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LIST OF ABBREVIATIONS

AD	Activity Data
AGB	Above Ground Biomass
AR	Afforestation/Reforestation
AWMS	Animal Waste Management Systems
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
EAF	Electric Arc Furnace
EB	Energy Balance
EC	European Commission
EF	Emission Factor

EUROSTAT	Statistical Office of the European Communities
ERT	Expert Review Team
ETS	European Union-Emission Trading Scheme
FAO	Food and Agriculture Organization
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
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
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
Rev	Revegetation
RNP	Public National Forest Administration
SF_6	Sulphur Hexafluoride
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
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 tenth version of the National Inventory Report (NIR) submitted by Romania, covering the national inventories of GHG emissions/removals for the period 1989-2008 (version 2 of the 2010 submission).

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, for the second time, the report specifies the information required under Article 7.1 of the Kyoto Protocol.

Romania is reporting the elements on Afforestation, Reforestation, Deforestation, Forest Management and Revegetation activities (KP Art. 3 paragraphs 3 and 4 activities) for the first time, 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

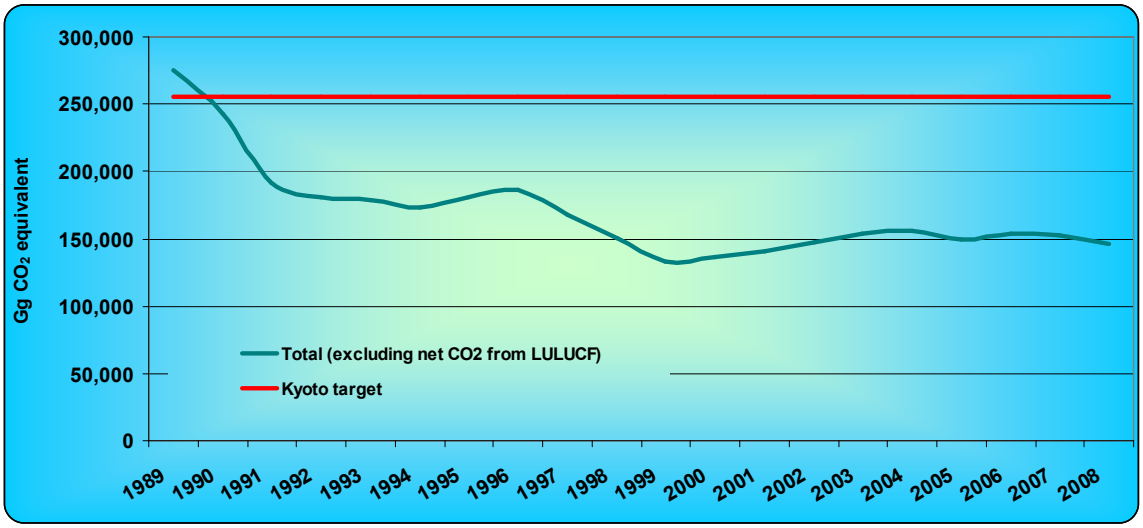
nuclear power plant (1996). The emissions have started to increase after 1999 as a consequence of the economy revitalization.

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 2008, and the average share of each direct GHG in total emissions for 1989-2008 are presented in the next table.

Table ES. 1 Share of each direct GHG in total emissions in 1989, 2008, respectively 1989-2008

GHG	1989 (%)	2008 (%)	Average share for 1989-2008 (%)
CO_2	70.36	71.07	71.29
CH_4	16.90	17.61	17.36
N_2O	11.53	10.86	10.58
HFCs	0.00	0.0141	0.0034
PFCs	1.22	0.43	0.77
SF_6	0.00	0.01119	0.0076

Figure ES 1 The total GHG emissions in CO_2 equivalent during 1989-2008



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 2008, the GHG emissions without LULUCF have decreased with 46.89% 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 1989–2008 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 tables generated using CRF Reporter version 3.4.3.

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 analysing 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 modelling of the effects produced by this phenomenon was realized focusing on the main hydrographic basins. The modellings results shows 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, 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 tenth 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 1989-2008 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, SO_2) 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

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 the 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.

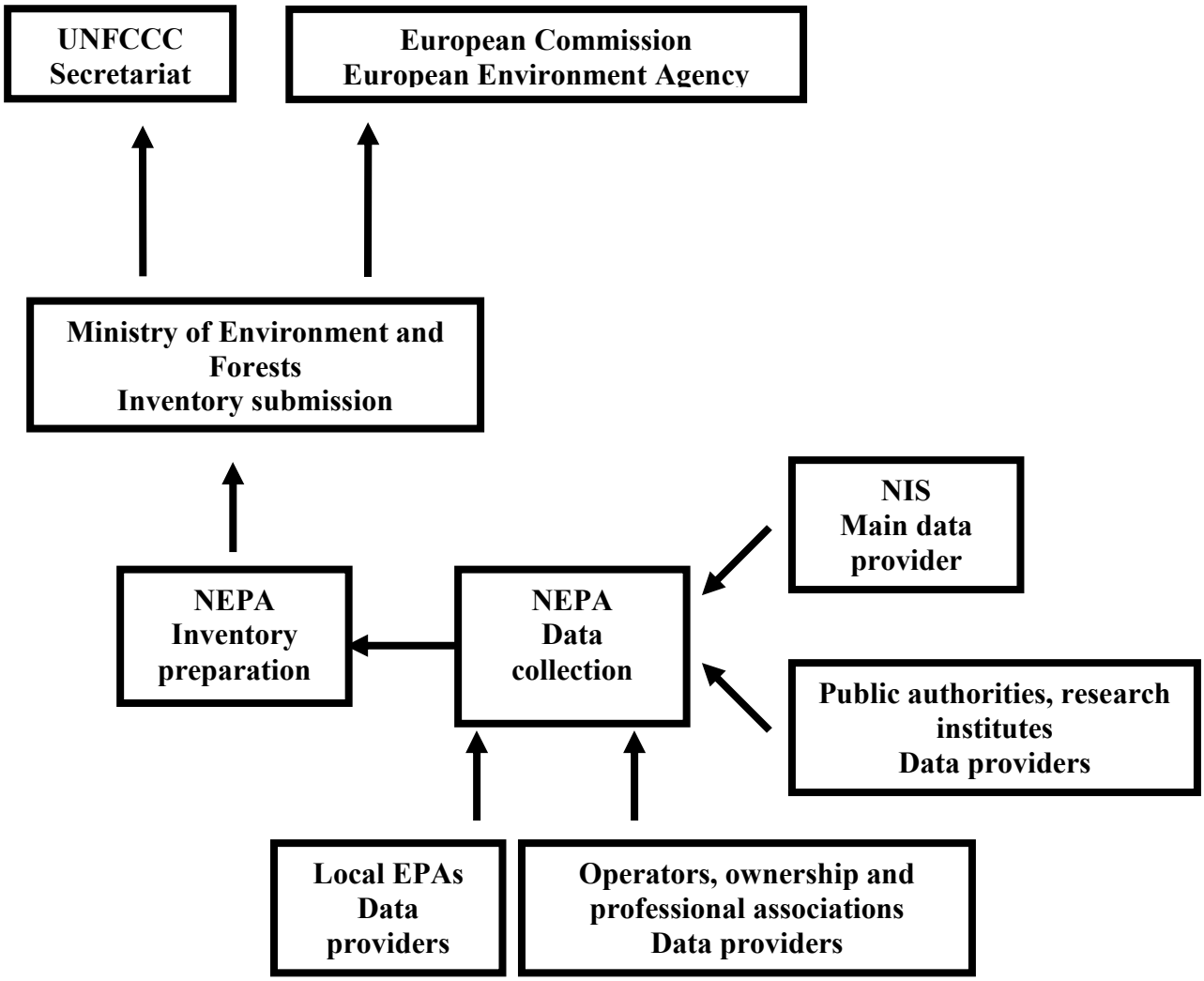
The competent authority, which is responsible for administrating the National System, is the National Environmental Protection Agency (NEPA), under the subordination of the Ministry of Environment and Forests.

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. In 2002, the Ministry of Environment and NIS signed a protocol of co-operation. Under this protocol, NIS agreed to provide, besides its yearly publication, additional data, necessary for the inventory preparation.

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 2008, 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 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 • Romanian Civil Aviation Authority
Industrial Processes	• National Institute for Statistics- Statistical Yearbook and other additional data • 42 Local Environmental Protection Agencies • Direct information from industrial operators
Solvent and other product use	• National Institute for Statistics • 42 local Environmental Protection Agencies
Agriculture	• National Institute for Statistics
LULUCF	• National Institute for Statistics through Statistical Yearbook • Ministry of Agriculture, Forests and Rural Development (MADR)

	• National Forest Administration (RNP)
Waste	• National Institute for Statistics • National Environmental Protection Agency • Public Health Institute • National Administration "Romanian Waters" • Food and Agriculture Organization

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 Tier1, 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 2008:

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

Taking into account the inclusion of the LULUCF sector, in 2008:

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

The most important key categories in 2008 are:

- CO_2 from Energy Industries - solid fuels;
- CO_2 from Road transport;
- CO_2 from Energy Industries - gaseous fuels;
- CO_2 from Residential - biomass;
- CO_2 from Iron and steel production;
- CO_2 from Forest Land remaining Forest Land.

The results of the key category analysis for 2008 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 the 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. 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. ME

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 the end of 2010, 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 comprise:
- advices on improving the GHG Inventory improvement plan and the 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 the IPCC 2006 methodology

- use of ETS data;
- use of COPERT model;
- use of IPCC 2006 methodology/data versus IPCC 1996.

- discussions/advices on methodological issues (data collection, emissions estimation) on GHG emissions recovery within the Industrial Processes and Waste activities;
- advices on moving on Tier 2 at the Enteric Fermentation, Manure Management and Agricultural Soils levels;

- precise identification of activity data needs;

- training courses/presentations on elaborating the specific requirements for a potential emission factors/other parameters study development;
- presentations of other relevant advices.

- advices on moving on First Order Decay method at the Solid Waste Disposal Sites level;
- 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;
- LULUCF – comparison of data sets used with the results of relevant scientific projects;
- 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 Industrial Processes activities by NIS, 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 1989-2008 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, and the estimation of emissions/removals from Cropland, Grassland, Wetlands, Settlements and Other land within LULUCF.

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.

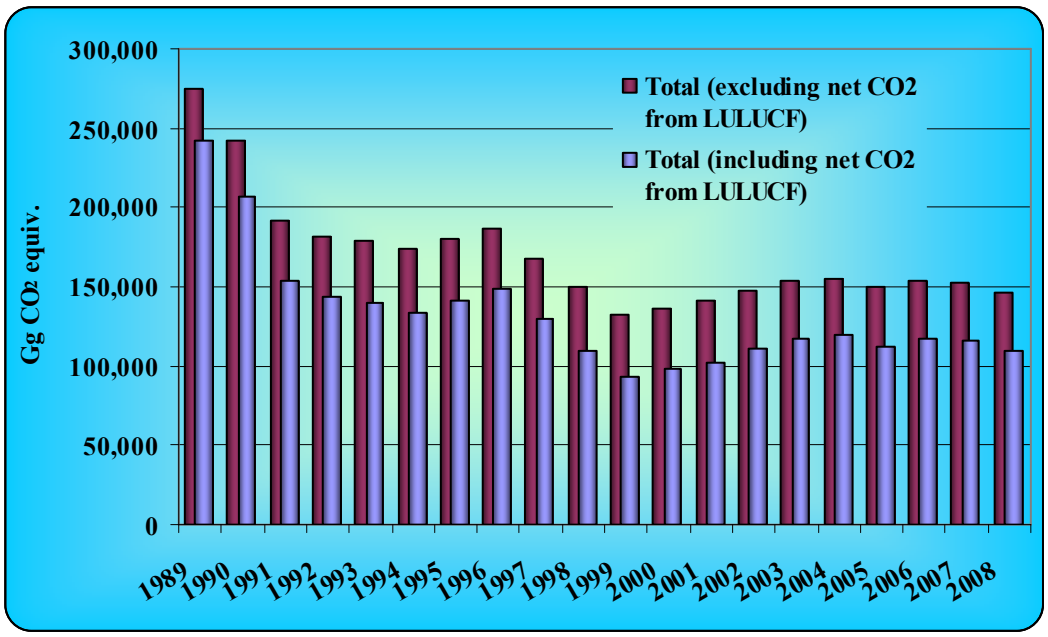
2. TRENDS IN GREENHOUSE GAS EMISSIONS

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

The total GHG emissions in 2008, excluding removals by sinks, amounted to 145,915.87 Gg CO_2 equivalent.

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 46.89% in 2008 in comparison to 1989 while the net GHG emissions/removals (taking into account the CO_2 removals) decreased with 54.81%. 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. 1Trends 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 two parts: the period 1989-1999 and the period 1999-2008. 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.

2.2 Description and interpretation of emissions trends by gas

All GHG emissions 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: 70.36% CO_2, 16.90% CH_4, 11.53% N_2O, 1.22% PFCs. In 2008, the shares of GHG emissions were: 71.07% CO_2, 17.61% CH_4, 10.86% N_2O, 0.43% PFCs. The F gases started to be used as substitutes for ODS in refrigerating and air conditioning systems since 1995. In 2008, the contribution of these gases to the total GHG emissions is negligible: 0.0141% HFCs and 0.01119% SF_6. Next table presents the trend of the aggregated emissions, split by gas.

Table 2. 1Trends by gas [Gg CO_2 equivalent]

Year	CO_2 emissions including net CO_2 from LULUCF	CO_2 emissions excluding net CO_2 from LULUCF	CH_4 emissions excluding CH_4 from LULUCF	N_2O emissions excluding N_2O from LULUCF	HFCs	PFCs	SF_6
1989	160,876.29	193,309.45	46,421.12	31,673.52	NO	3,349.56	NO
1990	136,547.20	172,131.60	40,568.86	27,280.68	NO	2,115.83	NO
1991	95,483.16	132,525.29	35,598.46	21,197.33	NO	1,942.09	NO
1992	89,929.03	127,776.67	32,181.39	19,638.97	NO	1,352.13	NO
1993	88,101.38	127,233.71	30,419.29	19,628.03	NO	1,409.43	NO
1994	84,324.37	124,059.54	29,413.14	18,569.40	NO	1,490.97	NO
1995	90,579.29	129,567.07	30,665.95	18,464.31	0.37	1,773.69	0.06
1996	97,509.75	135,513.00	31,238.82	18,008.06	0.73	1,769.07	0.06
1997	82,681.31	121,071.19	27,565.89	17,590.58	1.22	1,788.82	0.02
1998	66,852.41	107,333.56	25,209.29	15,746.32	2.65	1,757.16	0.01
1999	52,442.57	91,651.34	24,528.77	14,923.29	2.84	1,608.37	0.05
2000	57,298.44	95,306.67	25,126.75	14,494.28	3.41	1,299.54	0.00
2001	61,288.29	100,298.02	24,968.02	14,618.90	3.53	1,054.32	0.00
2002	69,791.26	106,336.32	25,770.14	14,256.97	4.22	730.99	0.01
2003	75,230.02	111,405.66	26,815.34	15,023.10	6.41	471.95	17.83
2004	76,682.25	112,174.55	26,247.83	16,522.70	8.93	513.45	22.64
2005	68,692.81	105,874.43	26,462.00	16,563.09	6.62	569.64	49.56
2006	73,915.95	111,118.13	26,774.38	15,585.72	22.61	609.65	67.76
2007	74,738.57	110,860.38	25,948.03	15,134.25	17.66	625.58	58.39
2008	67,288.94	103,705.60	25,702.96	15,839.56	20.52	630.90	16.33

Carbon dioxide (CO_2) – the most significant anthropogenic greenhouse gas is the carbon dioxide. The decrease of CO_2 emissions (from 193,309.45 Gg in 1989 to 103,705.60 Gg in 2008) 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 2008 by 44.63 % compared with the levels in 1989. The decrease of CH_4 emissions in Agriculture is due to the decrease of the livestock level.

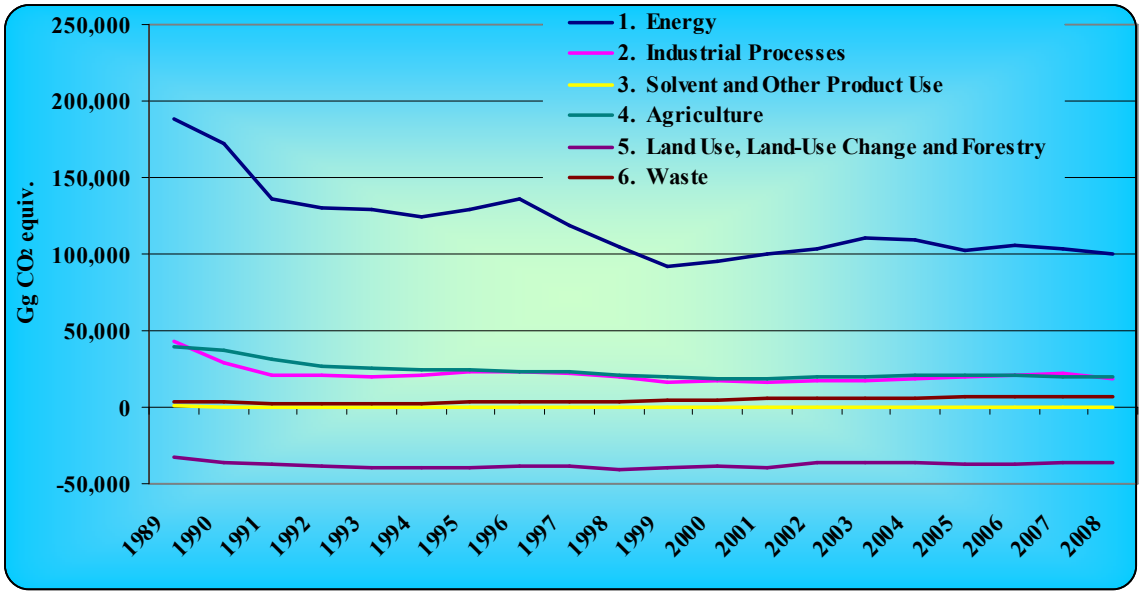
Nitrous oxide (N_2O) –the N_2O emissions are mainly generated within the Agricultural Soils activities in the Agriculture sector and within the Chemical industry activities in the Industrial Processes sector. The decline of these activities (decline of livestock, decline of N synthetic fertilizer applied on soils amounts) is reflected in the N_2O emissions trend. The N_2O emissions in 2008 decreased with 49.99% 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 (1989-2008) and have decreased with 81.16% in 2008 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 68.63% of the total national GHG emissions in 2008. The GHG emissions resulted from the Energy sector decreased with 46.85% compared with the base year.

Industrial Processes contributes to total GHG emissions with 12.84%. A significant decrease of GHG emissions was registered in this sector (56.2% decrease in 2008 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, due to the revitalization of the relevant economic activities (automobile manufacture, construction and buildings).
The GHG emissions level decreased in 2008 by 79.14% in comparison with the level recorded in 1989.

Agriculture GHG emissions have also decreased. The GHG emissions in 2008 are 49.28% lower in comparison with the 1989 emissions due to:
- the decline of livestock;
- the decrease of rice cultivated area;
- the decrease of crops productions;
- the decline of N synthetic fertilizer applied amounts.

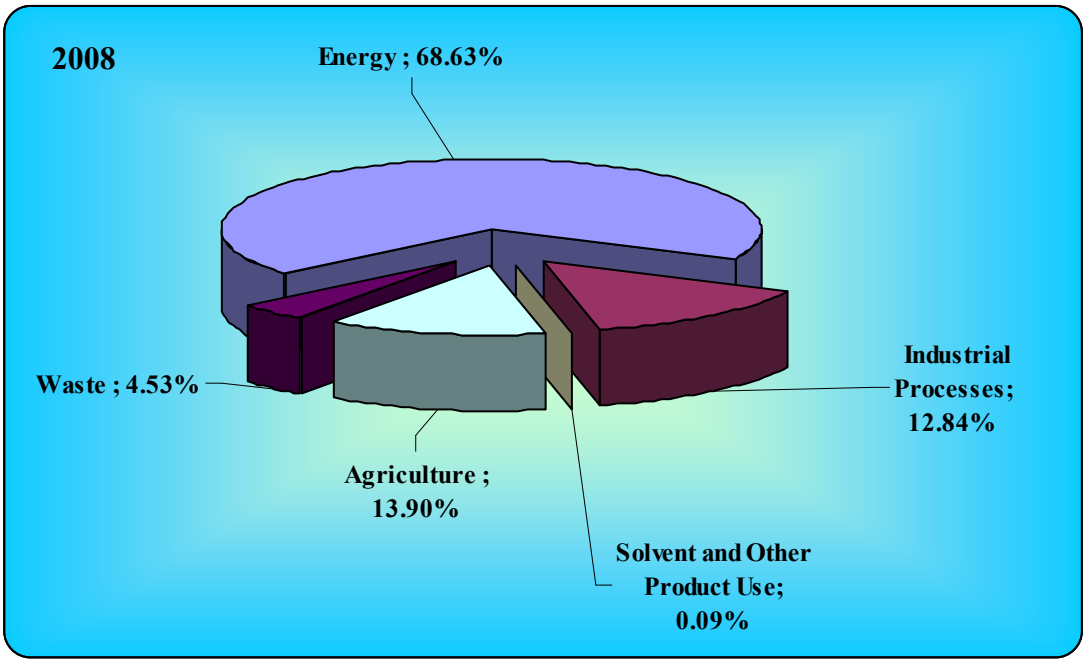
In 2008, 13.9% of the total GHG emissions resulted from the agriculture sector.

LULUCF The net GHG removals/emissions level is 12.28 % higher in 2008 in comparison with the level in the base year. The Romanian land use sector acts as a net sink, at an average uptake of 37,472 Gg/year, being relatively stable over the last 20 years.

Waste sector emissions have increased in 2008 with 126.58% in comparison with the level in 1989. The contribution of the waste sector to the total GHG emissions in 2008 is 4.53%.

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

Figure 2. 3 Sectoral GHG emissions in 2008 [%]



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.

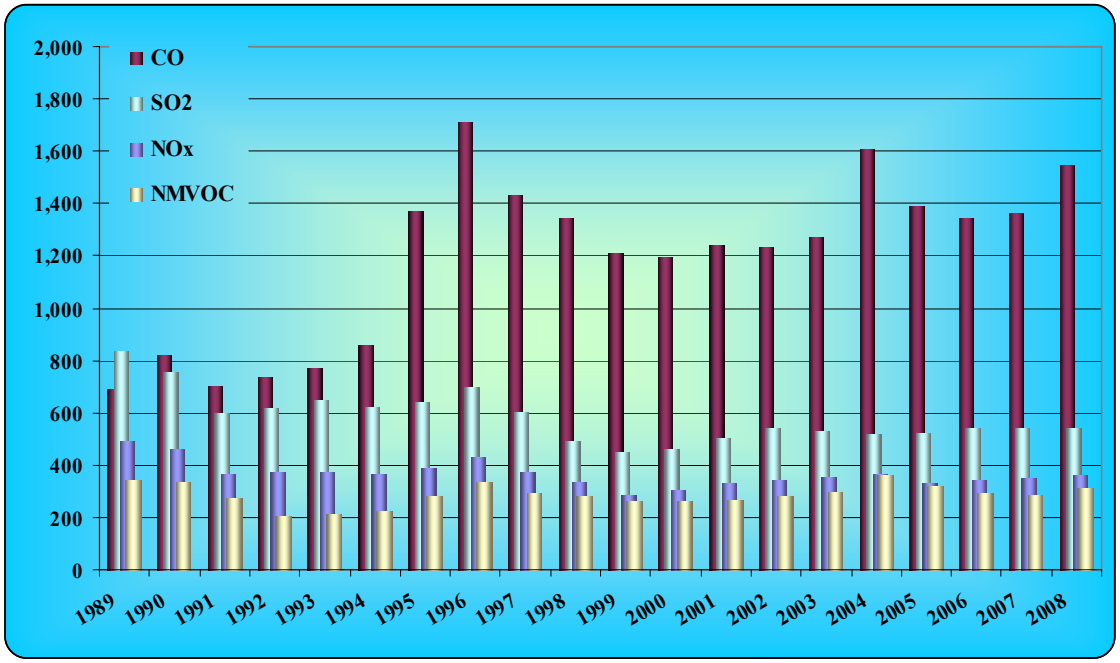
The NO_x, NMVOC and SO_2 emissions evolution follows the general direct GHG emissions trend. The SO_2 emissions decrease is caused by the decline of the fuels burnt for energy and the decrease of sulphur content in fuels.

The indirect GHG emissions trends are presented in Figure 2.4.

Table 2. 2 Indirect GHG emissions levels [Gg]

Year	NOx	CO	NMVOC	SO2
1989	490.53	692.04	344.94	834.75
1990	459.28	824.42	335.34	756.68
1991	366.70	701.29	276.08	600.25
1992	376.28	732.12	207.06	615.15
1993	373.26	770.17	209.76	645.53
1994	367.76	861.91	221.96	621.93
1995	386.17	1370.43	280.53	638.74
1996	429.21	1715.39	335.01	698.17
1997	376.13	1434.57	292.99	606.07
1998	335.76	1343.61	280.19	494.50
1999	289.37	1208.67	259.12	447.63
2000	304.21	1195.63	264.57	459.54
2001	327.61	1237.75	266.39	506.08
2002	341.74	1233.01	281.97	540.45
2003	352.71	1268.84	300.70	531.81
2004	367.02	1610.33	358.97	514.05
2005	332.05	1389.78	320.82	522.74
2006	343.94	1345.03	295.85	542.78
2007	351.15	1364.89	288.32	542.79
2008	361.22	1542.59	309.33	539.90

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 2008, the Energy sector was responsible for about 91.45% of the total GHG emissions (100,143.83 Gg CO_2 equivalent).

In 2008, the energy resources (primary energy produced, energy imported and 31 december 2007 stock) and the final energy consumption registered a slight increase compared to 2007, with 2% and, respectively, 1.1%. The increase in the energy resources was due to the increased production of primary energy (+5.7%). Final energy consumption increased in transport (+13.9%) and decreased mainly in the tertiary sector (-15.1%) and industry (-5.7%). (Extracts from the Energy Balance for 2008).

Figure 3. 1 Contribution of the Energy sector to total GHG emissions in 2008

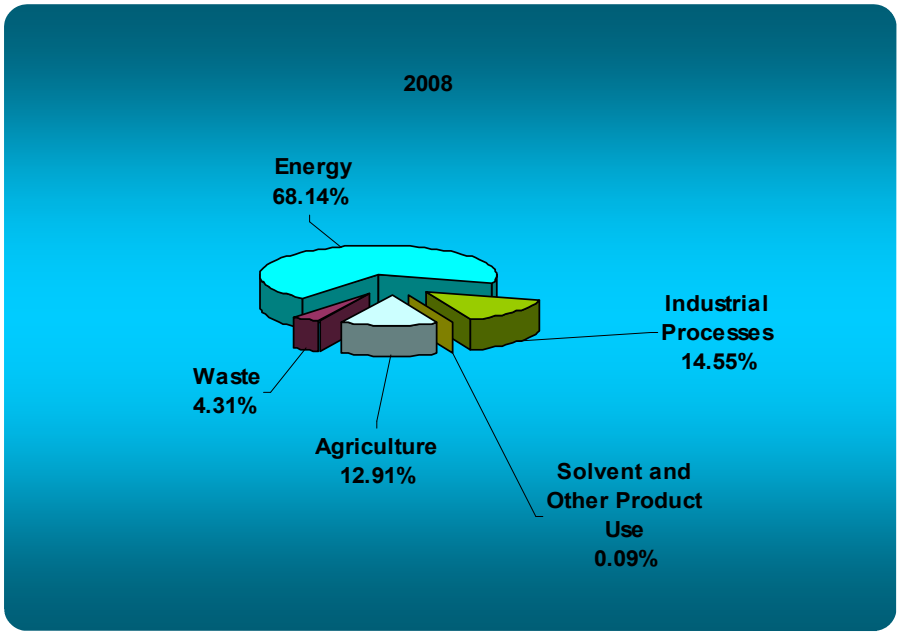


Table 3. 1 Status of emissions estimation within the Energy Sector for 2008

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	✓	✓	✓
1A3c Navigation	✓	✓	✓
1A3d Other Transportation - pipeline	✓	NO, NE	NO, NE
1A4 Other Sectors			
1A4a Commercial/institutional	✓	✓	✓
1A4b Residential	✓	✓	✓
1A4c Agriculture/Forestry/Fisheries	✓	✓	✓
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

IPCC category-Energy Sector	Emissions estimation status		
	CO_2	CH_4	N_2O
1B2 Oil and Natural Gas			
1B2a Oil	NO,NE	✓	NE
1B2b Natural Gas	IE, NE	✓	
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 2008

Energy sector-categories	Percentages for 2008
Energy industries	39.07%
Manufacturing Industries and Construction	16.21%
Commercial/ institutional	3.05%
Residential	18.26%
Agriculture/ Forestry/ Fisheries	0.55%
Fugitive emissions - solid fuels	2.31%
Fugitive emissions - oil and natural gas	6.76%
Transports	12.50%

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 2008 Energy emissions

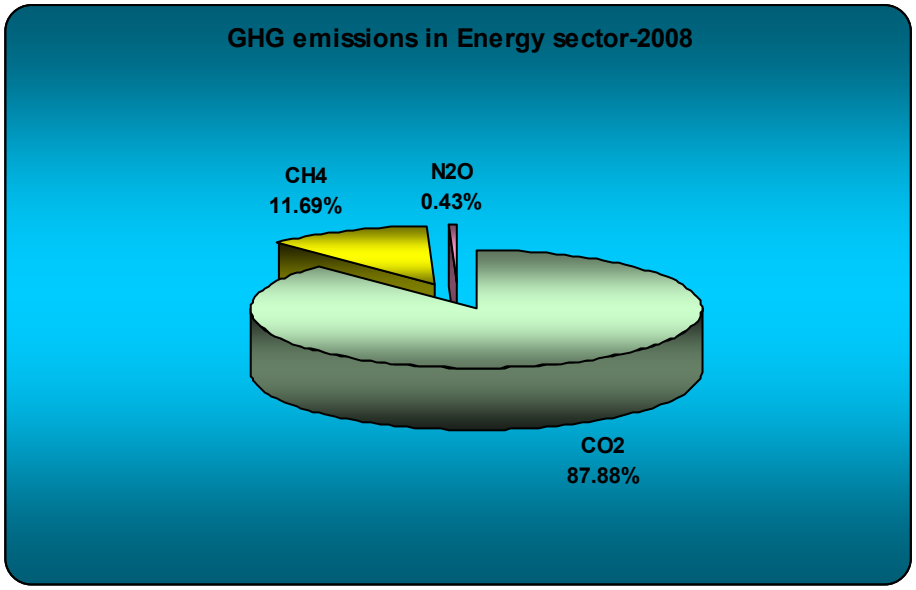
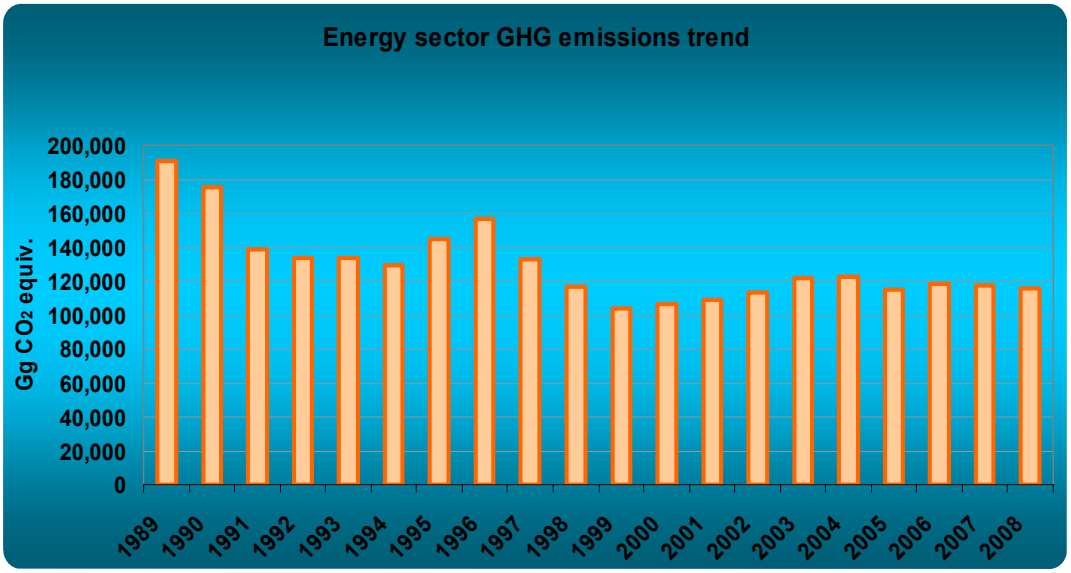


Figure 3. 3 The energy sector emission trend for the period 1989-2008



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

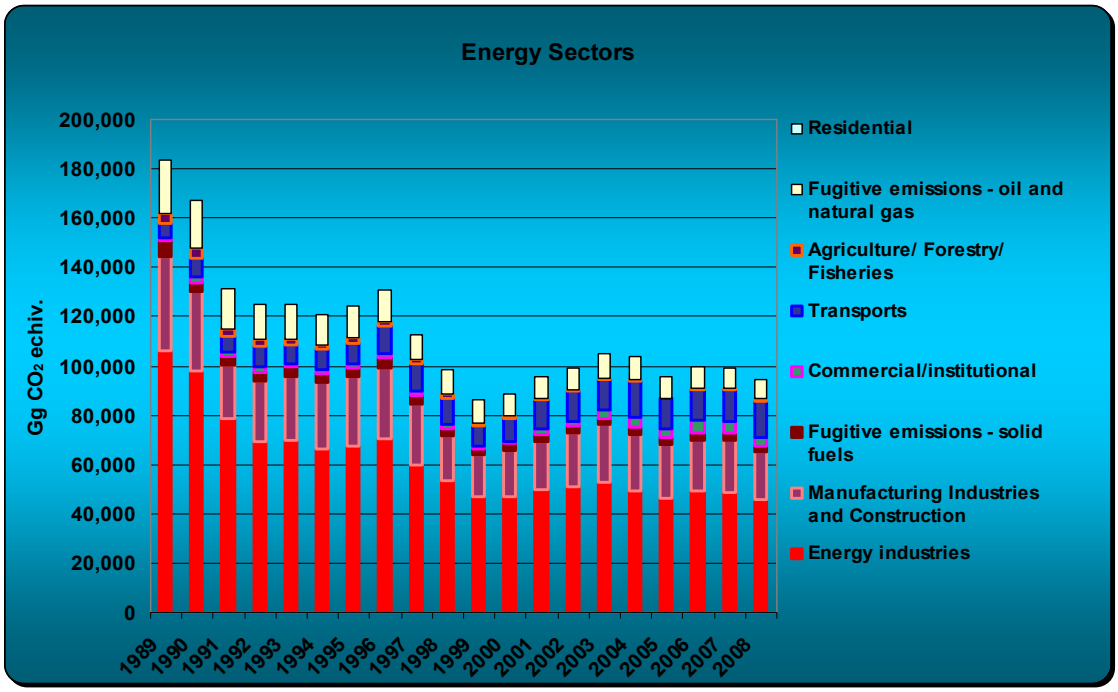
The emissions trend can be split in two parts: the period 1989-1996 and the period 1996-2004. The decline of economic activities and energy consumption in the period 1989-

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. (dar pentru anul 2008 se remarca o usoara tendinta de scadere a emisiilor).

Figure 3. 4 The trend of the GHG emissions in the Energy sector in the 1989-2008 period (Gg CO2 equivalent)



The contribution of various subsectors to the total Energy GHG emissions for 1989 and for 2008 is presented in the following table.

