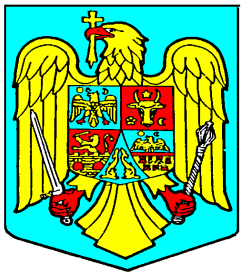

Ministry of Environment and Sustainable Development

National Environmental Protection Agency

Romania's Greenhouse Gas Inventory 1989-2006

National Inventory Report

March 2008

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AD	Activity Data
AWMS	Animal Waste Management Systems
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
DOC	Degradable Organic Carbon
DOC_F	Fraction of DOC Dissimilated
EAF	Electric Arc Furnace
EB	Energy Balance
EC	European Commission
EF	Emission Factor
EUROSTAT	Statistical Office of the European Communities
ERT	Expert Review Team
FAO	Food and Agriculture Organization
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
L	Level
LULUCF	Land Use, Land Use Change and Forestry
M	meter
MCF	Methane Conversion Factor
MESD	Ministry of Environment and Sustainable Development
$MgCO_3$	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
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
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

LIST OF ANNEXES

ES. EXECUTIVE SUMMARY

ES.1 Background information

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.

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 seventh version of the National Inventory Report (NIR) submitted by Romania, covering the national inventories of GHG emissions for the period 1989-2006 (2008 submission).

This report documents Romania's National Inventory of anthropogenic emissions of direct GHG: CO_2, CH_4, N_2O, HFC, PFC, SF_6 and indirect GHG: NO_x, CO, NMVOC and SO_2.

This report includes descriptions of methods, data sources, key sources, uncertainties, quality assurance and quality control (QA/QC) activities carried out and a trend analysis. For the first time, the NIR comprises a full quantitative assessment of the uncertainty; the uncertainty analysis is presented both on the subsectoral level and in the Annex 7.

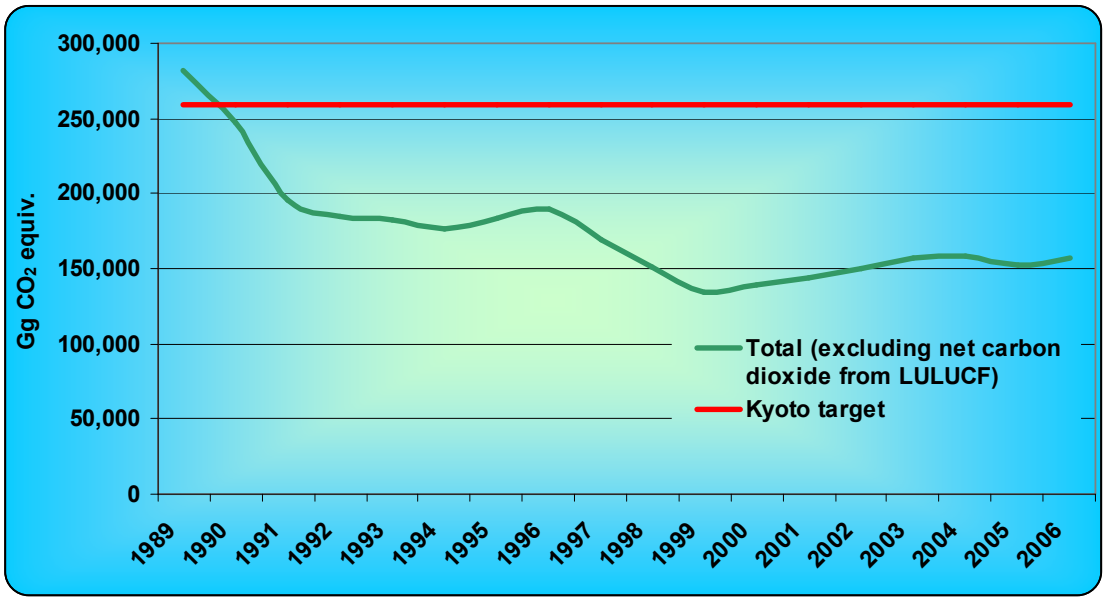
ES.2 Summary of trends

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 CO_2 emissions accounted for some 67.87% to 71.29% of the total GHG emissions in the period 1989-2006. The CH_4 emissions accounted for some 17.79% to 20.09% and N_2O for 9.79% to 11.85% of the total GHG emissions in the same period. The F-gases contributed to the total GHG emissions with 0.23% to 1.2%, depending on year.

Figure ES 1 The total GHG emissions in CO_2 equivalent in the period 1989-2006



According to the figure above, there is a great probability for Romania to meet the Kyoto Protocol commitments regarding the limitation of the GHG emissions in the first commitment period (2008-2012). The GHG emissions (without LULUCF) have decreased with 44.42% since the base year.

ES.3 Overview of the source and sink category emission estimates and trends

The present NGHGI for the period 1989 – 2006 was compiled according to the recommendations for GHG inventories set out in the UNFCCC Guidelines on Reporting and Review, (FCCC/CP/2002/8 and FCCC/SBSTA/2004/8), using the Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories (IPCC Guidelines, 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 for LULUCF, 2003).

The inventories cover all sectors and the majority of the IPCC source categories. The direct GHG (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 calculations of emissions of the indirect GHGs NO_x, NMVOC, CO and SO_2, which should be included according to the reporting guidelines. The GHG emissions from both domestic and international bunkers were estimated for the first time and presented in this submission following the identification of activity data from new sources. Some minor IPCC source categories are not estimated, such as the emissions from asphalt roofing, from road paving with asphalt, and from histosols due to the lack of activity data.

GHG emissions inventories have been reported since the 2005 submission by using the software CRF Reporter, delivered by the UNFCCC Secretariat. This version of NIR refers to figures in CRF tables generated using CRF Reporter version 3.2.1.

ES.4 Indirect greenhouse gases and SO_2

The emissions of the indirect GHGs (NO_x, NMVOC, CO and SO_2) are included in the report, as requested by the UNFCCC guidelines. These gases are called "indirect" gases because their influence (decrease or increase) upon the warming of the atmosphere is indirectly, through secondary effects. 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. For the NMVOC emissions, another important source is the "Solvent and Other Product Use" sector.

1. INTRODUCTION

1.1 Background information

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 seventh complete submission of the national GHG inventory of Romania. The structure of the National Inventory Report is in line with the Annex I of the Guidelines for the preparation of national communication by parties included in Annex I to the Convention, Part I: UNFCCC reporting guidelines on annual inventories (FCCC/CP/2002/8 and FCCC/SBSTA/2004/8).

For this submission, Romania prepared: the CRF Reporter database and the CRF Tables containing emission estimates and background data for the 1989-2006 period and the National Inventory Report.

The greatest attention during the preparation was focused on direct GHGs provided by the Kyoto Protocol - CO_2, CH_4, N_2O, HFCs, PFCs and SF_6. In addition, the indirect GHGs and aerosols (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

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

1.2 Institutional arrangements

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, is regulating all the institutional and procedural aspects in order to support the estimation of the GHG emissions levels, the reporting and the archiving of the Greenhouse Gas Inventory information.

The aim of the Governmental Decision is to ensure the fulfillment of the provisions and of the obligations Romania assumed through 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), in the subordination of the Ministry of Environment and Sustainable Development (MESD). NEPA has also the obligation of the preparation of the NGHGI.

Central public authorities and the institutions under their authority, in their coordination or subordination, different research institutes, the economic operators and the ownership

and professional associations have all different responsibilities of delivering relevant activity data.

However, the main activity data supplier remains the National Institute for Statistics (NIS) through the yearly-published documents like National Statistical Yearbook and the Energy Balance. In 2002, the Ministry of Environment and the National Institute for Statistics signed a protocol of co-operation. Under this protocol, NIS agreed to provide, besides its yearly publication, additional data, necessary for the inventory preparation.

Starting with the 2006 – 2nd submission of the NGHGI, the LULUCF sector begun to be prepared by NEPA experts. Previously, the LULUCF sector has been prepared by the Forest Research Institute (ICAS), under a contract with the National Research and Development Institute for Environmental Protection (ICIM Bucharest; the entity previously responsible for inventory preparation).

MESD submits the National Greenhouse Gas Inventory to the United Nations Framework Convention on Climate Change Secretariat, to the European Commission and to the European Environment Agency taking into account the specific deadlines.

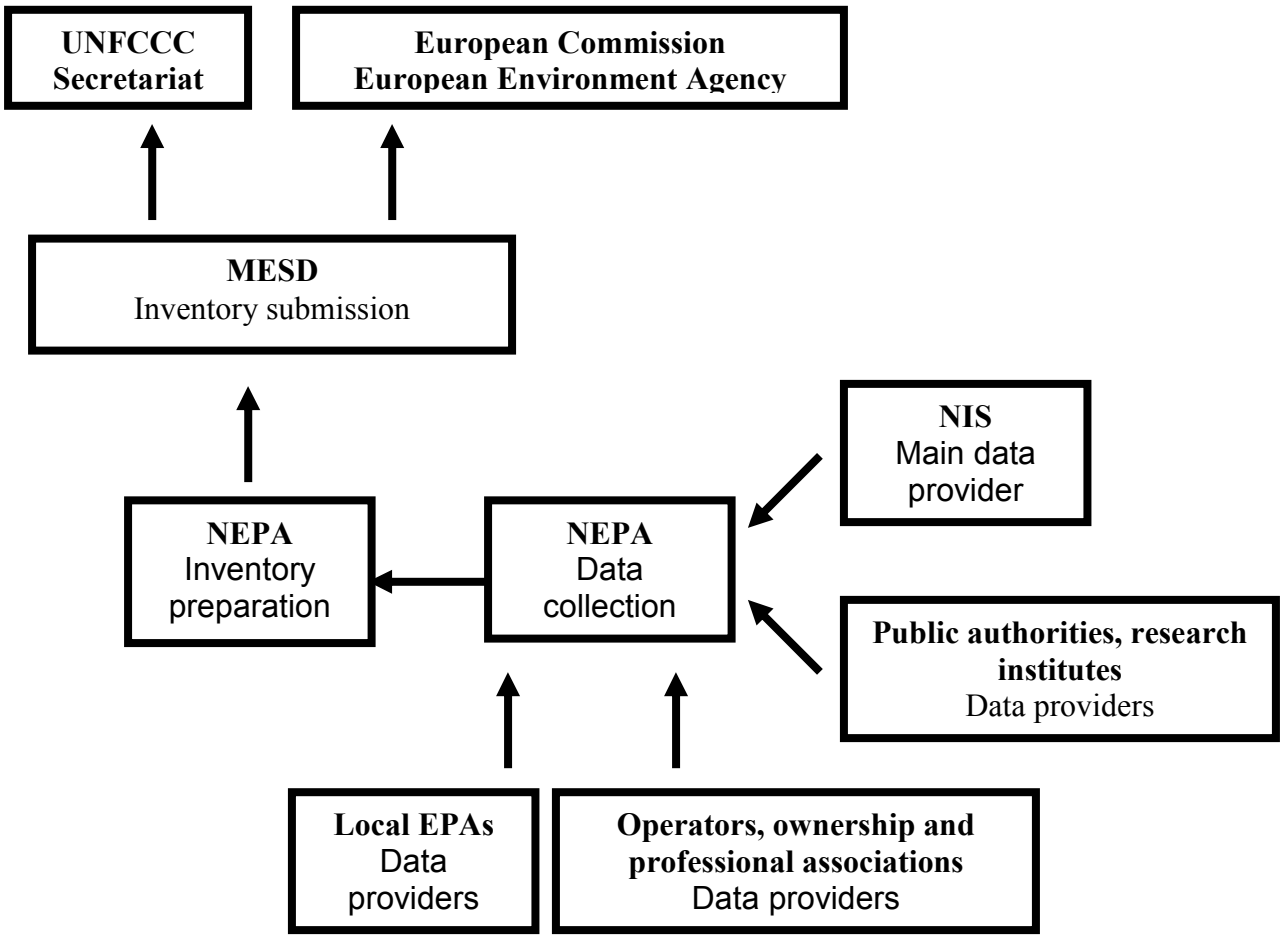
National System

Based on Article 5 of the Kyoto Protocol, Romania established a National System for estimating the anthropogenic emissions from sources and removals by sinks for all GHGs not covered by the Montreal Protocol. The system complies with the COP/MOPs Decisions and the Decision 280/2004/EC of the European Parliament and of the Council and Decision 166/2005/EC of European Commission concerning a mechanism for monitoring Community GHG emissions and for implementing the Kyoto Protocol.

Romania has regularly prepared and submitted annually the GHG inventory, based on a clear internal plan and structure.

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

Figure 1. 1 Current national inventory system structure



The Governmental Decision no. 1570/2007 establishing the National System for the estimation of anthropogenic GHG emissions levels from sources and removals by sinks represents the support of NEPA in the preparation of the National Greenhouse Gas Inventories (NGHGI) by defining the legal, institutional and procedural framework involving actively the relevant public authorities, different research institutes, economic operators, ownership and professional associations.

The following three stages are considered in the elaboration of the inventory: planning, preparation and management. In the first stage specific responsibilities are defined and allocated, the second stage refers to inventory preparation process (data collection, relevant information needed for estimating emissions, methodological choices) and the

third stage refers to the inventory management that also includes quality management, as well as documentation on QA/QC activities.

Although the NGHGI preparation was already supported by involving the organizations outlined in the figure above through the existing protocols of cooperation, contracts and other regulating documents, beginning with the 2007 all the specific institutional and procedural aspects are regulated by the Governmental Decision no. 1570/2007 establishing the National System for the estimation of anthropogenic GHG emissions levels from sources and removals by sinks.

1.3 Inventory preparation

The present NIR was compiled according to the recommendations for inventories set out in the UNFCCC Guidelines on Reporting and Review (FCCC/CP/2002/8 and FCCC/SBSTA/2004/8) and includes detailed information on the inventories for all years from the base year to the year 2006, 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

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 emission calculation

Activities are carried out at NEPA and comprise:

- primary data processing (aggregation, disaggregation);
- selection of the emission factors and of the methods;
- application of methods;
- emission estimates, using the most recent data;
- internal review (errors are rectified);
- preparation of the national inventory report

Data archive

NEPA team manages and maintains the NGHGI database and the documentation of specific inventory information. According to the provisions in IPCC GPG, 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 source 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 – most of the documents;
- on paper – the documents specific to the early period of the time series

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 within a three-day interval frequency in rest of cases.

The manager of the archiving system is represented by the same person designated to fulfill the tasks of the NGHGI general coordinator.

1.4 Methodology

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
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 • National Forest Administration (RNP)
Waste	• National Institute for Statistics • National Environmental Protection Agency • Public Health Institute

The sources of the emission factors used are: IPCC 1996, IPCC GPG 2000 and plant specific in a very limited number. The methods used to estimate emissions and the sources of EF are described in Summary 3 of CRF Reporter (mostly Tier1, Tier 2 for some industrial processes and CORINAIR methodology in case of solvents and other product use).

1.5 Key categories

The key category analysis has been performed according to the provisions of Chapter 7 of IPCC GPG 2000 and Chapter 5 of IPCC GPG.
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 2006:

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

Taking into account the inclusion of the LULUCF sector, in 2006:

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

The most important key categories in 2006 are:

- CO_2 from stationary combustion solid fuels;
- CO_2 from stationary combustion gaseous fuels;
- CO_2 from stationary combustion liquid fuels;
- CO_2 from mobile combustion – road;
- CO_2 from Forest Land remaining Forest Land

The results of the key category analysis for 2006 are presented in the Annex 1 using the template provided by Tables 7A1-7A3 of IPCC GPG2000 and by Tables 5.4.5, 5.4.7 and 5.4.8 of IPCC GPG 2003.

1.6 QA/QC information

Romania established the QA/QC Programme 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. The document comprises information on:

- the national authority responsible for the coordination of QA/QC activities;
- the objectives of the QA/QC Programme;
- the QA/QC Plan;
- the QC procedures;
- the QA procedures;
- the reporting, documenting and archiving procedures

According to the provisions of the Governmental Decision no.1570/2007 establishing the national system, NEPA represents the competent authority responsible with the coordination of the QA/QC activities under the NGHGI. For this purpose, NEPA is performing the following activities:

- ensures that the objectives of the QA/QC programme are established;
- develops and regularly updates a QA/QC plan;
- implements the QA/QC procedures;
- establishes and ensures the implementation of reporting, documenting and archiving procedures

The QA/QC coordinator is represented by the same person designated to fulfill the tasks of the NGHGI general 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 programme. 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 will be 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 GHG Inventory principles in Romania. The objectives of the plan include:

- applying greater QC effort for key source categories and for those source 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 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 categories or sinks and checking the values consistency between source categories or sinks;
- checking the emissions calculation into the calculation sheets by reproducing a representative sample calculation;
- checking the correctness of the aggregation of estimated emissions 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 estimates existence for all sources and sinks and for the entire time series;
- checking the explanations existence when the emissions 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 description, at the NIR's level;
- checking the references completeness at the NIR's level;
- checking the archiving of the CRF tables, NIR, „xml" database and of the CRF Reporter's specific databases, including the calculation sheets;
- checking the key sources 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 checklist for inventory preparation. For this purpose QC checklists will be 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 of all 27 EU Member sSates after 15th 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 plans to 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. MESD through its international contacts and bilateral agreements supports NEPA in identifying the available processes for ensuring the implementation of QA activities.

National inventory submissions to the UNFCCC Secretariat are subject to the review procedures defined in the relevant COP/MOP decisions. In response to the UNFCCC ERT recommendations, all recalculations implemented are mentioned in the improvements list.

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

1.7 Uncertainty

For the first time, 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 Good Practice Guidance (2000), in the Chapter 5 of the IPCC Good Practice Guidance for Land-Use, Land-Use Change and Forestry 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 for LULUCF 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 subsectoral level and in Annex 7.

1.8 Completeness

The inventory covers all sectors and all gases in the period 1989-2006 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, road paving with asphalt, cultivation of histosols.

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

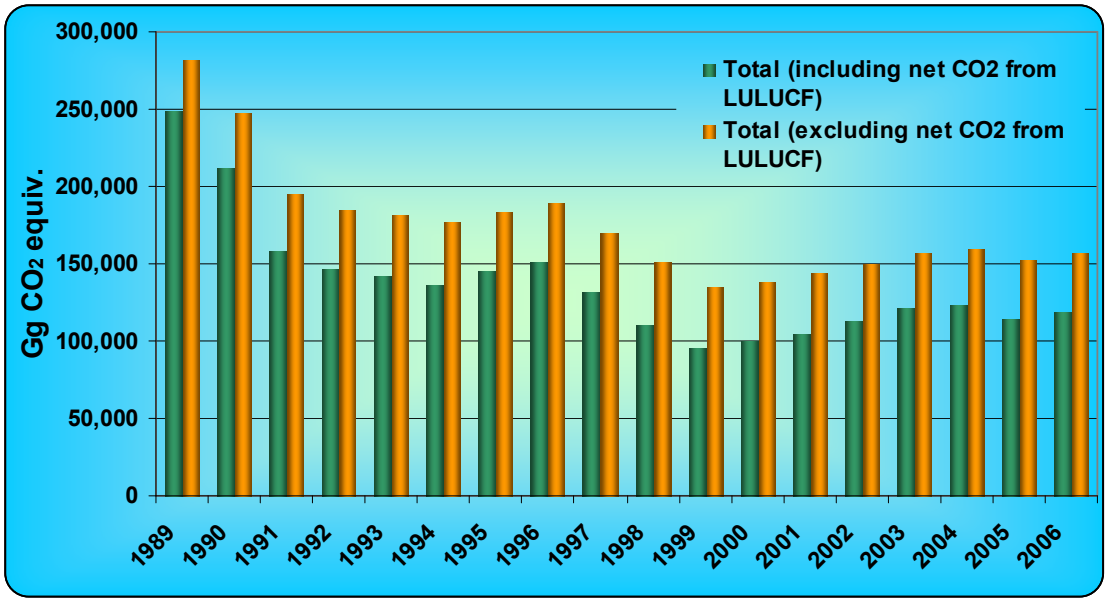
2. TRENDS IN GREENHOUSE GAS EMISSIONS

2.1 Trends of the aggregated GHG emissions

The total GHG emissions in 2006, excluding removals by sinks, amounted to 156,680.02 Gg CO_2 equivalent.

According to the provisions of the Kyoto Protocol, Romania has committed itself to reduce the GHG emissions by 8% in the period 2008-2012 comparing to the base year 1989 (281,894.91 Gg CO_2 equivalent). The total GHGs emissions (without considering sinks) decreased with 44.42% in the period 1989-2006, and the net GHG emissions (taking into account the CO_2 removals) decreased with 52.18% in the same period. Based on these observations, there is a great probability for Romania to meet the commitments to reduce the GHG emissions in the first commitment period 2008-2012.

Figure 2. 1 Trends of the aggregated GHG emissions



The emissions trend reflects the changes in this period characterized by a process of transition to a market economy. The emissions trend can be split in two parts: the period 1989-1996 and the period 1996-2006. 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 at 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 1999-2004. The limited decrease of GHG emissions in 2005, compared with the 2004 and 2006 levels was caused by the record-breaking hydrological year positively influencing the energy produced in hydropower plants.

2.2 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: 68.51% CO_2, 18.46% CH_4, 11.85% N_2O, 1.19% PFCs. In 2006, the shares of GHG emissions were: 70.85% CO_2, 18.55% CH_4, 10.20% N_2O, 0.39% PFCs. The F gases started to be use as substitutes for ODS in refrigerating and air conditioning systems since 1995. In 2006, the contribution of these gases to the total GHG emissions is negligible: 0.0139% HFCs and 0.00006% SF_6. Next table presents the trend of aggregated emissions, divided by gases.

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

Year	CO_2 including LULUCF	CO_2 excluding LULUCF	CH_4 excluding LULUCF	N_2O excluding LULUCF	HFCs	PFCs	SF_6
1989	160,476.75	193,118.17	52,027.98	33,399.24	NE	3,349.52	NE
1990	136,151.60	171,999.84	44,932.17	28,649.83	NE	2,115.77	NE
1991	95,109.54	132,429.25	38,903.87	21,839.70	NE	1,942.01	NE
1992	89,573.89	127,699.99	35,012.57	20,856.73	NE	1,352.05	NE
1993	87,739.15	127,170.76	32,996.33	20,248.36	NE	1,409.32	NE
1994	83,945.76	123,980.18	31,852.86	19,278.41	NE	1,490.97	NE
1995	90,226.16	129,511.14	33,574.90	19,237.15	0.22	1,773.67	0.06
1996	97,138.20	135,439.27	33,945.44	18,832.94	0.44	1,768.98	0.06
1997	82,335.14	121,024.08	30,197.10	18,173.60	0.73	390.19	0.02
1998	66,499.74	107,300.96	27,668.11	16,273.88	1.97	416.47	0.01
1999	52,121.92	91,635.27	27,043.20	15,515.67	2.43	415.04	0.05
2000	56,966.84	95,263.99	27,828.17	15,210.31	2.93	413.14	0.00
2001	60,959.69	100,267.44	27,701.54	15,324.32	2.78	428.75	0.00
2002	69,465.05	106,309.47	28,566.95	14,685.74	3.25	444.59	0.01
2003	74,896.77	111,382.94	29,632.04	15,400.19	5.12	471.90	0.00
2004	76,373.14	112,141.58	29,015.88	17,074.30	6.94	513.34	0.08
2005	68,369.86	105,853.20	28,502.16	17,051.70	4.00	569.63	0.11
2006	73,513.86	111,011.11	29,059.45	15,978.02	21.70	609.65	0.09

Carbon dioxide (CO_2) – the most significant anthropogenic greenhouse gas is the carbon dioxide. The decrease of CO_2 emissions (from 193,118.17 Gg in 1989 to 111,011.11 Gg in 2006) 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 construction sectors) as a consequence of activity decline in this sector.

Methane (CH_4) – the methane emissions, related to the Fugitive emissions from fossil fuels extraction and distribution and to the livestock, declined in the same period. The CH_4 emissions estimated for the year 2006 decreased with 44.15% compared with the 1989.

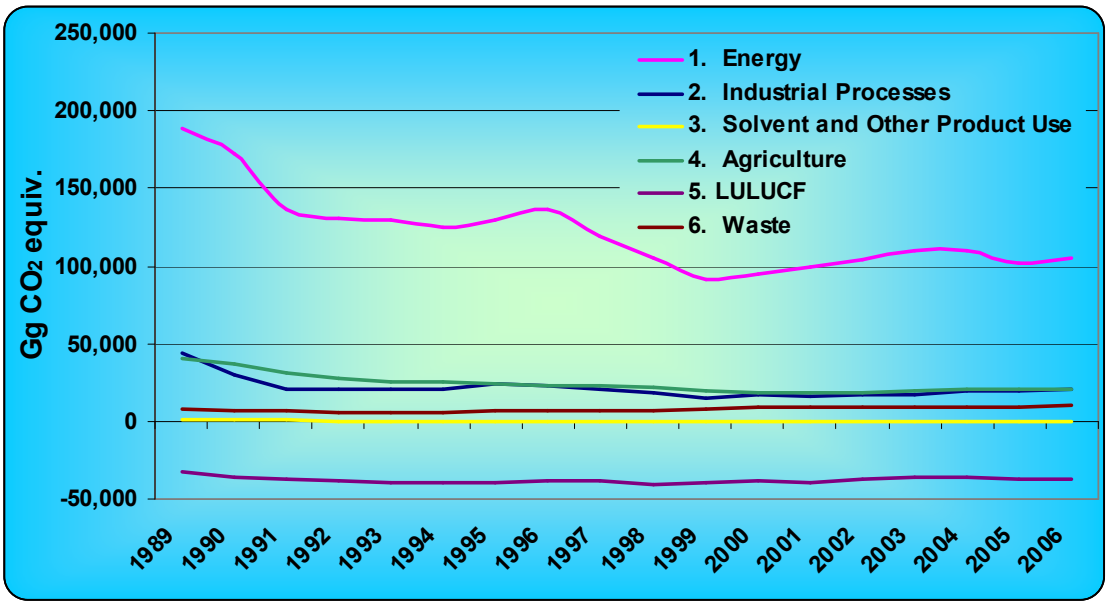
Nitrous oxide (N_2O) –the N_2O emissions are mainly provided by the Agricultural Soils in the Agriculture sector and the Chemical industry in the Industrial Processes sector. The decline of these activities is reflected in the N_2O emissions trend. The decrease in N_2O emissions in 2006 is 52.16% compared with 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 are estimated beginning with the same year. The PFCs emissions generated in the production of the primary aluminium are reported for the entire period since 1989 (and have decreased with 81.8% in 2006 comparing with 1989).

2.3 Trends by sector

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 67.29% of the total national GHG emissions in 2006. The GHG emissions resulted from the Energy sector decreased with 44.04% compared with the base year.

Industrial Processes contributes to total GHG emissions with 13.28%. A significant decrease of GHG emissions was registered in this sector (52.58% decrease from 1989 to 2006) due to the decline or the termination of certain production activities.

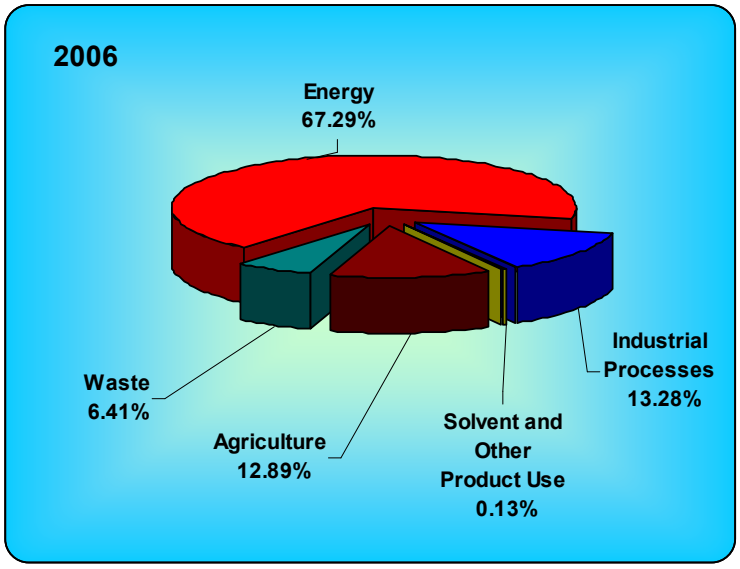
Agriculture GHG emissions have also decreased. The GHG emissions in 2006 are 50.28% lower in comparison with the 1989 emissions. In 2006, 12.89% of the total GHG emissions resulted from the agriculture sector.

LULUCF CO_2 removals by sinks are 14.87 % higher in comparison with the base year.

Waste sector emissions have increased in the period 1989-2006 (20.22%). Contribution of the waste sector to the total GHG emission is 6.41% in 2006.

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

Figure 2. 3 Sectoral GHG emissions in 2006 [%]



2.4 Trends of the indirect GHG and SO_2

The trends of the indirect GHG are similar with the GHG trends, except for CO emissions, which strongly increased staring with 1995, due to the raise of the firewood used in households.

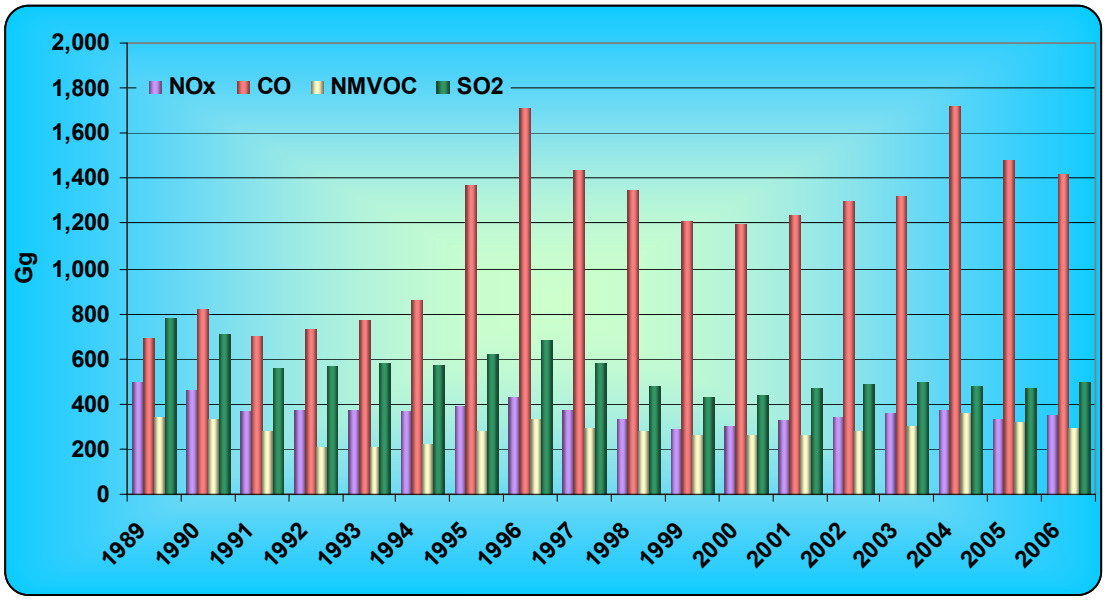
The NO_x, NMVOC and SO_2 emissions evolution follows the general GHG emissions trend. The SO_2 emissions decrease is caused by the decline of the fuels burnt for energy and the decrease of sulphur content in fuels.

The indirect GHG emissions trends are presented in Figure 2.4.

Table 2. 2 Indirect GHG emissions levels [Gg]

Year	NO_x	CO	NMVOC	SO_2
1989	494.02	692.04	344.94	780.11
1990	461.81	824.42	335.34	707.39
1991	367.28	701.29	276.08	560.08
1992	378.37	732.12	207.06	567.61
1993	373.69	770.17	209.76	585.11
1994	368.43	861.91	221.96	570.69
1995	386.96	1,370.43	280.53	618.65
1996	430.10	1,715.39	335.01	685.17
1997	376.34	1,434.57	292.99	585.17
1998	335.81	1,343.61	280.19	477.14
1999	289.57	1,208.67	259.12	431.70
2000	304.76	1,195.63	264.57	439.38
2001	328.13	1,237.75	266.39	469.17
2002	345.17	1,298.03	281.97	483.78
2003	356.18	1,320.54	300.70	492.57
2004	372.41	1,718.18	358.98	478.95
2005	336.83	1,481.37	320.82	473.92
2006	347.84	1,419.39	295.85	497.23

Figure 2. 4 Indirect GHG emissions trends [Gg]



3. ENERGY (CRF SECTOR 1)

3.1 Overview of the sector

The emissions for the Energy sector are generated by two categories of activities:

- ✓ 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 refer to:

- ✓ 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 2006, the Energy sector was responsible for about 67% of the total GHG emissions (105,432 Gg CO_2 equivalent).

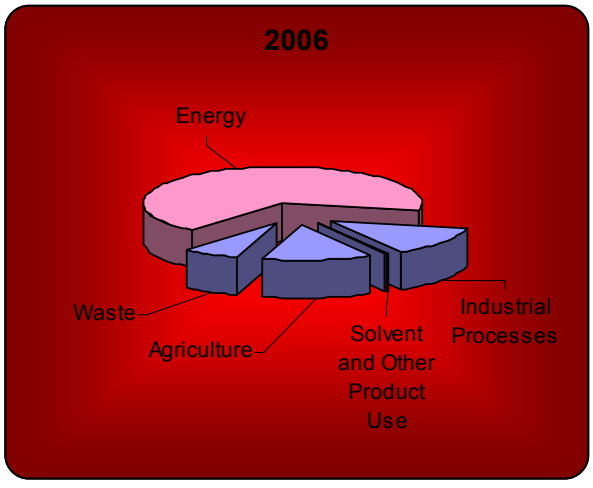


Figure 3. 1 Contribution of the Energy sector to total GHG emissions in 2006.

Within the Energy sector, the most significant category is "Energy industries" (41.81% from the Energy sector GHG emissions), followed by "Manufacturing industries and construction" (with 17.3%).

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 2006 Energy emissions

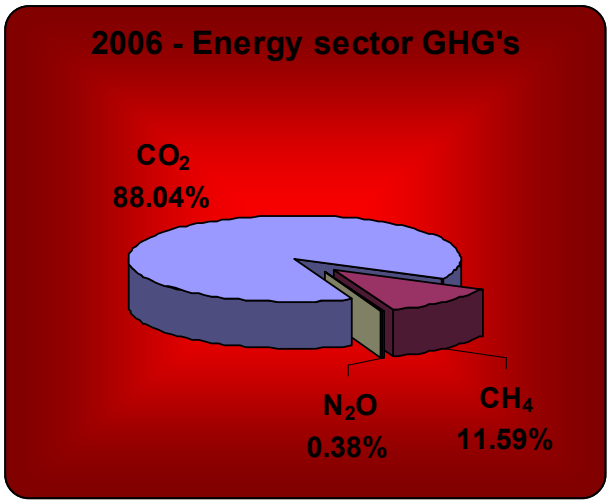
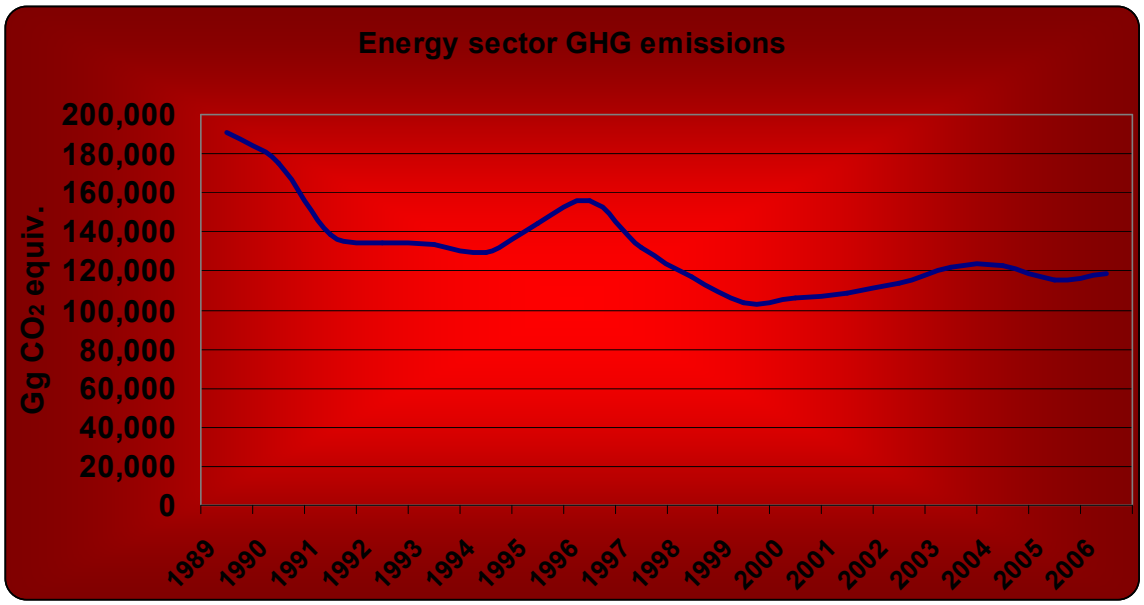


Figure 3. 3 The energy sector emission trend for the period 1989-2006



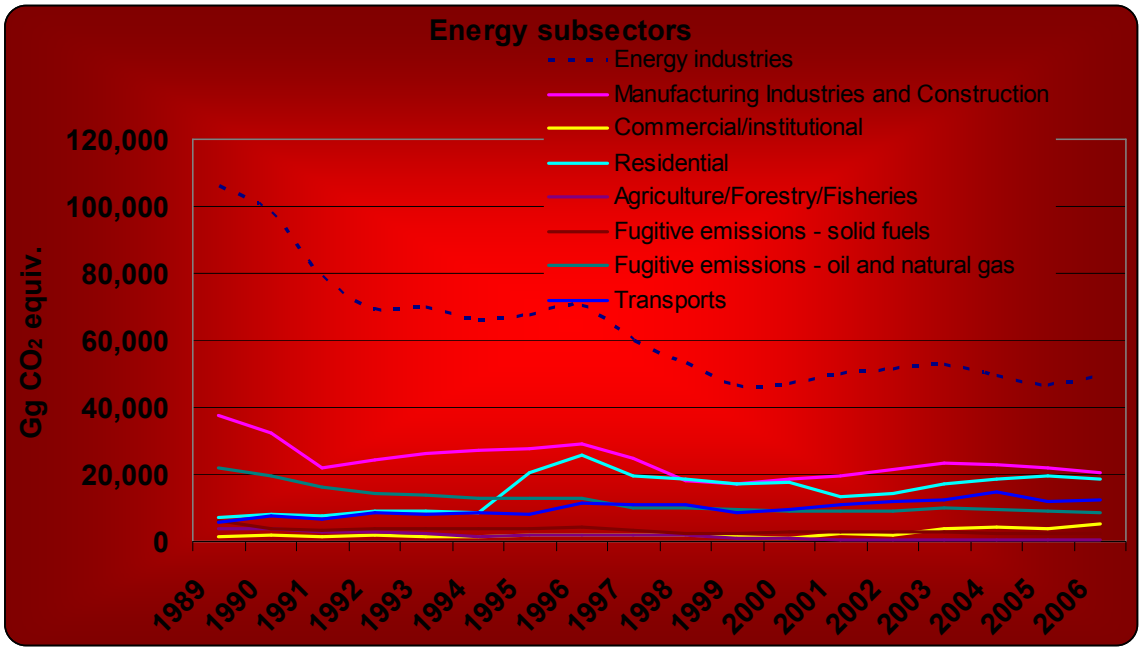
The emissions trend reflects the changes in this period characterized by a process of transition to a market economy.

