4 recovery, and N_2O recovery notation keys for the Glass production sub-sector was changed from NE in NO (2.A.7.1);
- Change in notation keys (NK) for all-time series 1989-2008 as the CO_2 recovery, CH_4 recovery, and N_2O recovery notation keys for the Ammonia production sub-sector was changed from NE in NO (2.B.1);
- Change in notation keys (NK) for all-time series 1989-2008 as the N_2O recovery, notation keys for the Nitric acid production sub-sector was changed from NE in NO (2.B.2);
- Change in notation keys (NK) for time series 1989-2001 as the CO_2 recovery, N_2O recovery notation keys for the Adipic acid production sub-sector was changed from NE in NO (2.B.3);
- Recalculation for 2003-2008 time series at the silicon carbide sub-sector activity data (AD) level , as a new source was identified; the CH_4 emissions started to be estimated with the 2011 submission (2.B.4.1);
- Change in notation keys (NK) for all-time series 1989-2008 as the CO_2 recovery and CH_4 recovery notation keys for the Silicon Carbide production sub-sector was changed from NE in NO (2.B.4.1);
- Change in notation keys (NK) for all-time series 1989-2008 as the CO_2 recovery and CH_4 recovery notation keys for the Calcium Carbide production sub-sector was changed from NE in NO (2.B.4.2);

- Change in notation keys (NK) for all-time series 1989-2008 as the CO_2 recovery, CH_4 recovery and N_2O recovery notation keys for the Other production sub-sector was changed from NE in NO (2.B.5);
- Recalculation of the entire time series of emissions at the iron and steel production sub-sector level as the CO_2 emissions released from consumed electrodes (2.C.1.5) were added to the CO_2 emissions resulted from steel production (according to the Tier 2 approach, starting with the 2011 submission (2.C.1);
- Change in notation keys (NK) for all-time series 1989-2008 as the CO_2 recovery and CH_4 recovery notation keys for the Iron and steel production sub-sector was changed from NE in NO (2.C.1);
- Since the CO_2 emissions released from consumed electrodes (2.C.1.5) were added to the CO_2 emissions resulted from steel production (tier 2) the activity data for electrodes have been noted as IE from NE during the all-time series (2.C.1);
- Change in notation keys (NK) for all-time series 1989-2008 as the CO_2 recovery and CH_4 recovery notation keys for the Ferroalloys production sub-sector was changed from NE in NO (2.C.2);
- Change in notation keys (NK) for all-time series 1989-2008 as the CO_2 recovery, CH_4 recovery, CF_4 recovery and C_2F_6 recovery notation keys for the Aluminium production sub-sector was changed from NE in NO (2.C.3);
- Recalculation of the 1989- 1993 / 1996-2000 period for CO_2 emissions for the aluminum production sub-sector due to finally activity data were provided (2.C.3);
- Recalculation of the 2003-2009 period due to starting with 2003 introduced an improvement in method for calculating CO_2 emissions for the aluminum production sub-sector. Has been passed from tier 1 to tier 3 Method - IPCC 2006 Methodology (2.C.3);
- Recalculation of the 1997-2009 period due to change the method for calculating PFC emissions for the aluminum production sub-sector. Has been passed from tier 1 to tier 2 Method - IPCC Methodology. For CF_4 emissions the recalculation were made due to improvement of the method starting with 2003 to 2009 year; there is used tier 2 method for emissions calculation. For C_2F_6 emissions the recalculation were made due to change the method for emissions calculation for 1997-2002 period. Starting with 2003 to 2009 the

recalculations was made due to improvement of the method for emissions calculation; it is used tier 2 method - IPCC Methodology, for C_2F_6 emissions calculation (2.C.3);

Solvents and Other Products Use:

- Considering new NMVOC emissions collected data, as a result of a performed recalculation, the NMVOC and CO_2 emissions data on 2008 have been recalculated (3.A).

Agriculture:

- Following the recommendation of the ERT reviewing the 2010 NGHGI, recommendations part of the "Potential Problems and Further Questions from the ERT formulated in the course of the 2010 review of the greenhouse gas inventories of Romania submitted in 2010", the values of the emission factors associated to the sheep and swine have been changed, the recalculations were performed for the 1989-2007 period (4.A);
- Following the recommendation of the ERT reviewing the 2010 NGHGI, recommendations part of the "Potential Problems and Further Questions from the ERT formulated in the course of the 2010 review of the greenhouse gas inventories of Romania submitted in 2010", the values of the emission factors associated to the sheep, goats, horses, mules and asses and poultry have been changed, the recalculations were performed for the 1989-2007 period (4.B);
- The industrial fibre crops (flax for fibre, hemp for fibre) and other industrial crops (tobacco, medicinal and aromatic plant) production values have been included within the non-N-fixing crops production solving an identified error; the recalculation is relevant to the 1989-2008 time series (4.D.1.4);
- New data on annual cultivated organic soils areas have been provided by the National Institute of Research and Development in Soil Science, Agrochemistry and Environment and by the Ministry of Agriculture and Rural Development; the recalculation is relevant to the 1989-2008 time series (4.D.1.5).

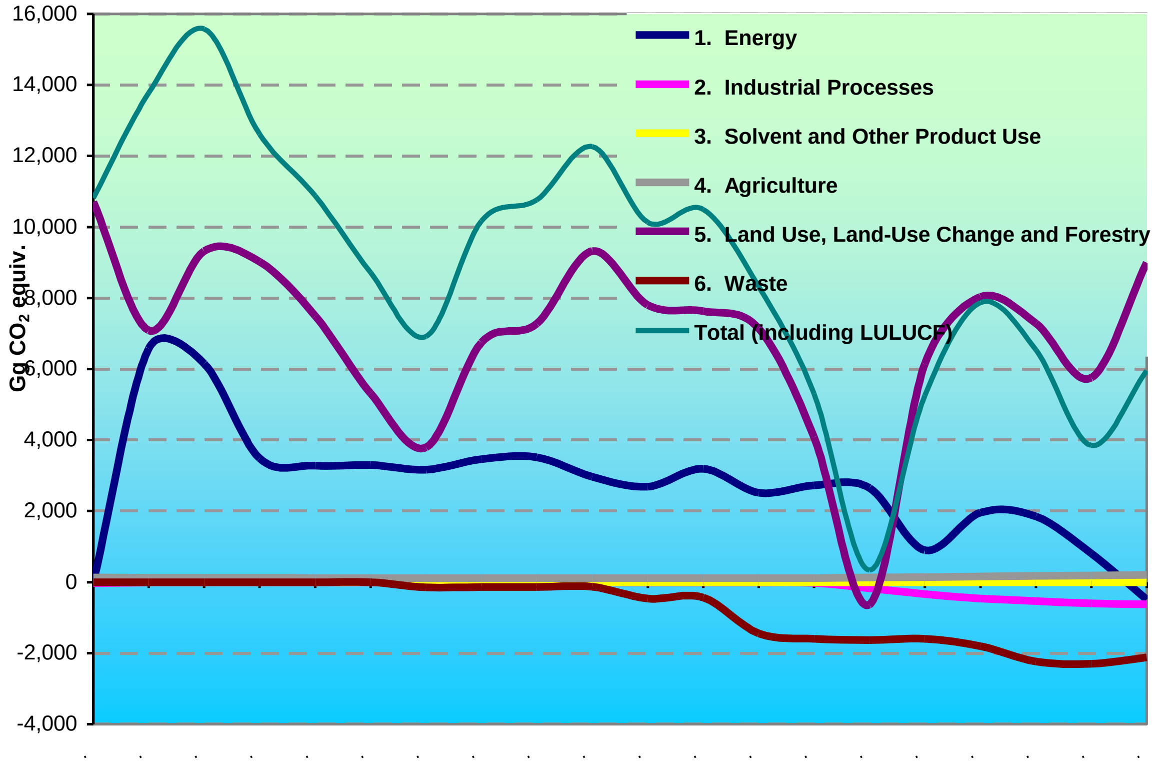
LULUCF:

- Recalculations are presented within Chapter 7 of the present NIR.

Waste:

- FOD method has been used to calculate methane emissions from solid waste disposal in managed sites (6.A.1);
- Final AD on the amount of municipal solid waste and for the percentage of composition of waste in 2008 were provided by the Waste Directorate of the National Environmental Protection Agency (6.A.1; 6.A.2);
- Starting with the current submission, data on methane recovered from landfill facilities, data specific to 2001-2008, have been collected from the operators (6.A.1);
- The data collection methodology on the percentage composition of waste has been changed, starting with 2008 (6. A.1; 6.A.2);
- Starting with 2006, the values for industrial hazardous incinerated waste amount have been recalculated because it has been noticed that three plants that have been considered as incineration plants proved to be co-incineration plants (6.C.2);

Figure 10.1 Category total emissions/removals change, for all gases, and for the entire time series, in comparison to the figures in the 2010 version 3.2 submission



Recalculations by gases

CO_2 recalculations were carried out in the following sectors:

- Public electricity and heat production (1.AA.1.A);
- Manufacturing industries and constructions (1.AA.1.C);
- Road Transport (1.A.A.3.B);
- Railways (1.AA.3.C);
- Commercial/ Institutional (1.A.A.4.A);
- Residential (1.A.A.4.B);
- Iron and steel production (2.C.1);
- aluminum production (2.C.3);
- Paint application (3.A);
- Waste incineration (6.C);
- Recalculations are presented within Chapter 7 of the present NIR (5).

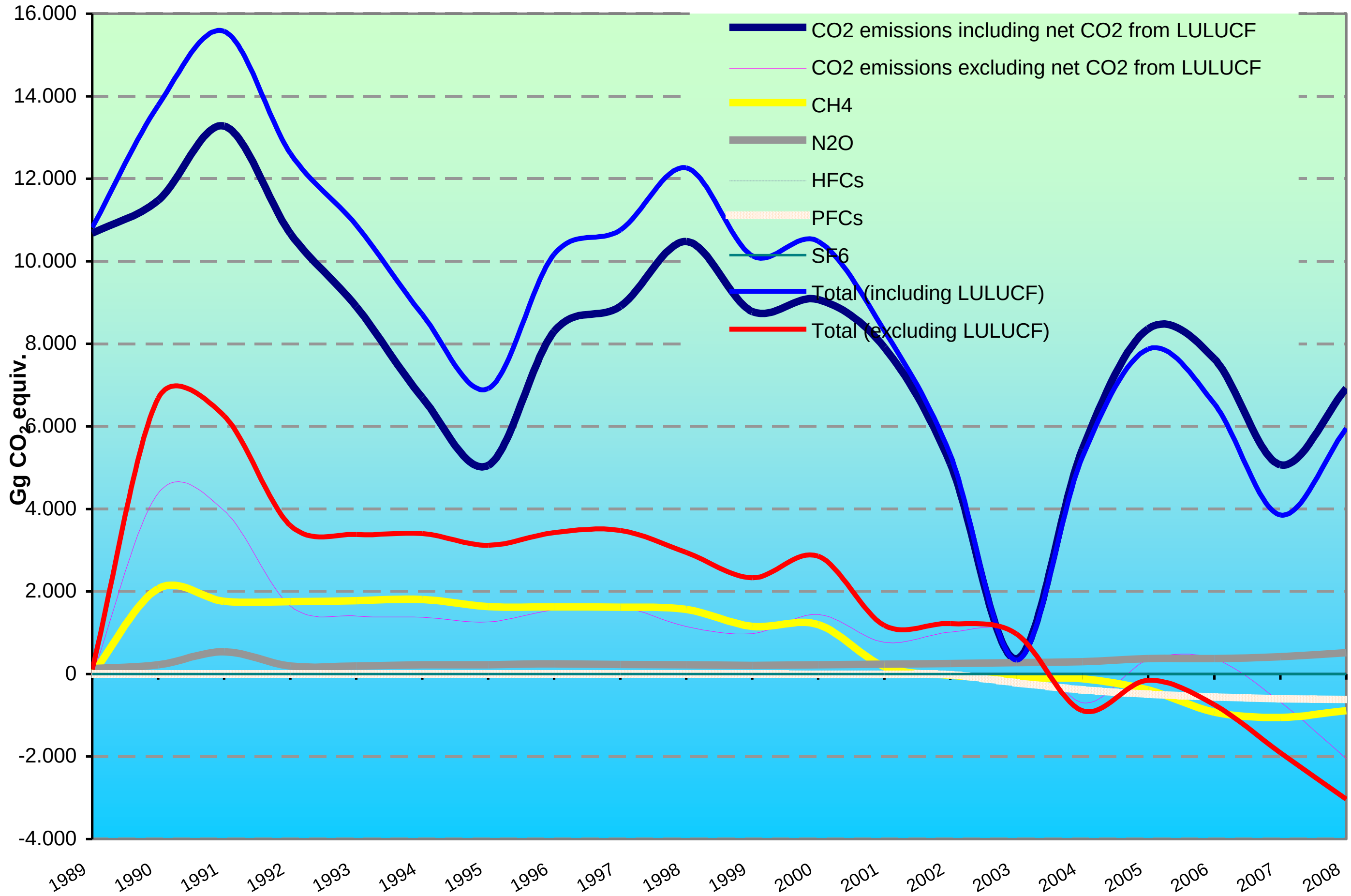
CH_4/N_2O recalculations were carried out in the following sectors:

- Public electricity and heat production (1.AA.1.A);
- Manufacturing industries and constructions (1.AA.1.C);
- Road Transport (1.A.A.3.B);
- Railways (1.AA.3.C);
- Commercial/Institutional (1.A.A.4.A);
- Residential (1.A.A.4.B);
- Agriculture/Forestry/Fischeries (1.A.A4.C;
- Transmission (1.B.2.B.3);
- Silicon carbide production (2.B.4.1);
- Crop residue (4.D.1.4);
- Cultivation of histosols (4.D.1.5);
- Solid Waste Disposal on Land (6.A);
- Recalculations are presented within Chapter 7 of the present NIR (5).

PFC recalculations were carried out in the following sectors:

- aluminum production (2.C.3);

Figure 10.2 Change in pollutant specific total emissions/removals, for all source/absorber categories, and for the entire time series, in comparison to the 2010 version 3.2 report



10.2.2. KP-LULUCF inventory

Recalculations are presented within Chapter 11 of the present NIR.

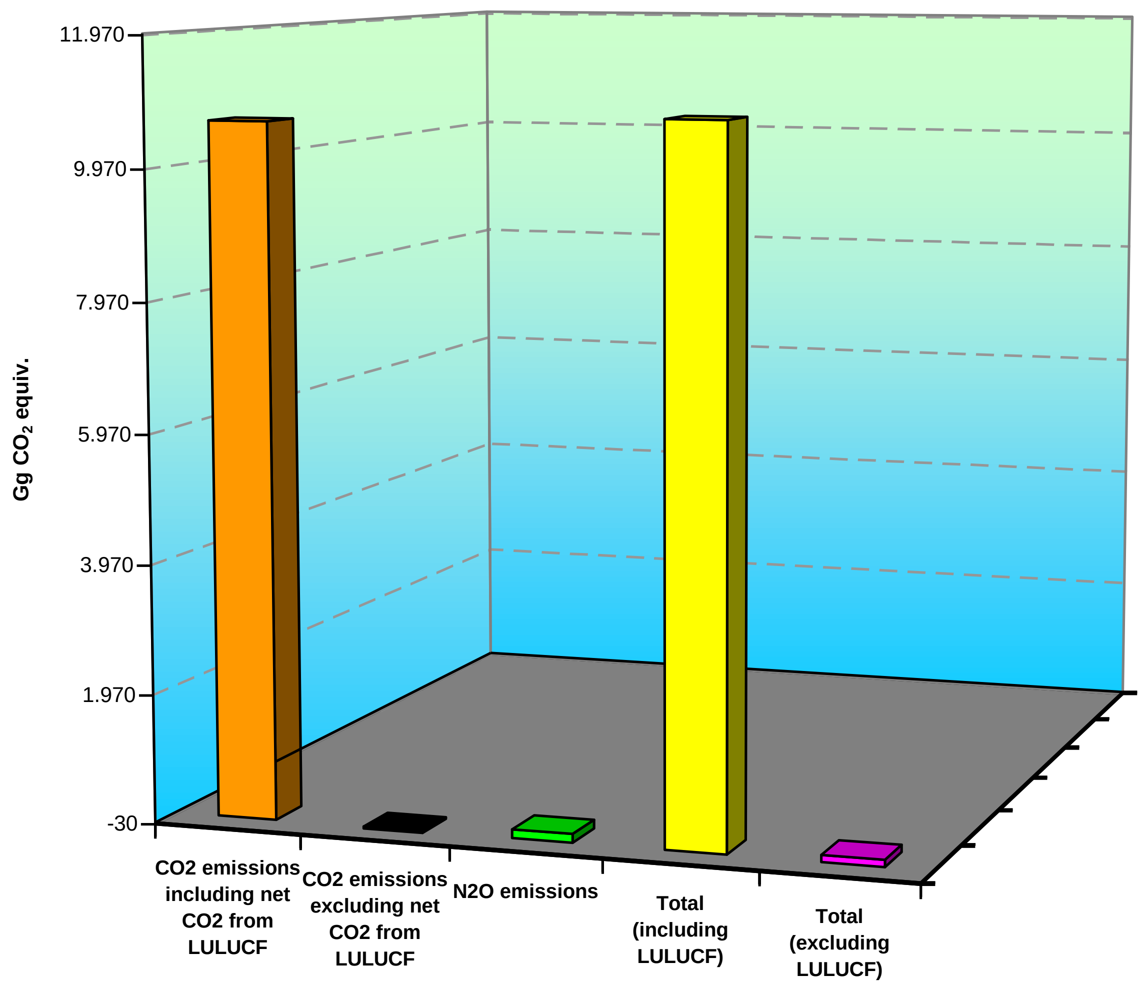
10.3. Implications for emissions levels, including on KP-LULUCF emissions levels

10.3.1. GHG inventory

Emissions changes due to recalculations, for 1989 are as follows:

- Total GHG including LULUCF (4.32%), excluding LULUCF (0.04%);
- N_2O (0.34%);
- CO_2 excluding LULUCF (-0.01%), CO_2 including LULUCF (6.64).

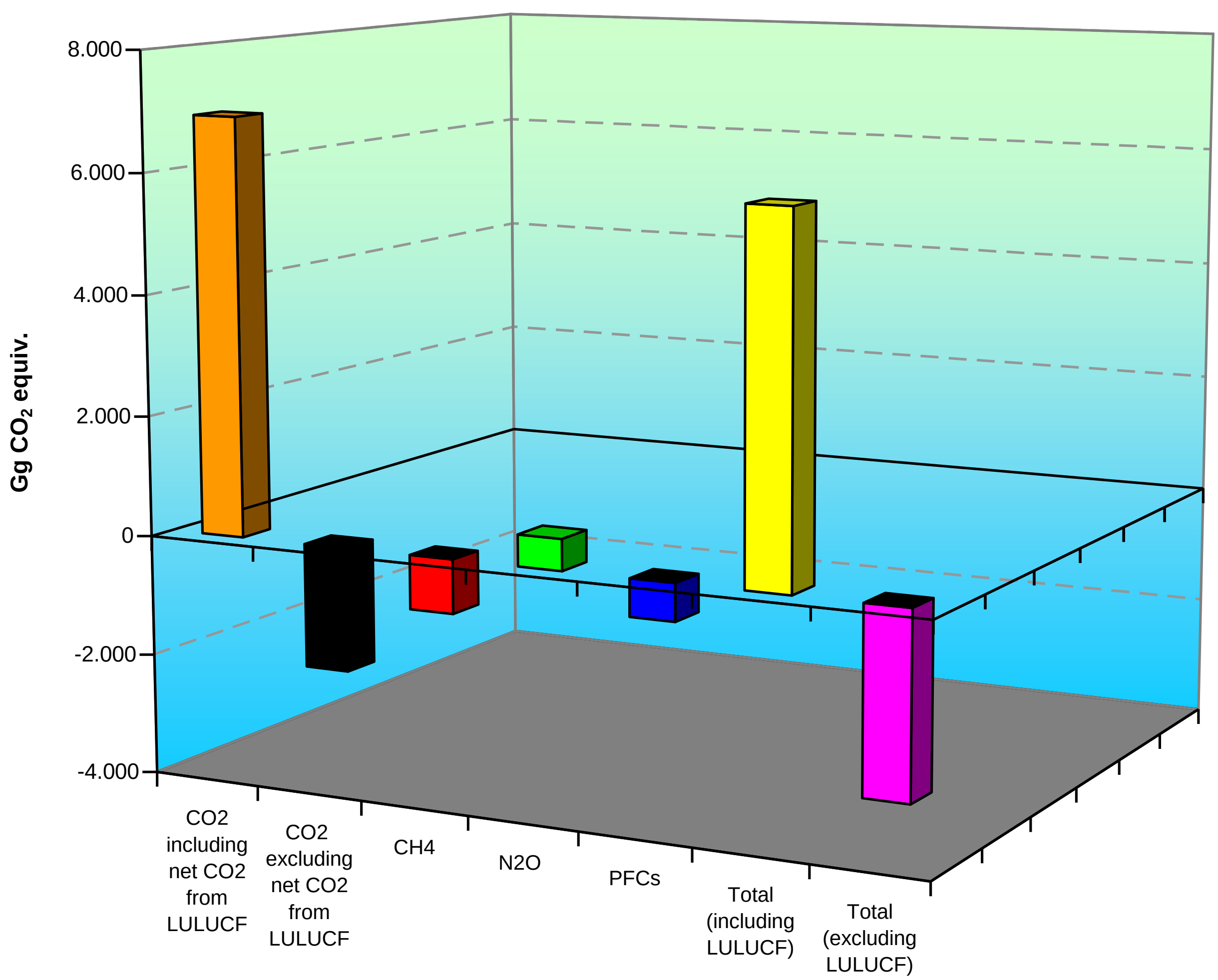
Figure 10. 3 Effects of recalculations (presented in the 2011 submission v2.1) for 1989, by gas



Emissions changes due to recalculations, for 2008, are as follows:

- CO_2 including LULUCF (10.01%), excluding LULUCF (-1.94%);
- CH_4 (-3.35 %);
- N_2O including LULUCF (2.68%); N_2O excluding LULUCF (2.57);
- PFC (-97.57);
- Total GHG including LULUCF (5.11%);
- Total GHG excluding LULUCF (-1.98%).