Table 3. 3 Contributions to the Energy sector GHG emissions

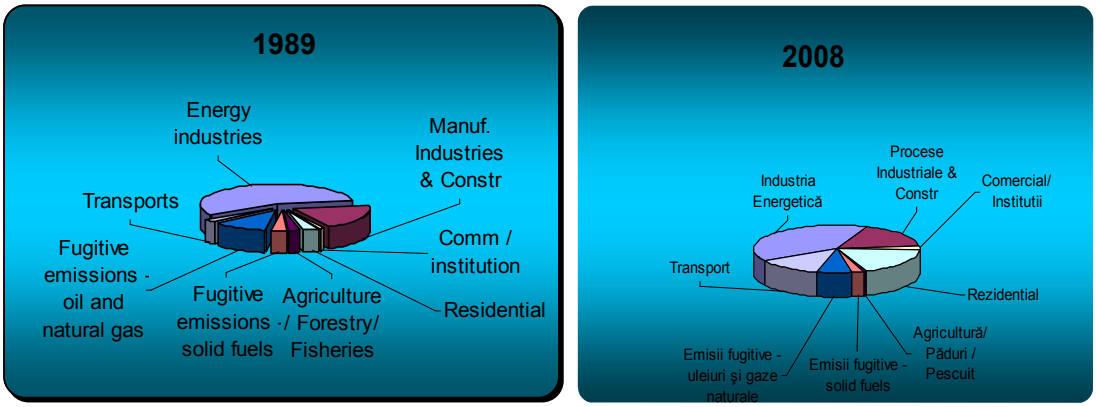
Energy categories GHG emissions contribution	1989	2008
A.1. Energy industries	55.71%	39.58%
A.2. Manufacturing Industries and Construction	19.72%	16.42%
A.3. Transports	3.04%	12.67%
A.4. Other sectors	6.76%	22.15%
B.1. Fugitive emissions - solid fuels	3.34%	2.34%
B.2. Fugitive emissions - oil and natural gas	11.42%	6.84%

There is a slight decrease of the CO2 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 CO2 emissions explained by the reduction of the economic activities level in the second half of 2008.

Within Transport it is noticed an increase in CO2 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 CO2 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).

Figure 3. 5 GHG Energy sector emissions by sub-sectors in 1989 and in 2008



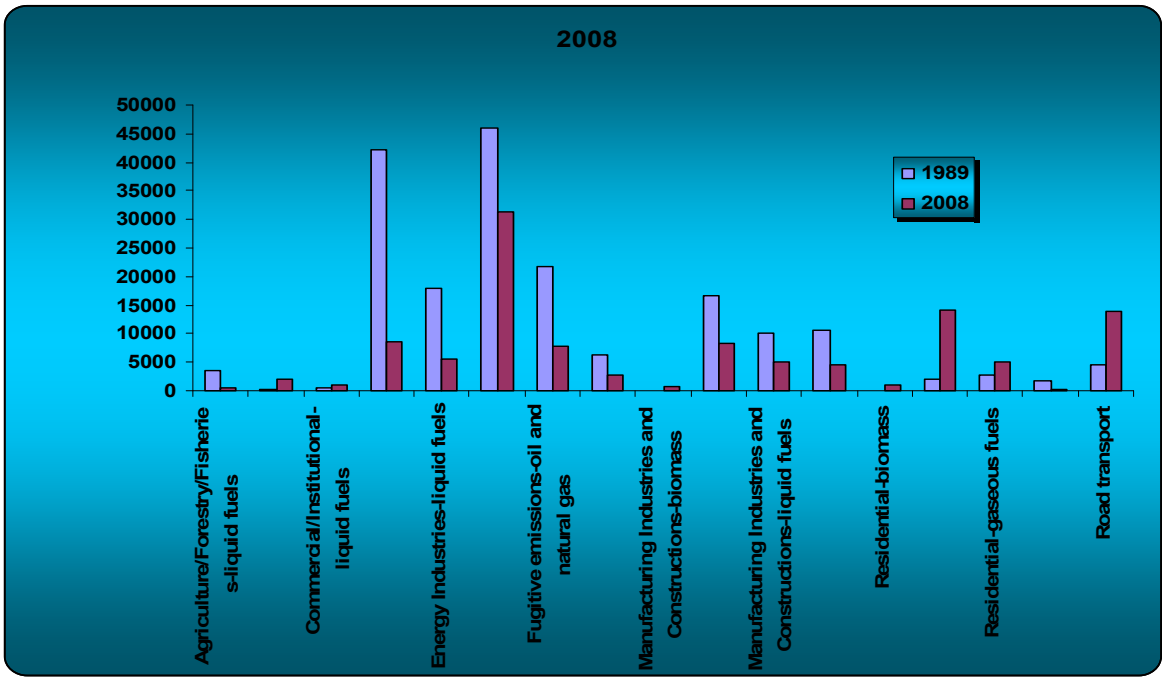
3.1.1 Key sources

Table 3. 4 Energy key sources in 2008

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	CO2	T	0.29%	T	0.24%
Commercial/Institutional-gaseous fuels	CO2	L,T	1.18%	L,T	0.96%
Commercial/Institutional-liquid fuels	CO2	L,T	0.66%	T	0.54%
Energy Industries-gaseous fuels	CO2	L,T	5.37%	L,T	4.39%
Energy Industries-liquid fuels	CO2	L,T	3.46%	L,T	2.82%
Energy Industries-solid fuels	CO2	L,T	19.35%	L,T	15.79%
Fugitive emissions-oil and natural gas	CH4	L,T	4.91%	L,T	4.00%
Fugitive emissions-solid fuels	CH4	L,T	1.68%	L,T	1.37%
Manufacturing Industries and Constructions-biomass	CO2	T	0.54%	T	0.44%
Manufacturing Industries and Constructions-gaseous fuels	CO2	L,T	5.18%	L,T	4.23%
Manufacturing Industries and Constructions-liquid fuels	CO2	L,T	3.17%	L,T	2.59%
Manufacturing Industries and Constructions-solid fuels	CO2	L,T	2.83%	L,T	2.31%
Residential-biomass	CO2	L,T	8.75%	L,T	7.14%
Residential-biomass	CH4	L,T	0.55%	T	0.46%

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 [%]
Residential-gaseous fuels	CO2	L,T	3.19%	L,T	2.61%
Residential-liquid fuels	CO2	T	0.52%		
Residential-solid fuels	CO2	T	0.11%	T	0.09%
Road transport	CO2	L,T	8.62%	L,T	7.03%

Figure 3. 6 Key sources Energy sector GHG emissions in 1989 and in 2008



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	13.44
1991	21.75
1992	13.01
1993	13.35
1994	11.71
1995	16.04
1996	7.96
1997	9.97

1998	11.50
1999	13.17
2000	11.06
2001	10.40
2002	3.52
2003	5.12
2004	2.85
2005	5.37
2006	8.78
2007	8.57
2008	6.4

Figure 3. 7 The differences between CO2 emissions estimates using RA and SA methods

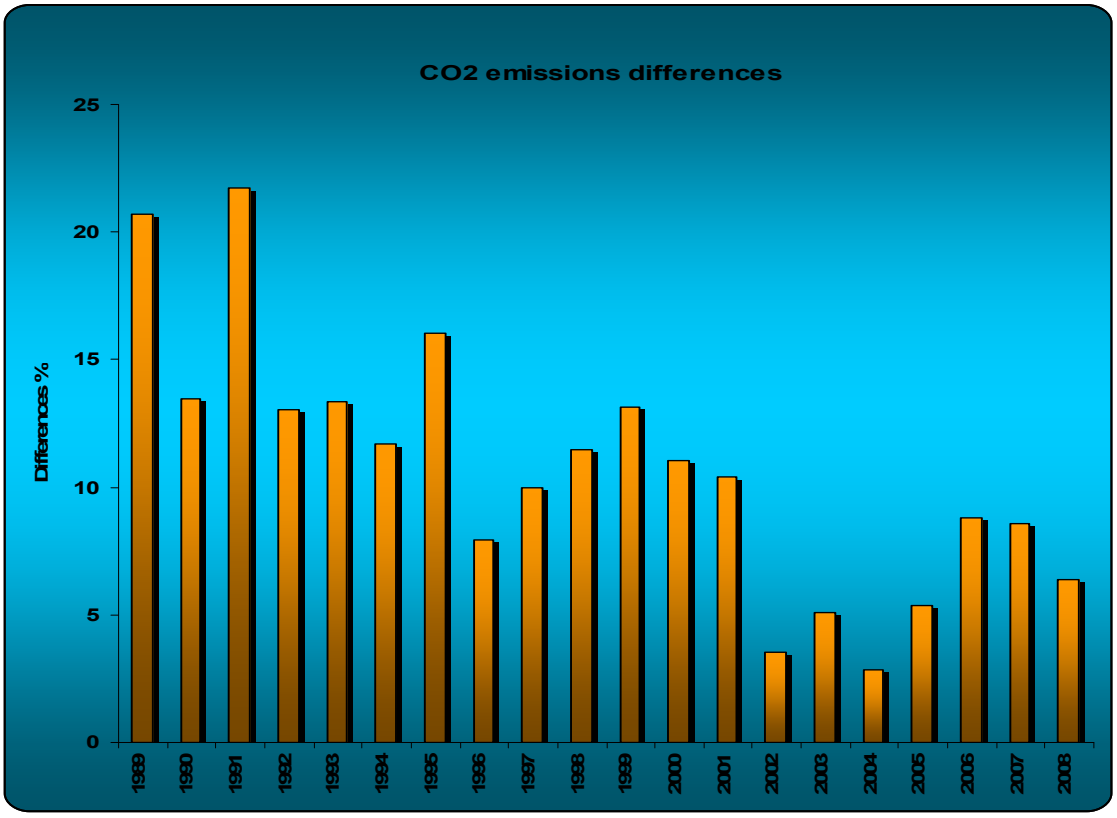


Table 3. 6 The difference between CO_2 emissions estimated using RA and using SA in 2008

2008	Liquid fuels	Solid fuels	Gaseous fuels	Total
	[%]			
Differences in fuel consumption	25.55	14.34	10.42	**16.59**
Differences in emissions	30.65	-19.34	17.13	**6.42**

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.

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.)

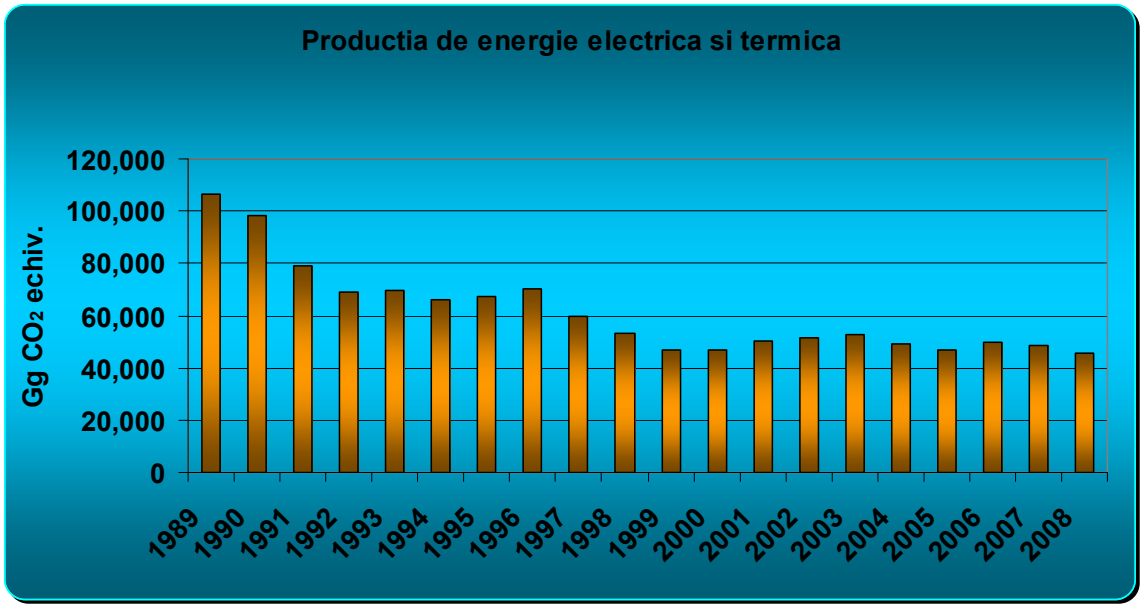
3.2.6. 1 Source category description

CO_2 emissions from fuel combustion activities accounted for 45,741.51 Gg CO_2 equivalent in 2008. Within the fuel combustion sector, 45.68% 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 1992-2008 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 autoproducers from the mining, refining, metallurgy, chemicals, car manufacturing and other industries.

The emission factors (EF) used for estimating CO_2, CH_4, N_2O, NO_x, CO, NMVOC, SO_2 emissions are the default EF indicated in the IPCC methodology:

- for CO_2: (Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories: Workbook) table I-2 (carbon emission factors CEF), table I-4 (fraction of carbon oxidised) and molecular mass transformation (44/12 tonnes CO_2/tone C) in order to convert Carbon emissions into CO_2 emissions;
- 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: 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:

- 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 (5% 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.

As a result of this activities there were no inconformity pointed out.

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

No recalculations were performed, related to the previous submission.

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.

From the autumn of 2009 questionnaires were sent to operators for collecting activity data in order to allow for a Tier 2 method use. After the validation of data (including checks on differences between the collected data and statistical data), we envisage to calculate the emissions within the Energy and Heat Production sub-sector using a higher tier method.

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 2008 for 18.06 % of the total Energy sector GHG emissions (about 18,157.28 Gg CO_2 equivalent). The industries included in this category are the following:

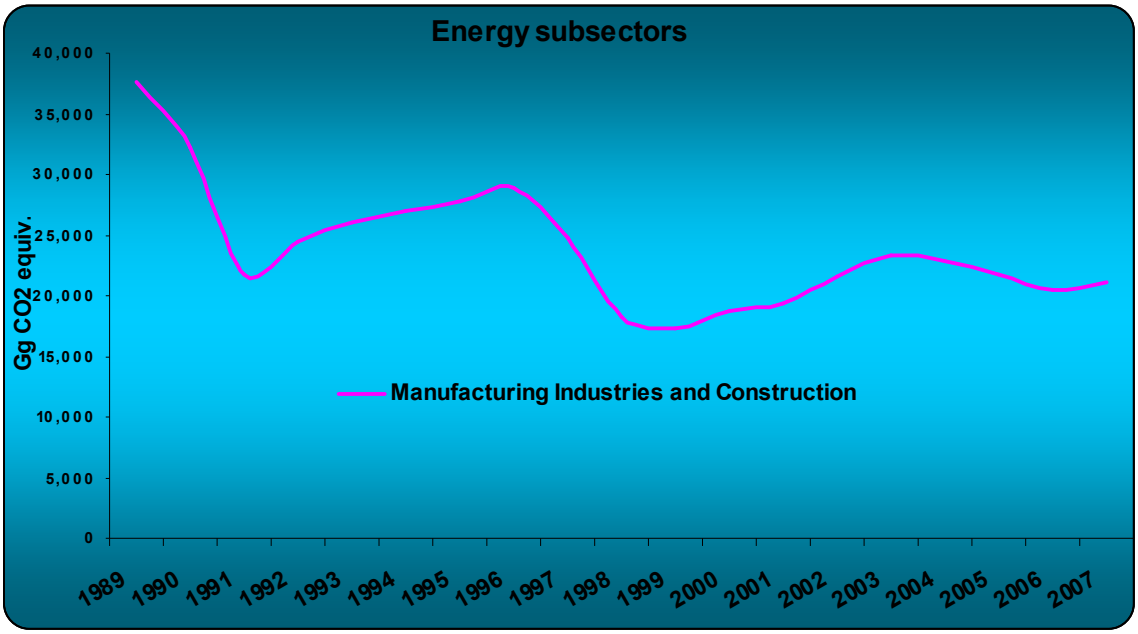
- Extraction and preparation of metal-bearing minerals (NACE Rev.1 code 13);
- Other mining activities (NACE Rev. 1 code 14);
- Food, beverages, tobacco (NACE Rev.1 code 15, 16);
- Textile and textile products (NACE Rev.1 code 17);
- Textile, fur and leather garments (NACE Rev. 1 code 18);
- Leather 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 1992-2008 system, and "direct consumption" - from the industry consumption category and "constructions", category 55 for the 2008 EB).

The emission factors (EF) used for estimating CO_2, 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.

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: 7% (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 industrial processes sector expert of the GHG Inventory, the results of this activities being mentioned in the Check Lists.

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

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

No recalculations were performed, related to the previous submission.

3.2.7.6. Source- specific planned improvements, if applicable

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

From the autumn of 2009 questionnaires were sent to operators for collecting activity data in order to allow for a Tier 2 method use. After the validation of data (including checks on differences between the collected data and statistical data), we envisage to calculate the emissions within the Manufacturing Industries sub-sector using a higher tier method.

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

3.2.8.1 Source category description

In 2007 the emissions from transport categories accounted for 14,679.92 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, 14.66 % 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.

Figure 3. 10 The total GHG emissions from the transport sector

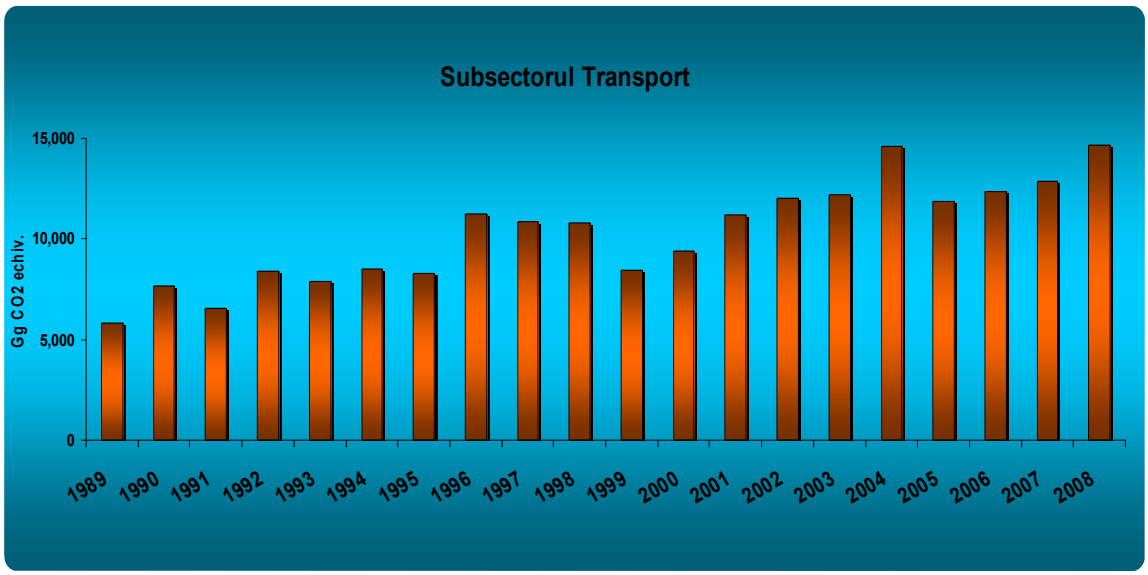
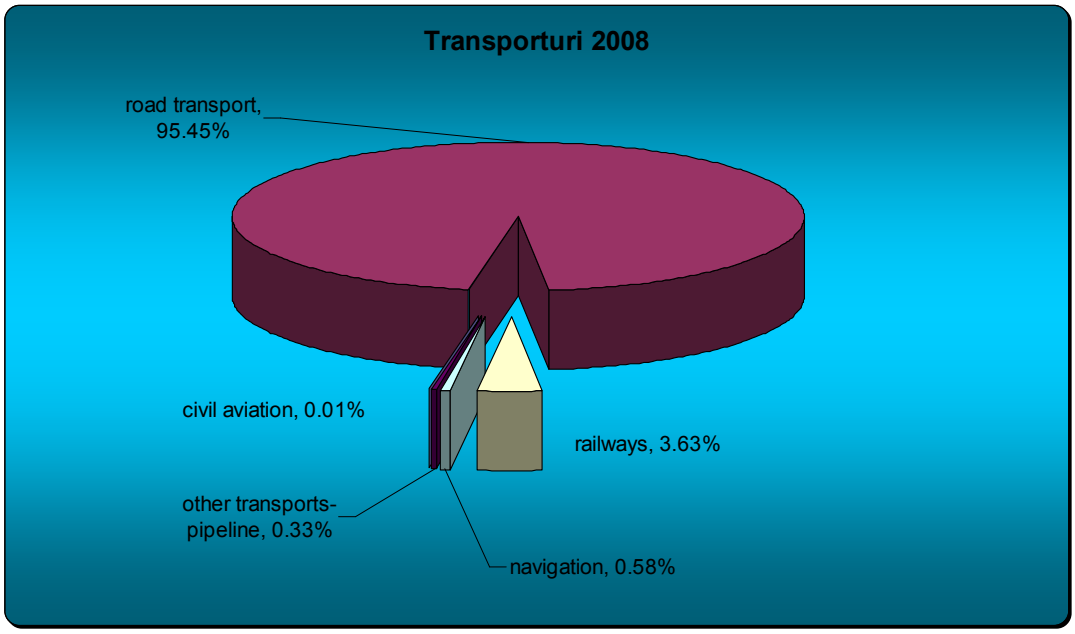
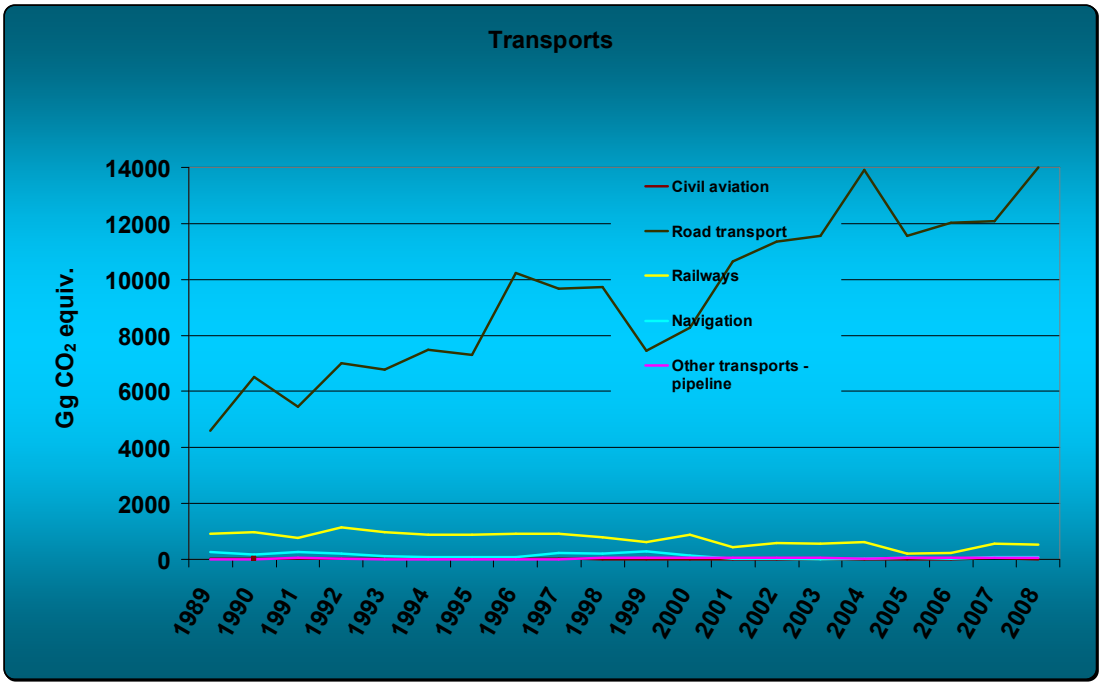


Figure 3. 11 Transport categories in 2008



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

Figure 3. 12 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. Although road transportation represents a key category both level and trend view for CO_2 emissions (including and excluding LULUCF), due to the lack of AD needed, a tier 2 method could not be applied. Therefore, for all 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.

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 – 2008. 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.

Domestic civil aviation transport

Starting with 2008 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 2008 and for jet kerosene 1994 to 2008. 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 2008.

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 1993-2008, 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 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.

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

3.2.8.6 Source- specific planned improvements, if applicable

More detailed data will try to be obtained, in respect to the IPCC GPG 2000 provisions. To improve the accuracy of the estimates by applying more accurate methods,

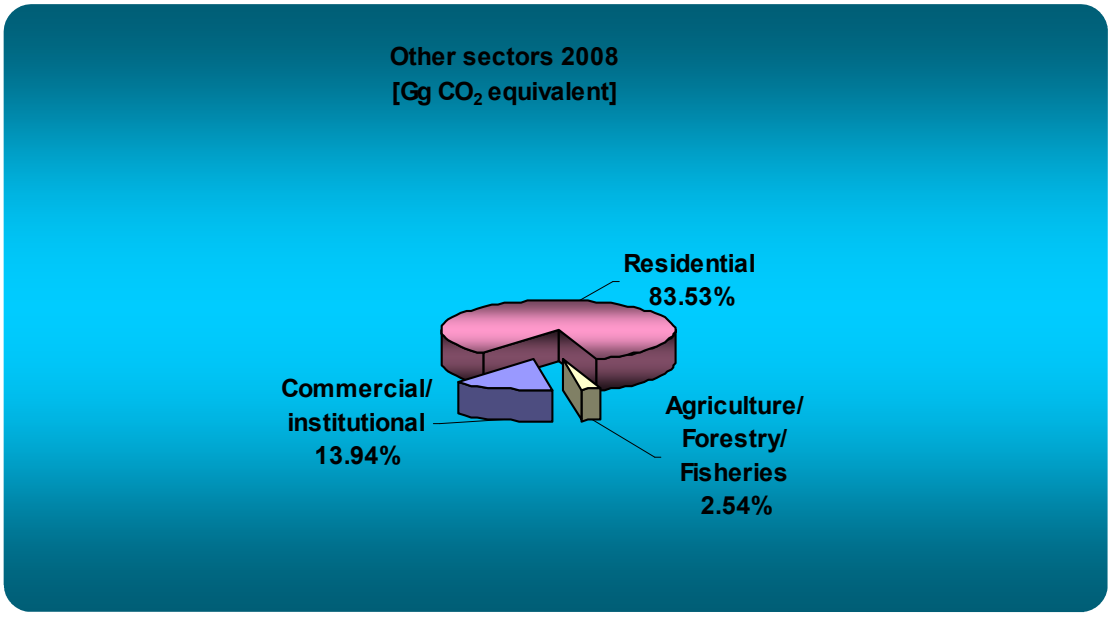
we consider the possibility of use the activity data obtained using the COPERT model, data by type of cars (with or without catalytic converters), in order to improve reporting of N_2O emissions within the 2010 submission of NGHGI.

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

3.2.9.1 Source category description

In 2008 the "Other sectors" category was responsible for about 10.91% of the energy sector total GHG emissions (10,921.38 Gg CO_2 equivalent). In this category are included emissions from commercial/institutional, residential and agriculture/forestry/fishery sectors.

Figure 3. 13 "Other sectors" structure in 2008



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.

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:

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.

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: 7% (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 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 Romanian industrial processes sector expert of the GHG Inventory, the results of this activities being mentioned in the Check Lists.

As a result, corrections regarding activity data used in some cases were necessary (due to wrong manipulation of data). The following categories were affected by this correction:

- Residential, in 2005 and 2006 (a solid fuel)
- Agriculture/forestry/fisheries, a solid fuel (in 2004) and a liquid fuel (in 2004 and in 2006).

The effect of these recalculations was negligible, therefore, it was not mentioned in the chapter regarding GHG Inventory recalculations performed.

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

No recalculations were performed in this GHG emissions category.

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 proposed; in parallel we try to obtain (through calculation) an EF specific to each fuel type, using the ETS data. After

the validation of obtained data, we envisage the use of a higher Tier method, using the EF obtained data and statistical data provided by NIS.

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

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

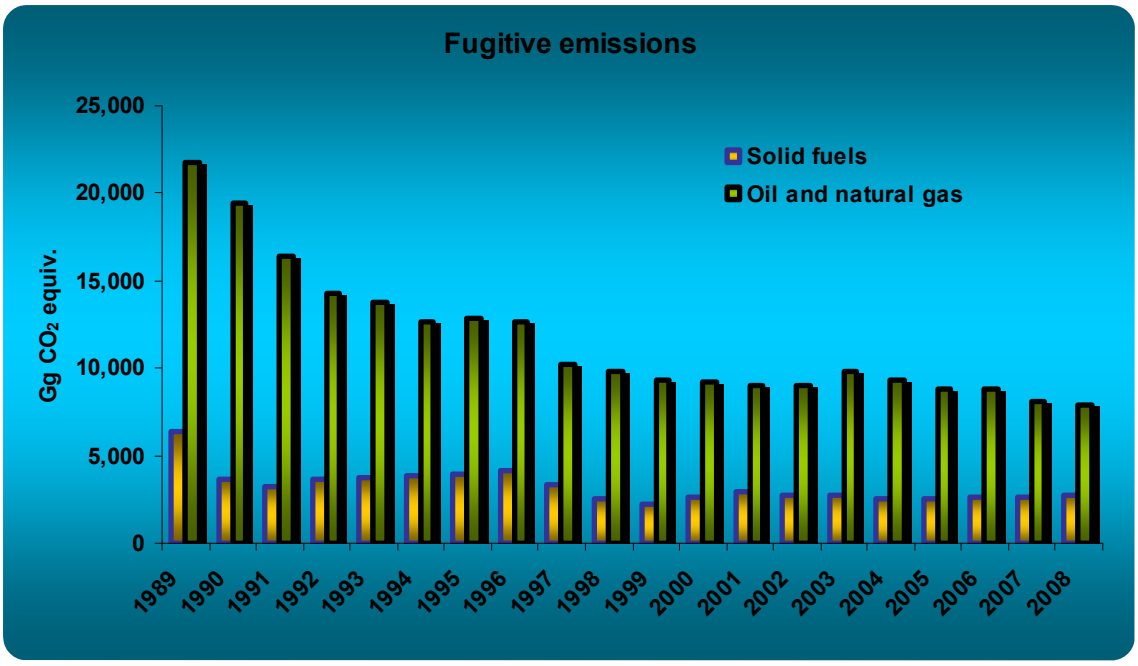
3.3.1.1 Source category description

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.

Figure 3. 14 Fugitive emissions trend for the 1989-2008 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 1989-2008 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: $EF_{refining} + EF_{storage}$
- 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

- 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 1989-2008 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.

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.

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

As a result of these activities there were no inconformity pointed out.

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

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

No recalculations were performed in this GHG emissions category.

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.

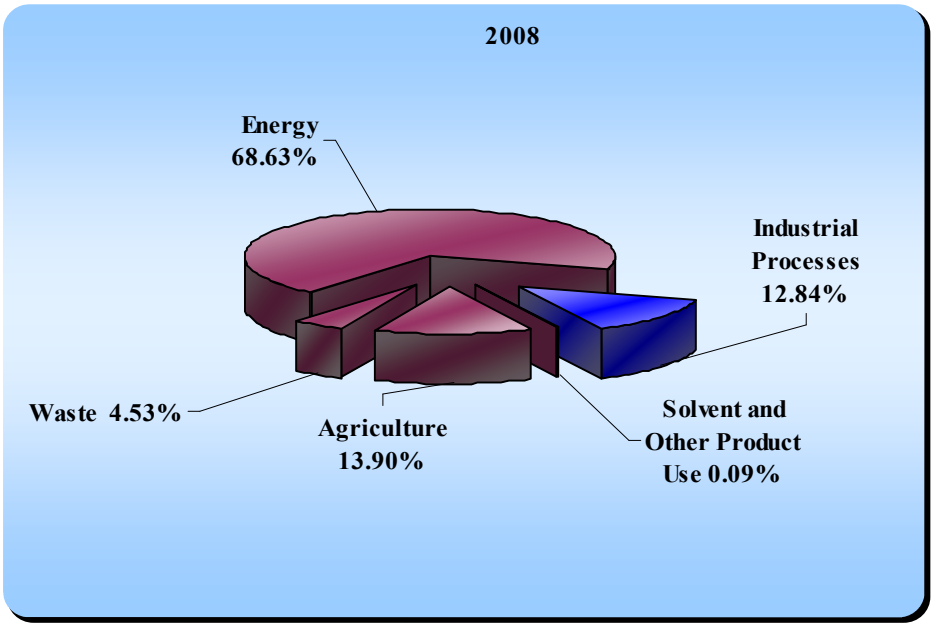
Table 4. 1 Status of emissions estimation within the Industrial processes sector

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 CARBIDE PRODUCTION	✓	NE	NA	NA
2 B 5 OTHER	NE	✓	NE	NA
2 C METAL PRODUCTION				

2 INDUSTRIAL PROCESSES	Emissions estimation status			
IPCC category	CO_2	CH_4	N_2O	PFC
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 2008 the GHG emissions from Industrial Processes contributed with 12.84% to the total GHG emissions in Romania.

Figure 4. 1 The contribution of Industrial Processes sector to the total GHG emissions in Romania, 2008



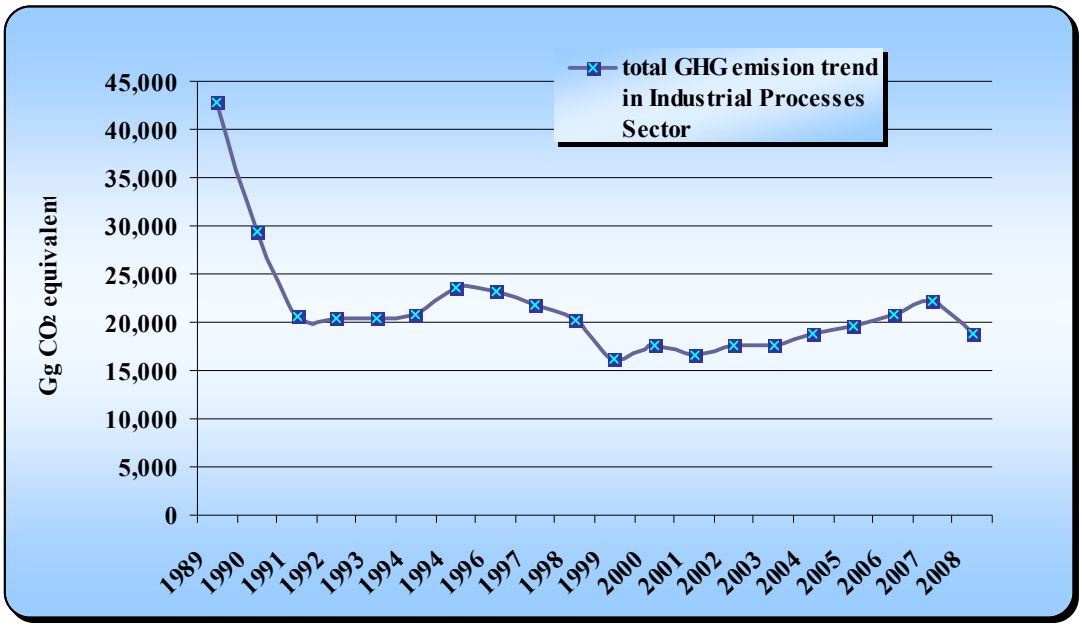
Emissions from this sector estimated in 2008 decreased by 56.20 % compared with 1989 and 15.67 % compared with 2007. The decrease from 1989 to 2008 is the result of the restructuration and privatization in various activity sectors:

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.

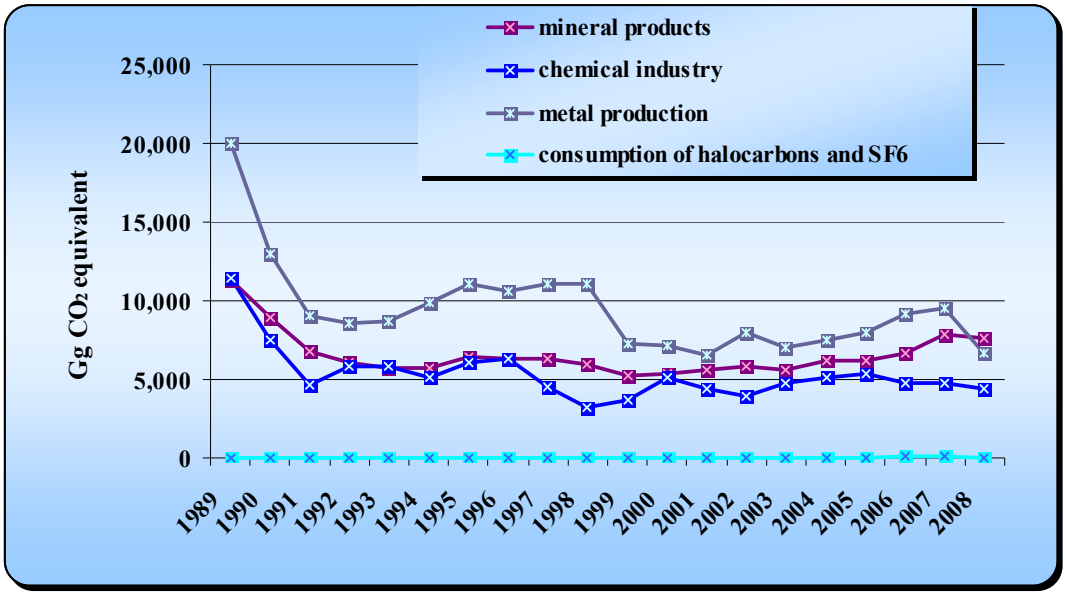
- Nitric acid production recorded a decrease after 1989.
- Adipic acid production stopped at the end of 2001. Starting with 2002, the activity was suspended.
- Carbide production recorded a decrease after 1989.
- Iron and steel production recorded a decrease after 1989.
- Ferroalloys production has recorded 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 1997 and 2003.
- In 2008 the trend of emission decreased due to reduction of production recorded for iron and steel production and ferroalloys production sub-sectors.