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.

The 2005 decrease of the GHG emissions is because it was a rainy year, therefore, the thermal power produced decreased, increasing the hydropower. In 2006, the situation changed (having a dry summer), with the decrease of the hydropower and the increase of the thermal power produced.

Figure 3. 4 The trend of the GHG emissions in the Energy sector in the 1989-2006 period (Gg CO_2 equivalent)

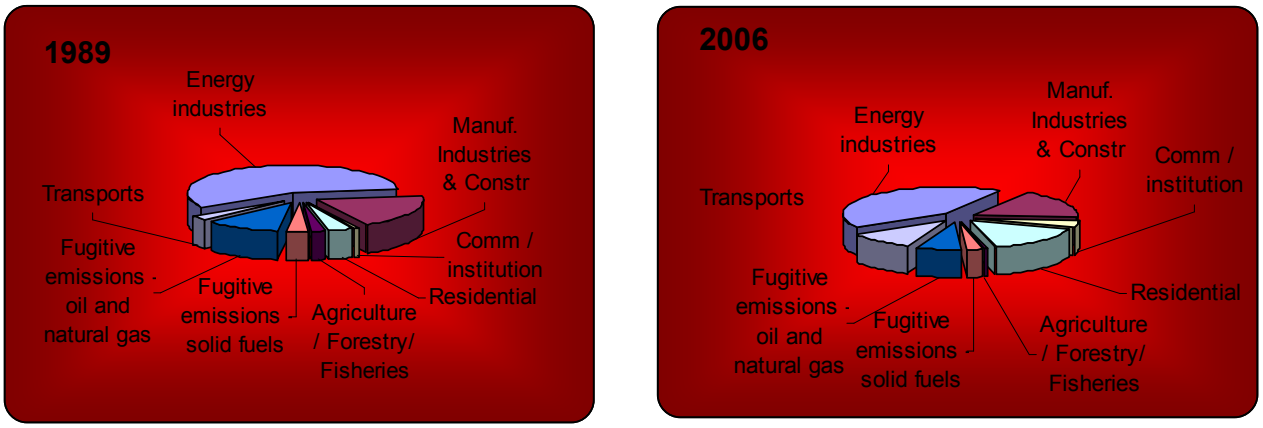


The contribution of various subsectors to the total Energy GHG emissions for 1989 and for 2006 is presented in the following table.

Table 3. 1 Contributions to the Energy sector GHG emissions

Energy categories GHG emissions contribution	**1989**	**2006**
A.1. Energy industries	55.71%	41.81%
A.2. Manufacturing Industries and Construction	19.72%	17.30%
A.3. Transports	3.04%	10.43%
A.4. Other sectors	6.76%	20.87%
B.1. Fugitive emissions - solid fuels	3.34%	2.19%
B.2. Fugitive emissions - oil and natural gas	11.42%	7.40%

Figure 3. 5 GHG Energy sector emissions by sub-sectors in 1989 and in 2006



3.1.1 Reference and sectoral approaches

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

- Reference Approach;
- Sectoral Approach

The "Reference Approach" is a top-down method that uses 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 bottom-up method (more specific), 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. 2 The differences between CO_2 emissions estimates using RA and SA methods

Differences RA-SA	
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	8.83%

Figure 3.6 The differences between CO_2 emissions estimates using RA and SA methods

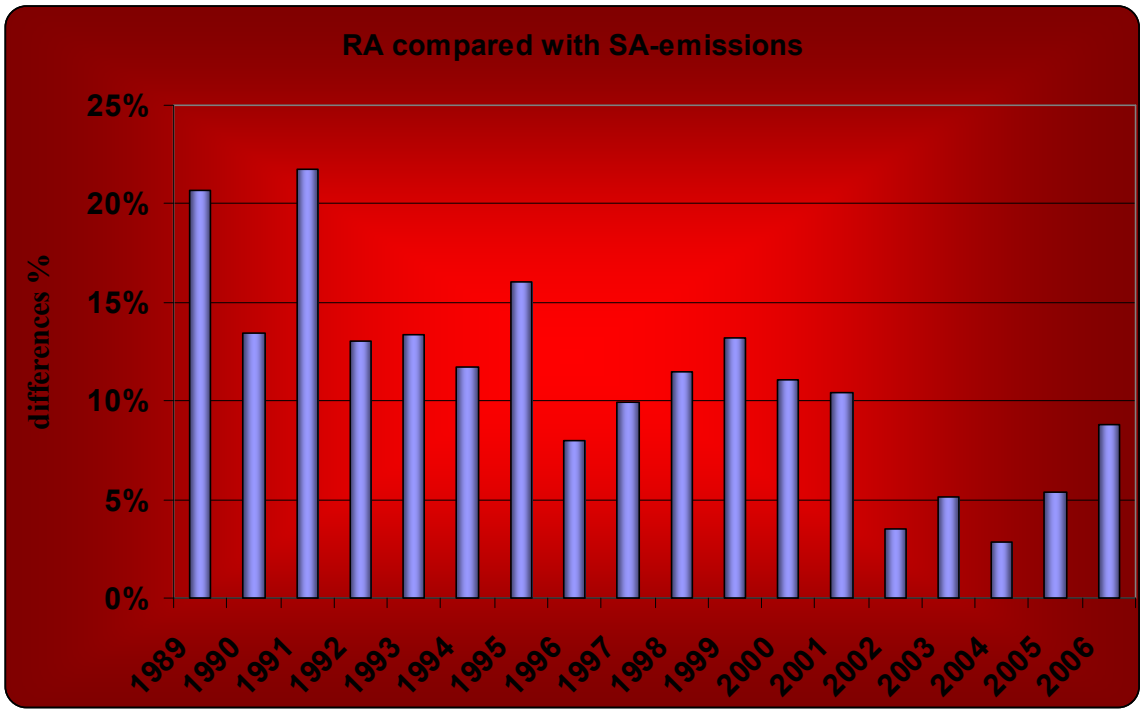


Table 3. 3 The difference between CO_2 emissions estimated using RA and using SA in 2006

2006	Liquid fuels	Solid fuels	Gaseous fuels	Total
Differences in fuel consumption	10.87%	14.24%	12.44%	**12.48%**
Differences in emissions	12.03%	5.12%	10.57%	**8.83%**

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.

Another 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 61 category "statistical differences", which includes:

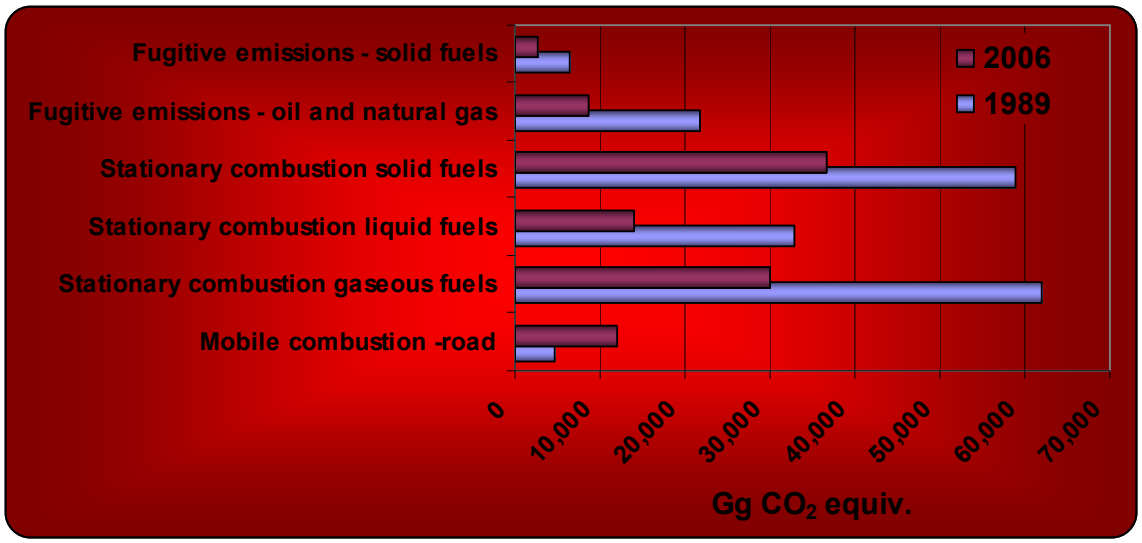
- stock variations not recorded statistically;
- energy consumptions for military purposes;
- differences generated by the statistical investigation system (while the energy producers are exhaustive recorded, the consumers are inquired on a sampling base, admitting a margin of error)

3.1.2 Key sources

In the Energy sector, the key sources do not correspond directly to the CRF categories (in the sense that each key source to correspond to a CRF category). Therefore, the presentation of these key sources will be done in this chapter.

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 [%]**
1.AA.3.B	Mobile combustion - road	CO_2	L, T	0.08	L, T	0.06
1.AA.1.+ 1.AA.2.+ 1.AA.4	Stationary combustion - gaseous fuels	CO_2	L, T	0.19	L, T	0.15
1.AA.1.+ 1.AA.2.+ 1.AA.4	Stationary combustion - liquid fuels	CO_2	L, T	0.09	L, T	0.07
1.AA.1.+ 1.AA.2.+ 1.AA.4	Stationary combustion - solid fuels	CO_2	L, T	0.23	L, T	0.19
1.B.2	Fugitive emissions - oil and natural gas	CH_4	L, T	0.06	L, T	0.05
1.B.1	Fugitive emissions - solid fuels	CH_4	L, T	0.02	L, T	0.01
1.AA.1.+ 1.AA.2.+ 1.AA.4	Stationary combustion - biomass	CH_4	T	0.0047	T	0.0038

Figure 3. 7 Key sources Energy sector GHG emissions in 1989 and in 2006



3.1.3 International bunker fuels

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

3.1.4 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.

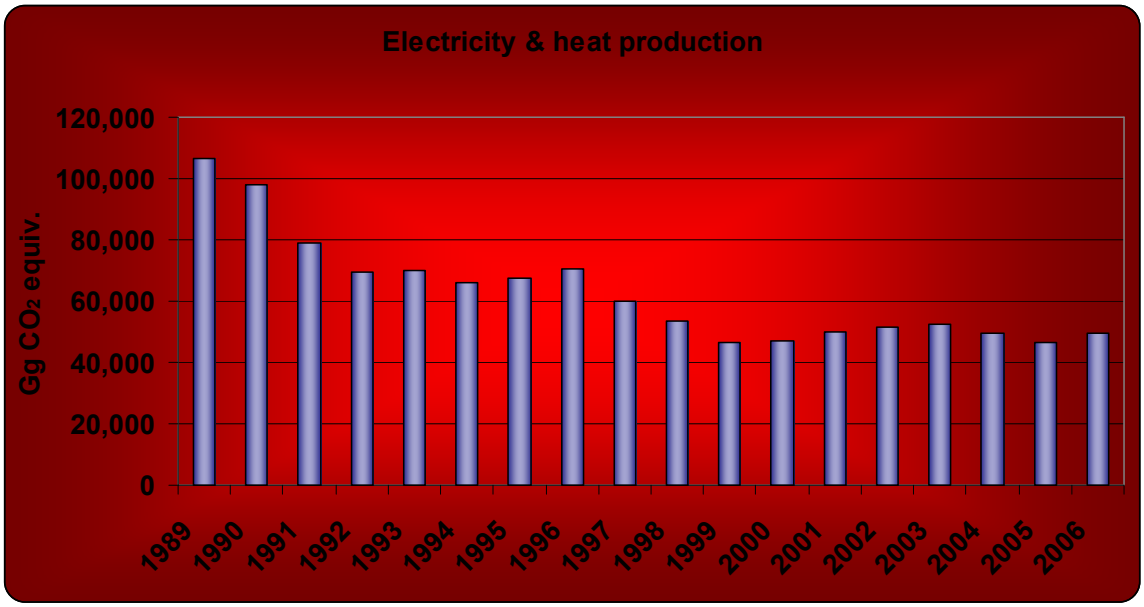
3.2 Fuel combustion, energy industry (CRF sector 1.A.1.)

3.2.1 Description

CO_2 emissions from fuel combustion activities accounted for 94,063.89 Gg CO_2 equivalent in 2006. Within the fuel combustion sector, 41.81% of the CO_2 emissions correspond to 1.A.1 Energy Industry, this sub-sector being the main emitter regarding combustion activities.

In this category are included the following fuel consumptions: 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



3.2.2 Methodological issues

The data regarding fuel consumption are taken from the Energy Balance (E.B.), an yearly publication of 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 1992-2006 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 an 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)

3.2.3 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 (stationary combustion gaseous, liquid, respectively solid fuels, for every GHG: CO_2, CH_4, and N_2O). 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:

- 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.

3.2.4 Source specific QA/QC and verification

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 this activities there were no inconformity pointed out.

The unconformities pointed out by the review team during the NGHGI 2006 review are described in chapter 10, quantitative effects of the recalculations following the unconformities are being described in every sector, in the “source specific recalculations” chapter.

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

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

No recalculations were performed, related to the previous submission.

3.2.6 Source specific planned improvements

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

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

3.3.1 Description

The subsector Manufacturing Industries and Construction was responsible in 2006 for 17.3% of the total Energy sector GHG emissions (about 204,95.90 Gg CO_2 equivalent).

The industries included in this category are the following:

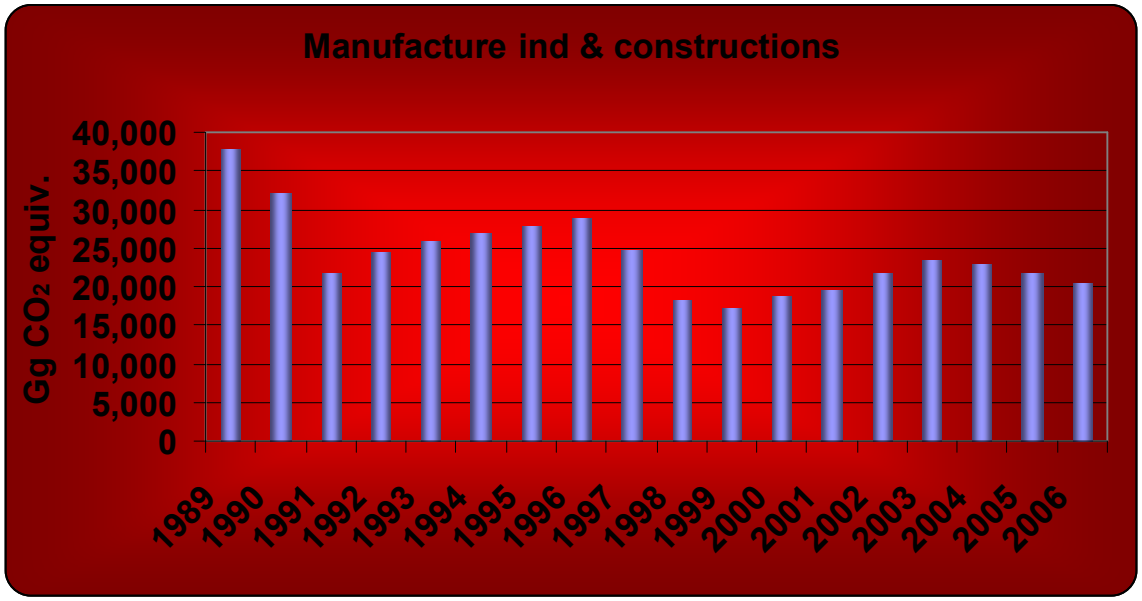
- Extraction and preparation of metal-bearing minerals (NACE Rev.1 code 13);
- Other mining activities (NACE Rev. 1 code 14);
- Food, beverages, tobacco (NACE Rev.1 code 15, 16);
- Textile and textile products (NACE Rev.1 code 17);
- Textile, fur and leather garments (NACE Rev. 1 code 18);
- Leather 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



3.3.2 Methodological issues

The activity data are taken from the Energy Balance (cat. 28 "industry" for the 1992-2006 system, and "direct consumption" - from the industry consumption category and "constructions", chapter 48 for the 1989 E.B.).

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.

3.3.3 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 (stationary combustion gaseous, liquid, respectively solid fuels, for every GHG: CO_2, CH_4, and N_2O). 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:

- 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, 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.

3.3.4 Source specific QA/QC and verification

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 this activities an error regarding EF used was identified: for refinery gas, in the previous submission an EF of 18 t C/TJ was used, while in table I-2 (Revised 1996 IPCC Guidelines foe National Greenhouse Gas Inventories: Workbook), the default value of the EF is 18.2 t C/TJ. Therefore, the entire refinery gas CO_2 emission estimate was recalculated.

The unconformities pointed out by the review team during the NGHGI 2006 review are described in chapter 10, quantitative effects of the recalculations following the unconformities are being described in every sector, in the "source specific recalculations" chapter.

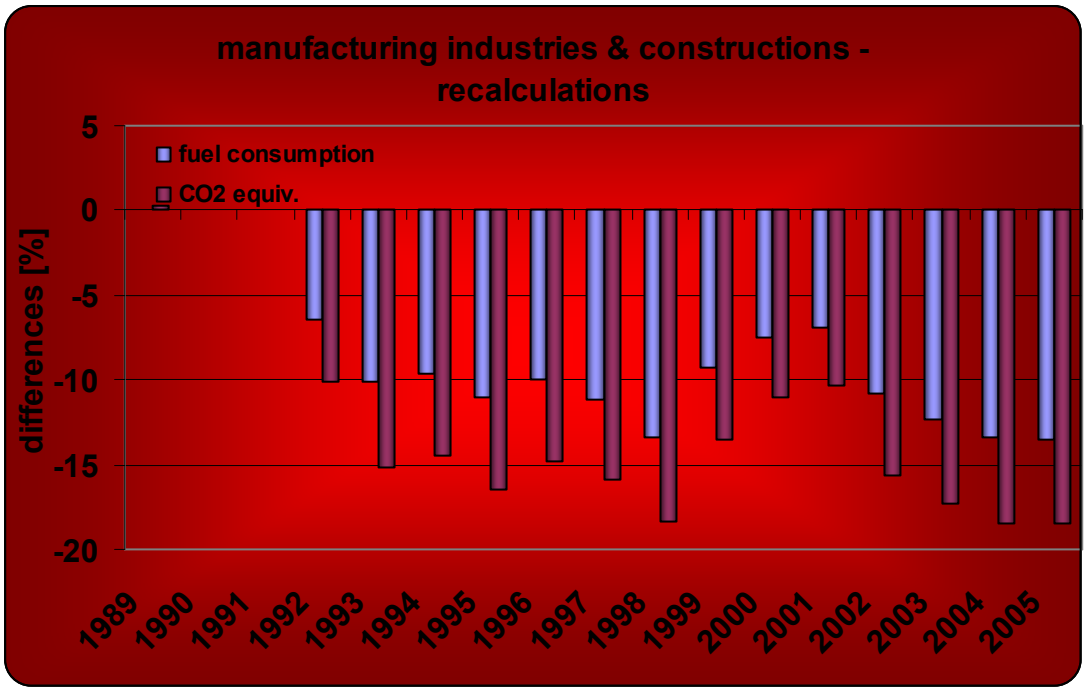
Following the quality assurance activities undertaken, as part of the GHG emissions estimates, there were no recalculations required.

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

During the review process, a question related to the double counting with the industry GHG emission sector appeared, regarding the coke oven coke consumption. After checking with the industry sector responsible and with energy sector data provider (National Institute for Statistics), the conclusion was that for the period 1992-2005, the fuel taken into consideration for the energy sector GHG emissions estimates included the quantity of coke oven coke used in metallurgy (which was accounted for already in the industry sector). Therefore, a correction was made in the energy sector estimates (manufacturing industries and construction), by subtracting the coke oven coke used in metallurgy (cat. 51 of the E.B.).

The differences due to the recalculations mentioned before, are presented in the next figure.

Figure 3. 10 Manufacturing industries and constructions differences in recalculation



3.3.6 Source specific planned improvements

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

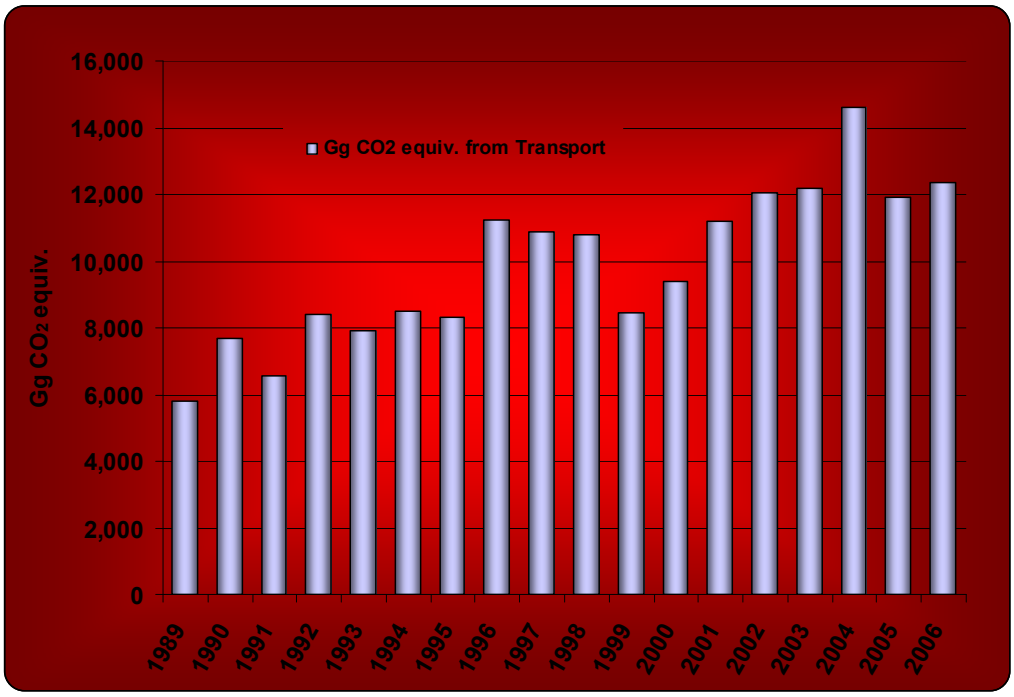
3.4 Fuel combustion, Transport (CRF sector 1.A.3.)

3.4.1 Description

The emissions from transport categories accounted for 12,351.77 Gg CO_2 equivalent in 2006. The GHG covered are: CO_2, CH_4, N_2O, NO_x, NMVOC, CO and SO_2.

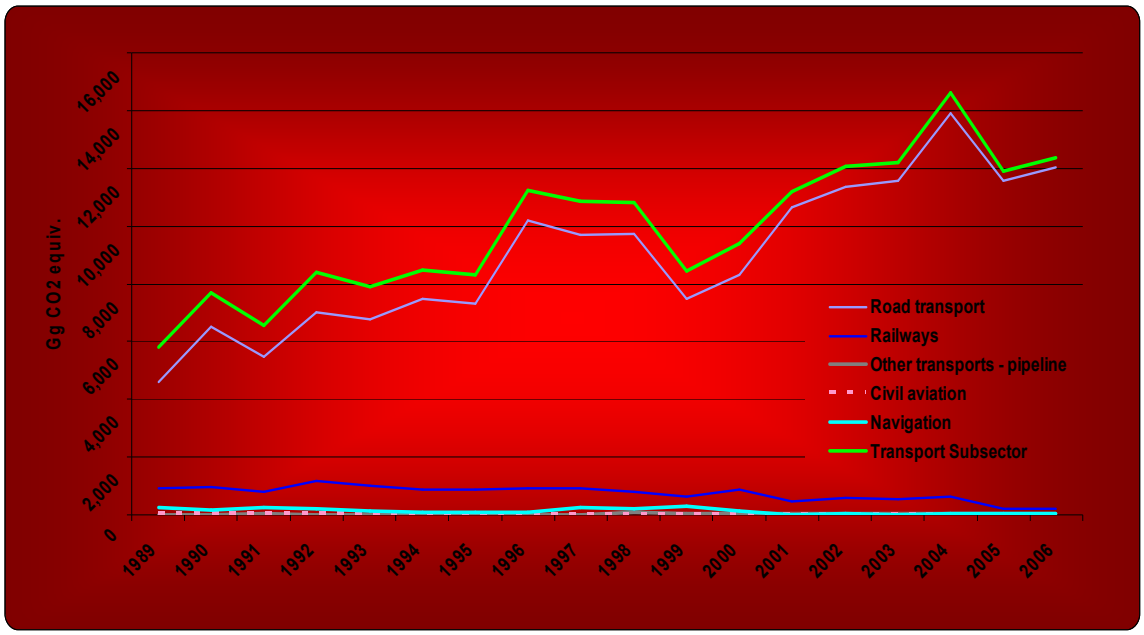
Within the fuel combustion sector, 13.13 % of the GHG emissions expressed in CO_2 equivalent are represented by the sub-sector 1.A.3 Transport. This sector includes emissions from road transportation, civil aviation, railways, navigation and pipeline transportation.

Figure 3. 11 The total GHG emissions from the transport sector



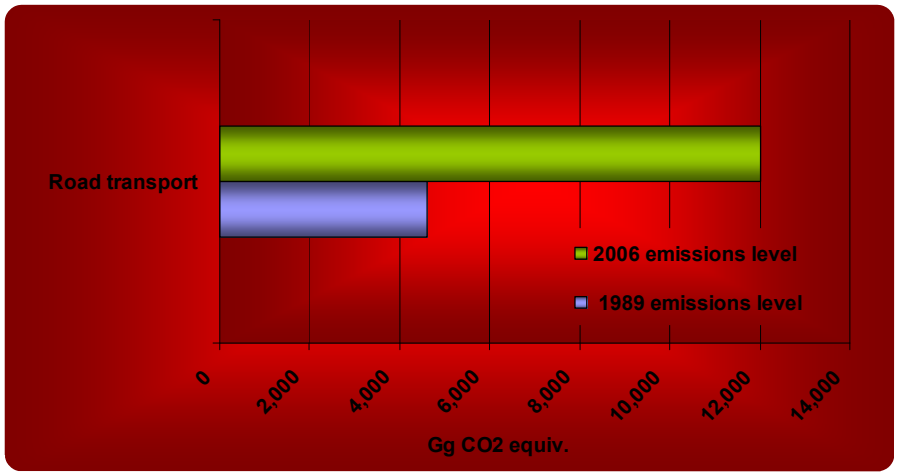
The emissions from road transportation represent 97.33% from the total GHG emissions from the transport sector. Therefore the overall increasing emission trend of the transport sub-sector is given by the emissions trend of the road mean of transport and is increasing in 2006 with 212.41% related to the level in the base year, reflecting the increasing trend of the registered motor vehicles with 231.8 % in 2006 comparing with the year 1990. There are decline periods, for example the year 1999 characterized by the highest value for the fuels consumer price index.

Figure 3. 12 The GHG emissions trends by transport categories



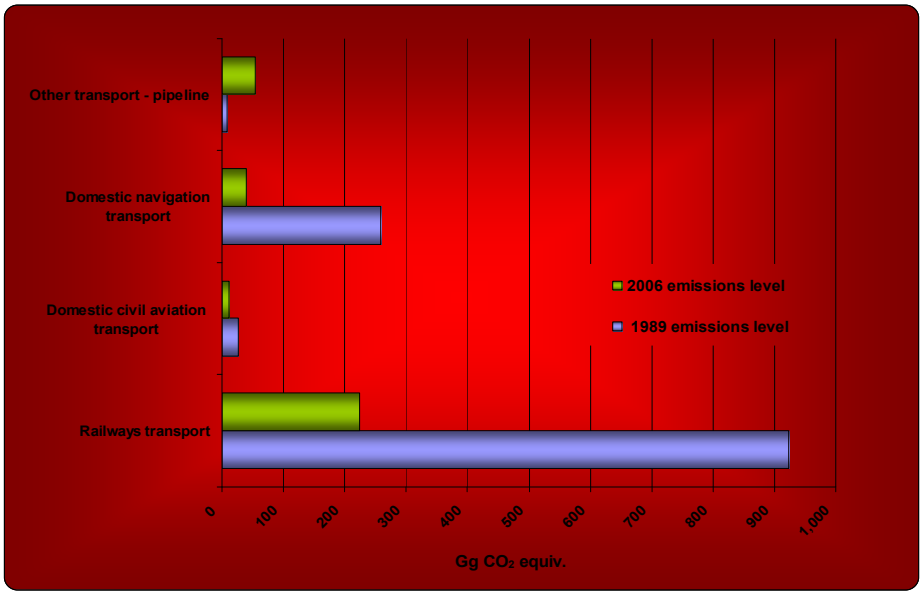
The GHG emissions in transport sector are increasing, as a consequence of increase of the mobility and of the number of vehicles.

Figure 3. 13 Road transport - Key category, both from level and trend views, 1989 and 2006



The CO_2 emissions from mobile combustion – road represent 6% of the total GHG emissions in 2006, including LULUCF and 8% of the total GHG emissions in 2006, excluding LULUCF.

Figure 3. 14 GHG emissions from the non-key transport category in 1989 and 2006



From the above figure it can be learned that emissions caused by railways transport, domestic civil aviation transport and domestic navigation transport decreased in 2006 comparing to 1989.

3.4.2 Methodological issues

Methodology

Emission data have been estimated using the amounts of fuel used in the transport sector. Even 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.

Activity data

Road transport, railways transport and pipeline transportation

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 – 2006. 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 from fuel consumption activity data for domestic and international operators, respectively, it was developed a new approach for the derivation of emissions from domestic and international civil aviation for the entire time series. For national operators, distances travelled in Romania in comparison to distances travelled abroad serve 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 2006 and for jet kerosene 1994 to 2006. 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 2006. All these data were provided by the Romanian Civil Aeronautical Authority through the Romanian Ministry of Transport.

Domestic navigation transport

For navigation it was used also new approaches in order to separate the fuels consumption into domestic and international. Since Romania has only 2 ports at the Black Sea 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. It was used the statistical indicator representing loaded goods, in thousands tones, for export and for domestic navigation, for the time series 1993-2006, to obtain the percentage that has been applied in order to disaggregate 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

They were 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).

3.4.3 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.

3.4.4 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.

Following the quality control activities some unconformities were found regarding two emission factors and their correction are described in the Improvements Lists and in the- *Chapter 3.4.5.- Source specific recalculation, including changes made in response to the review process.*

The unconformities noticed by the UNFCCC Secretariat ERT during the in-country review of the 2006 – 2nd submission of the NGHGI (8th – 13th October 2007), are described in the *Chapter 10 - Recalculations and improvements*.

The quantitative results following the solution found are described at the *Chapter 3.4.5 - Source specific recalculation, including changes made in response to the review process.*

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.

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

The inventory contains improvements in the emissions estimates due to recalculations made at the following levels:

- activity data
  - ✓ recalculation for all GHG emissions for entire time series, at the domestic civil aviation level, as a result of: the new approach for the separation of the fuels consumption values between domestic and international civil aviation and the replacement of the AD series provided by NIS with the AD series provided by the Romanian Civil Aeronautical Authority. There were used these new AD because the fuels consumption were given as total consumption

of the Romanian operators and total consumption of the foreign operators for each type of fuel and also distances travelled abroad and inside Romania by the national operators - information which allowed the disaggregation into domestic and international of the fuels consumption. This new approach for the separation of fuels consumption into domestic and international for civil aviation allowed the disaggregation of the GHG emissions into domestic and international and is explained at the chapter 3.4 Fuel consumption, Transport (CRF sector 1.A.3), sub-chapter 3.4.2. Methodological issues (Activity data). Based on these recalculations there were revised the estimates for CO_2, CH_4 and N_2O emissions from civil aviation (domestic and international respectively). The implications of the changes at the activity data level and their effects on the domestic civil aviation GHG emissions estimates are described in the Table 3.4, 3.5 and 3.6;

- ✓ recalculation for all GHG emissions for entire time series, at the navigation transport level, due to the separation of the liquid fuels and lubricants consumption values between domestic and international navigation. The new approaches for the deviation of fuels consumption into domestic and international, in order to disaggregate the GHG emissions into domestic and international, are presented at the chapter 3.4 Fuel consumption, Transport (CRF sector 1.A.3), sub-chapter 3.4.2. Methodological issues (Activity data). Based on these calculations there were revised the estimates for CO_2, CH_4 and N_2O emissions from navigation (domestic and international respectively). The implications of the changes at the activity data level and their effects on the domestic navigation GHG emissions estimates are described in Table 3.7, 3.8 and 3.9;

- Emission factors
  - ✓ recalculation for CO_2 emissions, at the railways transport level, for entire time series, due to the correction of the emission factor for diesel oil from 20 to 20.2 (as per the tab. 1-1, Reference Manual);

- ✓ recalculation for the CO2 emissions, at the navigation transport level, due to the correction of the emission factor for gas/diesel oil, from 20 to 20.2 (as per the Table 1-1 of Reference Manual).