Figure 10.4 Effects of recalculations (presented in the 2011 submission v 2.1) for 2008, by gas



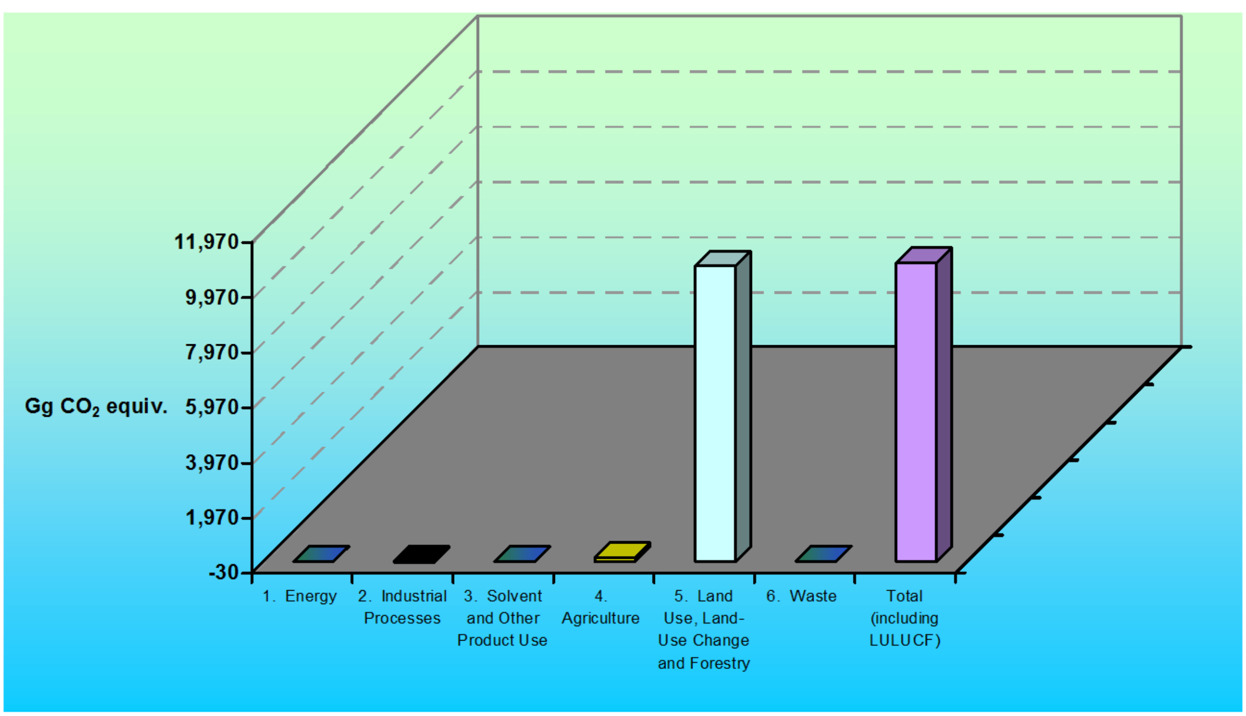
Impacts on 1989 emissions levels

Total emissions in 1989 including LULUCF increased by 4.32% compared to the 2010 submission. Version 3.2.

Table 10.1 Recalculation of total emissions/removals, by sector, for all gases, for 1989

Differences for 1989 estimates	Differences		2011 version 2.1 submission	2010 version 3.2 submission
	Gg CO_2 eq.	%	Gg CO_2 eq.	Gg CO_2 eq.
1. Energy	0	0	188,410.31	188,410.31
2. Industrial Processes	-26.67	-0.06	42,751.12	42,777.79
3. Solvent and Other Product Use	0	0	645.80	645.80
4. Agriculture	134.27	0.28	48,265.56	48,131.29
5. Land Use, Land-Use Change and Forestry	10709.01	-33.02	-21,723.92	-32,432.93
6. Waste	0	0	2,919.60	2,919.60
Total (including LULUCF)	10816.61	4.32	261,268.47	250,451.86

Figure 10.5 Changes of 1989 emissions/removals, in respect to the 2010 version 3.2 figures

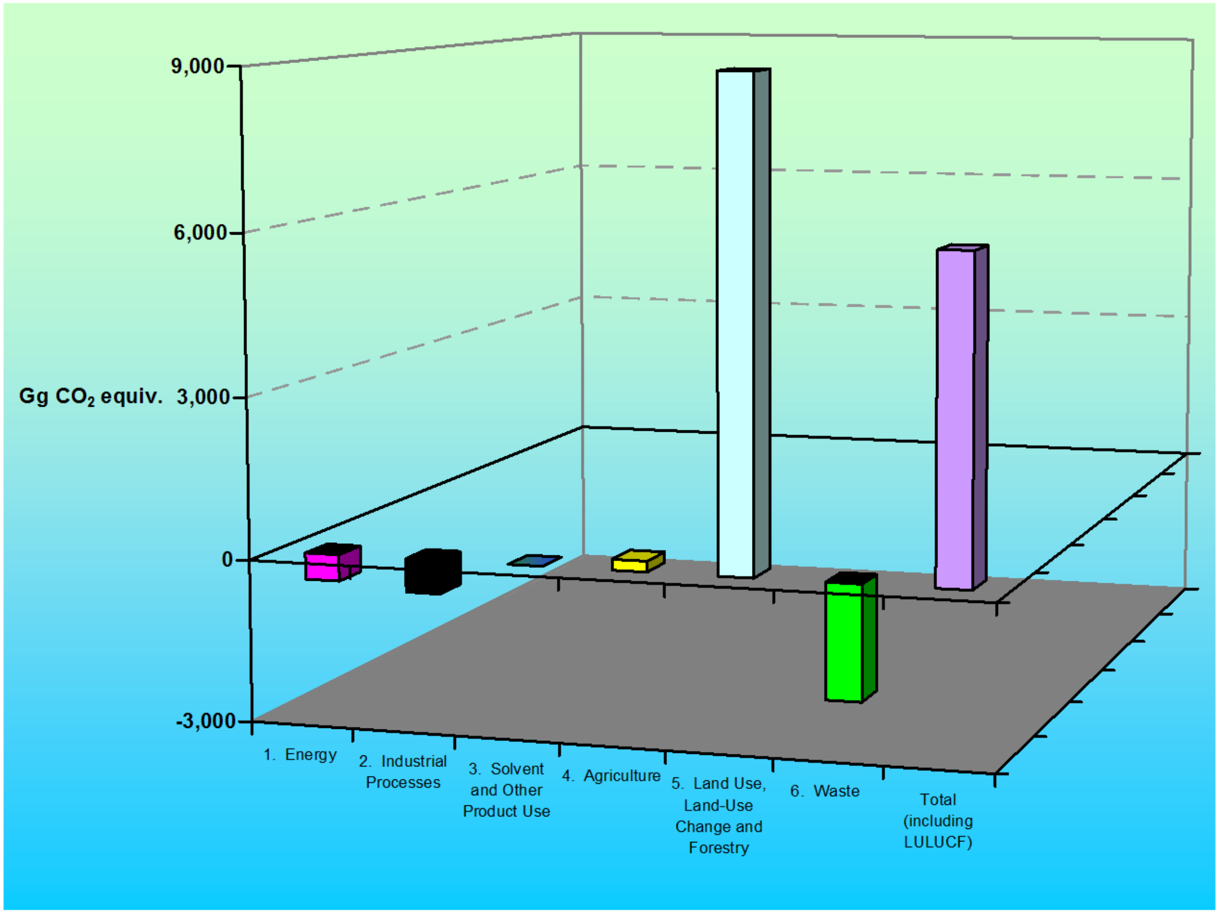


Total emissions in 2008, including LULUCF increased by 5.11 % compared to the 2010 submission. Version 3.2

Table 10. 2 Recalculation of total emissions/removals, by sector, for all gases, for 2008

Differences for 2008 estimates	Differences		2011 version 2.1 submission	2010 version 3.2 submission
	Gg CO_2 eq.	%	Gg CO_2 eq.	Gg CO_2 eq.
1. Energy	**-491.06**	**-0.48**	**101,500.34**	**101,991.40**
2. Industrial Processes	**-620.67**	**-3.31**	**18,128.01**	**18,748.67**
3. Solvent and Other Product Use	**0.40**	**0.30**	**135.14**	**134.74**
4. Agriculture	**199.23**	**0.78**	**25,643.34**	**25,444.12**
5. Land Use, Land-Use Change and Forestry	**8993.54**	**-24.70**	**-27,421.02**	**-36,414.56**
6. Waste	**-2123.04**	**-32.09**	**4,492.17**	**6,615.22**
Total (including LULUCF)	**5958.40**	**5.11**	**122,477.99**	**116,519.59**

Figure 10.6 Changes of 2008 emissions/removals, in respect to the 2010 version 3.2 figures



Elements on LULUCF related recalculations

Compared to previous submission, there is major recalculation that leads to 33% decrease of the annual sink in 2009 for the category 5A1, the most important contributor to LULUCF sector. Meantime LULUCF sink is reported 33% less compared to earlier version of the national GHG inventory. This is due to major re-calculation of the emissions/removal on forest land and all other categories. Detailed explanations are available with the relevant sections for each land category or GHG sources.

10.3.2. KP-LULUCF inventory

Recalculations are presented within Chapter 11 of the present NIR.

10.4. Implications for emissions trends, including time series consistency, and also for KP-LULUCF trends and time series consistency

10.4.1. GHG inventory

The time-series consistency has been improved as a result of recalculations.

KP-LULUCF inventory

The time-series consistency has been improved as a result of recalculations.

10.5. Recalculations in response to the review process, including for the KP-LULUCF activities

10.5.1. GHG inventory

In response to the review process, recalculations were carried out as follows:

- As a result of the Energy Balance (EB) revision by the National Institute of Statistics (NIS), the natural gas and biomass consumptions changed for 1989-2008 year (1.AA.1.A);
- As a result of the EB revision by NIS, the gasoline, coke oven coke and refinery gas consumptions changed for 1989 - 2008 years (1.AA.2.F);
- As a result of the EB revision by NIS, the biomass consumption in the railways transport changed for 1992 - 2008 years (1.AA.3.C);

- As a result of the EB revision by NIS, the refinery gas consumption changed for 2008 year the emissions values were corrected because NIS revised EB(1.AA.4.A);
- Considering new monitoring data provided by Transgaz, the CH_4 emissions from the natural gas pipeline transit begun to be characterized within the current submission, for the 2000-2008 period (1.B.2.B.3);
- 1 AA.1.B.- Petroleum Refinery – Other fuels - notation key "NE" was changed in "NO" for 2009 because in this domain not there consumption by other fuels;
- 1.B.2.A.2, 1.B.2A.3, 1.B.2.B.2, 1.B.2.B.3 and 1.B.2.C.1.1 - The adjustments proposed by the European Commission in activity data and CH_4 and CO_2 emissions using the emissions factors the Bulgaria's in CRF tables.
- 1.A.A.2.F.- Other- Other Fuels- notation key "NE" was changed in "NO" for CO_2, CH_4 and N_2O;
- 1A.A.3.B – Road Transport – Biomass - notation key "NE" was changed in "NO" for CO_2, CH_4 and N_2O;
- 1.A.A.3.E – Other Transportation– Other non-specified- Biomass- notation key "NE" was changed in "NO" for CH_4 and N_2O;
- 1.A.A.3.E – Other Fuels - notation key "NE" was changed in "NO" for CH_4 and N_2O;
- 1.A.A.4.B- Residential- Other Fuels- notation key "NE" was changed in "NO" for CO_2, CH_4 and N_2O;
- 1.A.A.4.C- Agriculture/Forestry/Fisheries- Other Fuels- notation key "NE" was changed in "NO" for CO_2, CH_4 and N_2O;
- 1A.A.5.A.- Mobile- Biomass- notation key "NE" was changed in "NO" for CO_2, CH_4 and N_2O;
- 1.A.A.1.A- Public Electricity and Heat Production, 1A.A.1.C- Manufacturing Ind. & Construction, 1.A.A.4.A- Commercial/Institutional, 1.A.A.4.B- Residential and 1.A.A.4.C- Agriculture/Forestry/Fischeries - Tier 2 - have used specific emission factors for each type of fuel Romania (liquid, gaseous and solid) for CO2 emissions;
- 1.A.A.3.B- Road Transportation – Tier 2 - have used Copert III model.
- Recalculation for 2003-2008 time series at the silicon carbide sub-sector activity data (AD) level, as a new source was identified; the CH_4 emissions started to be estimated with the 2011 submission (2.B.4.1);