Figure 4. 2 Total GHG emissions trend in Industrial Processes, for 1989–2008 period



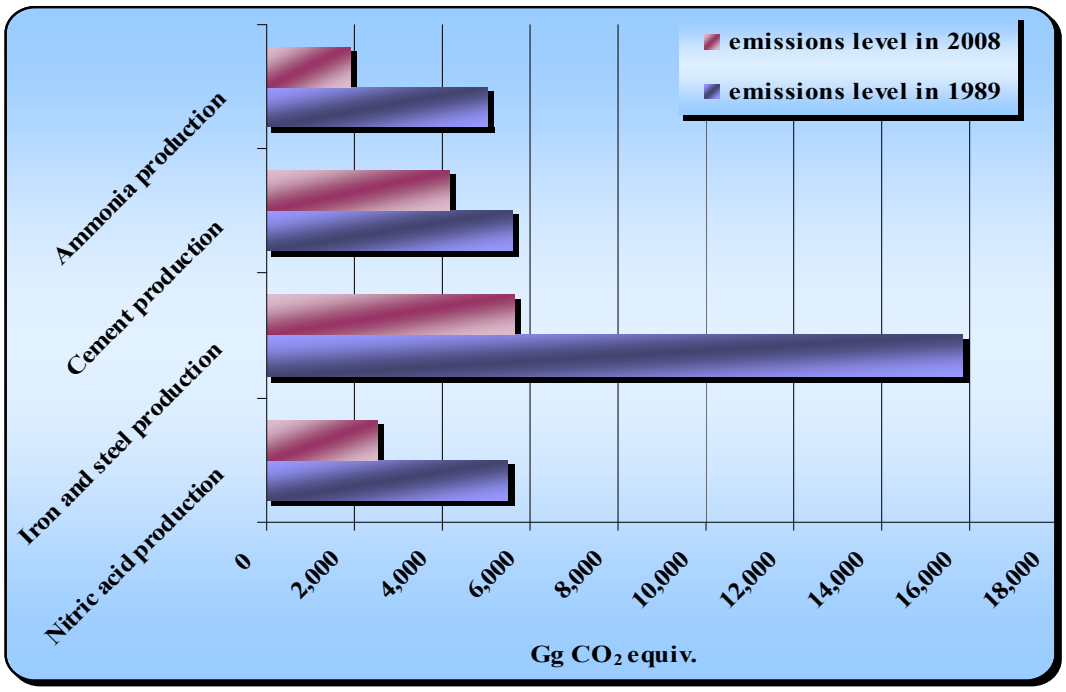
Metal production contributes with 35.60 % to the total GHG emissions from Industrial Processes in 2008. Mineral Product and Chemical Industry are the two other main contributing sectors with 40.44 % and 23.76 %, respectively, of the total GHG emissions in this sector. The contribution of Consumption of halocarbons and SF_6 to the overall sector is very low: 0.2 %.

Figure 4. 3 GHG emissions trends in Industrial Processes, by sub-sectors, for 1989–2008 period



In the base year, various industrial processes sub-sectors contributions were: Mineral products 26.50%, Chemical industry 26.62%, Metal production 46.88%, Consumption of halocarbons and SF_6 0%.

Figure 4. 4 Key categories in Industrial Processes in 2008, both by level and trend criteria



The Tier 1 key category analysis performed for 2008 has revealed the following key categories:

Table 4. 2 Key categories in industrial processes sector in 2008

2008						
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 [%]**
2B.1	**Ammonia production**	CO_2	L,T	1.18%	L,T	0.97%
2C.1	**Iron and steel production**	CO_2	L,T	3.48%	L,T	2.84%
2.A.1	**Cement production**	CO_2	L,T	2.56%	L,T	2.09%
2.A.2	**Lime production**	CO_2	L	1.65%	L	1.34%
2B.2	**Nitric acid production**	N_2O	L,T	1.56%	L,T	1.28%
2C.3	**Aluminium production**	PFC	T	0.39%	T	0.32%

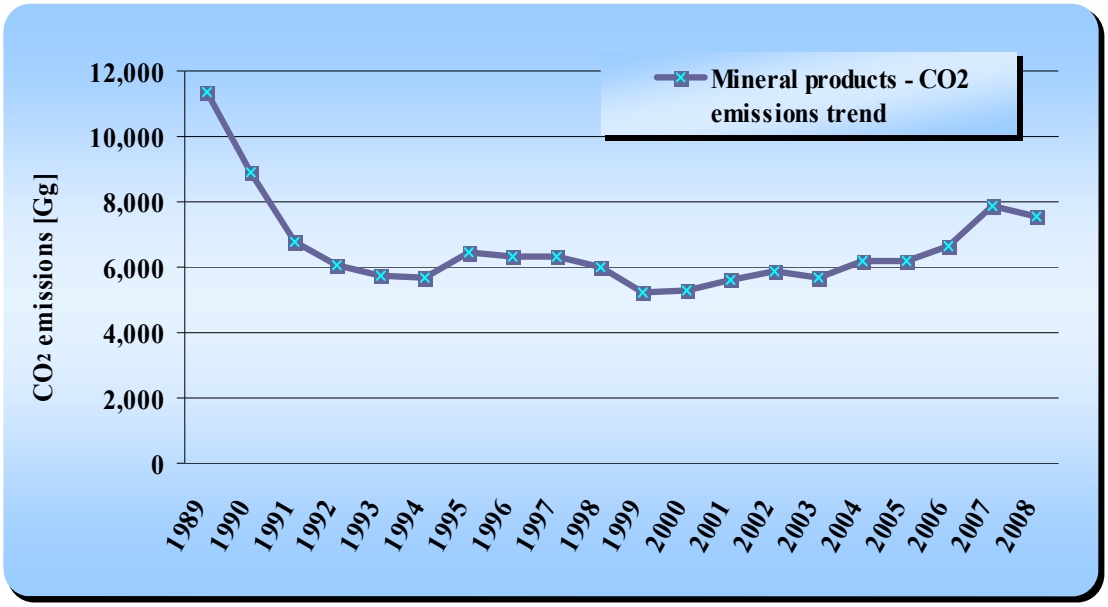
4.2 Source category Mineral products (CRF sector 2.A)

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) and other: glass production (2A7). Emissions from asphalt roofing (2A5) and road paving with asphalt (2A6) are not estimated due to unavailability of data.

CO_2 emissions cement production represent an important key category of the inventory because of its contribution to the total inventory level (in 2008 CO_2 emissions from production of cement contributed 2.84 % to total greenhouse gas emissions). In the base year, these emissions accounted for 2.03 % from the total GHG emissions.

Figure 4. 5 GHG emissions trend in the Mineral Products sub-sector for 1989-2008 period [Gg CO_2]



GHG emissions trend in the Mineral Products sub-sector was decreasing during 1989-2008 period due to the decrease recorded after 1989 in cement production, lime production, limestone and dolomite consumption, soda ash production and use, glass

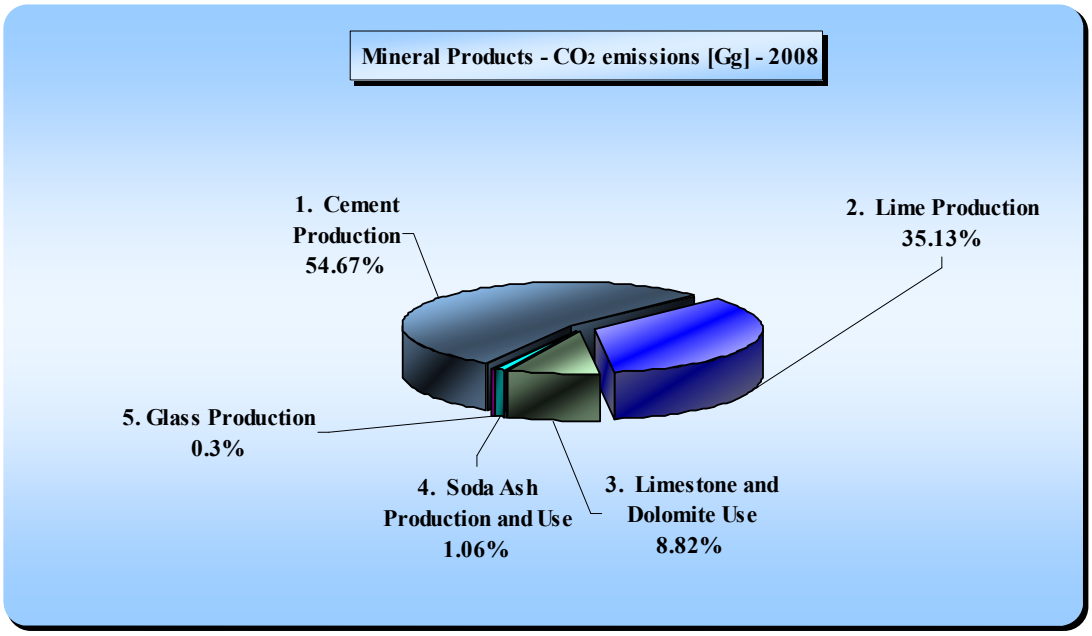
production; the emissions were relatively stable during 1993–2007. Starting with 2004 the cement production has recorded a minor increase. In 2008 a minor decrease was recorded in the consumption of limestone and dolomite level.

Mineral products sub-sector was responsible for 40.44% of the Industrial Processes sector's GHG emissions in 2008.

Table 4. 3 CO_2 emissions in the Mineral products sector, in the year 2008

Sector	CO_2 emissions [Gg] 2008
2.A Mineral Products	7,577.38
2.A.1 Cement Production	4,142.66
2.A.2 Lime Production	2,662.19
2.A.3 Limestone and Dolomite Use	668.24
2.A.4 Soda Ash Production and Use	80.58
2.A.7.1 Glass production	23.70

Figure 4. 6 Structure of the Mineral products sub-sector, in 2008



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. The method for calculating emissions of CO_2 from cement is in line with the IPCC GPG 2000 (Tier 2).

Activity data

The AD necessary to estimate emissions from this source category are provided by economic agents (clinker production data) and 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;
- an average of 64.5% of CaO content was provided by all companies (for 1989-2007 period);
- an average of 2% of MgO content was provided by all companies (for 1989-2007 period);
- plant specific content of CaO (%) in clinker was provided by each companies (according with laboratory analyses) for 2008 year;
- plant specific content of MgO (%) in clinker was provided by each companies (according with laboratory analyses) for 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 and 2008.

Emission factors

For the period 1989-2007 Romania 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.

For year 2008 it has been done representative annual analysis of CaO and MgO content in clinker and they have been taken into account in order to estimate the **plant specific CO_2 EF for clinker production.**
In order to estimate CO_2 emissions from **CKD**, it is used the same EF, **0.525 t CO_2/t** clinker, because the amount of CKD is very small (for all time period).

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

Equation 4. 1 Calculation of CO_2 emissions from clinker

Emissions = $EF_{clinker}$ x Clinker Production x CKD Correction Factor

Equation 4. 2 Calculation of EF for clinker

EF for clinker is calculated based on IPCC formula:
$EF_{clinker}$ = 0.785 x CaO Content (Weight Fraction) in Clinker

IPCC neglect CO_2 from decomposition of $MgCO_3$. Discussions with companies have concluded to apply a correction for MgO content to the default IPCC EF. According to these assumptions: **64.5% CaO content and 2% MgO** content in clinker, the resulted EF is **0.525 t CO_2/t clinker, for 1989-2007 period.**

For 2007 the figures related with the EF 0.525 t CO_2/t clinker (CaO and MgO content in clinker) and 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.

Starting with 2008 year the CO_2 emission have been calculated separately for each company taken into account the specific data from companies: plant specific CaO and MgO content in clinker (based on annual analysis) in order to estimated **plant specific CO_2 EF for clinker production.**

For 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.

Emissions resulted from discarded cement kiln dust were calculated separately (this is the case for 1989-2003 period, 2006 and 2008 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 the EF used for estimate CO_2 emission from CKD is also 0.525 t CO_2/t clinker.

Table 4. 4 Clinker production data and CO_2 emissions from clinker production in the period 1989- 2008

Years	Activity data and CO_2 emissions from Cement Production subsector (2.A.1) 2010 submission		
	Clinker production [kt]	**Emission factor [tCO_2/t clinker]**	**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 (average)	4142.66

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

Equation 4. 3 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. 5 Cement production data and SO_2 emissions from cement production in the period 1989- 2008

Years	Activity data and SO_2 emissions from Cement Production subsector (2.A.1) 2010 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

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 from level point of view.

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.

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.

A linear extrapolation was used to estimate dolomite lime production for 1989-1991 in order to complete the time series.

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

Emission factors

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

Table 4. 6 CO_2 emissions from lime production in the period 1989-2008

Year	Emissions from Lime Production subsector (2.A.2) 2010 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

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. 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).

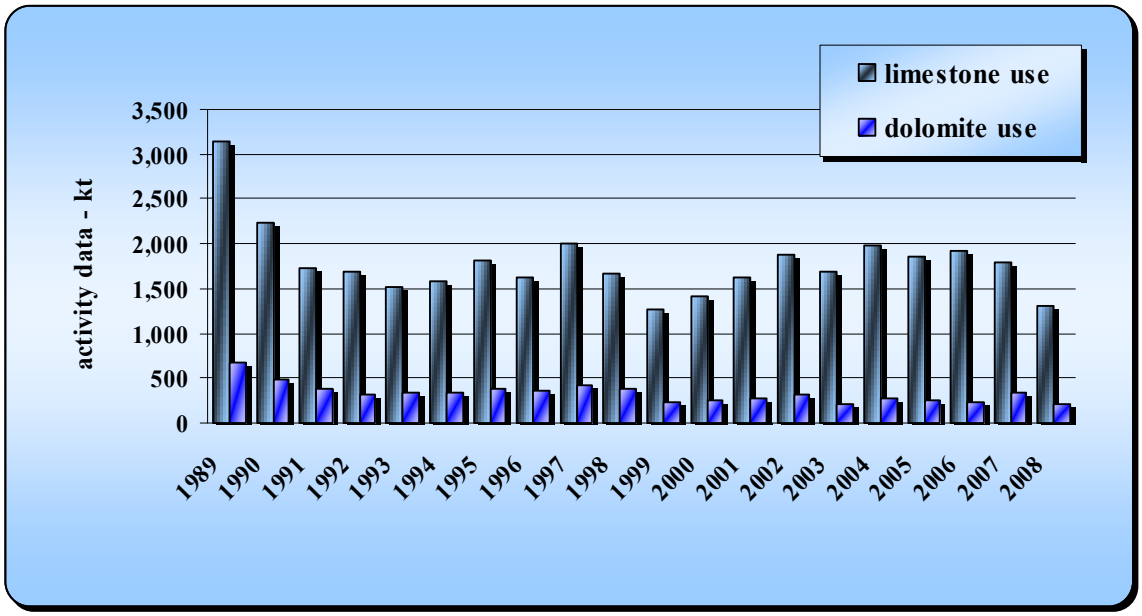
Table 4. 7 Amount of limestone and dolomite used and CO_2 emissions in the period 1989-2008

Year	Activity data from Limestone and Dolomite Use subsector (2.A.3) 2010 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

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 1989-2008



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

Methodology

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 theirs 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).

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 1989-2008

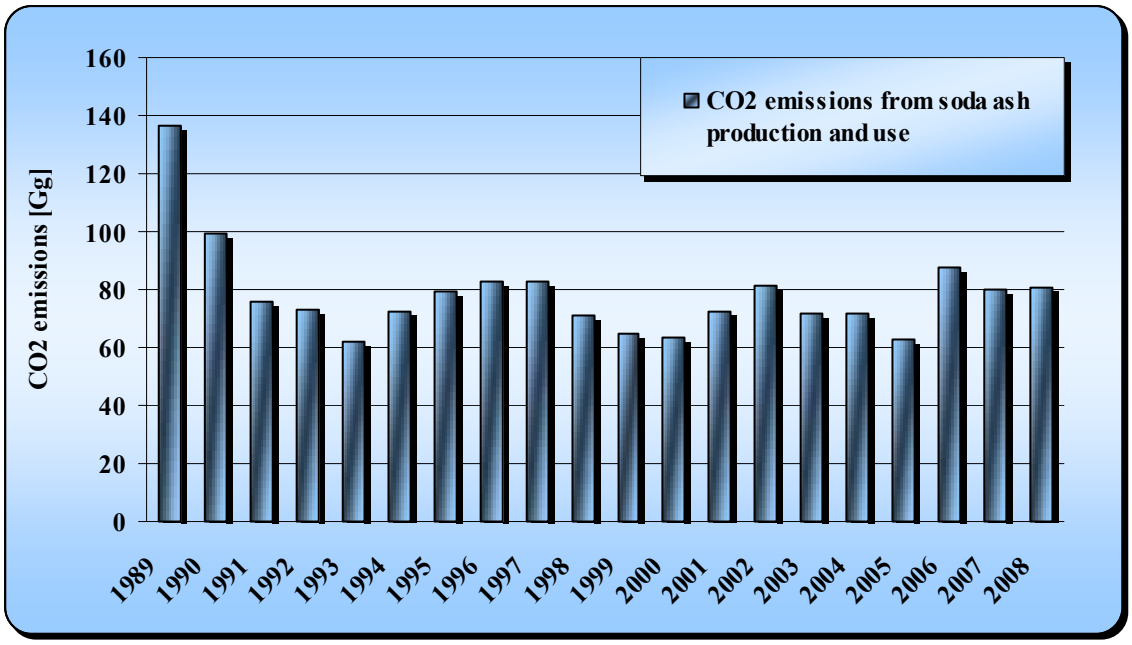


Table 4. 8 CO_2 emissions from soda ash production and use in the period 1989-2008

Year	Emissions from Soda Ash Production and Use subsector (2.A.4) 2010 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

Asphalt roofing production (2.A.5)

Methodology

The default IPCC methodology for estimation the emissions from asphalt roofing production sub-sector cannot be applied due to the lack of data.

Activity data

The data on asphalt roofing production sub-sector are not available.

Emission factors

The default IPCC emission factors cannot be use due to the unavailability of the activity data.

Road paving with asphalt (2.A.6)

Methodology

The default IPCC methodology for estimation the emissions from road paving with asphalt sub-sector cannot be applied due to the lack of data.

Activity data

The data on road paving with asphalt sub-sector are not available.

Emission factors

The default IPCC emission factors cannot be use due to the unavailability of the activity data.

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.

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. 9 CO_2 emissions from Container glass and flat glass production in the period 1989-2008

Year	Emissions from Glass Production subsector (2.A.7.1) 2010 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

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 1989-2008.

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 1989-2008.

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 1989-2008.

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 1989-2008.

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 1989-2008.

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.

For 2007 and 2008 years 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

Table 4. 10 The effects of recalculations in Mineral Production sub-sector (2A)

The effects of recalculations in Mineral Products subsector (2A)			
Years	**2009 submission**	**2010 submission**	
	CO_2 emissions [Gg]		**Differences [%]**
1989	11336.08	11337.86	0.01570
1990	8900.80	8901.97	0.01313
1991	6803.11	6804.87	0.02576
1992	6049.60	6050.27	0.01118
1993	5764.51	5764.89	0.00671
1994	5707.04	5707.39	0.00610
1995	6442.03	6442.25	0.00342
1996	6337.34	6337.58	0.00383
1997	6299.77	6299.92	0.00238
1998	5982.99	5983.13	0.00232
1999	5240.20	5240.38	0.00332
2000	5307.52	5307.68	0.00311
2001	5631.54	5631.70	0.00290
2002	5876.91	5877.10	0.00333
2003	5648.45	5648.65	0.00358
2004	6218.31	6218.58	0.00436
2005	6164.99	6165.19	0.00318
2006	6669.24	6669.39	0.00227
2007	7845.73	7845.92	0.00239
2008		7577.38	

Soda Ash Use (2.A.4.2)

Recalculation of the entire time series of soda ash use sub-sector as few new economic agents using soda ash in their activity were identified starting with the 2010 submission (2.A.4.2);

Table 4. 11 Recalculations of CO_2 [Gg] emissions in Soda Ash Use subsector (2.A.4.2)

Years	The effects of recalculations in Soda Ash Use subsector (2.A.4.2)		
	2009 submission	2010 submission	Differences [%]
	CO_2 emissions [Gg]		
1989	12.03	13.78	14.5
1990	10.83	11.97	10.5
1991	9.24	10.97	18.7
1992	10.41	11.06	6.2
1993	10.42	10.77	3.4
1994	10.37	10.69	3.0
1995	9.75	9.94	1.9
1996	8.44	8.64	2.4
1997	7.56	7.67	1.4
1998	7.40	7.50	1.3
1999	7.53	7.66	1.7
2000	9.18	9.29	1.1
2001	9.87	9.97	1.0
2002	18.95	19.07	0.6
2003	15.32	15.45	0.9
2004	16.56	16.67	0.7
2005	14.95	15.00	0.3
2006	24.85	24.88	0.2
2007	17.46	17.52	0.4
2008		12.47	

Limestone and Dolomite Use sub-sector (2.A.3)

Recalculation of the entire time series in AD for the limestone and dolomite consumption sub-sector, as few new economic agents using limestone and dolomite in their activity were identified starting with the 2010 submission (2.A.3);

Table 4. 12 Recalculations of CO_2 [Gg] emissions in the limestone and dolomite use sector

Years	The effects of recalculations in Limestone and Dolomite Use subsector (2.A.3)		
	2009 submission	2010 submission	Differences [%]
	CO_2 emissions [Gg]		
1989	1709.97	1710.01	0.002
1990	1221.23	1221.26	0.002
1991	941.67	941.69	0.003
1992	896.66	896.69	0.004
1993	828.49	828.53	0.004
1994	856.04	856.08	0.004
1995	981.05	981.08	0.004
1996	885.42	885.45	0.004
1997	1080.32	1080.36	0.004
1998	913.08	913.12	0.005
1999	672.37	672.42	0.007
2000	736.17	736.23	0.008
2001	845.50	845.57	0.008
2002	973.73	973.81	0.008
2003	848.91	848.97	0.008
2004	997.93	998.09	0.016
2005	931.26	931.41	0.016
2006	945.86	945.98	0.012
2007	945.96	946.08	0.013
2008		668.24	

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

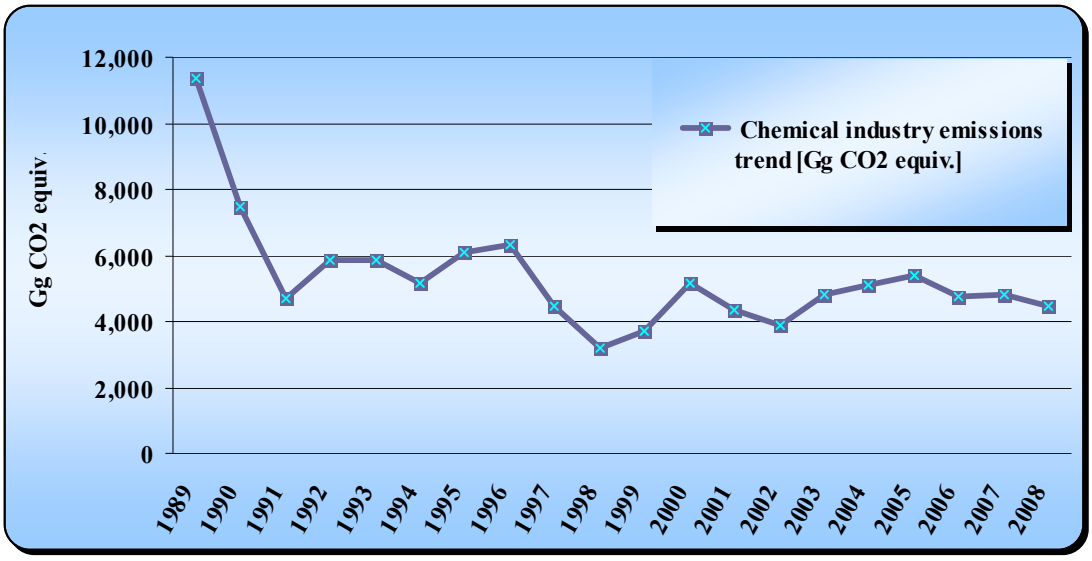
More detailed data will try to be obtained, in respect to the IPCC GPG 2000 provisions.

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, calcium carbide production (2B.4) and other productions (2B.5): carbon black, methanol, ethylene, etc. Chemical industry sub-sector was responsible for 23.76 % of the total Industrial Processes sector's GHG emissions in 2008.

Figure 4. 9 GHG emissions trend in the Chemical Industry sub-sector for 1989-2008 period [Gg CO_2 equiv.]



GHG emissions trend in the Chemical Industry sub-sector for 1989-2008 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 recorded a decreased after 1989

Table 4. 13 GHG emissions from the Chemical Industry sector, in 2008 (Gg)

Sector	CO_2	CH_4	N_2O
	[Gg] - 2008		
2.B Chemical Industry	1,912.50	0.48	8.16
2.B.1 Ammonia Production	1,912.50	0.00	0.00
2.B.2 Nitric Acid Production	0.00	0.00	8.16
2.B.3 Adipic Acid Production	NO	NO	NO
2.B.4.2 Carbide Production	C	0.00	0.00
2.B.5 Others (ethylene, carbon black, methanol, sulphuric acid)	0.00	0.48	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.

Activity data

Ammonia production data are annually provided by National 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 1.5tCO_2/t ammonia production.

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

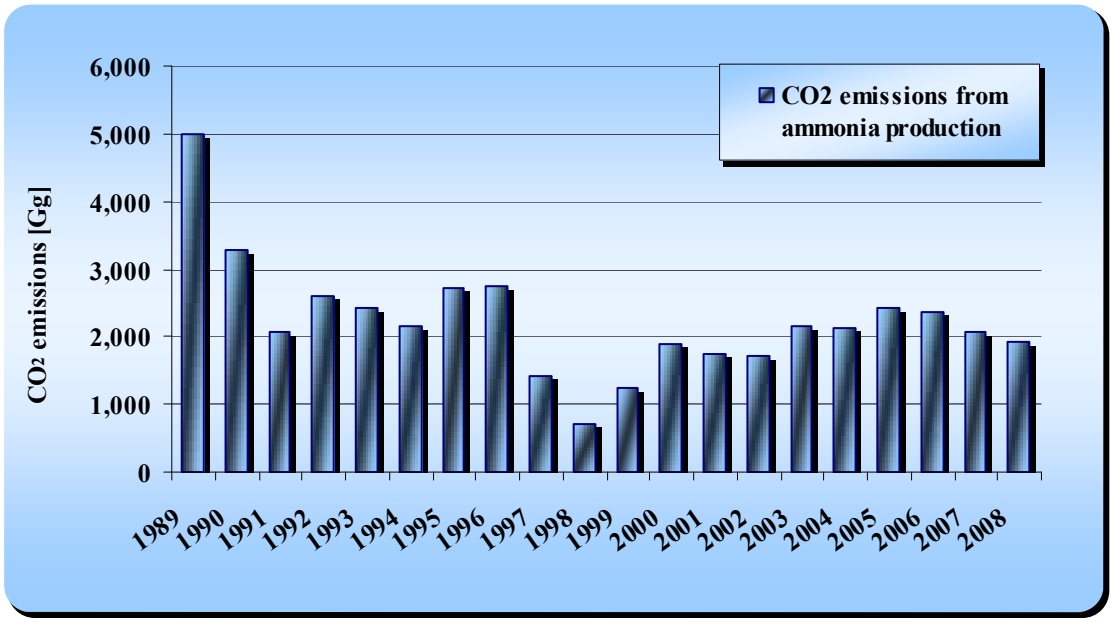
Within the chemical industry sector, ammonia production is one of the most important GHG emission source. The lowest level of emissions was recorded in 1998, due to the activity data decreased by almost a half compared to the previous and next year. This happened as one producing plant has stopped its 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 7.9kg CO/ tonne of product and 0.03kg SO_2/ tonne of product).

Table 4. 14 Ammonia production related to the CO_2 emissions in the period 1989-2008

Year	Activity data and emissions from Ammonia Production subsector (2.B.1) 2010 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

Figure 4. 10 The trend of CO_2 emissions from ammonia production in the period 1989 –2008



Nitric acid production (2.B.2)

Methodology

The nitric acid production is a key category, from both level and 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 an emission factor, which reflects the process.

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 in 2006.

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 NOx abatement technology installed at each plant:

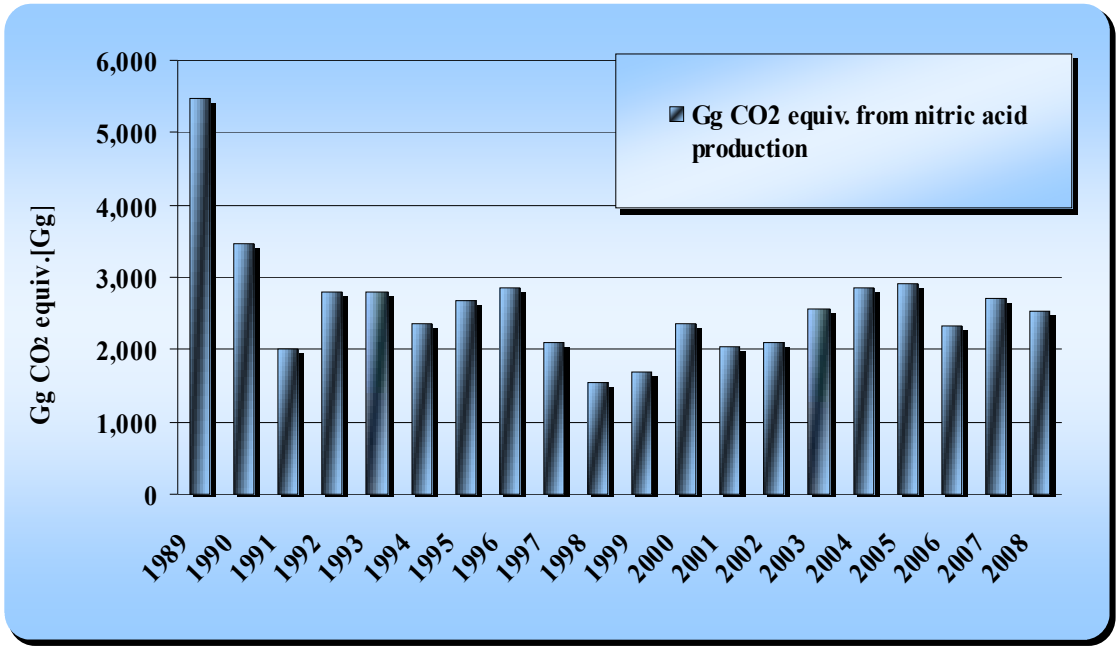
- extended absorption for NOx – used at one factory (it was used since 1997);
- selective catalytic reduction (SCR) for NOx – used at one single plant since 2003;

These abatement techniques are used for NOx reduction and do not result is reduction of N_2O.

Table 4. 15 Nitric acid production related to the N_2O and NO_x emissions in the period 1989-2008

Years	Activity data and emissions from Nitric acid Production subsector (2.B.2) 2010 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

Figure 4. 11 The trend of CO_2 emissions from nitric acid production, 1989- 2008 [Gg CO_2 equiv]



Adipic acid production (2.B.3)

Methodology

The IPCC methodology has been followed for estimating the emissions from adipic acid production.

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. 16 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**

Carbide production (2.B.4.2)

Methodology

Total CO_2 emissions from calcium carbide production were estimated using the production data and the emission factor, in line with IPCC 1996.

Activity data

National Statistics provided annually the amount of calcium carbide production. Starting with 2007 the data related with calcium carbide production are confidential.

Emission factors

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

Table 4. 17 CO_2 emissions from Calcium Carbide Production in the period 1989-2008

Years	Emissions from Calcium Carbide Production subsector (2.B.4.2) 2010 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	C
2008	C

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

Methodology

Total emissions from other production were estimated using the production data and the emission factors, in line with IPCC 1996.

.

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, 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 1989-2008.

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 1989-2008.

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 1989-2008.

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 10.19%.

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 1989-2008.

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 1989-2008.

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

Nitric acid production sub-sector (2.B.2)

Recalculation of the entire time series in AD for the Nitric acid production sub-sector as the data production were reviewed; starting with 2010 submission the data production of HNO_3 are reported in tons HNO_3 100 % by each plant (2.B.2).

Table 4. 18 Recalculations of N_2O emission [Gg CO_2 equiv.] in the nitric acid production sub-sector

The effects of recalculations in Nitric acid Production subsector (2.B.2)			
Years	**2009 submission**	**2010 submission**	
	N_2O emissions [Gg CO_2 equiv.]		**Differences [%]**
1989	6762.31	5464.46	-19.19
1990	4402.34	3459.66	-21.41
1991	2238.07	2022.17	-9.65
1992	3563.00	2786.20	-21.80
1993	2940.92	2781.99	-5.40
1994	2603.79	2353.29	-9.62
1995	2983.86	2689.89	-9.85
1996	3181.86	2853.65	-10.31
1997	2176.86	2098.46	-3.60
1998	1563.45	1543.78	-1.26
1999	1778.51	1703.53	-4.22
2000	2557.43	2350.84	-8.08
2001	2242.73	2047.10	-8.72
2002	2272.19	2091.01	-7.97
2003	2716.62	2567.79	-5.48
2004	3167.18	2843.58	-10.22
2005	3173.52	2918.94	-8.02
2006	2507.01	2334.09	-6.90
2007	2769.50	2718.55	-1.84
2008		2529.68	

4.3.6 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.

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

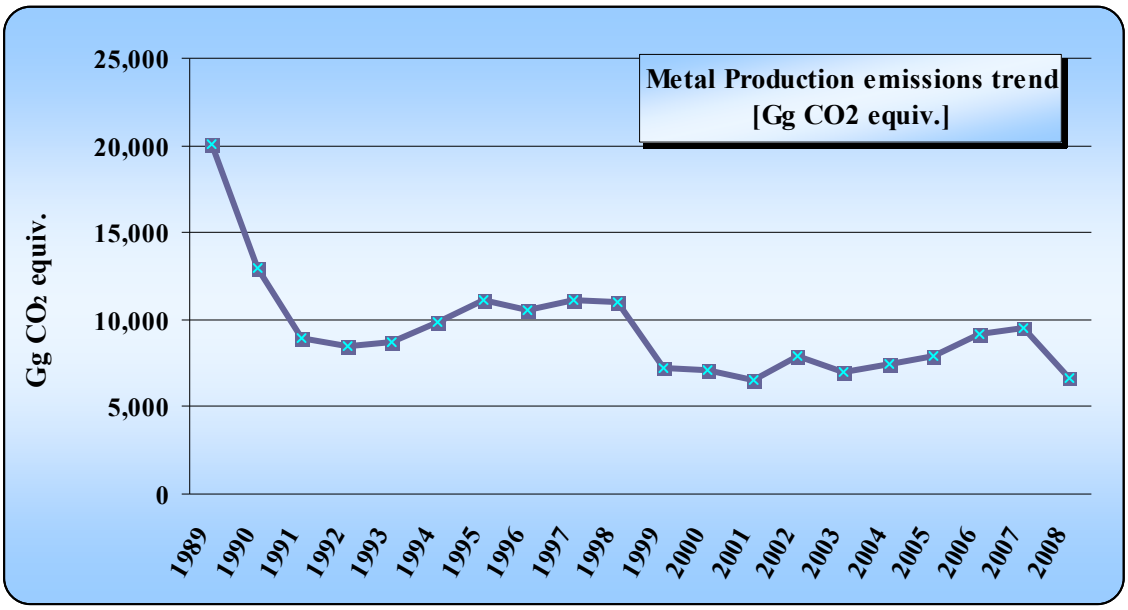
4.4.1 Source category description

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 35.60 % of the total Industrial Processes sector's GHG emissions in 2008.

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 2008 CO_2 emissions from production of iron and steel contributed 3.85 % to total greenhouse gas emissions). In the base year, these emissions accounted for 5.76 % 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 1989-2008 period [Gg CO2 equiv.]