Table 3. 4 Changes at the activity data level and their effects on the domestic civil aviation CO_2 emissions estimates

Year	Changes on AD Domestic civil aviation			Effects of changes on CO_2 emission estimates for domestic civil aviation		
	NIR 2007 - Fuel consumption (TJ)	**NIR 2008 - Fuel consumption (TJ)**		NIR 2007 CO_2 emissions [Gg]	**NIR 2008 CO_2 emissions [Gg]**	**Difference [%]**
1989	2,734.38	**362.88**		193.46	**25.69**	**-86.72**
1990	2,764.76	**348.55**		195.51	**24.67**	**-87.38**
1991	1,979.58	**334.21**		139.97	**23.66**	**-83.10**
1992	3,197.04	**319.87**		226.13	**22.64**	**-89.99**
1993	2,517.29	**305.54**		177.95	**21.63**	**-87.85**
1994	1,649.78	**412.13**		116.71	**29.17**	**-75.00**
1995	1,817.98	**353.50**		128.68	**25.02**	**-80.55**
1996	847.84	**216.57**		59.78	**15.33**	**-74.36**
1997	1,459.07	**249.72**		102.73	**17.68**	**-82.79**
1998	1,335.23	**145.58**		93.78	**10.30**	**-89.01**
1999	1,548.31	**187.24**		108.85	**13.25**	**-87.82**
2000	1,495.21	**109.31**		105.23	**7.74**	**-92.65**
2001	1,174.71	**117.11**		82.91	**8.29**	**-90.00**
2002	1,018.42	**118.47**		71.84	**8.39**	**-88.33**
2003	882.63	**200.46**		62.46	**14.19**	**-77.28**
2004	962.76	**189.93**		67.64	**13.44**	**-80.13**
2005	1,269.61	**204.27**		88.84	**14.46**	**-83.73**
2006		**168.03**			**11.89**	

Table 3. 5 Changes at the activity data level and their effects on the domestic civil aviation CH_4 emissions estimates

Year	Changes on AD Domestic civil aviation			Effects of changes on CH_4 emission estimates for domestic civil aviation		
	NIR 2007 - Fuel consumption (TJ)	**NIR 2008 - Fuel consumption (TJ)**		NIR 2007 CH_4 emissions [10^{-3} Gg]	**NIR 2008 CH_4 emissions [10^{-3} Gg]**	**Difference [%]**
1989	2,734.38	**362.88**		1.37	**0.18**	**-86.73**
1990	2,764.76	**348.55**		1.38	**0.17**	**-87.39**
1991	1,979.58	**334.21**		0.99	**0.17**	**-83.12**
1992	3,197.04	**319.87**		1.60	**0.16**	**-89.99**
1993	2,517.29	**305.54**		1.26	**0.15**	**-87.86**
1994	1,649.78	**412.13**		0.82	**0.21**	**-75.02**
1995	1,817.98	**353.50**		0.91	**0.18**	**-80.56**
1996	847.84	**216.57**		0.42	**0.11**	**-74.46**
1997	1,459.07	**249.72**		0.73	**0.12**	**-82.89**
1998	1,335.23	**145.58**		0.67	**0.07**	**-89.10**
1999	1,548.31	**187.24**		0.77	**0.09**	**-87.91**
2000	1,495.21	**109.31**		0.75	**0.05**	**-92.69**
2001	1,174.71	**117.11**		0.59	**0.06**	**-90.03**
2002	1,018.42	**118.47**		0.51	**0.06**	**-88.37**
2003	882.63	**200.46**		0.44	**0.10**	**-77.29**
2004	962.76	**189.93**		0.48	**0.09**	**-80.27**
2005	1,269.61	**204.27**		0.63	**0.10**	**-83.91**
2006		**168.03**			**0.08**	

Table 3. 6 Changes at the activity data level and their effects on the domestic civil aviation N_2O emissions estimates

Year	Changes on AD Domestic civil aviation			Effects of changes on N_2O emission estimates for domestic civil aviation		
	NIR 2007 - Fuel consumption (TJ)	**NIR 2008 - Fuel consumption (TJ)**		NIR 2007 N_2O emissions [10^{-3} Gg]	**NIR 2008 N_2O emissions [10^{-3} Gg]**	**Difference [%]**
1989	2,734.38	**362.88**		5.47	**0.73**	**-86.73**
1990	2,764.76	**348.55**		5.53	**0.70**	**-87.39**
1991	1,979.58	**334.21**		3.96	**0.67**	**-83.12**
1992	3,197.04	**319.87**		6.39	**0.64**	**-89.99**
1993	2,517.29	**305.54**		5.03	**0.61**	**-87.86**
1994	1,649.78	**412.13**		3.30	**0.82**	**-75.02**
1995	1,817.98	**353.50**		3.64	**0.71**	**-80.56**
1996	847.84	**216.57**		1.70	**0.43**	**-74.46**
1997	1,459.07	**249.72**		2.92	**0.50**	**-82.89**
1998	1,335.23	**145.58**		2.67	**0.29**	**-89.10**
1999	1,548.31	**187.24**		3.10	**0.37**	**-87.91**
2000	1,495.21	**109.31**		2.99	**0.22**	**-92.69**
2001	1,174.71	**117.11**		2.35	**0.23**	**-90.03**
2002	1,018.42	**118.47**		2.04	**0.24**	**-88.37**
2003	882.63	**200.46**		1.77	**0.40**	**-77.29**
2004	962.76	**189.93**		1.93	**0.38**	**-80.27**
2005	1,269.61	**204.27**		2.54	**0.41**	**-83.91**
2006		**168.03**			**0.34**	

Table 3. 7 Changes at the activity data level and their effects on the domestic navigation transport CO_2 emissions estimates

Year	Changes on AD – Domestic navigation transport				Effects of changes on CO_2 emission estimates for domestic navigation transport		
	NIR 2007 - Liquid fuel consumption (TJ)	**NIR 2008 - Liquid fuels consumption (TJ)**	NIR 2007 - Other liquid fuels consumption (TJ)	**NIR 2008 - Other liquid fuels consumption (TJ)**	NIR 2007 CO_2 emissions [Gg]	**NIR 2008 CO_2 emissions [Gg]**	**Difference [%]**
1989	21,132.65	**3,376.93**	NA	**NA**	1,607.34	**257.18**	**-84.00**
1990	13,995.60	**2,436.55**	NA	**NA**	1,059.66	**184.87**	**-82.55**
1991	17,555.72	**3,307.34**	NA	**NA**	1,334.30	**251.72**	**-81.13**
1992	12,924.25	**2,619.59**	NA	**NA**	974.45	**198.08**	**-79.67**
1993	5,504.33	**1,667.86**	98.21	**21.31**	417.56	**124.20**	**-70.26**
1994	5,288.42	**1,241.55**	79.70	**18.43**	401.98	**93.34**	**-76.78**
1995	4,196.43	**1,048.01**	71.05	**17.45**	318.13	**78.50**	**-75.32**
1996	6,033.81	**1,336.98**	63.23	**13.87**	456.76	**100.56**	**-77.98**
1997	13,951.02	**3,282.90**	184.94	**42.95**	1,063.75	**247.80**	**-76.70**
1998	13,432.73	**2,838.16**	104.48	**21.91**	1,020.97	**214.64**	**-78.98**
1999	8,886.46	**3,831.82**	80.69	**34.48**	676.25	**289.76**	**-57.15**
2000	4,578.21	**1,875.51**	46.97	**19.05**	345.36	**140.67**	**-59.27**
2001	540.59	**204.32**	7.79	**2.90**	39.72	**14.94**	**-62.39**
2002	1,454.80	**496.82**	12.86	**4.35**	107.04	**36.55**	**-65.85**
2003	558.63	**186.24**	13.86	**4.51**	41.47	**13.62**	**-67.16**
2004	912.34	**337.66**	17.87	**6.49**	67.57	**24.76**	**-63.36**
2005	1,783.29	**624.57**	7.85	**2.74**	130.28	**45.86**	**-64.80**
2006		**542.84**		**7.32**		**39.84**	

Table 3. 8 Changes at the activity data level and their effects on the domestic navigation transport CH_4 emissions estimates

Year	Changes on AD - Domestic navigation transport					Effects of changes on CH_4 emission estimates for domestic navigation transport		
	NIR 2007 - Liquid fuel consumption (TJ)	**NIR 2008 - Liquid fuels consumption (TJ)**	NIR 2007 - Other liquid fuels consumption (TJ)	**NIR 2008 - Other liquid fuels consumption (TJ)**		NIR 2007 CH_4 emissions [10^{-3} Gg]	**NIR 2008 CH_4 emissions [10^{-3} Gg]**	**Difference [%]**
1989	21,132.65	**3,376.93**	NA	**NA**		105.66	**16.88**	**-84.02**
1990	13,995.60	**2,436.55**	NA	**NA**		69.98	**12.18**	**-82.59**
1991	17,555.72	**3,307.34**	NA	**NA**		87.78	**16.54**	**-81.16**
1992	12,924.25	**2,619.59**	NA	**NA**		64.62	**13.10**	**-79.73**
1993	5,504.33	**1,667.86**	98.21	**21.31**		28.01	**8.34**	**-70.23**
1994	5,288.42	**1,241.55**	79.70	**18.43**		26.84	**6.21**	**-76.87**
1995	4,196.43	**1,048.01**	71.05	**17.45**		21.34	**5.24**	**-75.44**
1996	6,033.81	**1,336.98**	63.23	**13.87**		30.49	**6.68**	**-78.07**
1997	13,951.02	**3,282.90**	184.94	**42.95**		70.68	**16.41**	**-76.78**
1998	13,432.73	**2,838.16**	104.48	**21.91**		67.69	**14.19**	**-79.03**
1999	8,886.46	**3,831.82**	80.69	**34.48**		44.84	**19.16**	**-57.27**
2000	4,578.21	**1,875.51**	46.97	**19.05**		23.13	**9.38**	**-59.45**
2001	540.59	**204.32**	7.79	**2.90**		2.74	**1.02**	**-62.74**
2002	1,454.80	**496.82**	12.86	**4.35**		7.34	**2.48**	**-66.15**
2003	558.63	**186.24**	13.86	**4.51**		2.86	**0.93**	**-67.47**
2004	912.34	**337.66**	17.87	**6.49**		4.65	**1.69**	**-63.70**
2005	1,783.29	**624.57**	7.85	**2.74**		8.96	**3.12**	**-65.13**
2006		**542.84**		**7.32**			**2.71**	

Table 3. 9 Changes at the activity data level and their effects on the domestic navigation transport N_2O emissions estimates

Year	Changes on AD - Domestic navigation transport				Effects of changes on N_2O emission estimates for domestic navigation transport		
	NIR 2007 - Liquid fuel consumption (TJ)	**NIR 2008 - Liquid fuels consumption (TJ)**	NIR 2007 - Other liquid fuels consumption (TJ)	**NIR 2008 - Other liquid fuels consumption (TJ)**	NIR 2007 N_2O emissions [10^{-3} Gg]	**NIR 2008 N_2O emissions [10^{-3} Gg]**	**Difference [%]**
1989	21,132.65	**3,376.93**	NA	**NA**	12.68	**2.03**	**-84.02**
1990	13,995.60	**2,436.55**	NA	**NA**	8.40	**1.46**	**-82.59**
1991	17,555.72	**3,307.34**	NA	**NA**	10.53	**1.98**	**-81.16**
1992	12,924.25	**2,619.59**	NA	**NA**	7.75	**1.57**	**-79.73**
1993	5,504.33	**1,667.86**	98.21	**21.31**	3.36	**1.00**	**-70.23**
1994	5,288.42	**1,241.55**	79.70	**18.43**	3.22	**0.74**	**-76.87**
1995	4,196.43	**1,048.01**	71.05	**17.45**	2.56	**0.63**	**-75.44**
1996	6,033.81	**1,336.98**	63.23	**13.87**	3.66	**0.80**	**-78.07**
1997	13,951.02	**3,282.90**	184.94	**42.95**	8.48	**1.97**	**-76.78**
1998	13,432.73	**2,838.16**	104.48	**21.91**	8.12	**1.70**	**-79.03**
1999	8,886.46	**3,831.82**	80.69	**34.48**	5.38	**2.30**	**-57.27**
2000	4,578.21	**1,875.51**	46.97	**19.05**	2.78	**1.13**	**-59.45**
2001	540.59	**204.32**	7.79	**2.90**	0.33	**0.12**	**-62.74**
2002	1,454.80	**496.82**	12.86	**4.35**	0.88	**0.30**	**-66.15**
2003	558.63	**186.24**	13.86	**4.51**	0.34	**0.11**	**-67.47**
2004	912.34	**337.66**	17.87	**6.49**	0.56	**0.20**	**-63.70**
2005	1,783.29	**624.57**	7.85	**2.74**	1.07	**0.37**	**-65.13**
2006		**542.84**		**7.32**		**0.33**	

In the tables below there are presented the effects of recalculation on GHG emissions estimates for the entire transport category.

Table 3. 10 Changes at the AD level and effects of recalculation on CO_2 emission estimates for transport category

Year	Changes on AD Transport category			Effects of recalculation on CO_2 emission estimates for transport category		
	NIR 2007 Fuel consumption (TJ)	**NIR 2008 Fuel consumption (TJ)**		NIR 2007 CO_2 emissions [Gg]	**NIR 2008 CO_2 emissions [Gg]**	**Difference [%]**
1989	**100,083.55**	**79,956.34**		7,294.29	**5,784.55**	**-20.70**
1990	**120,982.13**	**107,006.86**		8,682.58	**7,645.90**	**-11.94**
1991	**107,665.09**	**91,771.35**		7,718.91	**6,527.55**	**-15.43**
1992	**129,858.90**	**116,677.08**		9,338.38	**8,369.75**	**-10.37**
1993	**116,402.82**	**110,256.38**		8,306.59	**7,866.44**	**-5.30**
1994	**124,079.97**	**118,715.76**		8,834.92	**8,447.26**	**-4.39**
1995	**122,027.97**	**117,344.01**		8,588.40	**8,253.73**	**-3.90**
1996	**162,372.52**	**156,981.20**		11,571.68	**11,179.87**	**-3.39**
1997	**163,432.99**	**151,370.57**		11,685.05	**10,792.85**	**-7.64**
1998	**163,159.83**	**151,271.13**		11,617.83	**10,735.60**	**-7.59**
1999	**124,689.24**	**118,192.84**		8,865.97	**8,390.07**	**-5.37**
2000	**135,655.52**	**131,519.94**		9,637.19	**9,343.71**	**-3.05**
2001	**158,237.72**	**156,836.05**		11,203.23	**11,108.19**	**-0.85**
2002	**170,584.44**	**168,713.64**		12,109.26	**11,981.17**	**-1.06**
2003	**171,209.98**	**170,141.55**		12,197.02	**12,126.14**	**-0.58**
2004	**206,508.02**	**205,142.63**		14,603.38	**14,512.36**	**-0.62**
2005	**168,399.83**	**166,167.92**		11,975.26	**11,818.53**	**-1.31**
2006		**172,081.27**			**12,281.90**	

Table 3. 11 Changes at the AD level and effects of recalculation on CH_4 emission estimates for transport category

Year	Changes on AD Transport category			Effects of recalculation on CH_4 emission estimates for transport category		
	NIR 2007 Fuel consumption (TJ)	**NIR 2008 Fuel consumption (TJ)**		NIR 2007 CH_4 emissions [Gg]	**NIR 2008 CH_4 emissions [Gg]**	**Difference [%]**
1989	**100,083.55**	**79,956.34**		0.82	**0.73**	**-10.97**
1990	**120,982.13**	**107,006.86**		1.28	**1.22**	**-4.63**
1991	**107,665.09**	**91,771.35**		1.13	**1.06**	**-6.35**
1992	**129,858.90**	**116,677.08**		1.23	**1.18**	**-4.31**
1993	**116,402.82**	**110,256.38**		1.26	**1.23**	**-1.66**
1994	**124,079.97**	**118,715.76**		1.42	**1.40**	**-1.50**
1995	**122,027.97**	**117,344.01**		1.63	**1.61**	**-1.03**
1996	**162,372.52**	**156,981.20**		1.82	**1.80**	**-1.32**
1997	**163,432.99**	**151,370.57**		1.78	**1.73**	**-3.08**
1998	**163,159.83**	**151,271.13**		1.84	**1.79**	**-2.93**
1999	**124,689.24**	**118,192.84**		1.45	**1.42**	**-1.82**
2000	**135,655.52**	**131,519.94**		1.53	**1.52**	**-0.94**
2001	**158,237.72**	**156,836.05**		1.93	**1.93**	**-0.12**
2002	**170,584.44**	**168,713.64**		2.01	**2.01**	**-0.26**
2003	**171,209.98**	**170,141.55**		1.87	**1.87**	**-0.12**
2004	**206,508.02**	**205,142.63**		2.51	**2.51**	**-0.13**
2005	**168,399.83**	**166,167.92**		1.86	**1.86**	**-0.16**
2006		**172,081.27**			**1.83**	

Table 3. 12 Changes at the AD level and effects of recalculation on N_2O emission estimates for transport category

Year	Changes on AD Transport category			Effects of recalculation on N_2O emission estimates for transport category		
	NIR 2007 Fuel consumption (TJ)	**NIR 2008 Fuel consumption (TJ)**		NIR 2007 N_2O emissions [10^{-3} Gg]	**NIR 2008 N_2O emissions [10^{-3} Gg]**	**Difference [%]**
1989	**100,083.55**	**79,956.34**		64.49	**49.09**	**-23.87**
1990	**120,982.13**	**107,006.86**		76.75	**64.98**	**-15.33**
1991	**107,665.09**	**91,771.35**		66.22	**54.38**	**-17.88**
1992	**129,858.90**	**116,677.08**		82.29	**70.35**	**-14.51**
1993	**116,402.82**	**110,256.38**		72.66	**65.87**	**-9.34**
1994	**124,079.97**	**118,715.76**		75.90	**70.95**	**-6.52**
1995	**122,027.97**	**117,344.01**		71.31	**66.45**	**-6.82**
1996	**162,372.52**	**156,981.20**		96.07	**91.96**	**-4.29**
1997	**163,432.99**	**151,370.57**		98.39	**89.46**	**-9.08**
1998	**163,159.83**	**151,271.13**		96.56	**87.76**	**-9.11**
1999	**124,689.24**	**118,192.84**		75.18	**69.37**	**-7.72**
2000	**135,655.52**	**131,519.94**		80.43	**76.01**	**-5.50**
2001	**158,237.72**	**156,836.05**		93.96	**91.64**	**-2.47**
2002	**170,584.44**	**168,713.64**		101.75	**99.37**	**-2.34**
2003	**171,209.98**	**170,141.55**		101.74	**100.14**	**-1.57**
2004	**206,508.02**	**205,142.63**		121.72	**119.82**	**-1.56**
2005	**168,399.83**	**166,167.92**		100.00	**97.47**	**-2.53**
2006		**172,081.27**			**101.74**	

3.4.6 Source specific planned improvements

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

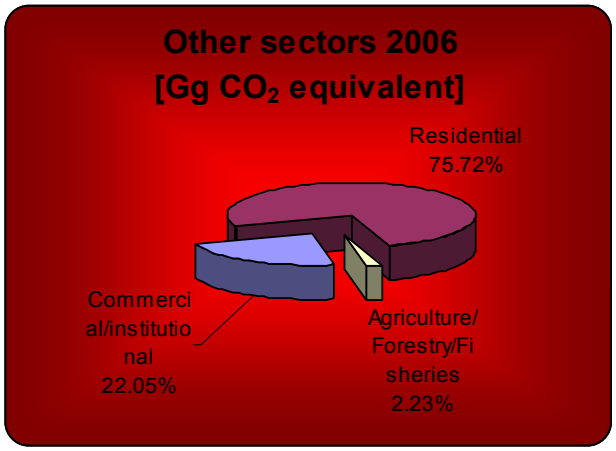
To improve the accuracy of the estimates by applying more accurate methods.

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

3.5.1 Description

In 2006 the "Other sectors" category was responsible for about 20.87% of the energy sector total GHG emissions (24,725.13 Gg CO_2 equivalent). Emissions from commercial/institutional, residential and agriculture/forestry/fishery sectors are included in this category.

Figure 3. 15 "Other sectors" structure in 2006



3.5.2 Methodological issues

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

- Categories: 60 ("other economy fields"), 58 ("population") and 59 ("agriculture and forestry"), for the 1992-2006 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.

3.5.3 Uncertainties and time series consistency

The uncertainty was estimated using the key categories ranking (stationary combustion gaseous, liquid, respectively solid fuels, for every GHG: CO_2, CH_4, and N_2O), because there was no data available regarding uncertainty estimates at this level of disaggregation. Therefore, the uncertainty associated with these categories is aggregated, along with the other categories (energy industries, manufacturing industries and constructions).

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:

- activity data uncertainty (5%) – based on information from the National Institute for Statistics (sampling error of the system aggregating statistical data of about 3-5%)
- emission factors (5% for CO_2 emissions, 20% for CH_4, and 200% for N_2O emission estimates) 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.

3.5.4 Source specific QA/QC and verification

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 this activities there were no inconformity pointed out.

The unconformities pointed out by the review team during the NGHGI 2006 review are described in chapter 10, quantitative effects of the recalculations following the unconformities are being described in every sector, in the "source specific recalculations" chapter.

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

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

No recalculations were performed in this GHG emissions category.

3.5.6 Source specific planned improvements

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

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

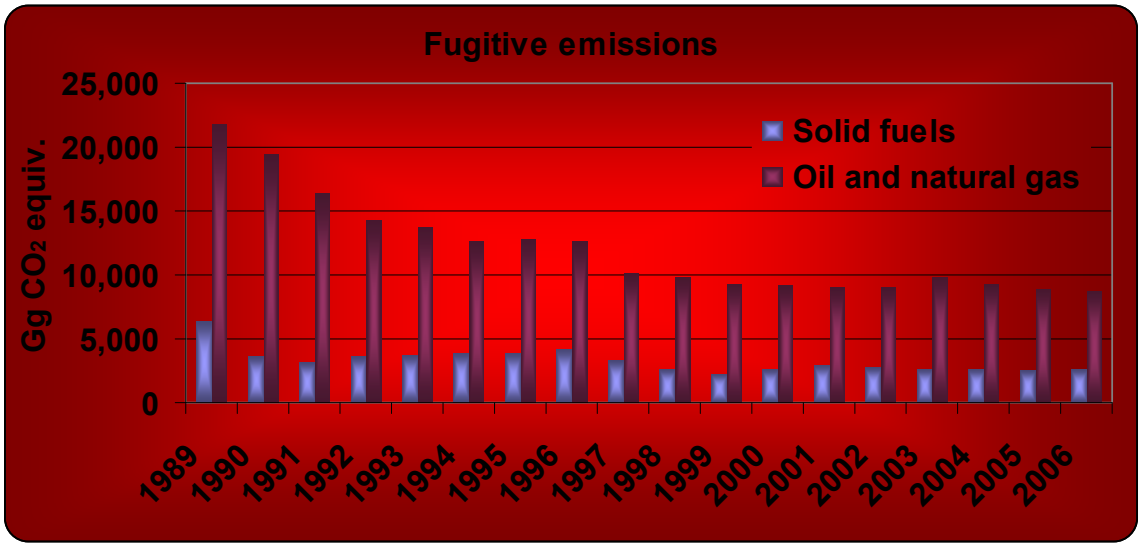
3.6.1 Description

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. 16 Fugitive emissions trend for the 1989-2006 period



3.6.2 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 1989-2006 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.

3.6.3 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.

3.6.4 Source specific QA/QC and verification

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 this activities there were no inconformity pointed out.

The unconformities pointed out by the review team during the NGHGI 2006 review are described in chapter 10, quantitative effects of the recalculations following the unconformities are being described in every sector, in the "source specific recalculations" chapter.

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

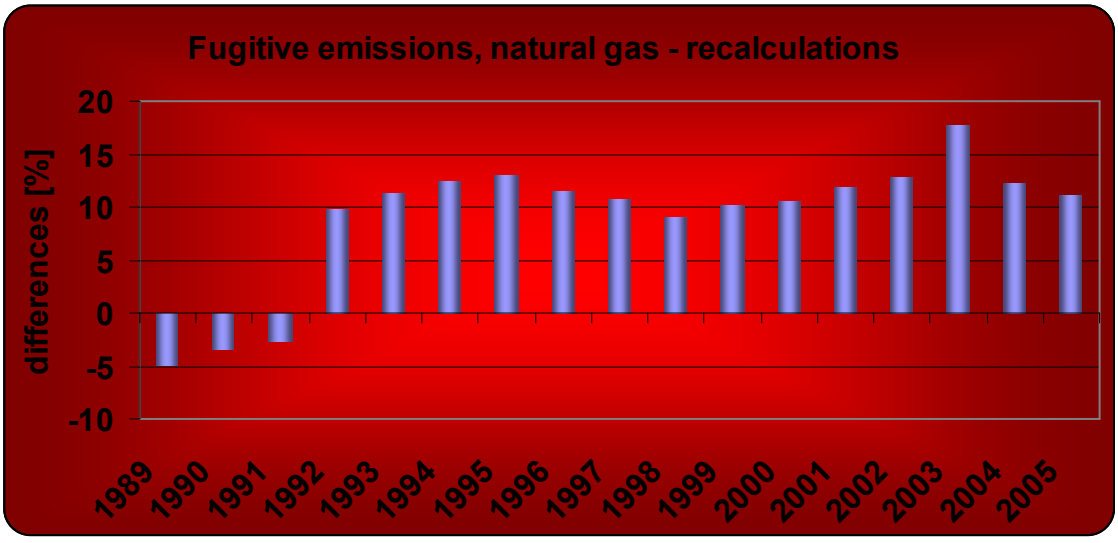
3.6.5 Source specific recalculation, including changes made in response to the review process

During the review process, an issue regarding fugitive emissions from natural gas, other leakage, fuel consumption aggregated. More specific: "The value of the consumption of natural gas used for the estimation of CH_4 emissions was different from the value used for transmission of natural gas. According to the 2006 inventory submission, consumption of natural gas used for the calculation of CH_4 emissions from the category "Other leakage – natural gas" was 1,382 PJ for 1989, whereas the value for consumption of natural gas used for estimating CH_4 emissions from transmission (1.B.2.b (iii)) in the same year was 1,353 PJ, the latter value corresponding to the apparent consumption of natural gas provided in the CRF table 1.A(b). CH_4 emissions from "other leakage" related to consumption of natural gas was therefore overestimated."

Therefore, the corresponding consumption has been recalculated: "The fuel consumption for the industrial sector and power plant was overestimated, and the consumption for the residential and commercial/institutional sector was underestimated. We have recalculated these consumptions, and the new sum of the two consumption categories is less than the value for transmission (1.B.2.b)."

The differences due to the recalculations mentioned before, are presented in the following figure.

Figure 3. 17 Recalculation for the fugitive emissions-natural gas estimates category - differences



3.6.6 Source specific planned improvements

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

4 INDUSTRIAL PROCESSES (CRF SECTOR 2)

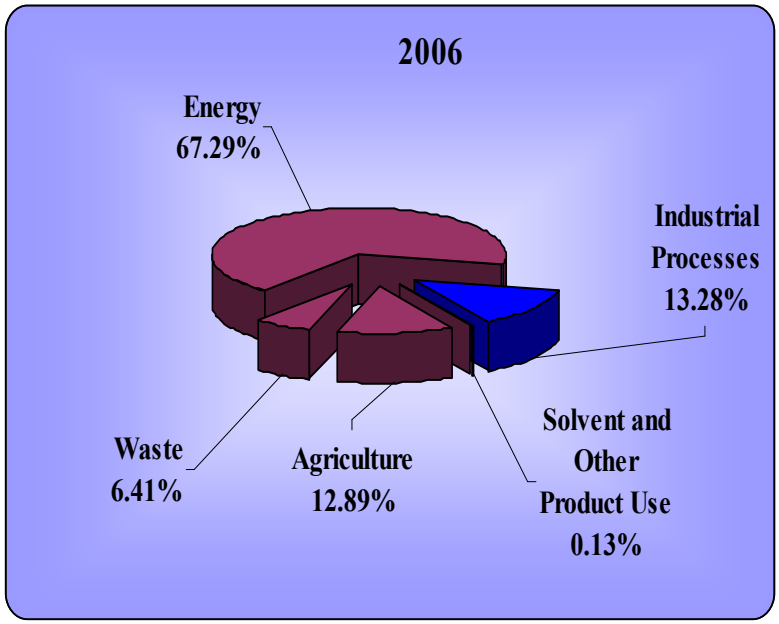
4.1 Overview of the sector

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.
In 2006 the GHG emissions from Industrial processes contributed to 13.28 % of the total GHG emissions in Romania.

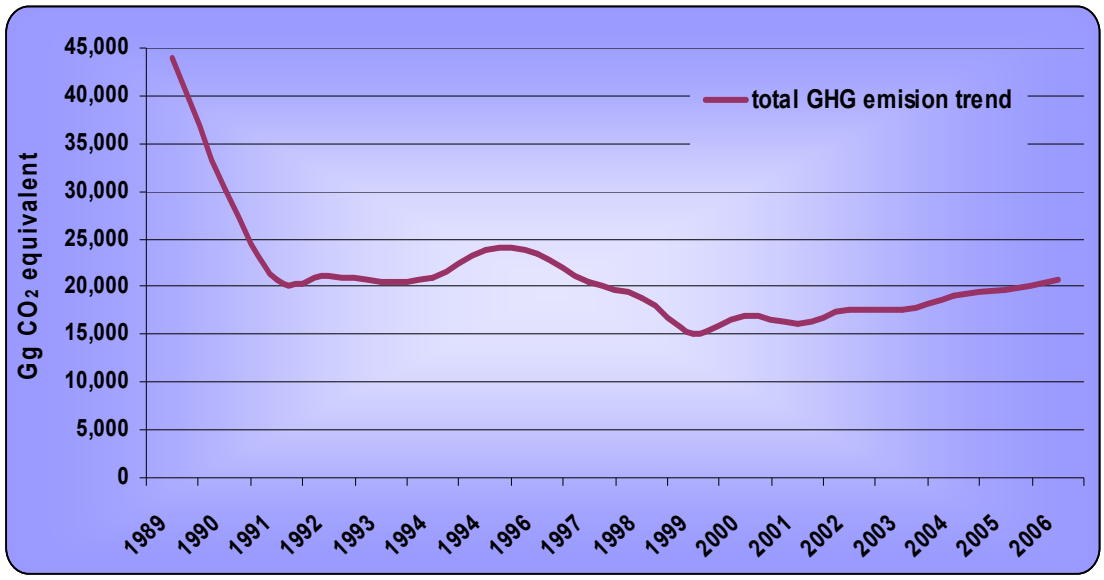
Figure 4. 1 The contribution of Industrial processes sector to the total GHG emissions in Romania, 2006



Emissions from this sector estimated in 2006 decreased by 53% compared with 1989 and increased by 5% compared with 2005. The decrease from 1990 to 2006 is caused by:

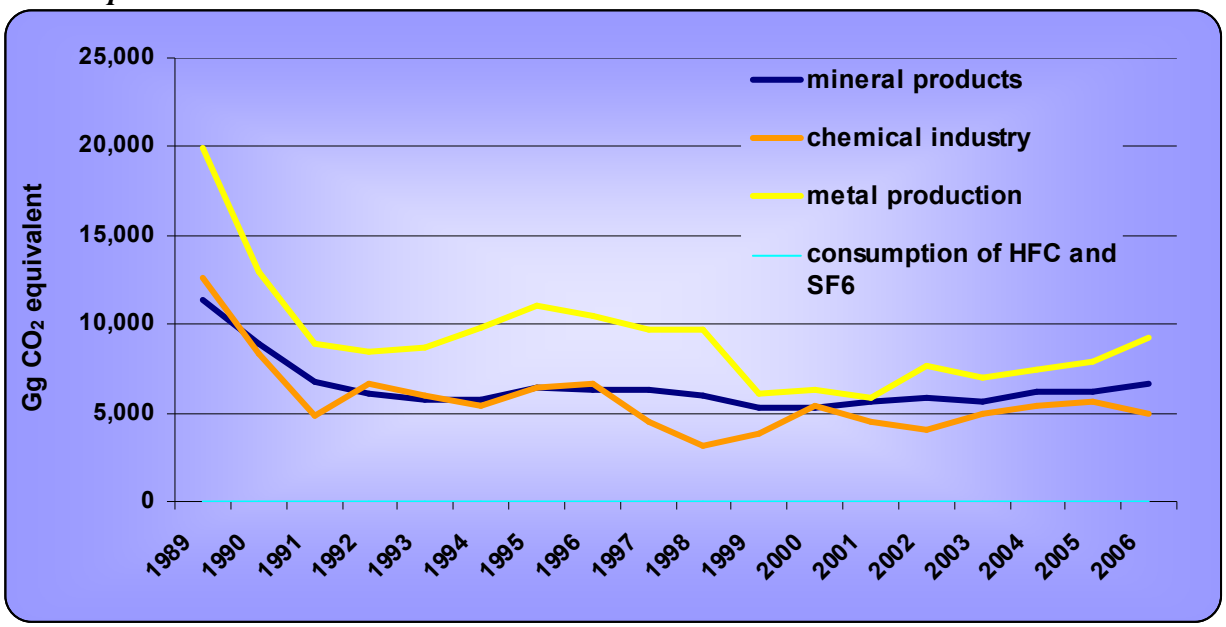
- the reduction of PFC emissions from production of aluminium due to changes in technologies;
- adipic acid is not produced anymore since 2001;
- many categories of industrial production have decreased: significant decrease in the iron and steel and ammonia productions.

Figure 4. 2 Total GHG emissions trend in Industrial Processes, for 1989–2006 period



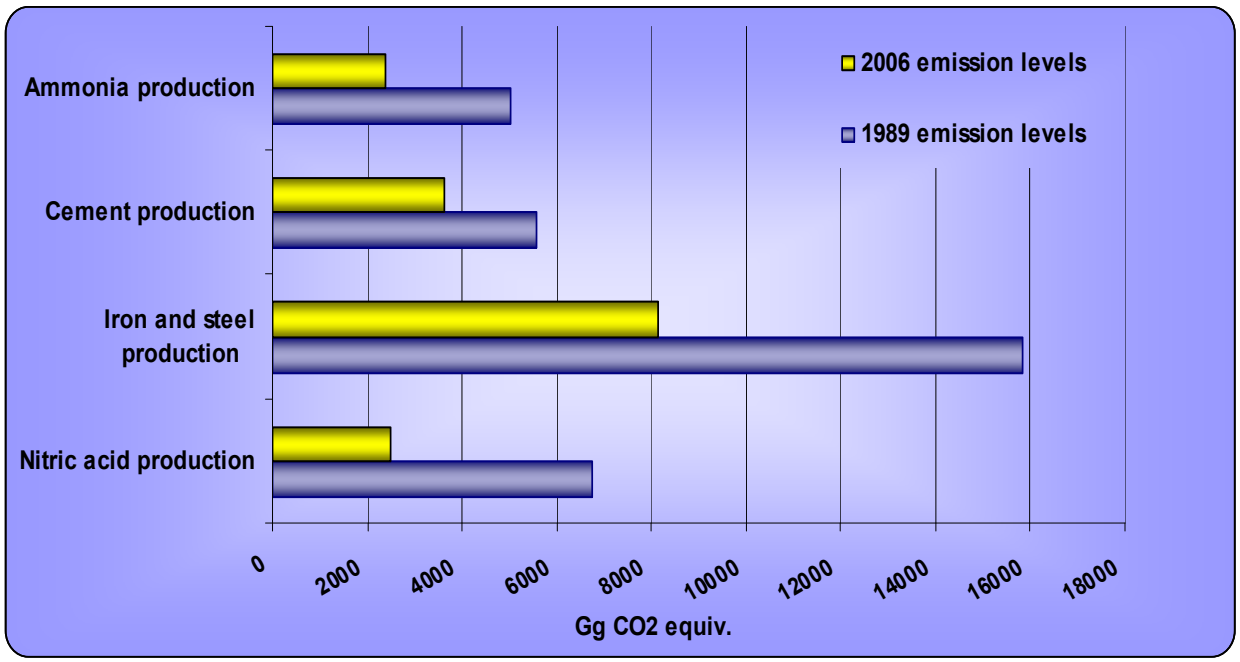
Metal production contributes to 44.29 % of the total GHG emissions from Industrial Processes in 2006. Mineral Product and Chemical Industry are the two other main contributing sectors with 31.97 % and 23.64 %, respectively, of the total GHG emissions in this sector. The contribution of Consumption of halocarbons and SF_6 to the overall sector is very low: 0.10 %.

Figure 4. 3 GHG emissions trends in Industrial Processes, by sub-sectors, for 1989–2006 period



In the base year, various industrial processes sub-sectors contributions were: Mineral products 25.85%, Chemical industry 28.77%, Metal production 45.39%, Consumption of halocarbons and SF_6 0%.

Figure 4. 4 Key categories in Industrial Processes: Iron and steel Production (2C.1), Nitric acid production (2B.2), Ammonia production (2B.1), Cement production (2A.1)- (both level and trend)



The Tier 1 key category analysis performed for 2006 has revealed the following key categories:

Table 4. 1 Key categories in industrial processes sector in 2006

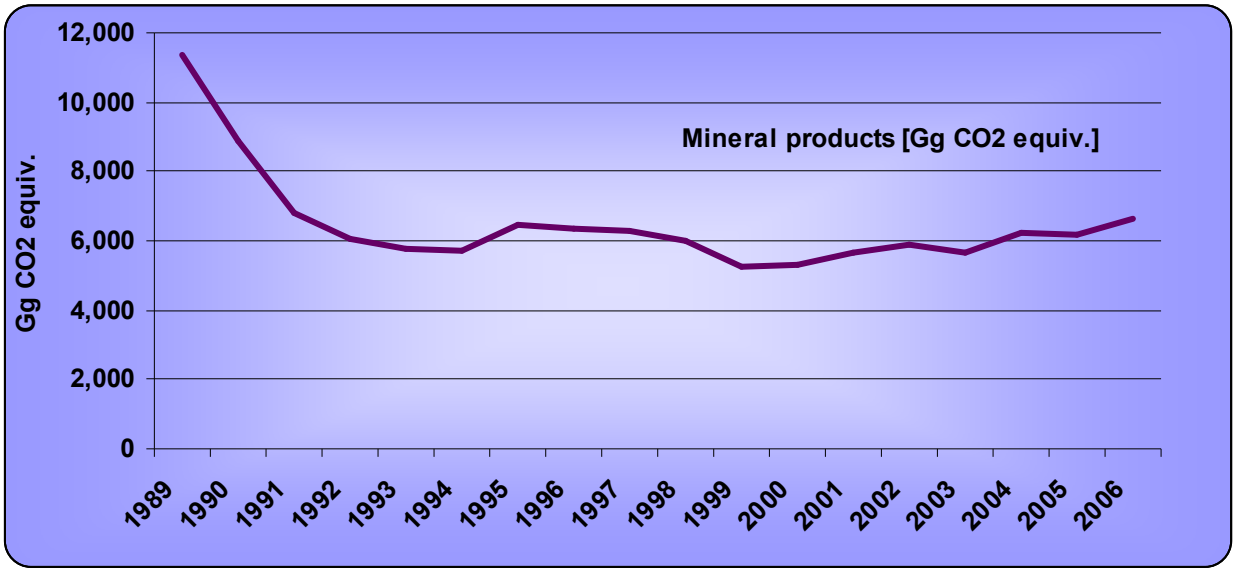
2006						
CRF categories	**Key category**	**GHG**	**Criteria (excluding LULUCF)**	**Contribution of Key categories in total GHG emissions [%]**	**Criteria (including LULUCF)**	**Contribution of Key categories in total GHG emissions [%]**
2C.1	Iron and steel production	CO_2	L,T	5.19	L,T	4.19
2.A.1	Cement production	CO_2	L,T	2.32	L,T	1.87
2B.2	Nitric acid production	N_2O	L,T	1.60	L,T	1.29
2B.1	Ammonia production	CO_2	L,T	1.51	L	1.22
2.A.2	Lime production	CO_2	L	1.26	-	-
2C.3	PFC emission from Aluminium production	PFC	T	0.39	T	0.31

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.

Figure 4. 5 GHG emissions trend in the Mineral Products sub-sector for 1989-2006 period [Gg CO_2 equiv.]