- Recalculation of the 2003-2009 period due to starting with 2003 introduced an improvement in method for calculating CO_2 emissions for the aluminum production sub-sector. Has been passed from tier 1 to tier 3 Method - IPCC 2006 Methodology (2.C.3);
- Recalculation of the 1997-2009 period due to change the method for calculating PFC emissions for the aluminum production sub-sector. Has been passed from tier 1 to tier 2 Method - IPCC Methodology. For CF_4 emissions the recalculation were made due to improvement of the method starting with 2003 to 2009 year; there is used tier 2 method for emissions calculation. For C2F6 emissions the recalculation were made due to change the method for emissions calculation for 1997-2002 period. Starting with 2003 to 2009 the recalculations was made due to improvement of the method for emissions calculation; it is used tier 2 method - IPCC Methodology, for C2F6 emissions calculation (2.C.3);
- The majority of recalculations have been performed considering the previous ERT recommendations;
- Following the recommendation of the ERT reviewing the 2010 NGHGI, recommendations part of the "Potential Problems and Further Questions from the ERT formulated in the course of the 2010 review of the greenhouse gas inventories of Romania submitted in 2010", the values of the emission factors associated to the sheep and swine have been changed, the recalculations were performed for the 1989-2007 period (4.A);
- Following the recommendation of the ERT reviewing the 2010 NGHGI, recommendations part of the "Potential Problems and Further Questions from the ERT formulated in the course of the 2010 review of the greenhouse gas inventories of Romania submitted in 2010", the values of the emission factors associated to the sheep, goats, horses, mules and asses and poultry have been changed, the recalculations were performed for the 1989-2007 period (4.B);
- Starting with the current submission, data on methane recovered from landfill facilities, data specific to 2001-2008, have been collected from the operators (6.A.1).
- FOD method has been used to calculate methane emissions from solid waste disposal in managed sites (6.A.1);

10.5.2. KP-LULUCF inventory

The majority of recalculations have been performed considering the previous ERT recommendations;

PART II: SUPPLEMENTARY INFORMATION REQUIRED UNDER ARTICLE 7, PARAGRAPH 1

11. KP-LULUCF

11.1 General information

Romania reports GHG emissions and CO_2 removal on the mandatory afforestation/reforestation and deforestation (ARD), and on the elected activities: forest management (FM) and revegetation (Rev). The accounting will be done at the end of the commitment period (in 2014).

11.1.1. Definition of the forest and any other criteria

In Romania, the forest vegetation refers to two main land categories (see also the section 7.1.1 on land representation):

i. “National forest fund” (FF), which includes lands under forestry use (forests, lands for afforestation, lands serving for the needs of forest administration, waters and unproductive lands) included in the forest management plans. The national forest fund is under the forest regime, which represents a system of technical, economical and juridical norms which ensure its sustainable management. The lands included in FF are totally under management planning, which is based on plans regularly renewed and updated (every 10(5) years), for each forest management unit (forest district). Under this land category, only the lands being “forests” are considered "managed forest lands" under KP.

ii. “Forest vegetation from outside the national forest fund” (VFAFF), which is not subject to the forest regime, and for which the development of management plans is not mandatory. Under the Convention it is included under 5C1. These are considered "unmanaged forest lands" under the KP.

Romania's Forest Code (Law 46/2008), currently in force, defines the “forest” as "land area of 0.25 hectares at least, covered with trees whose height must be at least 5 m at maturity under normal conditions of vegetation". The law does not specify the minimum width and crown cover threshold of forest vegetation. This also includes: forest belts, junipers and "wooded grasslands with crown cover greater than 0.4." The definition of forest in 1990 is consistent with the current definition in terms of minimum area of forest land and brings further specifications related to the minimum height of the trees in normal conditions of vegetation.

The new forest code also includes in FF the protective forest belts, junipers area, and wooded pastures with the crown cover over 0.4 (which according to the Forest Law 1996 were included in the VFAFF), but they are still considered as unmanaged till management plans are prepared for them. Data collected by the national and forest statistics are consistent with these definitions, and further on with the definitions implemented by the National Forest Inventory.

11.1.2. Elected activities under Article 3, paragraph 4, of the Kyoto Protocol

Romania has selected two types of activities related to land use in accordance with Article 3.4 of the Kyoto Protocol, namely:

- **forest management** (FM) - applied to managed forest lands, respectively the forests from the “national forest fund”;
- **revegetation** (Rev) - for the activities of establishment of woody plantations on lands outside the national forest fund.

11.1.3. Description of how the definitions of each activity under Article 3.3 and each elected activity under Article 3.4 have been implemented and applied consistently over time.

According to the Romanian legislation, **"afforestation/reforestation"** means “conversion of non-forest land through forest plantations with the transfer of land in the forest fund”, also called “entries into the forest fund”. Such definition implies direct human intervention and allows full consistency with the activity defined in the Marrakesh Accords. These areas are annually reported in the statistical surveys SILV 4 – "Works of forest regeneration executed in the forest fund, on degraded lands and other lands from outside the forest fund". This activity is reported under its Chapter 1 "Regenerated areas on land categories", under the following indicators:

i. unproductive lands;
ii. degraded lands included (transferred) into the national forest fund;
iii. degraded and unproductive lands;
iv. amelioration perimeters and unproductive lands;
v. degraded lands from the forest fund.

Forestry legislation in Romania does not distinguish between afforestation (A) and reforestation activities (R) in the sense of the Marrakesh Accord, so they were treated similarly in the national GHG inventory and supplementary reporting. A/R works has been funded totally or partially from public funds, and it is considered directly human induced.

Natural expansion of forest vegetation on "Other lands" is not considered direct human action, what explains less area under AR in Kyoto reporting than the area reported under conversion to Forestland in the land subcategory 5A2. Further on, since they are included in the FF and are subject to management planning, such lands are reported under the FM.

According to Romanian law the "**deforestation**" (D) is identified with the "definitive leave of a land from the forest fund", which means permanent "change of the forest destination of a land to another destination by the law". Definitive leave from the forest fund follows a procedure drawn by the forest laws. This activity corresponds to the sub-category "5.E.2.1. - Conversions to Settlements", as far as "permanent leave" of a land from the forest fund are only allowed for public works of infrastructures. Major part of the "definitive leave from forest fund" is reported also under 5F2 Forest land converted to Other land, under natural circumstances.

"**Forest management**" (FM) applies to the forest lands included under the national forest fund. The management of the FF is regulated by forest management plans consistent with the environmental, economic and social objectives of the forests. Forest management activity is associated with the subcategory "Forest Land remaining Forest Land - 5A1", which matches with the area reported under the Convention (1990-2009) plus area reported under 5A2.4 Other land converted to Forestland.

"Revegetation" doesn't have an own specific definition in the national statistics, but as defined in Marrakech Accords, it is identified with forest vegetation areas created by planting (thus directly human induced) outside the national forest fund (thus on land which do not belong to the national forest fund). In the statistical report SILV 4, under same Chapter 1, there are reported following additional indicators:

i. plantations on excessively degraded lands outside the forest fund;
ii. plantations on degraded lands not included (taken) in the forest fund;
iii. plantations on other lands including: tree lines (like along roads), belts for field protection (implemented according the Law 83/1993, Law 107/1999), green areas around urban and industrial platforms, anti-erosional plantations and land amelioration perimeters (implemented according the Law 18/1991, Law 107 / 1999).

This activity occurs on non-forest land categories, practically entirely associated with the subcategory "5B1 - Cropland remaining Cropland”.

11.1.4. Description of precedence conditions and/or hierarchy among Article 3.4 activities, and how they have been consistently applied in determining how land was classified

Assignment of the land with forest vegetation in one of the land uses and activities is done in the accordance with the criteria of “land classification by destination”, stipulated in the Technical Norms for the Introduction of the General Cadastre, elaborated by the National Office for Cadastre and Land Registration (ANCPI), according to the Law no. 7 / 1996. National statistics are consistent over time and there is no risk of double accounting or omission of a piece of land, as far as land assignment criteria are applied and verified, according to the Cadastre Law, across the system of data collection and reporting by the NIS.

Afforestation/reforestation and deforestation are provided by separate statistics which do not interfere with each other (in any case afforestation of a deforested land cannot occur under the allocation of such land for infrastructures, and if any further planting of tree occur that is reported under the indicators relevant for Revegetation). On the other hand, an area subject of AR could become subject of deforestation, which is also recorded in the “permanent leave” documentation (but this was not reported so far).

Revegetation activity is associated strictly with non-forest lands categories, and do not interfere with any other activity under the Kyoto Protocol, under strict implementation of forest regime. Revegetation can be easily identified through indicators outlined in Section 0.

11.2. Land-related information

11.2.1. Spatial assessment unit used for determining the area of the units of land under Article 3.3

Estimation and reporting CO_2 emissions from the national GHG inventory for the KP activities is made at national boundary scale. Existing information on AR, D and FM allow "Reporting Method 1" based on administrative data, according to GPG LULUCF (IPCC 2003).

Afforestation / reforestation. It is not applicable any condition of area as all afforested lands which are subject to AR enters into forest fund. Furthermore, the lands subject to AR consist in large and compact areas of land, under future need of management, thus minimal area defined for forestland has no practical relevance. If a very small area of afforestation occurs it is usually located next to an existing forest parcel, and it becomes part of a larger unit.

Forest management. It does not apply any area condition for a land which is classified as forest fund. Furthermore, the forest fund consist in large pieces of land under forest planning and management, thus minimal area defined for forestland has no practical relevance.

Deforestation. Activity data for D were obtained from official documents for the approval of the “definitive leave from the forest fund”, according the regulations in force. National law does not establish a minimum area for the land leaving the forest fund as subject to documentation. Very detailed information on such lands (i.e. location, limits, stands description – species, volume, soil type, etc.) is all specified in the documentation submitted for the approval of “definitive leave from the forest fund”. Official documentation is archived by the central public authority responsible for forestry in Romania and its regional branches.

11.2.2. Methodology used to develop the land transition matrix

Methodology for the preparation of the land use change matrix is described in the section 7.2. There are developed 2 matrices: one that starts in 1989, developed for the Convention purpose and another one that starts in 1990 developed for the Kyoto reporting and accounting purpose. The two are fully consistent, the difference are that Convention's one implements 20 years transition period and under KP matrix some lands are relocated (i.e. lands under conversions to forestland resulted from natural expansion of forest, included in forest fund, are reported under FM). The matrix used for estimation of emission/removal on KP eligible lands is presented in the Annex 8.4.