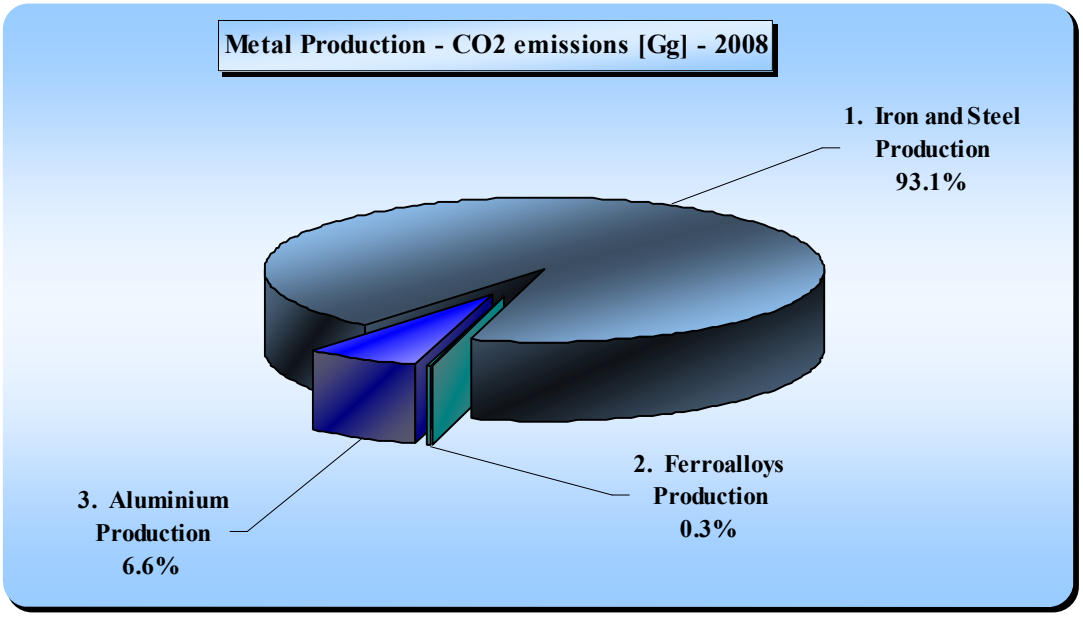
GHG emissions trend in the Metal Products sub-sector for 1989-2008 period due:

- 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 1997 and 2003;
- In 2008 the trend of emission decreased due to reduction of production recorded for iron and steel production and ferroalloys production sub-sectors.

Table 4. 19 GHG emissions from Metal Production sub-sector, in the year 2008 [Gg CO_2 equiv.]

Sector	**CO_2**	**PFCs**
	CO_2 equivalent [Gg]	**2008**
2.C Metal Production	6,038.01	630.90
2.C.1 Iron and Steel Production	5,622.56	0.00
2.C.2 Ferroalloys Production	18.32	0.00
2.C.3 Aluminium Production	397.13	630.90

Figure 4. 13 Structure of the Metal Production sub-sector, in 2008



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 the Good Practice Guidance (Tier 2 method.).

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).

Also, for steel produced in electric arc furnace, the carbon released from consumed electrodes was added to the total CO_2 iron and steel production emissions**,** for all time series (according to IPCC Good Practice Guidance the carbon released from consumed electrodes is in the range from 1 to 1.5kg carbon per tonne of steel, but the average value of this range 1.25kg carbon per tonne of steel has been used to estimate the CO_2 emissions from consumed electrodes).

For 1989-2006 period the data related sinter consumption were provided by Ministry of Economy due to inconsistence in data provided by economic agents.

For 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. 4 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. 5 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: 3.6% (country specific value)

Carbon content in crude steel: 0.34 % (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. 20 Emission factors for NMVOC, NO_x, CO, SO_2 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 1989-2008

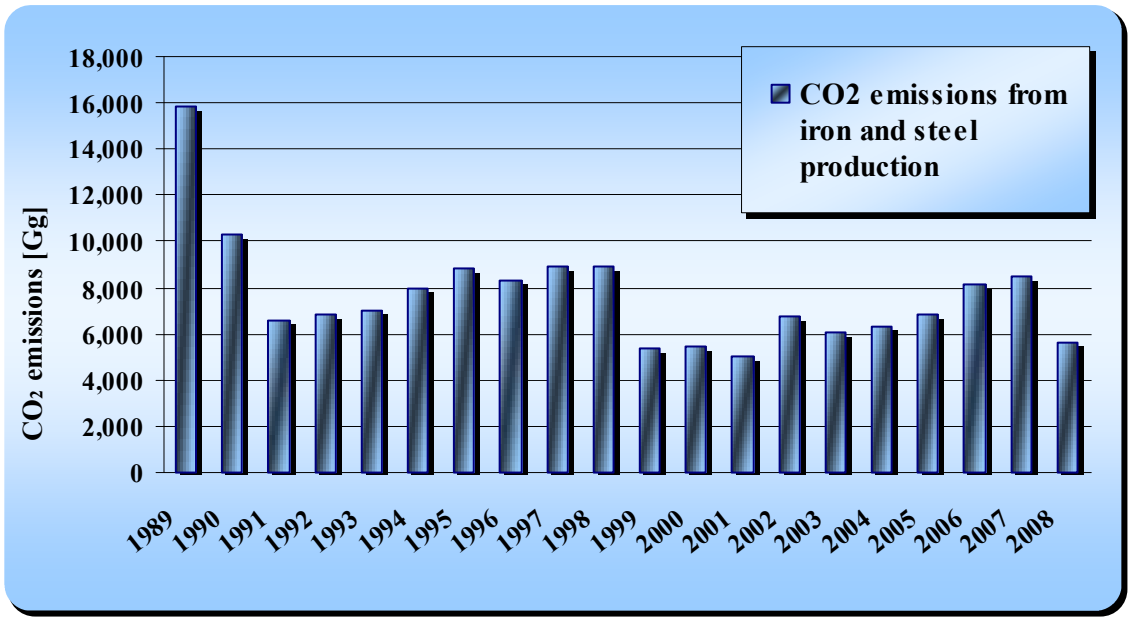


Table 4. 21 The input data used to calculate emissions from iron and steel industry in the period 1989-2008

Years	Activity data from Iron and Steel Production subsector (2.C.1) 2010 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

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.

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

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 and 2008 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. 22 CO_2 emission from Ferroalloys Production in the period 1989-2008

Years	Emissions from Ferroalloys Production subsector (2.C.2) 2010 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

Aluminium production (2.C.3)

Methodology

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

The CO_2 emissions within the production of aluminium are calculated based on the production volume (Tier 1b) and the PFC emissions from aluminium production are in line with IPCC Good Practice Guidance 2000 (Tier 1 Method).

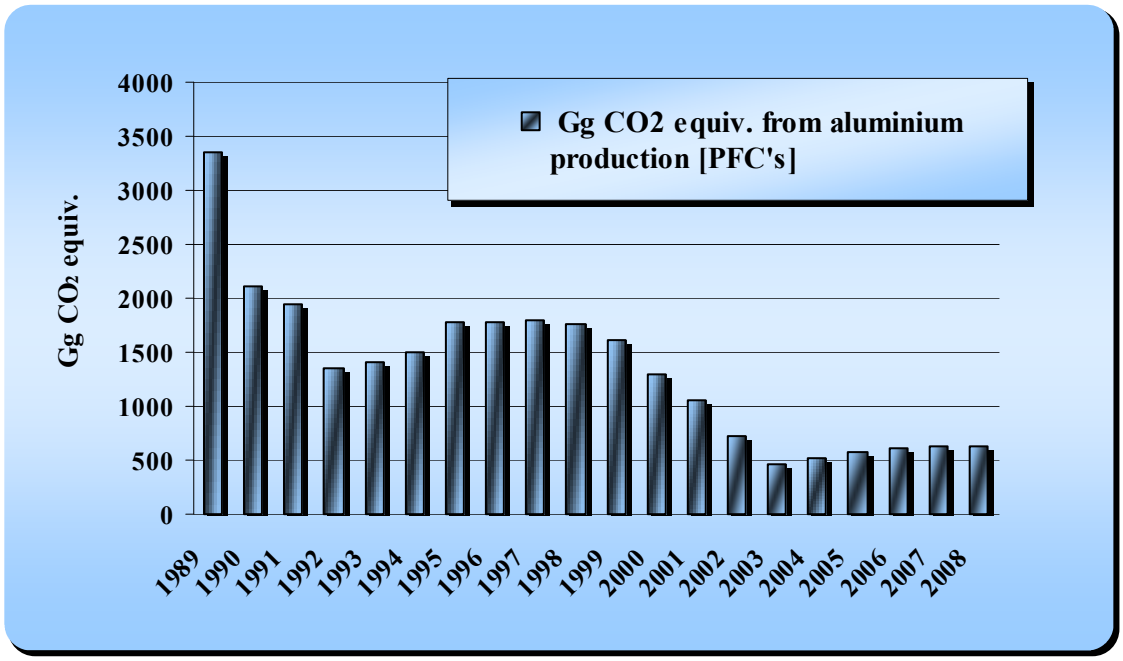
Activity data

Primary aluminium production is carried out in one facility, where the pre-baked process is used, so the production data are confidential.

Emissions have been calculated based on activity data and technology type information provided by the plant.

- 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 (PFC emissions for the period 1997-2002 were estimated as a weighted average of the two constants related technologies applied SWPB and CWPB)
- Starting with 1997, the technology was changed to CWPB (Centre Worked Pre-baked).

Figure 4. 15 The trend of PFC emissions [GgCO2 equiv] from Primary aluminium production sub-sector in the period 1989-2008



Emission factors

For confidentiality reasons the presentation of CO_2 , CF_4 and C_2F_6 emission factors used to estimate emission from primary aluminium production are omitted.

Emissions of CF_4 and C_2F_6 were estimated by multiplying annual primary aluminium production with the emission factors provided by Good Practice Guidance and considering the changes in technologies over the period.

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

Table 4. 23 The PFC and CO_2 emissions from aluminium production in the period 1989-2008

Year	Emissions from Aluminium Production subsector (2.C.3) 2010 submission		
	CF_4 emissions	**C_2F_6 emissions**	**CO_2 emissions [Gg]**
	[tones]		
1989	451.42	45.14	398.31
1990	285.15	28.52	251.60
1991	261.74	26.17	230.94
1992	182.23	18.22	160.79
1993	189.95	18.99	167.60
1994	200.94	20.09	177.30
1995	239.02	23.90	210.90
1996	238.39	23.84	210.35
1997	240.75	24.32	245.55
1998	236.30	24.02	262.07
1999	216.08	22.13	261.11
2000	174.14	18.19	259.90
2001	140.73	15.14	269.73
2002	96.75	11.10	279.89
2003	61.39	7.92	297.07
2004	66.73	8.61	322.89
2005	74.09	9.56	358.51
2006	79.31	10.23	383.74
2007	81.38	10.50	393.76
2008	82.07	10.59	397.13

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 use 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 1989-2008.

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 1989-2008.

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; 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.

By expert judgment 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%.

By expert judgment the uncertainty related to the activity data for PFC emissions is 1% and the uncertainty associated with the default emission factor for PFC emissions is 6%.

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 10.05% and for PFC is 6.08%.

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

The effects of recalculations in Metal Production subsector (2C)			
Years	**2009 submission**	**2010 submission**	
	CO_2 equivalent [Gg]		**Differences [%]**
1989	20,053.14	20,053.12	-0.00014
1990	12,990.09	12,990.07	-0.00015
1991	8,999.49	8,999.47	-0.00019
1992	8,530.48	8,530.47	-0.00012
1993	8,694.58	8,694.57	-0.00007
1994	9,884.55	9,884.54	-0.00005
1995	11,076.26	11,076.25	-0.00005
1996	10,555.63	10,555.62	-0.00007
1997	**9,692.44**	**11,090.94**	**14.42873**
1998	**9,676.44**	**11,017.04**	**13.85430**
1999	**6,082.03**	**7,275.29**	**19.61954**
2000	**6,270.20**	**7,156.56**	**14.13611**
2001	**5,893.89**	**6,519.39**	**10.61262**
2002	**7,637.11**	**7,923.45**	**3.74930**
2003	7,035.01	7,035.00	-0.00019
2004	7,454.37	7,454.36	-0.00020
2005	7,934.96	7,934.94	-0.00018
2006	9,217.81	9,217.80	-0.00014
2007	9,505.70	9,505.70	-0.00002
2008		6668.92	

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

Recalculation of the entire time series in AD for the iron and steel production sub-sector, as few new economic operators producing steel in electric arc furnaces (EAF) were identified starting with the 2010 submission (2.C.1.1 and 2.C.1.5).

Table 4. 25 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	**2009 submission**	**2010 submission**	
	CO_2 emissions [Gg]		**Differences [%]**
1989	15831.13	15831.10	-0.00018
1990	10291.47	10291.45	-0.00019
1991	6577.73	6577.71	-0.00025
1992	6824.75	6824.74	-0.00015
1993	6973.81	6973.80	-0.00009
1994	7992.64	7992.64	-0.00006
1995	8862.29	8862.28	-0.00006
1996	8310.23	8310.22	-0.00010
1997	8893.76	8893.75	-0.00009
1998	8877.88	8877.87	-0.00007
1999	5405.11	5405.10	-0.00011
2000	5455.86	5455.86	-0.00010
2001	5050.06	5050.05	-0.00029
2002	6768.56	6768.55	-0.00018
2003	6024.44	6024.43	-0.00022
2004	6287.14	6287.12	-0.00024
2005	6805.46	6805.45	-0.00020
2006	8128.88	8128.87	-0.00015
2007	8440.72	8440.71	-0.00002
2008		5622.56	

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

Aluminum production sub-sector (2.C.3)

Recalculation of the 1997-2002 time series of aluminium production sub-sector due to improve the information on the type of technological process of primary aluminum production, provided by the operator (2.C.3). The recalculations have been done just for PFC emission.

Table 4. 26 Recalculations of PFC [Gg CO2 equiv.] emissions in the Aluminum production sub- sector

The effects of recalculations in Aluminium Production subsector (2.C.3)			
Years	**2009 submission**	**2010 submission**	**Differences [%]**
	PFC emissions [Gg CO_2 equiv.]		
1989	3349.56	3349.56	0.00
1990	2115.83	2115.83	0.00
1991	1942.09	1942.09	0.00
1992	1352.13	1352.13	0.00
1993	1409.43	1409.43	0.00
1994	1490.97	1490.97	0.00
1995	1773.53	1773.53	0.00
1996	1768.86	1768.86	0.00
1997	390.11	1788.61	**358.49**
1998	416.34	1756.95	**322.00**
1999	414.83	1608.10	**287.65**
2000	412.90	1299.27	**214.67**
2001	428.51	1054.02	**145.97**
2002	444.64	730.99	**64.40**
2003	471.95	471.95	0.00
2004	512.96	512.96	0.00
2005	569.56	569.56	0.00
2006	609.63	609.63	0.00
2007	625.55	625.55	0.00
2008		630.90	

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

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, 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, 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.

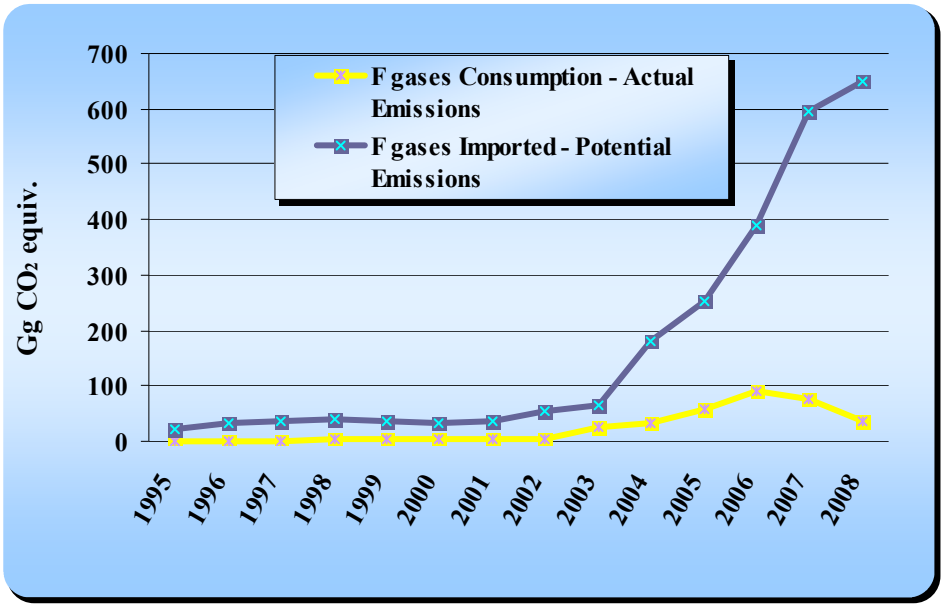
4.7 Source category Consumption of Halocarbons and SF_6 (CRF sector 2.F)

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 1989-2008



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 2008
- The most important economic agent is a 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.

Starting with 2010 submission for 2003-2008 period the actual emissions increased significantly relative to last submission 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 new indentified. In 2008 the actual emissions decreased related to 2007 because the same economic agent user of SF_6 has reduced significantly its SF_6 consumption.

The ascending trend 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 SF6 category there were take into account next activity:

- Marketing refrigeration equipment and installations;
- Distribution Refrigeration accessories;
- Nuclear electricity and heat production;
- Tobacco products
- production of pieces and accessories for vehicles and motor vehicle
- Production of beer

Emission factors

- **Potential emissions**

Potential emissions were estimated using Tier 1a method, based on formula:

Equation 4. 6 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 2008)
- 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. 27 Implied emission factors use to estimated the emissions related to Consumption of halocarbons and SF6

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	65.00 - fixes fire extinguishers 40.00 - portable fire extinguishers	-	-
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 2008, the sub-sector 2F Consumption of halocarbons and SF_6 includes the following source categories and the following F-gases:

Table 4. 28 Source categories and the F-gases in Consumption of halocarbons and SF6 sub-sector

Source category	Sub-sector	HFCs/PFCs/SF_6
2F1 Refrigeration and air conditioning equipment	Domestic refrigeration	C5F12, HFC-32, HFC-143a, HFC-134a, HFC-125, HFC-134, HFC-23
2F1 Refrigeration and air conditioning equipment	Commercial refrigeration	HFC-143a, HFC-32, HFC-125, HFC-134a, C5F12, HFC-23, HFC-134, HFC-227ea, HFC-143, HFC-236fa
2F1 Refrigeration and air conditioning equipment	Industrial refrigeration	HFC-143a, HFC-134a, HFC-32, HFC-23, HFC-134, HFC-227ea, HFC-125, HFC-134, HFC 143, SF6, HFC-236fa
2F1 Refrigeration and air conditioning equipment	Transport refrigeration	HFC-134a,HFC-134,HFC-125, HFC-143a, HFC-32
2F1 Refrigeration and air conditioning equipment	Stationary air conditioning	HFC-125, HFC-134a, HFC-32, HFC-143a, HFC-41, HFC-227ea, HFC-23, HFC-134, HFC-236fa
2F1 Refrigeration and air conditioning equipment	Mobile air conditioning	HFC-134a, HFC-134, HFC-143a, HFC-125, HFC-227ea, HFC-32, HFC 41
2F8 Electrical equipments	Electrical equipments	SF6, HFC-134a, HFC-23
2F3 Fire extinguishers		HFC-134 HFC-227ea, HFC-125
2F5 Solvents		HFC-23, HFC-134a, HFC-143a
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

Recalculation of the 2003-2007 time series of activity data for consumption of halocarbons and SF_6 sub-sector, as few new economic operators using F-gases in their activity were identified starting with 2010 submission (2.F).

Table 4. 29 The effects of recalculations in Consumption of halocarbons and SF_6 sub-sector – 2.F

The effects of recalculations in Consumption of halocarbons and SF6 subsector (2F)			
Years	**2009 submission**	**2010 submission**	
	CO_2 equivalent [Gg]		**Differences [%]**
1989	0.00	0.00	0.00
1990	0.00	0.00	0.00
1991	0.00	0.00	0.00
1992	0.00	0.00	0.00
1993	0.00	0.00	0.00
1994	0.00	0.00	0.00
1995	0.58	0.58	0.00
1996	1.00	1.00	0.00
1997	1.45	1.45	0.00
1998	2.87	2.87	0.00
1999	3.16	3.16	0.00
2000	3.69	3.69	0.00
2001	3.83	3.83	0.00
2002	4.23	4.23	0.00
2003	6.53	24.24	**271.22**
2004	9.49	32.06	**237.79**
2005	6.89	56.27	**716.54**
2006	22.69	90.39	**298.40**
2007	19.28	76.08	**294.66**
2008		36.84	

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)

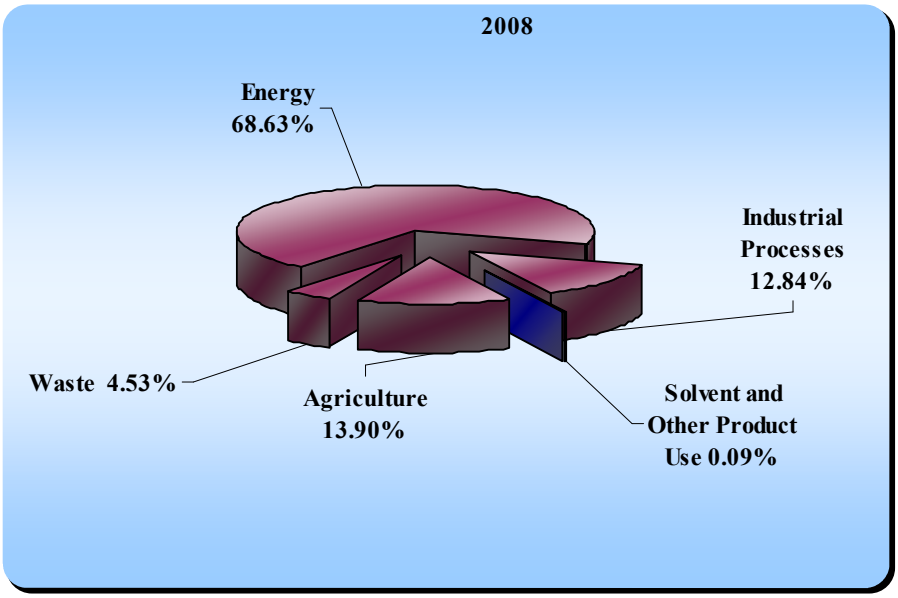
5.1 Overview of the sector

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 UNFCCC.

5.2 Source category

Paint application (3A), Degreasing and Dry Cleaning (3B), Chemical Products, Manufacture and Processing (3C), Other (3D). In 2008 the GHG emissions from Solvent and other product use sector contributed to 0.09% 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, 2008



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 enduction, preservation of wood, domestic solvent use (other than paint application), underseal 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 2008 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

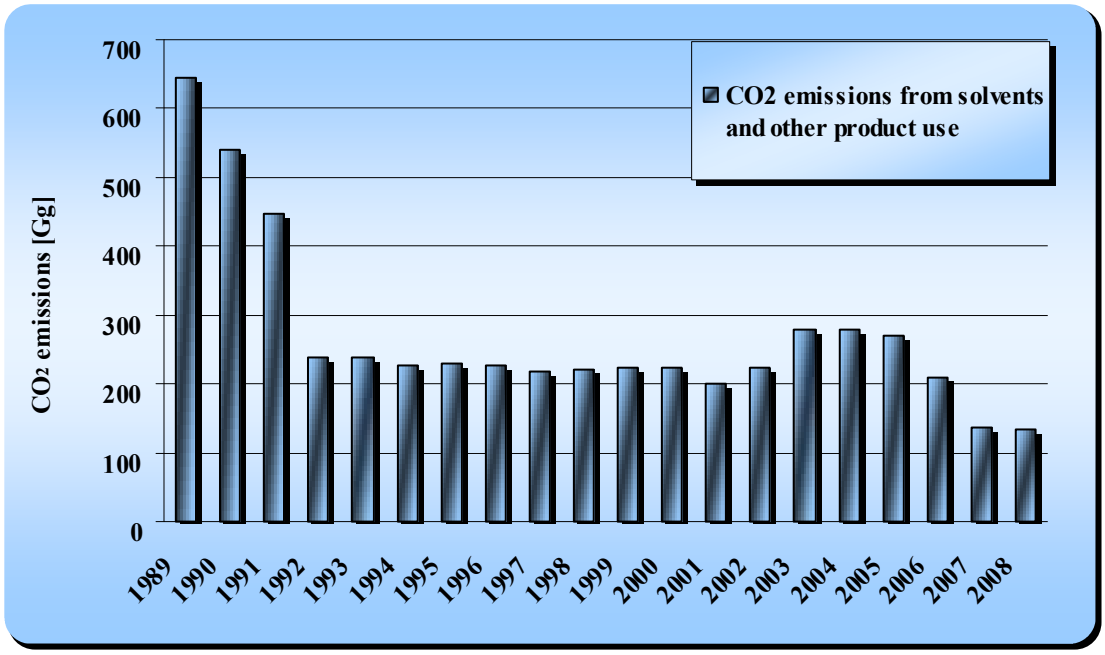
CO_2 emissions = 0,85 x (44/12) x emissions of NMVOC

Where 0,85 is carbon content conversion factor.

Table 5. 1 CO_2 emissions resulted from Solvent and other product use in the period 1989-2008

Solvents and Other Product Use 2010 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	24.76	28.19	0.00	81.79	**134.74**

Figure 5. 2 The trend of CO_2 emissions resulted from Solvent and other product use sector, in the year 2008



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

Solvent and Other Product Use sector (3.CRF)

Recalculation of the 2007 year for Solvent and Other Product Use sector as the NMVOC emissions are estimated using EF's in line with the EMEP/EEA air pollutant emission inventory guidebook — 2009 (3.CRF);

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			
Years	**2009 submission**	**2010 submission**	**Differences [%]**
	CO_2 emissions [Gg]		
1989	645.80	645.80	0.00
1990	540.50	540.50	0.00
1991	448.20	448.20	0.00
1992	237.60	237.60	0.00
1993	237.50	237.50	0.00
1994	225.40	225.40	0.00
1995	229.40	229.40	0.00
1996	225.30	225.30	0.00
1997	219.00	219.00	0.00
1998	221.90	221.90	0.00
1999	222.40	222.40	0.00
2000	224.30	224.30	0.00
2001	200.50	200.50	0.00
2002	222.30	222.30	0.00
2003	279.90	279.90	0.00
2004	277.40	277.40	0.00
2005	269.65	269.65	0.00
2006	208.50	208.50	0.00
2007	161.07	137.82	**-14.44**
2008		134.74	

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. 1 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	NO
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. 1 Total GHG emissions trend in Agriculture for 1989–2008

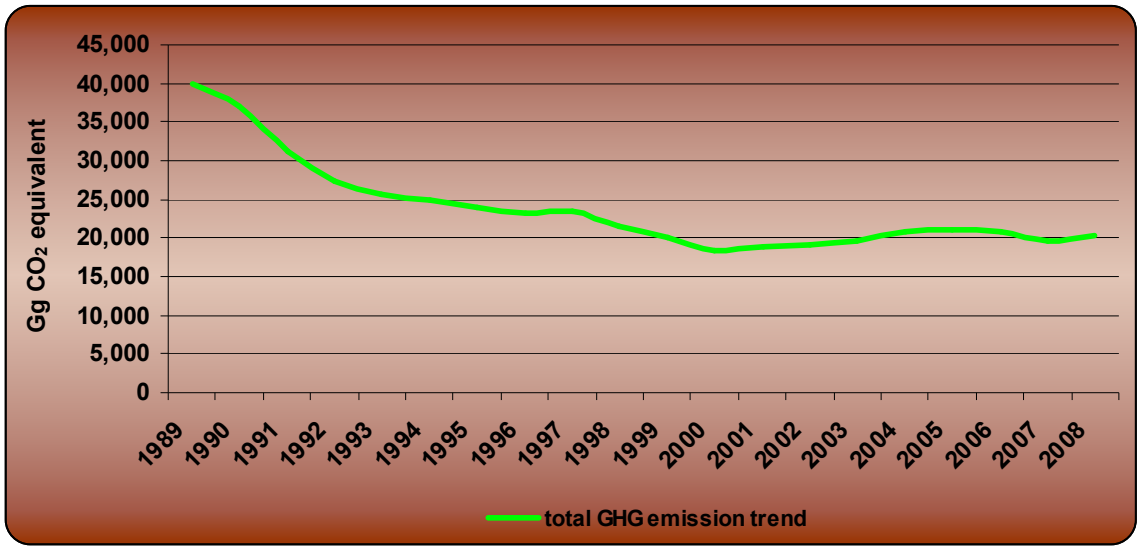
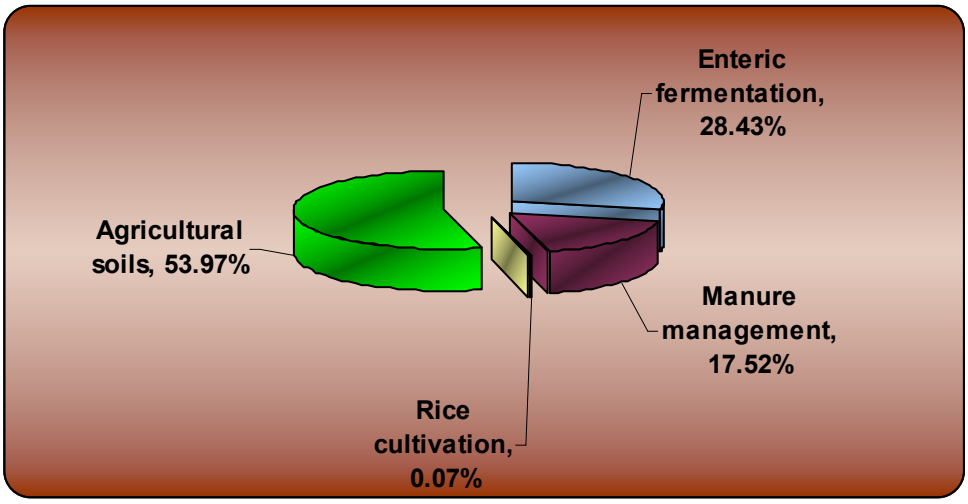


Figure 6. 2 Contribution of the sub-sectors in the total GHG emissions from Agriculture, in 2008



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 2008 emissions are considered as not occurring.

Emissions from prescribed burning of savannas do not occur in Romania.

The Agriculture sector accounted for 13.9% of the total GHG emissions in 2008, reaching 20,286.76 Gg CO_2 equivalent (Table 6.2). Within the GHG emissions from the agriculture sector, the N_2O emissions have the largest contribution (in 2008, N2O emissions contribution is 62.04% to the total Agriculture sector's CO2 equivalent emissions), followed by the CH_4 emissions (that account for the remaining 37.96%).
Over the period 1989–2008, the GHG emissions resulted from agriculture sector decreased by 49.28% (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 2008 a significantly reduced emission compared to the base year 1989 (75.86% decrease comparing with the base year).

In case of agricultural soils, the emissions decreased over the period (49.68% decrease in 2008 comparing with 1989), due to the decrease of the amount of the synthetic fertilizer applied, of the livestock populations and of the cultivated areas. The emissions trend is also fluctuating considering the crop productions level that vary from one year to another.

As presented in the Table 6.3, the Agriculture sector's CH_4 emissions decreased in 2008 with almost a half the level recorded in the base year (-48.8%). 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 2008 with 49.58% 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

Table 6. 2 Contribution of Agriculture sector in total GHG emissions, in 1989–2008

Year	Total GHG emissions [Gg CO_2 equivalent]	GHG emissions from Agri-culture [Gg CO_2 equivalent]	Contribu-tion of Agricul-ture 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	274,753.66	40,000.18	14.56	15,038.84	37.60	24,961.34	62.40
1990	242,096.97	36,998.65	15.28	14,280.54	38.60	22,718.11	61.40
1991	191,263.17	31,137.99	16.28	12,906.56	41.45	18,231.44	58.55
1992	180,949.17	27,234.30	15.05	11,205.08	41.14	16,029.22	58.86
1993	178,690.46	25,721.65	14.39	9,909.93	38.53	15,811.72	61.47
1994	173,533.06	24,979.23	14.39	9,791.70	39.20	15,187.54	60.80
1995	180,471.44	23,974.42	13.28	9,403.07	39.22	14,571.35	60.78
1996	186,529.75	23,262.73	12.47	9,393.94	40.38	13,868.79	59.62
1997	168,017.73	23,362.40	13.90	9,280.32	39.72	14,082.08	60.28
1998	150,048.98	21,457.65	14.30	8,643.04	40.28	12,814.61	59.72
1999	132,714.66	20,084.79	15.13	8,048.10	40.07	12,036.69	59.93
2000	136,230.67	18,293.57	13.43	7,523.95	41.13	10,769.61	58.87
2001	140,942.79	18,958.26	13.45	7,391.34	38.99	11,566.92	61.01
2002	147,098.66	19,187.00	13.04	7,585.21	39.53	11,601.78	60.47
2003	153,740.28	19,550.78	12.72	7,712.08	39.45	11,838.70	60.55
2004	155,490.09	20,849.13	13.41	7,814.03	37.48	13,035.10	62.52
2005	149,525.35	20,935.21	14.00	7,936.14	37.91	12,999.07	62.09
2006	154,178.24	20,715.36	13.44	8,147.18	39.33	12,568.18	60.67
2007	152,644.28	19,700.67	12.91	7,982.05	40.52	11,718.62	59.48
2008	145,915.87	20,286.76	13.90	7,700.20	37.96	12,586.56	62.04

Table 6. 3 Distribution of CH_4 emissions within Agriculture sub-sectors, in 1989–2008 [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	716.14	505.52	202.80	2.96	NA, NE	NO	4.86
1990	680.03	492.72	180.64	2.39	NA, NE	NO	4.27
1991	614.60	438.40	170.78	1.30	NA, NE	NO	4.13
1992	533.58	380.65	149.27	0.98	NA, NE	NO	2.68
1993	471.90	335.36	132.17	0.86	NA, NE	NO	3.50
1994	466.27	335.26	126.65	0.33	NA, NE	NO	4.03
1995	447.77	328.32	114.51	0.45	NA, NE	NO	4.49
1996	447.33	327.78	116.15	0.61	NA, NE	NO	2.78
1997	441.92	320.16	116.83	0.29	NA, NE	NO	4.64
1998	411.57	302.33	105.71	0.12	NA, NE	NO	3.41
1999	383.24	285.33	94.35	0.10	NA, NE	NO	3.46
2000	358.28	270.81	84.87	0.08	NA, NE	NO	2.52
2001	351.97	266.11	81.47	0.05	NA, NE	NO	4.34
2002	361.20	274.31	86.87	0.02	NA, NE	NO	NO
2003	367.24	279.40	87.83	0.01	NA, NE	NO	NO
2004	372.10	276.54	95.47	0.09	NA, NE	NO	NO
2005	377.91	280.24	97.39	0.28	NA, NE	NO	NO
2006	387.96	287.85	99.71	0.40	NA, NE	NO	NO
2007	380.10	283.20	96.29	0.60	NA, NE	NO	NO
2008	366.68	274.65	91.31	0.71	NA, NE	NO	NO

Table 6. 4 Distribution of N_2O emissions within Agriculture sub-sectors, in 1989–2008 [Gg]

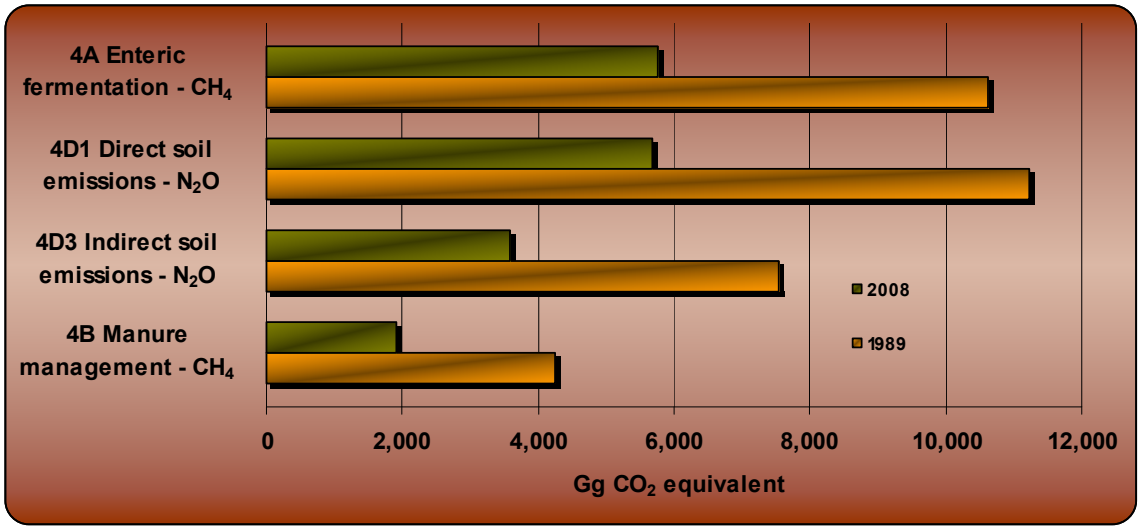
Year	Total N_2O emission - Agriculture	Enteric Fermentation	Manure Management	Rice Cultivation	Agricultural Soils	Prescribed Burning of Savannas	Field burning of agricultural residues
1989	80.52		10.21		70.19	NO	0.12
1990	73.28		8.88		64.30	NO	0.10
1991	58.81		8.72		49.99	NO	0.11
1992	51.71		7.93		43.71	NO	0.07
1993	51.01		7.28		43.64	NO	0.09
1994	48.99		6.99		41.90	NO	0.10
1995	47.00		6.41		40.48	NO	0.11
1996	44.74		6.48		38.18	NO	0.08
1997	45.43		6.47		38.84	NO	0.12
1998	41.34		5.91		35.34	NO	0.09
1999	38.83		5.37		33.36	NO	0.09
2000	34.74		5.01		29.66	NO	0.06
2001	37.31		4.87		32.34	NO	0.11
2002	37.43		5.11		32.31	NO	NO
2003	38.19		5.16		33.03	NO	NO
2004	42.05		5.48		36.56	NO	NO
2005	41.93		5.62		36.31	NO	NO
2006	40.54		5.72		34.82	NO	NO
2007	37.80		5.54		32.26	NO	NO
2008	40.60		5.28		35.32	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. 5 Key categories overview – Agriculture, 2008

Key categories	GHG	Excluding LULUCF		Including LULUCF	
		Criteria	Contribution in total GHG emissions [%]	Criteria	Contribution in total GHG emissions and removals [%]
4A Enteric fermentation	CH_4	L	**3.95**	L, T	**2.91**
4D1 Direct soil emissions	N_2O	L, T	**3.89**	L, T	**2.87**
4D3 Indirect soil emissions	N_2O	L, T	**2.46**	L, T	**1.81**
4B Manure management	CH_4	L, T	**1.31**	L, T	**0.97**
4D2 Pasture, Range and Paddock Manure	N_2O	L	**1.16**	L	**0.85**
4B Manure management	N_2O	L	**1.12**	L	**0.83**

Figure 6. 3 Key Categories in Agriculture, both by level and trend



Considering the lack of data needed to apply tier 2 methods, the Governmental Decision for establishment of the National System for estimating the GHG emissions underlines

the need to move to higher tier methods in case of key categories and facilitates the involvement of different institution and experts from agricultural field.