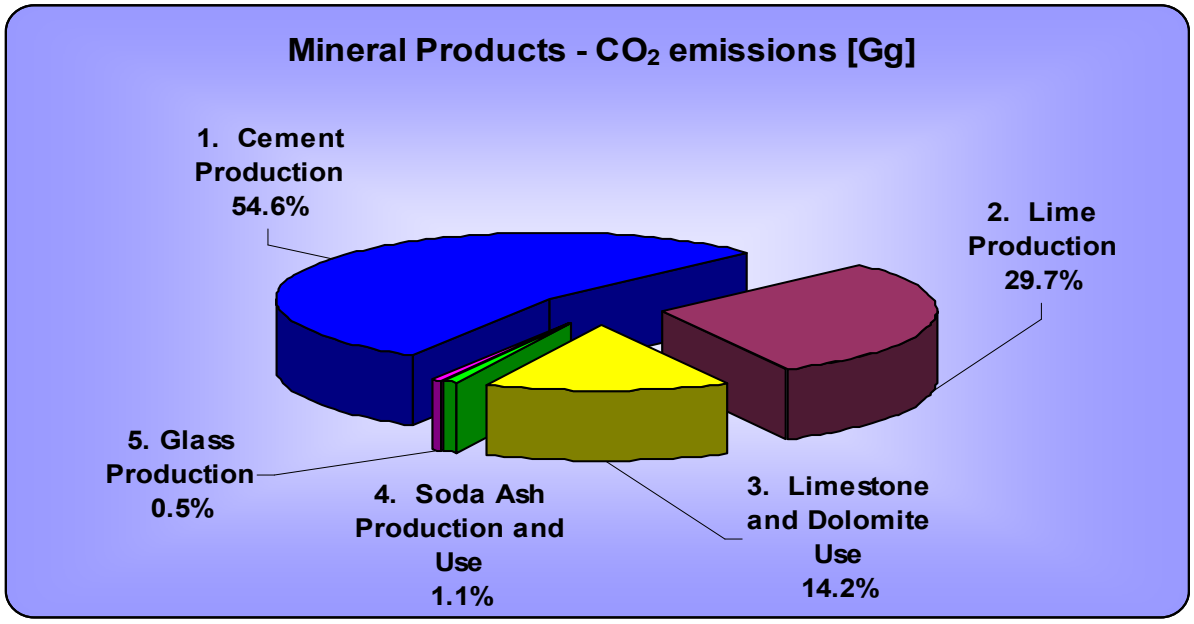
GHG emissions trend in the Mineral Products sub-sector for 1989-2006 period due to decrease recorded after 1989 in cement production, lime production, limestone and dolomite consumption, soda ash production and use, glass production, then the emissions are relatively stable from 1993 – 2006.

Mineral products sub-sector was responsible for 31.97 % of the Industrial Processes sector's GHG emissions in 2006.

Table 4. 2 CO_2 emissions in the Mineral products sector, in the year 2006

Sector	CO_2 emissions [Gg]
2A Mineral Products	**6,652.74**
2A1 Cement Production	3,631.21
2A2 Lime Production	1,974.76
2A3 Limestone and Dolomite Use	945.58
2A4 Soda Ash Production and Use	71.09
2A7.1 Glass production	30.10

Figure 4. 6 Structure of the Mineral products sub-sector, in 2006



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 Good Practice Guidance (Tier 2).

Activity data

There are nine cement-producing plants in Romania and all of them are covered in the inventory.

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;
- an average of 2% of MgO content was provide by all companies;
- 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.

Emission factors

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.

Emissions resulted from discarded cement kiln dust were calculated separately (this is the case for 1989-2003 period and 2006 year), taking into account its degree of calcinations and added to the CO_2 emissions resulted from calcinations. The correction factor for discarded amounts of dust for the period 1989-2003 and 2006 year varies between 1.02 and 1.13.

Table 4. 3 Clinker production data and CO_2 emissions from clinker production in the period 1989- 2006

Years	Clinker production [kt]	Emission factor [tCO_2/t clinker]	CO_2 Emissions [Gg]
1989	10,571.00	0.525	5,571.72
1990	8,379.00	0.525	4,415.68
1991	6,037.00	0.525	3,179.42
1992	5,488.00	0.525	2,886.60
1993	5,349.00	0.525	2,814.55
1994	5,232.00	0.525	2,752.45
1995	5,937.82	0.525	3,124.87
1996	6,037.50	0.525	3,178.71
1997	5,669.27	0.525	2,984.91
1998	5,497.25	0.525	2,896.51
1999	4,971.03	0.525	2,627.14
2000	5,005.78	0.525	2,638.26
2001	5,218.31	0.525	2,749.91
2002	4,984.02	0.525	2,624.48
2003	4,995.76	0.525	2,632.38
2004	5,661.24	0.525	2,972.15
2005	6,006.96	0.525	3,153.65
2006	6,916.22	0.525	3,631.21

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. 4 Cement production data and SO_2 emissions from cement production in the period 1989- 2006

Years	Cement production [kt]	Emission factor [kg SO_2 /t cement]	SO_2 Emissions[Gg]
1989	12,225	0.30	3.67
1990	9,468	0.30	2.84
1991	6,692	0.30	2.01
1992	6,271	0.30	1.88
1993	6,158	0.30	1.85
1994	5,998	0.30	1.80
1995	6,842	0.30	2.05
1996	6,956	0.30	2.09
1997	6,553	0.30	1.97
1998	6,577	0.30	1.97
1999	5,580	0.30	1.67
2000	6,058	0.30	1.82
2001	5,668	0.30	1.70
2002	5,680	0.30	1.70
2003	5,992	0.30	1.80
2004	6,239	0.30	1.87
2005	7,043	0.30	2.11
2006	8,253	0.30	2.48

The amount of cement produced is provided by the National Institute for Statistics and it is published in the annual statistical yearbook. 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. The method for calculating emissions of CO_2 from lime production is in line with the Good Practice Guidance (Table 3.4 from the Good Practice Guidance).

Activity data

The ADs necessary to estimate emissions from this source category (quicklime and dolomite lime) are provided by the National Institute for Statistics. Quicklime statistics are published in the annual statistical yearbook. 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.

Emission factors

CO_2 EF's were determined by stoichiometric ratio, default ranges of CaO/MgO in lime and proportion of CaO and CaO*MgO content in lime, for all time series (Table 3.4 from the Good Practice Guidance)

Table 4. 5 The default EFs used to estimate emissions from Lime production

EMISSION FACTORS FOR LIME PRODUCTION (TONNE CO_2/TONNE PRODUCT)	
Quicklime	**0.75**
Dolomite lime	**0.86**

Table 4. 6 Quicklime and dolomite lime production and CO_2 emissions from lime production in the period 1989-2006

Year	Quicklime production [kt]	Dolomite lime production [kt]	Total CO_2 emissions[Gg]
1989	3,983	956.73	3,810.03
1990	3,028	940.66	3,079.97
1991	2,324	924.59	2,538.15
1992	1,946	781.87	2,131.90
1993	1,738	813.31	2,002.94
1994	1,621	879.96	1,972.52
1995	1,763	1,017.17	2,197.02
1996	1,748	952.07	2,129.78
1997	1,688	973.10	2,102.86
1998	1,813	810.29	2,056.60
1999	1,623	727.37	1,842.79
2000	1,666	674.59	1,829.65
2001	1,790	673.30	1,921.54
2002	1,919	823.72	2,147.65
2003	1,936	673.97	2,031.61
2004	1,978	753.60	2,131.59
2005	1,791	742.82	1,982.07
2006	1,942	602.63	1,974.76

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 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).

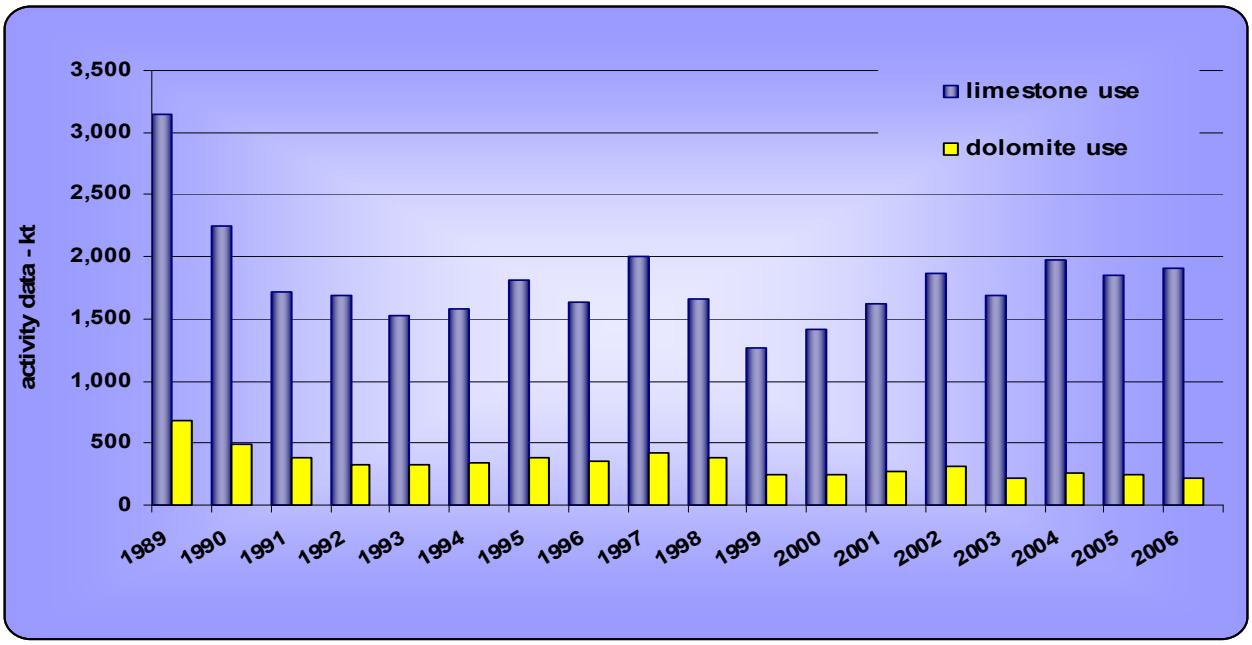
Table 4. 7 Amount of limestone and dolomite used, in the period 1989-2006

Year	Limestone use [kt]	Dolomite use[kt]	Total limestone and dolomite consumption [kt]
1989	3,148.71	680.25	3,828.96
1990	2,244.37	489.82	2,734.18
1991	1,721.15	386.38	2,107.53
1992	1,686.97	323.56	2,010.52
1993	1,525.06	330.00	1,855.06
1994	1,581.50	335.68	1,917.18
1995	1,815.20	382.20	2,197.39
1996	1,627.94	354.44	1,982.38
1997	1,998.44	421.28	2,419.72
1998	1,658.74	384.04	2,042.78
1999	1,266.55	241.16	1,507.70
2000	1,409.90	242.67	1,652.57
2001	1,625.49	272.75	1,898.24
2002	1,866.83	318.93	2,185.77
2003	1,691.33	219.23	1,910.56
2004	1,980.60	264.64	2,245.24
2005	1,847.96	247.15	2,095.11
2006	1,909.00	221.43	2,130.43

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 1989-2006



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

Methodology

The IPCC methodology has been followed for estimating the CO_2 emissions from soda ash production. CO_2 emissions from soda ash production were estimated using the quantity of trona utilized. A surrogate method was used to determine the soda ash consumption for the missing years (1989-1993).

Activity data

Soda ash production data are annually reported in the statistical yearbook. Data on soda ash used are not published and the National Institute for Statistics did not provide any data for the periods 1989-1993. A surrogate method was used to determine the soda ash consumption for the missing years. This method correlates the production data to the consumption figures.

Emission factors

The default emission factors used are 0.097 tonnes CO_2 / tonne of trona and 415 kg CO_2 / tonne of soda ash use, are used.

Figure 4. 8 Soda ash consumption related to soda ash production in the period 1989-2006

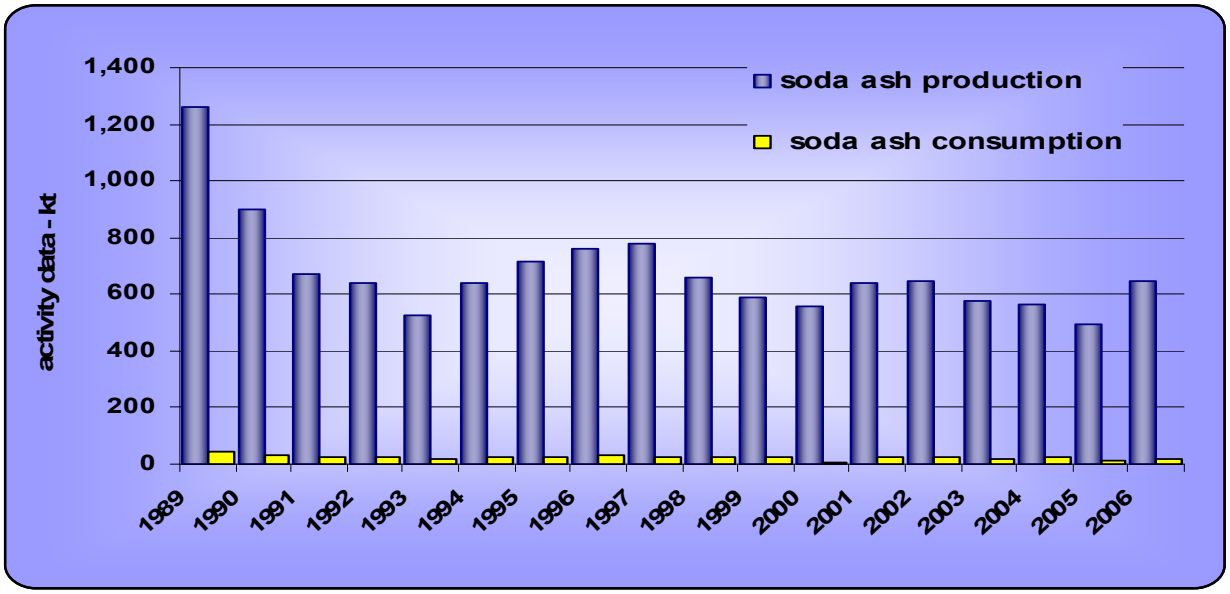


Table 4. 8 Soda ash consumption related to soda ash production and CO_2 emissions in the period 1989-2006

Year	Soda ash production [kt]	Soda ash use [kt]	CO_2 emissions from soda ash production and use - [Gg]
1989	1,263.61	47.25	142.18
1990	898.31	33.59	101.08
1991	669.47	25.03	75.33
1992	642.47	24.02	72.29
1993	527.33	19.72	59.33
1994	638.20	23.86	71.81
1995	716.38	24.92	79.83
1996	761.86	30.00	86.35
1997	777.47	25.81	86.13
1998	656.68	26.00	74.49
1999	589.87	24.22	67.27
2000	555.76	8.44	57.41
2001	641.42	25.09	72.63
2002	645.31	25.30	73.10
2003	577.08	19.82	64.20
2004	565.71	23.97	64.82
2005	491.80	14.02	53.52
2006	643.89	20.80	71.09

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

Emissions are estimated for both container glass and flat glass. The CO_2 emissions are estimated using the EMEP/CORINAIR methodology

Activity data

Emissions are estimated for both container glass and flat glass, based on national statistics. Flat glass production is reported in the Statistical Yearbook in square meters. The conversion in tones was made using the thickness (2 mm) and the glass density (2.5 tones/cubic meter).

Emission factors

The NMVOC emissions are estimated according to the revised methodology (default 4.5 kg NMVOC/ tonne of product). The CO_2 emissions are estimated using the EMEP/CORINAIR methodology, using: 150 kg CO_2/t of container glass and 140 kg CO_2/t of flat glass.

Table 4. 9 Container glass and flat glass production and CO_2 emissions in the period 1989-2006

Year	Container glass production [kt]	Flat glass production [kt]	CO_2 Emissions [Gg]
1989	377	380	109.75
1990	307	285	85.95
1991	250	230	69.70
1992	206	220	61.70
1993	165	230	56.95
1994	181	190	53.75
1995	203	210	59.85
1996	216	205	61.10
1997	180	155	48.70
1998	160	155	45.70
1999	95	135	33.15
2000	129	150	40.35
2001	134	160	42.50
2002	134	210	49.50
2003	265	175	64.25
2004	152	160	45.20
2005	133	110	35.35
2006	126	80	30.10

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 were used for the entire time series 1989-2006.

By expert judgment the uncertainty related to the activity data for CO_2 emissions is 2% (based on clinker production data) and the uncertainty associated with emission factor for CO_2 is 6% in line with the IPCC Good Practice Guidance (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 6%.

Lime production (2.A.2)

There are inconsistencies in time series in the statistical data set for dolomite lime production and for this reason a linear extrapolation was used to estimate dolomite lime production for 1989-1991.
The same emission factors were used for the entire period.

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 ± 2% in line with the IPCC Good Practice Guidance (Table 3.4).
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 8%.

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 were used for the entire time series 1989-2006.
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 31%.

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

There are inconsistencies in time series in the statistical data set for soda ash use and for this reason a surrogate method was used to estimate soda ash use for the missing years (1989-1993).
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%.
The same emission factors were used for the entire period.

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 31%.

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 were used for the entire time series 1989-2006.
By expert judgment 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 20%.
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 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 Energy sector expert, activity results of these actions being mentioned in Check lists. After these activities unconformities have not been notified.

As a result of the recommendations by the ERT during the in-country review of the 2006 - 2nd submission of the NGHGI (which did not included potential problems), 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.

4.2.5 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 sub-sector (2A)			
Years	**2007 submission (CO_2 emissions) [Gg]**	**2008 submission (CO_2 emissions) [Gg]**	**Differences [%]**
1989	10,907.81	11,343.59	4.00
1990	8,593.83	8,903.84	3.61
1991	6,533.18	6,804.21	4.15
1992	5,646.24	6,049.10	7.13
1993	5,435.53	5,762.21	6.01
1994	5,389.00	5,706.51	5.89
1995	6,100.19	6,442.56	5.61
1996	6,063.97	6,341.30	4.57
1997	5,897.05	6,302.87	6.88
1998	5,746.92	5,986.33	4.17
1999	5,041.23	5,242.66	4.00
2000	5,047.98	5,301.77	5.03
2001	5,296.38	5,631.90	6.33
2002	5,511.15	5,868.26	6.48
2003	5,417.32	5,641.20	4.13
2004	5,862.81	6,211.47	5.95
2005	5,852.36	6,155.59	5.18
2006		6,652.74	

Lime production (2.A.2)

Changes in the lime production sub-sector, because the CO_2 EF's for dolomitic lime and quicklime used for determined CO_2 emissions for the last submission (0.79 tonne CO_2/tonne quicklime and 0.91 tonne CO_2/ tonne dolomite lime) have been replaced with the default CO_2 EF's determined by stoichiometric ratio, default ranges of CaO/MgO in lime and proportion of CaO and CaO*MgO content in lime (0.75 tonne CO_2/t quicklime and 0.86 tonne CO_2/ tonne dolomite lime), for all time series (Table 3.4 from the Good Practice Guidance);

Table 4. 11 Recalculations of CO_2 [Gg] emissions in the lime production sector

Years	2007 submission(CO_2 emissions) - [Gg]	2008 submission(CO_2 emissions) - [Gg]	Differences [%]
1989	4,017.19	3,810.03	-5.16
1990	3,248.12	3,079.97	-5.18
1991	2,677.34	2,538.15	-5.20
1992	2,248.84	2,131.90	-5.20
1993	2,113.13	2,002.94	-5.21
1994	2,081.36	1,972.52	-5.23
1995	2,318.40	2,197.02	-5.24
1996	2,247.30	2,129.78	-5.23
1997	2,219.04	2,102.86	-5.24
1998	2,169.63	2,056.60	-5.21
1999	1,944.08	1,842.79	-5.21
2000	1,930.02	1,829.65	-5.20
2001	2,026.81	1,921.54	-5.19
2002	2,265.60	2,147.65	-5.21
2003	2,142.75	2,031.61	-5.19
2004	2,248.39	2,131.59	-5.19
2005	2,090.85	1,982.07	-5.20
2006		1,974.76	

Limestone and dolomite consumption (2.A.3)

Changes in activity data for the limestone and dolomite consumption sub-sector, because, the method, used in previous submission to estimate AD (limestone and dolomite consumption related with pig iron production), has been replaced with a method who estimate the amount of limestone and dolomite used the iron and steel production, pulp and paper production, sugar mills production, ceramics plants, for all time series;

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

Years	2007 submission(CO_2 emissions) - [Gg]	2008 submission(CO_2 emissions) - [Gg]	Differences [%]
1989	1,066.97	1,709.91	60.26
1990	743.00	1,221.16	64.36
1991	531.39	941.61	77.20
1992	376.81	896.60	137.94
1993	391.57	828.44	111.57
1994	429.63	855.98	99.23
1995	517.24	980.99	89.66
1996	490.51	885.36	80.50
1997	558.27	1,080.26	93.50
1998	560.59	913.03	62.87
1999	369.59	672.31	81.91
2000	381.94	736.11	92.73
2001	404.53	845.32	108.96
2002	498.48	973.54	95.30
2003	512.70	848.76	65.55
2004	532.98	997.70	87.19
2005	516.79	930.99	80.15
2006		945.58	

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

Changes in activity data for the soda ash production and used sub-sector because for 2003-2006 the data source was changed for the soda ash use. The data regarding soda ash use, obtained from surrogate method for the missing years (used in previous submission) has been replaced with data provided by National Institute for Statistics, for the 2003-2005 period.

Table 4. 13 Recalculations of CO_2 [Gg] emissions in the soda ash production and used sub-sector

Years	2007 submission(CO_2 emissions) - [Gg]	2008 submission(CO_2 emissions) - [Gg]	Differences [%]
1989	19.61	19.61	0
1990	13.94	13.94	0
1991	10.39	10.39	0
1992	9.97	9.97	0
1993	8.18	8.18	0
1994	9.90	9.90	0
1995	10.34	10.34	0
1996	12.45	12.45	0
1997	10.71	10.71	0
1998	10.79	10.79	0
1999	10.05	10.05	0
2000	3.50	3.50	0
2001	10.41	10.41	0
2002	10.50	10.50	0
2003	9.26	8.22	-11.17
2004	9.21	9.95	8.07
2005	8.00	5.82	-27.27
2006		8.63	

4.2.6 Source specific planned improvements

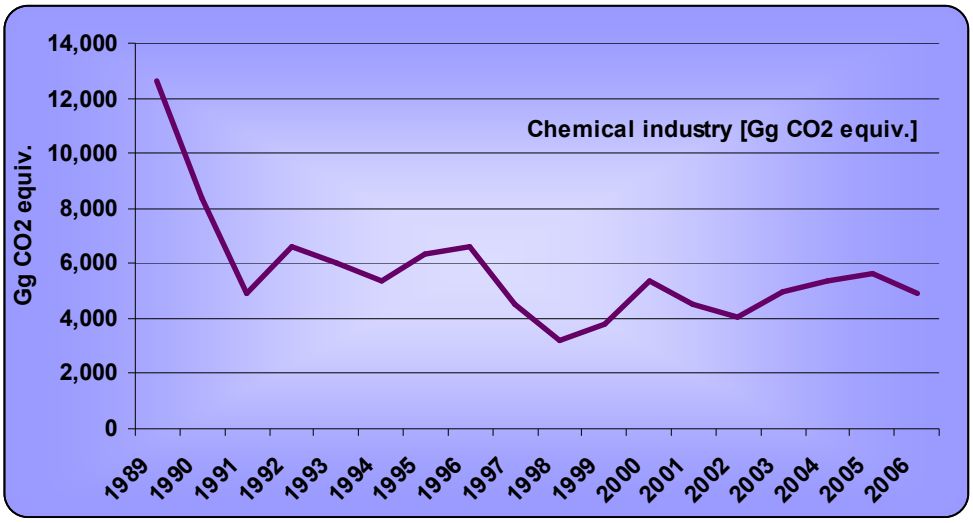
More detailed data will try to be obtained, in respect to the IPCC GPG 2000 provisions.

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 23.64 % of the total Industrial Processes sector's GHG emissions in 2006.

Figure 4. 9 GHG emissions trend in the Chemical Industry sub-sector for 1989-2006 period [Gg CO_2 equiv.]



GHG emissions trend in the Chemical Industry sub-sector for 1989-2006 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. 14 GHG emissions from the Chemical industry sector, in 2006 (Gg)

Source	CO_2	CH_4	N_2O
B. Chemical Industry	**2,385.20**	**1.27**	**8.09**
2B1 Ammonia Production	2,370.00	-	-
2B2 Nitric Acid Production	-	-	8.09
2B3 Adipic Acid Production	NA	NA	NA
2B4.2 Carbide Production	15.20	-	-
2B5 Others (ethylene, carbon black, methanol, sulphuric acid)	-	1.27	-

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 reported in the statistical yearbook.

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 1.5t/t.

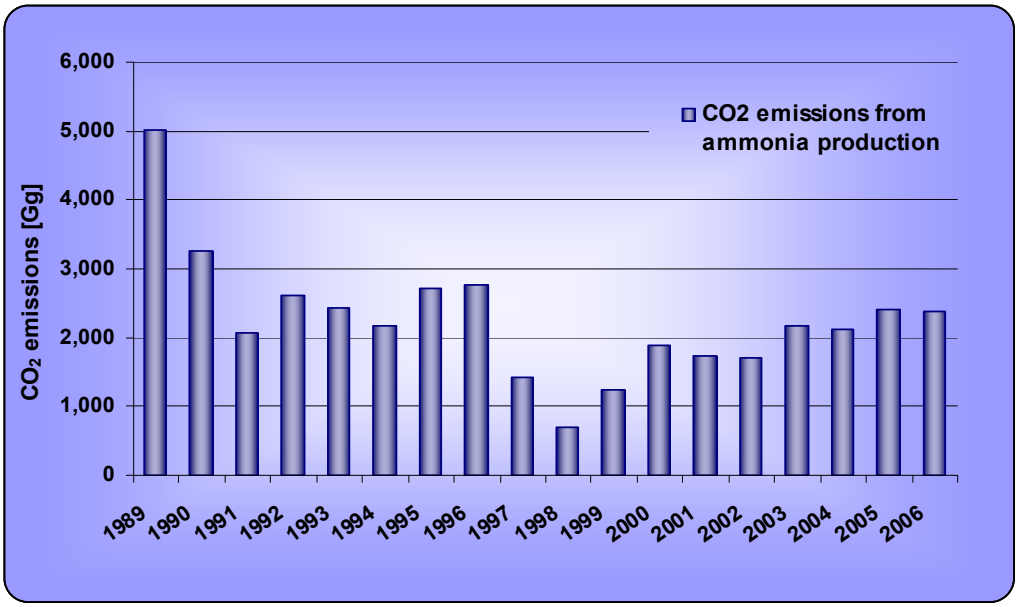
Although emissions from ammonia production are decreasing along the time series, this source category results in a large amount of CO_2 emissions. Within the chemical industry sector, ammonia production is one of the most important GHG emission source. The lowest level of emissions was recorded in 1998, 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. 15 Ammonia production related to the CO_2 emissions in the period 1989-2006

Year	Ammonia production[kt]	CO_2 emissions [Gg]
1989	3,337	5,005.50
1990	2,178	3,267.00
1991	1,375	2,062.50
1992	1,733	2,599.50
1993	1,620	2,430.00
1994	1,443	2,164.50
1995	1,809	2,713.50
1996	1,841	2,761.50
1997	951	1,426.50
1998	468	702.00
1999	834	1,251.00
2000	1,255	1,882.50
2001	1,155	1,732.50
2002	1,137	1,705.50
2003	1,445	2,167.50
2004	1,422	2,133.00
2005	1,611	2,416.50
2006	1,580	2,370.00

Figure 4. 10 The trend of CO_2 emissions from ammonia production in the period 1989 –2006



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 by an emission factor, which reflects the process type.

Activity data

Specific questionnaires have been sent to the local EPA in order to collect information on nitric acid production. 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;
- older (pre 1975) plants, without NSCR – this is the case of only one factory. According to IPCC Good Practice Guidance, N_2O emission factor for old plants 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 at plant level, considering the process type and the NOx abatement technology installed at each plant:

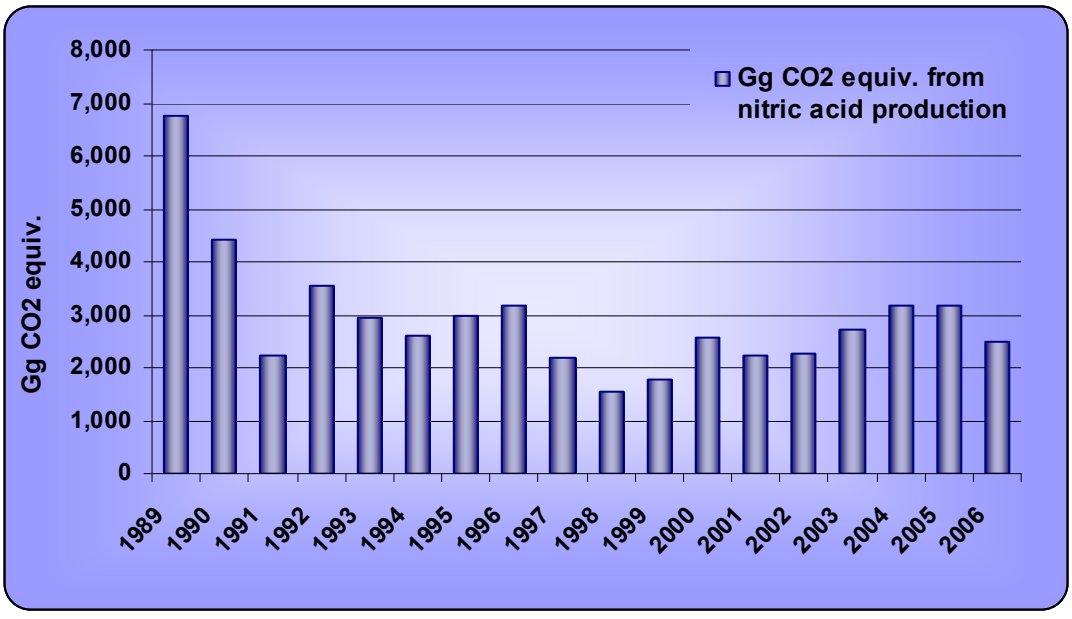
- extended absorption – used at two factories (at one plant it was used since 1997 with 86% reduction efficiency for NOx and at the other plant it was installed in 2004 with 98% reduction efficiency for NOx.;
- selective catalytic reduction (SCR) – used at one single plant since 2003, with 80% reduction efficiency for NOx and 90.3% reduction efficiency for NOx for 2006.

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

Table 4. 16 Nitric acid production related to the N_2O and NO_x emissions in the period 1989-2006

Years	Nitric acid production[kt]	N_2O emission[Gg]	NO_x emissions[Gg]
1989	2,328.38	21.81	18.17
1990	1,505.35	14.20	11.82
1991	772.65	7.22	6.01
1992	1,235.55	11.49	9.57
1993	1,013.53	9.49	7.90
1994	920.55	8.40	7.00
1995	1,060.18	9.63	8.02
1996	1,135.82	10.26	8.55
1997	774.15	7.02	4.99
1998	554.31	5.04	3.94
1999	622.62	5.74	4.30
2000	892.99	8.25	5.88
2001	775.96	7.23	5.40
2002	805.14	7.33	5.46
2003	967.64	8.76	2.93
2004	1,094.63	10.22	3.14
2005	1,118.55	10.24	3.83
2006	878.11	8.09	2.55

Figure 4. 11 The trend of CO_2 emissions from nitric acid production, 1989- 2006 [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. 17 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

The methodology for estimating emissions of CO_2 from calcium carbide production is in line with the IPCC Methodology.

Activity data

National Institute for Statistics provided annually the amount of carbide production.

Emission factors

The default EF of 0.76 tonnes CO_2/tonne carbide was used to estimate CO_2 emissions from calcium carbide production.

Table 4. 18 Carbide production related to the CO_2 emissions in the period 1989-2006.

Years	Carbide production[kt]	CO_2 emissions[Gg]
1989	180	136.80
1990	129	98.04
1991	94	71.44
1992	87	66.12
1993	84	63.84
1994	67	50.92
1995	90	68.40
1996	106	80.56
1997	91	69.16
1998	73	55.48
1999	54	41.04
2000	55	41.80
2001	53	40.28
2002	53	40.28
2003	45	34.20
2004	63	47.88
2005	34	25.84
2006	20	15.20

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

Methodology

The methodology for estimating the emissions from these production processes is in line with the IPCC Methodology.

Activity data

National Institute for Statistics provided annually the amount of these production processes.

Emission factors

SO_2, CO, NMVOC, CH_4 and NOx emissions resulted from these production processes are estimated using the default EF recommended in the methodology.

Table 4. 19 EF used to estimate GHG emissions from 2B5 Other productions

EF [kg/t]	CH_4	NO_x	NMVOC	CO	SO_2
Carbon black	**11**	**0.4**	**40**	**10**	**3.1**
Ethylene	**1**	**-**	**1.4**	**-**	**-**
Methanol	**2**	**-**	**-**	**-**	**-**
Propylene	**-**	**-**	**1.4**	**-**	**-**
Polystyrene	**-**	**-**	**5.4**	**-**	**-**
Polyethylene-low density	**-**	**-**	**3**	**-**	**-**
Polyethylene-high density	**-**	**-**	**6.4**	**-**	**-**
Sulphuric acid	**-**	**-**	**-**	**-**	**17.5**

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 1989-2006.

By expert judgment 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%.

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 43%.

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 1989-2006.

By expert judgment the uncertainty related to the activity data for N_2O emissions is 3% and the uncertainty associated with emission factor for N_2O emissions is 40%.

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%.

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 1989-2006.

By expert judgment 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%.

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%.

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 1989-2006.

By expert judgment 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%.

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%.

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 1989-2006.

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 31%.

4.3.3 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 Energy 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 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.

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.

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

No recalculations have been made relative to previous submission

4.3.5 Source specific planned improvements

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

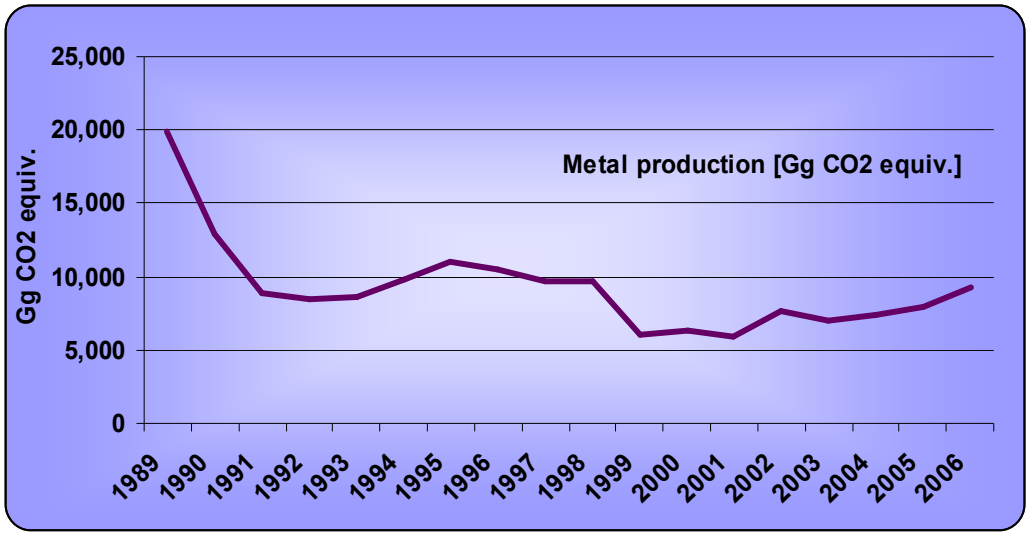
4.4 Source category Metal Production (CRF sector 2.C)

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 44.29 % of the total Industrial Processes sector's GHG emissions in 2006.

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 2006 CO_2 emissions from production of iron and steel contributed 5.19 % to total greenhouse gas emissions). In the base year, these emissions accounted for 5.62 % 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 1989-2006 period [Gg CO_2 equiv.]



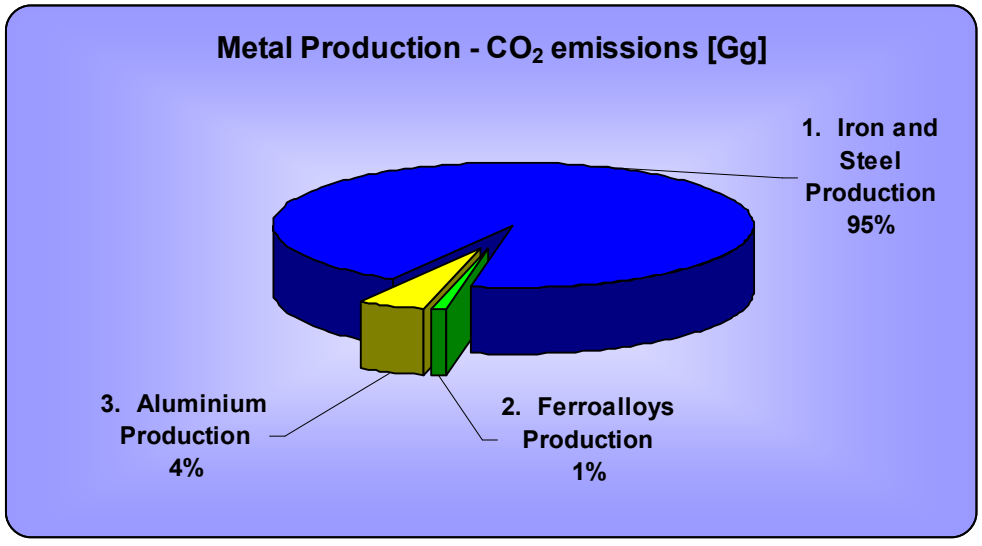
GHG emissions trend in the Chemical Industry sub-sector for 1989-2006 period due:

- to decrease recorded after 1989 in Iron and steel production;
- the reduction of PFC emissions from production of aluminium due to changes in technologies, starting with 1997.

Table 4. 20 GHG emissions from Metal Production sub-sector, in the year 2006 [Gg CO_2 equiv.]

Sector	CO_2	PFCs
C. Metal Production	**8,608.52**	**609.63**
2.C.1. Iron and Steel Production	8,128.88	-
2.C.2. Ferroalloys Production	95.90	-
2.C.3. Aluminium Production	383.74	609.63

Figure 4. 13 Structure of the Metal Production sub-sector, in 2006



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 this submission the data regarding sinter consumption were provided by the Ministry of Economy and Finance because the data used in preview submission (provided by the economic agents) are inconsistent.