11.2.3. Maps and/or database to identify the geographical locations, and the system of identification codes for the geographical locations

Afforestation and reforestation (**AR**) - mapping and identification

The identification of land area eligible as AR activities could be done based on forest management plans and forest maps, in which these areas are included after the conversion to the forest fund. Thus, the explicit location and plantation/stand description is available for each such area. The respective areas are included in the forest fund based on a set of legal documents, which allow funding of afforestation related work. The land "entering into the forest fund" are registered in the management plan documentation and are reported at the end of each year in the SILV 1, then after the initiation of plantation work in SILV 4. With the "entering into the forestry fund" the land is measured and temporarily mapped, while it is fully included in the forest maps with next management planning of the respective forest district. Further on, such land can be tracked in time through the numbering systems of the forest parcels (compartments), as far as the number (code) remains unchanged over the planning cycles.

Deforestation (D) - mapping and identification

According to Romanian legislation the approval of areas less than 10 ha to “leave the forest fund” is directly approved by the central public authority responsible for forestry. In case of areas larger than 10 ha the approval is given by the Romanian Government. In any case, the data on the area annually “leaving the forest fund” is entirely collected by the central public authority responsible for forestry, which provides aggregated information in the "Annual Report on the status of Romanian Forests". Historical data are archived by the authority as forestry records.

Approval for an area to “leave the forest fund” is based on a special regulation which requires a standard documentation to be filed up and submitted for approval (permit procedure), including a map. This allows explicit identification of the location (i.e. forest district, production units, parcel and sub-parcel) and provides accurate quantitative data on area and stand description parameters. The areas “leaving the forest fund” under natural circumstances (i.e. Danube and internal rivers banks erosion, etc.) are also reported as “leaving the forest fund” (and transferred to “Other lands”).

Revegetation (Rev) - mapping and identification

Activity data on land areas eligible for the re-vegetation activities are provided by SILV 4 (under the indicators mentioned above), without possibility to make an explicit location of all areas reported under such activities, although many areas can be identified based on initial plantation establishment documentation.

11.3. Activity-specific information

11.3.1. Methods for carbon stock change and GHG emission and removal estimates

11.3.1.1. Description of the methodologies and the underlying assumptions used

Afforestation/reforestation

As indicated in GPG LULUCF (IPCC 2003), gross-net accounting rules are applicable for AR activities, and only the net changes in C pools during each year of the commitment period are estimated and reported for accounting purpose. As described under the Chapter 5, the change in the C pools over the commitment period is reported in AR areas for aboveground and belowground biomass, and for the litter pool (under Tier 2). Belowground biomass is currently reported as IE but in the future it is planned to be reported separately. DW is not reported as such pool as it does not occur in such small plantations (less than 20 years old), thus reported as NO in the CRF tables. Estimation methodology and data use is reported under chapter 5, under section 5A2 - Land converted to forestland. Currently there are not reported areas of afforestation which have been subject to harvest, as arguments is the normative techniques for production cycles on degraded lands in Romania. The AR seems not to be a key activity under KP, but in any case with data available it is achievable a Tier 2 data for the estimation.

Deforestation

Total deforested area over 1990-2009 is 54.64 kha, including 4.12 kha reported in the land subcategory 5E2 and 50.5 kha in 5F2. The calculation of associated emissions is done following same methods and input data as described under the chapter 7.6.2. All data used is country specific (with the exception of R factor). C pools reported are aboveground and belowground biomass. Emissions from soils, dead wood and litter C pools are not reported as GPG LULUCF does not provide a method for that and national data is not yet available (for the conversion to settlements). Nevertheless, the emissions from dead wood are reported in the KP table (consistent with convention estimates). D seems not to be a key activity under KP, but in any case it is expected a Tier 1/2 data for the estimation (cause by use of average standing stock volume).

Forest management

FM area is consistent with forest fund areas reported under 5A1 in the convention tables plus area reported under 5A2.4 conversion from other lands. Emissions/removals from FM activity have been calculated, for the purpose of LULUCF KP reporting, following same assumption, formulas and parameters as used for the estimation under the convention (see section 7.2.2. of the NIR). C pools reported are aboveground and belowground biomass. Change in soil organic matter, dead wood and litter are not yet reported (steps for reporting them are described in the section 7.2.7), which does not allow immediate meeting of the requirement of reporting under superior tiers, as far as it is a key category in the national GHG inventory (by association with 5A1).

Revegetation estimates

For the LULUCF-KP reporting, data on “forest vegetation outside the forest fund” established by planting reaches 13.12 kha over 1990-2009, compared to 3.54 kha in 1990. This land type is entirely associated with 5B2 Conversion to cropland. This activity is subject of “net-net accounting”. C pools reported are the same as in case of 5A2 land converted to forestland, with update of data for the following year. Revegetation is not a key activity under KP, but in any case a Tier 2 estimate is achievable under the type of data available for the estimation.

11.3.1.2. Justification when omitting any carbon pool or GHG emissions/removals from activities under Article 3.3 and elected activities under Article 3.4

For the moment there are several C pools which are not yet estimated and a decision on what could be reported as “not a source” is not yet made. Nevertheless, it is very likely that DW in AR and Rev to be reported as NR (as not occurring or as proved as small sinks).

11.3.1.3. Information on whether or not indirect and natural GHG emissions and removals have been factored out

Available activity data and methodologies did not allow the exclusions of indirect and natural GHG emissions from the present estimation of anthropogenic GHG emissions for the relevant activities.

11.3.1.4. Changes in data and methods since the previous submission (recalculations)

With current submissions there are numerous changes compared to previous submissions that affects estimates under the KP, mainly related to the development of a consistent land use change matrix and errors in estimation of GHG emissions/removal. The major change with this submission results from the strict implementation of the definitions of land use: 1) separation of "national forest fund" by the "vegetation outside the national forest fund", 2) consistency in using SILV 4 reported indicators for reporting afforestation/reforestation and revegetation, and 3) reporting entire area "leaving of national forest fund" as deforestation.

The area currently reported under *forest management* activity is some 8% less than that reported previously, because of moving "forest vegetation outside the national forest fund" under the right land classification (grassland) and also, separation of the areas being under conversion to forestland. Thus annual CO_2 removal was re-computed 45 % less than previously estimated (more detailed reasons are explain under section 7.2.6.).

Notable differences occur in case of *deforestation* as far as the areas previously reported as "leaving the forest fund" by natural circumstances were not counted at all. Thus the area reported under deforestation increased to 54.5 kha in 2009. With this, the emissions for 2008 were recalculated to higher annual estimates (some 1500 Gg CO_2) under a large area transferred to "other land" in that year. For 2009 both emissions estimates are very low.

For *afforestation/reforestation*, the CO_2 removal halved for 2008 and 2009 compared to previous submission, despite total areas are close (but better comparison is not possible under missing time series used for previous submissions).

Table 11.15 Percentage differences regarding the previous submission in 2008

	Previous submission Net CO_2 emissions/ removals in Gg	**Current submission** Net CO_2 emissions/ removals in Gg	**%**
FM	-36201.55	-22892.54	58
AR	-271.7	-149.23	82
D	73.94	1190.14	-94
Rv	-48	-82.24	-42

Table 11.16 Report of the individual review of the annual submission of Romania submitted in 2010

No.	**Report paragr anh**	**Identified issue**	**Current status of implementation**
Overview			
1	142	Romania reports complete KP-LULUCF tables, and all activities and pools are reported, either with values or notation keys. **However, the inventory is not complete and the Party has not estimated net carbon soil changes in the litter and dead wood pools in areas under forest management and in mineral soils under revegetation and has not provided verifiable information that the non-accounted carbon pools are not net sources.** The ERT concludes that the Party is not complying with the requirements in paragraph 21 of the annex to decision 16/CMP.1 and the requirements in paragraph 6(e) of the annex to decision 15/CMP.1. **The ERT recommends that Romania complete the reporting of these activities and provide estimates for the missing pools in its next annual submission.**	2011 national GHG inventory includes a new land use change matrix, which allows the estimation of KP activities related area. An improvement plan to ensure completeness on C pools and GHG sources for the relevant KP activities is provided under the Convention section 7.2.7
2	143	**Emissions of N2O from drainage of soils and from disturbances associated with land-use conversion to cropland, CO2 emissions from liming of soils, and net carbon stock changes in dead wood in areas under revegetation, organic soils in areas under all activities, and mineral soils under forest management, are reported as "NO", and although explanations are provided in the NIR, the ERT considers the explanations to be insufficiently transparent.** The ERT recommends that, in its next annual submission, the Party improve the explanations in the NIR, including references supporting the	New estimates on the C pool and GHG sources are provided with the current re-submission. Also, an improvement plan to ensure completeness on C pools and GHG sources for the relevant KP activities is provided under the Convention section

No.	Report paragr anh	Identified issue	Current status of implementation
		assumptions used, in order to increase the transparency of its reporting.	7.2.7
3	144	In the NIR, Romania addresses and discusses all the information requested by the annexes to decisions 15/CMP.1 and 16/CMP.1. However, the ERT considers that the information is not provided in a fully transparent manner and that it does not provide the necessary detail for an objective assessment of the activities, for example: information on the methodologies and country-specific parameters used for the calculation of emissions and removals from forest management and revegetation activities are insufficient; and details on the expert judgement assumptions used to construct the land-use matrices are not provided.	Effort to improve the transparency of reporting is ensured with the current re-submissions.
4	145	The representation of land-use change is not consistent with the IPCC good practice guidance for LULUCF: Romania combines statistical information on land use for each year with expert judgement to develop the land-use matrices. In addition, in order to prepare the reporting on forest management, Romania uses sources of information, such as data on afforestation and reforestation projects that are different from those it used to prepare estimates under the LULUCF sector. The ERT concludes that the information provided by the Party is insufficient to clarify how the annual areas reported are estimated. The ERT recommends that Romania provide more detailed and transparent information on how the land-use matrices are constructed in its next annual submission.	2011 national GHG inventory includes a new land use change matrix, which allows the estimation of KP activities related area.
Activities under Article 3, paragraph 3, of the Kyoto Protocol *Afforestation and reforestation – CO_2*			
5	147	In its submission of 13 August 2010, and in accordance with the NIR, the Party included under the definition of afforestation and reforestation all areas smaller than the minimum threshold (0.25 ha) if the minimum width of these areas was larger than 20 m. The ERT informed Romania that Parties may consider an additional variable to restrict the definition of forest, provided that these attributes cannot be used to include additional areas under forest, and the ERT requested that Romania remove these areas and recalculate the emission and removals estimates for afforestation and reforestation in the list of potential problems and further questions.	Consistency in the implementation of land definition is ensured and transparently explained in the NIR See also section 7.1.1. on land consistency.