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 2008, CH_4 emissions from Enteric Fermentation represented 74.9% of total CH_4 emissions in the Agriculture sector);
- is the largest source in the Agriculture sector (in 2008, CH_4 emissions from Enteric Fermentation as CO_2 equivalent represented 28.43% from Total Agriculture emissions);
- contributed with 3.95% 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. 4 Methane emission trend due to the Enteric Fermentation

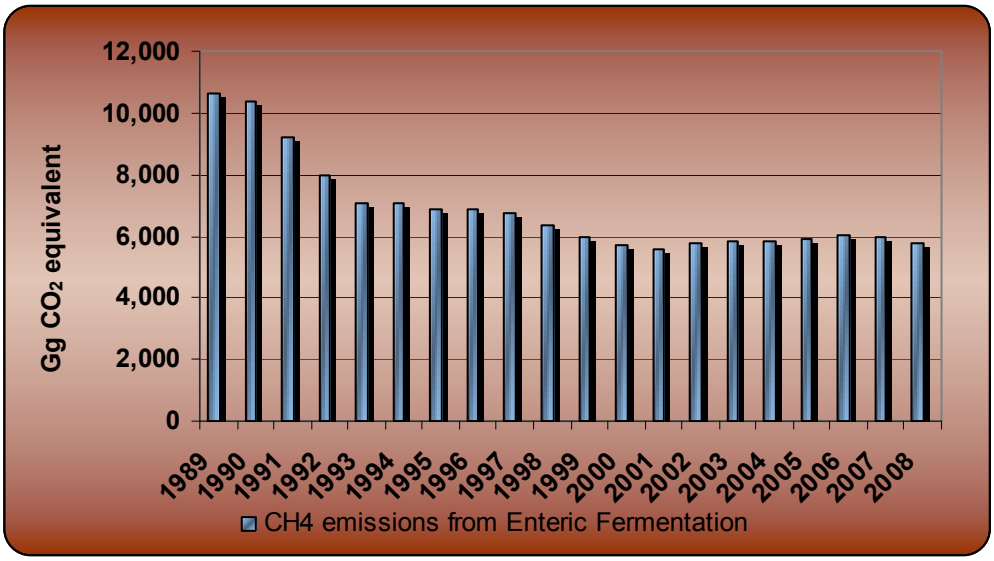


Table 6. 6 Observations on source category 4A – "Enteric Fermentation"

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, 1989-2009; expert judgment; EF: IPCC GPG 2000, IPCC 1996
4A2	Buffalo		AD: SY, other correspondence, NIS, 1989-2009; expert judgment; EF: IPCC GPG 2000, IPCC 1996
4A3	Sheep		AD: SY, other correspondence, NIS, 1989-2009; EF: IPCC GPG 2000, IPCC 1996
4A4	Goats		
4A6	Horses		
4A7	Mules and asses		AD: FAO, 2009; EF: IPCC GPG 2000, IPCC 1996
4A8	Swine		AD: SY, other correspondence, NIS, 1989-2009; 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 developing 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 developing 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) data series (Table 6.7).

Table 6. 7 Default emission factors used for calculation of Dairy cows methane emissions from Enteric fermentation

Year	Average milk production per animal (cow and buffao cow for 1989-2007/cow for 2008, 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

The emission factors used for livestock except Dairy cows are presented in Table 6.8.

Table 6. 8 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	5
4A4	Goats	5
4A6	Horses	18
4A7	Mules and asses	10
4A8	Swine	1
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 2004-2008 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 1989-2009 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 1989-2009 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 1989-2009 and other relevant correspondence.

Livestock data series are presented in Table 6.9.

Table 6. 9 Livestock data series for 1989-2008

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

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 1989-2008 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 2007 and 2008 submissions 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

There was not any recalculation done since last submission.

6.2.6 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.

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 2008, CH_4 emissions from Manure Management represented 24.9% of total CH_4 emissions while N_2O accounted for 13.01% of total N_2O emissions in the Agriculture sector);
- is the fourth largest source in the Agriculture sector (in 2008, CH_4 and N_2O emissions from Manure Management as CO_2 equivalent represented 17.52% from Total Agriculture emissions);
- contributed with 2.43% 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).

Figure 6. 5 Overall trend of emissions from Manure Management

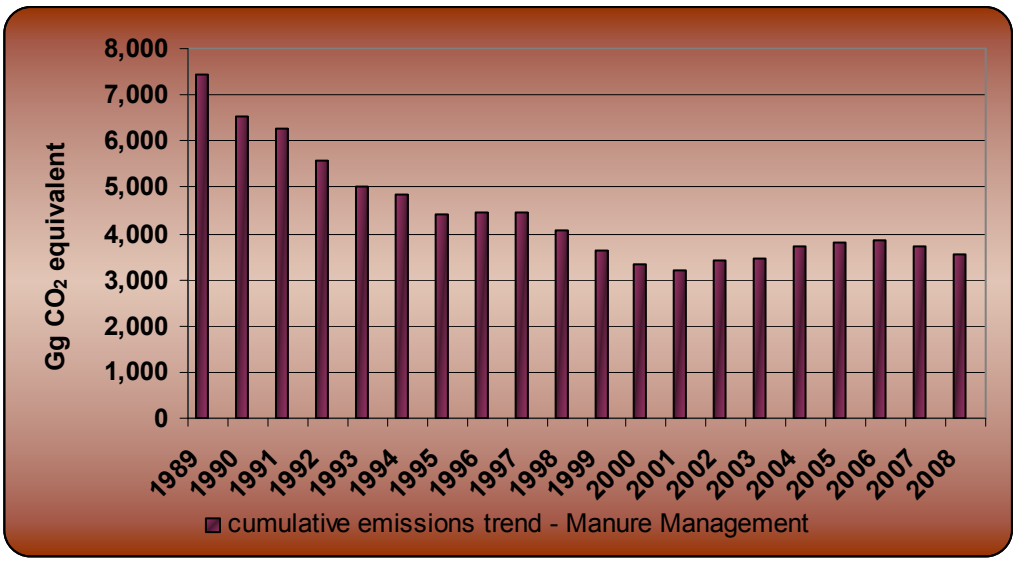


Table 6. 10 Observations on source category 4B – "Manure Management"

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, 1989-2009; expert judgment; EF: IPCC GPG 2000, IPCC 1996
4B2	Buffalo		AD: SY, other correspondence, NIS, 1989-2009; expert judgment; EF: IPCC GPG 2000, IPCC 1996
4B3	Sheep		AD: SY, other correspondence, NIS, 1989-2009; EF: IPCC GPG 2000, IPCC 1996
4B4	Goats		
4B6	Horses		
4B7	Mules and asses		AD: FAO, 2009; EF: IPCC GPG 2000, IPCC 1996
4B8	Swine		AD: SY, other correspondence, NIS, 1989-2009; 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, both by 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 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 developing 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 developing countries

The emission factors used are presented in Table 6.11.

Table 6. 11 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	0.16
4B4	Goats	0.17
4B6	Horses	1.6
4B7	Mules and asses	0.9
4B8	Swine	7
4B9	Poultry	0.018

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 Daily spread and 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 6.12.

Table 6. 12 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 6.13);
- 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 6.14).

Table 6. 13 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. 14 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 6.14 (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 1989-2008 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 2007 and 2008 submissions 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

There was not any recalculation done since last submission.

6.3.6 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.

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 2008, CH_4 emissions from Rice Cultivation represented 0.19% of total CH_4 emissions in the Agriculture sector);
- is the smallest source in the Agriculture sector (in 2008, CH_4 emissions from Rice Cultivation as CO_2 equivalent represented 0.07% from Total Agriculture emissions);
- contributed with 0.01% 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. 6 Methane emission trend due to the Rice Cultivation

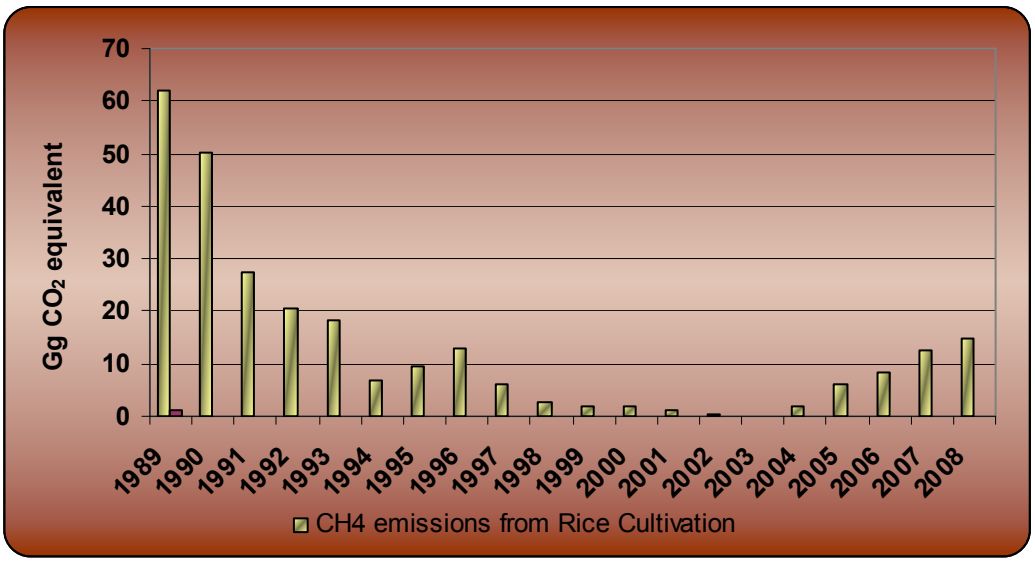


Table 6. 25 Observations on source category 4C – "Rice Cultivation"

Source indicative	Source (livestock) type	Observation	Data source
4C122	Rice harvested area		AD: SY, NIS, 1989-2009; 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 new 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 6.16.

Table 6. 3 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

Activity data

Total rice cultivated area is provided by Romanian National Institute for Statistics (NIS) being released through Statistical Yearbook 1989-2009.
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 6.17.

Table 6. 4 Harvested area data series for 1989-2008

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

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 1989-2008 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 2007 and 2008 submissions 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 2008, N_2O Direct soil emissions represented 45.1% of total N_2O emissions in the Agriculture sector);

- is the second largest source in the Agriculture sector (in 2008, N_2O Direct soil emissions as CO_2 equivalent represented 27.98% from Total Agriculture emissions);
- contributed with 3.89% 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 2008, N_2O emissions from Pasture, Range and Paddock Manure represented 13.44% of total N_2O emissions in the Agriculture sector);
- is the fifth largest source in the Agriculture sector (in 2008, N_2O emissions from Pasture, Range and Paddock as CO_2 equivalent represented 8.34% from Total Agriculture emissions);
- contributed with 1.16% 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 2008, N_2O Indirect soil emissions represented 28.46% of total N_2O emissions in the Agriculture sector);
- is the third largest source in the Agriculture sector (in 2008, N_2O Indirect soil emissions as CO_2 equivalent represented 17.66% from Total Agriculture emissions);
- contributed with 2.46% 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;
- cultivated areas

Figure 6. 7 Overall emissions trend of Agricultural Soils

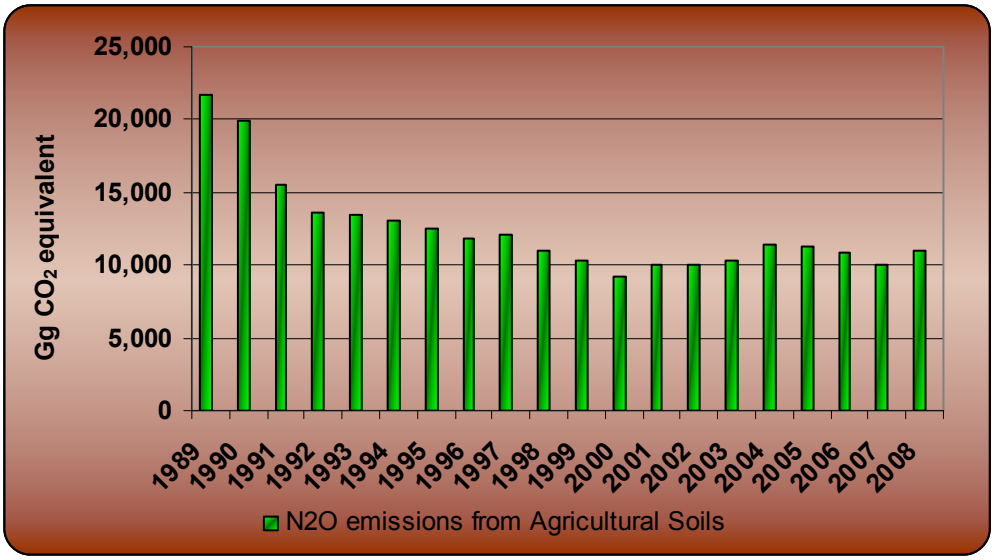


Figure 6. 8 N_2O emissions trends – Agricultural Soils

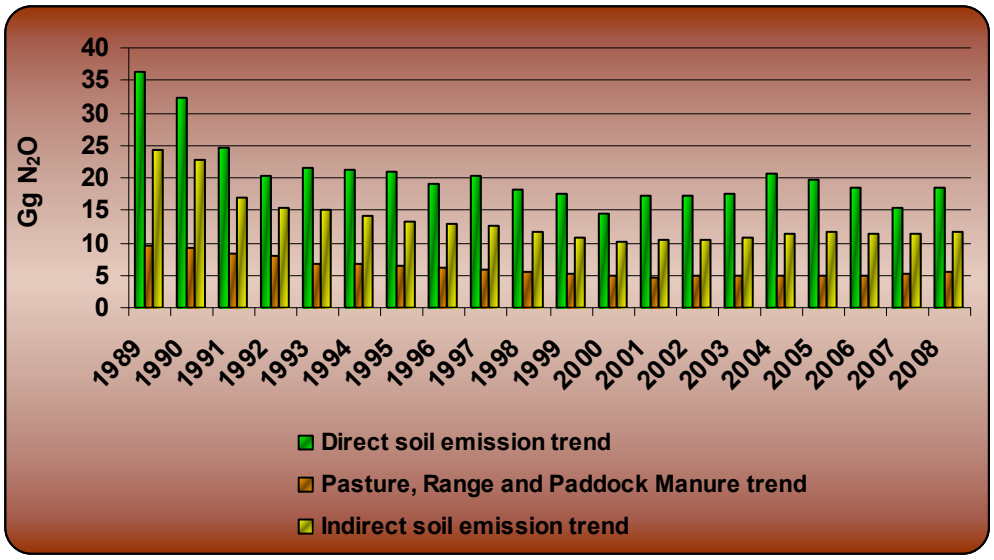


Table 6. 5 Observations on source category 4D – "Agricultural Soils"

Source indicative	Source (livestock) type	Observation	Data source
4D11, 4D3	Amount of N synthetic fertilizer used		AD: SY, NIS, 1989-2009; 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, 1989-2009; expert judgment; FAO 2009; 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 and soybeans	AD: SY, other correspondence, NIS, 1989-2009; 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, perennial green fodder	

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 ($Frac_{PRP}$)

$$\mathbf{Frac_{PRP} = N_{ex(Pasture\ Range\ and\ Paddock)}/N_{ex}}$$

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 1989-2009.

Data series are presented in Table 6.20.

Default IPCC GPG 2000 value of $Frac_{GASF}$ used is presented in Table 6.19.

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 6.20.

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 6.19.

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 1989-2009 and are presented in Table 6.20.

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 6.19.

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 1989-2009 and specific correspondence and are presented in Table 6.20.

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 6.19.

Table 6. 6 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 1989-2009 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

Although we asked for area of organic soils cultivated data we did not receive any specific data. Even they are some areas of organic soils cultivated, they are considered to be of small size; the emissions generated are considered to be irrelevant, the "Not Occurring" notation key being used.

Table 6. 70 Activity data series used for calculation of direct soil emissions, for 1989-2008

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

Table 6.20 (continued) Activity data series used for calculation of direct soil emissions, for 1989-2008

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

Table 6.20 (cont.) AD series used for calculation of direct soil emissions, for 1989-2008

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

Table 6.20 (continued) Activity data series used for calculation of direct soil emissions, for 1989-2008

Year	Production of non-N-fixing crops [thousands tonnes/year]								
	Dry onion	Dry garlic	Cabbage	Green peppers	Water melons	Melons	Other vegetables	Annual green fodder	Perennial green fodder (lucerne, clover)
1989	412.7	46.6	877.3	253.3			1,594.4	15,801.8	18,057.0
1990	225.4	30.6	551.9	182.0			1,247.7	14,403.5	12,963.9
1991	218.5	32.2	616.5	166.8			1,519.6	11,036.2	15,228.6
1992	339.3	43.5	676.2	181.7			1,389.5	7,124.8	10,989.5
1993	344.0	48.9	853.9	176.3			1,770.1	7,001.4	11,758.2
1994	310.9	56.4	711.3	163.2			1,590.5	6,491.3	11,669.4
1995	363.0	69.5	824.4	195.6			1,685.1	6,019.5	12,209.9
1996	305.6	54.1	857.4	186.6			1,841.4	6,014.6	12,088.2
1997	337.0	63.3	761.2	167.4			1,767.4	5,344.1	13,301.2
1998	365.2	72.0	837.8	191.4			1,796.0	4,919.3	12,331.4
1999	401.1	84.5	885.4	212.3	787.9	65.3	1,220.5	5,362.9	13,509.2
2000	296.3	68.3	731.9	174.8	488.0	43.1	950.0	3,317.4	9,212.0
2001	396.5	82.9	819.2	184.8	506.7	43.9	1,162.6	3,725.6	11,535.7
2002	340.8	72.4	821.4	197.4	600.0	51.3	1,231.3	4,382.4	12,469.4
2003	350.4	76.5	1,019.2	249.1	706.3	58.3	1,405.8	4,725.3	12,613.9
2004	332.8	65.9	919.1	237.2	723.2	41.9	1,123.7	1,923.5	6,608.8
2005	363.6	68.4	1,009.4	203.8	691.8		660.6	2,455.0	10,127.5
2006	390.7	64.2	1,106.0	279.1	641.8		822.1	3,182.6	10,622.3
2007	325.0	49.9	893.2	184.9	408.0		615.0	2,222.5	7,330.2
2008	395.6	72.3	964.6	238.7	562.3		772.0	2,860.7	9,273.3

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, 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 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 or FAO and the same emission factors and methodologies are used for the whole period, the time series 1989-2008 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.
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 2007 and 2008 submissions of the NGHGI are described at the Improvements list level, their solving being envisaged as planned improvement.

The unconformities noted and solved following the quality control 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
  - ✓ due to the implementation of the legislation which forbidden the burning of the agricultural residues, for 2002-2008 the value of the fraction of crop residue that is burned rather than left on field ($Frac_{BURN}$) has been set to zero.

All the changes made at the activity data level and their implications on emission estimates are described in Table 6.21.

Table 6. 21 Changes made at activity data level and their effects on emission estimates

Year	Changes on fraction of crop residue that is burned rather than left on field ($Frac_{BURN}$) series [kg N/kg crop-N]		Effects of changes on emission estimates		
	NIR 2009	**NIR 2010**	NIR 2009 – N_2O emissions [Gg]	**NIR 2010 – N_2O emissions [Gg]**	**Difference [%]**
1989	0.1	**0.1**	70.19	**70.19**	**0.00**
1990	0.1	**0.1**	64.30	**64.30**	**0.00**
1991	0.1	**0.1**	49.99	**49.99**	**0.00**
1992	0.1	**0.1**	43.71	**43.71**	**0.00**
1993	0.1	**0.1**	43.64	**43.64**	**0.00**
1994	0.1	**0.1**	41.90	**41.90**	**0.00**
1995	0.1	**0.1**	40.48	**40.48**	**0.00**
1996	0.1	**0.1**	38.18	**38.18**	**0.00**
1997	0.1	**0.1**	38.84	**38.84**	**0.00**
1998	0.1	**0.1**	35.34	**35.34**	**0.00**
1999	0.1	**0.1**	33.36	**33.36**	**0.00**
2000	0.1	**0.1**	29.66	**29.66**	**0.00**
2001	0.1	**0.1**	32.34	**32.34**	**0.00**
2002	0.1	**0**	31.56	**32.31**	**2.40**
2003	0.1	**0**	32.27	**33.03**	**2.34**
2004	0.1	**0**	35.59	**36.56**	**2.73**
2005	0.1	**0**	35.49	**36.31**	**2.32**
2006	0.1	**0**	34.03	**34.82**	**2.32**
2007	0.1	**0**	31.77	**32.26**	**1.53**
2008		**0**		**35.32**	

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.

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 2008 emissions are considered as not occurring.

Emissions from field burning of agricultural residues in 2008 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. 9 Cumulative emissions trend - Field Burning of Agricultural Residues

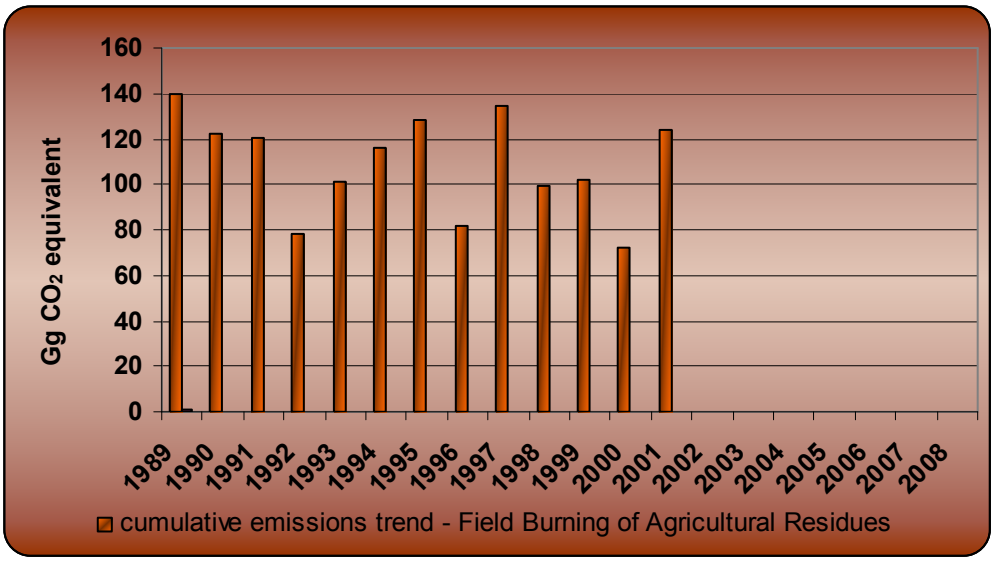


Table 6. 82 Observations on source category 4F – "Field Burning of Agricultural Residues"

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 6.23.

Table 6. 93 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 6.24.

Table 6. 104 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 1989-2008 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 2007 and 2008 submissions 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

The land uses in Romania have been relatively stable over the last 20 years, even strong mutation occurred at political, economic and social levels. Due to various and spatially equilibrated forms of the relief of the Romanian national territory, as well as due to the much diversified climate the land is suitable for a large range of activities and uses.

Geographical coverage of the country is complete and consistent over time. There is no part of the territory that has not been taken into account in the inventory. Table 7.1 gives an overview of the IPCC categories included in this chapter and provides information on the status of related emissions/removals estimates.

Table 7. 1 Status of emissions/removals estimation within the LULUCF sector

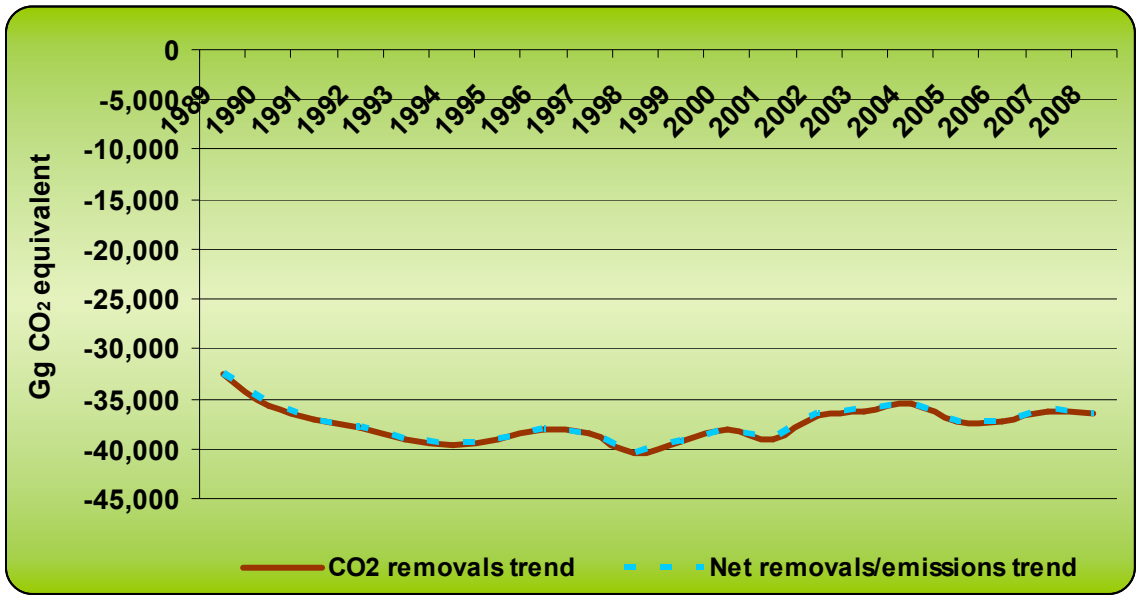
IPCC category	Emissions/removals estimation status		
	CO_2	CH_4	N_2O
5A Forest Land			
5A1 Forest Land remaining Forest Land	✓	✓	✓
5A2 Land converted to Forest Land	NA, NE	NA	IE, NA
5B Cropland	NA, NE	NA	NA, NE
5C Grassland	NA, NE	NA	NA
5D Wetlands	NA, NE	NA, NE	NA, NE
5E Settlements	NA, NE	NA, NE	NA, NE
5F Other Land	NA, NE	NA, NE	NA, NE
5G Other			
5G1 Harvested Wood Products	NE	NE	NE

Observations

1) There are no available data in order to allow for subtracting the amount of N fertilizer used in Forest Land from the amount used at the national level (included in 4D11 Synthetic Fertilizers category).

Over the period 1989-2008 there is no significant variations at the removals/emissions levels. Actual submission of the inventory is based on a land use change matrix over the span.

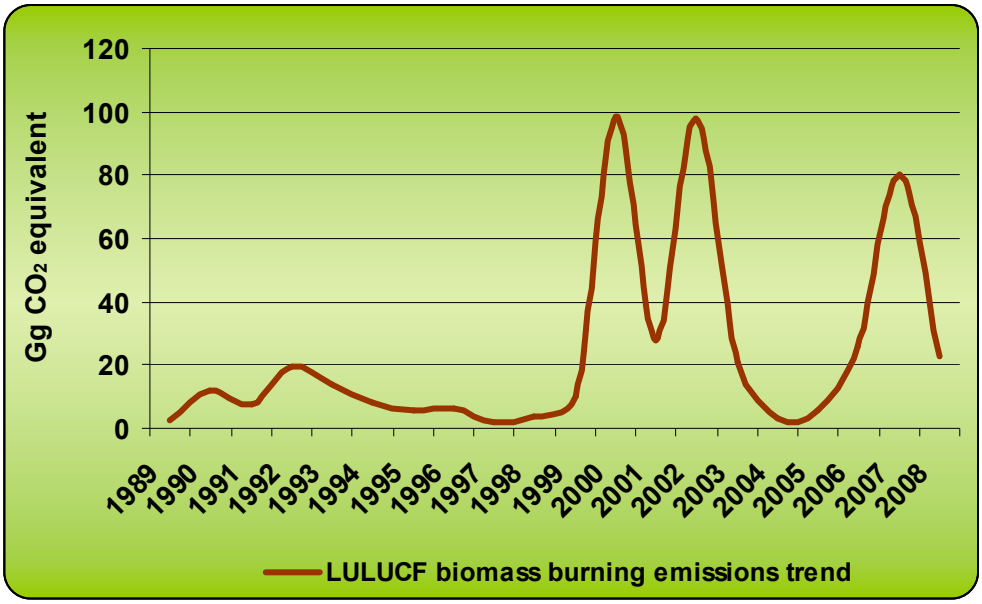
Figure 7. 1 CO_2 removals trend and Net removals/emissions trend - LULUCF in Romania over the last 20 years



Consequently, Romanian land use sector act as a net sink (Figure 7.1; Table 7.2), at an average uptake of 37,471.55 Gg/year, relatively stable over the last 20 years.

Emissions from LULUCF comprise CO_2, CH_4 and N_2O emissions from biomass burning. Due to the long drought in Romania, during 1999-2003, the area affected by wildfires increased and, as a direct consequence, levels of emissions increased (Figure 7.2).

Figure 7. 2 LULUCF biomass burning emissions trend



Due to the decrease trend of emissions from all other sectors, the percentage of net emissions/removals from LULUCF related to the total GHG emissions increased from 11.8% in 1989 to 24.96 in 2008 (Table 7.2).

Out of the national territory, agricultural land represents some 62%, forests and other wooded lands is 28%, construction and roads/railways is 4.5%, waters & ponds are 3.5% and other areas some 2%. Agricultural lands comprise arable lands whose areas were relatively stable to 64% over the 1989-2008, pastures and hayfields increased from 32% in 1989 to 33% in 2008. Comparatively, orchards and vineyards areas equally decreased, from 4 to 3%. Land use types strictly follow the national definitions. The estimation of GHG from LULUCF follow the methodology provided in the Good Practice Guidance for Land Use, Land use change and Forestry, IPCC, 2003.

Table 7. 2 Emissions/removals levels on 1989-2008

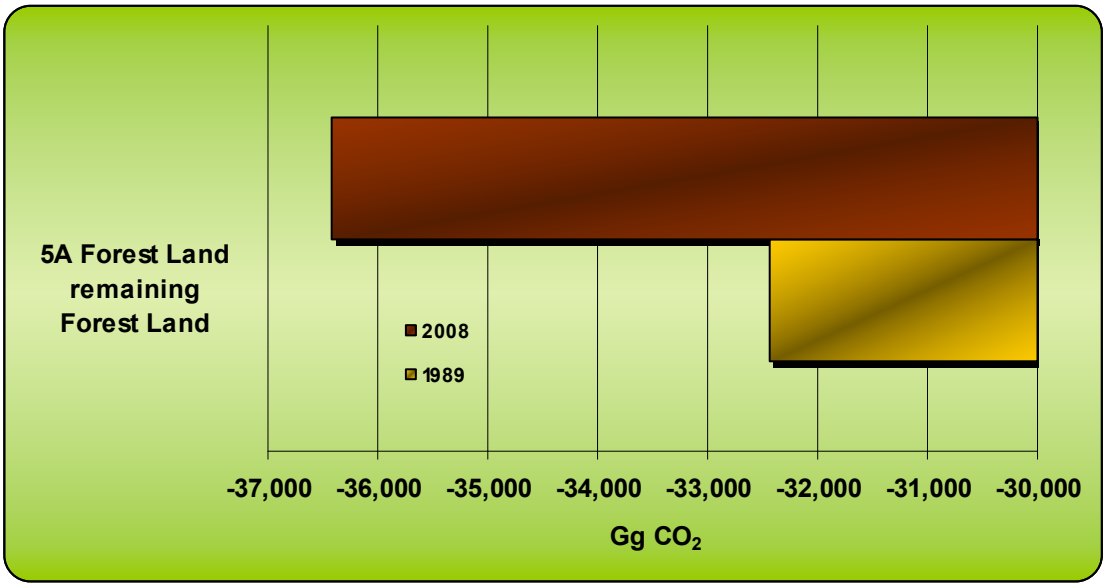
Year	Total GHG emissions [Gg CO_2 equiv.]	Net emissions/ removals from LULUCF [Gg CO_2 equiv.]	Percentage of Net emissions/ removals from LULUCF in Total GHG emissions [%]	CO_2 removals [Gg]	Emissions from biomass burning [Gg CO_2 equivalent]			
					Total	CO_2	CH_4	N_2O
1989	**274,753.66**	**-32,432.93**	**11.80**	**-32,435.47**	2.54	2.30	0.21	0.02
1990	**242,096.97**	**-35,583.29**	**14.70**	**-35,595.40**	12.11	11.00	1.01	0.10
1991	**191,263.17**	**-37,041.44**	**19.37**	**-37,048.99**	7.55	6.86	0.63	0.06
1992	**180,949.17**	**-37,845.82**	**20.92**	**-37,865.70**	19.88	18.06	1.65	0.17
1993	**178,690.46**	**-39,131.03**	**21.90**	**-39,145.16**	14.13	12.83	1.18	0.12
1994	**173,533.06**	**-39,734.40**	**22.90**	**-39,742.90**	8.51	7.73	0.71	0.07
1995	**180,471.44**	**-38,987.26**	**21.60**	**-38,992.93**	5.67	5.15	0.47	0.05
1996	**186,529.75**	**-38,002.68**	**20.37**	**-38,008.87**	6.19	5.62	0.52	0.05
1997	**168,017.73**	**-38,389.71**	**22.85**	**-38,391.56**	1.85	1.68	0.15	0.02
1998	**150,048.98**	**-40,480.80**	**26.98**	**-40,484.54**	3.74	3.39	0.31	0.03
1999	**132,714.66**	**-39,207.82**	**29.54**	**-39,218.16**	10.33	9.39	0.86	0.09
2000	**136,230.67**	**-37,999.22**	**27.89**	**-38,097.58**	98.36	89.34	8.19	0.83
2001	**140,942.79**	**-39,007.19**	**27.68**	**-39,035.00**	27.81	25.26	2.32	0.23
2002	**147,098.66**	**-36,536.08**	**24.84**	**-36,633.97**	97.89	88.92	8.15	0.83
2003	**153,740.28**	**-36,173.73**	**23.53**	**-36,194.51**	20.78	18.87	1.73	0.18
2004	**155,490.09**	**-35,491.98**	**22.83**	**-35,495.37**	3.38	3.07	0.28	0.03
2005	**149,525.35**	**-37,181.08**	**24.87**	**-37,186.86**	5.78	5.25	0.48	0.05
2006	**154,178.24**	**-37,199.82**	**24.13**	**-37,225.61**	25.80	23.43	2.15	0.22
2007	**152,644.28**	**-36,114.44**	**23.66**	**-36,194.85**	80.41	73.03	6.69	0.68
2008	**145,915.87**	**-36,414.56**	**24.96**	**-36,437.56**	23.00	20.89	1.91	0.19

Table 7.3 and Figure 7.3 describe Key categories in LULUCF, both from level and trend views.