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

Mass of reducing agent: plant level data

Carbon content in ore: 0 (default value)

Carbon content in iron: 3.6% (country specific value)

- **CO_2 emissions from steel production**

CO_2 emissions resulted from steel productions were estimated based on IPCC GPG formula*:*

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: 0.7 % (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. 21 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 1989-2006

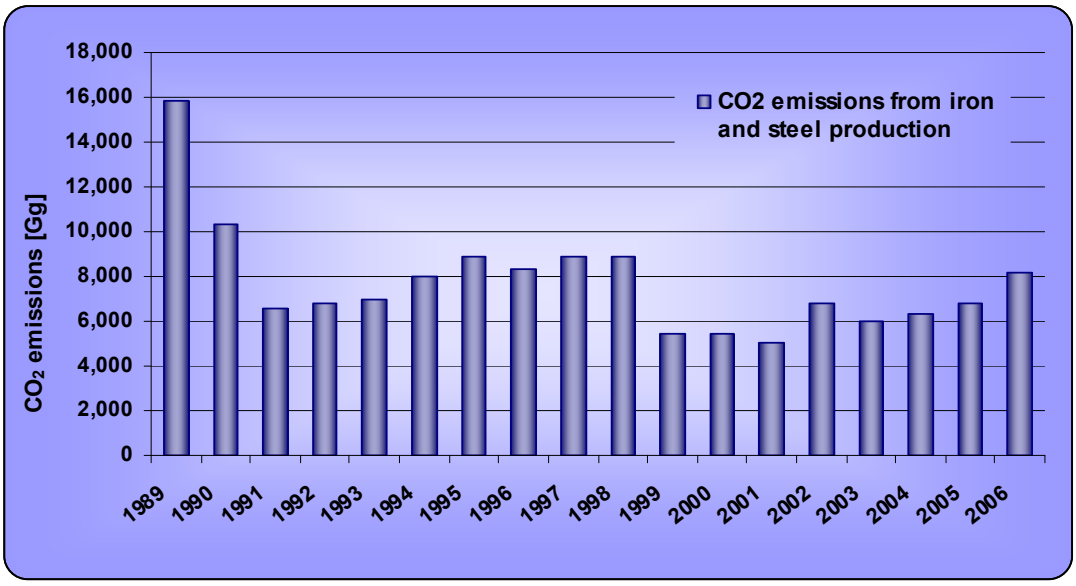


Table 4. 22 The input data used to calculate emissions from iron and steel industry in the period 1989-2006

Years	Steel [kt]	Pig iron[kt]	Sinter[kt]	Coke[kt]
1989	13,275.76	8,495.13	13,626	4,484.93
1990	8,945.10	5,916.27	11,357	2,885.29
1991	6,468.62	4,231.80	7,290	1,813.25
1992	4,897.53	3,001.32	4,761	1,983.73
1993	4,972.66	3,118.79	3,346	2,022.36
1994	5,517.10	3,421.21	5,452	2,328.98
1995	6,231.27	4,118.57	6,671	2,556.48
1996	5,730.19	3,905.79	5,449	2,393.18
1997	6,407.26	4,445.20	6,532	2,542.14
1998	6,200.00	4,463.69	6,514	2,533.64
1999	4,204.65	2,943.28	4,164	1,526.91
2000	4,511.35	3,041.54	3,875	1,535.27
2001	4,768.66	3,221.86	6,185	1,391.06
2002	5,396.14	3,969.80	6,979	1,887.50
2003	5,643.70	4,084.94	6,609	1,639.11
2004	6,181.81	4,246.50	6,601	1,713.40
2005	6,259.50	4,117.92	6,600	1,892.03
2006	6,225.15	3,984.65	5,780	2,330.18

Ferroalloys production (2.C.2)

Methodology

The CO_2 emissions within the production of ferroalloys are calculated based on the production volume (Tier 1b).

Activity data

The national statistics reports the ferroalloys production for the period 1992-2006.

National Institute for Statistics did not provide any data for the periods 1989-1991. For the last submission a linear extrapolation method was used to determine the ferroalloys production for the missing years. For this submission activity data for the beginning of the time series (1989-1991) were provided by Ministry of Economy and Finance.

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.

Emission factors

For the most recent years, ferroalloys are reported in a disaggregate manner, by type of products: ferromanganese and silicon manganese. The main production type is silicon manganese (94% in 2006, 99% in 2004, 99.8% in 2003 and 100% in 2002).

The IPCC defaults EF for silicon manganese (1.7 tonnes CO_2/ tonne product) has been considered for estimating emissions for this source category for the entire period, except 2005 year.

For the year 2005, ferroalloys are also reported in a disaggregate manner, by type of products: ferromanganese and silicon manganese, but ferromanganese represents 16% from the total production and silicon manganese represents 84% from the total production so for this reason, in 2005 the CO_2 emissions were calculated used the IPCC defaults EF for ferromanganese (1.6 tonnes CO_2/ tonne product) and silicon manganese (1.7 tonnes CO_2/ tonne product).

Table 4. 23 Ferroalloys production and CO_2 emission in the period 1989-2006

Years	Ferroalloys production [kt]	CO_2 emissions[Gg]
1989	199.00	338.30
1990	142.00	241.40
1991	109.00	185.30
1992	86.40	146.88
1993	65.90	112.03
1994	98.78	167.93
1995	119.93	203.88
1996	132.22	224.77
1997	84.65	143.90
1998	64.21	109.16
1999	0.58	0.98
2000	72.62	123.45
2001	78.13	132.82
2002	84.72	144.02
2003	142.10	241.57
2004	194.95	331.41
2005	119.58	201.43
2006	56.41	95.90

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 Good Practice Guidance (Tier 1 Method)

Activity data

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

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). Starting with 1997, the technology was changed to CWPB (Centre Worked Pre-baked).

Emission factors

The quantity of CO_2 released was estimated from the production of primary aluminium**,** considering that, in case of using pre-baked anodes, approximately 1.5 tonnes of CO_2 is emitted for each tonne of primary aluminium produced.

Table 4. 24 Emission factors for NO_x, CO and SO_2 from aluminium production

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

There are no emissions measurement data available in the plant, so emissions of CF_4 and C_2F_6 were estimated by multiplying annual primary aluminium production with the default emission factors provided by Good Practice Guidance and considering the changes in technologies over the period.

Table 4. 25 EF used for the calculation of PFC emissions from aluminium production

Technology	CF_4	C_2F_6
	[Kg/tonne Al produced]	
SWPB	**1.7**	**0.17**
CWPB	**0.31**	**0.04**

Table 4. 26 The PFC emissions from aluminium production in the period 1989-2006

Year	2008 submission		
	Emissions CF_4 [tones]	Emissions C_2F_6 [tones]	Emissions CO_2 [Gg]
1989	451.42	45.14	398.31
1990	285.15	28.51	251.60
1991	261.73	26.17	230.94
1992	182.22	18.22	160.79
1993	189.94	18.99	167.60
1994	200.94	20.09	177.30
1995	239.02	23.90	210.90
1996	238.39	23.83	210.35
1997	50.74	6.54	245.55
1998	54.16	6.98	262.07
1999	53.96	6.96	261.11
2000	53.71	6.93	259.90
2001	55.74	7.19	269.73
2002	57.84	7.46	279.89
2003	61.39	7.92	297.07
2004	66.72	8.61	322.89
2005	74.09	9.56	358.51
2006	79.31	10.23	383.74

Table 4. 27 . Aluminium production (AD) in the period 1989-2006

Years	Aluminium production [kt]
1989	265.54
1990	167.73
1991	153.96
1992	107.19
1993	111.73
1994	118.20
1995	140.60
1996	140.23
1997	163.70
1998	174.71
1999	174.08
2000	173.27
2001	179.82
2002	186.60
2003	198.05
2004	215.25
2005	239.01
2006	255.82

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

Methodology

The default IPCC methodology for estimation the emissions from this sub-sector 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 1989-2006.

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%.

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 1989-2006.

By expert judgment 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%.

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 38%.

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 1989-2006.

By expert judgment the uncertainty related to the activity data for CO_2 emissions is 3% and the uncertainty associated with the default emission factor for CO_2 emissions is 30%.

More uncertainties are related to calculation PFC emissions because smelter specific parameters were not available, so default emissions factor were used to calculate PFC emissions.

By expert judgment the uncertainty related to the activity data for PFC emissions is 30% and the uncertainty associated with the default emission factor for PFC emissions is 50%.
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 30% and for PFC is 58%.

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 Energy sector expert, activity results of these actions being mentioned in Check lists. After these activities unconformities have not been notified.
As a result of the recommendations by the ERT during the in-country review of the 2006 – 2nd submission of the NGHGI (which did not included potential problems), there were developed new approaches which are presented in the sub- sectors "Source specific recalculation" and Chapter 10.
AD on primary aluminium production obtained from national statistics 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 (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 and Finance. The differences in AD generated by these three different data sources are negligible (there are some small differences in the first part of the time series).
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. 28 The effects of recalculations in Metal production sub-sector (2.C)

The effects of recalculations in Metal production sub-sector (2C)			
Years	**2007 submission (CO_2 emissions) [Gg]**	**2008 submission (CO_2 emissions) [Gg]**	**Differences [%]**
1989	16,306.85	16,567.74	1.60
1990	10,637.43	10,784.47	1.38
1991	6,915.08	6,993.97	1.14
1992	7,121.44	7,132.42	0.15
1993	7,242.62	7,253.44	0.15
1994	8,326.58	8,337.87	0.14
1995	9,266.22	9,277.07	0.12
1996	8,735.69	8,745.34	0.11
1997	9,273.68	9,283.21	0.10
1998	9,237.65	9,249.11	0.12
1999	5,751.89	5,667.20	-1.47
2000	5,833.30	5,839.22	0.10
2001	5,480.26	5,452.61	-0.50
2002	7,186.89	7,192.47	0.08
2003	6,554.88	6,563.08	0.13
2004	6,931.24	6,941.43	0.15
2005	7,608.13	7,365.40	-3.19
2006		8608.52	

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

Changes in activity data regarding the pig iron production, because for this submission were identified 3 new pig iron producers and they were not taken into account in the last submission, for all time series (2.C.1.2);

Changes in activity data for the sinter use because the data source was changed (the data used in preview submission, provided by the economic agents, are inconsistent and were replaced with data from Ministry of Economy and Finance, for all time series (2.C.1.3);

Changes in activity data for the coke used in blast furnace for the production of pig iron, because for this submission were identified 3 new pig iron producers and they were not taken into account in the last submission, for all time series (2.C.1.4);

Changes in CO_2 emission because 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 (2.C.1.5).

Table 4. 29 Recalculations of CO_2 [Gg] emissions in the Iron and steel production sub-sector

Years	2007 submission(CO_2 emissions) - [Gg]	2008 submission(CO_2 emissions) - [Gg]	Differences [%]
1989	15,802.97	15,831.13	0.18
1990	10,273.16	10,291.47	0.18
1991	6,564.36	6,577.73	0.20
1992	6,813.77	6,824.75	0.16
1993	6,962.99	6,973.81	0.16
1994	7,981.35	7,992.64	0.14
1995	8,851.44	8,862.29	0.12
1996	8,300.57	8,310.23	0.12
1997	8,884.23	8,893.76	0.11
1998	8,869.92	8,877.88	0.09
1999	5,399.59	5,405.11	0.10
2000	5,449.95	5,455.86	0.11
2001	5,043.63	5,050.06	0.13
2002	6,762.98	6,768.56	0.08
2003	6,016.24	6,024.44	0.14
2004	6,276.95	6,287.14	0.16
2005	6,793.92	6,805.46	0.17
2006		8,128.88	

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

Ferroalloys production sub-sector (2.C.2.)

Changes in activity data for the ferroalloys production sub-sector because for 1989-1991 the data source was changed for this submission (for preview submission linear extrapolation method was used to determine the ferroalloys production for the missing years 1989-1991. For this submission activity data for the beginning of the time series were provided by Ministry of Economy and Finance).
Changes in activity data for the ferroalloys production sub-sector for 1998-1999/2001/2005 do to wrong manipulation on activity data.

Table 4. 30 Recalculations of CO_2 [Gg] emissions in the Ferroalloys production sub-sector

Years	2007 submission(CO_2 emissions) - [Gg]	2008 submission(CO_2 emissions) - [Gg]	Differences [%]
1989	105.57	338.30	220.45
1990	112.67	241.40	114.25
1991	119.78	185.30	54.70
1992	146.88	146.88	0.00
1993	112.03	112.03	0.00
1994	167.93	167.93	0.00
1995	203.88	203.88	0.00
1996	224.77	224.77	0.00
1997	143.90	143.90	0.00
1998	105.66	109.16	3.32
1999	91.19	0.98	-98.93
2000	123.45	123.45	0.00
2001	166.90	132.82	-20.42
2002	144.02	144.02	0.00
2003	241.57	241.57	0.00
2004	331.41	331.41	0.00
2005	455.69	201.43	-55.80
2006		95.90	

4.4.6 Source specific planned improvements

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.

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 in the Statistical Yearbook.

In the food and drink production (2.D.2) sub-sector the AD was provided by the National Institute for 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

NMVOCs are emitted during the production of alcoholic beverages, bread making and other food products. The emission factors are those indicated in the revised methodology.
Emissions of NO_x, NMVOC, CO and SO_2 are emitted during the production of pulp and paper.
The emission factors are those indicated in the revised methodology.

Table 4. 31 Emission factors used to estimate emissions from CRF sector 2.D

Activity		**NOx**	**CO**	**NMVOC**	**SO_2**	**Units**
Pulp	**Kraft type**	**1.5**	**5.6**	**3.7**	**7**	**Kg/t**
	Sulphite type	**-**	**-**	**-**	**30**	**Kg/t**
Wine		**-**	**-**	**0.08**	**-**	**Kg/hL**
Beer		**-**	**-**	**0.035**	**-**	**Kg/hL**
Meat, fish and poultry		**-**	**-**	**0.3**	**-**	**Kg/t**
Sugar		**-**	**-**	**10**	**-**	**Kg/t**
Margarine		**-**	**-**	**10**	**-**	**Kg/t**
Cakes, biscuits		**-**	**-**	**1**	**-**	**Kg/t**
Bread		**-**	**-**	**8**	**-**	**Kg/t**

4.5.3 Uncertainties and time series consistency

There are inconsistencies in time series in the statistical data set for bread production Activity data for missing years were estimated using alternative methods provided by the IPCC good practice. The same source of activity data was used for the entire time series 1989-2006.

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 Energy 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

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.

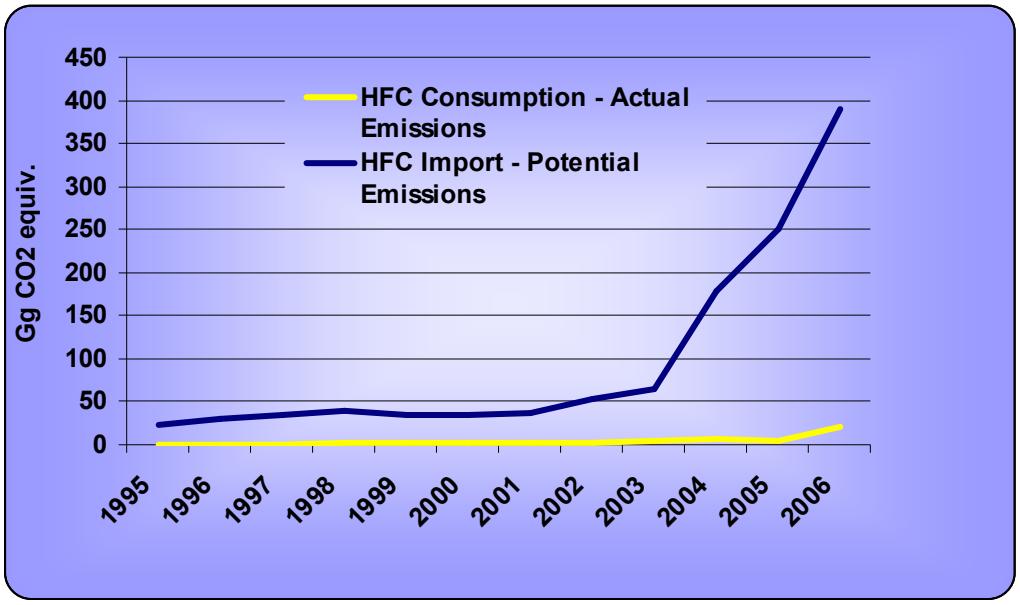
4.7 Source category Consumption of Halocarbons and SF_6 (CRF sector 2.F)

4.7.1 Source category Description

In order to estimate consumption of HFCs, PFCs and SF_6 in the period 1989-2006 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. 15 The trend of CO_2 emissions [Gg CO_2 equiv.] Consumption of Halocarbons and SF_6 sub-sector in the period 1989-2006



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 few importers (there are two important economic agents in the country that imports for their own consumption and one big distributing company);
- four types of refrigeration equipment are produced in Romania; domestic, commercial, transport and industrial. 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, but the main source of F-gases is the Air-Conditioning 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.

In 2005, the consumption of HFC and SF_6 decreased significantly relative to 2004, because the three most important economic agents, which are importers and also users of HFC and SF_6, had important changes regarding the HFC and SF_6 consumption.

- one of the economic agents decreased the consumption of HFC-134a, in the Domestic Refrigeration sector, because his intention is to gradually replace the HFC-134a;
- the second economic agent, decreased the service activity, so the own consumption of the refrigerant agents decreased;
- the third economic agent increased the HFC -134a consumption in the Mobile Air Conditioning sector, because from the beginning of 2005 its own activity developed.

In 2006 the actual emissions increased significantly relative to 2005 and the rest of the period because a new economic agent was identified using the HFC's as solvents in various activity areas. The ascending trend is also caused by the increasing production of the equipments using F-Gases and the developing field industry.

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 2006)
- 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).

In 2006, the sub-sector 2F Consumption of halocarbons and SF_6 includes the following source categories and the following F-gases:

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-41
2F1 Refrigeration and air conditioning equipment	Commercial refrigeration	HFC-143a, HFC-32, HFC-125, HFC-134a, C5F12, HFC-23, HFC-134, HFC-227ea,HFC-41, HFC-43-10-mee
2F1 Refrigeration and air conditioning equipment	Industrial refrigeration	HFC-143a, HFC-134a, HFC-32, HFC-23, HFC-134, HFC-227ea, HFC-41, HFC-43-10-mee, HFC-152a
2F1 Refrigeration and air conditioning equipment	Transport refrigeration	HFC-134a
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
2F1 Refrigeration and air conditioning equipment	Mobile air conditioning	HFC-134a, HFC-134
2F8 Electrical equipments	Electrical equipments	SF6
2F3 Fire extinguishers		HFC-134a
2F5 Solvents		HFC-23, HFC-134a, HFC-143a
2F9 Other non specified		HFC-134a

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%.

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 Energy 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

No recalculations were made relative to previous submission.

4.7.6 Source specific planned improvements

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

5 SOLVENTS AND OTHER PRODUCT USE (CRF SECTOR 3)

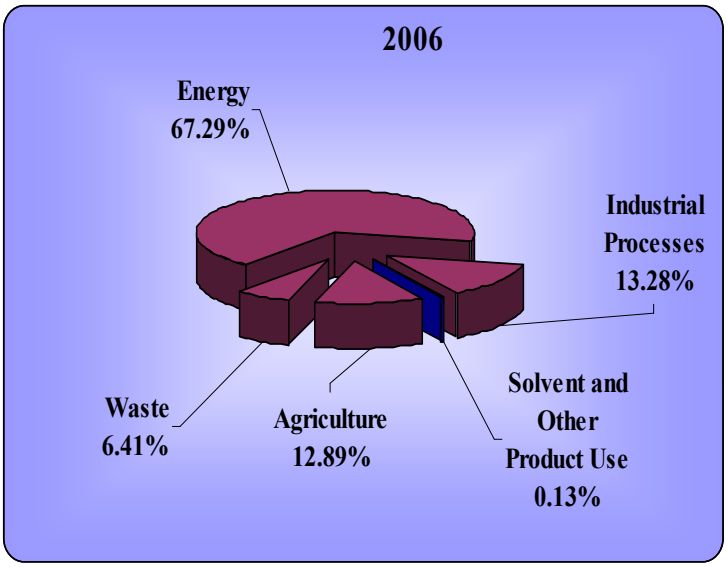
5.1 Overview of the sector

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 2006 the GHG emissions from Solvent and other product use sector contributed to 0.13 % 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, 2006



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 2006 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

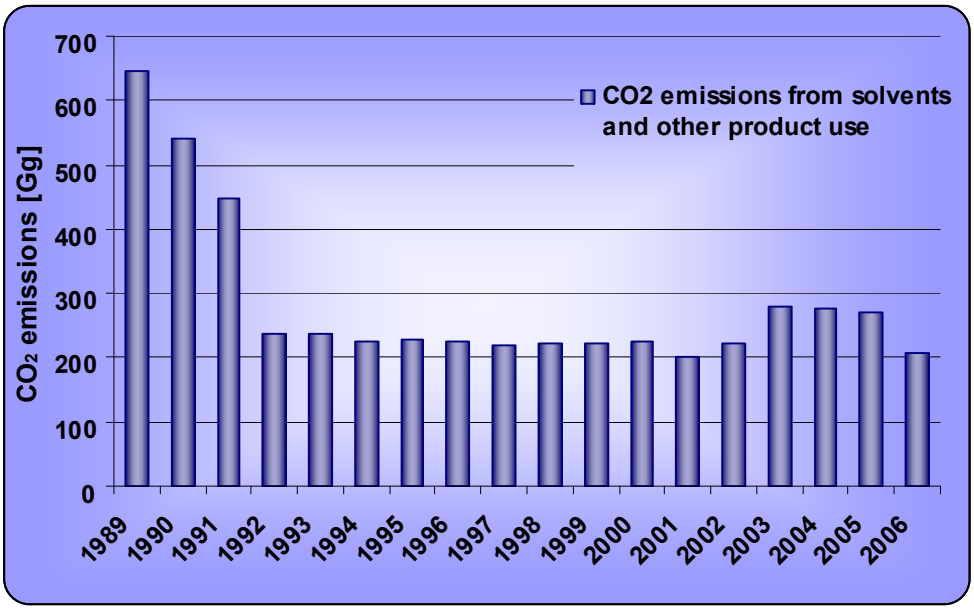
CO_2 emissions = 0,85 x (44/12) x emissions of NMVOC

Where 0,85 is carbon content conversion factor.

Table 5. 1 CO_2 emissions resulted from Solvent and other product use in the period 1989-2006

Solvents and other product use					
Year	**3a**	**3b**	**3c**	**3d**	**total**
1989	141.20	100.70	0	403.90	645.80
1990	111.60	88.20	0	340.70	540.50
1991	84.50	70.10	0	293.60	448.20
1992	52.00	31.00	0	154.60	237.60
1993	51.10	30.90	0	155.50	237.50
1994	41.50	30.90	0	153.00	225.40
1995	43.90	30.90	0	154.60	229.40
1996	39.60	30.80	0	154.90	225.30
1997	33.00	30.80	0	155.20	219.00
1998	31.50	30.80	0	159.60	221.90
1999	30.50	30.80	0	161.10	222.40
2000	32.70	30.80	0	160.80	224.30
2001	41.50	17.50	0	141.50	200.50
2002	45.50	17.80	0	159.00	222.30
2003	106.60	21.80	0	151.50	279.90
2004	99.80	25.80	0	151.80	277.40
2005	95.14	16.85	0	157.66	269.65
2006	162.42	16.82	0	29.26	208.50

Figure 5. 2 The trend of CO_2 emissions resulted from Solvent and other product use sector, in the year 2006



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%.

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 Energy sector expert, activity results of these actions being mentioned in Check lists. After these activities unconformities have not been notified.

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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

No recalculations have been performed in this source category**.**

5.2.6 Source specific planned improvement

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 the 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.

Figure 6. 1 Total GHG emissions trend in Agriculture for 1989–2006 period

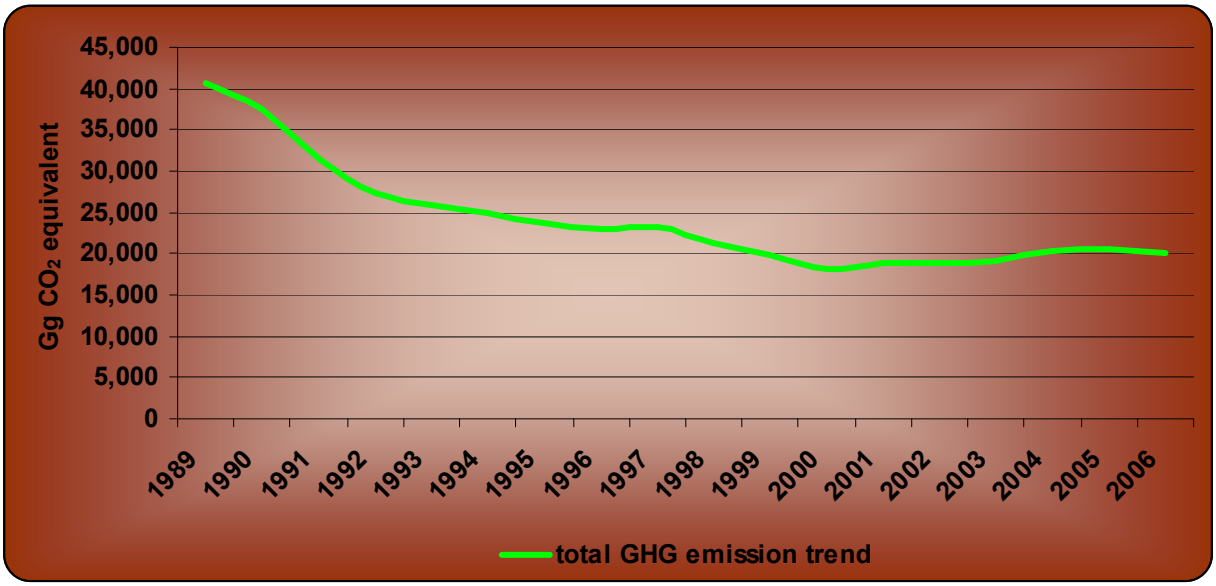
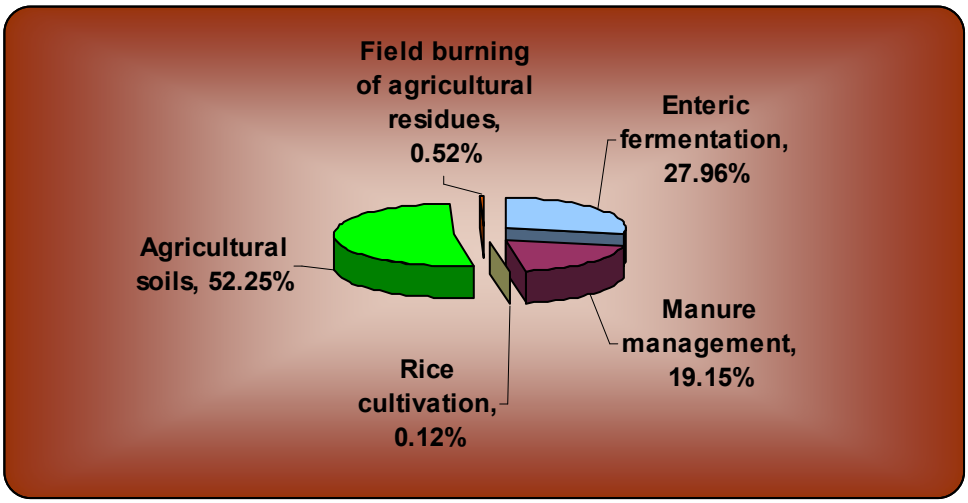


Figure 6. 2 Contribution of the sub-sectors in the total GHG emissions from Agriculture ,in 2006



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

The Agriculture sector accounted for 12.89 % of the total GHG emissions in 2006, reaching 20,190.6 Gg CO_2 equivalent (Table 6.1). Within the GHG emissions from the agriculture sector, the N_2O emissions have the largest contribution (in 2006, N_2O emissions contribution is 61.18% to the total Agriculture sector's CO_2 equivalent emissions), followed by the CH_4 emissions (that account for the remaining 38.82%).
Over the period 1989–2006, the GHG emissions resulted from agriculture sector decreased by 50.28% (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 2006 a significantly reduced emission compared to the base year 1989 (88.64% decrease comparing with the base year).

In case of agricultural soils, the emissions decreased over the period (51.51% decrease in 2006 comparing with 1989), and the evolution of emissions fluctuates, depending on the crop productions that vary from one year to another.

As presented in the Table 6.2, the Agriculture sector's CH_4 emissions decreased in 2006 with almost a half the level recorded in the base year (-49.9 %). 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 6.3 indicates that N_2O emissions from the Agriculture sector decreased with 50.51% 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. 1 Contribution of Agriculture sector in total GHG emissions, in 1989–2006 period

Year	Total GHG emissions [Gg CO_2 equivalent]	GHG emissions from Agriculture [Gg CO_2 equivalent]	Contribution of Agriculture in total GHG emissions [%]	Methane emissions from Agriculture [Gg CO_2 equivalent]	Contribution of methane emissions in total GHG emissions from Agriculture [%]	Nitrous oxide emissions from Agriculture [Gg CO_2 equivalent]	Contribution of nitrous oxide emissions in total GHG emissions from Agriculture [%]
1989	281,894.91	40,605.25	14.40	15,643.91	38.53	24,961.34	61.47
1990	247,697.61	37,421.59	15.11	14,703.48	39.29	22,718.11	60.71
1991	195,114.83	31,413.07	16.10	13,181.64	41.96	18,231.44	58.04
1992	184,921.35	27,422.75	14.83	11,393.53	41.55	16,029.22	58.45
1993	181,824.77	25,816.91	14.20	10,005.19	38.75	15,811.72	61.25
1994	176,602.44	24,888.35	14.09	9,700.82	38.98	15,187.54	61.02
1995	184,097.14	23,815.99	12.94	9,244.64	38.82	14,571.35	61.18
1996	189,987.13	23,085.04	12.15	9,216.26	39.92	13,868.79	60.08
1997	169,785.72	23,162.27	13.64	9,080.19	39.20	14,082.08	60.80
1998	151,661.38	21,267.22	14.02	8,452.61	39.74	12,814.61	60.26
1999	134,611.66	19,914.24	14.79	7,877.55	39.56	12,036.69	60.44
2000	138,718.56	18,167.96	13.10	7,398.34	40.72	10,769.61	59.28
2001	143,724.84	18,795.75	13.08	7,228.83	38.46	11,566.92	61.54
2002	150,010.01	18,829.98	12.55	7,437.72	39.50	11,392.26	60.50
2003	156,892.19	19,125.24	12.19	7,498.48	39.21	11,626.76	60.79
2004	158,752.12	20,326.34	12.80	7,550.24	37.15	12,776.11	62.85
2005	151,980.80	20,481.83	13.48	7,702.59	37.61	12,779.24	62.39
2006	156,680.02	20,190.60	12.89	7,837.52	38.82	12,353.09	61.18

Table 6. 2 Distribution of CH_4 emissions within Agriculture sub-sectors, in 1989–2006 period [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	744.95	527.43	202.80	9.86	NA, NE	NA	4.86
1990	700.17	507.27	180.64	7.98	NA, NE	NA	4.27
1991	627.70	448.47	170.78	4.32	NA, NE	NA	4.13
1992	542.55	387.33	149.27	3.28	NA, NE	NA	2.68
1993	476.44	338.36	132.17	2.40	NA, NE	NA	3.50
1994	461.94	330.34	126.65	0.92	NA, NE	NA	4.03
1995	440.22	319.98	114.51	1.24	NA, NE	NA	4.49
1996	438.87	318.23	116.15	1.70	NA, NE	NA	2.78
1997	432.39	310.12	116.83	0.80	NA, NE	NA	4.64
1998	402.51	293.05	105.71	0.34	NA, NE	NA	3.41
1999	375.12	276.99	94.35	0.32	NA, NE	NA	3.46
2000	352.30	264.63	84.87	0.28	NA, NE	NA	2.52
2001	344.23	258.18	81.47	0.24	NA, NE	NA	4.34
2002	354.18	264.11	86.87	0.10	NA, NE	NA	3.10
2003	357.07	266.76	87.83	0.02	NA, NE	NA	2.46
2004	359.54	258.69	95.47	0.24	NA, NE	NA	5.13
2005	366.79	264.26	97.39	0.78	NA, NE	NA	4.36
2006	373.22	268.85	99.71	1.12	NA, NE	NA	3.54

Table 6. 3 Distribution of N_2O emissions within Agriculture sub-sectors, in 1989–2006 period [Gg]

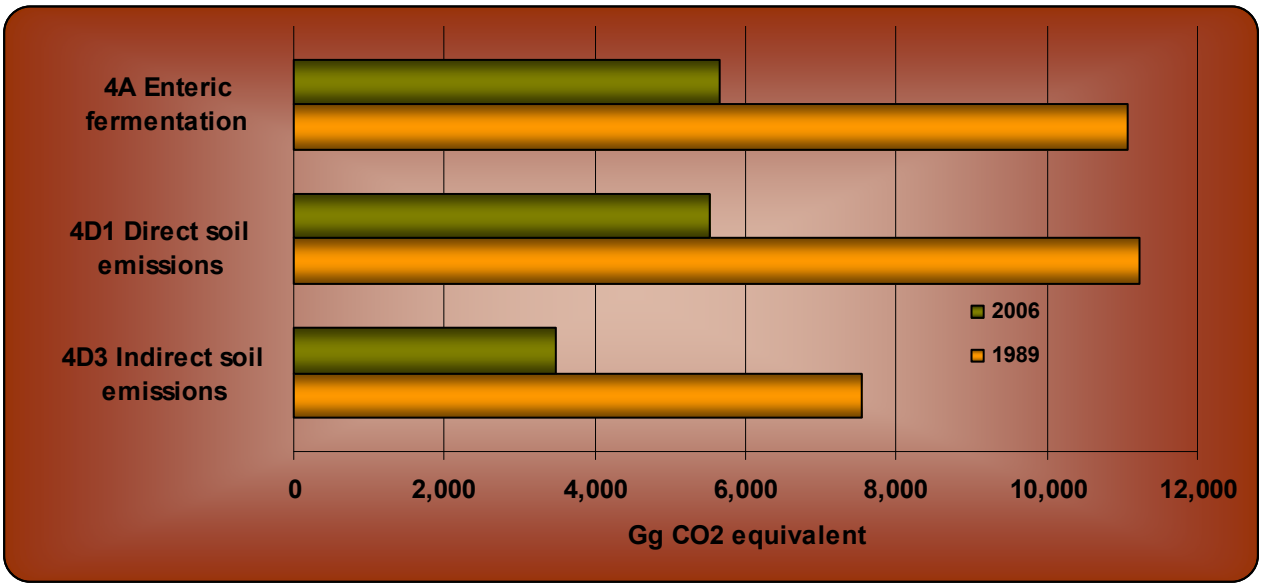
Year	Total N_2O emission - Agriculture	Enteric Fermentation	Manure Management	Rice Cultivation	Agricultural Soils	Prescribed Burning of Savannas	Field burning of agricultural residues
1989	80.52		10.21		70.19	NA	0.12
1990	73.28		8.88		64.30	NA	0.10
1991	58.81		8.72		49.99	NA	0.11
1992	51.71		7.93		43.71	NA	0.07
1993	51.01		7.28		43.64	NA	0.09
1994	48.99		6.99		41.90	NA	0.10
1995	47.00		6.41		40.48	NA	0.11
1996	44.74		6.48		38.18	NA	0.08
1997	45.43		6.47		38.84	NA	0.12
1998	41.34		5.91		35.34	NA	0.09
1999	38.83		5.37		33.36	NA	0.09
2000	34.74		5.01		29.66	NA	0.06
2001	37.31		4.87		32.34	NA	0.11
2002	36.75		5.11		31.56	NA	0.08
2003	37.51		5.16		32.27	NA	0.07
2004	41.21		5.48		35.59	NA	0.14
2005	41.22		5.62		35.49	NA	0.11
2006	39.85		5.72		34.03	NA	0.10

Table 6.4 and Figure 6.3 describe Key categories in Agriculture, both from level and trend and including and excluding LULUCF views.