No.	Report paragr anh	Identified issue	Current status of implementation
		Responding to the ERT (in the submission of 5 November 2010), Romania provided revised estimates for afforestation and reforestation in accordance with the request made by the ERT, with the result that the total area under afforestation and reforestation in 2008 was reduced from 28,187 ha to 28,163 ha and reported removals were reduced from 178.93 Gg CO_2 eq to 178.77 Gg CO_2 eq. The ERT concludes that this issue was resolved.	
6	148	In its original submission, Romania reported net carbon stock changes in soils as "NE", and did not provide information demonstrating that this unaccounted pool was not a source of anthropogenic GHGs in 2008. During the review, the ERT informed the Party that it had not provided the mandatory information requested by decision 15/CMP.1 (annex, para. 6(e)), and requested that the Party provide revised estimates or a justification. In response to the ERT's request, Romania provided, in its submission of 5 November 2010, an estimate of carbon stock changes from this pool using a tier 1 approach, which resulted in an additional removal of 25.23 Gg C. The ERT encourages the Party to use a higher-tier level to estimate emissions from this pool in its next annual submission.	An improvement plan to ensure completeness on C pools and GHG sources for the relevant KP activities is provided under the Convention section 7.2.7
	149	The ERT noted that areas reported in the CRF tables under the Convention and under the Kyoto Protocol are not consistent, and no explanations for the differences are provided by the Party: an area of 25.60 kha was reported as afforestation and reforestation in table NIR 2; while 28.16 kha was reported in CRF table 5(KP-1) A.1.1 and "NO" in CRF table 5(KP-1) A1.1.2; and the total area of land converted to forest land calculated from the cumulative areas reported in CRF table 5.A for the period 1989–2008 was 664.40 kha. Although the Party reports that it only considers as afforestation and reforestation the areas where the status was officially changed (see para. 146 above), the difference between both values is very significant. The ERT recommends that Romania re-check the underlying statistical information and explain the difference in its next annual submission.	Consistency across CRF tables is ensured with the current submission.
7	150	Romania uses a tier 3 model to estimate carbon stock	Effort to improve the

No.	Report paragr anh	Identified issue	Current status of implementation
		changes in living biomass. The ERT considers that the description of the model in the NIR does not contain all the necessary details; for example, data on annual growth is only presented for one forest species, and comprehensive information on the values of parameters used for all species is not found in the NIR. The ERT recommends that the Party improve the transparency of the reporting of the model in its next annual submission, providing more detail and comprehensive information on the values of the parameters used.	general transparency of the NIR has been made, also regarding the availability of supporting references and documentation.
Deforestation – CO_2			
8	151	Romania does not provide transparent information on the methodology and AD used to estimate emissions from deforestation. The NIR presents the equations used to estimate losses of living biomass, dead organic matter and carbon stocks in mineral soil, but does not provide details supporting the underlying assumptions (e.g. the delay of emissions over several years after the approval for deforestation, and the chosen values for the average dead organic matter in forests). The ERT recommends that the Party improve the transparency of its reporting of the methodology and AD used by providing clear explanations of the assumptions.	Effort to improve the general transparency of the NIR has been made, also regarding the availability of supporting references and documentation.
9	152	The NIR states that, due to legal constraints in Romania, deforestation only occurs to settlements. However, in the CRF tables for the LULUCF sector the Party reports annual values of forest land converted to grassland, wetlands, settlements and other land. The cumulative area for these land-use changes over the period 1989–2008 is 485.40 kha, and the cumulative area of forest land converted to settlements is 17.35 kha; both of these values represent larger areas than the 3.80 kha reported in CRF table 5(KP-1)A.2. The ERT considers that emissions from this activity may be underestimated and recommends that the Party revise the estimates for the next annual submission.	Consistency across CRF tables is ensured with the current submission.
Activities under Article 3, paragraph 4, of the Kyoto Protocol *Forest management – CO_2*			
10	153	Forest management is a non-mandatory activity elected by the Party and it is a key category responsible in 2008 for net removals of 36,247.46 Gg CO_2 eq, which amount to 23.7 per cent of total GHG emissions excluding LULUCF.	Effort to improve the general transparency of the NIR has been made, also regarding the availability of

No.	Report paragr anh	Identified issue	Current status of implementation
		Nevertheless, the Party uses a tier 1 methodology to estimate emissions and removals from this category, which, furthermore, is not transparently presented in the NIR. The ERT considers that the methodology used by Romania is not appropriate to the national circumstances and to the importance of the emissions from this activity, and therefore recommends that the Party move to a higher-tier level in its next annual submission.	supporting references and documentation. See section 7.2.
11	154	In the list of potential problems and further questions, the ERT requested Romania to provide estimates of carbon stock changes for the litter and dead wood pools, which were reported as “NE”. In the NIR, the Party justifies this option with the use of a tier 1 methodology, which the ERT finds is not in accordance with the IPCC good practice guidance for LULUCF. Responding to the request from the ERT, Romania stated that it will wait for the results from the next national forestry inventory, expected in 2011, to prepare estimates and report in the 2012 submission. The ERT recommends that the Party make efforts through the arrangements set in the national system to speed up the availability of the necessary data.	An improvement plan to ensure completeness on C pools and GHG sources for the relevant KP activities is provided under the Convention section 7.2.7
		Revegetation – CO_2	
12	155	Under the activity revegetation, Romania includes forest patches and belts with a width of less than 20 m and an area of less than 0.5 ha, planted for protecting crop fields, and short rotation forestry crops for bioenergy. The ERT found little information on this activity in the NIR related to the methodology and parameters used. Net carbon stock changes are only estimated for living biomass, and mineral soils are reported as “NE”. The ERT recommends that the Party improve the transparency of reporting for this activity in its next annual submission.	Effort to improve the general transparency of the NIR has been made, also regarding the availability of supporting references and documentation. See section 7.2.

11.3.1.5. Uncertainty estimates

See section 7.2.4 under the convention.

11.3.1.6. Information on other methodological issues

Similar methodological approaches were implemented under the convention and KP reporting. Estimation of GHG emissions from sources is consistent with data and methods used in the convention estimation, and described under the section 7.9 of NIR.

11.3.1.7. The year of the onset of an activity, if after 2008

The area on which KP eligible activities are implemented is reported according the type of source data. FM area matches the forest fund area at the end of 2008 and 2009, and any change compared to beginning of the respective year (or the end of previous year) is reported as "leaving the forest fund" (thus deforestation), while increasing this area is reported as AR. Reporting is annual which ensures right time moment capture of the initiation of an activity.

11.4. Article 3.3

11.4.1. Information that demonstrates that activities under Article 3.3 began on or after 1 January 1990 and before 31 December 2012 and are direct human-induced

Afforested areas are reported by the national statistics (SILV 4) in the year when the planting work starts, which may be later than the year when land entered into the forest fund. In any case, reporting of all AR and D related indicators is annual, which ensures the capture of the initiation of an activity. An afforestation could only occur on non-forest fund land, which is observed by the approval of documentation for funding and "entering the forest fund". Otherwise it is "reforestation after wood harvesting" under national forestry regime (thus eligible as forest management land under the Marrakech Accords).

D areas belonged to the national forest area from 1 January 1990 to the moment in time (between 1 January 1990 and 31 December 2009) when were designated, by means of an administrative act (e.g., minister order, governmental decision), a different land use category.

11.4.2. Information on how harvesting or forest disturbance that is followed by the re-establishment of forest is distinguished from deforestation

A land which is included in the national forest fund cannot leave this land category without following the legal deforestation procedure. The forest disturbance alone cannot trigger land conversions from forestland. Thus distinction between harvested and disturbance affected areas, on the one hand, and deforestation, on the other, is made as follows: for the former, there is legal obligation for the forest owner/administrator to maintain the land under forests category and forestry regime, to apply the forest management plans specifications and regenerate it within a given timeframe (maximum 2 years) and under specific conditions; for the latter, with the issuance of the approval, a new land use category is assigned to this land, and the forestry regime is no longer applicable.

11.4.3. Information on the size and geographical location of forest areas that have lost forest cover but which are not yet classified as deforested

A land which is included under the forest fund is under forestry regime, which consists in application of a set of administrative and technical norms. A basic requirement of the forest regime is that an area has to be afforested in maximum 2 years, since entered into the forest fund or after wood harvesting, without reference to a minim area. Its implementation is observed by public authority responsible for forestry.

11.5. Article 3.4

11.5.1. Information that demonstrates that activities under Article 3.4 have occurred since1 January 1990 and are human-induced

Confirmation that the revegetation activity occurred since 1990 is given by the fact that they were reported in SILV 4 in the year when activity started. Planting of trees subject to revegetation were also mainly funded from public funding.

11.5.2. Forest management activity occurs on lands which are part of the national forest fund. Information relating to Revegetation

This activity has no direct equivalent in Romanian forestry or land management system, but correspondences with plantation of trees on non-forest lands (as shown above). Its election for KP target compliance was due under the initiative of establishment of national forest belt system, initially thought flexible in terms of meeting forest definition thresholds, legal classification of the land, ownership, management obligations and administration patterns.

Activity data is available either as *number of planted trees* or *km of tree lines*. Though information on these areas is available in SILV 4, their management is in the competence of the land owners of the agricultural land or companies that own/administrate infrastructure (e.g., railways, roads, etc.). With the adoption of the new Forest Law in 2008, forestry shelterbelts are made subject to the forestry regime, even though they do not meet the definition of “forest”, which becomes effective with the initiation of the forest management planning cycle (until then they are still unmanaged). Recent decline of forest shelterbelts or tree lines establishment is caused by fragmentation of lands ownership and improved road safety rules implementation.

11.5.3. Information relating to Forest Management

Forest management activity refers to forest fund land for which a management plan has been set up and the forest regime is implemented. Such lands are managed according to management plans, mapped, continually surveyed for disturbances, landmarked and up-dated in statistics. The forestry regime relies primarily on the forest law, then in subsequent legislation and technical norms, in order to ensure sustainable forests management at national scale.

11.6. Other information

11.6.1. Key category analysis for Article 3.3 activities and any elected activities under Article 3.4

In the national GHG inventory, the Tier 1 analysis (Level Assessment, including LULUCF), showed that the CO_2 removals from the category “5A1 forest land remaining forest land” is a key category. For this category country specific data is used, with still incomplete reporting on some C pools under missing national data. Significant change regarding the two related estimates (“forestland remaining forestland” under the Convention tables and “forest management” activity under the KP) are not expected for the following years.

11.7. Information relating to Article 6

Romania is implementing an AR activity project as Joint Implementation flexible mechanism under Article 3.3 of the Kyoto Protocol. The project lasts over 2002 to 2017. The transaction of the emission reductions is subject to a commercial contract between RNP Romsilva (Romania) and Carbon Prototype Fund (managed by the World Bank). Calculation of the emissions reduction is based on the partners agreed monitoring plan, while emission reduction amount is subject to an independent verification. The amount of tradable emission reduction associated with the project is determined for three consecutive stages:

- for the pre-commitment period (until the end of 2007) for which there is already an independent verification report available. The removals reported for the period 1 January 2002 to 31 December 2007 is 10.767 Mt CO_2eq for a total area of 6.033 kha.

- for the commitment period (2008-2012) it will be determined by the end of 2012, with the second monitoring of the project plantations;
- post Kyoto period (starting 2013 till 2017).

The monitoring for the accomplishment of the second phase is scheduled in 2012, with the estimates subject to independent verification (JI Track II). The estimates will be calculated for each year of the commitment period and consequently also reported under the Kyoto Protocol.

Current supplementary report includes the JI project area and CO_2 removal, so far. This approach is consistent with GPG LULUCF (IPCC 2003), p. 4.19. CO_2 removal from the JI project activities will be subtracted from the total AR emissions/removals at the end of the commitment period, as allocated to third party.