Table 7. 3 Key categories overview – LULUCF, 2008

Key categories	GHG	Criteria	Contribution in total GHG emissions and removals [%]
5A Forest Land remaining Forest Land	CO_2	L, T	18.38

Figure 7. 3 Key Categories in LULUCF, both by level and trend



7.2 Category Forest land (CRF category 5.A)

7.2.1 Description

The forest and woodlands represents some 28% from the national territory, which fits to 0.31 ha per inhabitant in 2008. Structure of forest fund in 2008 is as follows: resinous forests (30.72%), beech forests (32.52%), oaks forests (16.77%), hardwood forests (15.12%) and softwood forest (4.87%). Additionally there is an area of some 419 300 ha of woodlands. According to the 1985 National Forest Inventory the national forest fund was characterized by: standing wood volume of 1287.8 millions. m^3, an average volume of 227 m^3/ha and an annual average increase of 5.7 m^3/ha/yr. Stands age reflects an uneven distribution of area in the elder classes. Romanian forests grow more than it harvests, with a ratio growth to harvest of some 2. Forest management is done according a decennial management plan elaborated for every single management unit. "Woodlands" (refers to pastoral forests, forest belts, re-growth and invasive trees on abandoned lands, etc) are not mapped and planned, compared to "forest "(refers to national forest fund). After 1990, abandoned lands (orchards, vineyards, pastures, crop fields) occasionally resulted in spontaneous forest regeneration, which is not yet assessed but it would be significant in the land use share and GHG balance.

Forest fire is not a management practice, but it may occur on very occasional and accidental base, affecting only the forest floor (litter, dead organic matter). In the structure of energy consumption pattern, the wood fire represents an important share.

Forestry sector is still in transition process, which consists in continuing of restoration of the properties and crystallization of a new administration system.

Due to lack of specific data, under Forest land only uptakes/emissions related to Forest land remaining Forest land are quantified.

Table 7. 4 Observations on sink/source category 5A – "Forest land"

Sink/source indicative	Sink/source type	Observation	Data source
Observations on sink category 5.A – "Forest land" – removals			
5A1	Forest area	Includes data from five forest category species: coniferous, beech, oak, hardwood species and softwood species.	AD: SY, NIS, 1989-2009; National Forest Fund publication, NIS, 2006-2009; expert judgment; EF: IPCC GPG 2003
	Woodland area		AD: SY, NIS, 1989-2009; SSP, 1980; EF: IPCC GPG 2003
Observations on source category 5.A – "Forest land" - emissions			
5A1	Wood harvested volume		AD: SY, NIS, 1989-2009; EF: IPCC GPG 2003
	Wildfires affected area		AD: RNP, 2007-2009; EF: IPCC GPG 2003
	Illegal wood extracted volume		AD: RNP, 2006-2008; MADR, 2009; EF: IPCC GPG 2003

7.2.2 Information on approaches used for representing land areas and on land-use databases used for the inventory preparation

Primary land fund and forest fund data have been provided by the National Institute for Statistics through the Statistical Yearbook for 1989-2008.

In order to obtain the "land remaining land" and "land converted to other land-use" data, data directly needed for the inventory preparation, primary data has been subject to an expert judgement, through their use within a land-use change matrix.

7.2.3 Land-use definitions and the classification systems used and their correspondence to the LULUCF categories

Forest area comprise forests within the national forest fund; forests are subject to management according to a decennial management plan elaborated for every single management unit.

Woodland area refers to pastoral forests, forest belts, re-growth and invasive trees on abandoned lands; the forests are not mapped and planned.

The elements on the correspondence between SY and IPCC categories are:

- forests (forest area) – Forest Land;
- other forest vegetation lands (woodland area) – Forest Land.

7.2.4 Methodological issues

Removals and emissions related to Forest land remaining forest land have been calculated following the Equation 3.2.1 and 3.2.2 of IPCC GPG 2003.

According to the provisions in pages 3.34 and 3.35 of IPCC GPG 2003, we assumed by default that the average transfer rates into the dead wood pool and into the litter pool are equal to the transfer rates out of the dead organic pool and out of the litter pool so the net change is zero.

By default, according to the provisions in page 3.41 of IPCC GPG 2003, we assume that when forest remains forest the carbon stock in soil organic matter in mineral soils does not change, so the net change is zero.
Due to lack of available data, we assume by expert judgment that area of drained organic forest soils is zero so carbon dioxide emissions are zero.

Removals (annual increase in carbon stocks due to biomass growth)

Methodology

Due to lack of detailed data needed, the amount of removals from Forest land remaining forest land has been calculated both using tier 2 and tier 1 methods. For calculation of carbon removals, the equations 3.2.4 and 3.2.5 of IPCC GPG 2003 were used.

Increment rates

Different data sources have been used for different parameters took into account for average annual increment rate in total biomass (G_{TOTAL}) calculation:

- average annual net increment in volume suitable for industrial processing (I_V) - Synthesis of National Forest Inventory, ICAS-Forestry Ministry, 1984;
- basic wood density (D) – Studies and research for expansion of wood industry row material base taking into account the structure, the physical-mechanical and technological characteristics of national species, ICPIL Manuscript, 1985, corroborated with data provided by National Institute for Wood, 2008;
- biomass expansion factor for conversion of annual net increment (including bark) to aboveground tree biomass increment (BEF_1) – Table 3A.1.10 of IPCC GPG 2003;
- root-to-shoot ratio (R) – Table 3A.1.8 of IPCC GPG 2003

Values of parameters took into account in average annual increment rate in total biomass (G_{TOTAL}) calculation are presented in Table 7.5.

Table 7. 5 Values used for average annual increment rate in total biomass (G_{TOTAL}) calculation

Type of species/Parameters	I_V [m^3/ha/year]	D [tonnes d.m./m^3]	BEF_1 [dimensionless]	R [dimensionless]
Coniferous	6.5	0.4	1.15	0.32
Beech	5.4	0.64	1.2	0.24
Oak	4.7	0.645	1.2	0.35
Hardwood species	4.7	0.6	1.2	0.43
Softwood species	7.8	0.41	1.2	0.43

According to SNFI 1984, root-to-shoot ratio values were chosen taking into consideration the following:

- a aboveground biomass density of 50-150 t/ha for coniferous species;
- a aboveground biomass density > 150 t/ha for beech species;
- a aboveground biomass density < 75 t/ha for hardwood and softwood species.

Activity data

Forest areas

They were took into consideration both Forest land and Woodlands.

Forest land comprises forest areas in National Forest Fund, managed under strict forestry regime (according to provisions in Forestry Code).

Woodlands refer to pastoral forests, forest belts, re-growth and invasive trees on abandoned lands, etc. Woodlands areas are not mapped and planned compared to Forest land.

Forest land

Forest land primary data series are provided by NIS through SY 1989-2009 as total value and as disaggregated categories: coniferous, beech, oak and various species.

By expert judgment, taking into consideration the provisions in National Forest Fund publication, NIS, 2006, with data from 2001 to 2005 both on hardwood and softwood

species, we completed the 1989-2000 series with specific data on hardwood and softwood species (average values of 0.753428 and of 0.246572 were applied to Total various species area in order to obtain the Hardwood, respectively Softwood species areas; fractions were obtained as arithmetic means of specific values for 2001-2005 period).
Primary activity data values are presented in Table 7.6.

For determining the area of Forest land remaining forest land a land use change matrix was built, on yearly base, as an expert judgment (land use change matrix takes also into consideration afforested and deforested areas).

In order to obtain the areas of Forest land remaining forest land for each species category, we apply to Total area of Forest land remaining forest land (obtained as a result of the land use change matrix) different fraction values. Values were previously obtained as contribution of each species on Total forest land (related to primary data from SY 1989-2009). Data effectively used for the calculation of the removals in Forest land remaining forest land, by species, are presented in Table 7.7.

Woodlands

Woodlands primary data series are provided by NIS through SY 1989-2009 as total value (by subtracting Forest areas from Forest and other forest vegetation lands). Values are presented in Table 7.6.
For determining the area of Woodlands remaining woodlands a land use change matrix was built, on yearly base, as an expert judgment.
Taking into considerations the provisions in Synthesis of sylvo-pastoral plans, 1980, we then split the Woodlands remaining woodlands area into five category species as follows:

- coniferous – 38%;
- beech – 37%;
- oak – 7%;
- hardwood species – 16%;

- softwood species – 2%.

Data effectively used for the calculation of the removals in Woodlands remaining woodlands, by species, are presented in Table 7.8.

Carbon fraction of dry matter (CF)

Default IPCC GPG 2003 value of 0.5 has been used for carbon fraction of dry matter (CF).

Table 7. 6 Primary activity data used for calculation of annual increase in carbon stocks due to biomass growth

Year/Parameter	Forest land areas by species [thousands hectares]						Woodlands [thousands hectares]
	Total Forest Fund	Coniferous	Beech	Oak	Hardwood	Softwood	
1989	6,249	1,926	1,893	1,146	967.40	316.60	306.2
1990	6,252	1,929	1,896	1,145	965.89	316.11	433.1
1991	6,253	1,930	1,902	1,142	963.63	315.37	426.7
1992	6,253	1,926	1,906	1,143	962.88	315.12	428.3
1993	6,249	1,916	1,915	1,139	963.63	315.37	431.9
1994	6,246	1,913	1,909	1,144	964.39	315.61	434.4
1995	6,245	1,903	1,925	1,133	967.40	316.60	435.4
1996	6,240	1,890	1,935	1,131	967.40	316.60	450.1
1997	6,236	1,883	1,939	1,129	968.15	316.85	451.9
1998	6,227	1,868	1,942	1,127	971.92	318.08	444.9
1999	6,226	1,861	1,943	1,122	979.46	320.54	564.8
2000	6,223	1,856	1,951	1,120	976.44	319.56	234.2
2001	6,225	1,853	1,956	1,117	979.00	320.00	427.5
2002	6,239	1,856	1,973	1,117	972.00	321.00	424.3
2003	6,221	1,839	1,985	1,109	971.00	317.00	530.3
2004	6,222	1,852	1,996	1,099	965.00	310.00	556.8
2005	6,233	1,873	2,023	1,084	941.00	312.00	509.8
2006	6,272	1,893	2,028	1,084	954.00	313.00	482.4
2007	6,315	1,920	2,041	1,077	963.00	314.00	426.0
2008	6,309	1,938	2,052	1,058	954.00	307.00	419.3

Table 7. 7 Data effectively used for the calculation of the removals in Forest land remaining forest land

Year/Parameter	Forest land remaining forest land areas [thousands hectares]					
	Total	**Coniferous**	**Beech**	**Oak**	**Hardwood**	**Softwood**
1989	**6,237.00**	1,922.30	1,889.36	1,143.80	965.54	315.99
1990	**6,250.20**	1,928.44	1,895.45	1,144.67	965.62	316.01
1991	**6,251.70**	1,929.60	1,901.60	1,141.76	963.43	315.30
1992	**6,253.20**	1,926.06	1,906.06	1,143.04	962.91	315.13
1993	**6,248.90**	1,915.97	1,914.97	1,138.98	963.62	315.36
1994	**6,245.40**	1,912.82	1,908.82	1,143.89	964.30	315.58
1995	**6,244.20**	1,902.76	1,924.75	1,132.85	967.28	316.56
1996	**6,239.10**	1,889.73	1,934.72	1,130.84	967.26	316.55
1997	**6,236.30**	1,883.09	1,939.09	1,129.05	968.20	316.86
1998	**6,227.20**	1,868.06	1,942.06	1,127.04	971.95	318.09
1999	**6,225.00**	1,860.70	1,942.69	1,121.82	979.30	320.49
2000	**6,222.10**	1,855.73	1,950.72	1,119.84	976.30	319.51
2001	**6,222.70**	1,852.32	1,955.28	1,116.59	978.64	319.88
2002	**6,222.80**	1,851.18	1,967.88	1,114.10	969.48	320.17
2003	**6,217.00**	1,837.82	1,983.72	1,108.29	970.38	316.80
2004	**6,217.00**	1,850.51	1,994.40	1,098.12	964.22	309.75
2005	**6,229.50**	1,871.95	2,021.86	1,083.39	940.47	311.82
2006	**6,258.36**	1,888.88	2,023.59	1,081.64	951.92	312.32
2007	**6,313.55**	1,919.56	2,040.53	1,076.75	962.78	313.93
2008	**6,308.96**	1,937.99	2,051.99	1,057.99	953.99	307.00

Table 7. 8 Data effectively used for the calculation of the removals in Woodlands remaining woodlands

Year/Parameter	Woodlands remaining woodlands areas [thousands hectares]					
	Total	**Coniferous**	**Beech**	**Oak**	**Hardwood**	**Softwood**
1989	**305.00**	115.90	112.85	21.35	48.80	6.10
1990	**306.20**	116.36	113.29	21.43	48.99	6.12
1991	**426.70**	162.15	157.88	29.87	68.27	8.53
1992	**426.70**	162.15	157.88	29.87	68.27	8.53
1993	**428.30**	162.75	158.47	29.98	68.53	8.57
1994	**431.90**	164.12	159.80	30.23	69.10	8.64
1995	**434.40**	165.07	160.73	30.41	69.50	8.69
1996	**439.90**	167.16	162.76	30.79	70.38	8.80
1997	**450.10**	171.04	166.54	31.51	72.02	9.00
1998	**444.90**	169.06	164.61	31.14	71.18	8.90
1999	**444.90**	169.06	164.61	31.14	71.18	8.90
2000	**234.20**	89.00	86.65	16.39	37.47	4.68
2001	**234.20**	89.00	86.65	16.39	37.47	4.68
2002	**424.30**	161.23	156.99	29.70	67.89	8.49
2003	**434.30**	165.03	160.69	30.40	69.49	8.69
2004	**530.30**	201.51	196.21	37.12	84.85	10.61
2005	**509.43**	193.58	188.49	35.66	81.51	10.19
2006	**482.40**	183.31	178.49	33.77	77.18	9.65
2007	**417.50**	158.65	154.48	29.23	66.80	8.35
2008	**419.30**	159.33	155.14	29.35	67.09	8.39

Emissions (annual decrease in carbon stocks due to biomass loss)

Methodology

Due to lack of detailed data needed, the amount of emissions from Forest land remaining forest land has been calculated both using tier 2 and tier 1 methods. For calculation of carbon emissions, the equations 3.2.6-3.2.9 and 3.2.19 of IPCC GPG 2003 were used; the equations are presented below:

Equation 7. 1 Annual decrease in carbon stocks due to biomass loss

$$\Delta C_{FFL} = L_{fellings} + L_{fuelwood} + L_{other\ losses}$$

where:

$L_{fellings}$ = annual carbon loss due to commercial fellings [tonnes C/year];

$L_{fuelwood}$ = annual carbon loss due to fuelwood gathering [tonnes C/year];

$L_{other\ losses}$ = annual other losses of carbon [tonnes C/year]

Equation 7. 2 Annual carbon loss due to commercial fellings

$$\mathbf{L_{fellings} = H \times D \times BEF_2 \times (1 - f_{BL}) \times CF \times BEF_{Root}}$$

where:

H = annually extracted volume, roundwood [m^3/year];

BEF_2 = biomass expansion factor for converting volumes of extracted roundwood to total aboveground biomass (including bark), [dimensionless];

f_{BL} = fraction of biomass left to decay in forest, [fraction]

BEF_{Root} = biomass expansion factor used to quantify for root volume remained in soil after logging [dimensionless]

We included in commercial fellings category the amount of wood removed illegally from forest.

It is considered by default that all wood removed from forest represents an immediate emission.

$$L_{fellings\ woodland} = \sum_i A_{woodland} \times D \times CF \times RR_{woodland}$$

where:

$L_{fellings\ woodland}$ = annual carbon loss due to fellings from woodlands [tonnes C/year];

$A_{woodland}$ = woodland area by species [ha];

$RR_{woodland}$ = wood removal rate in woodland [cubic meters/year];

i = type of woodland area [coniferous, beech, oak, hardwood species and softwood species]

CO_2 emission [Gg/year] = (carbon released) [t/year] x (44/12) /1000

Equation 7. 3 Annual carbon loss due to fuelwood gathering

$$\mathbf{L_{fuelwood} = FG \times D \times BEF_2 \times CF}$$

where:

FG = annual volume of fuelwood gathering [m^3/year]

Because the NIS wood harvest data could not be disaggregated into commercial fellings and fuelwood, all annual losses from volume of fuelwood gathered are presented in the commercial fellings section.

Equation 7. 4 Annual other losses of carbon

$$\mathbf{L_{other\ losses} = A_{disturbance} \times B_W \times (1-f_{BL}) \times CF}$$

where:

$A_{disturbance}$ = forest areas affected by disturbances [ha/year];

B_W = average biomass stock of forest areas [tonnes d.m./ha]

Because we took into consideration as disturbance only wildfires and we assume by expert judgment that in wildfires only the forest floor (dead organic matter and litter) is affected, we took into account the following:

$$\mathbf{L_{other\ losses} = A_{wildfires} \times 6.755}$$

where:

$A_{wildfires}$ = area of forest affected by wildfires [ha/year];

6.755 = amount of C in the forest floor [t C/ha]

CO_2 emissions [Gg/year] = (carbon released) [t/year] x (44/12) /1000
CH_4 emissions [Gg/year] = (carbon released) [t/year] x (emission ratio) x (16/12) /1000
CO emissions [Gg/year] = (carbon released) [t/year] x (emission ratio) x (28/12) /1000

N_2O emissions [Gg/year] = (carbon released) [t/year] x (N/C ratio) x (emission ratio) x (44/28) /1000

NO_x emissions [Gg] = (carbon released) x [N/C ratio] x (emission ratio) x (46/14) /1000

where:

N/C ratio = nitrogen/carbon ratio of fuel burnt [fraction]

Emission ratios

Default IPCC GPG 2003 emission ratios values have been used for calculation of amounts of direct and indirect GHG released by wildfires into the atmosphere. According to the provisions in Table 3A.1.15 of IPCC GPG 2003, default values related to released gases are:

- CH_4 – 0.012;
- CO – 0.06;
- N_2O – 0.007;
- NO_x – 0.121

Activity data

Activity data related to emission of CO_2 into the atmosphere due to commercial fellings

Legal commercial felling

The amounts of wood removed from forests due to legal commercial fellings are provided by NIS through SY 1989-2009 and are presented in Table 7.9.

Densities values (D) used are presented in Table 7.5.

According to provisions in page 3.27 of IPCC GPG 2003, the default value to be used with carbon fraction of dry matter (CF) is 0.5.

By expert judgment, according to discussions with NIS and forestry experts, all bark and branches volume, is included in the annually extracted volume provided by NIS (the bark and branches volume is estimated also before wood leaves the forest as part of legal procedures). Therefore, biomass expansion factor value (BEF_2) equals zero.

By expert judgment, according to provisions in specific dendro-metrical studies, in order to have a full closed balance of carbon related to living biomass in forests, we accounted to root volume remaining in forest soils after logging by applying a biomass expansion factor value, as follows:

- coniferous: 1.16;
- beech: 1.18;
- oak: 1.16;
- hardwood species: 1.14;
- softwood species: 1.1

According to the provisions in page 3.27 of IPCC GPG 2003, if changes in dead organic matter are not being explicitly accounted, fraction of biomass left to decay (f_{BL}) should be set to zero.

According to the provisions in Synthesis of sylvo-pastoral plans, 1980, wood removal rates values used for woodlands are as follows:

- coniferous: 8 [cubic meters/ha/year];
- beech: 5 [cubic meters/ha/year];
- oak: 10 [cubic meters/ha/year];
- hardwood: 3 [cubic meters/ha/year];
- softwood: 4 [cubic meters/ha/year].

Data effectively used for the calculation of the emissions in Woodlands remaining woodlands, by species, are presented in Table 7.8.

Illegal cutting

The amounts of wood illegally cut and removed from forests are provided by RNP for 1989-2006, and, respectively by MADR for 2007-2008; the values are presented in Table 7.9.

By expert judgment, we consider that the wood removed belongs equally to all categories of species (coniferous, beech, oak, hardwood species and softwood species). Therefore we used an average wood density of 0.539 (tonnes d.m./m^3; calculated as arithmetic mean of densities specific to categories of species).

By expert judgment, we use a value of 1.148 (obtained as arithmetic mean of values related to categories of species) for biomass expansion factor for account to root volume remained in forest soils.

All other values took into account correspond to the provisions in Legal commercial felling chapter.

Activity data related to emission of direct and indirect GHG into the atmosphere due to wildfires

Annually forest affected areas by wildfires are provided by RNP and are presented in Table 7.9.

By expert judgment, according to Assessment of the carbon stock in the forest soils in the monitoring network level I and II progress scientific report, ICAS, 2004, an average amount of carbon in the forest floor (corresponding to dead organic matter and litter which are affected by wildfires) of 6.755 t C/ha was taken into account.
According to the provisions in page 3.50 of IPCC GPG 2003, a default value of 0.01 was considered for nitrogen-carbon ratio.

Table 7. 9 Activity data used for GHG emissions calculation

Year/Type of activity data	Legally harvested wood [thousands cubic meters/year]					Illegal logging volume [th. c.m./year]	Wildfire affected areas [ha]
	Coniferous	Beech	Oak	Hardwood species	Softwood species		
1989	6,516	6,636	1,842	2,268	2,004	83.1680	93
1990	5,813	4,958	2,045	2,071	1,762	120.7680	444
1991	4,956	4,644	1,919	2,089	1,769	186.6172	277
1992	4,418	4,629	1,739	2,109	1,524	281.5178	729
1993	4,564	4,073	1,629	1,872	1,452	157.7159	518
1994	4,285	4,037	1,651	1,741	1,228	145.8188	312
1995	4,973	4,215	1,551	1,774	1,300	122.1831	208
1996	5,751	4,266	1,658	1,876	1,252	128.7116	227
1997	5,836	4,263	1,489	1,757	1,164	136.6576	68
1998	5,195	3,635	1,276	1,491	1,045	122.2967	137
1999	5,564	4,115	1,358	1,588	1,093	130.3549	379
2000	5,346	4,509	1,333	1,731	1,366	142.8996	3,607
2001	4,915	4,260	1,288	1,673	1,274	141.0910	1,020
2002	7,166	4,439	1,495	1,805	1,478	101.9970	3,590
2003	7,139	4,748	1,532	1,823	1,450	80.8530	762
2004	6,357	5,412	1,694	2,030	1,589	70.4790	124
2005	6,061	4,794	1,586	1,852	1,378	86.0280	212
2006	5,765	4,997	1,632	1,915	1,375	64.5990	946
2007	7,491	5,182	1,485	1,668	1,412	175.7430	2,949
2008	6,766	5,208	1,653	1,760	1,318	173.8580	844

7.2.5 Uncertainties and time-series consistency

By expert judgment, the uncertainty related to the activity data is 45% and the uncertainty related to the emission factors is 60%.

The overall uncertainty resulted after the aggregation of the activity data and of the emission factors uncertainties according to the provisions in Chapter 5 of the IPCC GPG 2003 is 75%.

Due to the fact that all activity data are provided by NIS, RNP and MADR and the same emission factors and methodologies are used for the whole period, the time series 1989-2008 is consistent.

7.2.6 Category-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 LULUCF sector, the results of these being mentioned on the Checklists level.

Following these activities there were no unconformities recorded.

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 2007 and 2008 submissions of the NGHGI are described at the Improvements list level, their solving being envisaged as planned improvement.

Results in different projects have been used to validate the input parameters in the GHG Inventory (e.g.: basic wood density measured for several species in some projects confirmed the values used in the estimation for the purpose of the inventory).

7.2.7 Category-specific recalculations, including changes made in response to the review process

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

- activity data
  - ✓ new data on the amount of wood illegally cut and removed from forests, data received from the MADR, are considered.

The changes at the amount of wood illegally cut and removed from forests level and their effects on the Net emissions/removals from LULUCF are presented in Table 7.10.

Table 7. 10 Changes made at activity data level and their effects on emission estimates

Year	Changes on amount of wood illegally cut and removed from forests series [tonnes d.m./m^3]			Effects of changes on Net emissions/removals from LULUCF data series		
	NIR 2009	**NIR 2010**		NIR 2009 - [Gg CO_2 equivalent]	**NIR 2010 - [Gg CO_2 equivalent]**	**Difference [%]**
1989	83.1680	**83.1680**		-32,432.93	**-32,432.93**	**0.00**
1990	120.7680	**120.7680**		-35,583.29	**-35,583.29**	**0.00**
1991	186.6172	**186.6172**		-37,041.44	**-37,041.44**	**0.00**
1992	281.5178	**281.5178**		-37,845.82	**-37,845.82**	**0.00**
1993	157.7159	**157.7159**		-39,131.03	**-39,131.03**	**0.00**
1994	145.8188	**145.8188**		-39,734.40	**-39,734.40**	**0.00**
1995	122.1831	**122.1831**		-38,987.26	**-38,987.26**	**0.00**
1996	128.7116	**128.7116**		-38,002.68	**-38,002.68**	**0.00**
1997	136.6576	**136.6576**		-38,389.71	**-38,389.71**	**0.00**
1998	122.2967	**122.2967**		-40,480.80	**-40,480.80**	**0.00**
1999	130.3549	**130.3549**		-39,207.82	**-39,207.82**	**0.00**
2000	142.8996	**142.8996**		-37,999.22	**-37,999.22**	**0.00**
2001	141.0910	**141.0910**		-39,007.19	**-39,007.19**	**0.00**
2002	101.9970	**101.9970**		-36,536.08	**-36,536.08**	**0.00**
2003	80.8530	**80.8530**		-36,173.73	**-36,173.73**	**0.00**
2004	70.4790	**70.4790**		-35,491.98	**-35,491.98**	**0.00**
2005	86.0280	**86.0280**		-37,181.08	**-37,181.08**	**0.00**
2006	64.5990	**64.5990**		-37,199.82	**-37,199.82**	**0.00**
2007	81.1380	**175.7430**		-36,221.76	**-36,114.44**	**-0.30**
2008		**173.8580**			**-36,414.56**	

7.2.8 Category-specific planned improvements, including those in response to the review process

In respect to the IPCC GPG 2003 provisions, more detailed data which allow for using of Tier 2 method are proposed to be obtained.

7.3. & 7.4. & 7.5. & 7.6. & 7.7 Cropland (CRF category 5.B), Grassland (CRF category 5.C), Wetlands (CRF category 5.D), Settlements (CRF category 5.E), Other land (CRF category 5.F)

7.3.1 & 7.4.1 & 7.5.1 & 7.6.1 & 7.7.1 Description

Data reported relay on statistics on land fund provided by the National Institute of Statistics through the Statistical Yearbook.
The actual reporting consistently represents the land fund and its breakdown over the 1989-2008, as based on land use change matrix.
Emissions/removals were not calculated due to the unavailability of relevant data.

7.3.2 & 7.4.2 & 7.5.2 & 7.6.2 & 7.7.2 Information on approaches used for representing land areas and on land-use databases used for the inventory preparation

Primary land fund and forest fund data have been provided by the National Institute for Statistics through the Statistical Yearbook for 1989-2008.
In order to obtain the "land remaining land" and "land converted to other land-use" data, data directly needed for the inventory preparation, primary data has been subject to an expert judgement, through their use within a land-use change matrix.

7.3.3 & 7.4.3 & 7.5.3 & 7.6.3 & 7.7.3 Land-use definitions and the classification systems used and their correspondence to the LULUCF categories

Arable land represents area which is ploughed each year or at several years, cultivated with annual or perennial plants.

Vineyards and vine nurseries represent areas with vineyards, vine nurseries and land prepared for vineyards.

Orchards and tree nurseries represent areas with tree plantations, fruit younglings , tree nurseries and land prepared for orchards.

Pastures represent lands covered with herbal vegetation grown in natural way, or regenerated by sowing, for animal pasturing.

Hayfields represent lands covered with herbal vegetation grown in natural way, or regenerated by sowing, for hay harvesting.

The elements on the correspondence between SY and IPCC categories are:

- arable land - Cropland;
- vineyards and vine nurseries – Cropland;
- orchards and tree nurseries – Cropland;
- pastures – Grassland;
- hayfields – Grassland;
- waters and ponds – Wetlands;
- constructions – Settlements;
- roads and railways – Settlements;
- other areas – Other Land.

7.3.4 & 7.4.4 & 7.5.4 & 7.6.4 & 7.7.4 Methodological issues

Data reported relay on statistics on land fund provided by the National Institute of Statistics through the Statistical Yearbook.

Emissions/removals were not calculated due to the unavailability of relevant data.

7.3.5 & 7.4.5 & 7.5.5 & 7.6.5 & 7.7.5 Uncertainties and time-series consistency

Data reported relay on statistics on land fund provided by the National Institute of Statistics through the Statistical Yearbook.
Emissions/removals were not calculated due to the unavailability of relevant data.

7.3.6 & 7.4.6 & 7.5.6 & 7.6.6 & 7.7.6 Category-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 LULUCF sector, the results of these being mentioned on the Checklists level.
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 QA/QC activities (including those following the UNFCCC review of the 2007 and 2008 submissions of the NGHGI) are described at the Improvements list level.

7.3.7 & 7.4.7 & 7.5.7 & 7.6.7 & 7.7.7 Category-specific recalculations, including changes made in response to the review process

No recalculations were performed since last submission.

7.3.8 & 7.4.8 & 7.5.8 & 7.6.8 & 7.7.8 Category-specific planned improvements, including those in response to the review process

In respect to the IPCC GPG 2003 provisions, more detailed data which allow for emissions/removals calculation are proposed to be obtained.

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 Sites;
- 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

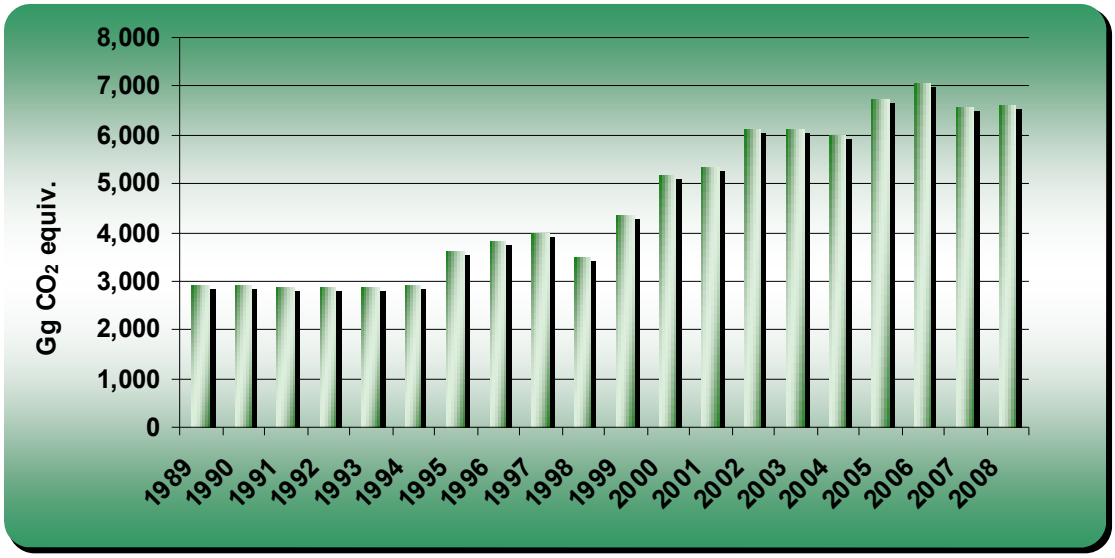
IPCC category	Emissions estimation status		
	CO_2	CH_4	N_2O
6A Solid Waste Disposal on Land			
6A.1 Managed Waste Disposal on Land	NA	✓	NA
6A.2 Unmanaged Waste Disposal on land	NA	✓	NA
6A.2.1 deep (>5m)	NA	✓	NA
6A.2.2 shallow (<5 m)	NA	✓	NA
6A.3 Other	NA	NA	NA
6B Wastewater Handling			
6B.1 Industrial 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

IPCC category	Emissions estimation status		
	CO_2	CH_4	N_2O
6B.2.1.a wastewater	NA	✓	NE
6B.2.1.b sludge	NA	✓	NE
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

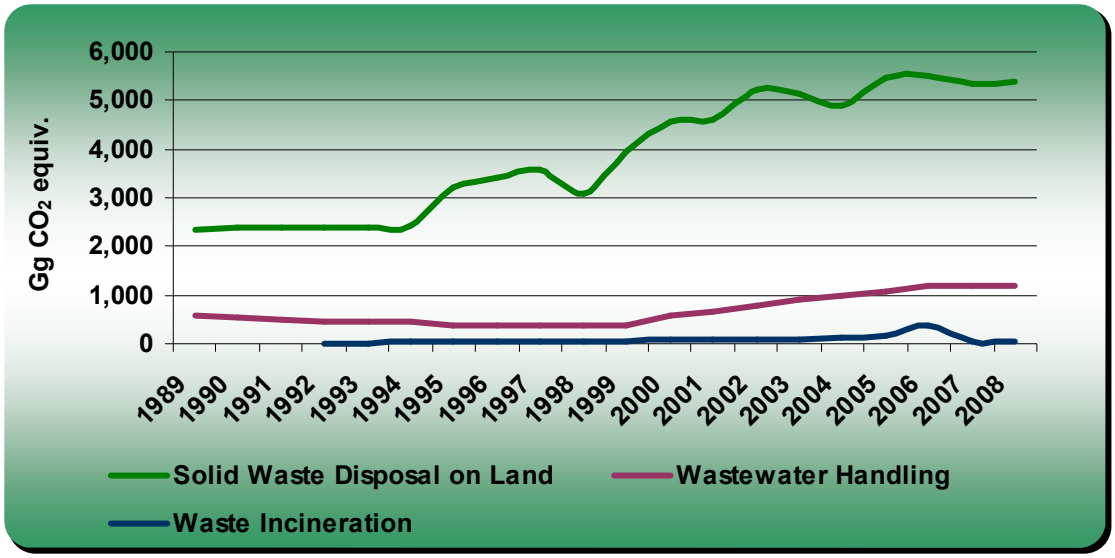
* CH_4 emissions from industrial sludge are reported under 6.B.1.a – Industrial wastewater

Figure 8. 1 Total GHG emissions trend in Waste for 1989–2008 period



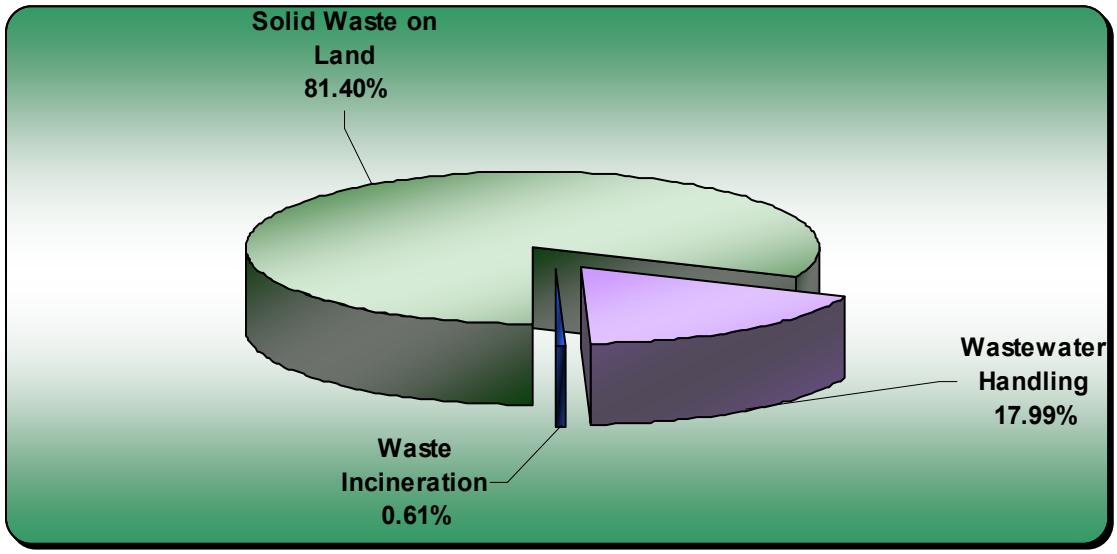
Over the period 1989-2008, GHG emissions resulted from Waste sector increased by 126.58 %, due to the population consumption growth, to the increase of waste managed sites number and also to the increase of population connected to sewerage.

Figure 8. 2 GHG emissions trends in Waste, by sub-sectors for 1989–2008 period



This sector includes emissions from landfills (6.A), wastewater handling (6.B) and waste incineration (6.C).

Figure 8. 3 Contribution of the sub-sectors in the total GHG emissions from Waste in 2008



In 2008 within the activities specific to the waste sector were generated 6,615.22.Gg CO_2 equivalent, accounting for 4.53% from the total GHG emissions. Solid waste disposal on land (Landfills) is the main category within the waste sector, accounting for 81.40% of

the sector's total emissions. Wastewater handling and waste incineration account for approximately 17.99% and, respectively, 0.61%.