Table 6. 4 Key categories overview – Agriculture, 2006

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, T	3.60	L, T	2.91
4D1 Direct soil emissions	N_2O	L, T	3.52	L	2.84
4D3 Indirect soil emissions	N_2O	L, T	2.23	L	1.80
4B Manure management	CH_4	L	1.34	L	1.08

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



A set of data requirements has been elaborated following the IPCC Tier 2 methods and it has been submitted to the National Institute for Statistics and to the Ministry of Agriculture, but the poor data received does not allow for the use of higher tier methods. The new 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 sector 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 2006, CH_4 emissions from Enteric Fermentation represented 72.03% of total CH_4 emissions in the Agriculture sector);
- is the largest source in the Agriculture sector (in 2006, CH_4 emissions from Enteric Fermentation as CO_2 equivalent represented 27.96% from Total Agriculture emissions);
- contributed with 3.6% 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

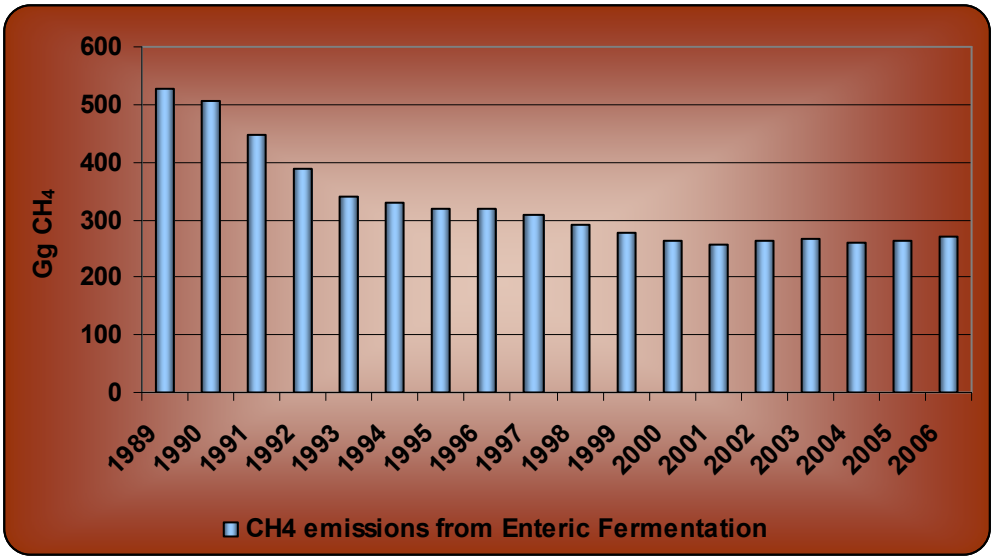


Table 6. 5 Observations on source category 4A – "Enteric Fermentation"

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, 1989-2007; expert judgment; EF: IPCC GPG 2000, IPCC 1996
4A2	Buffalo		AD: SY, other correspondence, NIS, 1989-2007; expert judgment; EF: IPCC GPG 2000, IPCC 1996
4A3	Sheep		AD: SY, other correspondence, NIS, 1989-2007; EF: IPCC GPG 2000, IPCC 1996
4A4	Goats		
4A5	Horses		
4A6	Mules and asses		AD: FAO, 2007; EF: IPCC GPG 2000, IPCC 1996
4A7	Swine		AD: SY, other correspondence, NIS, 1989-2007; EF: IPCC GPG 2000, IPCC 1996
4A8	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

The emission factors used are presented in Table 6.6:

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

Source indicative	Livestock (source) type	Emission Factors [kg CH_4/head/year]
4A1	Cattle – Dairy cows	81
	Cattle – Non-dairy cattle	56
4A2	Buffalo	55
4A3	Sheep	5
4A4	Goats	5
4A5	Horses	18
4A6	Mules and asses	10
4A7	Swine	1
4A8	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 2004-2006 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 1989-2007 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 1989-2007 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 1989-2007 and other relevant correspondence.

Livestock data series are presented in Table 6.7:

Table 6. 7 Livestock data series for 1989-2006 period

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

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 1989-2006 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 Waste 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.
The unconformities noted following the UNFCCC review of the 2006 – 2nd submission of the NGHGI are described at the Chapter 6.2.5 - Source specific recalculation, 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 6.2.5 – Source specific recalculation, including changes made in response to the review process.

All noted and solved unconformities following the QA/QC activities are described at the Improvements list level.

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

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

- activity data
  - ✓ based on the recommendation of the Expert Review Team following the UNFCCC review of the 2006 – 2nd submission of the NGHGI, for the 1989-2003 period, the number of Dairy cows began to be calculated by dividing the Cow's and buffalo cow's milk (calves feeding included) production to the Average production per animal (cow's and buffalo cow's milk);
  - ✓ following the previous recalculation, the number of Non-dairy cattle have been adjusted accordingly

All the changes made at activity data level and their implications on emission estimates are described in Table 6.8.

Table 6. 8 Changes made at activity data level and their effects on emission estimates

Year	Changes on livestock data series [thousands heads]					Effects of changes on emission estimates		
	Dairy cows		Non-dairy cattle			NIR 2007 – CH_4 emissions [Gg]	**NIR 2008 - CH_4 emissions [Gg]**	**Difference [%]**
	NIR 2007	**NIR 2008**	NIR 2007	**NIR 2008**				
1989	3,612.21	**2,177.27**	2,715.25	**4,150.19**		563.30	**527.43**	**-6.37**
1990	3,541.83	**1,954.00**	2,662.35	**4,250.19**		546.97	**507.27**	**-7.26**
1991	3,029.50	**1,898.46**	2,277.24	**3,408.29**		476.75	**448.47**	**-5.93**
1992	2,451.87	**1,782.17**	1,843.04	**2,512.73**		404.07	**387.33**	**-4.14**
1993	2,073.53	**1,783.07**	1,558.65	**1,849.10**		345.63	**338.36**	**-2.10**
1994	2,025.11	**1,778.92**	1,522.25	**1,768.44**		336.50	**330.34**	**-1.83**
1995	1,959.80	**1,787.82**	1,473.16	**1,645.14**		324.28	**319.98**	**-1.33**
1996	1,968.25	**1,771.94**	1,479.51	**1,675.82**		323.14	**318.23**	**-1.52**
1997	1,933.91	**1,720.02**	1,453.69	**1,667.58**		315.47	**310.12**	**-1.69**
1998	1,821.31	**1,679.93**	1,369.05	**1,510.42**		296.58	**293.05**	**-1.19**
1999	1,717.71	**1,647.12**	1,291.18	**1,361.77**		278.75	**276.99**	**-0.63**
2000	1,615.81	**1,692.29**	1,214.58	**1,138.10**		262.72	**264.63**	**0.73**
2001	1,576.40	**1,692.12**	1,184.96	**1,069.24**		255.29	**258.18**	**1.13**
2002	1,620.31	**1,684.01**	1,217.97	**1,154.28**		262.52	**264.11**	**0.61**
2003	1,631.01	**1,694.78**	1,226.01	**1,162.24**		265.16	**266.76**	**0.60**
2004	1,566.40	**1,566.40**	1,207.87	**1,207.87**		258.69	**258.69**	
2005	1,625.68	**1,625.68**	1,191.18	**1,191.18**		264.26	**264.26**	
2006		**1,639.36**		**1,253.64**			**268.85**	

6.2.6 Source specific planned improvements

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 sector 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 third source of N_2O emissions in the Agriculture sector (in 2006, CH_4 emissions from Manure Management represented 26.72% of total CH_4 emissions while N_2O accounted for 14.35% of total N_2O emissions in the Agriculture sector);
- is the third largest source in the Agriculture sector (in 2006, CH_4 and N_2O emissions from Manure Management as CO_2 equivalent represented 19.15% from Total Agriculture emissions);
- contributed with 2.47% 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

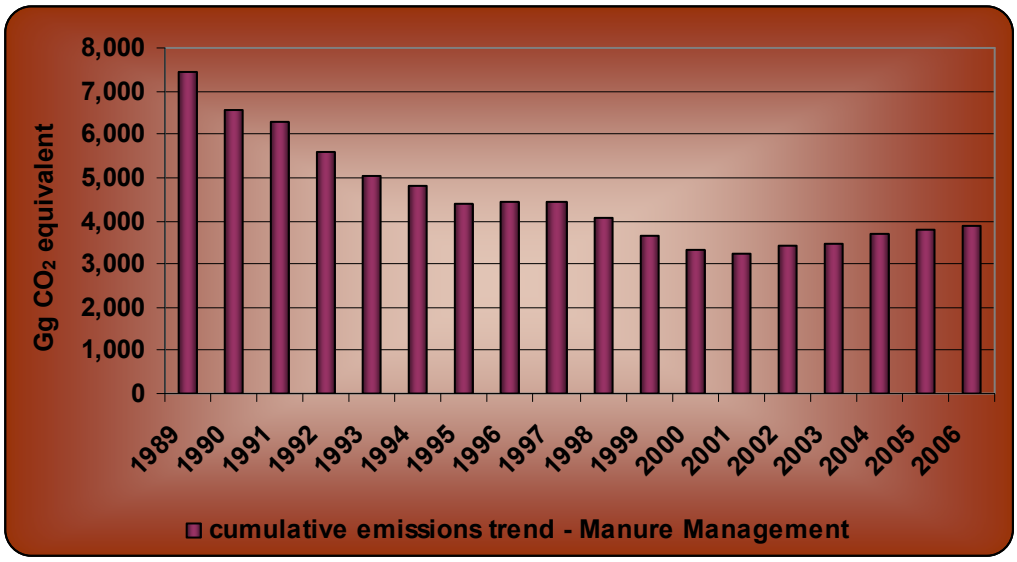


Table 6. 9 Observations on source category 4B – "Manure Management"

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, 1989-2007; expert judgment; EF: IPCC GPG 2000, IPCC 1996
4B2	Buffalo		AD: SY, other correspondence, NIS, 1989-2007; expert judgment; EF: IPCC GPG 2000, IPCC 1996
4B3	Sheep		AD: SY, other correspondence, NIS, 1989-2007; EF: IPCC GPG 2000, IPCC 1996
4B4	Goats		
4B5	Horses		
4B6	Mules and asses		AD: FAO, 2007; EF: IPCC GPG 2000, IPCC 1996
4B7	Swine		AD: SY, other correspondence, NIS, 1989-2007; EF: IPCC GPG 2000, IPCC 1996
4B8	Poultry		
Observations on source category 4B – "Manure Management – N_2O emissions"			
4B9	Anaerobic Lagoon		AD: IPCC GPG 2000, IPCC 1996; EF: IPCC GPG 2000, IPCC 1996
4B10	Liquid/Slurry		
4B11	Daily Spread		
4B12	Solid storage		
4B13	Dry lot		
4B14	Pasture/range/paddock		
4B15	Pit		
4B16	Other AWMS		

6.3.2 Methodological issues

CH_4 emissions

Methodology

Despite the fact that CH_4 emissions from Manure Management is a key category, by level view, tier 2 method could not be applied, due to the lack of detailed data needed. Therefore, a tier 1 method has been applied. For calculation of methane emissions from manure management, the equations 4.15 and 4.13 of IPCC GPG 2000 were used.

Emission factors

According to the provisions in IPCC GPG 2000, the calculation methodology took into account IPCC 1996 default emissions factors for 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 6.10:

Table 6. 10 Default emission factors used for calculation of methane emissions from Manure management

Source indicative	Livestock (source) type	Emission Factors [kg CH_4/head/year]
4B1	Cattle – Dairy cows	19
	Cattle – Non-dairy cattle	13
4B2	Buffalo	9
4B3	Sheep	0.16
4B4	Goats	0.17
4B5	Horses	1.6
4B6	Mules and asses	0.9
4B7	Swine	7
4B8	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

Due to the fact that N_2O emissions from Manure Management is not a key category, 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 6.11:

Table 6. 11 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]
4B9	Anaerobic Lagoon	0.001
4B10	Liquid/Slurry	0.001
4B11	Daily Spread	0
4B12	Solid storage	0.02
4B13	Dry lot	0.02
4B14	Pasture/range/paddock	0.02
4B15	Pit	0.001
4B16	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 6.12);
- 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 6.13)

Table 6. 12 Default values for nitrogen excretion per head of animal

Source indicative	Livestock (source) type	Nitrogen excretion [kg N/head/year]
4B1	Cattle – Dairy cows	70
	Cattle – Non-dairy cattle	50
4B2	Buffalo	50
4B3	Sheep	16
4B4	Goats	25
4B5	Horses	25
4B6	Mules and asses	25
4B7	Swine	20
4B8	Poultry	0.6

Table 6. 13 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 6.13 (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 1989-2006 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 Waste sector, the results of these being mentioned on the Checklists level.
The unconformities noted are described at the Chapter 6.3.5 - Source specific recalculation, 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 6.3.5 – Source specific recalculation, 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.
The unconformities noted following the UNFCCC review of the 2006 – 2nd submission of the NGHGI are described at the Chapter 6.2.5 - Source specific recalculation, 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 6.3.5 – Source specific recalculation, including changes made in response to the review process.
All noted and solved unconformities following the QA/QC activities are described at the Improvements list level.

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

CH_4 emissions

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

- activity data
  - ✓ all changes done at livestock data level are explained in Chapter 6.2.5
- emission factors
  - ✓ according to the provisions in IPCC GPG 2000 and in Table 4-5 of IPCC 1996 Reference Manual, the specific value for Horses was changed from 1.64 to 1.6

The implications of all recalculations on emissions level are described in Table 6.14:

Table 6. 14 Effects of recalculations on CH_4 emission level

Year	Effects of changes on emission estimates		
	NIR 2007 – CH_4 emissions [Gg]	**NIR 2008 - CH_4 emissions [Gg]**	**Difference [%]**
1989	211.44	**202.80**	**-4.09**
1990	190.20	**180.64**	**-5.02**
1991	177.59	**170.78**	**-3.84**
1992	153.32	**149.27**	**-2.64**
1993	133.94	**132.17**	**-1.32**
1994	128.16	**126.65**	**-1.18**
1995	115.57	**114.51**	**-0.92**
1996	117.36	**116.15**	**-1.03**
1997	118.15	**116.83**	**-1.11**
1998	106.59	**105.71**	**-0.83**
1999	94.81	**94.35**	**-0.48**
2000	84.45	**84.87**	**0.50**
2001	80.81	**81.47**	**0.82**
2002	86.52	**86.87**	**0.40**
2003	87.48	**87.83**	**0.40**
2004	95.50	**95.47**	**-0.04**
2005	97.42	**97.39**	**-0.03**
2006		**99.71**	

N_2O emissions

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

- activity data
  - ✓ changes done at livestock data level are explained in Chapter 6.2.5;
  - ✓ according to the provisions in IPCC GPG 2000, some percentage of manure N produced in different AWMS values have been replaced (Table 6.15)
- emission factors
  - ✓ due to the last recalculation on activity data, the value of 0.001 for EF_3 specific to Swine and Pit management system began to be used

The implications of all recalculations on emissions level are described in Table 6.16.

Table 6. 15 Changes made at AWMS values level

Livestock type / Animal Waste Management Systems [%]	Type of value (Old/New)	Dairy cows	Non-dairy cattle	Buffalo	Swine
Anaerobic Lagoon	Old	0	8	8	0
	New	**0**	**0**		**8**
Liquid/Slurry	Old	18	39	39	29
	New	**18**	**28**	**24**	**0**
Daily Spread	Old	1	0	0	0
	New	**1**	**0**	**0**	**0**
Solid storage	Old	67*1	52*1	52*1	0
	New	**68**	**0**		**39**
Dry lot	Old	*1	*1	*1	0
	New	**0**	**0**	**0**	**14**
Pasture/range/paddock	Old	13	0	0	27
	New	**13**	**26**	**29**	
Pit	Old				
	New				**38**
Other AWMS	Old	0	1	1	45
	New	**0**	**46**	**47**	**1**

Observation

*1 – the value written in the Solid storage cell is specific to the Solid storage and dry lot system

Table 6. 16 Effects of recalculations on N_2O emission level

Year	Effects of changes on emission estimates		
	NIR 2007 – N_2O emissions [Gg]	**NIR 2008 - N_2O emissions [Gg]**	**Difference [%]**
1989	9.99	**10.21**	**2.24**
1990	9.54	**8.88**	**-6.97**
1991	8.44	**8.72**	**3.24**
1992	7.05	**7.93**	**12.45**
1993	6.02	**7.28**	**21.00**
1994	5.80	**6.99**	**20.43**
1995	5.50	**6.41**	**16.55**
1996	5.55	**6.48**	**16.72**
1997	5.47	**6.47**	**18.21**
1998	5.07	**5.91**	**16.57**
1999	4.72	**5.37**	**13.68**
2000	4.41	**5.01**	**13.75**
2001	4.29	**4.87**	**13.59**
2002	4.46	**5.11**	**14.76**
2003	4.49	**5.16**	**15.06**
2004	4.51	**5.48**	**21.49**
2005	4.61	**5.62**	**21.89**
2006		**5.72**	

6.3.6 Source specific planned improvements

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 sector 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 2006, CH_4 emissions from Rice Cultivation represented 0.3% of total CH_4 emissions in the Agriculture sector);
- is the smallest source in the Agriculture sector (in 2006, CH_4 emissions from Rice Cultivation as CO_2 equivalent represented 0.12% from Total Agriculture emissions);
- contributed with 0.02% to Total GHG emissions of Romania

Emissions from rice cultivation are declining since 1989 due to the decrease of rice cultivated area (Figure 6.6).

Figure 6. 6 Methane emission trend due to the Rice Cultivation

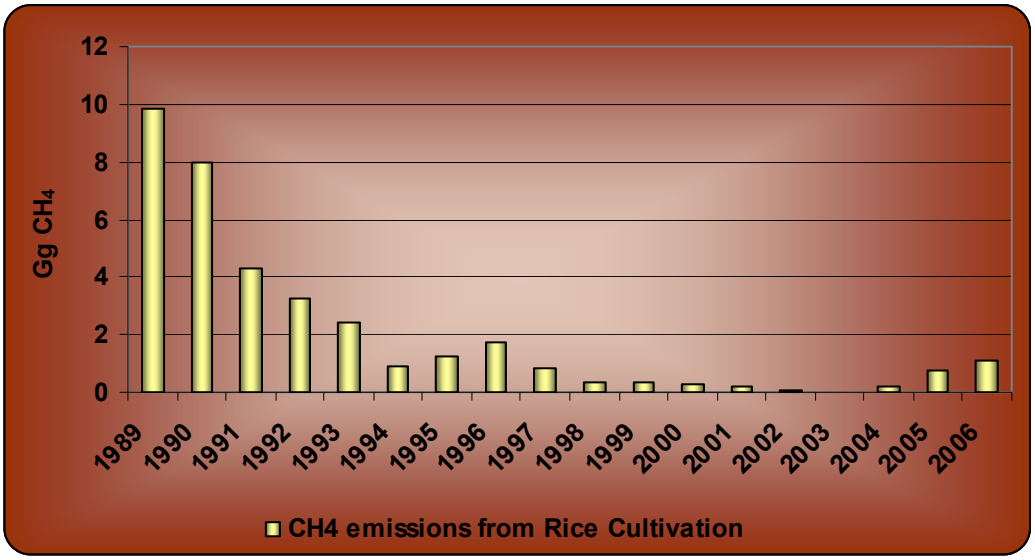


Table 6. 17 Observations on source category 4C – "Rice Cultivation"

Source indicative	Source (livestock) type	Observation	Data source
4C1	Rice harvested area		AD: SY, NIS, 1989-2007; 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

The calculation methodology took into account by expert judgment a default IPCC GPG 2000 seasonally integrated emission factor value for continuously flooded fields without organic amendments (20) and also default scaling factors values (1). Therefore, a value of 20 g CH_4/m^2 was considered for adjusted seasonally integrated emission factor for a particular harvested area

Activity data

Total rice cultivated area is provided by Romanian National Institute for Statistics (NIS) being released through Statistical Yearbook 1989-2007.
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 6.18:

Table 6. 18 Harvested area data series for 1989-2006 period

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

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 1989-2006 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 Waste 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 2006 – 2nd submission of the NGHGI.

6.4.5 Source specific recalculation, 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

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 sector 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 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 2006, N_2O Direct soil emissions represented 44.7% of total N_2O emissions in the Agriculture sector);

- is the second largest source in the Agriculture sector (in 2006, N_2O Direct soil emissions as CO_2 equivalent represented 27.35% from Total Agriculture emissions);
- contributed with 3.52% to Total GHG emissions of Romania

Pasture, Range and Paddock Manure (4D2)

Pasture, Range and Paddock Manure:

- is the fourth largest source of N_2O emissions in the Agriculture sector (in 2006, N_2O emissions from Pasture, Range and Paddock Manure represented 12.45% of total N_2O emissions in the Agriculture sector);
- is the fifth largest source in the Agriculture sector (in 2006, N_2O emissions from Pasture, Range and Paddock as CO_2 equivalent represented 7.62% from Total Agriculture emissions);
- contributed with 0.98% 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 2006, N_2O Indirect soil emissions represented 28.25% of total N_2O emissions in the Agriculture sector);
- is the fourth largest source in the Agriculture sector (in 2006, N_2O Indirect soil emissions as CO_2 equivalent represented 17.28% from Total Agriculture emissions);
- contributed with 2.23% 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 emission trend of Agricultural Soils

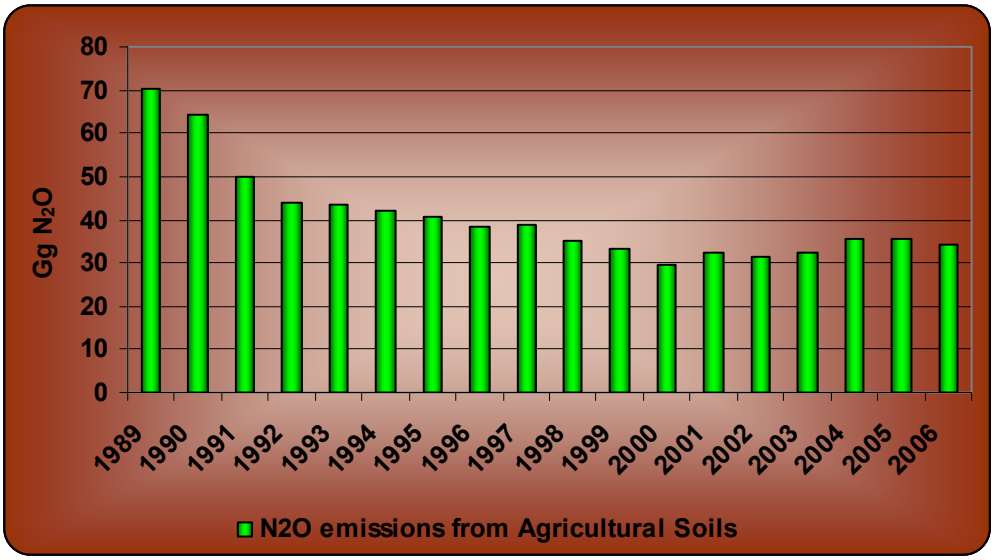


Figure 6. 8 N_2O emission trends – Agricultural Soils

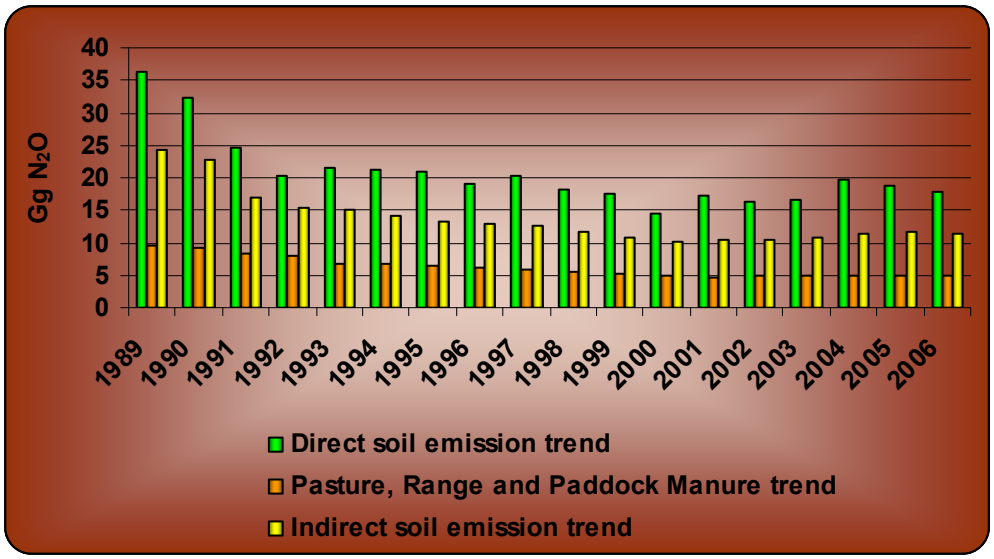


Table 6. 19 Observations on source category 4D – "Agricultural Soils"

Source indicative	Source (livestock) type	Observation	Data source
4D1	Amount of N synthetic fertilizer used		AD: SY, NIS, 1989-2007; EF: IPCC GPG 2000
4D2-4D9	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, 1989-2007; expert judgment; FAO 2007; EF: IPCC GPG 2000
4D10-4D13	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, 1989-2007; EF: IPCC GPG 2000
4D14-4D39	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 1989-2007.

Data series are presented in Table 6.21.

Default IPCC GPG 2000 value of $Frac_{GASF}$ used is presented in Table 6.20.

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 6.21.

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 6.20.

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 1989-2007 and are presented in Table 6.21.

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 N-fixing crop ($Frac_{NCRBF}$) default value used is presented in Table 6.20.

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 1989-2007 and specific correspondence and are presented in Table 6.21.

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 6.20.

Table 6. 20 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)	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 1989-2007 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; accordingly, the emissions generated are considered to have a small relevance.

Table 6. 21 Activity data series used for calculation of direct soil emissions, for 1989-2006 period

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

Table 6.21 (continued) Activity data series used for calculation of direct soil emissions, for 1989-2006 period

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

Table 6.21 (continued) Activity data series used for calculation of direct soil emissions, for 1989-2006 period

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

Table 6.21 (continued) Activity data series used for calculation of direct soil emissions, for 1989-2006 period

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

Pasture, Range and Paddock Manure emissions

Methodology

Due to the fact that Pasture, Range and Paddock Manure is not a key category, a tier 1 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 1989-2006 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 Waste sector, the results of these being mentioned on the Checklists level.
The unconformities noted are described at the Chapter 6.5.5 - Source specific recalculation, 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 recalculation, 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.

The unconformities noted following the UNFCCC review of the 2006 – 2nd submission of the NGHGI are described at the Chapter 6.2.5 - Source specific recalculation, 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 recalculation, including changes made in response to the review process.

All noted and solved unconformities following the QA/QC activities are described at the Improvements list level.

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

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

- methodology
  - ✓ according to the provisions in IPCC GPG 2000, the equation 1 from page 4.92 of the IPCC 1996 Reference Manual, used also for the 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, has been replaced with the equation 4.23 of the IPCC GPG 2000
- activity data
  - ✓ all changes made at the livestock data level are presented in Chapters 6.2.5;
  - ✓ according to the provisions in IPCC GPG 2000, some percentage of manure N produced in different AWMS values have been replaced (Table 6.15);
  - ✓ due to the recalculations performed at the livestock data level, the values specific to the Fraction of livestock nitrogen excreted and deposited onto soil during grazing ($Frac_{PRP}$) have been changed (Table 6.22);
  - ✓ according to the provisions in IPCC GPG 2000, the value specific to the Fraction of total aboveground biomass that is removed from the field as crop product ($Frac_R$) has been changed from 0.45 to 0.5

Implications of changes on emission estimates are described in Table 6.22.

Table 6. 22 Changes made at the $Frac_{PRP}$ level and the effects of all changes made on emission estimates level

Year	Changes at the $Frac_{PRP}$ values level			Effects of changes on emission estimates		
	NIR 2007	**NIR 2008**		NIR 2007 – N_2O emissions [Gg]	**NIR 2008 – N_2O emissions [Gg]**	**Difference [%]**
1989	0.3223	**0.2972**		71.54	**70.19**	**-1.89**
1990	0.3231	**0.3118**		65.37	**64.30**	**-1.63**
1991	0.3258	**0.3008**		50.97	**49.99**	**-1.93**
1992	0.3485	**0.3150**		44.21	**43.71**	**-1.14**
1993	0.3524	**0.3114**		43.75	**43.64**	**-0.27**
1994	0.3542	**0.3144**		42.08	**41.90**	**-0.44**
1995	0.3579	**0.3255**		40.58	**40.48**	**-0.24**
1996	0.3481	**0.3146**		38.23	**38.18**	**-0.13**
1997	0.3415	**0.3047**		39.12	**38.84**	**-0.70**
1998	0.3453	**0.3125**		35.44	**35.34**	**-0.27**
1999	0.3437	**0.3173**		33.73	**33.36**	**-1.08**
2000	0.3463	**0.3242**		29.65	**29.66**	**0.06**
2001	0.3433	**0.3228**		32.54	**32.34**	**-0.61**
2002	0.3408	**0.3166**		31.73	**31.56**	**-0.54**
2003	0.3439	**0.3192**		32.43	**32.27**	**-0.50**
2004	0.3360	**0.2992**		36.10	**35.59**	**-1.39**
2005	0.3373	**0.2997**		35.85	**35.49**	**-1.02**
2006		**0.2987**			**34.03**	

6.5.6 Source specific planned improvements

In respect to the IPCC GPG 2000 provisions, more detailed data which allow for using of Tier 2 method are proposed to be obtained. Data on area of cultivated organic soils are also proposed to be obtained.

6.6 Source category Prescribed Burning of Savannas (CRF sector 4.E)

Prescribed Burning of Savannas does not occur in Romania.

6.7 Source category Field Burning of Agricultural Residues (CRF sector 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.

Field Burning of Agricultural Residues:

- is the third source of CH_4 and the fifth source of N_2O emissions in the Agriculture sector (in 2006, CH_4 emissions from Field Burning of Agricultural Residues represented 0.95% of total CH_4 emissions while N_2O emissions represented 0.24% of total N_2O emissions in the Agriculture sector);
- is the sixth source in the Agriculture sector (in 2006, CH_4 and N_2O emissions from Field Burning of Agricultural Residues as CO_2 equivalent represented 0.52% from Total Agriculture emissions);
- contributed with 0.07% to Total GHG emissions of Romania

Emissions from field burning of agricultural residues in 2006 are lower than emissions in 1989. 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

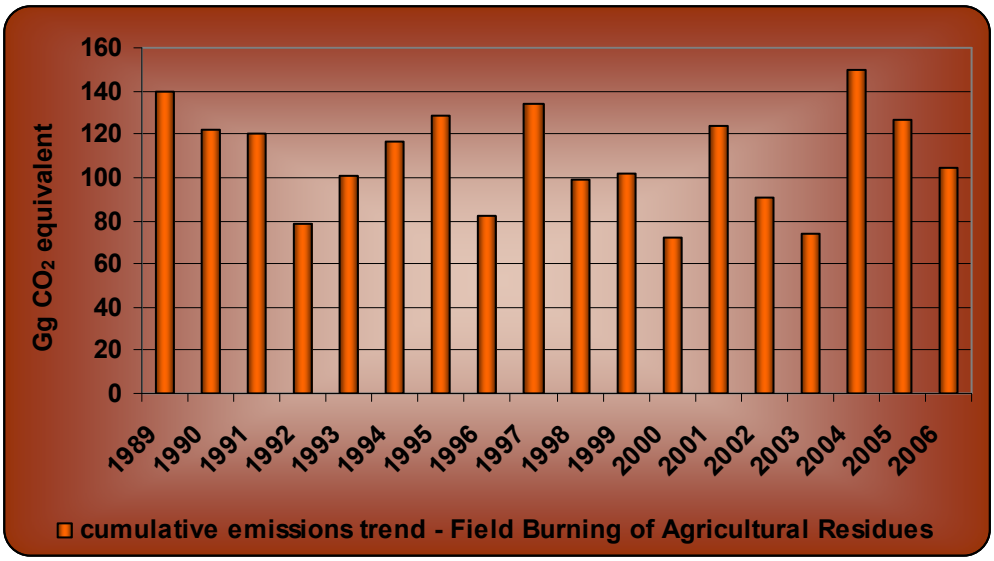


Table 6. 23 Observations on source category 4F – "Field Burning of Agricultural Residues"

Source indicative	Source (livestock) type	Observation	Data source
4F1	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, 1989-2007; 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 6.24.

Table 6. 24 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 6.25.

Table 6. 25 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 and the same default parameters, emission factors and methodologies are used for the whole period, the time series 1989-2006 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 Waste 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 2006 – 2nd submission of the NGHGI.

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

No recalculations were performed related to the previous submission.

6.7.6 Source specific planned improvements

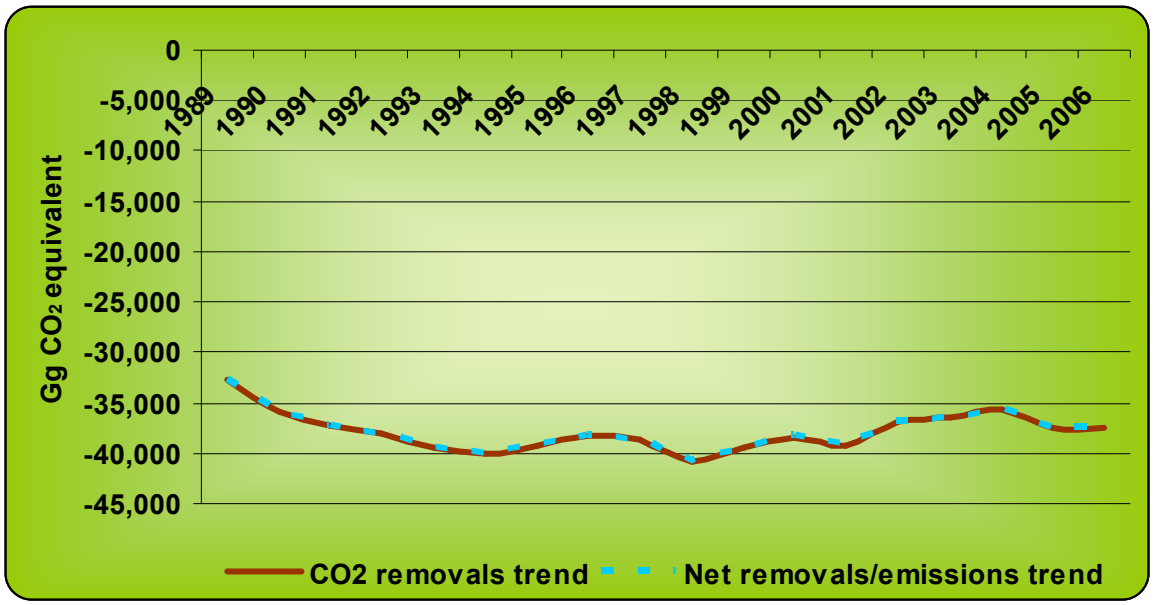
In respect to the IPCC GPG 2000 provisions, country specific values for fractions and emission ratios used in the calculations which allow for tier 2 method use are proposed to be developed.

7 LULUCF (CRF SECTOR 5)

7.1 Overview of the sector

The land uses in Romania have been relatively stable over the last 18 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.
Over the period 1989 - 2006 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 18 years

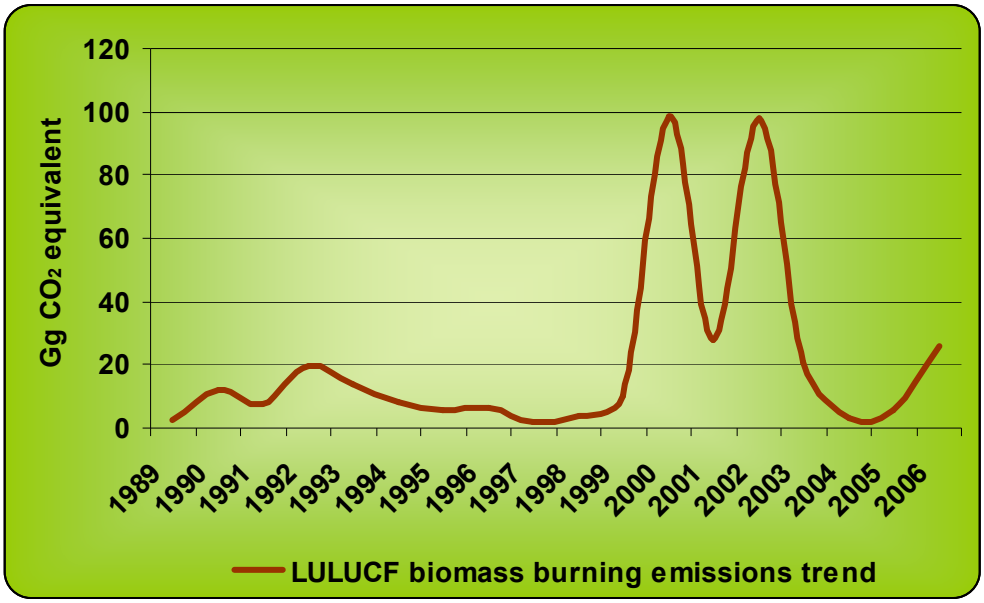


Consequently, Romanian land use sector act as a net sink (Figure 7.1; Table 7.1), at an average uptake of 37,889.65 Gg/year, relatively stable over the last 18 years.

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 period, 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 11.58% in 1989 to 23.93 in 2006 (Table 7.1).