12. INFORMATION ON ACCOUNTING OF KYOTO UNITS

12.1. Background information

The standard electronic format (SEF) for providing information on ERUs, CERs, tCERs, lCERs, AAUs and RMUs for the year 2010 for the Romanian registry is submitted together with this report (Annex 6.2.3). The data in the Romanian registry reflect the transactions to and from the Community registry and to and from ITL. Summary of information reported in the SEF tables for the Community Registry

The SEF reporting software has been used for submission the standard electronic format tables for the Romanian registry. The tables include information on the AAU, ERU, CER, t-CER, l-CER and RMU in the Romanian registry at 31.12.2010 as well as information on transfers of the units in 2010 to and from other Parties of the Kyoto Protocol. Neither AAUs, nor RMUs have been issued in the Romanian Registry in 2010.

In the Romanian Registry were issued a number of 422159 ERU’s, corresponding to 4 JI projects.

The assigned amount for the Romanian, calculated pursuant to Article 3 paragraphs 7 and 8 as described in the Romanian’s initial report is 1,279,835,099 tonnes CO_2-equivalent.

The total quantities of AAUs during the reporting period are provided in SEF table 5a and 5b.

12.2. Summary of information reported in the SEF tables

SEF tables for the Romanian Registry are provided in Annex 6.2.3.

The following table provides an overview of total quantities of Kyoto Protocol units by account type at end of reported year, information included in Table 4 in Romanian SEF.

Account type	Unit type		
	AAUs	**ERUs**	**CERs**
Party holding accounts	1135305593	NO	NO
Entity holding accounts	45535367	30174	432363
Article 3.3/3.4 net source cancellation accounts	NO	NO	NO
Non-compliance cancellation accounts	NO	NO	NO
Other cancellation accounts	NO	NO	NO
Retirement account	62926235	NO	890591
tCER replacement account for expiry	NO	NO	NO
lCER replacement account for expiry	NO	NO	NO
lCER replacement account for reversal of storage	NO	NO	NO
lCER replacement account for non-submission of certification report	NO	NO	NO
Total	1243767195	30174	1322954

12.3. Discrepancies and notifications

With respect to the respective paragraphs of decision 15/CMP.1 the following information is provided for the Romanian registry:

- Paragraph 12: No discrepances identified by the transaction log;
- Paragraph 13: No notifications directed to the Partry to replace ICERs in accordance with Pararaph 49 of the annex to decision 5/CMP.1;
- Paragraph 14: No notifications directed to the Party to replace ICERs in accordance with para 50 of the annex to decision 5/CMP.1;
- Paragraph 15: No issue of non-replacement;
- Paragraph 16: See Annex 6.2.4;
- Paragraph 17: See Annex 6.2.1.

12.4. Publicly accessible information

The information based on the requirements in the annex to decision 13/CMP is publicly available on the Romanian registry website: http://rnges.anpm.ro .

12.5. Calculation of the commitment period reserve (CPR)

According to the relevant provisions in Decisions 11/CMP. 1 and 13/CMP. 1, Romania calculated the Commitment Period Reserve (CPR) based on the emissions level of 2009 excluding Land Use, Land Use Change and Forestry, as follows:

CPR (tones CO_2 equivalent) = 5 * GHG emissions level in 2009 (tones CO_2 equivalent)

CPR = 5 * 128,745,914.65 = 643,729,573 tones CO2 equivalent

12.6. KP-LULUCF accounting

Romania selected accounting of activities under Art. 3, paragraphs 3 and 4 (forest management and revegetation), of the Kyoto Protocol, for the entire commitment period and intends to report the relevant data at the end of the commitment period.

13. INFORMATION ON CHANGES IN NATIONAL SYSTEM

In accordance with the Governmental Decision no. 1570/December 2007 for establishing the National System for the estimation of anthropogenic greenhouse gas emissions levels by sources and CO_2 removals by sinks, in order to fulfill the relevant provisions in paragraphs 14.b and 14.c of Decision 19/CMP.1 Romania is developing/will develop and/or collect the relevant data/information as are necessary to prepare all estimates of the occurring emissions/removals, considering the provisions in the Revised 1996 IPCC guidelines for national GHG Inventories, in the IPCC good practice guidance and/or in the IPCC good practice guidance on land use, land-use change and forestry, by implementing the studies mentioned in the Table below on a contractual base, by specialized third party organizations.

Table 13.1 Studies under development/which will be developed by Romania in order to fulfill its 'Inventory Preparation' function as described in paragraphs 14.b and 14.c of Decision 19/CMP.1

No.	Title of the study	Outcomes, impact	Results incorporated into NGHGI	Financial instrument
1.	"Elaboration of national emission factors/other parameters relevant to NGHGI Sectors Energy, Industrial Processes, Agriculture and Waste, to allow for the higher tier calculation methods"	Data collection, improvement of information, processing and development of EFs, which will enable Romania to move to higher tier calculations in almost all key categories in the energy, industrial processes, agriculture and waste sectors.	Revised 2011	MEF budget
2.	"NGHGI LULUCF both under the UNFCCC and KP obligations"	Development of national parameters to support the use of higher tier calculation methods in the LULUCF sector, including FM, consistent representation of land matrix and estimating emissions/removals from not-estimated categories and carbon pools.	Revised 2011	MEF budget
3.	"Support for the implementation of the European Union requirements on the monitoring and reporting of the carbon dioxide (CO_2) and other greenhouse gas emissions"	Improved functioning of NS (updating the relevant regulations, including GD no. 1570/2007), improved knowledge of staff in NEPA and subsequent data providers, programs of administrating the national EFs.	Revised 2011	MEF budget
4.	"Environmental Integrated Informational System"	Optimized NGHGI informational fluxes, including on Public electricity and heat production category, implementation of key category and uncertainty analysis. This will supplement the other studies and enhance the NS by optimizing the process through which the NGHGIs are compiled.	2013	MEF budget
5.	Development of historical data (1989-2010) for allowing to estimate direct and indirect GHG emissions from Road Transport using the COPERT IV model associated to the Tier 2 approach"	Developing values of national EFs/other parameters to allow for the use of higher tier calculation methods within the Road transport subsector through the use of COPERT IV model.	2013	Swiss Financial Cooperation Framework 2011/2012 MEF budget

The studies in the Table above have been officially approved by the designated national authority, the Ministry of Environment and Forests. The organization having the responsibility of implementing the acquisition procedure pertaining to the studies previously mentioned, including the contracting stage is the Ministry of Environment and Forests (MEF).

In respect to the provisions in the current Improvement Plan, the studies are meant to improve the accuracy of the GHG Inventory through the use of higher Tier methods according to the specific IPCC good practice guidance decision trees provisions, to improve its completeness by allowing for the estimation of all relevant emissions/removals, to improve the consistency of the data series and the associated transparency.

The scope of the studies is to provide additional information to the Romanian authorities and to optimize the NGHGI related informational fluxes in order to strengthen the compliance with the reporting obligations under the UNFCCC process and the EU monitoring mechanism. The Romanian authorities in charge of the GHG emission reporting are the Ministry of Environment and Forests (MEF) and the National Environmental Protection Agency (NEPA), and thus both institutions will ensure that the studies will provide adequate information. The results of the studies will provide the necessary data for the national GHG emission inventory to fully comply with the IPCC reporting requirements.

According to the specific provisions within the Romanian legislation, namely the Government Decision nr. 1635/2009, the MEF is the responsible institution with implementation of UNFCCC and KP. In addition, MEF is the coordinator of funds distribution for studies in the field of environment and forests.

The NEPA, institution subordinated to MEF, has tasks in the implementation of environment policy and legislation, including the entire responsibility regarding the National GHG Inventory.

Therefore MEF is the contracting authority in charge with the promotion of the different studies and is ensuring the elaboration of relevant documentation necessary for the acquisition of these studies, the formal approval of documents as well as with financial disbursement. NEPA is the beneficiary of these studies and will use the results to adequately meet the reporting obligations.

MEF ensured the fast development of the Terms of Reference (ToRs) of the studies and NEPA supported MEF in drawing up the technical aspects of ToRs, in a way to comply with the needs and the provisions of reporting requirements.

The authority responsible with the technical verification of the results of studies is NEPA which will need to use the results in the inventory preparation and hence the interest of NEPA in participating in the process of contracting the best institution to perform the studies in a professional and timely manner.

The quality management from the initiation, throughout the completion of the studies themselves, and the quality assurance of the findings, will be ensured as follows:

1) within the initiation phase – when drawing up the relevant ToRs, MEF as a contracting authority and NEPA as the implementing agency ensured/will ensure that the necessary data and information provided by the studies will support the Romanian authorities to fully comply with the reporting requirements;

The required quality of these studies is assured by the following legal procedure:

- the Terms of Reference (ToRs) for each of these studies are approved and published by the MEF by using technical elements developed by NEPA with the aim to fill the gaps of recent inventory,
- the funding is provided by the MEF from the sources mentioned below;
- the contractor is developing a work plan approved by the beneficiary observing the timeline indicated in ToRs;
- the implementation is carried out in intermediate steps followed by progress reports subject to the approval of the NEPA as the main beneficiary of these studies;

- during the implementation phase, the contractor is required to provide NEPA, after the generation of the results, the proper documentation on the scope, methods, assumptions, key parameter values and data sources; further on, NEPA is ensuring the adequate use, archive and storage of the information provided;
- the studies are providing also recommendation for long terms solutions in generating similar information annually.

2) during the development phase of the studies

The organizations/entities selected to develop the studies have to perform QC activities through all the stages of the study development, to document all the activities performed and to provide NEPA the specific documentation including the relevant methodology. In this respect, the contractor is asked to perform and document the QC activities through all stages of the study development and to provide relevant documentation to the beneficiary.

Also, through the contract, the organization elaborating the study is asked to ensure the implementation of QA activities in the preparation of the respective studies and to provide NEPA with the relevant documentation.

The implementation of the studies is following the classic procedure: inception phase, progress phases and final phase, and thus offering the possibility to MEF and NEPA to monitor closely their development and avoiding in this way the deviation from the initial scope of the studies.

3) within the reception phase

MEF is making the payments for the contractor only after NEPA's endorsement of results according to contract. Therefore, the studies are providing quality and useful information for the elaboration of GHG inventories in accordance with reporting requirements.

The entire documentation on the scope, methods, assumptions, key parameter values and data sources for each study will be part of the electronic/paper archive stored within the NEPA's headquarters, and are/will be available for using further by experts and checked by review teams. Copies of the relevant documentation are/will be stored at the MEF's headquarters.

Giving its legally assigned task and its designation as the responsible authority for the national system and preparation of the National GHG Inventory management, NEPA is responsible for the incorporation within the NGHGI of all studies results immediately after their delivery.

The issue of on-going collection and QC of currently missing data is one of the most important on-going actions under the national system management. The NEPA inventory team is already engaged in analyzing the previously NE sources in order to minimize the number of NE and decide the sources that are NO or NA in Romania. The planned studies will also support the same endeavor in minimizing the NE sources, and in addition the studies will result in the possibility of using higher tier methods in estimating emissions/removals associated to the key categories.

Sufficient funding to strengthen the NS and improve NGHGI including through the development of specific studies are available from:

- MEF budget;
- Environmental Administration Fund budget

The Environment Fund Administration is a public self-financed authority with legal capacity, under the coordination of MEF and with responsibilities in managing the Romanian Environment Fund in compliance with the provisions of the Emergency Ordinance no. 196/2005 on the establishment of the Environment Fund, subsequently amended and supplemented.