Table 8. 2 Contribution of Waste sector in total GHG emissions, in 1989–2008 period

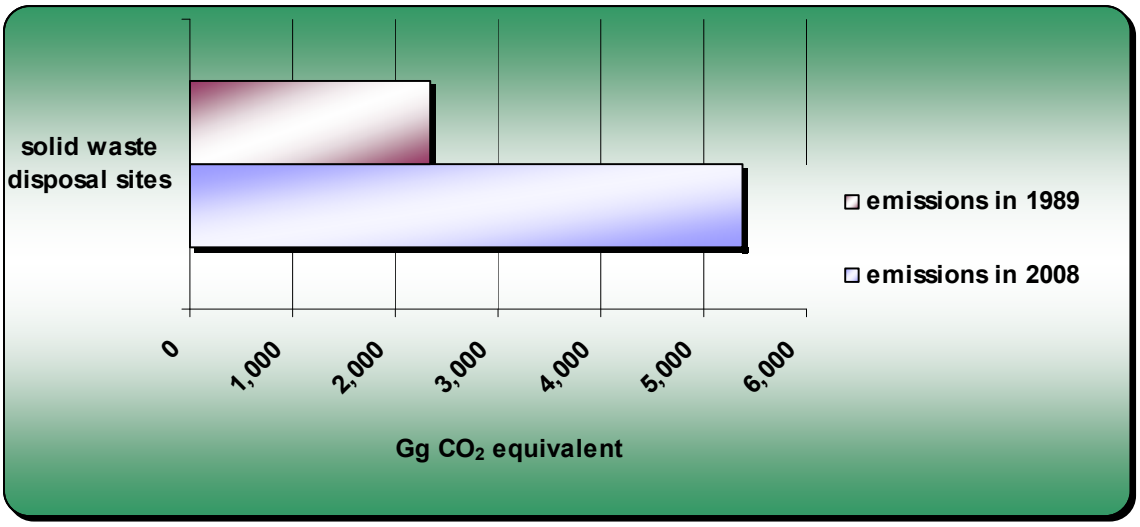
Year	Total GHG emissions (excluding LULUCF) [Gg CO_2 equivalent]	GHG emissions from Waste [Gg CO_2 equivalent]	Contribution of Waste in total GHG emissions [%]	CH_4 emissions from Waste [Gg CO_2 equivalent]	Contribution of CH_4 emissions in total GHG emissions from Waste [%]	N_2O emissions from Waste [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	274,753.66	2,919.60	1.06	2,748.11	94.13	171.49	5.87		
1990	242,096.97	2,923.83	1.21	2,749.50	94.04	174.33	5.96		
1991	191,263.17	2,890.69	1.51	2,716.93	93.99	173.76	6.01		
1992	180,949.17	2,855.88	1.58	2,673.92	93.63	171.06	5.99	10.90	0.38
1993	178,690.46	2,873.69	1.61	2,684.45	93.42	173.02	6.02	16.21	0.56
1994	173,533.06	2,899.94	1.67	2,703.19	93.22	175.22	6.04	21.53	0.74
1995	180,471.44	3,592.56	1.99	3,412.24	94.98	153.48	4.27	26.84	0.75
1996	186,529.75	3,829.91	2.05	3,644.83	95.17	152.93	3.99	32.15	0.84
1997	168,017.73	3,969.23	2.36	3,775.74	95.13	156.03	3.93	37.47	0.94
1998	150,048.98	3,487.83	2.32	3,287.15	94.25	157.90	4.53	42.78	1.23
1999	132,714.66	4,355.58	3.28	4,147.63	95.23	159.85	3.67	48.09	1.10
2000	136,230.67	5,183.39	3.80	4,943.91	95.38	173.50	3.35	65.97	1.27
2001	140,942.79	5,352.38	3.80	5,092.64	95.15	185.08	3.46	74.65	1.39
2002	147,098.66	6,102.34	4.15	5,805.33	95.13	218.74	3.58	78.27	1.28
2003	153,740.28	6,132.72	3.99	5,813.09	94.79	233.75	3.81	85.88	1.40
2004	155,490.09	5,998.30	3.86	5,644.22	94.10	246.75	4.11	107.32	1.79
2005	149,525.35	6,728.18	4.50	6,289.64	93.48	259.75	3.86	178.79	2.66
2006	154,178.24	7,052.02	4.57	6,385.11	90.54	283.85	4.03	383.05	5.43
2007	152,644.28	6,571.56	4.31	6,255.41	95.19	287.78	4.38	28.37	0.43
2008	145,915.87	6,615.22	4.53	6,285.86	95.02	289.09	4.37	40.27	0.61

Table 8.3 describes Key categories in the Waste sector.

Table 8. 3 Key categories overview – Waste, 2008

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	3.33	L, T	2.72
6.B	**Wastewater handling**	CH_4	T	0.56	T	0.45

Figure 8. 4 The GHG emissions of the 2008 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 2008.

The landfills are classified as managed and, respectively, unmanaged.

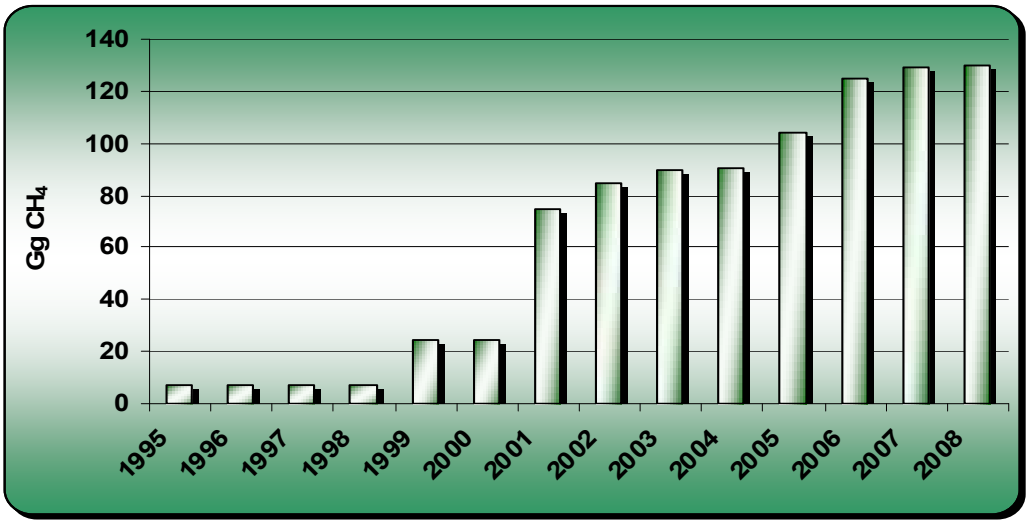
In 2008 from 203 waste deposits:

- 20 managed waste landfills had free storage capacity; the deposits complyed with the provisions in the Directive 99/31/EC, respective in the GD 349/2005;

- 183 unmanaged waste landfills (92 deep sites and 91 shallow sites) were functioning; the deposits will cease storage activity gradually until 2017.

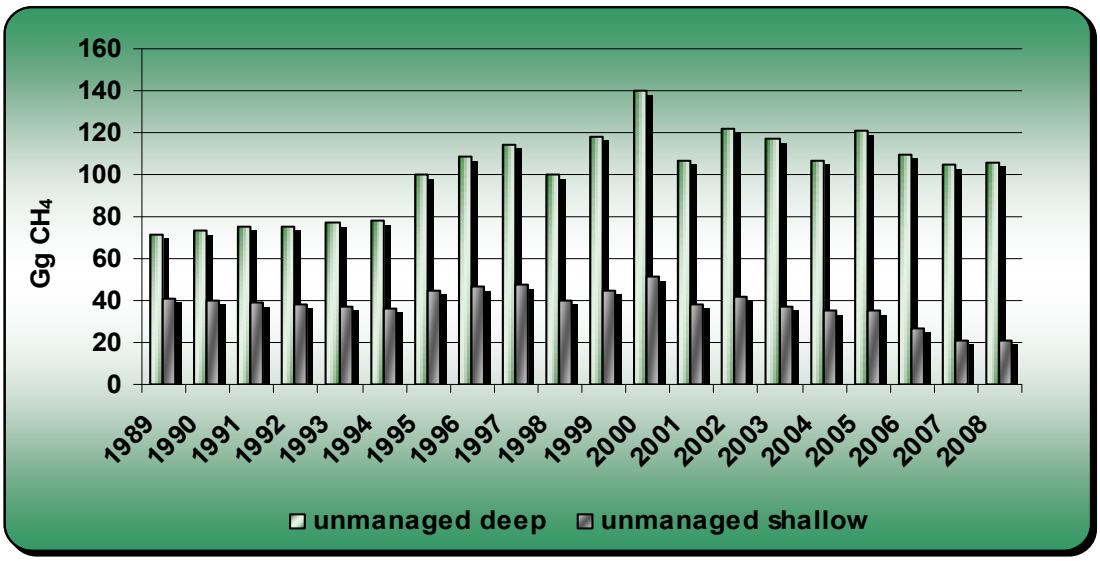
The percentage of domestic wastes selective collection is very low and large amounts of recyclable materials (paper, cardboard, glass, plastics, metals) are not recovered, but are finally stored together with other municipal wastes.

Figure 8. 5 CH_4 emissions trends from waste disposed to managed sites for 1995–2008 period



Since 1995 new managed sites have been opened the total number of these facilities reaching the sum of 20 in 2008.

Figure 8. 6 CH_4 emissions trends from waste disposed to unmanaged site for 1989–2008 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 not be applied, due to the fact that there are no sufficient historical data series to estimate the amount of the collected waste. Therefore a tier 1 method has been applied. Methane emissions from SWDS were calculated according to the equation 5.3 from page 5.7 of IPCC GPG 2000.

Emission factors

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)
Managed	1	0.55	0.5
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 2003-2008 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*	11.48	13.77	34.45	1.00

Observations

* Data were estimated using a 0.8% growth factor according to the National Waste Management Plan.

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 2003–2008 period.
The Amounts of MSW disposed to managed 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 2003–2008 period. For 1989-2002 period data were obtained using extrapolation technique.

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	1,790.68	2,034.92
1990	NO	1,851.25	2,022.55
1991	NO	1,884.31	1,979.35
1992	NO	1,891.51	1,910.43
1993	NO	1,930.19	1,874.47
1994	NO	1,968.02	1,837.61
1995	150.00	2,501.33	2,245.52
1996	150.00	2,733.21	2,358.88
1997	150.00	2,878.27	2,387.82
1998	150.00	2,501.01	1,994.16
1999	490.00	2,964.97	2,271.75
2000	490.00	3,525.69	2,595.30
2001	1,500.00	2,682.43	1,896.57
2002	1,705.00	3,073.21	2,086.45
2003	1,720.00	2,810.00	1,800.00
2004	1,930.00	2,850.00	1,850.00
2005	2,080.00	3,020.00	1,780.00
2006	2,558.26	2,817.22	1,392.41
2007	2,841.68	2,874.98	1,132.44
2008*	2,864.41	2,897.98	1,141.49

Observations

* Data were estimated using a 0.8% growth factor according to National Waste Management Plan.

CH_4 recovery

According to the data sources used there is no methane recovery from the unmanaged sites. The emissions are reported as NO.
The methane recovered from the managed sites is considered to be negligible and, as a consequence, the emissions are reported also 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 %;
  =0.6: +60%
- Fraction by volume of CH_4 in landfill gas (0.5): +20%.

The uncertainty associated with the emission factors specific to CH_4 from managed solid waste disposal is estimated to 42.43% while that associated to the emission factors specific to CH_4 from unmanaged solid waste disposal is estimated to 72.8%.

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 51.96% 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.

Following QA activity accomplishment according to the European Community's GHG emissions inventory compiling procedure, as described in 280/2004/EC Decision, it was concluded that no recalculations are necessary.

Unconformities have not been notified following NGHGI 2007 and 2008 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:

- 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 2006–2007 and for the percentage composition of waste in 2007 (comparative to provisional data used in the 2009 submission of NGHGI).

Effects of the recalculations due to changes at the AD series are described within the Table 8.7.

Table 8. 7 Effects of recalculations on CH_4 emissions from SWDS

CH_4 from Solid Waste Disposal Sites			
Year	**2009 submission**	**2010 submission**	**Difference**
	[Gg]		**[%]**
1989	111.79	**111.79**	**0**
1990	113.95	**113.95**	**0**
1991	114.41	**114.41**	**0**
1992	113.32	**113.32**	**0**
1993	114.15	**114.15**	**0**
1994	114.92	**114.92**	**0**
1995	151.73	**151.73**	**0**
1996	163.22	**163.22**	**0**
1997	169.57	**169.57**	**0**
1998	146.72	**146.72**	**0**
1999	187.63	**187.63**	**0**
2000	216.39	**216.39**	**0**
2001	219.17	**219.17**	**0**
2002	248.71	**248.71**	**0**
2003	244.74	**244.74**	**0**
2004	232.61	**232.61**	**0**
2005	260.83	**260.83**	**0**
2006	261.20	**261.45**	**0.09**
2007	253.61	**254.38**	**0.30**

8.2.6 Source specific planned improvement including those in response to the review process

In order to allow for the improvement of the accuracy of the estimates, more detailed data are envisaged to be obtained.

8.3 Source category Wastewater Handling (CRF sector 6.B)

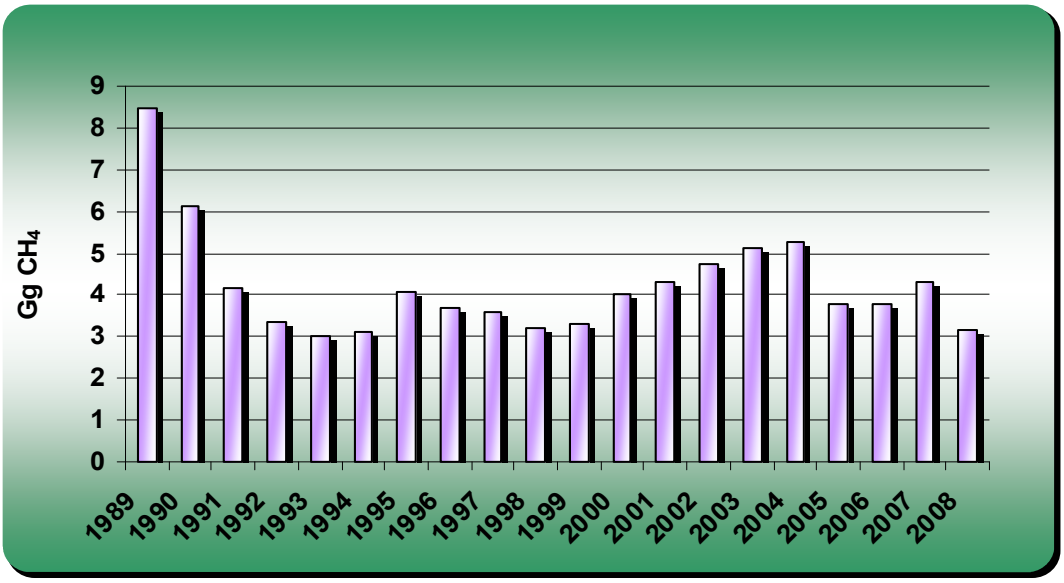
8.3.1 Source category description

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 2008, the statistical analysis of the main sources of wastewater in Romania revealed the following global issues:

- ✓ to a total volume of 5,254.57 million evacuated m^3/an, 35.57% is wastewater which must be treated;
- ✓ of the total volume of wastewater requiring treatment plant 1,868.83 million m^3/year, about 30% were sufficient (appropriate) treatment, 33.13%, representing untreatment wastewater and 37%, insufficient treatment wastewater. Therefore in 2008, 70% of untreatment or insufficient sewage originating from major pollution sources reached in the natural receptors especially in rivers.

Figure 8. 7 CH_4 emissions trends from industrial wastewater handling for 1989–2008 period



The specific emissions trend is due to the decrease of the major industrial productions.

Figure 8. 8 CH_4 emissions trends from domestic/commercial wastewater for 1989–2008 period

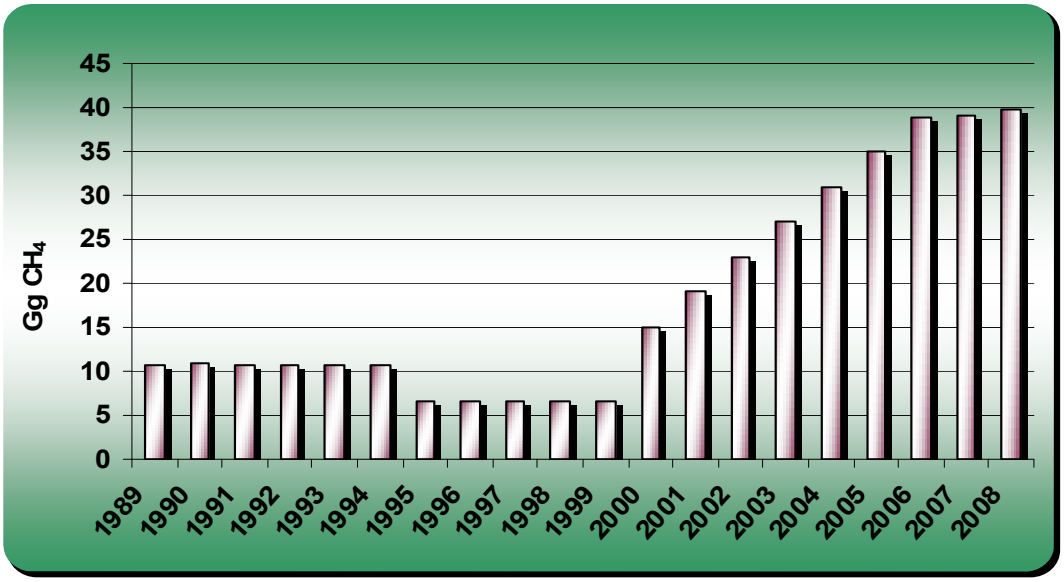
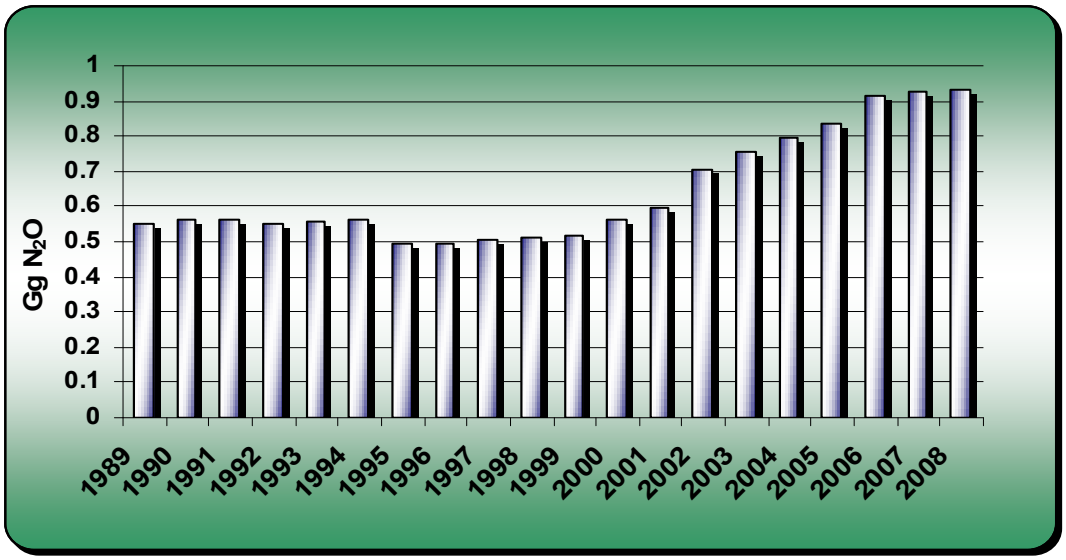


Figure 8. 9 N_2O emissions trends from human sewage for 1989–2008 period



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;
- 2000-2008: 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

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

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 8.10 CH_4 emissions trends from Domestic/ Commercial wastewater

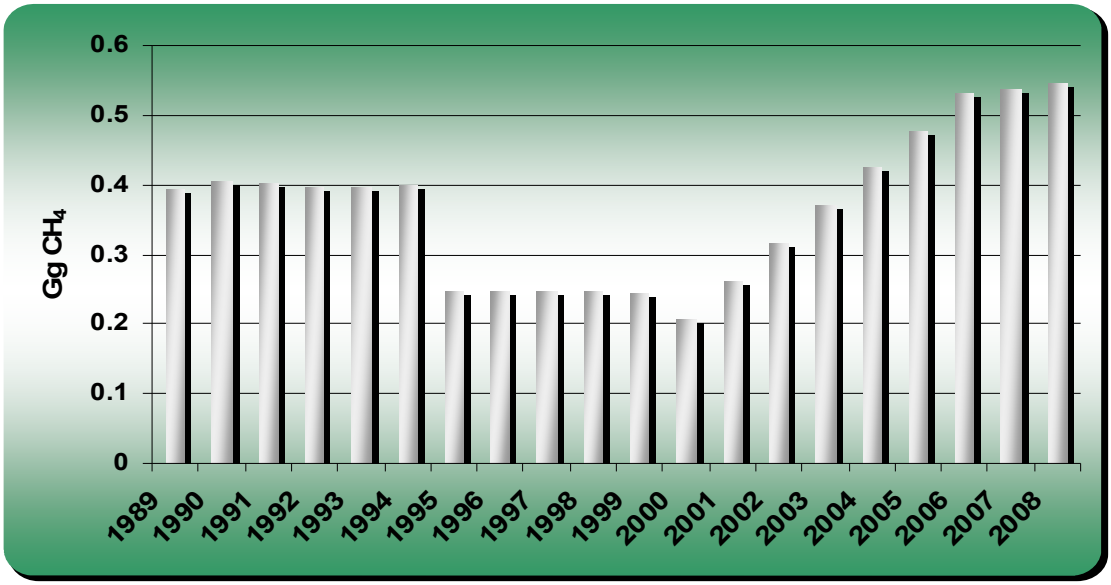
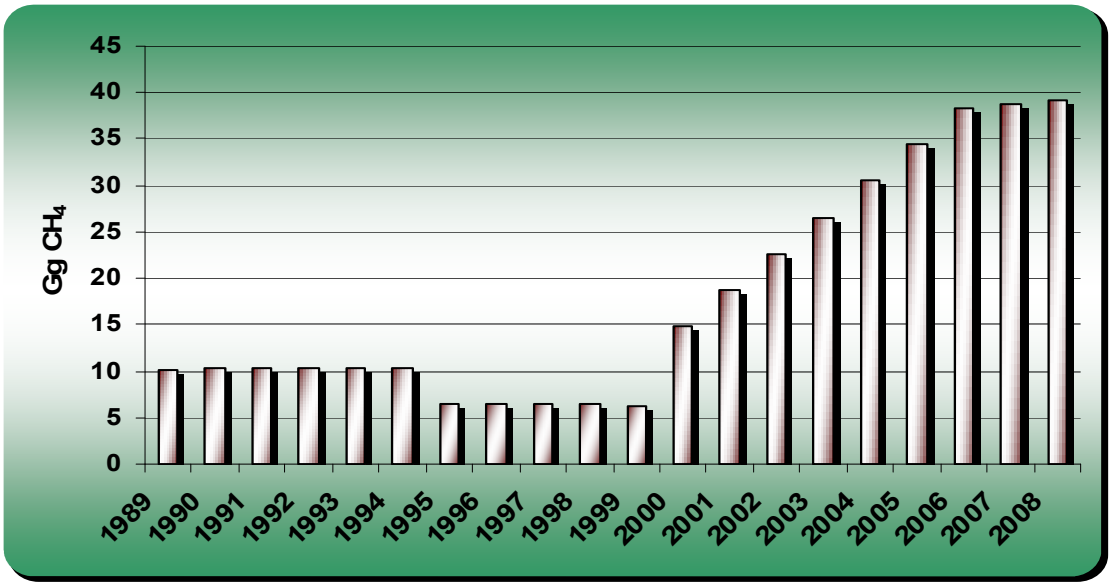


Figure 8. 11 CH_4 emissions trends from Domestic/commercial sludge



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 Mr. 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	45% urban / 10% rural	40% urban / 8% rural
Treated wastewater	50% urban / 0% rural	35% urban / 0% rural

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 – 2008 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
Urban sewerage systems [number of people]	9,070,564	9,195,900	9,237,821
Urban sewerage systems with treatment [number of people]	6,068,655	6,130,399	6,215,164

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
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

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 – 2008 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

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

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 N2O-N/kg sewage=N produced]**
Source: IPCC 1996	Source: IPCC 1996
0.16	0.01

Activity data

Population connected to sewerage has been used using an expert judgment on the issue of domestic wastewater and for 2006 – 2008 period, data were provided by INS.

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 overall uncertainty resulted after the aggregation of the AD and EF uncertainties according to the provisions in Chapter 6 of IPCC GPG 2000 is 147%.

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 overall uncertainty resulted after the aggregation of the AD and EF uncertainties according to the provisions in Chapter 6 of IPCC GPG 2000 is 43%.

N_2O from human sewage

The uncertainty in N_2O emissions is 30% both for activity data and emission factor, 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 42%.

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 2007 and 2008 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

In order to improve the quality of the emission estimates, important recalculations were made:

- activity data

✓ Changes in activity data for the domestic and commercial wastewater handling for 2000 – 2007 period are caused by new data on inhabitants whose houses are connected to sewerage and wastewater handling systems provided by the National Institute for Statistics;

✓ Changes for the 2000 - 2007 period in activity data for the human sewage are caused by new data on inhabitants whose houses are connected to sewerage provided by the National Institute for Statistics. Updated values for protein consumption are provided by Food and Agriculture Organization websites. Updated values for protein consumption provided by Food and Agriculture Organization websites.

Table 8. 15 Effects of recalculations for CH_4 emissions from Domestic and Commercial Wastewater Handling

CH 4 from Domestic and Commercial Wastewater Handling			
Year	**2009 submission**	**2010 submission**	**Difference**
	Unit [Gg]		**[%]**
1989	0.39	0.39	0.00
1990	0.40	0.40	0.00
1991	0.40	0.40	0.00
1992	0.40	0.40	0.00
1993	0.40	0.40	0.00
1994	0.40	0.40	0.00
1995	0.25	0.25	0.00
1996	0.25	0.25	0.00
1997	0.25	0.25	0.00
1998	0.25	0.25	0.00
1999	0.25	0.25	0.00
2000	0.18	0.21	12.02
2001	0.22	0.26	17.51
2002	0.25	0.31	25.85
2003	0.29	0.37	25.76
2004	0.35	0.42	21.51
2005	0.40	0.48	19.40
2006	0.40	0.53	32.53
2007	0.40	0.54	34.27

Table 8. 16 Effects of recalculations for CH_4 emissions from Domestic and Commercial Sludge

CH 4 from Domestic and Commercial Wastewater Handling			
Year	**2009 submission**	**2010 submission**	**Difference**
	Unit [Gg]		**[%]**
1989	10.19	10.19	0.00
1990	10.44	10.44	0.00
1991	10.39	10.39	0.00
1992	10.24	10.24	0.00
1993	10.27	10.27	0.00
1994	10.29	10.29	0.00
1995	6.42	6.42	0.00
1996	6.39	6.39	0.00
1997	6.39	6.39	0.00
1998	6.36	6.36	0.00
1999	6.34	6.34	0.00
2000	13.24	14.83	12.02
2001	15.95	18.74	17.51
2002	18.01	22.66	25.85
2003	21.13	26.58	25.76
2004	25.10	30.49	21.51
2005	28.82	34.41	19.40
2006	28.88	38.28	32.53
2007	28.80	38.67	34.27

Table 8. 17 Effects of recalculations for N_2O emissions from Human Sewage

N_2O from Human sewage			
Year	**2009 submission**	**2010 submission**	**Difference**
	Unit [Gg]		**[%]**
1989	0.55	0.55	0.00
1990	0.56	0.56	0.00
1991	0.56	0.56	0.00
1992	0.55	0.55	0.00
1993	0.57	0.56	-1.99
1994	0.58	0.57	-2.32
1995	0.51	0.50	-2.11
1996	0.50	0.49	-2.11
1997	0.50	0.50	0.00
1998	0.53	0.51	-4.46
1999	0.54	0.52	-4.35
2000	0.58	0.56	-4.05
2001	0.68	0.60	-11.74
2002	0.71	0.71	-0.76
2003	0.77	0.75	-2.40
2004	0.85	0.80	-6.73
2005	0.92	0.84	-8.55
2006	0.94	0.92	-2.43
2007	0.95	0.93	-2.08

8.3.6 Source specific planned improvement including those in response to the review process

To improve the accuracy of the estimates, will try to obtain more detailed data.

8.4 Source category Waste Incineration (CRF sector 6.C)

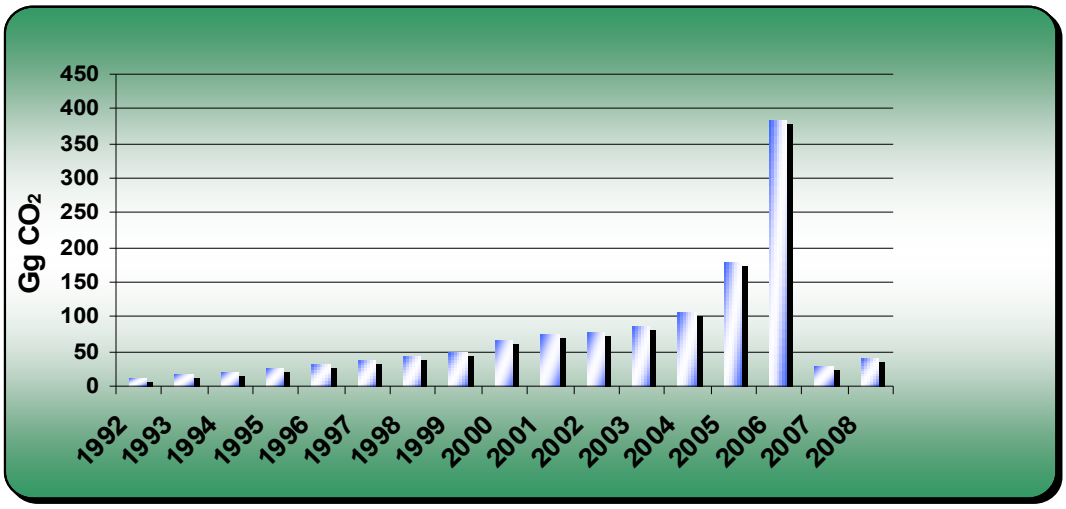
8.4.1 Source category description

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. 12 CO_2 emissions trends from waste incineration, for 1992–2008 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 a incinerator.

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

Table 8. 18 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. In 2008, this type of waste was not burnt in improper installation.

Table 8. 19 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

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.

Table 8. 20 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	226.90
2007	12.19
2008	21.25

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%.
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 2007 and 2008 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
  - ✓ final activity data has been provided by the Waste Directorate of the National Environmental Protection Agency (NEPA) for the amount of hazardous waste incinerated (comparative to provisional data in 2009 submission of NGHGI).

Table 8. 21 Effects of recalculations for CO_2 emissions from Hazardous Waste Incineration

CO_2 from Hazardous Waste Incineration			
Year	**2009 submission**	**2010 submission**	**Difference**
	Unit [Gg]		**[%]**
2007	28.28	28.37	0.33

8.4.6 Source specific planned improvement including those in response to the review process

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

This chapter presents the changes in GHG emissions/removals between the first and the second version of the 2010 submission.

The recalculations performed within the first version of the 2010 submission, comparing with the 2009 submission, are described at the sectoral relevant sections level.

10.1 Explanations and justifications for recalculations, including for KP-LULUCF activities

10.1.1 GHG Inventory

No recalculations were performed since the last submission (version 1 of the 2010 submission).

10.1.2 KP-LULUCF inventory

Romania is reporting the elements on Afforestation, Reforestation, Deforestation, Forest Management and Revegetation activities for the first time, within the current NGHGI.

10.2 Implications for emissions levels, including on KP-LULUCF emissions levels

10.2.1 GHG inventory

No recalculations were performed since the last submission (version 1 of the 2010 submission).

10.2.2 KP-LULUCF inventory

Romania is reporting the elements on Afforestation, Reforestation, Deforestation, Forest Management and Revegetation activities for the first time, within the current NGHGI.

10.3 Implications for emissions trends, including time series consistency, and also for KP-LULUCF trends and time series consistency

10.3.1 GHG inventory

No recalculations were performed since the last submission (version 1 of the 2010 submission).

10.3.2 KP-LULUCF inventory

Romania is reporting the elements on Afforestation, Reforestation, Deforestation, Forest Management and Revegetation activities for the first time, within the current NGHGI.

10.4 Recalculations, including in response to the review process, and planned improvements to the inventory, including for the KP-LULUCF activities

10.4.1 GHG inventory

No recalculations were performed since the last submission (version 1 of the 2010 submission).

10.4.2 KP-LULUCF inventory

No recalculations in response to the review process have been performed.

Romania plans to improve the quality of its elements.

PART II: SUPPLEMENTARY INFORMATION REQUIRED UNDER ARTICLE 7, PARAGRAPH 1

11 KP-LULUCF

11.1 General information

11.1.1 Definition of forest and any other criteria

Taking into consideration the definition provided by the Governmental Emergency Ordinance no. 139/2005 regarding the administration of forests in Romania, "forest represents a land of minimum 0.25 hectares with a tree crown cover of more than 10 percent of the area. Tree's minimum height must be 5 m in mature stage in natural sites. The definition includes also: forest nurseries, trees genetic trials within the forest land, forest pathways and roads, meadows, glades and other forest gaps, forest ecosystems within the national and natural parks, natural protected areas and other protected forest areas, protection forest belts with an area larger than 0.5 ha and a minimum width of 20 m, as well as Pinus mugo shrubs in alpine areas". This definition is consistent with the information reported by Romania to FAO.

According to the Romanian legislation "deforestation represents the removal of forest vegetation followed by land use or land cover change", as provided by the Governmental Ordinance no. 96/1998 (amended subsequently). In comparison, the definition provided by the Marrakech Accords specifies that "deforestation is the direct human-induced conversion of forested land to non-forested land".

As a summary, the forest in Romania is characterized by the following elements:
- minimum value for area: 0.25 hectares;
- minimum value for tree crown cover: 10%;
- minimum value for tree height: 5 m;
- minimum value for width: 20 m.

11.1.2 Elected activities under Article 3, paragraph 4, of the Kyoto Protocol

Romania selected two types of activities under Article 3.4 of the Kyoto Protocol, namely:

- forest management – applied on forest land that was forest on 1st of January 1990 ("Forest management" is a system of practices for stewardship and use of forest land aimed at fulfilling relevant ecological (including biological diversity), economic and social functions of the forest in a sustainable manner);
- revegetation – applied to forest patches and belts (with a width of less than 20 m and area less than 0.5 ha, planted for protecting crop fields) and to short rotation forestry crops for bioenergy ("Revegetation" is a direct human-induced activity to increase carbon stocks on sites through the establishment of vegetation that covers a minimum area of 0.05 hectares and does not meet the definitions of afforestation and reforestation).

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

Land areas for which *afforestation* and *reforestation* activities (AR) are applicable belonged to non-forest land use category at 31 December 1989, and were included, for afforestation purpose, into national forest area, in the period from 1 January 1990 to 31 December 2008. Romanian legal system and forestry technical norms do not distinguish between A and R activities, in the sense of KP, so that they were treated on an equal basis in this reporting. One typical example of land under AR activity are degraded agricultural lands included into land reclamation perimeters ("*perimetre de ameliorare*"), which benefited from afforestation works and, following the assessment of the success of plantation, were included into forest management plans (and consequently into the national forest area). In other words, AR activities refer to areas affected by the change of land use category from e.g., agriculture to forest land, including those overtaken by the Forest Administration as compensation for the *deforested* lands. An additional criteria for inclusion of lands into AR activities was that the change of (legal) land *use* category had also been followed by change in land *cover*, as also described in sections 11.2.1, 11.3.1.1 and 11.4.1. The natural expansion of forest into abandoned lands (e.g., remote grasslands) and the administrative act of changing the land use category from afforested pasture (woodland) into forest do not qualify, in the sense of Romanian legislation and for the scope of the KP reporting, as AR activities. Instead, they are treated under *forest management* (FM) activity.

Land areas for which *deforestation* activities (D) are applicable are those areas belonging to the national forest area (land use category) from 1 January 1990 to the moment in time

(between 1 January 1990 and 31 December 2008) when were designated, by means of an administrative act (e.g., minister order, governmental decision), a different land use category. The change of (legal) land use category may be definitive or temporary ("*scoatere definitiva/temporara din fond forestier*") and may be followed by deforestation at a later time. The definitive land use change followed by deforestation is authorized on the provision that an equivalent land area is returned and afforested in compensation, as referred to above. Additional information on D activity are presented in sections 11.2.1, 11.3.1.1 and 11.4.1.