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 1989-2006, pastures and hayfields increased from 32% in 1989 to 33% in 2006. 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. 1 Levels in emissions and removals on 1989-2006 period

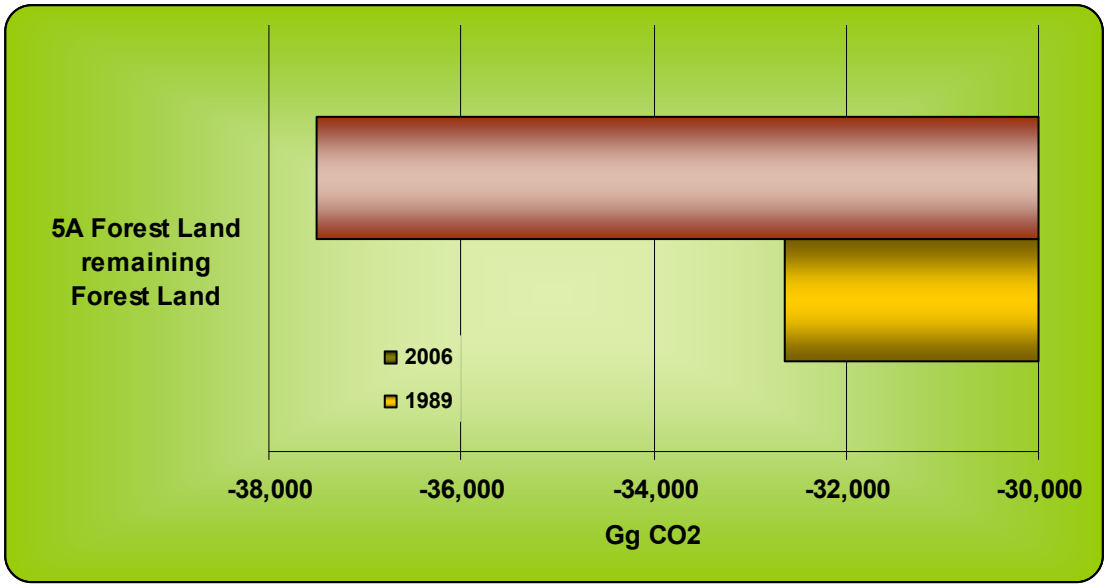
Year	Total GHG emissions [Gg CO_2 equiv.]	Net emissions/ removals from LULUCF [Gg]	Percentage of Net emissions/ removals from LULUCF in Total GHG emissions [%]	CO_2 removals [Gg]	Emissions from biomass burning [Gg CO_2 equivalent]			
					Total	CO_2	CH_4	N_2O
1989	**281,894.91**	**-32,641.18**	**11.58**	**-32,643.72**	2.54	2.30	0.21	0.02
1990	**247,697.61**	**-35,847.13**	**14.47**	**-35,859.24**	12.11	11.00	1.01	0.10
1991	**195,114.83**	**-37,319.02**	**19.13**	**-37,326.58**	7.55	6.86	0.63	0.06
1992	**184,921.35**	**-38,124.28**	**20.62**	**-38,144.16**	19.88	18.06	1.65	0.17
1993	**181,824.77**	**-39,430.32**	**21.69**	**-39,444.45**	14.13	12.83	1.18	0.12
1994	**176,602.44**	**-40,033.65**	**22.67**	**-40,042.15**	8.51	7.73	0.71	0.07
1995	**184,097.14**	**-39,284.46**	**21.34**	**-39,290.13**	5.67	5.15	0.47	0.05
1996	**189,987.13**	**-38,300.50**	**20.16**	**-38,306.69**	6.19	5.62	0.52	0.05
1997	**169,785.72**	**-38,688.77**	**22.79**	**-38,690.62**	1.85	1.68	0.15	0.02
1998	**151,661.38**	**-40,800.87**	**26.90**	**-40,804.61**	3.74	3.39	0.31	0.03
1999	**134,611.66**	**-39,512.41**	**29.35**	**-39,522.74**	10.33	9.39	0.86	0.09
2000	**138,718.56**	**-38,288.13**	**27.60**	**-38,386.49**	98.36	89.34	8.19	0.83
2001	**143,724.84**	**-39,305.20**	**27.35**	**-39,333.02**	27.81	25.26	2.32	0.23
2002	**150,010.01**	**-36,835.44**	**24.56**	**-36,933.34**	97.89	88.92	8.15	0.83
2003	**156,892.19**	**-36,484.27**	**23.25**	**-36,505.05**	20.78	18.87	1.73	0.18
2004	**158,752.12**	**-35,768.14**	**22.53**	**-35,771.52**	3.38	3.07	0.28	0.03
2005	**151,980.80**	**-37,482.81**	**24.66**	**-37,488.59**	5.78	5.25	0.48	0.05
2006	**156,680.02**	**-37,494.88**	**23.93**	**-37,520.68**	25.80	23.43	2.15	0.22

Table 7.2 and Figure 7.3 describe Key categories in LULUCF, both from level and trend views.

Table 7. 2 Key categories overview – LULUCF, 2006

Key categories	GHG	Criteria	Contribution in total GHG emissions and removals [%]
5A Forest Land remaining Forest Land	CO_2	L, T	19.31

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



Information on completeness

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. For most sources the emission/uptake has been estimated. Sources not estimated or included in different other chapter:

Sinks/sources not reported (NE)		
GHG	**Sink/source category**	**Explanation**
CO_2	Cropland remaining cropland	Biomass data not available at the time of NI preparation
CO_2	Grassland remaining grassland	Biomass data not available at the time of NI preparation
CO_2	Wetland remaining wetlands	Biomass, SOM and DOM data not available at the time of NI preparation
CO_2	Settlements remaining settlements	Biomass data not available at the time of NI preparation
CO_2	Settlements	Biomass change data not available at the time of NI preparation
CO_2	Limestone/dolomite application	Data not available at the time of NI preparation
CO_2	Different conversion from one use to another	Biomass change data not available at the time of NI preparation
N_2O	Forest land, mineral soils	Emissions from N fertilizers may happen on very a small area; Data not available at the time of NI preparation
N_2O	Wetlands, organic and mineral soils	This may happen on very a small area; Data not available at the time of NI preparation
N_2O	Cropland, land use conversion to cropland	This may happen on very a small area; Data not available at the time of NI preparation
Sinks/sources reported elsewhere (IE)		
N_2O	Forest land remaining forest land	Allocation: agriculture There are no statistics on the fertilizers used in the forestry or data collection on this activity does not occur in the forest statistics

7.2 Sink/source category Forest land (CRF sector 5.A)

7.2.1 Sink/Source category description

The forest and woodlands represents some 28% from the national territory, which fits to 0.31 ha per inhabitant in 2006. Structure of forest fund in 2006 is as follows: resinous forests (30.18%), beech forests (32.33%), oaks forests (17.28%), hardwood forests (15.21%) and softwood forest (4.99%). Additionally there is an area of some 482 400 ha of woodlands. According 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 or owner, according circumstances. "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. 3 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, 1989-2007; National Forest Fund publication, NIS, 2006-2007; expert judgment; EF: IPCC GPG 2003
5A2	Woodland area		AD: SY, NIS, 1989-2007; SSP, 1980; EF: IPCC GPG 2003
Observations on source category 5.A – "Forest land" - emissions			
5A3	Wood harvested volume		AD: SY, NIS, 1989-2007; EF: IPCC GPG 2003
5A4	Wildfires affected area		AD: RNP, 2007; EF: IPCC GPG 2003
5A5	Illegal wood extracted volume		AD: RNP, 2006-2007; EF: IPCC GPG 2003

7.2.2 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;
- 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 7.4.

Table 7. 4 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	0.655	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 2006 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).
Activity data values are presented in Table 7.5.

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 2006).

Woodlands

Woodlands primary data series are provided by NIS through SY 2006 as total value (by subtracting Forest areas from Forest and other forest vegetation lands). Values are presented in Table 7.5.
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%

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. 5 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**

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

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

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

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

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 [tC/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 2006 and are presented in Table 7.6.

Densities values (D) used are presented in Table 7.4.

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 legally 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/year];
- beech: 5 [cubic meters/year];
- oak: 10 [cubic meters/year];
- hardwood: 3 [cubic meters/year];
- softwood: 4 [cubic meters/year]

Illegal cutting

The amounts of wood illegally cut and removed from forests are provided by RNP and are presented in Table 7.6.

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 0.542 (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 7.6.

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 tC/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. 6 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**

7.2.3 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 and RNP and the same emission factors and methodologies are used for the whole period, the time series 1989-2006 is consistent.

7.2.4 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 Transport sub-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.
There were no unconformities noted following the UNFCCC review of the 2006 – 2nd submission of the NGHGI.

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).

7.2.5 Source-specific recalculations, including changes made in response to the review process

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

- activity data
  - ✓ due to small changes performed at the land use change matrix level, the figures specific to the Area of Forest Land remaining Forest Land changes

The changes at the Area of Forest Land remaining Forest Land level and their effects on the Net emissions/removals from LULUCF are presented in Table 7.7.

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

Year	Changes on Area of Forest Land remaining Forest Land data series [thousands hectares]			Effects of changes on Net emissions/removals from LULUCF data series		
	NIR 2007	**NIR 2008**		NIR 2007 - [Gg CO_2 equivalent]	**NIR 2008 - [Gg CO_2 equivalent]**	**Difference [%]**
1989	6,542.00	**6,542.00**		-32,641.18	**-32,641.18**	
1990	6,556.40	**6,556.40**		-35,847.13	**-35,847.13**	
1991	6,678.40	**6,678.40**		-37,319.02	**-37,319.02**	
1992	6,679.90	**6,679.90**		-38,124.28	**-38,124.28**	
1993	6,677.20	**6,677.20**		-39,430.32	**-39,430.32**	
1994	6,677.30	**6,677.30**		-40,033.65	**-40,033.65**	
1995	6,678.60	**6,678.60**		-39,284.46	**-39,284.46**	
1996	6,674.50	**6,679.00**		-38,292.70	**-38,300.50**	**0.02**
1997	6,686.40	**6,686.40**		-38,688.77	**-38,688.77**	
1998	6,672.10	**6,672.10**		-40,800.87	**-40,800.87**	
1999	6,669.90	**6,669.90**		-39,512.41	**-39,512.41**	
2000	6,456.30	**6,456.30**		-38,288.13	**-38,288.13**	
2001	6,456.90	**6,456.90**		-39,305.20	**-39,305.20**	
2002	6,647.10	**6,647.10**		-36,835.44	**-36,835.44**	
2003	6,651.30	**6,661.30**		-36,466.92	**-36,484.27**	**0.05**
2004	6,747.30	**6,747.30**		-35,768.14	**-35,768.14**	
2005	6,731.85	**6,738.93**		-37,421.11	**-37,482.81**	**0.16**
2006		**6,740.76**			**-37,494.88**	

7.2.6 Source-specific planned improvements

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 sector 5.B), Grassland (CRF sector 5.C), Wetlands (CRF sector 5.D), Settlements (CRF sector 5.E), Other land (CRF sector 5.F)

7.3.1 & 7.4.1 & 7.5.1 & 7.6.1 & 7.7.1 Description

Data reported relay on statistics on agricultural lands in the National Institute of Statistics and provided in annual reports. There is no computed the emissions /uptake as there is no available data on cropland and grassland biomass change.

7.3.2 & 7.4.2 & 7.5.2 & 7.6.2 & 7.7.2 Methodological issues

There is not improving since last submission. There have not been available national data on crop biomass, particularly for some type of crops (perennial: vineyards, orchards).

7.3.3 & 7.4.3 & 7.5.3 & 7.6.3 & 7.7.3 Uncertainties and time-series consistency

Data reported relay on statistics on agricultural lands in the National Institute of Statistics and provided in annual reports. There is no computed the emissions /uptake as there is no available data on cropland and grassland biomass change.

7.3.4 & 7.4.4 & 7.5.4 & 7.6.4 & 7.7.4 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 Transport sub-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.
There were no unconformities noted following the UNFCCC review of the 2006 – 2nd submission of the NGHGI.

7.3.5 & 7.4.5 & 7.5.5 & 7.6.5 & 7.7.5 Source-specific recalculations, including changes made in response to the review process

The actual reporting consistently represents the agricultural land and its breakdown over the 1989-2006, as based on recently developed land use change matrix.

7.3.6 & 7.4.6 & 7.5.6 & 7.6.6 & 7.7.6 Source-specific planned improvements

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

8 WASTE (CRF SECTOR 6)

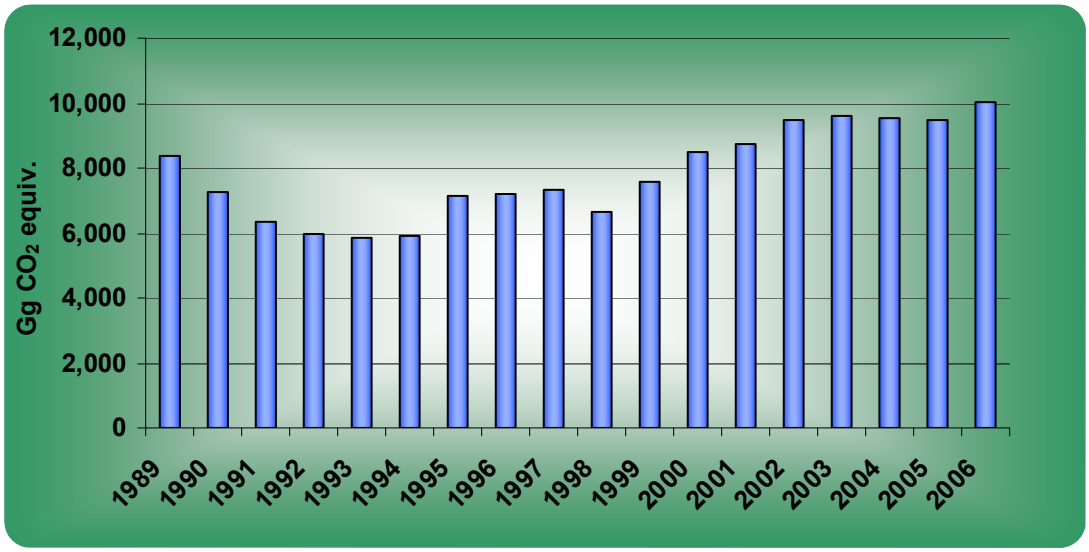
8.1 Overview of the sector

This chapter provides information on the estimation of the greenhouse gas emissions from the Waste sector.

The following source categories are quantified and reported:

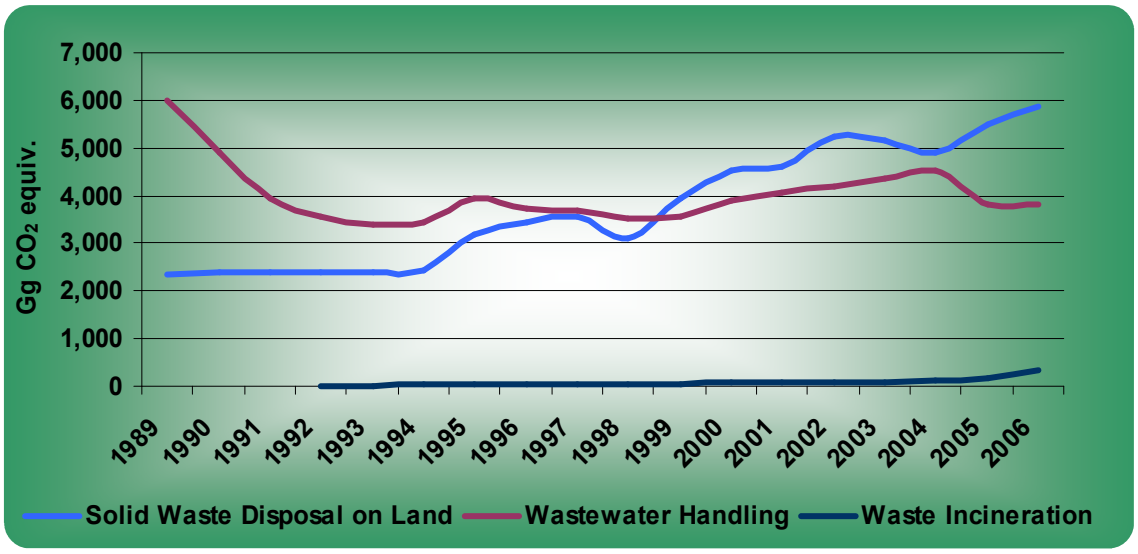
- CH_4 emissions from Solid Waste Disposal Sites
- CH_4 and N_2O emissions from Wastewater Handling
- CO_2 emissions from Waste Incineration

Figure 8. 1 Total GHG emissions trend in Waste for 1989–2006 period



Over the period 1989 - 2006, GHG emissions resulted from the Waste sector increased by 20.22%, due to population consumption growth and also to the increase of waste managed sites number.

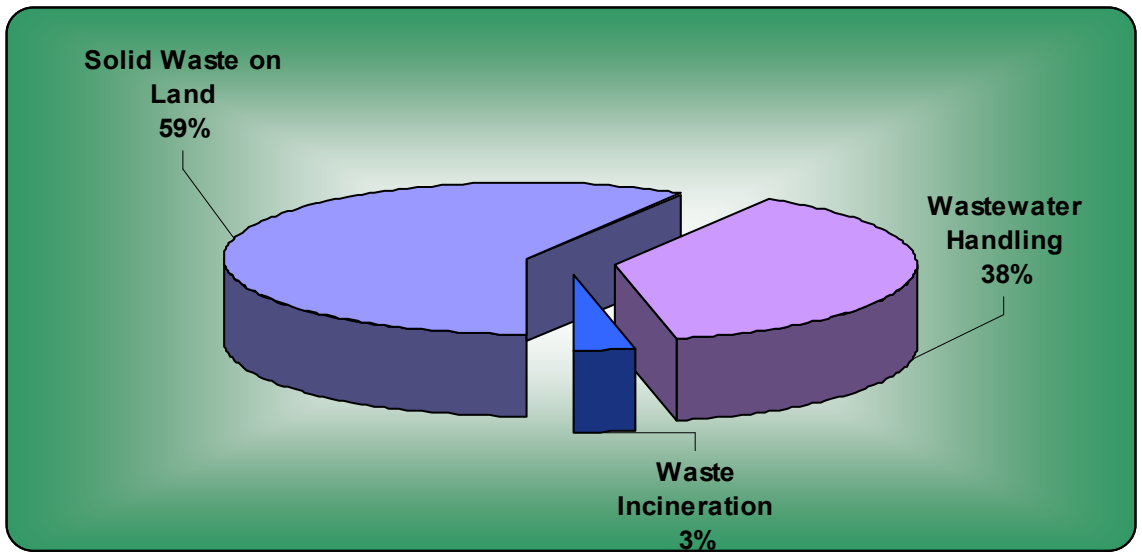
Figure 8. 2 GHG emissions trends in Waste, by sub-sectors for 1989–2006 period



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

In 2006 the waste sector contributed with 6.41% of total GHG emissions, accounting for 10,037.75 Gg CO_2 equivalent. Solid waste disposal on land (Landfills) is the main category within the waste sector, accounting for 58.64% of the sector's total emissions. Wastewater handling and waste incineration account for approximately 37.98% and 3.38% respectively.

Figure 8. 3 Contribution of the sub-sectors in the total GHG emissions from Waste in 2006



In this sector, the most important emissions of greenhouse gases are those of CH_4 from solid waste landfills and CH_4 from wastewater handling.

Table 8. 1 Contribution of Waste sector in total GHG emissions, in 1989–2006 period

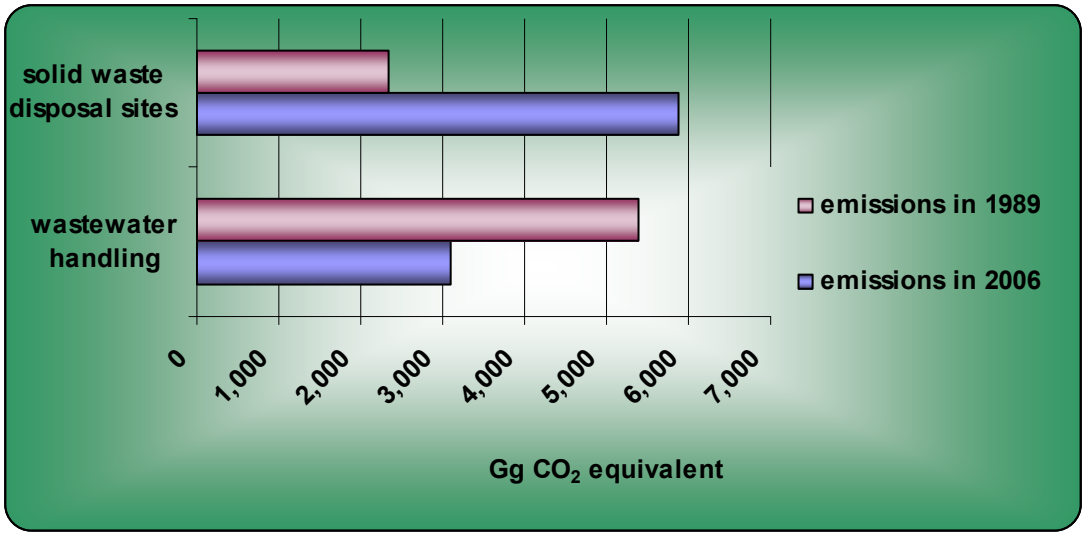
Year	Total GHG emissions (Excluding LULUCF) [Gg CO_2 equivalent]	GHG emissions from Waste [Gg CO_2 equivalent]	Contribution of Waste in total GHG emissions [%]	CH_4 emissions from Waste [Gg CO_2 equivalent]	Contribution of CH_4 emissions in total GHG emissions from Waste [%]	N_2O emissions from Waste [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	281,894.91	8,349.26	2.96	7,749.89	92.82	599.36	7.18		
1990	247,697.61	7,290.67	2.94	6,689.88	91.76	600.79	8.24		
1991	195,114.83	6,347.48	3.25	5,747.25	90.54	600.23	9.46		
1992	184,921.35	5,939.56	3.21	5,316.64	89.51	612.02	10.30	10.90	0.18
1993	181,824.77	5,816.87	3.20	5,166.24	88.81	634.42	10.91	16.21	0.28
1994	176,602.44	5,889.05	3.33	5,233.79	88.87	633.73	10.76	21.53	0.37
1995	184,097.14	7,138.81	3.88	6,479.63	90.77	632.35	8.86	26.84	0.38
1996	189,987.13	7,210.88	3.80	6,529.13	90.55	649.60	9.01	32.15	0.45
1997	169,785.72	7,305.19	4.30	6,607.07	90.44	660.65	9.04	37.47	0.51
1998	151,661.38	6,644.96	4.38	5,936.38	89.34	665.79	10.02	42.78	0.64
1999	134,611.66	7,557.95	5.61	6,832.61	90.40	677.25	8.96	48.09	0.64
2000	138,718.56	8,519.86	6.14	7,770.94	91.21	682.94	8.02	65.97	0.77
2001	143,724.84	8,758.20	6.09	7,988.67	91.21	694.87	7.93	74.65	0.85
2002	150,010.01	9,503.75	6.34	8,749.63	92.07	675.85	7.11	78.27	0.82
2003	156,892.19	9,603.21	6.12	8,843.38	92.09	673.95	7.02	85.88	0.89
2004	158,752.12	9,517.05	5.99	8,675.99	91.16	733.74	7.71	107.32	1.13
2005	151,980.80	9,455.75	6.22	8,563.35	90.56	713.61	7.55	178.79	1.89
2006	156,680.02	10,037.75	6.41	8,980.41	89.47	718.45	7.16	338.89	3.38

Table 8.2 and Figure 8.4 describe Key categories in Waste sector.

Table 8. 2 Key categories overview – Waste, 2006

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	3.76	L, T	3.03
6.B	**Wastewater handling**	CH_4	L	1.97	L,T	1.59
6.B	**Wastewater handling**	N_20	T	0.46	T	0.37
6.C	**Waste incineration**	CO_2	T	0.22		

Figure 8. 4 The GHG emissions of the 2006 Waste key categories, 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 84.83% are stored in 2006.

Approximately 80% of deposits are situated on relatively small areas (between 0.5 and 5 hectares), the remaining 20% are large urban deposits and lie on areas between 5 to 20 hectares.

The landfills are classified as managed and unmanaged.

In 2006 from 254 urban waste deposits:

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

-234 unmanaged waste landfills which 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 1995–2006 period

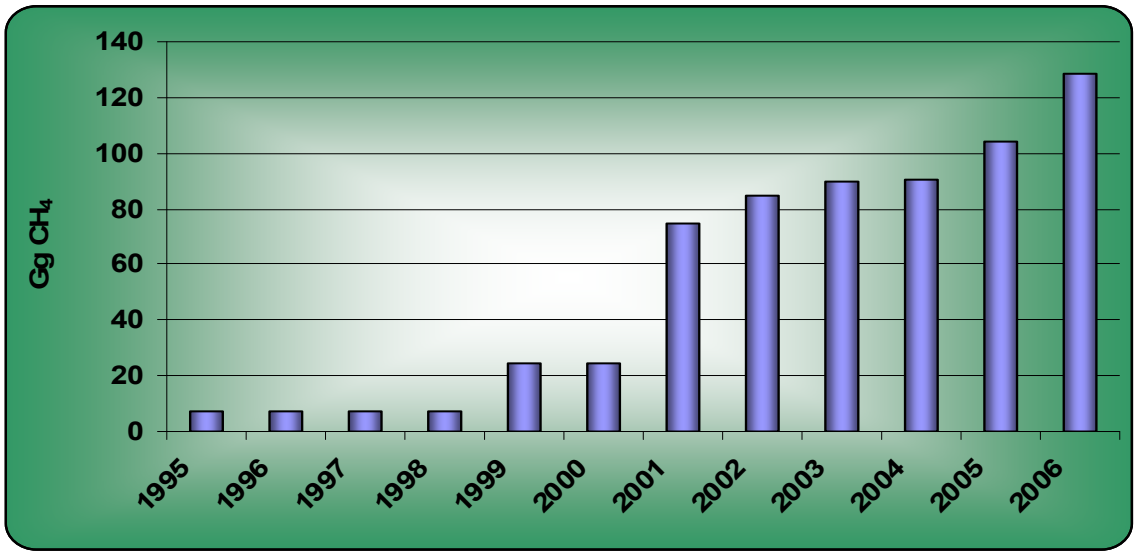
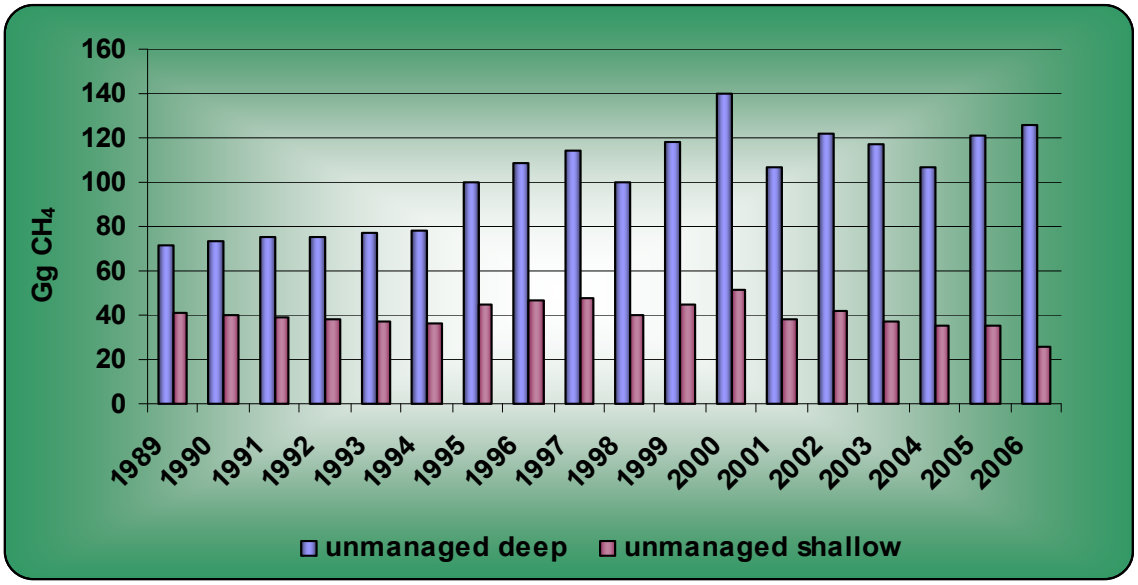


Figure 8. 6 CH_4 emissions trends from waste disposed to unmanaged site for 1989–2006 period



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. 3 Parameters used to calculated 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 2003-2006 period was provided by the Waste Directorate of NEPA. Data for 1989-2002 period were obtained using backward trend extrapolation, by expert judgment.

Table 8. 4 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
2004	11.67	12.53	38.12	1
2005	12.76	14.50	38.60	1
2006	12.51	14.23	38.97	1

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) is responsible for statistical inquires on waste for 1998 – 2002 period and the Waste Directorate of National Environment Protection Agency is responsible for statistical inquires on waste for 2003 – 2006 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 NA because there are no managed sites before 1995 year.

Starting with this submission, the Waste Directorate of NEPA provided activity data for unmanaged sites, divided in deep and shallow sites. Data has been provided for 2003-2006 period and for 1989-2002 period data were obtained using extrapolation technique.

Table 8. 5 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	NA	1,790.68	2,034.92
1990	NA	1,851.25	2,022.55
1991	NA	1,884.31	1,979.35
1992	NA	1,891.51	1,910.43
1993	NA	1,930.19	1,874.47
1994	NA	1,968.02	1,837.61
1995	150	2,501.33	2,245.52
1996	150	2,733.21	2,358.88
1997	150	2,878.27	2,387.82
1998	150	2,501.01	1,994.16
1999	490	2,964.97	2,271.75
2000	490	3,525.69	2,595.30
2001	1,500	2,682.43	1,896.57
2002	1,705	3,073.21	2,086.45
2003	1,720	2,810.00	1,800.00
2004	1,930	2,850.00	1,850.00
2005	2,080	3,020.00	1,780.00
2006	2,590	3,150.00	1,310.00

CH_4 recovery

According to the data sources used there is no methane recovery from the unmanaged sites. The emissions are reported as NA.

The methane recovered from the managed sites is considered to be negligible and the emissions are reported as NE.

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 IPCC GPG 2000 the uncertainties related with parameters are following: (Table 5.2)

- 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 uncertainties associated with the emission factors specific to CH_4 from managed solid waste disposal are estimated to be 42% and 73% to CH_4 from unmanaged solid waste disposal.

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 51.61% for CH_4 from managed sites and 78.92% 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 Agriculture and LULUCF sectors, activity results being mentioned in the Check lists.

Unconformities have not been notified as a result of these activities.

Also the activity data series used have been compared with the data provided by the Eurostat, the two data sets being comparable.

No recalculations were needed following the QA activities developed under the procedures for the compilation of the European Community GHG Inventory, described in the Decision 280/2004/EC of the European Parliament and of the Council and Decision 166/2005/EC of the European Commission. Unconformities have not been notified following the review of the 2006 – 2nd submission of the NGHGI.

All notified and solved improvement following various QA/QC activities are described in 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 some recalculations were made:

- activity data
  - ✓ new activity data has been provided by the Waste Directorate of the National Environmental Protection Agency (NEPA) for the amount of municipal solid waste (6.A.1; 6.A.2);
  - ✓ the Waste Directorate of NEPA provided activity data for unmanaged sites, divided in deep and shallow sites (6.A.2.1; 6.A.2.2). In the previous submission the amounts of waste disposed to unmanaged sites were divided in half both for deep and shallow categories (data regarding these sub-categories were not provided).

Table 8. 6 Effects of recalculations for CH_4 emissions from SWDS

CH_4 from Solid Waste Disposal Sites			
Year	**2007 submission**	**2008 submission**	**Difference**
	Unit [Gg]		**[%]**
1989	123.08	111.79	-9.18
1990	124.63	113.95	-8.57
1991	124.31	114.41	-7.96
1992	122.32	113.32	-7.35
1993	122.41	114.15	-6.75
1994	122.43	114.92	-6.14
1995	160.60	151.73	-5.52
1996	171.64	163.22	-4.90
1997	177.38	169.57	-4.40
1998	143.53	146.72	2.22
1999	183.70	187.63	2.14
2000	209.17	216.39	3.45
2001	216.20	219.17	1.37
2002	238.11	248.71	4.45
2003	227.64	244.74	7.51
2004	204.92	232.61	13.51
2005	243.33	260.83	7.19

8.2.6 Source specific planned improvement

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

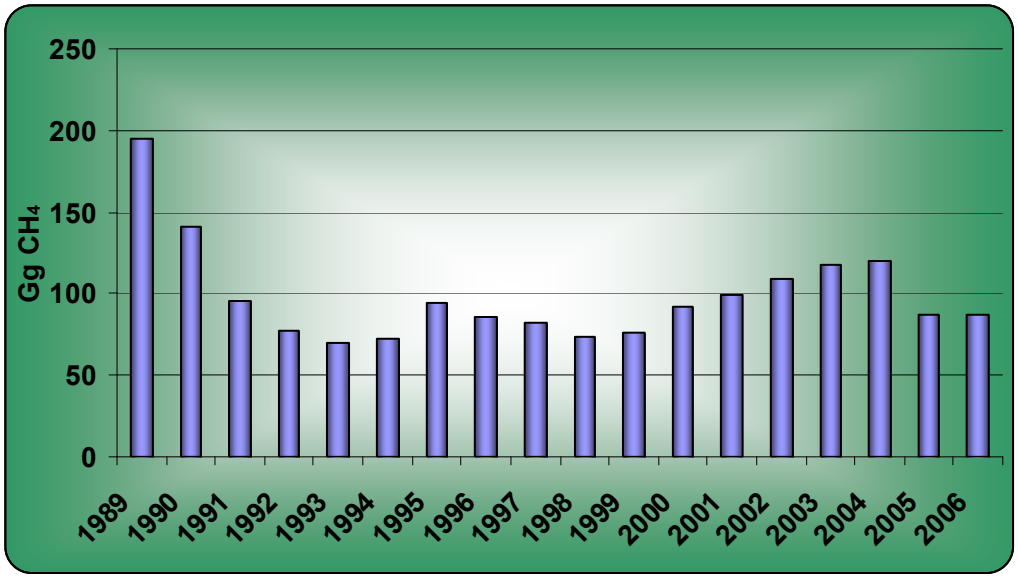
8.3 Source category Wastewater Handling (CRF sector 6.B)

8.3.1 Source category description

This sector includes methane emissions from domestic/industrial wastewater handling and nitrous oxide emissions from human sewage.

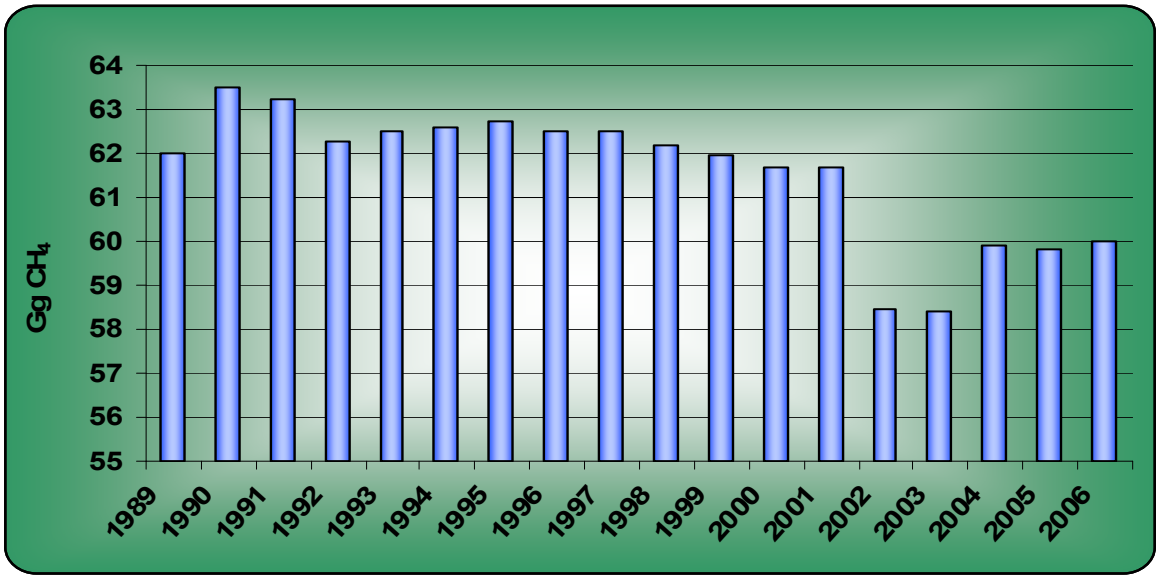
Methane and nitrous oxide are produced from anaerobic decomposition of organic matter by bacteria in sewage facilities, from food processing and other industrial facilities during wastewater handling. N_2O may also be released from wastewater handling and human waste.

Figure 8. 7 CH_4 emissions trends from industrial wastewater handling for 1989–2006 period



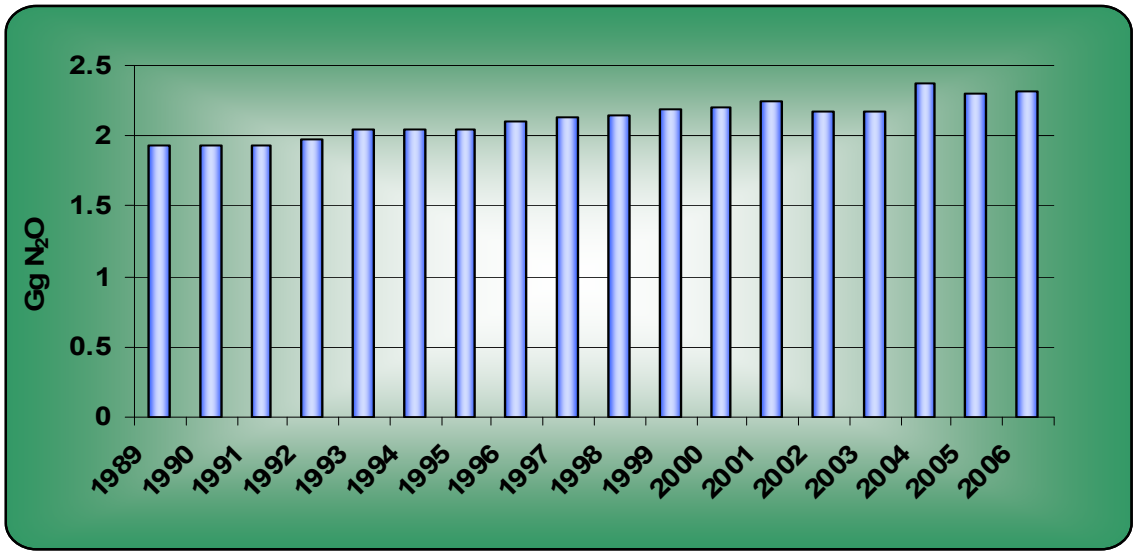
The specific emissions trend is due to the decrease of the major industrial productions (pulp/paper and petroleum refining – see table 8.7).

Figure 8. 8 CH_4 emissions trends from domestic/commercial wastewater for 1989–2006 period



CH_4 emissions trend in 1989-2006 period are directly influenced by the fluctuation of the urban population (see table 8.9).

Figure 8. 9 N_2O emissions trends from human sewage for 1989–2006 period



N_2O emissions trend in 1989-2006 period are directly influenced by the fluctuation of the total population and by the protein consumption (see table 8.11-total population).

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 value is determined according to equation 5.8 from IPCC GPG 2000; the national value for MCF is 0.46.

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. 7 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

In 2006, pulp and refined petroleum production decreased considerably compared to the base year.

Table 8. 8 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 NE because there are no data available. Data for the fraction of degradable organic component removed as sludge are unavailable, so default value 0 has been used according to the IPCC methodology.