- Swiss Financial Cooperation budget, in the cooperation between Romania and Switzerland.

The funding will be mostly used to strengthen the national system in complying with the reporting requirements.

In addition, the national system will be strengthen by ensuring the proper functioning of the institutional structure and arrangements described in the existing legislation (Governmental Decision 1570/2007). In this process, MEF and NEPA are analyzing the functioning of the institutional arrangements and the involvement of other institutions responsible with providing information, data, methods, factors, parameters.

The national system has been developed from 2008 and it has functioned continuously since then without any disruptions. However, some activities under the national system that were supposed to be implemented in the last couple of years based on previous ERT recommendations, were postponed due to the international financial crisis and the required budget restrictions in the public administration. The trend not only is not continuing but tremendous efforts have been taken in the last period to ensure the financial and human resources necessary in solving the issues identified in due time.

Elements on improvements implemented within the 2011 v. 1.3 NGHGI in comparison to the version 1 of the 2010 NGHGI submission

The improvements implemented within the 2011 v. 1.3 NGHGI in comparison to the version 1 of the 2010 NGHGI submission include:

- estimation of emissions associated to the Electricity and Heat production sub-sector using the calculation method associated to the Tier 1A approach, emission factor values specific to fuels have been calculated based on national data and used (see Annex 8);
- CH_4 fugitive emissions from the natural gas transit were characterized based on national data;
- N_2O emissions from the cultivation of histosols were characterized based on national activity data;
- estimation of CH_4 emissions recovered associated to the Managed Waste Disposal on Land sub-sector;
- estimates associated to the KP-LULUCF activities have been provided;
- as a result of a specific analysis implementation, an important number of NE notation keys associated to the Kyoto Protocol Annex A sectors have been adequately replaced;

consequently, the number of categories whose emissions/removals were not estimated decreased from 299 to 247.

Elements on improvements implemented within the 2011 v. 2.1 NGHGI in comparison to the version 1.3 of the 2011 NGHGI submission

Elements on strengthening the NS

Following the governmental approval of establishing a new unit at NEPA having exclusively the responsibilities of administrating the NS and the NGHGI and allowing for an increased staff number, from 5 to 16, the progresses made comprise:

- finalizing the first phase of staff selection: a total of 3 people have been recruited; the second phase will be implemented at the end of August. As a result, the additional 11 people will be hired by end of August 2011;
- finalizing ensuring appropriate working space and facilities;
- continuing the acquisition of sufficient and performing IT equipment through the support of study “Environmental Integrated Informational System”;
- training the dedicated stuff will be subject of the UNFCCC training courses and of study “Support for the implementation of the European Union requirements on the monitoring and reporting of the carbon dioxide (CO_2) and other greenhouse gas emissions”; additionally, the European Environment Agency (EEA) confirmed the EEA and the European Topic Centre for Air pollution and Climate Change Mitigation will provide technical assistance to the NS/NGHGI dedicated team.

Elements on improving the NGHGI

Based on intermediary results of study “NGHGI LULUCF both under the UNFCCC and KP obligations” and on NEPA’s work, important improvements have been developed and incorporated within the version 2.1 of the 2011 NGHGI.

➢ improving the accuracy

- based on intermediary results of study “NGHGI LULUCF both under the UNFCCC and KP obligations”:
    - revised estimates associated to the Forest land remaining forest land category based also on a revised land use change matrix (LULUCF under the UNFCCC);
    - new estimates of emissions/removals associated to the Land converted to forest land, Cropland, Grassland, Settlements and Other land categories (LULUCF under the UNFCCC);
    - new characterization of the activities pertaining to the Wetlands category (LULUCF under the UNFCCC);
    - implementation of a combined Tier 1-Tier 2 approach to estimate the emissions/removals from KP Article 3.4 Forest management activity (LULUCF under the KP).
- based on NEPA’s work:
    - Tier 2 CO_2 estimates for Public electricity and heat production (Energy);
    - Tier 2 CO_2 estimates for Manufacturing industries and construction, Other sectors and Road transport categories, based on COPERT 3 model use (Energy; activities performed earlier than planned-January 2012, as part of the 2012 NGHGI submission);
    - Tier 3 CO_2 emissions estimates and Tier 2 PFC emissions estimates associated to the Aluminium production category (Industrial processes; elements developed earlier than planned –Middle September 2011, as part of the version 3 of the 2011 NGHGI);
    - Tier 2 estimates for Managed waste disposal on land category (Waste)

- improving the completeness:

- based on intermediary results of study “NGHGI LULUCF both under the UNFCCC and KP obligations”:
    - new estimates of emissions/removals associated to the Land converted to forest land, Cropland, Grassland, Settlements and Other land categories (LULUCF under the UNFCCC);

- new characterization of the activities pertaining to the Wetlands category (LULUCF under the UNFCCC);
- as a result of implementing the two activities mentioned above, the number of categories whose emissions/removals were not estimated (NE categories) decreased with 111 (from 127, for 2009, within the 2011 version 1.3 NGHGI submission, to 16, for 2009, within the version 2 of the 2011 NGHGI submission).

➢ based on NEPA's work

- the number of NE categories in the Energy Sector decreased with 20, from 64, for 2009, within the 2011 v. 1.3 NGHGI, to 44, for 2009, within the 2011 v. 2 NGHGI, as a result of an improved characterization of emissions/removals associated to several categories.

In total, the number of NE categories decreased for 2009 with 131, from 247 within the 2011 v. 1.3 NGHGI submission (April 2011) to 116 within the 2011 v. 2 NGHGI submission.

➢ improving the transparency

- the NIR's sections relevant for the LULUCF under the UNFCCC and, respectively, under the KP, have been updated by the Forest Research and Management Planning Institute, the contractor of the study "NGHGI LULUCF both under the UNFCCC and KP obligations", a third party organization with LULUCF advanced expertise, allowing for better transparency.

➢ improving the consistency

- as a result of the ongoing study "NGHGI LULUCF both under the UNFCCC and KP obligations", the time series consistency and the consistency between the LULUCF under the UNFCCC and the LULUCF under the KP have been improved through revising the land use change matrix associated to the LULUCF under the UNFCCC and the land use change matrix associated to the LULUCF under the KP.

Elements on improvements implemented within the 2011 v. 3.1 NGHGI in comparison to the version 2.1 of the 2011 NGHGI submission

Elements on strengthening the NS

Following the governmental approval of establishing a new unit at NEPA having exclusively the responsibilities of administrating the NS and the NGHGI and allowing for an increased staff number, from 5 to 16, the progresses made comprise:

- finalizing the staff selection: the additional 11 people were hired;
- finalizing ensuring appropriate working space and facilities;
- finalizing ensuring sufficient and performing IT equipment through the support of study "Environmental Integrated Informational System";
- training the dedicated stuff will be subject of the UNFCCC training courses and of study "Support for the implementation of the European Union requirements on the monitoring and reporting of the carbon dioxide (CO_2) and other greenhouse gas emissions"; additionally, the European Environment Agency (EEA) confirmed the EEA and the European Topic Centre for Air pollution and Climate change Mitigation will provide technical assistance to the NS/NGHGI dedicated team; the formalities of accessing the three training lines are under implementation.

Elements on improving the NGHGI

The progresses associated to the 2011 v. 3.1 NGHGI in comparison to the version 2.1 of the 2011 NGHGI submission comprise:

- improvement of transparency of sectoral level;
- improvement of estimates quality in Agriculture and LULUCF Sectors.

The update of the Governmental Decision no. 1570 for establishing the National System for the estimation of anthropogenic greenhouse gas emissions levels from sources and removals by sinks, adopted in 2007 is under consideration within NEPA, aiming mainly to improve the institutional arrangements for collecting data and information to support higher Tier estimation methods.

14. INFORMATION ON CHANGES IN NATIONAL REGISTRY

A description of the Romanian registry was provided in the Romanian initial report. This description was updated in 2010 and the revised description was provided in the last National Inventory Report.

Referring to paragraph 22 of the annex to Decision 15/CMP.1, the following changes have occurred in the Romanian Registry since the last report:

- the website for Romanian Registry (rnges.anpm.ro) including the information based on the requirements in the annex to decision 13/CMP, concerning the Publicly accessible information was periodically updated;
- between 11 - 14 October 2010, the Romanian registry was tested by the Member States registry administrator in order to demonstrate the ability of the registry to perform the processes required under the ETS and its good functioning in conjunction with the Community Independent Transaction Log and in accordance with Art. 72 of Commission Regulation (EC) No 2216/2004 for a standardized and secured system of registries pursuant to Directive 2003/87/EC of the European Parliament and of the Council and Decision 280/2004/EC of the European Parliament and of the Council, as amended by Commission Regulation (EC) No 916/2007 and by Commission Regulation (EC) No 994/2008. Also, the conformity of the tested registry software is verified against the requirements elicited in the Data Exchange Standards for registry systems under the Kyoto Protocol - TECHNICAL SPECIFICATIONS (Version 1.1), document containing the description of the processes, transaction types and supplementary transaction types applicable to the EC registry system (Downloadable from https://quickplace.unfccc.int/QuickPlace/itl-rsa). The Test Confirmation is available in Annex 6.2.2.

No further changes of the Romanian national registry occurred compared to the description provided in the 2010 submission of the NIR.

15. INFORMATION ON MINIMIZATION OF ADVERSE IMPACTS IN ACCORDANCE WITH ARTICLE 3, PARAGRAPH 14

According to the Article 3.14 of the Kyoto Protocol, Annex I countries will take mitigation measures in such a way as to minimize adverse social, environmental and economic impacts on developing countries.

As Romania pointed out in the previous National Communications on Climate Change following the Article 12 of the UNFCCC and also to the European Commission and the European Environmental Agency, following the Decisions 280/2004/EC and 166/2005/EC, the levels of GHG emissions during 1989-2008 were far below the reduction commitment taken within the Kyoto Protocol.

This reduction was mainly the result of the reduction on the economic activities level, the upgrading of technologies and energy efficiency activities promoted in the European Union integration process.

Therefore we can appreciate that the national climate change policy developed so far to reduce GHG emissions has had no impact abroad and especially on developing countries.

The application of the Joint Implementation mechanism in our country aimed firstly at upgrading and refurbishment of old technologies and at improved energy efficiency, with no trans-boundary effects, as well as the implementation in Romania of the European Union Emission Trading Scheme.

Nevertheless Romania is of the opinion that the technical and financing assistance towards the developing countries is very important for the development international policy on climate change, and is willing to join the European Union initiative to provide a “fast start financing” for the developing countries.

Under the fast start financing Romania decided to focus its contribution for the benefit of developing countries associated to the Copenhagen Accord, countries which have committed to take GHG emissions reducing measures and have developed economic strategic partnership relations with our country.

Republic of Moldavia associated to the Copenhagen Accords and committed to reduce the GHG emissions until 2020 by 25% in comparison with the 1990 level.

In this context the 15 million Euros Romanian contribution planned for the fast start financing mechanism will be used for energy efficiency and transport infrastructure projects.

This contribution will strengthen the cooperation for developing the climate change policy in Europe and will support the European integration of the Republic of Moldavia.

16. OTHER INFORMATION

There is no other relevant information which needs to be reported.

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