Areas for which the activity *forest management* (FM) is applicable decreased over time in accordance with areas leaving the national forest area through deforestation (D) activities. FM also increased with the natural expansion of forest into other land use categories (e.g., grassland) and the inclusion of former forestry pastures (Woodland in chapter 7) into management, which made them subject to the forestry regime[1]. All Romanian forests, treated under chapter 7 as *forest land remaining forest lands,* are land areas for which the national forestry legislation and forestry technical norms are now applicable. For this reason they are included, for the purpose of KP reporting, under FM activity. Additional information is presented in section 11.3.1.1.

The activity *revegetation* (Rev) occurs on non-forest land use categories, on areas that do not meet de past and current definition of forests, are not subject to the forestry regime, but are occupied with woody/tree vegetation. For the scope of the KP reporting, forestry shelterbelts and tree lines reported as such under sectoral statistics data Silv 4 have been included in this category. It is reported separately from what is included under AR activity, although they are also reported in hectares. Areas affected by this activity are not considered to have changed the land use category (they are usually agricultural lands). Additional information on these activity data are presented in section 11.3.1.1.

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.

For the reporting under the Convention, the basis for activity data (land areas) in CRF sector 5 was the Yearbooks of the National Institute for Statistics. These national

[1] Until the entering into force of the new Forest Law (46/2008) there were forests within the national forest area and forests outside the national forest area (Woodlands), which were consequently treated separately in NIRs. The origin of these Woodlands is mostly the 1921 land reform, when closed forests were designated to be converted into communal pastures, yet this was not pursued in all cases. The forestry regime was applicable for "forests", but only in part applicable for "woodlands". While the former were included in forest management plans, inventoried and mapped, the latter were nevertheless managed, as they were either assigned, in time, forest land use, or made subject to *silvo-pastoral* planning or other local management rules. With the adoption of the new Forest Law in 2008, all lands falling under the new forest definition (area min. 0.25 ha occupied with trees min. 5 m height, i.e., consistent with the KP definition in Decision 16/CMP.1), as well as former "Woodlands" with min. 0.4 canopy closure are included into the national forest area and made subject to the forestry regime.

statistics only include the annual distribution of land by use categories; land use changes have been recorded in land matrix worksheets and sector 5 CRF tables mostly following expert judgment complemented by inquiry addressed to land administrators (e.g., National Forest Administration). In doing so, there were different criteria for defining deforestation and afforestation, i.e., they were sometimes associated with harvesting in forest areas and regeneration by seedlings, respectively. This can explain the abnormal large values of land areas entering or leaving annually the national forest area within CRF.

ARD activities, in the understanding of KP rules assimilated in this chapter, refer solely to areas affected by land use change, based on official documents/approvals issued by the competent authorities. This was the basis for collecting comprehensive ARD data, including the geographic boundaries of the affected areas. Data collected for KP reporting will represent the basis for the recalculation, in the next submissions, of activity data in CRF sector 5 tables. Additional support for correcting the land use and land transition matrix will be provided by the completion of the ongoing work on the new National Forest Inventory (NFI 2011).

According to the information available following the collection of activity data, AR activities correspond to the following sub-categories in CRF tables:
5.A.2.1. Cropland to forest
5.A.2.2. Grassland to forest

Based on the same information collected on the individual land parcels affected by D activity, it corresponds to the following sub-categories:
5.E.2.1. Forest to settlement
5.F.2.1. Forest to other

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

As specified above, activity data on AR were obtained from official documents approving the change of land use from agriculture (croplands and grasslands) to forest. The minimum applicable area was consistent with the legal definition of forest (0.25 ha); if afforestation was made at the border of existing forest (a usual occurrence e.g., for enclaves within forests), smaller land area units have also been considered, provided that they have a minimum width of 20 m. The largest area in which AR activities occurred from 1 January 1990 to 31 December 2008 are represented by the perimeters for land reclamation through afforestation, financed by the state during the last years, for which comprehensive data on areas, boundaries (forest management unit, management plan parcel, map), beneficiary, technologies employed, species used, etc., are readily available. Areas included within this “perimeters” where afforestation works have not started at the date the information has been collected/up-dated (2009) have not been included in the

current submission. Lands afforested as compensation for deforestation works (i.e., legal requirement for most D activities) have also been reported under AR activity. This largely corresponds to the method 1, approach 2 within the GPG LULUCF (IPCC 2003).

Activity data on D were also obtained from the official documents approving the change of land use from forest to other sub-categories, i.e., settlements (i.e., mostly infrastructure) and other land. Since an official document is required for any land use change from forest, it was not set a minimum area, so that activity data include parcels above 0.01 ha. Both definitive and temporary D activities ("*scoateri*") have been included, irrespective of the year of actual deforestation. In all cases, there were collected information on boundaries (similar with those for AR activities) and on stock (wood volumes) at the time of approval (i.e., a certain criteria for determining fees and compensation measures) and, as the case may be, in 2008. These data were also used for the estimation of emissions, as further described in section 11.3.1.

Land areas for which ARD activities apply are presented below in the time series 1990-2008. It is important to emphasize the relative small areas affected by ARD (28,187 ha AR and 3,801 ha D in total) compared to forest management (FM) activity data or the country's area.

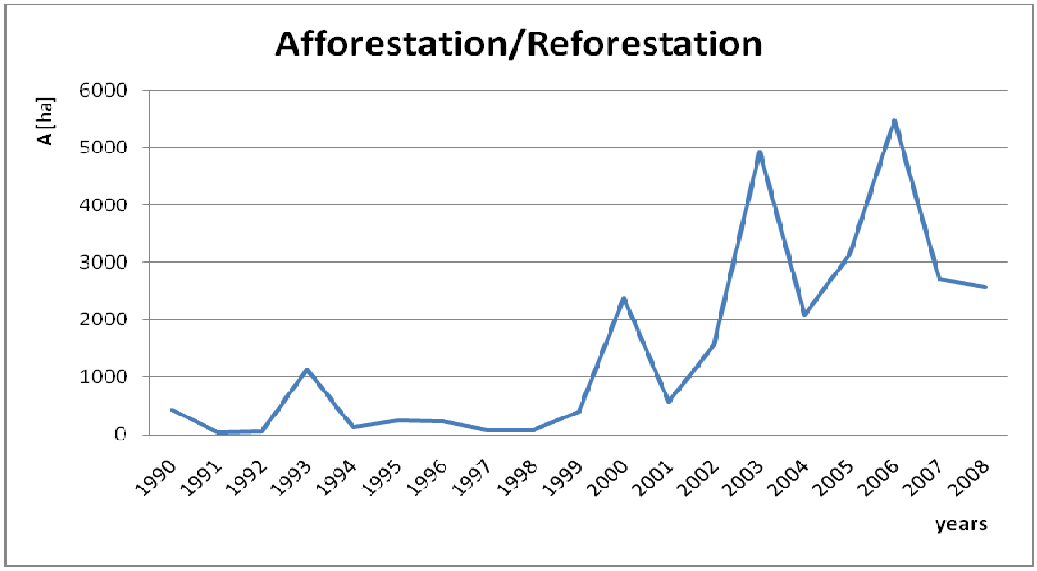


Figura 11. 1 Areas affected yearly by AR activities from 1990-2008

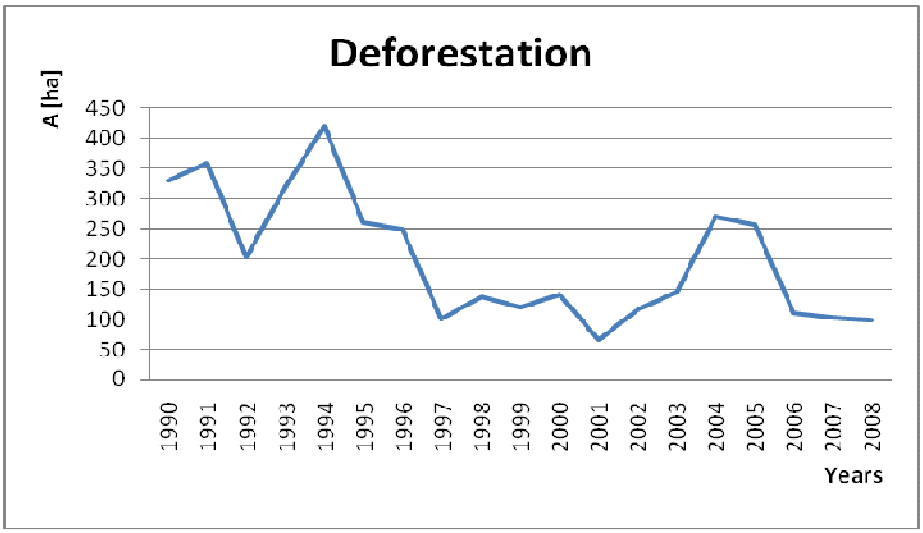


Figura 11. 2 Areas affected yearly by D activities from 1990-2008

11.2.2 Methodology used to develop the land transition matrix

As already introduced in sections 11.1.3 and 11.2.1, official documents approving the land entering or leaving the national forest area (and consequently forest management plans) represented the basis for developing the land transition matrix. As Romania did not elect any of the art. 3.4 activities Cropland management and Grazing land management (assumed consistent with subcategories 2.1 and 2.2 in table 5A CRF), areas affected yearly (from 1990-2008) by AR activities have been subtracted from the category "Other" in table NIR 2 and will be maintained under AR for the following years. Areas affected yearly by D activities have been subtracted, obviously, from FM activity and will also be maintained under D category for the following years. The yearly areas entering Revegetation activity has been subtracted from Cropland management, as specified in the guidelines in the Annex to Decision 6/CMP.3.

11.2.3 Maps and/or database to identify the geographical locations, and the system of identification codes for the geographical locations

AR activity data have been drawn upon:

- Forest management plans endorsed by the ministry responsible for forestry and kept by the forestry districts, with annexed maps (Sc. 1:10.000, 1:5.000);
- Governmental decisions or minister orders approving the overtaking, by the National Forest Administration, of degraded agricultural lands for afforestation purposes;
- Feasibility studies, technical projects and financial sheets accompanying the application for financing of the works of afforestation of degraded lands included within the land reclamation perimeters;

- Relevant documentation available at the ministry responsible for forestry, subordinated territorial inspectorates and branches of the National Forest Administration.

D activity data are based on:

- Forest management plans endorsed by the ministry responsible for forestry and kept by the forestry districts, with annexed maps (Sc. 1:10.000, 1:5.000);
- Governmental decisions or minister orders ceding forest areas for public works purposes;
- Technical and financial documentation accompanying the approval, which indicate the area, boundaries, affected wood volume, applicable fees and required compensatory measures;
- Relevant documentation available at the ministry responsible for forestry, subordinated territorial inspectorates and branches of the National Forest Administration.

Areas affected by ARD activity can be traced back in time on forest maps and technical documentation for these activities, as well as by landmarks in the field. FM activity data rely on chapter 7 (CRF sector 5). Data on forestry shelterbelts and tree lines treated under Revegetation activity rely on the sectoral statistics Silv 4 maintained by the National Forest Administration.

11.3 Activity-specific information

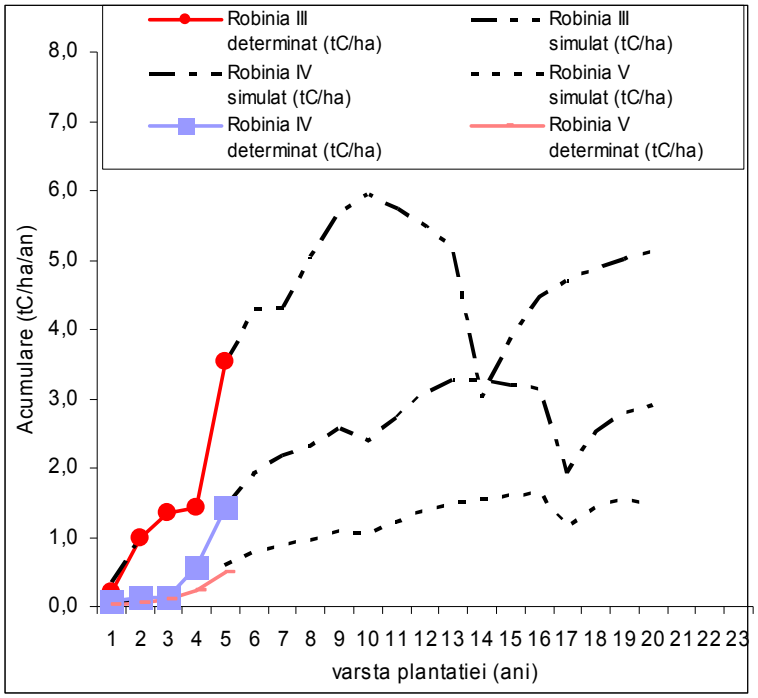
11.3.1 Methods for carbon stock change and GHG emission and removal estimates

11.3.1.1 Description of the methodologies and the underlying assumptions used AR estimates

As indicated in GPG LULUCF (IPCC 2003, p. 4.54), gross-net accounting rules are applicable for AR activities, and only the net changes in ecosystem carbon stocks during each year of the commitment period are estimated and reported. Based on the results of the study of the Forest Research and Management Planning Institute (ICAS, 2009) on carbon stocks modeling in transitory ecosystems associated with forest land use change in Romania (FORLUC), and the detailed activity data on AR (disaggregated at the individual area), it was possible to employ a tier 3 estimation method of carbon stock changes in living biomass.

Simulated and measured data on accumulation of both below and above ground biomass have been developed for young forest stands established on non-forest lands, for the most

important species used in Romania for afforestation works: willow, poplar, black locust, oak and pine. An example of data used in the calculation in worksheets (for *Robinia pseudacaccia*, 3 production classes) is presented below.



Vârsta plantației (ani)	Robinia III (tC/ha)	Robinia IV (tC/ha)	Robinia V (tC/ha)
1	0.28	0.08	0.02
2	0.99	0.12	0.06
3	1.35	0.14	0.10
4	1.43	0.58	0.22
5	3.51	1.43	0.54
6	4.29	1.91	0.79
7	4.32	2.19	0.92
8	5.05	2.31	0.96
9	5.69	2.56	1.10
10	5.94	2.39	1.06
11	5.74	2.73	1.21
12	5.49	3.10	1.40
13	5.18	3.28	1.48
14	3.02	3.26	1.56
15	3.88	3.20	1.61
16	4.48	3.13	1.64
17	4.70	1.92	1.14
18	4.88	2.51	1.44
19	5.02	2.81	1.55
20	5.15	2.90	1.48

Figura 11. 3 Annual growth of biomass in Robinia plantations, classes III-V

The gains (growth) in living biomass (both AGB and BGB), in 2008, in AR areas have been calculated using the following equation:

Equation 11. 1 Growth in living biomass

$$\Delta C\ LF_{Growth\ LB\ 2008} = \sum_i G_{sp,\ cl,\ y} * S_i / 1000$$

where,

$\Delta C\ LF_{Growth\ LB\ 2008}$ = Total growth in living biomass in 2008, in areas subject to AR from 1990-2008 [Gg C]

$G_{sp,\ cl,y}$ = Growth for species (sp), production class (cl), at the (y) age of plantation in 2008 [Mg C/ha]

S_i = Area of land parcel (i) with characteristics of the plantation sp, cl and y.

The use of biometric data based on allometric equations for calculating the growth on AR areas was not possible, as the Romanian volume tables usually start with 20 years. Parcels where activity data revealed higher production classes than those for which simulated data on growth by species are available, were assimilated, conservatively, with the lower class.

Romanian forestry norms for management planning (Vol. 5, 2000) provision min. 20 year rotation age for willow and poplar stands. However, given the special conditions in low-productive lands that were assigned forest use category, gains in willow and poplar plantations were assumed to be lost in their 15th year. This is the basis for calculating the Loss in living biomass presented in table 5(KP-I)A.1.1. Given the legal limitations for conversions of forest/afforested land into other land uses, the inexistence of short-rotation bioenergy plantations in the forest national area and the detailed activity data, it was safely assumed that AR areas have not been subject to deforestation from 1990-2008 (NO in table 5(KP-II)A.1.1.).

Changes in dead organic matter (DOM), consisting of both litter and deadwood, have been calculated on the basis of the Monitoring Report Form – "Afforestation of degraded agricultural land project in Romania" (ICAS, 2009), developed within the A/R Joint Implementation Romanian project.

Equation 11. 2 Growth in dead organic matter

$$\Delta C\ LF_{Growth\ DOM\ 2008} = \sum_i C_{sp,\ cl,\ y} * S_i / 1000$$

where,

$\Delta C\ LF_{Growth\ DOM\ 2008}$ = Growth in DOM in 2008, in areas subject to AR from 1990-2008 [Gg C]

$C_{sp,\ cl,y}$ = C content for species (sp), production class (cl), at the (y) age of plantation in 2008 [Mg C/ha]

S_i = Area of land parcel (i) with characteristics of the plantation sp, cl and y.

ICAS study developed values of C content in DOM pool for three species (poplar, black locust and willow) until 5 years of age of the plantations. For older plantation, values applicable for 5 years have conservatively been used. As afforestation works usually occur in Romania on low fertile soils, often uncovered by natural vegetation, it was assumed that DOM before afforestation was 0, so that growth in DOM pool equals the net change.

This methodology lead to the following values reported in LULUCF-KP tables, in GgC/28,187 ha AR:

- Growth LB: + 39.500
- Loss LB: - 3.394
- Net change DOM: + 12.694

D estimates

As deforestation activities in Romania are only permitted for specific public works (e.g., infrastructure), the calculation of losses in living biomass was developed from the eq. 3.6.1 in GPG LULUCF (IPCC, 2003), applicable for land converted to settlements. According to the chapter 3.6 of GPG LULUCF, the tier 1 estimates may assume that all living biomass has been lost in the year of conversion. However, as D activity also include parcels affected by land use change that were not deforested in the same year, it was assumed that C stock in living biomass changes uniformly from the year D activity was endorsed to 2008.

Equation 11. 3 Annual change in carbon stocks in AGB in forest lands converted to settlements

$$\Delta C\ FC_{Loss\ AGB\ 2008} = \sum_i (V_{FCi} - V_{2008i}) * D * CF * 0.001/t$$

where,

$\Delta C\ LF_{Loss\ AGB\ 2008}$ = Loss in above ground biomass in 2008, in areas subject to D from 1990-2008 [Gg C]

V_{FCi} = Total volume of standing wood (stock) in the year deforestation was approved, for the parcel i [m^3]

V_{FCi} = Total volume of standing wood (stock) in 2008, for the parcel i [m^3]

D = average wood density [0.5 t/m^3 dry matter], (IPCC Guidelines 1996, table. 4.14)

CF = carbon fraction of dry matter, dimensionless (GPG LULUCF 2003)

t = time (years) from deforestation approval to 2008

The total difference between the volume of standing wood in the year deforestation was approved and that in 2008 was ca. 246,000 m^3. Dividing this to the total area of 3,804 ha affected by D, an average loss of 65 m^3/ha is calculated. That represent some 1/3 of the average stock in forest at the country level, which seems reasonable, as deforestation are costly actions, often affecting marginal forests, in areas densely populated, below-average stocked.

If the values on volume change were negative, that would have permitted the calculation of sink (increase) in C stock in living biomass for the respective parcels. However, to consider the likely overestimation of standing wood in 2008 (based in some cases on expert judgment, compared to documents for approval of D activity), and to ensure conservativeness, it was chosen not to calculate sink for this and other pools, for the respective areas. Gains under D activity are therefore reduced to 0.

Equation 11. 4 Annual change in carbon stocks in BGB in forest lands converted to settlements

$$\Delta C\ FC_{Loss\ BGB\ 2008} = \Delta C\ FC_{Loss\ AGB\ 2008} * R$$

where,

$\Delta C\ LF_{Loss\ BGB\ 2008}$ = Loss in below ground biomass in 2008, in areas subject to D from 1990-2008 [Gg C]

R = root to short factor for broadleaves (0.25), consistent with chapter 7 data

The assumption that LB in D affected areas was lost on equal shares per each year of the period from D to 2008 was consistently employed for the calculation of the loss in dead organic matter.

Equation 11. 5 Annual change in carbon stocks in dead organic matter (DOM)

$$\Delta C\ FC_{Loss\ DOM\ 2008} = 6.755*0.001*S/t$$

where,

$\Delta C\ LF_{Loss\ DOM\ 2008}$ = Loss in DOM (litter and deadwood) in 2008, in areas subject to D from 1990-2008 [Gg C]

6.755 = average quantity of DOM in Romanian forests [Mt/ha], see chapter 7, p. 235

S = area affected by D for which decrease in living biomass was recorded [ha]

t = time (years) from the deforestation approval to 2008

Equation 11. 6 Annual change in carbon stocks in mineral soil

$$\Delta C\ FC_{Loss\ SC\ 2008} = 0.3*88*0.001*S/20$$

where,

$\Delta C\ LF_{Loss\ SC\ 2008}$ = Loss in mineral soil carbon in 2008, in areas subject to D from 1990-2008 [Gg C]

0.3 = average reductions (30%) in soil carbon stock for the top 30 cm, in land cleared from natural vegetation, in 20 years (IPCC Guidelines 1996, p. 5.39)

88 = default reference value (under native vegetation) for organic carbon for mineral soils [tC/ha], IPCC Guidelines 2006, corroborated with national data (Dinca, 2009)

S = area affected by D for which decrease in living biomass was recorded [ha]

The values reported in LULUCF-KP, in GgC/3,804 ha D, are presented below. It should be noted that implied emission factors are, in module, considerably larger than those for AR activity.

- Loss AGB: - 11.873
- Loss BGB: - 2.968
- Net change DOM: - 2.154
- Net change mineral soil: -3.182

FM estimates

Emissions/removals from FM activity have been calculated, for the purpose of LULUCF-KP reporting, solely for 2008. In the table below are presented the areas affected by ARD activities in 1990-2008, by groups of species, subtracted from the subcategory Forest Land in table 7.6. Because for Woodlands (table 7.6), legal document for land use change (from or into forest) was not required until the entering into force of the Law 46/2008, they were considered as a whole under the FM activity.

Tabel 11. 1 Calculation of land area for which FM activity applies

[ha]

AR	Coniferous	Beech	Oak	Hard-wood	Soft-wood	Total 1	Wood-land	Total 2
Proportion	0.15	0	0.25	0.3	0.3	1		
Area	4,228		7,047	8,456	8,456	28,187		
D								
Proportion	0.38	0.37	0.07	0.16	0.02	1		
Area	1,446	1,407	266	609	76	3,804		
"Forest"								
Table 7.6	1,938,000	2,052,000	1,058,000	954,000	307,000	3,309,000		
FM	1,932,326	2,050,593	1,050,687	944,935	298,468	**6,277,009**	419,300	6,696,309

Proportions of AR areas by groups of species are based on information on the species used in afforestation works. Proportions of D areas by groups of species are those indicated in chapter 7. The estimation of removals in living biomass is also based on the methodology presented in chapter 7. Gains in living biomass are estimated at +15,741.870 GgC and losses at -5,863.05 GgC.

In the present submission, it was provisionally assumed that net changes in carbon stock in mineral soils do not occur. This is based on the perpetuation for decades of the rules for forest management, and supported by the study of Dinca et al (2009) on the accumulation of C in Romanian forest soils. Based on the aggregation of laboratory results of soil samples from forest management plans elaborated from 2000-2008, the study indicated small standard deviation values, and consequently relatively constant C content in time. Since this study covers a period in time below the average period of significant change of C content in mineral soils, it should be completed by further studies, broader in coverage.

Rev estimates

For the LULUCF-KP reporting, data on forestry shelterbelts and tree lines (forestry cultures that do not meet the forest definition in Decision 16/CMP.1) have been estimated and reported. The graphic below presents the evolution, from 1985-2008, of areas affected by Rev activity, as resulted from sectoral statistics Silv 4. Data for 1985 and 1988 have been extrapolated and interpolated, respectively. Data from the period 1970 to 1984 have not been identified in the sectoral statistics.

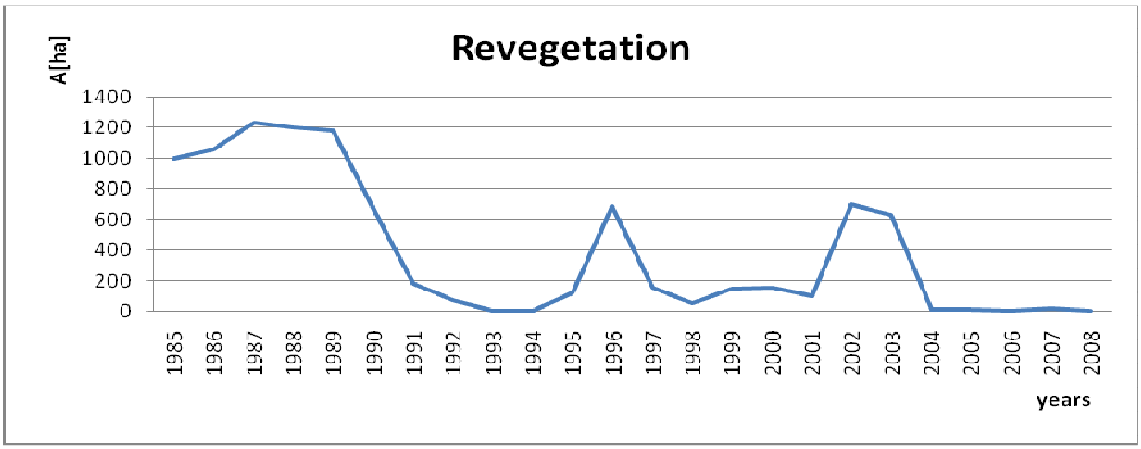


Figura 11. 4 Annual growth of biomass in Robinia plantations, classes III-V

Based on the similar species and plantation technologies, the estimation of gains and losses in C pools in years 1990 and 2008 (net-net accounting), is based on a methodology similar with that employed for AR activity. The average harvesting age was set at 20 years for different softwood species (e.g., poplar in tree lines), and at 40 years for different hardwood species (e.g., oak in shelterbelts), in accordance with the technical norms. Based on the activity data on species used in these plantations, it was assumed a 50:50 distribution on softwood and hardwood species. Plantations reaching the specified age are considered harvested (and consequently the C stock lost) in that particular year.

A significant difference from AR activity with regard to C pools estimation is that net accumulation in dead organic matter was conservatively reduced to 0. This is based on the small width of forestry shelterbelts and the characteristic of tree lines (often consisting of a single line), impeding the accumulation of dead organic matter on the soils. From calculations resulted a net gain of C stock of 13.091 GgC for 2008 and 1.34 GgC for 1990. Different values would have been obtained, however, if data had been available from 1970 on.

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

There are expected increases in C content in mineral soil pool, in areas where AR and Rev activities took place, according to IPCC Guidelines 1996 and GPG LULUCF 2003. C stock change in soil poll in AR areas will be estimated in the following years, provided that additional data from A/R JI project or other national studies become available.

FM clearly represent key category under LULUCF-KP reporting (see section 11.6.1). Given several studies referred to in IPCC Guidelines 1996 or elaborated thereafter, there are not expected substantive changes in litter and deadwood pools in close-to-nature managed forests, where management practices were maintained in time. Data on net changes in these pools will be estimated in the following years, provided that national

studies become available. An important tool for these estimates will be represented by the completion of NFI 2011.

Fertilization and liming are not usual practices in areas on which FM activity applies, and only in outstanding situations in AR areas. As specified in chapter 7 (p. 221), the emissions from N fertilization are not subtracted from those in the agriculture sector (sector 4 CRF), but included there (IE) for both AR and FM activities. Liming was considered as not occurring (NO) for all mandatory (art. 3.3 KP) and selected (art. 3.4 KP) activities.

Drainage in forest soils have not been performed and documented in the period from 1990 to present. Also, ARD activities do not occur in lands rich in organic soils. These are in line with the significant decrease of economic activity in the transition period, as well as the gradual ratification of all relevant multilateral environmental agreements. N_2O emissions from these activities are therefore reduced to 0.

Controlled burning is not allowed in Romania. Wildfire (natural disturbance) occurs in Romania at a level proportional with the intensity of drought in the vegetation season, but it solely affects the dead organic matter. CO_2, CH_4 and N_2O emissions estimated for 2008 in chapter 7 were proportionally applied for FM activity.

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.

11.3.1.4 Changes in data and methods since the previous submission (recalculations)

The previous submissions under the Convention did not contain methodologies for estimations of GHG emissions/removals in areas affected by changes in land cover/use. They were introduced in this submission for ARD and Rev activities, and are based on activity data at different level of aggregation (from 0.01 ha to the country level). Consequently, combinations of tier 1-3 estimation methods have been employed and described in section 11.3.1.1.

11.3.1.5 Uncertainty estimates

Uncertainty estimates were not prepared for the first year of reporting under KP.

11.3.1.6 Information on other methodological issues

In the KP reporting there was need to develop methodologies for activities (land categories) not covered in chapter 7 and sector 5 CRF tables. In addition, there were employed higher tier methodologies for several pools calculated for ARD and Rev activities, and additional pools were considered for art. 3.3 and 3.4 activities.

11.3.1.7 The year of the onset of an activity, if after 2008

Areas affected in 2008 by art. 3.3 and elected art. 3.4 activities are:

- AR 2,563 ha
- D 98 ha
- FM 6,277,009 ha
- Rev 5 ha

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

As specified in section 11.1.3., AR areas belonged to non-forest land use category at 31 December 1989, and were included, for afforestation purpose, into national forest area, from 1 January 1990 on. D areas belonged to the national forest area from 1 January 1990 to the moment in time (between 1 January 1990 and 31 December 2008) when were designated, by means of an administrative act (e.g., minister order, governmental decision), a different land use category. Certification of the commencement of ARD activities is certified by the official documents referred to in section 11.2.3. Extensive, costly plantation works which AR activities rely on, as well as compensatory measures and payments made by the beneficiaries of D lands are unequivocal indications that ARD activities are directly human induced.

11.4.2 Information on how harvesting or forest disturbance followed by the re-establishment of forest is distinguished from deforestation

In the present chapter, the distinction between forest harvest and forest disturbance, 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 use category, keep it subject to the forestry regime, observe management plans and regenerate it within a given timeframe 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

It is estimated that in the period from 1990 to 2008, following the adoption of three consecutive restitution laws (1991, 2000, 2005), some 40,000 ha returned to their pre-1948 owners have been clear felled, out of a total area of ca. 100,000 ha harvested massively (see Irimie 2006). They were not classified as deforested areas because of the preservation of their legal status (land use category) and their regeneration (natural or humanly induced), in the meantime. Owing to the near finalization of land reforms, the administrative measures taken in the last years and the severe contraction of wood markets at the onset of economic recession, areas affected by massive cuttings decreased considerably in the reported year (2008). However, illegal or large-scale harvests in national forest area the exception, not the rules. In fact, all sources, including the present submission, clearly indicate that total wood cuttings are well below increment rates, so that Romanian forests continue to act as a C sink. Furthermore, the intermediary results of the NFI 2011 shows that essential forest data known from the previous NFI (e.g., forest area, stock, canopy closure), could be substantially outdone by the new ones, which is an additional indicator of their C sequestration potential.

11.5 Article 3.4

11.5.1 Information that demonstrates that activities under Article 3.4 have occurred since 1 January 1990 and are human-induced

11.5.2 Information relating to Revegetation

Revegetation activities occur on areas that do not meet de forest definition, but are occupied with woody/tree vegetation. Forestry shelterbelts and tree lines reported under sectoral statistics data Silv 4 have been included in this category. As the rotation age of these “plantations” is above 20 years, for the purpose of net-net accounting, activity data on revegetation should have been available for the period starting with 1970. Silv 4 only permitted documentation on areas affected by revegetation activities from 1985 on. Data on growth and C stock change have been calculated in accordance with the methodology in section 11.3.1.1.

The special shape and composition of tree lines and forestry shelterbelts is the primary proof that their establishment is humanly induced. Though information on these areas is available at the National Forest Administration, their management is in the competence of the companies that own/administrate infrastructure (e.g., railways, roads, etc.) or the agricultural land. With the adoption of the new Forest Law in 2008, forestry shelterbelts are made subject to the forestry regime, for protection and management purposes, even

though they do not meet the national and KP definition of "forest". The areas in which forestry shelterbelts are established declined significantly in the last years, mostly due to land dissipation. For the tree lines, the decline can be explained by the high additional costs required for land purchasing along the existing or projected roads.

11.5.3 Information relating to Forest Management

Forest management activity refers to forest land and woodland on which management measures have been set up and implemented. With regard to forest land, basic Forest Law and subsequent forestry legislation have a long tradition in Romania, the last three enacted in 1962, 1996 and 2008. Until the latest Forest law (2008), forests (i.e., land cover) belonging to "national forest area" (i.e., land use) had a different regime than woodlands, in that they were managed according to management plans, mapped, inventoried, landmarked and up-dated in statistics. Woodlands were not subject, until 2008, to the forestry regime, but they were nevertheless managed, in that they were either assigned, in time, forest land use category (i.e., integrated into the national forest area), or made subject to *silvo-pastoral* planning or other local use rules. In fact, the land use category was more of a difference that the land cover, for a good part of the 400,000 ha Woodlands. The latest change in definition was made for management and protection purposes, and it is estimated that for some ¼ of Woodlands still existing in 2008, forest management plans have already been elaborated.

The forestry regime, consisting of forest law, subsequent legislation and technical norms, is well developed in Romania. According to art. 5 of the Forest Law of 2008, sustainable forest management is based on the following principles:

- Assurance of forest permanence
- Expansion of national forest area
- Assurance of an appropriate institutional and organizational framework
- Increase of role of forests and forestry in rural development
- Close to nature forestry and preservation of biodiversity
- Harmonization of interests between the forest sector and other socio-economic activities
- Support for private forest owners
- Prevention of forest degradation due to anthropogenic factors and natural disturbances

11.6 Other information

11.6.1 Key category analysis for Article 3.3 activities and any elected activities under Article 3.4

Key category analysis is reported in Annex 1 to NIR 2010. In the Tier 1 Analysis (Level Assessment, including LULUCF), CO_2 removals from the category "forest land remaining forest land" are the first key category, amounting 36.4 Mt CO_2eq (ca. 18% of the total GHG estimate). Net change in C stock in FM activity in 2008 amounts 36.2 MtCO_2eq, that is, very close to estimates under FLRFL category in table 5A CRF. Significant change with regard to the two estimates (FLRFL in CRF and FM in KP) are not expected for the following years.

11.7 Information relating to Article 6

Romania implements since 2002 the A/R Joint Implementation project „Afforestation of degraded agricultural lands in Romania". The project was developed by the National Forest Administration and the Carbon Prototype Fund of the World Bank. NFA is the managing entity and independent monitoring is performed by TÜV SÜD Industrie Service GmbH. The removals reported for the period 1 January 2002 to 31 December 2007 is 10.767 Mt CO_2eq, for a total area of 5,881 ha. The provisioned lifetime of the project is 30 years.

AR activity data and emissions/removal from AR activity estimated herein also include the areas and stock changes in A/R JI project area. This is consistent with GPG LULUCF (IPCC 2003) , p. 4.19. C stock data on A/R JI project will be subtracted from AR total emissions/removals at the end of the commitment period, when accounting under KP-LULUCF is due for Romania.

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 2009 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 31.12.2009 as well as information on tranfers of the units in 2009 to and from other Parties of the Kyoto Protocol. Neither AAUs, nor ERUs or RMUs have been issued in the Romanian Registry in 2009.

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 certifi**cation** 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 Partry 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 2008 excluding Land Use, Land Use Change and Forestry, as follows:

CPR (tones CO_2 equivalent) = 5 * GHG emissions level in 2008 (tones CO_2 equivalent)

CPR = 5 * 145,915,868.81 = 729,579,344 tones CO_2 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

No changes occurred on National System since the last submission of the National Inventory Report (2010 version 1 submission of the National GHG Inventory).

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 2009 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 name and contact information of the registry staff designated by the Party to maintain the national registry: the registry operator Andreea Popa changes to Valentina Sterian;
- the website for Romanian registry include the information based on the requirements in the annex to decision 13/CMP, concerning the Publicly accessible information;
- in 13th and 14th July 2009, 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 standardised 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 results and evaluation Report is in Annex 6.2.2.

No further changes of the Romanian national registry occurred compared to the description provided in the 2009 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 at present, we cannot consider that there is an adverse social, environmental and economic impacts on developing countries produced by our national climate change policy.

As a European Union (EU) Member State, our national climate change policy will be developed for the next period in compliance with the European relevant policy and will adopt the necessary measures to contribute to reducing the adverse impacts on developing countries, impacts specific to its implementation (example: during the next period of the European Union-Emission Trading Scheme, particularly on the inclusion of aviation).

During the current international negotiation process in order to conclude a new binding reduction targets, our country is expressing its intention to contribute to the fast start financing EU effort to support the developing countries to develop proper mitigation policies.

16 OTHER INFORMATION

There is no other relevant information which needs to be reported.

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