Domestic and commercial wastewater handling

CH_4 emissions from domestic and commercial wastewater and sludge (CRF 6.B.2)

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 national value for MCF is 0.46.
The default value of 0.6 kg CH_4/kg BOD (Biochemical Oxygen Demand) according to IPCC GPG 2000 has been used.

Activity data

Parameters used to estimate total domestic/commercial organic wastewater are:
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).
The National Institute for Statistics through the Statistical Yearbooks provided data about the number of urban population.

Table 8. 9 Urban population

Year	Urban Population [Unit 1000 persons]
1989	12,311.80
1990	12,608.84
1991	12,552.40
1992	12,367.35
1993	12,406.20
1994	12,427.61
1995	12,457.20
1996	12,411.17
1997	12,404.69
1998	12,347.89
1999	12,302.73
2000	12,244.60
2001	12,243.75
2002	11,608.74
2003	11,600.16
2004	11,895.60
2005	11,879.90
2006	11,913.94

CH_4 from domestic/commercial wastewater recovered and/or flared are reported NE because there are no data available.

CH_4 emissions from domestic and commercial sludge

CH_4 emissions from domestic and commercial sludge are reported NE because there are no data available.

Nitrous Oxide emissions from Human Sewage (CRF 6.B.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. 10 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

The National Institute for Statistics through the Statistical Yearbook provided data about the number of total population.

The following values of the protein consumption have been used, data from the Food and Agriculture Organization of the United Nations (FAO):

- 91g/person/day for years 1989-1991
- 98g/person/day for years 1993-1995
- 109g/person/day for years 2001-2003
- 119g/person/day for 2004 year

The values for the missing years have been obtained using the interpolation and extrapolation technique.

Table 8. 11 Total population

Year	Total Population [Unit 1000 persons]
1989	23,151.56
1990	23,206.72
1991	23,185.08
1992	22,788.96
1993	22,755.26
1994	22,730.62
1995	22,680.95
1996	22,607.62
1997	22,545.92
1998	22,502.80
1999	22,458.02
2000	22,435.21
2001	22,408.39
2002	21,794.79
2003	21,733.56
2004	21,673.33
2005	21,623.85
2006	21,584.37

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 147.09%.

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 42.43%.

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 42.43%.
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 QA/QC Programme have been undertaken.
These activities have been accomplished by the person in charge with Agriculture and LULUCF sectors, activity results being mentioned in Check lists.
No recalculations were needed following the QA activities developed under the procedures for the compilation of the European Community GHG Inventory, described in

the Decision 280/2004/EC of the European Parliament and of the Council and Decision 166/2005/EC of the European Commission.

The unconformities and recommendations announced by ERT following the review of the 2006 – 2nd submission of the NGHGI are described in chapter 10. Quantified effects of solved unconformities are described in "Source specific recalculation, including changes made in response to the review process" sub-chapter;

All notified and solved unconformities 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
  - ✓ correction of small errors found at the industrial productions data series;
  - ✓ for the amount of the industrial wastewater produced and degradable organic component values from IPCC GPG 2000 have been used. In the previous submission, values from IPCC 1996 have been used
  - ✓ new values for protein consumption provided by Food and Agriculture Organization have been used. In the previous submission, a fixed value for per capita protein intake, 104 g/person/day, over the entire time series has been used.

- emission factors
  - ✓ change of emission factor CH_4/biochemical oxygen demand (BOD) for CH_4 emission from domestic and commercial wastewater: 0.6 kg CH_4/kg BOD value from IPCC GPG 2000 have been used instead of 0.25 kg CH_4/kg BOD used in previous submission;

Table 8. 12 Effects of recalculations for CH_4 emissions from Industrial Wastewater Handling

CH_4 from Industrial Wastewater Handling			
Year	**2007 submission**	**2008 submission**	**Difference**
	Unit [Gg]		**[%]**
1989	90.78	195.24	115.08
1990	74.89	141.10	88.42
1991	63.53	96.04	51.18
1992	62.92	77.56	23.25
1993	66.53	69.37	4.27
1994	77.62	71.71	-7.62
1995	77.36	94.07	21.60
1996	70.86	85.18	20.21
1997	70.51	82.57	17.10
1998	57.13	73.77	29.12
1999	62.39	75.76	21.43
2000	76.59	91.98	20.09
2001	67.57	99.57	47.36
2002	70.74	109.47	54.74
2003	73.20	117.94	61.13
2004	83.74	120.61	44.04
2005	49.59	87.11	75.65

Table 8. 13 Effects of recalculations for CH_4 emissions from Domestic and Commercial Wastewater Handling

CH 4 from Domestic and Commercial Wastewater Handling			
Year	**2007 submission**	**2008 submission**	**Difference**
	Unit [Gg]		**[%]**
1989	25.84	62.01	140.00
1990	26.46	63.51	140.00
1991	26.34	63.23	140.00
1992	25.96	62.29	140.00
1993	26.04	62.49	140.00
1994	26.08	62.60	140.00
1995	26.14	62.75	140.00
1996	26.05	62.52	140.00
1997	26.03	62.48	140.00
1998	25.92	62.20	140.00
1999	25.82	61.97	140.00
2000	25.70	61.68	140.00
2001	25.70	61.67	140.00
2002	24.36	58.47	140.00
2003	24.35	58.43	139.96
2004	24.97	59.92	139.96
2005	24.93	59.84	140.00

Table 8. 14 Effects of recalculations for N_2O emissions from Human Sewage

N_2O from Human sewage			
Year	2007 submission	2008 submission	Difference
	Unit [Gg]		[%]
1989	2.21	1.93	-12.50
1990	2.21	1.94	-12.50
1991	2.21	1.94	-12.50
1992	2.18	1.97	-9.23
1993	2.17	2.05	-5.77
1994	2.17	2.04	-5.77
1995	2.16	2.04	-5.77
1996	2.16	2.10	-2.88
1997	2.15	2.13	-0.96
1998	2.15	2.15	0.00
1999	2.14	2.18	1.92
2000	2.14	2.20	2.88
2001	2.14	2.24	4.81
2002	2.08	2.18	4.81
2003	2.07	2.17	4.81
2004	2.07	2.37	14.42
2005	2.06	2.30	11.54

8.3.6 Source specific planned improvement

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

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

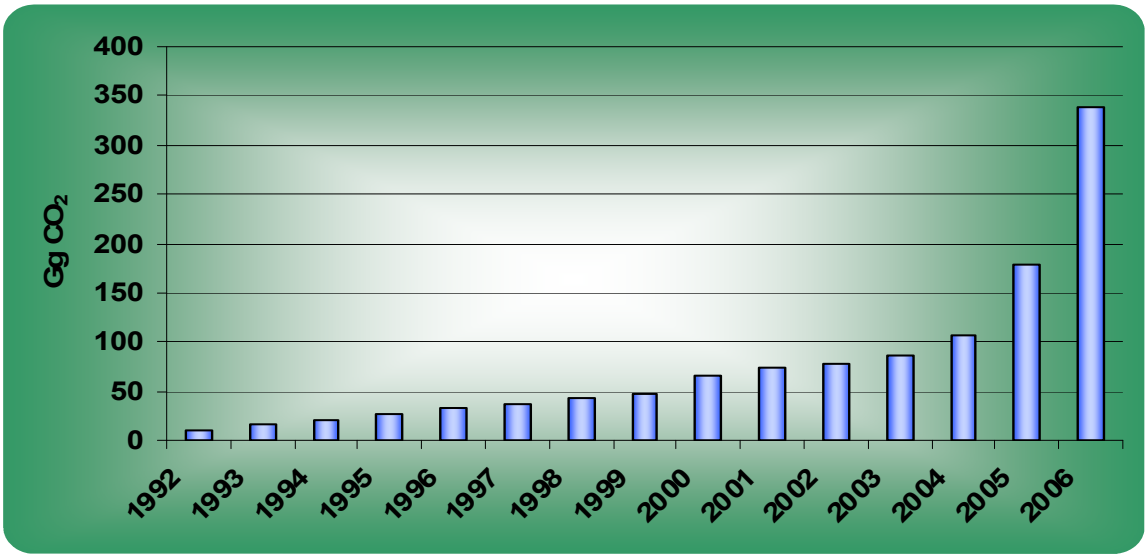
8.4.1 Source category description

Waste incineration like other types of combustion, is a source of CO_2 emissions.

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. Incinerated biogenic waste are reported NE.

Waste incineration includes emissions resulted from the incineration of clinical waste and hazardous waste.

Figure 8. 10 CO_2 emissions trends from waste incineration, for 1992–2006 period



The CO_2 emissions trend is due to the increase of incinerators number over 1992 – 2006 period.

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. 15 Default data for estimation of CO_2 from waste incineration (source: IPCC GPG 2000. table 5-6)

EF's	Clinical Waste	Hazardous Waste
C content of Waste	60%	50%
Fossil Carbon as % of Total Carbon	40%	90%
Efficiency of Combustion	95%	99,5%

Activity data

Public Health Institute of Bucharest (ISPB) was provided the data on amounts of clinical waste generated and of clinical waste incinerated.

Table 8. 16 Amounts of clinical waste (source: ISPB)

Year	Amount of clinical waste generated	Amount of clinical waste incinerated
	Unit [Gg/yr]	
2000	15.03	15.03
2001	19.06	19.06
2002	17.6	17.03
2003	18.98	18.79
2004	17.55	17.03
2005	15.49	13.55
2006	14.84	12.61

Hazardous waste is generated by industrial sector. Data regarding the amounts of incinerated hazardous waste were provided only for 2003-2006 period. The amounts were estimated using backward trend extrapolation for 1992-2002 period, by expert judgment.

Table 8. 17 Amounts of hazardous waste incinerated (source: NEPA)

year	Amount of hazardous waste incinerated
	Unit [Gg/yr]
2003	42.74
2004	56.70
2005	102.00
2006	200.00

8.4.3 Uncertainties and time series consistency

The uncertainty estimate associated with activity data amounts to10% 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 31.62%.
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 as described in QA/QC Programme have been undertaken.
These activities have been accomplished by the person in charge with Agriculture and LULUCF sectors, activity results being mentioned in Check lists.
Unconformities have not been notified as a result of these activities.

The improvement has been notified; solve being described at Improvement Lists level and at "Source specific recalculation, including changes made in response to the review process" sub-chapter 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.

Unconformities have not been notified following the review of the 2006 – 2nd submissions of the NGHGI.

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
  - ✓ old clinical activity data provided by ICIM have been replaced with data provided by ISPB due to high accuracy of these data.

Table 8. 18 Effects of recalculations for CO_2 emissions from clinical waste incineration

CO_2 from Clinical Waste Incineration.			
Year	**2007 submission**	**2008 submission**	**Difference**
	Unit [Gg]		**[%]**
1995	1.99	NE	-100.00
1996	1.97	NE	-100.00
1997	2.20	NE	-100.00
1998	3.03	NE	-100.00
1999	2.77	NE	-100.00
2000	7.54	12.57	66.67
2001	9.56	15.93	66.67
2002	8.83	14.23	61.20
2003	9.52	15.71	65.00
2004	8.80	14.23	61.67
2005	7.77	11.33	45.81

- new data provided by NEPA shown that before 1992 hazardous waste incineration did not occur in Romania. The industrial incinerators did not exist before 1992 year.

Table 8. 19 Effects of recalculations for CO_2 emissions from Hazardous Waste Incineration

CO_2 from Hazardous Waste Incineration			
Year	**2007 submission**	**2008 submission**	**Difference**
	Unit [Gg]		**[%]**
1989	85.02	NA	-100.00
1990	85.02	NA	-100.00
1991	85.02	NA	-100.00
1992	85.01	10.90	-87.18
1993	85.02	16.21	-80.93
1994	85.00	21.53	-74.68
1995	85.05	26.84	-68.44
1996	84.96	32.15	-62.15
1997	85.14	37.47	-55.99
1998	84.78	42.78	-49.54
1999	85.49	48.09	-43.74
2000	84.07	53.41	-36.47
2001	86.92	58.72	-32.44
2002	81.22	64.03	-21.16
2003	92.62	70.17	-24.24
2004	69.81	93.09	33.34
2005	81.22	167.47	106.20

8.4.6 Source specific planned improvement

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 estimates between the 2008 and the 2007 submissions. Since the 2007 submission, recalculations have been performed for almost all sectors. The recalculations have been carried out in order to account for better activity data and emission factors and to correct some errors in the calculations.

10.1 Explanations and justifications of the recalculations

10.1.1 Recalculations in the 2008 submission, by source categories

The inventory contains the following improvements:

Energy:

- ✓ Recalculation of the CO_2, CH_4 and N_2O emissions from solid fuels in the sectoral approach (for coke oven coke), in the manufacturing industries and construction, because of a double counting issue (with the industrial processes; 1.AA.2);
- ✓ Recalculation of the CH_4 emissions for the fugitive emissions from natural gas sub-sector, in the other leakages category, because of the misallocation of the activity data (1.B.2.B);
- ✓ Recalculation for all GHG's emissions for the civil aviation for the entire time series, due to the separation of the fuels consumption values between domestic civil aviation and international aviation bunkers and also to the new activity data provided by the national relevant authorities (1.AA.3.A);
- ✓ Recalculation of the CO_2 emissions for railway transport for the entire time series, due to the correction of the emission factor for diesel oil (according to the provisions in the Table 1-1 of the Reference Manual) (1.AA.3.C);
- ✓ Recalculation of all GHG's emissions from the navigation for the entire time series, due to the separation of the liquid fuels and lubricants consumption values between domestic navigation and international marine bunkers. Also the CO_2 emission factor

for gas/diesel oil was corrected according to the provisions in the Table 1-1 of the Reference Manual (1.AA.3.D).

Industrial Processes:

- ✓ Recalculation of the whole time series in the lime production sub-sector, because the CO_2 EF's for dolomitic lime and quicklime used for determined CO_2 emissions for the last submission have been replaced with the default CO_2 EF's determined by stoichiometric ratio, default ranges of CaO/MgO in lime and proportion of CaO and CaO*MgO content in lime (Table 3.4, Good Practice Guidance)(2.A.2);
- ✓ Recalculation of the whole time series in activity data (AD) for the limestone and dolomite consumption sub-sector, because the method used in previous submission to estimate the AD, has been replaced with a method that estimate the amount of limestone and dolomite used for the iron and steel production, pulp and paper production, sugar mills production, ceramics plants (2.A.3);
- ✓ Recalculation of activity data for the soda ash production and used sub-sector because for the 2003-2006 period the data source was changed for the soda ash use (2.A.4.2);
- ✓ Recalculation of the whole time series in activity data for the iron and steel production sub-sector, because for this submission they were identified 3 new economic agents who produce pig iron that were not taken into account in the last submission (2.C.1.2);
- ✓ Recalculation of the whole time series in activity data for the sinter use because the data source was changed (2.C.1.3);
- ✓ Recalculation of the whole time series in activity data for coke used in blast furnace for the production of the pig iron, because starting with this submission 3 new economic agents who produce pig iron were identified that were not taken into account in the last submission (2.C.1.4);
- ✓ Recalculation of the whole time series in CO_2 emission levels due to the addition of the emissions from steel produced in electric arc furnace the carbon released from consumed electrodes (2.C.1.5);
- ✓ Recalculation of activity data for the ferroalloys production sub-sector because for 1989-1991 period the data source was changed beginning with this submission.

Changes in activity data for the ferroalloys production sub-sector for 1998-1999/ 2001/ 2005 due to wrong manipulation of the activity data (2.C.2);

Agriculture:

- ✓ Recalculation of cattle and non-dairy cattle livestock data series due to the use of an incorrect algorithm to disaggregate the bovines livestock data series (4.A);
- ✓ Recalculation of cattle and non-dairy cattle livestock data series due to the use of an incorrect algorithm to disaggregate the bovines livestock data series (4.B);
- ✓ Recalculation due to the change of the emission factor value used for the calculation of the CH_4 emissions from horses (4B);
- ✓ Recalculation due to the changes at the level of the percentage of manure N produced in different AWMS parameter (4.B);
- ✓ Beginning of use of the EF_3 specific to swine and pit management system (4B);
- ✓ Recalculation of cattle and non-dairy cattle livestock data series due to the use of an incorrect algorithm to disaggregate the bovines livestock data series (4.D);
- ✓ Recalculation of the level of the fraction of livestock nitrogen excreted and deposited onto soil during grazing ($Frac_{PRP}$);
- ✓ Recalculation due to the changes at the fraction of total aboveground biomass that is removed from the field as crop product ($Frac_R$) value level (4D);
- ✓ Recalculation due to the changes at the level of the percentage of manure N produced in different AWMS parameter (4.D);
- ✓ Recalculation due to the changes at the methodology applied for the calculations of emissions from the animal manure nitrogen intentionally applied to soils adjusted to account for the amount that volatilizes as NH_3 and NO_x (4D)

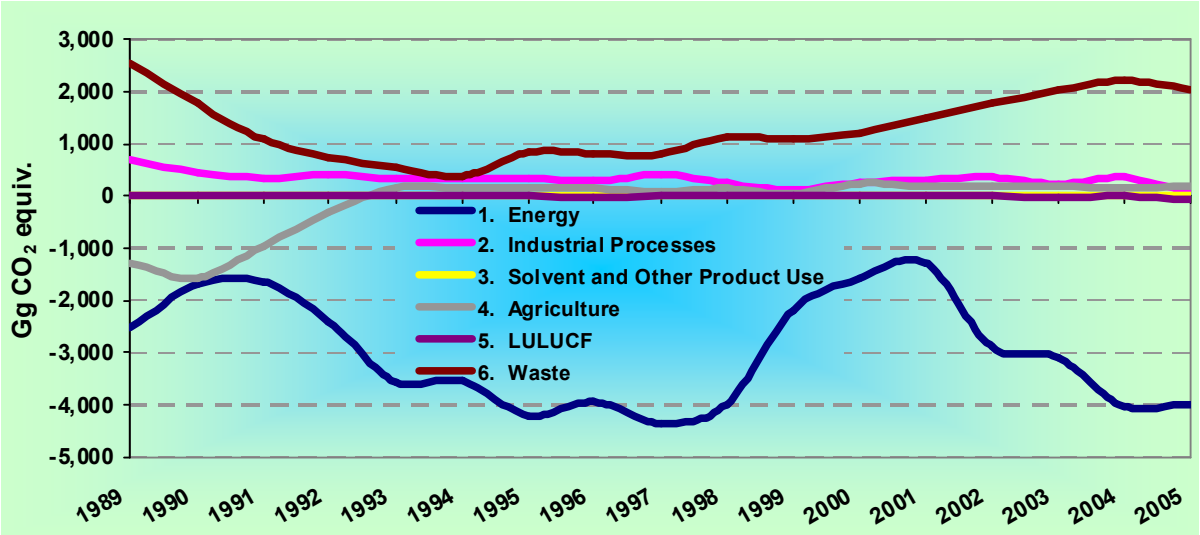
Land use, land use change and forestry:

- ✓ Recalculation due to changes at the Forest land remaining Forest land values level (5A)

Waste:

- ✓ Use of the new activity data provided by the Waste Directorate of the National Environmental Protection Agency (NEPA) for the amount of municipal solid waste (6.A.1; 6.A.2);
- ✓ Use of the new data provided by the Waste Directorate of NEPA divided taking into account the unmanaged deep and the shallow sites criteria (6.A.2.1; 6.A.2.2);
- ✓ Recalculation due to the changes at the amount of the wastewater produced and in the degradable organic component (COD/unit wastewater) values level, for the industrial type (6.B.1);
- ✓ Recalculation due to the change of the emission factor CH_4/biochemical oxygen demand (BOD) for CH_4 emission from domestic and commercial wastewater (6.B.2.1);
- ✓ Use of the new values for protein consumption provided by Food and Agriculture Organization (6.B.2.2);
- ✓ Use of the new data provided by the Public Health Institute of Bucharest and by the Waste Directorate of NEPA (6.C)

Figure 10. 1 Source category total emissions change, for all gases, and for whole time series, in comparison to the figures in the 2007 submission.



10.1.2 Recalculations in the 2008 submission, by gases

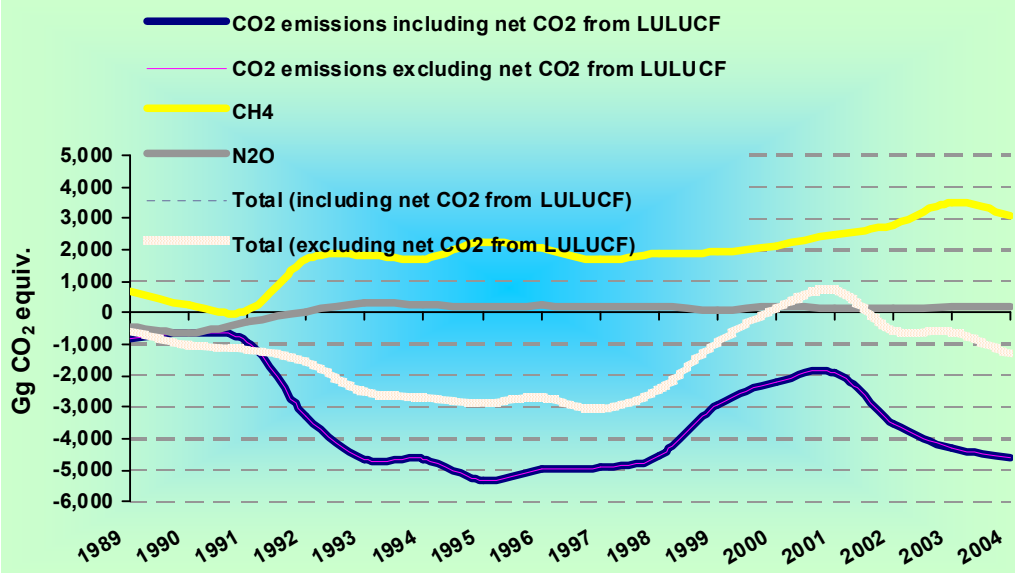
CO_2 related recalculations were carried out in the following sectors:

- ✓ Manufacturing Industries and Construction (1.AA.2);
- ✓ Civil Aviation (1.AA.3.A.);
- ✓ Railways (1.AA.3.C);
- ✓ Navigation (1.AA.3.D);
- ✓ Lime production (2.A.2);
- ✓ Limestone and dolomite consumption (2.A.3);
- ✓ Soda Ash Production and Used (2.A.4.);
- ✓ Iron and steel production (2.C.1);
- ✓ Ferroalloys production (2.C.2);
- ✓ Forest land (5A);
- ✓ Waste incineration (6.C)

N2O/CH4 related recalculations were carried out for the following sectors:

- ✓ Manufacturing Industries and Construction (1.AA.2);
- ✓ Natural Gas (1.B.2.B);
- ✓ Civil Aviation (1.AA.3.A.);
- ✓ Navigation (1.AA.3.D);
- ✓ Enteric fermentation (4.A);
- ✓ Manure management (4.B);
- ✓ Agricultural soils (4.D);
- ✓ Solid Waste Disposal on Land (6.A);
- ✓ Wastewater handling (6.B)

Figure 10. 2 Change in gas specific total emissions, for all source/sink categories, and for the entire time series, in comparison to the 2007submission.



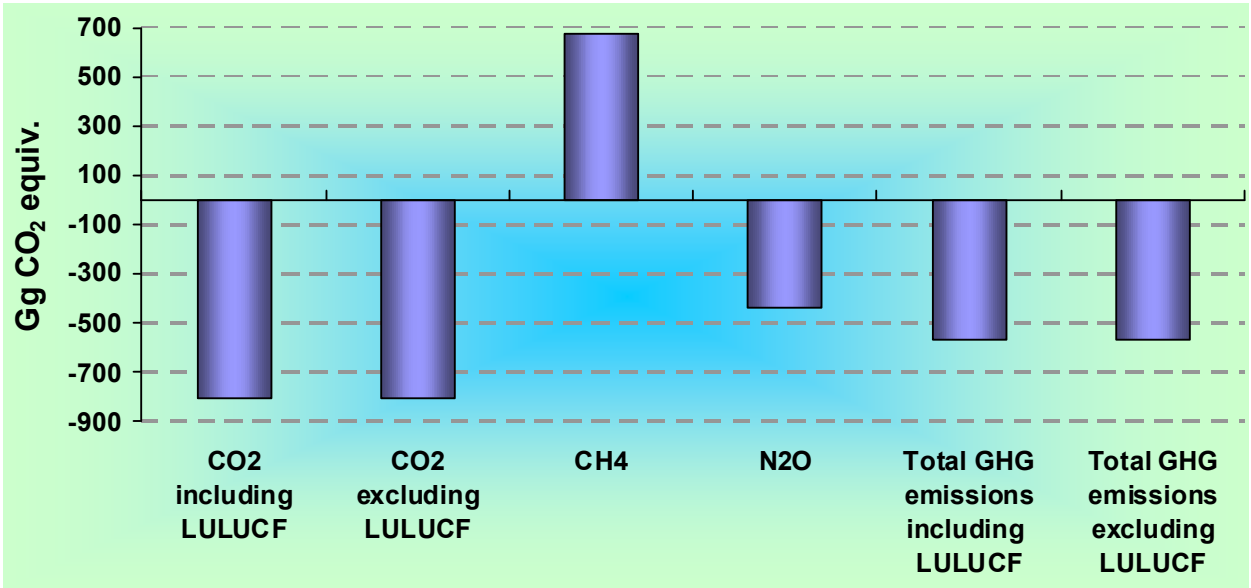
10.2 Impact on emissions levels

Emission levels' changes due to recalculations, for 1989, by gases, are as follows:

- ✓ CO_2 including LULUCF (-0.5%), excluding LULUCF (-0.42%)
- ✓ CH_4 (1.32%)
- ✓ N_2O (-1.3%)

Total GHG including LULUCF decreased for 1989 with 0.23%.

Figure 10. 3 Effects of recalculations (presented in 2008 submission) for 1989, by gases

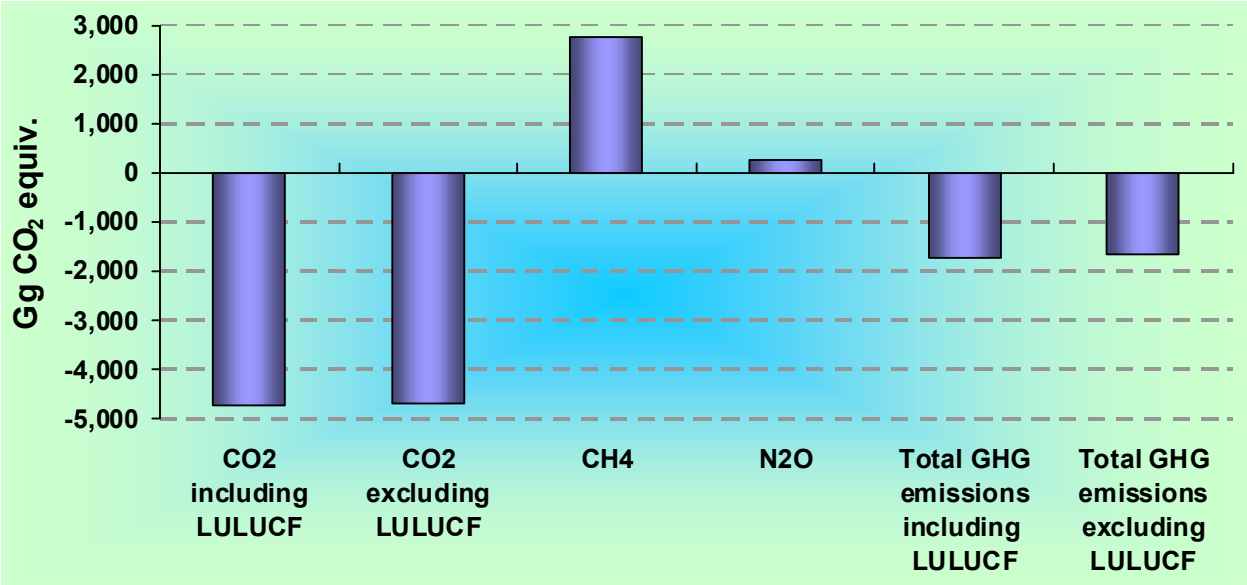


Emission levels' changes due to recalculations, for 2005, by gases, are as follows:

- ✓ CO_2 including LULUCF (-6.48%), excluding LULUCF (-4.23%);
- ✓ CH_4 (10.69%);
- ✓ N_2O (1.51%)

Total GHG including LULUCF decreased for 2005 with 1.49%.

Figure 10. 4 Effects of recalculations (presented in 2008 submission) for year 2005, by gases

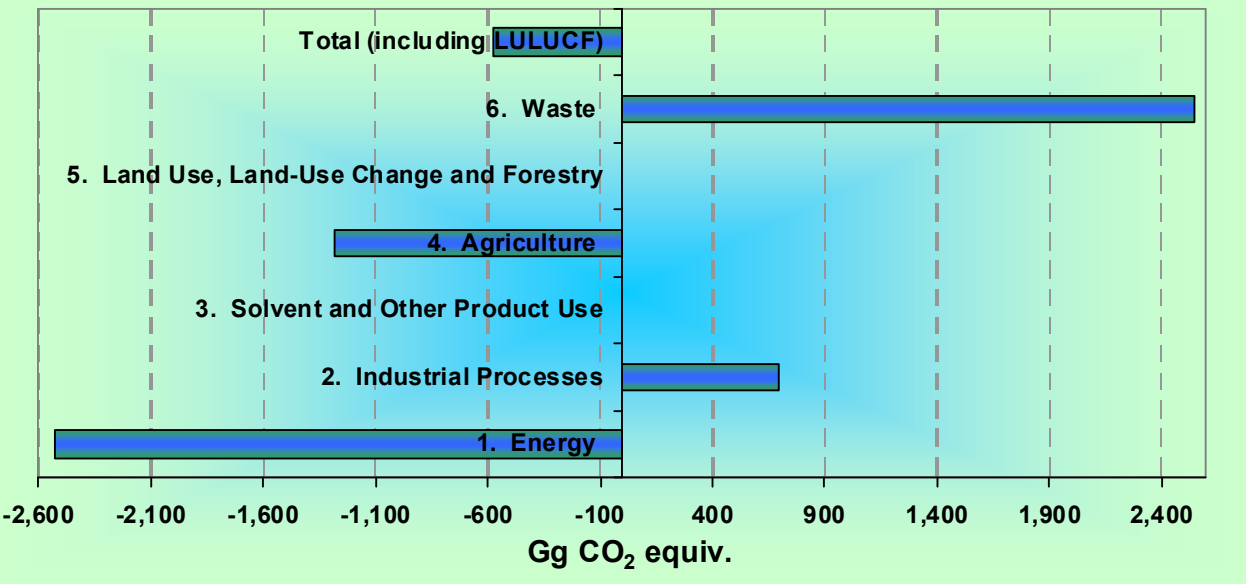


10.2.1 Impacts on 1989 emissions levels

Table 10. 1 Recalculation of total emissions, by sectors, for all gases, for 1989

Differences for 1989 estimates	Differences		2007 submission	2008 submission
	Gg CO_2 equiv.	%	Gg CO_2 equiv.	Gg CO_2 equiv.
1. Energy	-2529.84	-1.32	190,940.13	188,410.29
2. Industrial Processes	696.67	1.61	43,187.65	43,884.31
3. Solvent and Other Product Use	0.00	0.00	645.80	645.80
4. Agriculture	-1284.49	-3.07	41,889.74	40,605.25
5. Land Use, Land-Use Change and Forestry	0.00	0.00	-32,641.18	-32,641.18
6. Waste	2545.62	43.86	5,803.64	8,349.26
Total (including LULUCF)	-572.04	-0.23	249,825.77	249,253.73

Figure 10. 5 Changes of 1989 emissions, in respect to 2007 figures

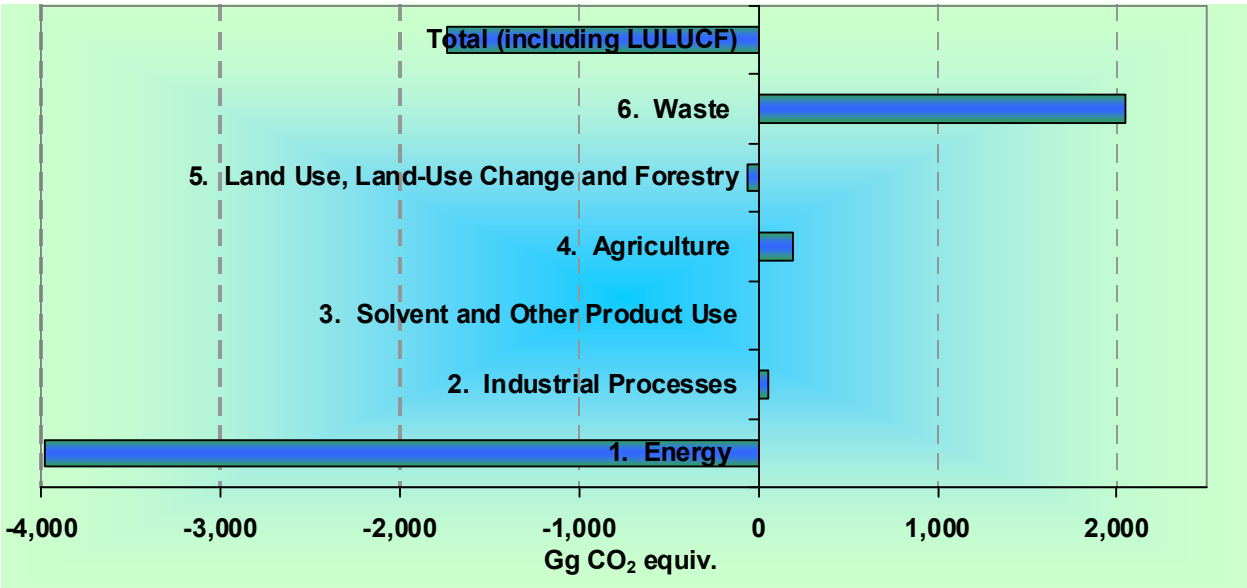


10.2.2 Impacts on 2005 emissions levels

Table 10. 2 Recalculation of total emissions, by sectors, for all gases, for 2005

Differences for 2005 estimates	Differences		2007 submission	2008 submission
	Gg CO_2 equiv.	%	Gg CO_2 equiv.	Gg CO_2 equiv.
1. Energy	-3984.47	-3.76	106,025.40	102,040.93
2. Industrial Processes	60.51	0.31	19,672.13	19,732.64
3. Solvent and Other Product Use	0.00	0.00	269.65	269.65
4. Agriculture	198.99	0.98	20,282.85	20,481.83
5. Land Use, Land-Use Change and Forestry	-61.70	0.16	-37,421.11	-37,482.81
6. Waste	2051.97	27.72	7,403.79	9,455.75
Total (including LULUCF)	-1734.71	-1.49	116,232.70	114,497.99

Figure 10. 6 Changes of 2005 emissions, in respect to 2007 figures



10.3 Impacts on emissions trends and on time-series consistency

As a result of recalculations, the time-series consistency has been improved.

10.4 Recalculations in response to the review process

In response to the review process, the following recalculations were carried out:

- ✓ Recalculation of the CO_2, CH_4 and N_2O emissions from solid fuels in the sectoral approach (for coke oven coke), in the manufacturing industries and construction, because of the double counting issue (with the industrial processes) (1.AA.2);
- ✓ Recalculation of the CH_4 emissions for the fugitive emissions from natural gas sub-sector, in the other leakages category, because of the misallocation of the activity data (1.B.2.B);
- ✓ Recalculation of all GHG's emissions for the civil aviation for the entire time series, due to the separation of the fuels consumption values between domestic civil aviation and international aviation bunkers and also to the new activity data provided by the national relevant authorities (1.AA.3.A);
- ✓ Recalculation of all GHG's emissions from the navigation for the entire time series, due to the separation of the liquid fuels and lubricants consumption values between domestic navigation and international marine bunkers. Also, the CO_2 emission factor for gas/diesel oil was corrected according to the provisions in the Table 1-1 of the Reference Manual (1.AA.3.D);
- ✓ Recalculation of the lime production sub-sector, for entire time series, because the CO_2 EF's for dolomitic lime and quicklime used for determined CO_2 emissions for the last submission have been replaced with the default CO_2 EF's determined by stoichiometric ratio, default ranges of CaO/MgO in lime and proportion of CaO and CaO*MgO content in lime (Table 3.4, Good Practice Guidance) (2.A.2);
- ✓ Recalculation of activity data for the limestone and dolomite consumption sub-sector, for entire time series, because the method used in previous submission to estimate the AD has been replaced with a method that estimates the amount of limestone and dolomite used the iron and steel production, pulp and paper production, sugar mills production, ceramics plants (2.A.3);

- ✓ Recalculation of activity data for the soda ash production and used sub-sector because for 2003-2006 period the data source was changed for the soda ash use (2.A.4.2);
- ✓ Recalculation of the whole time series in CO_2 emission levels because it was added to the emissions from steel produced in electric arc furnace the carbon released from consumed electrodes (2.C.1.5);
- ✓ Recalculation of activity data for the ferroalloys production sub-sector, because for 1989-1991 period the data source was changed beginning with this submission. Changes in activity data for the ferroalloys production sub-sector for 1998-1999/2001/2005 due to wrong manipulation of the activity data (2.C.2);
- ✓ Recalculation of the cattle and non-dairy cattle livestock data series due to the use of an incorrect algorithm to disaggregate the bovines livestock data series (4.A, 4B, 4D);
- ✓ Recalculation due to the changes at the amount of the wastewater produced and in the degradable organic component (COD/unit wastewater) values level, for the industrial type (6.B.1);
- ✓ Recalculation of due to the change of the emission factor CH4/biochemical oxygen demand (BOD) for CH_4 emission from domestic and commercial wastewater (6.B.2.1);
- ✓ Use of new values for protein consumption provided by Food and Agriculture Organization (6.B.2.2).
- ✓ Use of new data provided by the Public Health Institute of Bucharest and by the Waste Directorate of NEPA (6.C)

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